

139-141 Queens Crescent

For Suresh Patel

October 2016

XCO2 energy

w: www.xco2energy.com :: e: mail@xco2energy.com t: +44 (0) 20 7700 1000 :: f: +44 (0) 20 7183 6620

17-18 Hayward's Place :: Clerkenwell :: London :: EC1R 0EQ



Contents

Executive Summary	3
Site	6
Planning Policies	7
Camden Core Strategy 2010	7
Camden Development Policies 2010	8
Camden Planning Guidance - Sustainability CPG3 - 2013	9
The London Plan	10
Proposed Sustainable Design & Construction Measures	13
Energy Hierarchy Summary	17
Demand Reduction (Be Lean)	18
Heating and Cooling Infrastructure (Be Clean)	19
Renewable Energy (Be Green)	20
Conclusion	22

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.

	Issue 01	Issue 02	Issue 03	Issue 04
Remarks	Draft	Final		
Prepared by	SL	SL		
Checked by	KM	KM		
Authorised by	RM	RM		
Date	04/07/2016	25/10/2016		
Project reference	8_764	8_764		





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 \times 2 bed and 3 \times 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 CO₂ 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 CO₂ 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 CO₂ 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 18m² of PV panels with a rated output of 2.7 kWp will reduce the development's regulated CO₂ emissions by 26.1%.

In total, the development is expected to reduce regulated CO₂ 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

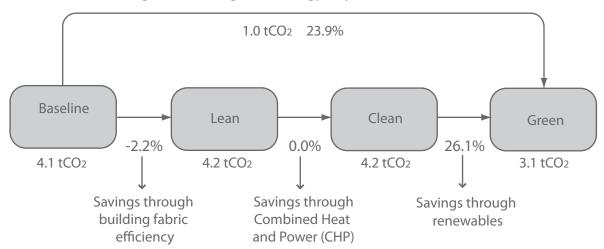
The diagram below provides a summary of the regulated CO_2 savings at each stage of the London Plan Energy Hierarchy. Overall, the development will achieve a regulated CO_2 saving of 23.9% beyond Part L 2013 baseline.





Total savings over part L 2013 Building regulations Baseline

(savings based on regulated energy only in accordance with Part L)





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

Camden Core Strategy 2010-2025 Local Development Framework







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 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.

MAYOR OF LONDON



THE LONDON PLAN
THE SPATIAL DEVELOPMENT STRATEGY FOR LONDON
CONSOLIDATED WITH ALTERATIONS SINCE 2011

MARCH 2015





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.

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.

 ${\rm CO}_2$ 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 18m² 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 prefabricated 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. <u>Minimising internal heat generation through energy</u> 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. <u>Reducing the amount of heat entering the building</u> in summer:

Appropriately sized windows and shading from blinds and curtains will reduce solar gains into occupied spaces during the summer.

c. <u>Use of thermal mass and high ceilings to manage the heat within the building:</u>

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 ${\rm CO_2}$ 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 10m³/m² at 50Pa. The development is likely to improve upon this to achieve at least 5m³/m² 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:

- 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.

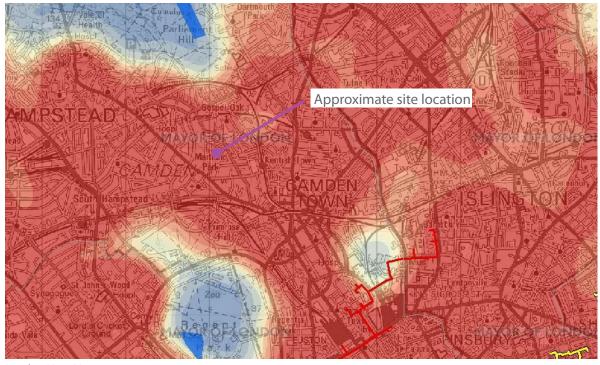
In a communal energy system, energy in the form of heat, cooling, and/or electricity is generated from a central source and distributed via a network to surrounding residencies and commercial units.

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 Creso	cent		
	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
Ad	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 CO2 savings in this site due to space limitations. In addition, they would have a significant visual impact on the neighbourhood.	25yrs	Med	High	1





Proposed roof PV

Photovoltaic Panels

Four types of solar cells are available on the market at present and these are mono-crystalline, polycrystalline, 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.

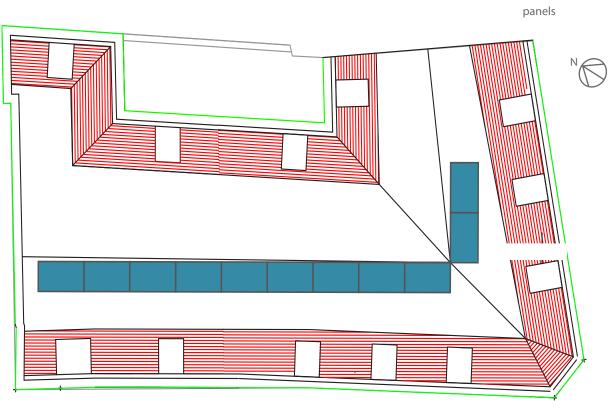
The feasibility study shows that photovoltaics are the most suitable renewable technology for this development for the following reasons:

- 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. 18m² of 15% efficiency monocrystalline PV panels, rated at 2.7 kWp, would produce regulated CO₂ 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 ${\rm CO_2}$ 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 CO₂ 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 CO₂ 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 CO₂ 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



		User Details:				
Assessor Name: Software Name:	Stroma FSAP 2012	Softw	na Number: are Version:	Versio	on: 1.0.3.15	
		Property Address	s: Flat 7			
Address: 1. Overall dwelling dime	vacione:					
1. Overall dwelling dime	11510115.	Area(m²)	Av He	ight(m)	Volume(m	3)
Ground floor		62	7 	.56 (2a) =	158.72	(3a)
Total floor area TFA = (1	a)+(1b)+(1c)+(1d)+(1e)+(1n) 62	(4)			
Dwelling volume		, L	(3a)+(3b)+(3c)+(3c	d)+(3e)+(3n) =	158.72	(5)
2. Ventilation rate:						` _
	main second heating heating		total		m³ per hou	ır
Number of chimneys		+ 0	= 0	x 40 =	0	(6a)
Number of open flues	0 + 0	+ 0	= 0	x 20 =	0	(6b
Number of intermittent fa	ns		3	x 10 =	30	(7a
Number of passive vents			0	x 10 =	0	(7b)
Number of flueless gas f	ires		0	x 40 =	0	(7c)
				Air ch	nanges per h	our
Infilt <mark>ration</mark> due to chi <mark>mne</mark>	ys, flues and fans = $(6a)+(6b)$	+(7a)+(7b)+(7c) =	30	÷ (5) =	0.19	(8)
	peen carried out or is intended, proc	eed to (17), otherwise	continue from (9) to	(16)		
Number of storeys in the Additional infiltration	ne dweiling (ris)			[(9)-1]x0.1 =	0	(9) (10
	.25 for steel or timber frame	or 0.35 for masor	ry construction	1(4) 14	0	(11
	resent, use the value corresponding	to the greater wall ar	ea (after			
deducting areas of openia	ngs); if equal user 0.35 floor, enter 0.2 (unsealed) or	0.1 (sealed), else	e enter 0		0	(12
If no draught lobby, en	,	011 (000.00), 0.00			0	(13
• ,	s 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 met	res per hour per s	square metre of e	envelope area	5	(17
If based on air permeabi	ity value, then $(18) = [(17) \div 20]$	+(8), otherwise (18) =	(16)		0.44	(18
	es if a pressurisation test has been o	lone or a degree air p	ermeability is being u	sed		
Number of sides sheltere	ed	(20) – 1.	· [0.075 x (19)] =		3	(19)
Shelter factor Infiltration rate incorpora	ting shalter factor		8) x (20) =		0.78	(20)
Infiltration rate modified f	-	(21) - (1)	o, x (=0) =		0.34	(21)
Jan Feb	Mar Apr May Jur	Jul Aug	Sep Oct	Nov Dec]	
Monthly average wind sp	1 ' 1 ' 1	1 -3 1 /109	1 556 500	1 500	J	
$\frac{\text{(22)m}= \begin{array}{ c c } \hline 5.1 & 5 \\ \hline \end{array}$	4.9 4.4 4.3 3.8	3.8 3.7	4 4.3	4.5 4.7	1	
···· ··· ·				¬,	J	
1						
Wind Factor (22a)m = (2	2)m ÷ 4			,	,	

Adjusted infiltra	ation rat	e (allowi	ng for sh	nelter an	d wind s	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 effec		_	rate for t	he appli	cable ca	se	<u> </u>	<u> </u>	<u>!</u>	<u> </u>			
If mechanica							.=					0	(2
If exhaust air he) = (23a)			0	(2
If balanced with		-	•	_								0	(2
a) If balance						- ` ` 	- 	í `	, 		1 ` '	• ÷ 100]	(0
(24a)m= 0	0	0	0	0	0	0	0	0	0	0	0	J	(2
b) If balance								í `	, ´ `	- ´-	1	1	(0
(24b)m= 0	0	0	0	0	0	0	0	0	0	0	0	J	(2
c) If whole h if (22b)n				•					.5 × (23b	o)			
(24c)m= 0	0	0	0	0	0	0	0	0	0	0	0		(2
d) If natural if (22b)n				•	•				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		(2
Effective air	change	rate - er	nter (24a) or (24b	o) or (24	c) or (24	d) 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		(2
3. Heat losse	s and he	eat loss	paramete	er:								_	
ELEMENT	Gros area	ss	Openin m	gs	Net Ar A ,r		U-valı W/m2		A X U (W/	K)	k-value kJ/m²-		A X k kJ/K
Doo <mark>rs</mark>					2	x	1.5	=	3				(2
Win <mark>dows</mark> Type	1				2.97	x1.	/[1/(1.3)+	0.04] =	3.67	Ħ			(2
Windows Type	2				4.77	x1.	/[1/(1.3)+	0.04] =	5.89	Ħ			(2
Windows Type	3				3.87	x1.	/[1/(1.3)+	0.04] =	4.78	5			(2
Floor					21.53	3 x	0.2		4.306	Ħ r		п г	(2
Walls Type1	67.4	18	11.6	1	55.87	=	0.15	=	8.38	=		7 F	(2
Walls Type2	20.8	=	2	_	18.86		0.24	=	4.46	=		7 F	(2
Roof	6.3		0	=	6.37	=	0.1	-	0.64	=		=	(3
Total area of e	L				116.2	_	U 0.1		0.04				(3
* for windows and			effective wi	ndow U-va			formula 1	/[(1/U-valu	ıe)+0.041 a	as aiven in	paragraph	ı 3.2	(0
** include the area								1(1	,	g	p =		
Fabric heat los	s, W/K	= S (A x	U)				(26)(30)	+ (32) =				35.1	(3
Heat capacity	Cm = S	(A x k)						((28).	(30) + (32	2) + (32a).	(32e) =	10646	S.15 (3
Thermal mass	parame	ter (TMF	P = Cm ÷	- TFA) ir	n kJ/m²K			Indica	tive Value	: Medium		250) (3
For design assess can be used instead				construct	ion are not	t known pr	ecisely the	indicative	e values of	TMP in T	able 1f		
Thermal bridge	es : S (L	x Y) cal	culated ı	using Ap	pendix ł	<						9.9	2 (3
if details of therma Total fabric he		are not kn	own (36) =	= 0.15 x (3	1)			(33) +	(36) =			45.0)5 (3
Ventilation hea	at loss ca	alculated	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		(3
Heat transfer of	coefficie	nt, 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		
Stroma FSAP 201	2 Version	: 1.0.3.15 ((SAP 9.92)	- http://w	ww.stroma	.com			Average =	Sum(39) ₁	12 /12=	74.	Page 2 of 8

Heat lo	ss para	meter (F	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)
Numbe	er of day	s in mor	nth (Tab	le 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. Wa	iter heat	ing ener	gy requi	rement:								kWh/ye	ar:	
if TF				[1 - exp	(-0.0003	49 x (TF	FA -13.9))2)] + 0.0	0013 x (⁻	ΓFA -13.		04		(42)
Reduce	the annua	ıl average	hot water	usage by		welling is	designed t	(25 x N) to achieve		se target o		59		(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot wate	er usage ir	n litres per	day for ea	ach month	Vd,m = fa	ctor 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		
Enorgy	contont of	hot water	usod sol	culated me	anthly = 1	100 v Vd r	n v nm v F	Tm / 3600			m(44) ₁₁₂ =		991.11	(44)
										-				
(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	1299.5	(45)
If instant	taneous w	ater heatii	ng at point	of use (no	hot water	storage),	enter 0 in	boxes (46)		rotar = Su	m(45) ₁₁₂ =	L	1299.5	(43)
(46)m=	2 0.21	17.68	18.24	15.9	15.26	13.17	12.2	14	14,17	16.51	18.02	19.57		(46)
	storage	loss:												
Storag	e volum	e (litres)	includir	ig any so	olar or W	WHRS	storage	within sa	me ves	sel		0		(47)
	-	_			•		litres in	, ,						
			hot wate	er (this in	icludes i	nstantar	neous co	mbi boil	ers) ente	er '0' in (47)			
	storage Janufacti		eclared l	oss facto	or is kno	wn (kWł	n/dav).					0		(48)
•			m Table) 10 IIIO	WII (IXVVI	"day).					0		(49)
•			storage		ear			(48) x (49)	. =			0		(50)
• • • • • • • • • • • • • • • • • • • •			_	-	oss facto	or is not		(- / (- /				<u> </u>		(00)
		_			e 2 (kWl	n/litre/da	ıy)					0		(51)
	•	eating s from Tal	ee secti	on 4.3										(50)
			m Table	2h								0		(52) (53)
•			storage		aar			(47) x (51)	v (52) v (53) –				
٠.		54) in (5	•	, KVVII/yC	zai			(47) X (01)	/ X (OZ) X (50) =	_	0		(54) (55)
	. , ,		culated f	or each	month			((56)m = (55) × (41)ı	m		<u> </u>		` ,
(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
												m Appendi	хH	(-0)
(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)
Primar	y circuit	loss (an	nual) fro	m Table	 3							0		(58)
	-	,	,			59)m = ((58) ÷ 36	65 × (41)	m					
(mod	dified by	factor fi	om Tab	le H5 if t	here is s	olar wat	er heatir	ng and a	cylinde	r thermo	stat)			
(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)

Combi loss cald					<u> </u>	· ` `	_	<u> </u>	ī	1	<u> </u>	1	(0.1)
(61)m= 46.3	40.3	42.93	39.92	39.56	36.66	37.88	39.56		42.93	43.17	46.3		(61)
Total heat requ							`		` ´ 	ì ´	`	(59)m + (61)m	
(62)m= 181.03	158.13	164.53	145.93	141.28	124.43	119.22	132.9		153	163.33	176.78]	(62)
Solar DHW input ca									r contribu	tion to wate	er heating)		
(add additional							. 					1	(00)
(63)m= 0	0	0	0	0	0	0	0	0	0	0	0	J	(63)
Output from wa					i						•	1	
(64)m= 181.03	158.13	164.53	145.93	141.28	124.43	119.22	132.9		153	163.33	176.78		٦,,,,
								utput from w				1794.92	(64)
Heat gains fron	n water l	heating,			1	× (45)m	+ (61)m] + 0.8 x	k [(46)m	1	+ (59)m	ı] •	
(65)m= 56.37	49.25	51.16	45.23	43.71	38.35	36.51	40.93	3 41.38	47.33	50.74	54.96]	(65)
include (57)n	n in calc	ulation o	of (65)m	only if c	ylinder i	s in the	dwellir	ng or hot w	ater is f	rom com	munity h	neating	
5. Internal gai	ins (see	Table 5	and 5a)):									
Metabolic gains	s (Table	5), Wat	ts									_	
Jan	Feb	Mar	Apr	May	Jun	Jul	Au	g Sep	Oct	Nov	Dec		
(66)m= 122.25	122.25	122.25	122.25	122.25	122.25	122.25	122.2	5 122.25	122.25	122.25	122.25		(66)
Lighting gains (calculat	ed in Ap	pendix l	L, equat	ion L9 o	r L9a), a	lso se	e 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 gair	ns (calcı	ulated in	Append	dix L, eq	uation L	13 or L1	3a), a	so see Ta	ble 5			'	
(68)m= 265.61	268.37	261.42	246.64	227.97	210.43	198.71	195.9	5 202.9	217.69	236.35	253.89]	(68)
Cooking gains	(calculat	ted in Ar	pendix	L, equat	ion 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]	(69)
Pumps and fan	s gains	(Table 5	ia)				<u> </u>				·	,	
(70)m= 3	3	3	3	3	3	3	3	3	3	3	3]	(70)
Losses e.g. eva	aporatio	n (negat	ive valu	es) (Tab	le 5)	<u> </u>	l	!	l .	1		1	
(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	1	(71)
Water heating												J	
(72)m= 75.77	73.3	68.77	62.82	58.75	53.26	49.08	55.0	57.48	63.62	70.48	73.87	1	(72)
Total internal	I		02.02					m + (69)m +			l .	J	()
(73)m= 474.67	470.45	452.29	424.49	396.2	370.61	355.82	363.4		407.58	438.67	462.17	1	(73)
6. Solar gains:		402.20	121.10	000.2	070.01	000.02	000.4	070.00	407.00	100.07	402.17		(1-5)
Solar gains are ca		ısina solaı	flux from	Table 6a	and assoc	iated equa	itions to	convert to th	ne applical	ble orientat	tion.		
Orientation: A		•	Area		Flu	•		g_		FF		Gains	
	able 6d		m ²			ble 6a		Table 6b	Т	able 6c		(W)	
Northeast _{0.9x}	0.77	x	3.8	37	x .	11.28	1 _x [0.63	x [0.7		13.34	(75)
Northeast _{0.9x}	0.77	x	3.8		-	22.97]	0.63		0.7	= =	27.16](75)
Northeast 0.9x	0.77	×	3.8			41.38] ^	0.63	^ L	0.7		48.94](75)
Northeast 0.9x	0.77	x	3.8			67.96	」^∟] _× 「	0.63	^ L	0.7	_	80.37](75)
Northeast 0.9x			_	==	=		┆		≓		=		╡
Atomicast U.9X	0.77	X	3.8	01	X (91.35	X	0.63	X	0.7	=	108.04	(75)

Northeast 0.9x Northeast 0.9x Northeast 0.9x	0.77	X	3.87	X	97.38	X		0.63	X	0.7	=	115.18	(75)
	0.77												
Northeast 0.9x		X	3.87	X	91.1	X		0.63	X	0.7	=	107.75	(75)
	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	×		0.63	x	0.7	_	16.79	(75)
Northeast _{0.9x}	0.77	x	3.87	x	9.21	×		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	7		0.63		0.7	=	107.24	(79)
Southwest _{0.9x}	0.77	x	2.97	x	113.91	1		0.63		0.7		103.39	(79)
Southwest _{0.9x}	0.77	x	2.97	x	104.39	7		0.63	×	0.7		94.75	(79)
Southwest _{0.9x}	0.77	x	2.97	×	92.85	7		0.63	= x [0.7		84.28	(79)
Southwest _{0.9x}	0.77	x	2.97	x	69.27	7		0.63	×	0.7		62.87	(79)
Southwest _{0.9x}	0.77	x	2.97	X	44.07			0.63	Х	0.7	=	40	(79)
Southwest _{0.9x}	0.77	x	2.97	x	31.49	7		0.63	х	0.7	=	28.58	(79)
Northwest 0.9x	0.77	x	4.77	х	11.28	₹ ×		0.63	х	0.7	=	16.45	(81)
Northwest _{0.9x}	0.77	x	4.77	x	22.97	= /x		0.63	х	0.7	=	33.48	(81)
Northwest _{0.9x}	0.77	x	4.77	x	41.38	×		0.63	х	0.7		60.32	(81)
Northwest _{0.9x}	0.77	x	4.77	×	67.96	= ×	Ħ	0.63	х	0.7		99.06	(81)
Northwest 0.9x	0.77	x	4.77	х	91.35	×		0.63	х	0.7	=	133.16	(81)
Northwest _{0.9x}	0.77	x	4.77	×	97.38	×		0.63	×	0.7		141.96	(81)
Northwest 0.9x	0.77	x	4.77	x	91.1	×		0.63	_ x [0.7	=	132.8	(81)
Northwest _{0.9x}	0.77	x	4.77	x	72.63	×		0.63	_ x [0.7	=	105.87	(81)
Northwest 0.9x	0.77	x	4.77	x	50.42	T x		0.63	 	0.7	-	73.5	(81)
Northwest _{0.9x}	0.77	x	4.77	x	28.07	×		0.63	×	0.7		40.92	(81)
Northwest 0.9x	0.77	x	4.77	×	14.2	T x		0.63	_ x [0.7		20.7	(81)
Northwest _{0.9x}	0.77	x	4.77	x	9.21	T x		0.63	= x [0.7		13.43	(81)
		•		•		_							_
Solar gains in wa	atts, calcula	ated	for each mon	th		(83)r	n = Su	m(74)m	.(82)m			_	
(83)m= 63.19 1	17.53 187	7.1	275.88 349.2	2 3	64.38 343.94	1 286	5.52	217.41	136.98	77.49	52.91		(83)
Total gains – inte	ernal and s	olar	(84)m = (73) r	n + (83)m , watts							•	
(84)m= 537.86 5	87.98 639	.39	700.37 745.4	2 7	34.99 699.76	650	0.02	597.01	544.57	516.16	515.08		(84)
7. Mean interna	l temperat	ure (heating seaso	on)									
Temperature du	ıring heatir	ng pe	eriods in the li	ving	area from Ta	able 9), Th1	(°C)				21	(85)
Utilisation factor	r for gains	for li	ving area, h1,	m (s	ee Table 9a)				_			_
Jan	Feb M	lar	Apr Ma	у	Jun Jul	A	ug	Sep	Oct	Nov	Dec		
(86)m= 0.99	0.98 0.9	97	0.92 0.8		0.62 0.46	0.	51	0.76	0.94	0.98	0.99		(86)
Mean internal te	emperature	e in li	iving area T1	(follo	ow steps 3 to	7 in ⁻	Table	9c)					
	20.04 20.		20.6 20.85	Ì	20.97 20.99	1	.99	20.91	20.6	20.2	19.87		(87)
<u> </u>	<u> </u>		.		<u> </u>	•	!_			-	•	•	

Tanananatura durina haatin a aariada in naat af durallina faana Tabla 0. The (100)	
Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) (88)m= 19.9 19.9 19.9 19.91 19.92 19.93 19.93 19.93 19.92 19.91 19.91	(88)
	(00)
Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)	1
(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)
$fLA = Living area \div (4) =$	0.5 (91)
Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$	
(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	1
(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-calc	culate
the utilisation factor for gains using Table 9a	_
JanFebMarAprMayJunJulAugSepOctNovDec	
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	1
(98)m= 449.01 352.2 287.77 150.67 55.86 0 0 0 153.59 311.19 460.43	<u> </u>
Total per year (kWh/year) = $Sum(98)_{15,912}$ =	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)
	1
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	kWh/year
Space heating requirement (calculated above)	1
449.01 352.2 287.77 150.67 55.86 0 0 0 0 153.59 311.19 460.43]
$(211)m = \{[(98)m \times (204)] \} \times 100 \div (206)$	(211)
494.51 387.89 316.93 165.93 61.52 0 0 0 169.16 342.73 507.08	
Total (kWh/year) =Sum(211) _{15,1012} =	2445.74 (211)
Space heating fuel (secondary), kWh/month	
= {[(98)m x (201)]} x 100 ÷ (208)	1
(215)m= 0 0 0 0 0 0 0 0 0 0 0 0 0	<u> </u>
Total (kWh/year) =Sum(215) _{15,1012} =	0 (215)

181.03 158.13 Efficiency of water hea	164.53	145.93	141.28	124.43	119.22	132.9	134.37	153	163.33	176.78	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	01.5	(217)
Fuel for water heating,	oxdot				5						J	, ,
$(219)m = (64)m \times 100$		m	400.00	450.00	4.40.00	400.07	404.07	470.4	400.04	000.05	1	
(219)m= 205.91 180.31	188.72	169.74	168.32	152.68	146.28	163.07 Tota	164.87 al = Sum(2)	178.1 19a) =	186.94	200.85	2105.78	(219)
Annual totals									Wh/year	•	kWh/year	_
Space heating fuel use	ed, main	system	1						,		2445.74	
Water heating fuel use	:d										2105.78	Ī
Electricity for pumps, fa	ans and	electric l	keep-hot	t								_
central heating pump	:									30]	(230c)
Total electricity for the	above, k	:Wh/yea	r			sum	of (230a).	(230g) =			30	(231)
Electricity for lighting											284.47	(232)
Electricity generated b	y PVs										-593.18	(233)
10a. Fuel costs - indiv	vidual he	ating sys	stems:									
		г		Fu	el /h/year			Fuel P (Table			Fuel Cost £/year	
Space heating - main	system 1			(211				3.4		x 0.01 =	85.11	(240)
Space heating - main s				(213				0.4		x 0.01 =	0	(241)
Space heating - secon					5) x			13.		x 0.01 =	0	(242)
Water heating cost (otl	·			(219				3.4		x 0.01 =	73.28](247)
Pumps, fans and elect	,	hot		(231	1)			13.		x 0.01 =	3.96](249)
(if off-peak tariff, list ea			230a) se	•	•	licable a	nd annly			ding to		_(243)
Energy for lighting	1011 01 (20	30a) to (2	200g) 30	(232		iloubic u	па арргу	13.		x 0.01 =	37.52	(250)
Additional standing cha	arges (Ta	able 12)									120	(251)
						(005))		13.	10	x 0.01 =		(252)
				one	of (233) to) (235) X)			19 1	X 0.01 -	1 ()	
Appendix Q items: rep	eat lines	(253) ar	nd (254)) (235) X)		10.	19	X 0.01 =	0	
Appendix Q items: rep Total energy cost		(253) ar	` ,	as need				10.	19	X 0.01 =	319.87	(255)
• •		` ,	(245)(as need	ded			10.	19	X 0.01 =		(255)
Total energy cost	vidual he	eating sy	(245)(as need	ded			10.	19	X 0.01 =		(255)
Total energy cost 11a. SAP rating - indi	vidual he	eating sy	(245)(rstems	as need 247) + (25	ded	=		10.	19	X 0.01 =	319.87	
Total energy cost 11a. SAP rating - indi Energy cost deflator (T	vidual he able 12) F)	eating sy	(245)(rstems	as need 247) + (25	ded 50)(254)	=		10.	19	X 0.01 =	319.87 0.42	(256)
Total energy cost 11a. SAP rating - indi Energy cost deflator (T Energy cost factor (EC	vidual he Table 12) CF)	eating sy	(245)(estems [(255) x	as neec 247) + (25 (256)] ÷ [(ded 50)(254) 4) + 45.0]	=		10.	19	X 0.01 =	0.42 1.26	(256) (257)

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	SU	um of (265)(271) =		838.48	(272)
CO2 emissions per m²	(2	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)

			User D	Details:						
Assessor Name: Software Name:	Stroma FSAP 2	012		Strom Softwa	Versio	ion: 1.0.3.15				
		Р	roperty	Address	: Flat 8					
Address :										
1. Overall dwelling dimer	nsions:		•	<i>(</i> 0)						2)
Ground floor				a(m²) 52.4	(1a) x		.92	(2a) =	Volume(m ²	3) (3a
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+(1r	1)	52.4	(4)					
Dwelling volume					(3a)+(3b	o)+(3c)+(3c	d)+(3e)+	.(3n) =	100.61	(5)
2. Ventilation rate:								'		
Number of chimneys	main heating 0 +	secondar heating	у ¬ + Г	other 0	7 ₌ [total 0	x	40 =	m³ per hou	ır
Number of open flues	0 +	0]	0	」		x	20 =	0	(6k
Number of open lides Number of intermittent fan	U		J L	0	J	0		10 =		╡`
	is				Ļ	2			20	(7a
Number of passive vents					Ĺ	0		10 =	0	(7b
Number of flueless gas fire	es					0	X	40 =	0	(70
								Δir ch	anges per he	our
Infiltration due to chimney	s flues and fans –	(6a)+(6b)+(7	a)+(7h)+((7c) -	Г		_			
If a pressurisation test has be					continue f	20 rom (9) to		÷ (5) =	0.2	(8)
Number of storeys in the									0	(9)
Additional infiltration							[(9)	-1]x0.1 =	0	(10
Structural infiltration: 0.2					•	ruction			0	(1
if both types of wall are pre deducting areas of opening		responding to	the great	ter wall are	a (after					
If suspended wooden flo		ealed) or 0.	1 (seale	ed), else	enter 0				0	(1:
If no draught lobby, ente	er 0.05, else enter ()							0	(1:
Percentage of windows	and doors draught	stripped							0	(14
Window infiltration				0.25 - [0.2	0	(15				
Infiltration rate				(8) + (10)					0	(16
Air permeability value, out of the Air permeability value, or air permeability	•		•	•	•	netre of e	envelope	area	5	(17
Air permeability value applies						is beina u	sed		0.45	(18
Number of sides sheltered			0 0, 4 40,	g. 00 a po		.o .og u	000		3	(19
Shelter factor				(20) = 1 -	[0.075 x (19)] =			0.78	(20
Infiltration rate incorporati	ng shelter factor			(21) = (18) x (20) =				0.35	(21
Infiltration rate modified fo	r monthly wind spe	ed								
Jan Feb I	Mar Apr Ma	y Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind spe	eed 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		
Mind Factor (22a\m = (22)m : 1									
Wind Factor (22a)m = (22 $(22a)$ m = 1.27 1.25 1	.23 1.1 1.08	0.95	0.95	0.92	1	1.08	1.12	1.18		
(0.00	3.00	1 3.02	<u> </u>	1	12		1	

Adjusted infiltr	ation rat	e (allowi	ing for sh	nelter an	d wind s	peed) =	(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 effec		_	rate for t	he appli	cable ca	se							
If mechanica				al.) (aa			.=	. (00)	\			0	(2
If exhaust air h) = (23a)			0	(2
If balanced with		-	•	_								0	(2
a) If balance		1				<u> </u>	- 	<u> </u>	- 	- 	' '	÷ 100]	,
(24a)m= 0	0	0	0	0	0	0	0	0	0	0	0		(2
b) If balance	d mech		entilation	without	heat rec	overy (N	ЛV) (24b	m = (2)	 		T	1	
24b)m= 0	0	0	0	0	0	0	0	0	0	0	0		(2
c) If whole h if (22b)n				•	-				.5 × (23b	o)		_	
24c)m= 0	0	0	0	0	0	0	0	0	0	0	0		(2
d) If natural if (22b)n		on or wh en (24d)		•					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		(2
Effective air	change	rate - er	nter (24a) or (24b	o) or (24	c) or (24	d) 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		(2
3. Heat losse	s and he	eat loss i	naramete	or.					_		_		
ELEMENT	Gros area	ss	Openin m	gs	Net Ar A ,r		U-valı W/m2		A X U (W/	K)	k-value		A X k kJ/K
Doo <mark>rs</mark>					2	x	1.5	=	3				(2
Vin <mark>dows</mark> Type	1				2.657	x1	/[1/(1.3)+	0.04] =	3.28	Ħ			(2
Windows Type	2				1.027	x1,	/[1/(1.3)+	0.04] =	1.27	Ħ			(2
Windows Type	3				1.027	x1,	/[1/(1.3)+	0.04] =	1.27	5			(2
Floor					4.76		0.2		0.952000				(2
Walls Type1	40.	6	4.71		35.89		0.15	╡ ॗ	5.38			-	\
Nalls Type2	3.4		2	_	1.43	x	0.24	= =	0.34	북 ¦		륏 늗	(2
Roof	43.5		0	=		_				믁 ¦		- -	(3
Total area of e	L				43.58	=	0.1		4.36	[
for windows and			affective wi	ndow I I-vs	92.37		ı formula 1	/[(1/ ₋ valı	ء 0.41 مراها	as aiven in	naragrani	132	(3
* include the area						atou uomg	Torritaia 1	n no van	10) 10.0-1] 0	io givoii iii	paragrapi	7 0.2	
abric heat los	s, W/K	= S (A x	U)				(26)(30)	+ (32) =				19.8	35 (3
Heat capacity	Cm = S((A x k)						((28).	(30) + (32	2) + (32a).	(32e) =	5020	.91 (3
Thermal mass	parame	ter (TMF	= Cm ÷	- TFA) ir	n kJ/m²K			Indica	itive Value	: Medium		250) (3
or design assess an be used inste				construct	ion are not	t known pr	ecisely the	indicative	e values of	TMP in T	able 1f		
hermal bridge	es : S (L	x Y) cal	culated (using Ap	pendix ł	<						9.2	(3
details of therma otal fabric he		are not kn	own (36) =	= 0.15 x (3	11)			(33) +	(36) =			29.0	05 (3
entilation hea	at loss ca	alculatec	d 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		(3
Heat transfer of	nefficie	 nt \///K						(39)m	= (37) + (38)m		ı	
iout tiurioiei (47.07	1 47 47	47.47	47.07	·	- ` 	<u> </u>	10.40	1	
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		

Heat loss parameter (HLP), W/m²K									(40)m	,				
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		
dumbe	r of day	rs in mor	nth (Tabl	le 1a)					,	Average =	Sum(40) ₁ .	12 /12=	0.92	(40)
T	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. Wa	ter heat	ing ener	gy requi	rement:								kWh/yea	ır:	
if TF			N + 1.76 x	[1 - exp	(-0.0003	49 x (TF	FA -13.9)2)] + 0.0	0013 x (⁻	ΓFA -13.		76		(42)
Reduce	the annua	al average	ater usag hot water person per	usage by	5% if the d	welling is	designed t			se target o		5.02		(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
lot wate	er usage in	n litres per	day for ea	ach month	Vd,m = fa	ctor from	Table 1c x	(43)			1			
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	040.05	
nergy o	content of	hot water	used - cal	culated mo	onthly $= 4$.	190 x Vd,r	n x nm x E	Tm / 3600			m(44) ₁₁₂ = ables 1b, 1		912.25	(44
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 = Su	m(45) ₁₁₂ =		1196.1	(45
			ng at point				_							/40
46)m= Vater	18.6 storage	16.27 loss:	16.79	14.64	14.04	12.12	11.23	12.89	13.04	15.2	16.59	18.01		(46
	_		includin	ig any so	olar or W	WHRS	storage	within sa	ame ves	sel		0		(47
f comr	nunity h	eating a	nd no ta	nk in dw	elling, e	nter 110	litres in	(47)						
			hot wate	er (this in	icludes i	nstantar	neous co	mbi boil	ers) ente	er '0' in (47)			
	storage anufact		eclared l	oss facto	or is kno	wn (kWł	n/dav):					0		(48
•			m Table			`	, , ,					0		(49
Energy	lost fro	m water	storage	, kWh/ye	ear			(48) x (49)) =			0		(50
,			eclared o	-										,_,
		-	factor fr ee section		e z (KVVI	i/iitie/ua	iy)					0		(51
	-	from Ta										0		(52
Tempe	rature fa	actor fro	m Table	2b								0		(53
			storage	, kWh/ye	ear			(47) x (51)) x (52) x (53) =		0		(54
	. ,	(54) in (5	•	or ooob	month			((EG)m - (EE) v (41):	~		0		(55
ı			culated f				ı	((56)m = (Ι ,			(56
56)m= cylinde	0 er contains	0 s dedicate	0 d solar sto	0 rage, (57)ı	m = (56)m	0 x [(50) – (0 H11)] ÷ (5	0 0), else (5	0 7)m = (56)	0 m where (0 H11) is fro	0 m Appendix	Н	(56
57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57
Primar	v circuit	loss (an	nual) fro	m Table	3		•					0		(58
	•	•	culated f			59)m = ((58) ÷ 36	55 × (41)	m					
`	dified by	factor fi	om Tab	le H5 if t	here is s	olar wat	ter heatii	ng and a	cylinde	r thermo	stat)	,		
59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59

Combi loss calc						- ` ` `			ı	ı	ı	1	
(61)m= 42.61	37.09	39.51	36.74	36.41	33.74	34.87	36.41		39.51	39.74	42.61		(61)
Total heat requi							(62)m		(45)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	2 123.68	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)												1	
(63)m= 0	0	0	0	0	0	0	0	0	0	0	0		(63)
Output from wat		er										1	
(64)m= 166.62	145.55	151.44	134.32	130.04	114.53	109.73	122.32	2 123.68	140.83	150.33	162.71		7
							O	utput from wa	ater heate	r (annual) ₁	112	1652.1	(64)
Heat gains from	water h	neating,	kWh/m	onth 0.2	5 ´ [0.85	× (45)m	+ (61)	m] + 0.8 x	د [(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 calcu	ulation o	of (65)m	only if c	ylinder i	s in the o	dwellin	g or hot w	ater is f	rom com	munity h	neating	
5. Internal gains (see Table 5 and 5a):													
Metabolic gains	(Table	5), Watt	ts										
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(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 (d	calculate	ed in Ap	pendix	L, equat	ion L9 o	r L9a), a	lso 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 gain	ıs (calcu	ılated in	Append	dix L, eq	uation L	13 or L1	3a), al	so see Ta	ble 5				
		225.44	212.69	196.59	181.46	171.36	168.98		187.72	203.82	218.94		(68)
Cooking gains (calculat	ed in Ar	ppendix	L. equat	ion L15	or L15a	. also	see Table	5		<u> </u>	•	
(69)m= 47.33	47.33	47.33	47.33	47.33	47.33	47.33	47.33	$\overline{}$	47.33	47.33	47.33]	(69)
Pumps and fans	s gains (Table 5	ia)										
(70)m= 3	3	3	3	3	3	3	3	3	3	3	3	1	(70)
Losses e.g. eva								1 -				I	` /
	-70.43	-70.43	-70.43	-70.43	-70.43	-70.43	-70.43	3 -70.43	-70.43	-70.43	-70.43	1	(71)
Water heating g			7 0.10	70.10	7 0.10	70.10	70.10	7 10.10	10.10	10.10	10.10	I	()
(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	1	(72)
		00.0	37.02	04.00			<u> </u>	n + (69)m + (<u> </u>	I	I	l	(12)
Total internal g		403.43	378.12	352.71	329.96	317.13	324.72	<u> </u>	365.16	393.15	413.97	1	(73)
6. Solar gains:		403.43	3/0.12	332.71	329.90	317.13	324.12	2 339.00	303.10	393.13	413.97		(10)
Solar gains are ca		sing solar	flux from	Table 6a	and assoc	iated equa	tions to	convert to th	e applicat	ole orientat	tion		
Orientation: Ac		•	Area		Flu			g_	о арриоа	FF		Gains	
	able 6d	20101	m ²			ble 6a		Table 6b	Т	able 6c		(W)	
Northeast _{0.9x}	0.77	x	1.0	13	x 1	11.28	x	0.63	x	0.7		3.54	(75)
Northeast 0.9x	0.77	= ^	1.0	==		22.97	」^ <u> </u>	0.63	^ x	0.7		7.21](75)
Northeast 0.9x	0.77	^ ^	1.0			11.38	」^∟ l	0.63	^ L	0.7	-	12.99](75)
Northeast 0.9x		=					╎ ⊨		╡╞		=](75)](75)
Northeast 0.9x	0.77	X	1.0	==	-	67.96		0.63		0.7	╡ -	21.33	-
Northeast U.9X	0.77	X	1.0	13	x 5	91.35	X	0.63	x	0.7	=	28.67	(75)

Northeast 0.9x 0.77	-	4.00	٦.,	07.00	1	0.00	п г		_	00.57	(75)
Nigotherat	X	1.03	X	97.38	X	0.63	_	0.7	=	30.57	(75)
N d	×	1.03	J X	91.1	X	0.63	_ ×	0.7	=	28.59	(75)
Northeast 0.9x 0.77	X	1.03	」 X □	72.63	X	0.63	_ ×	0.7	=	22.8	(75)
Northeast 0.9x 0.77	X	1.03	X	50.42	X	0.63		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	Х	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	х	0.63	_ x [0.7	=	84.77	(77)
Southeast 0.9x 0.77	X	2.66	j x	92.85	x	0.63	×	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	Х	0.63	х	0.7		35.79	(77)
Southeast 0.9x 0.77	X	2.66	i x	31.49	X	0.63	x	0.7		25.57	(77)
Northwest 0.9x 0.77	X	1.03	x	11.28	i 🖈	0.63	x	0.7		3.54	(81)
Northwest 0.9x 0.77	X	1.03	i x	22.97	X	0.63	×	0.7	_	7.21	(81)
Northwest 0.9x 0.77	X	1.03	x	41.38	Х	0.63		0.7	=	12.99	(81)
Northwest 0.9x 0.77	X	1.03	i x	67.96	X	0.63		0.7	= =	21.33	(81)
Northwest 0.9x 0.77	x	1.03	X	91.35]] x	0.63	×	0.7	= =	28.67	(81)
Northwest 0.9x 0.77	×	1.03		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	×	1.03] x	72.63] ^] x	0.63	^ L _ x [0.7		22.8	(81)
Northwest 0.9x 0.77	= x	1.03] ^] x	50.42] ^] x	0.63	_	0.7		15.83	(81)
N d	$=$ \hat{x}		」 ^] x] ^] x		_ ^ L 				(81)
N	=	1.03	」^] x	28.07] ^] x	0.63	_ ^ L 	0.7	=	8.81	(81)
	X	1.03	╡	14.2	1	0.63	╡	0.7	=	4.46	=
Northwest 0.9x 0.77	X	1.03	X	9.21	X	0.63	x	0.7	=	2.89	(81)
Solar gains in watto gal	aulatad	l for oach man	.th		(02)~	- Cum/74\m	(92)m				
Solar gains in watts, cal (83)m= 36.96 65.31	95.61	128.94 153.9		57.07 149.68	130	n = Sum(74)m.	73.86	44.7	31.35		(83)
Total gains – internal ar								1		l	, ,
(84)m= 461.66 485.6	499.04	507.06 506.6	<u>`</u>	87.03 466.81	455	.08 446.73	439.03	437.85	445.32		(84)
		l			<u> </u>						
7. Mean internal temperature during he		·		avaa fuana Tab	-l- 0	Th4 (9C)					7(05)
Temperature during he			_		oie 9	, Ini (°C)				21	(85)
Utilisation factor for ga			Ť			Con	O e t	Nov	Daa		
Jan Feb 0.99 0.98	Mar 0.96	Apr Ma 0.91 0.8		Jun Jul 0.61 0.45	0.4	ug Sep 18 0.7	Oct 0.91	0.97	Dec 0.99		(86)
` '		<u> </u>		<u>l</u>	<u> </u>		0.91	0.97	0.99		(00)
Mean internal tempera							00 - :	60 5 :	62.5	Ī	/OZ\
(87)m= 20.32 20.42	20.58	20.77 20.92	2 2	20.99 21	2	1 20.97	20.81	20.54	20.3		(87)

T						. .	LL O T	L O (0O)					
Temperature						20.16	20.16		20.45	20.45	20.45		(88)
(88)m= 20.14	20.14	20.14	20.15	20.15	20.16	<u> </u>		20.16	20.15	20.15	20.15		(00)
Utilisation fac	 				```	·			0.00				(00)
(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 interna					` `	i		i e	e 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)
								f	LA = Livin	g area ÷ (4	1) =	0.75	(91)
Mean interna	l temper	ature (fo	r the wh	ole dwe	lling) = f	LA × T1	+ (1 – fL	A) × 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 adjustr	nent to th	ne mean	interna	temper	ature fro	m Table	4e, whe	ere appro	priate				
(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 hea	ıting requ	uirement											
Set Ti to the the utilisation					ned at sto	ep 11 of	Table 9l	b, so tha	t Ti,m=(76)m an	d re-calc	ulate	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation fac	tor for g	ains, 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)
Usefu <mark>l gains</mark> ,	hmGm ,	W = (9	4)m x (8	4)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 aver	age exte	rna <mark>l tem</mark>	perature	from Ta	able 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		_			Lm , W =		x [(93)m]				
(97)m= 770.85		673.43	560.43	432.34	293.3	198.85	207.91	317.58	479.57	636.31	766.79		(97)
Space heatin				_	Wh/mon	th = 0.02	24 x [(97)m – (95					
(98)m= 236.72	183.46	147.99	75.96	26.8	0	0	0	0	65.03	154	244.59		_
							Tota	l per year	(kWh/year) = Sum(9	8) _{15,912} =	1134.54	(98)
Space heating	g require	ement in	kWh/m²	/year								21.65	(99)
9a. Energy red	quiremen	ıts – Indi	ividual h	eating sy	ystems i	ncluding	micro-C	CHP)					
Space heating	•			, .							Г		_
Fraction of sp			,		mentary	•						0	(201)
Fraction of sp	pace hea	t from m	nain syst	em(s)			(202) = 1	- (201) =				1	(202)
Fraction of to	tal heatir	ng from	main sys	stem 1			(204) = (2	02) x [1 –	(203)] =			1	(204)
Efficiency of	main spa	ce heat	ing syste	em 1								90.8	(206)
Efficiency of	seconda	ry/suppl	ementar	y heating	a system	ղ. %					Ī	0	(208)
Linelettey of				•	9 0,0.0	,							
Jan	Feb	Mar	Apr		Jun		Aug	Sep	Oct	Nov	Dec	kWh/ye	ear
	Feb		Apr alculate	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/ye	ear
Jan	Feb			May	Jun		Aug 0	Sep 0	Oct 65.03	Nov	Dec 244.59	kWh/ye	ear
Jan Space heatin	Feb g require 183.46	ement (c 147.99	alculate 75.96	May d above) 26.8	Jun	Jul						kWh/ye	
Jan Space heatin	Feb g require 183.46	ement (c 147.99	alculate 75.96	May d above) 26.8	Jun	Jul						kWh/ye	(211)
Jan Space heatin 236.72 (211)m = {[(98	Feb g require 183.46)m x (20	ement (c 147.99 4)] } x 1	alculate 75.96 00 ÷ (20	May d above 26.8	Jun) 0	Jul 0	0	0	65.03 71.62	154 169.6	244.59	kWh/ye	
Jan Space heatin 236.72 (211)m = {[(98	Feb g require 183.46 3)m x (20 202.05	ement (c 147.99 4)] } x 1 162.98	75.96 00 ÷ (20 83.65	May d above 26.8 26) 29.51	Jun) 0	Jul 0	0	0	65.03 71.62	154 169.6	244.59		(211)
Jan Space heatin 236.72 (211)m = {[(98	Feb 183.46 183.46 202.05 18 fuel (se	ement (c 147.99 4)] } x 1 162.98	75.96 00 ÷ (20 83.65 y), kWh/	May d above 26.8 26) 29.51	Jun) 0	Jul 0	0	0	65.03 71.62	154 169.6	244.59		(211)
Jan Space heatin 236.72 (211)m = {[(98 260.7)	Feb 183.46 183.46 202.05 18 fuel (se	ement (c 147.99 4)] } x 1 162.98	75.96 00 ÷ (20 83.65 y), kWh/	May d above 26.8 26) 29.51	Jun) 0	Jul 0	0 Tota	0 0 (kWh/yea	65.03 71.62 ar) =Sum(2	154 169.6 211) _{15,1012}	244.59		(211)
Jan Space heatin 236.72 (211)m = {[(98) 260.7} Space heatin = {[(98)m x (20)	Feb 183.46 183.46 202.05 19 fuel (second)] } x 1	ement (c 147.99 4)] } x 1 162.98 econdar 00 ÷ (20	alculate 75.96 00 ÷ (20 83.65 y), kWh/	May d above; 26.8 29.51 month	Jun) 0	Jul 0	0 Tota	0 0 I (kWh/yea	65.03 71.62 ar) =Sum(2	154 169.6 211) _{15,1012}	244.59		(211)

Water heating											
Output from water heat			444.50	100.70	400.00	400.00	440.00	450.00	100.74	7	
166.62 145.55 Efficiency of water heat		4.32 130.04	114.53	109.73	122.32	123.68	140.83	150.33	162.71	81.5	(216)
(217)m= 86.71 86.44		1.63 82.95	81.5	81.5	81.5	81.5	84.23	85.95	86.84	61.5	(217)
Fuel for water heating,			00	00	00	00	00	00.00	00.0]	()
$(219)m = (64)m \times 100$	÷ (217)m									7	
(219)m= 192.16 168.39	176.4 15	8.71 156.77	140.53	134.64	150.09	151.75	167.21	174.9	187.37		٦
Annual totala					1018	I = Sum(2		Mbbass		1958.9	(219)
Annual totals Space heating fuel use	d, main sys	stem 1					K	Wh/year		kWh/year 1249.49	
Water heating fuel used	d									1958.9	
Electricity for pumps, fa	ans and ele	ctric keep-ho	t								_
central heating pump:									30]	(230c)
Total electricity for the	above, kWh	n/year			sum	of (230a).	(230g) =			30	(231)
Electricity for lighting										285.16	(232)
Electricity generated by	/ PVs									-501.93	(233)
10a. Fuel costs - indiv	idual heatir	ng systems:									
			Fu kW	el /h/ye <mark>ar</mark>			Fuel P (Table			Fuel Cost £/year	
Spa <mark>ce he</mark> ating - main s	ystem 1		(211	I) x			3.4	.8	x 0.01 =	43.48	(240)
Spa <mark>ce he</mark> ating - main s	ystem 2		(213	3) x			0		x 0.01 =	0	(241)
Space heating - second	dary		(215	5) x			13.	19	x 0.01 =	0	(242)
Water heating cost (oth	er fuel)		(219	9)			3.4	8	x 0.01 =	68.17	(247)
Pumps, fans and electr	ic keep-hot		(231	1)			13.	19	x 0.01 =	3.96	(249)
(if off-peak tariff, list each	ch of (230a) to (230g) se	eparately (232		licable a	nd apply			rding to - x 0.01 =		7(050)
Energy for lighting	/ T	4.0\	(232	-)			13.	19	X 0.01 =	37.61	(250)
Additional standing cha	arges (Table	9 12)								120	(251)
			one	of (233) to	o (235) x)		13.	19	x 0.01 =	0	(252)
Appendix Q items: repe	eat lines (25	53) and (254)	as need	led							_
Total energy cost			(247) + (25	0)(254)	=					273.22	(255)
11a. SAP rating - indiv	vidual heati	ng systems									
Energy cost deflator (Ta	able 12)									0.42	(256)
Energy cost factor (ECI	F)	[(255) x	(256)] ÷ [(4) + 45.0]	=					1.18	(257)
SAP rating (Section 1)	2)									83.56	(258)
12a. CO2 emissions -	- Individual	heating syste	ems inclu	uding mi	cro-CHF)					
				ergy /h/year			Emiss kg CO	ion fac 2/kWh	tor	Emissions kg CO2/yea	

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	S	um of (265)(271) =		596.08	(272)
CO2 emissions per m²	(2	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)

		User Details:				
Assessor Name: Software Name:	Stroma FSAP 2012	Soft	na Number: vare Version:	Versio	on: 1.0.3.15	
		Property Addres	ss: Flat 9			
Address: 1. Overall dwelling dime	ancione:					
1. Overall dwelling dime	11510115.	Area(m²)	Δv. H	eight(m)	Volume(m	3)
Ground floor		51.3	¬ —	1.92 (2a) =	98.5	(3a)
Total floor area TFA = (1	a)+(1b)+(1c)+(1d)+(1e)+((1n) 5 _{1.3}	(4)			
) Owelling volume		,		3d)+(3e)+(3n) =	98.5	(5)
Ventilation rate:					30.3	
2. Verillation rate.	main second		total		m³ per hou	ur
Number of chimneys	heating heating	g + 0	= 0	x 40 =	0	(6a)
Number of open flues	0 + 0	+ 0	= 0	x 20 =	0	(6b)
' Number of intermittent fa				x 10 =	20	(7a
Number of passive vents			0	x 10 =	0	(7b)
Number of flueless gas f				x 40 =		=
Nulliber of flueless gas fi	165		0	X 40 =	0	(7c)
				Air ch	nanges <mark>per</mark> h	our
Infilt <mark>ration</mark> due to chi <mark>mne</mark>	ys, flues and fans = (6a)+(6b)	+(7a)+(7b)+(7c) =	20	÷ (5) =	0.2	(8)
	een ca <mark>rried o</mark> ut or is intended, prod	eed to (17), otherwis	e continue from (9) to	(16)		
Number of storeys in t	ne dw <mark>elling</mark> (ns)				0	(9)
Additional infiltration	.25 for steel or timber frame	or 0.35 for mass	nry construction	[(9)-1]x0.1 =	0	(10
	resent, use the value corresponding		•		0	(11
deducting areas of opening						
•	floor, enter 0.2 (unsealed) or	0.1 (sealed), els	e enter 0		0	(12
If no draught lobby, en		ı			0	(13
Window infiltration	s and doors draught stripped		0.2 x (14) ÷ 100] =		0	(14
Infiltration rate			0) + (11) + (12) + (13)) + (15) =	0	(15 (16
	q50, expressed in cubic me	, , ,			5	(17
	ity value, then $(18) = [(17) \div 20]$		•		0.45	(18
Air permeability value applie	es if a pressurisation test has been o	done or a degree air	permeability is being	used		
Number of sides sheltere	ed				3	(19
Shelter factor			- [0.075 x (19)] =		0.78	(20
Infiltration rate incorpora	-	(21) = (18) x (20) =		0.35	(21)
Infiltration rate modified f		1 1 .		1	1	
1	Mar Apr May Jur	n Jul Aug	Sep Oct	Nov Dec]	
Jan Feb						
Monthly average wind sp	eed from Table 7		1,1	1 45 1	1	
1 1		3.8 3.7	4 4.3	4.5 4.7]	
Monthly average wind sp	need from Table 7 4.9 4.4 4.3 3.8	3.8 3.7	4 4.3	4.5 4.7]	

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 effec		J	rate for t	he appli	cable ca	se	<u>!</u>	<u> </u>	<u> </u>				
If mechanica												0	(2
If exhaust air h		0		, ,	,	. `	,, .	,) = (23a)			0	(2
If balanced with		•	•	•		,		,				0	(2
a) If balance	1	1				- 	- ^ ` 	ŕ	 		- ` `	÷ 100]	-
24a)m= 0	0	0	0	0	0	0	0	0	0	0	0		(2
b) If balance	1					, , ,	ИV) (24b	í `	2b)m + ('			
24b)m= 0	0	0	0	0	0	0	0	0	0	0	0		(2
c) If whole h				•	•				E (00k	. \			
<u> </u>	n < 0.5 ×	(23b), t	nen (240	(230)	o); otner	wise (24	$\frac{C}{C} = (22)$	o) m + 0.	· `	í 			(2
								<u> </u>	0	0	0		(2
d) If natural if (22b)n		on or wn en (24d)							0.51				
4d)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		(2
Effective air	change	rate - er	nter (24a	or (24b	o) or (24	c) or (24	d) in box	(25)	l	<u> </u>	<u>.</u> ļ		
(5)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		(2
B. Heat losse												_	
LEMENT	Gros area		Openin m		Net Ar A ,r		U-val W/m2		A X U (W/	K)	k-value kJ/m²-k		A X k kJ/K
oo <mark>rs</mark>	5 5				2	x	1.5	= 1	3	7			(2
in <mark>dows</mark> Type	e 1				1.63	x1	/[1/(1.3)+	0.041 =	2.01	Ħ			(2
indows Type					3.684		/[1/(1.3)+		4.55	Ħ			(2
oor					3.46		0.2	=	0.692	믁 ,			(2
alls Type1	04.6			\neg		=		=		=		╡╞	
alls Type1	24.8		5.31	_	19.5	=	0.15	=	2.93	_		-	`
	7.60		2	=	5.66	=	0.24	=	1.34	_		┥	(2
oof	42.7		0		42.77	=	0.1	=	4.28				(3
otal area of e			<i>(()</i>		78.7			/F/4/11) 0.047			0.0	(;
or windows and include the area						atea using	j tormula 1	/[(1/U-vail	ie)+0.04] a	as given ir	n paragrapn	3.2	
abric heat los	ss, W/K :	= S (A x	U)	•			(26)(30)) + (32) =			[18.8	(:
eat capacity	Cm = S	(A x k)	,					((28).	(30) + (3	2) + (32a)	(32e) =	3533.57	ऱ.
nermal mass		` '	P = Cm ÷	- TFA) ir	n kJ/m²K	,		Indica	tive Value	: Medium	[250	(;
r design assess	•	,		,			ecisely the	e indicative	values of	TMP in T	able 1f		`
n be used inste													
	•	,			-	K						7.84	(;
•	al hridaina	are not kn	own (36) =	= 0.15 x (3	11)			(33) 1	(26) -		Γ		
details of therma								(33) +	(36) =		. [26.64	(;
details of therma otal fabric he	at loss	aloulote -	l manthi	,				(20)	_ 0 22	75\ /-	1		
details of therma otal fabric he entilation hea	at loss				li i in	1,.1			= 0.33 × (1			
details of therma otal fabric he entilation hea	eat loss at loss ca Feb	Mar	Apr	May	Jun	Jul 18.06	Aug	Sep	Oct	Nov	Dec		15
details of thermal otal fabric he entilation hea Jan 19.51	eat loss at loss ca Feb 19.38	Mar 19.26			Jun 18.06	Jul 18.06	Aug 17.97	Sep 18.26	Oct 18.57	Nov 18.79			(3
	eat loss at loss ca Feb 19.38	Mar 19.26	Apr	May	 	-	l 	Sep 18.26	Oct	Nov 18.79	Dec		(3

Heat loss para	ımeter (I	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 .	12 /12=	0.88	(40)
Number of day		`	<u> </u>										
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		(44)
(41)m= 31	28	31	30	31	30	31	31	30	31	30	31		(41)
4. Water hea	ting ene	rgy requi	rement:								kWh/ye	ear:	
Assumed occu if TFA > 13.9 if TFA £ 13.9	9, N = 1		[1 - exp	(-0.0003	349 x (TF	FA -13.9)2)] + 0.0	0013 x (⁻	TFA -13.		73		(42)
Annual average Reduce the annual not more that 125	, al average	hot water	usage by	5% if the α	lwelling is	designed t	` ,		se target o		.25		(43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage i	n litres per	r day for ea	ach month	Vd,m = fa	ctor 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		
		•								m(44) ₁₁₂ =		903	(44)
Energy content of	hot water	used - cal	culated m	onthly $= 4$.	190 x Vd,r	n x nm x D	Tm / 3600) kWh/mor	nth (see Ta	ables 1b, 1	c, 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		
If instantaneous w	vater heati	na at noint	of use (no	hot water	storage)	enter () in	hoves (46		Total = Su	m(45) ₁₁₂ =		1183.97	(45)
				_					45.04	40.40	47.00		(46)
(46)m= 18.41 Water storage	16.1 loss:	16.62	14.49	13.9	12	11.12	12.76	12.91	15.04	16.42	17.83		(46)
Storage volum) includir	ig any so	olar or W	/WHRS	storage	within sa	ame ves	sel		0		(47)
If community h	neating a	and no ta	nk in dw	elling, e	nter 110	litres in	(47)						
Otherwise if no	o stored	hot wate	er (this in	ncludes i	nstantar	neous co	mbi boil	ers) ente	er '0' in (47)			
Water storage													
a) If manufact				or is kno	wn (kWł	n/day):					0		(48)
Temperature f											0		(49)
Energy lost fro		_	-				(48) x (49)) =			0		(50)
b) If manufactHot water store			-								0		(51)
If community h	•			_ (., 0, 0.0	.,,					<u> </u>		(0.)
Volume factor	from Ta	ble 2a									0		(52)
Temperature f	actor fro	m Table	2b								0		(53)
Energy lost fro	m water	r storage	, kWh/ye	ear			(47) x (51)) x (52) x (53) =		0		(54)
Enter (50) or	(54) in (5	55)									0		(55)
Water storage	loss cal	culated t	or 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	s dedicate	d solar sto	rage, (57)	m = (56)m	x [(50) – (H11)] ÷ (5	0), else (5	7)m = (56)	m where (H11) is fro	m Appendi	x H	
(57)m= 0	0	0	0	0	0	0	0	0	0	0	0		(57)
Primary circuit	loss (ar	nnual) fro	m Table	e 3							0		(58)
Primary circuit	•	•			59)m = ((58) ÷ 36	65 × (41)	m					
(modified by	factor f	rom Tab	le H5 if t	here is s	olar wat	er heatii	ng and a	cylinde	r thermo	stat)			
(59)m= 0	0	0	0	0	0	0	0	0	0	0	0		(59)

					()								
Combi loss calcu				,	<u> </u>	- ` ` 		- 1 00 07		T 00 04	10.40	1	(64)
` '		39.11	36.37	36.05	33.4	34.51	36.05		39.11	39.34	42.18		(61)
Total heat requir						1	`		` 	`	`´	(59)m + (61)m 1	(22)
` '		149.9	132.95	128.72	113.37	108.62	121.0		139.4	148.81	161.06		(62)
Solar DHW input cal									r contribut	ion to wate	er heating)		
(add additional li							. 			1 -		1	(20)
(63)m= 0	0	0	0	0	0	0	0	0	0	0	0		(63)
Output from water						1		<u> </u>			1	1	
(64)m= 164.93	144.07	149.9	132.95	128.72	113.37	108.62	121.0		139.4	148.81	161.06		1
								utput from wa				1635.35	(64)
Heat gains from	water he	eating,	kWh/mo	onth 0.2	5 ´ [0.85	× (45)m	+ (61)m] + 0.8 >	۲ [(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 calcu	lation o	of (65)m	only if c	ylinder i	s in the	dwellin	ng or hot w	ater is f	rom com	munity h	neating	
5. Internal gain	ns (see T	Table 5	and 5a)):									
Metabolic gains	(Table 5	i), Watt	S										
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	g Sep	Oct	Nov	Dec		
(66)m= 103.71 1	103.71	103.71	103.71	103.71	103.71	103.71	103.7	1 103.71	103.71	103.71	103.71		(66)
Lighting gains (c	alculate	d in Ap	pendix l	L, equati	ion L9 o	r L9a), a	lso se	e 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	s (ca <mark>lcul</mark>	ated in	Append	dix L, eq	uation L	.13 or L1	3a), al	so see Ta	ble 5				
		221.24	208.73	192.93	178.09	168.17	165.8		184.23	200.03	214.87		(68)
Cooking gains (c	calculate	d in Ar	pendix	L. equat	ion L15	or L15a	. also	see Table	5		<u>!</u>	•	
	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 5	a)				<u> </u>				1		
(70)m= 3	3	3	3	3	3	3	3	3	3	3	3]	(70)
Losses e.g. evar	noration	(negati	ive valu	es) (Tah	le 5)	<u> </u>	<u> </u>		<u> </u>	<u> </u>	<u> </u>	I	
		-69.14	-69.14	-69.14	-69.14	-69.14	-69.1	4 -69.14	-69.14	-69.14	-69.14]	(71)
Water heating ga						1		1			1	I	` /
		62.65	57.23	53.53	48.53	44.72	50.12	2 52.37	57.96	64.21	67.3	1	(72)
		02.00	07.20	00.00		<u> </u>	l	m + (69)m + (l		J	()
Total internal ga (73)m= 416.96 4		396.36	371.67	346.86	324.56	311.9	319.2		358.64	386	406.38	1	(73)
6. Solar gains:	+12.74	390.30	3/ 1.0/	340.00	324.30	311.9	319.2	7 333.76	330.04	300	400.36		(10)
Solar gains are cal	culated us	ing solar	flux from	Table 6a	and assoc	riated equa	tions to	convert to th	e applical	ole orientat	tion		
Orientation: Ac		•	Area		Flu	•		g_	о арриса	FF		Gains	
	ble 6d	otoi	m ²			ble 6a		Table 6b	Т	able 6c		(W)	
Southeast 0.9x	0.77	×	1.6	3	x (36.79	x	0.63	x [0.7		18.33	(77)
Southeast 0.9x	0.77	^ x	1.6		-	62.67	」^ <u> </u>	0.63	^	0.7		31.22](77)
Southeast 0.9x	0.77	$=$ $\begin{pmatrix} 1 & 1 \\ 1 & 1 \end{pmatrix}$	1.6		-	B5.75	」^ <u>∟</u> lx	0.63	^ L	0.7	╡ -	42.72](77)
Southeast 0.9x		=					╎ ⊨		≓		=](77)
Southeast 0.9x	0.77	_ X	1.6	==	-	06.25	х <u> </u> , Г	0.63		0.7	╡ -	52.93	-
Journeast U.9X	0.77	X	1.6	აპ	x 1	19.01	X	0.63	Х	0.7	=	59.29	(77)

F		7			_		1 1		_				_
Southeast 0.9x	0.77	X	1.63	,	× _ 1	18.15	X	0.63	×	0.7	=	58.86	(77)
Southeast 0.9x	0.77	X	1.63	3 ,	×1	13.91	X	0.63	X	0.7	=	56.74	(77)
Southeast 0.9x	0.77	X	1.63	3 ,	×1	04.39	X	0.63	X	0.7	=	52	(77)
Southeast 0.9x	0.77	X	1.63	3 ,	x	92.85	X	0.63	X	0.7	=	46.25	(77)
Southeast 0.9x	0.77	X	1.63	3	x (69.27	X	0.63	X	0.7	=	34.51	(77)
Southeast 0.9x	0.77	X	1.63	3	X A	44.07	X	0.63	X	0.7	=	21.95	(77)
Southeast 0.9x	0.77	X	1.63	3	x (31.49	x	0.63	X	0.7	=	15.69	(77)
Southwest _{0.9x}	0.77	X	3.68	3	x :	36.79]	0.63	x	0.7	=	41.43	(79)
Southwest _{0.9x}	0.77	X	3.68	3	× (62.67		0.63	X	0.7	=	70.56	(79)
Southwest _{0.9x}	0.77	X	3.68	3	x	85.75]	0.63	x	0.7	=	96.55	(79)
Southwest _{0.9x}	0.77	X	3.68	3	x 1	06.25		0.63	X	0.7	=	119.63	(79)
Southwest _{0.9x}	0.77	X	3.68	3 ,	x 1	19.01		0.63	x	0.7	=	133.99	(79)
Southwest _{0.9x}	0.77	X	3.68	3 ,	x 1	18.15		0.63	x	0.7	_ =	133.02	(79)
Southwest _{0.9x}	0.77	X	3.68	3 ,	x 1	13.91	j	0.63	x	0.7	=	128.25	(79)
Southwest _{0.9x}	0.77	X	3.68	3 ,	x 1	04.39	j	0.63	x	0.7	=	117.53	(79)
Southwest _{0.9x}	0.77	x	3.68	3)	x (92.85	j	0.63	x	0.7	=	104.54	(79)
Southwest _{0.9x}	0.77	X	3.68	3 ,	x (69.27		0.63	x	0.7	=	77.99	(79)
Southwest _{0.9x}	0.77	X	3.68	3	x	44.07		0.63	X	0.7	=	49.62	(79)
Southwest _{0.9x}	0.77	j x	3.68	,	x :	31.49	i	0.63	X	0.7		35.45	(79)
Solar gains in (83) m= 59.75 Total gains – in (84) m= 476.72	101.78 139	9.26 solar	172.56 (84)m =	193.28 (73)m +	,	184.99 , watts	(83)m	= Sum(74)m . .53 150.79	(82)m 112.4	71.57	51.14	1	(83)
		0.02	344.22	540.14	516.44	496.89	488	3.8 484.57	471.1	457.57	457.52		(84)
7. Mean inter		ture (heating s	season)					471.1	457.57	457.52		
Temperature	during heati	ture (heating s	season) the livin	g area	from Tal			471.1	457.57	457.52	21	(84)
Temperature Utilisation fac	during heati	ture (heating seriods in ving area	season) the livin a, h1,m	g area (see Ta	from Tal	ole 9,	Th1 (°C)				21	
Temperature Utilisation fac	during heati tor for gains Feb M	ture (ng pe for li	heating seriods in ving area	season) the livin a, h1,m May	g area (see Ta Jun	from Tal able 9a) Jul	ole 9,	Th1 (°C)	Oct	Nov	Dec	21	(85)
Temperature Utilisation fac	during heati tor for gains Feb M	ture (heating seriods in ving area	season) the livin a, h1,m	g area (see Ta	from Tal	ole 9,	Th1 (°C)				21	
Temperature Utilisation fac	during heati stor for gains Feb M	ture (ng pe for li lar	heating seriods in ving area Apr	season) the livin a, h1,m May	g area (see Ta Jun _{0.55}	from Tal able 9a) Jul 0.4	ole 9,	Th1 (°C) ug Sep 2 0.62	Oct	Nov	Dec	21	(85)
Temperature Utilisation fac Jan (86)m= 0.98	during heati tor for gains Feb M 0.97 0.9	ture (ng pe for li lar	heating seriods in ving area Apr	season) the livin a, h1,m May	g area (see Ta Jun _{0.55}	from Tal able 9a) Jul 0.4	ole 9,	Th1 (°C) ug Sep 2 0.62 able 9c)	Oct	Nov 0.96	Dec	21	(85)
Temperature Utilisation fac Jan (86)m= 0.98 Mean interna	during heati stor for gains Feb M 0.97 0.9 I temperature 20.53 20	for li for li far 94 e in li	heating seriods in ving area Apr 0.87 iving area 20.85	season) the livin a, h1,m May 0.74 a T1 (fo	g area (see Ta Jun 0.55 Ilow ste	from Tal able 9a) Jul 0.4 eps 3 to 7	ole 9, 0.4 7 in T	Th1 (°C) ug Sep 2 0.62 able 9c) 1 20.99	Oct 0.86	Nov 0.96	Dec 0.98	21	(85)
Temperature Utilisation factors Jan (86)m= 0.98 Mean interna (87)m= 20.42	during heati stor for gains Feb N 0.97 0.9 I temperature 20.53 20 during heati	for li for li far 94 e in li	heating seriods in ving area Apr 0.87 iving area 20.85	season) the livin a, h1,m May 0.74 a T1 (fo	g area (see Ta Jun 0.55 Ilow ste	from Tal able 9a) Jul 0.4 eps 3 to 7	ole 9, 0.4 7 in T	Th1 (°C) ug Sep 2 0.62 able 9c) 1 20.99 9, Th2 (°C)	Oct 0.86	Nov 0.96 20.63	Dec 0.98	21	(85)
Temperature Utilisation factors Jan (86)m= 0.98 Mean interna (87)m= 20.42 Temperature	during heatietor for gains Feb N 0.97 0.97 I temperature 20.53 20 during heati 20.17 20	for li for li far e in li .68	heating seriods in ving area Apr 0.87 iving area 20.85 eriods in 20.18	season) the livin a, h1,m May 0.74 a T1 (fo 20.96 rest of c 20.18	g area (see Ta Jun 0.55 Illow ste 20.99 dwelling 20.19	from Tale able 9a) Jul 0.4 eps 3 to 7 21 g from Tale 20.19	Ole 9, Ole 9,	Th1 (°C) ug Sep 2 0.62 able 9c) 1 20.99 9, Th2 (°C)	Oct 0.86	Nov 0.96 20.63	Dec 0.98	21	(86)
Temperature Utilisation factors Jan (86)m= 0.98 Mean interna (87)m= 20.42 Temperature (88)m= 20.17	during heatietor for gains Feb N 0.97 0.9 I temperature 20.53 20 during heati 20.17 20 etor for gains	for li for li far e in li .68	heating seriods in ving area Apr 0.87 iving area 20.85 eriods in 20.18	season) the livin a, h1,m May 0.74 a T1 (fo 20.96 rest of c 20.18	g area (see Ta Jun 0.55 Illow ste 20.99 dwelling 20.19	from Tale able 9a) Jul 0.4 eps 3 to 7 21 g from Tale 20.19	Ole 9, Ole 9,	Th1 (°C) ug Sep 2 0.62 table 9c) 1 20.99 0, Th2 (°C) 19 20.19	Oct 0.86	Nov 0.96 20.63	Dec 0.98	21	(86)
Temperature Utilisation factors Jan (86)m= 0.98 Mean interna (87)m= 20.42 Temperature (88)m= 20.17 Utilisation factors (89)m= 0.97	during heatietor for gains Feb N 0.97 0.9 I temperature 20.53 20 during heati 20.17 20 etor for gains 0.96 0.9	ture (ng pe for li Mar 94 e in li .68 ng pe .17 for re	cheating seriods in ving area 20.85 ceriods in 20.18 cest of dw 0.83	the livin a, h1,m May 0.74 a T1 (fo 20.96 rest of c 20.18 velling, h 0.68	g area (see Ta Jun 0.55 Illow ste 20.99 dwelling 20.19 n2,m (se	from Tal able 9a) Jul 0.4 eps 3 to 7 21 g from Tal 20.19 ee Table 0.32	ole 9, Ole 9,	Th1 (°C) ug Sep 2 0.62 Table 9c) 1 20.99 0, Th2 (°C) 19 20.19	Oct 0.86 20.88 20.18	Nov 0.96 20.63	Dec 0.98 20.39	21	(85) (86) (87) (88)
Temperature Utilisation factors Jan (86)m= 0.98 Mean interna (87)m= 20.42 Temperature (88)m= 20.17 Utilisation factors	during heatietor for gains Feb N 0.97 0.97 I temperature 20.53 20 during heatie 20.17 20 etor for gains 0.96 0.90 I temperature	ture (ng pe for li Mar 94 e in li .68 ng pe .17 for re	cheating seriods in ving area 20.85 ceriods in 20.18 cest of dw 0.83	the livin a, h1,m May 0.74 a T1 (fo 20.96 rest of c 20.18 velling, h 0.68	g area (see Ta Jun 0.55 Illow ste 20.99 dwelling 20.19 n2,m (se	from Tal able 9a) Jul 0.4 eps 3 to 7 21 g from Tal 20.19 ee Table 0.32	ole 9, Ole 9,	Th1 (°C) ug Sep 2 0.62 fable 9c) 1 20.99 9, Th2 (°C) 19 20.19 5 0.56 to 7 in Table	Oct 0.86 20.88 20.18	Nov 0.96 20.63 20.18	Dec 0.98 20.39	21	(85) (86) (87) (88)
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Temperature Utilisation fact Jan (86)m= 0.98 Mean interna (87)m= 20.42 Temperature (88)m= 20.17 Utilisation fact (89)m= 0.97 Mean interna (90)m= 19.41	during heatietor for gains Feb M 0.97 0.9 I temperature 20.53 20 during heati 20.17 20 etor for gains 0.96 0.9 I temperature 19.58 19 I temperature 20.29 20	for li for re for re ge in t .79 e (for .79	heating seriods in ving area 20.85 viving area 20.85 viving area 20.85 viving area 20.18 viving area 2	season) the livin a, h1,m May 0.74 a T1 (fo 20.96 rest of c 20.18 velling, h 0.68 of dwelling 20.14	g area (see Ta Jun 0.55 Illow ste 20.99 dwelling 20.19 n2,m (se 0.48 ng T2 (f 20.19 ling) = f 20.79	from Tal able 9a) Jul 0.4 eps 3 to 7 21 g from Tal 20.19 ee Table 0.32 follow ste 20.19	ole 9, Ole 9,	Th1 (°C) ug Sep 2 0.62 able 9c) 1 20.99 0, Th2 (°C) 19 20.19 5 0.56 to 7 in Table 19 20.18 f - fLA) × T2 8 20.78	Oct 0.86 20.88 20.18 0.82 e 9c) 20.06 LA = Liv	Nov 0.96 20.63 20.18 0.95 19.73 ving area ÷ (-	Dec 0.98 20.39 20.18 0.98		(85) (86) (87) (88) (89)

83 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
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 8.9 111.7 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) (93)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)s12 888.92 (98) Space heating requirements - Individual heating systems including micro-CHP) Space heating: Fraction of space heat from secondary/supplementary system Fraction of space heat from main system(s) Fraction of total heating from main system 1 (202) x [1 - (203)] = 1 (204)
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 0 41.85 122 208.38 Total per year (kWh/year) = Sum(98)s = 888.92 (98) Space heating requirements – Individual heating systems including micro-CHP) Space heating: Fraction of space heat from secondary/supplementary system Fraction of space heat from main system 1 (204) = (202) x [1 - (203)] = 1 (204) = (202) x [1 - (203)] = 1 (204) = (202) x [203] = 1 (204) = (204) = (202) x [203] = 1 (204) = (204) = (202) x [203] = 1 (204) = (204) = (202) x [203] = 1 (204) = (204) = (204) x [203] = 1 (204) = (204) = (204) x [203] = 1 (204) = (204) x [203] = (204) = (204) x [203] = 1 (204) = (204) x [204] =
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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 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 Monthly average external temperature from Table 8 (96)m= 4.3 4.9 6.5 8.9 11.7 14.6 16.6 16.4 14.1 10.6 7.1 4.2 Heat loss rate for mean internal temperature, Lm , W = ((39)m x ((93)m - (96)m)
(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)ss2 888.92 (98) Space heating requirements - Individual heating systems including micro-CHP) Space heating: Fraction of space heat from main system (s) (202) = 1 - (201) =
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 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)s.12 888.92 (98) Space heating: Fraction of space heat from secondary/supplementary system Fraction of space heat from main system 1 (202) x [1 - (203)] = 1 (204) = 1 (204) = 1 (204) = 1 (204) = 1 (204) = 1 (204) = 1 (202) x [1 - (203)] = 1 (204) = 1 (204) = 1 (204) = 1 (204) = 1 (204) = 1 (202) x [1 - (203)] = 1 (204) = 1 (20
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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)49.12 = 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 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 (204)
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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) _{1.59-12} = 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 Fraction of space heat from main system(s) Fraction of total heating from main system 1 (202) x [1 - (203)] = 1 (204) = (204) = (202) x [1 - (203)] = 1 (204) = (204) = (204) = (206) = 1 (206
(98)m= 199.36 144.95 108.1 49.27 15.01 0 0 0 41.85 122 208.38 Total per year (kWh/year) = Sum(98) _{15,912} = 888.92 (98) Space heating requirement in kWh/m²/year
Total per year (kWh/year) = Sum(98) ₁₅₉₁₂ = 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 Fraction of space heat from main system(s) Fraction of total heating from main system 1 Efficiency of main space heating system 1 [204] = (202) × [1 – (203)] = 1 (204) [204] = (202) × [1 – (203)] = 1 (204)
Space heating requirement in kWh/m²/year 9a. Energy requirements – Individual heating systems including micro-CHP) Space heating: Fraction of space heat from secondary/supplementary system Fraction of space heat from main system(s) Fraction of total heating from main system 1 Efficiency of main space heating system 1 Efficiency of main space heating system 1 90.8 (202) = 1 - (201) =
9a. Energy requirements – Individual heating systems including micro-CHP) Space heating: Fraction of space heat from secondary/supplementary system Fraction of space heat from main system(s) Fraction of total heating from main system 1 Efficiency of main space heating system 1 90.8 (201) (202) (201) (202) (204) (202) (204) (203) (204) (206)
Space heating:Fraction of space heat from secondary/supplementary systemFraction of space heat from main system(s) $(202) = 1 - (201) =$ Fraction of total heating from main system 1 $(204) = (202) \times [1 - (203)] =$ Efficiency of main space heating system 1 90.8
Space heating:Fraction of space heat from secondary/supplementary systemFraction of space heat from main system(s) $(202) = 1 - (201) =$ Fraction of total heating from main system 1 $(204) = (202) \times [1 - (203)] =$ Efficiency of main space heating system 1 90.8
Fraction of space heat from secondary/supplementary system Fraction of space heat from main system(s) Fraction of total heating from main system 1 Efficiency of main space heating system 1 $(202) = 1 - (201) = 1$ $(202) \times [1 - (203)] = 1$ $(204) = (202) \times [1 - (203)] = 1$ $(204) = (202) \times [1 - (203)] = 1$ $(204) = (202) \times [1 - (203)] = 1$ $(204) = (202) \times [1 - (203)] = 1$
Fraction of total heating from main system 1 Efficiency of main space heating system 1 (204) = (202) × [1 – (203)] = 1 (204) 90.8 (206)
Efficiency of main space heating system 1
Efficiency of main space heating system 1
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec kWh/year
Space heating requirement (calculated above) 199.36
$ (211)m = \{ [(98)m \times (204)] \} \times 100 \div (206) $ $ (211)$ $ (211)m = \{ [(98)m \times (204)] \} \times 100 \div (206) $ $ (211)m = \{ [(98)m \times (204)] \} \times 100 \div (206) $ $ (211)m = \{ [(98)m \times (204)] \} \times 100 \div (206) $ $ (211)m = \{ [(98)m \times (204)] \} \times 100 \div (206) $ $ (211)m = \{ [(98)m \times (204)] \} \times 100 \div (206) $ $ (211)m = \{ [(98)m \times (204)] \} \times 100 \div (206) $ $ (211)m = \{ [(98)m \times (204)] \} \times 100 \div (206) $ $ (211)m = \{ [(98)m \times (204)] \} \times 100 \div (206) $ $ (212)m = \{ [(98)m \times (204)] \} \times 100 \div (206) $ $ (213)m = \{ [(98)m \times (204)] \} \times 100 \div (206) $ $ (214)m = \{ [(98)m \times (204)] \} \times 100 \div (206) $ $ (215)m = \{ [(98)m \times (204)] \} \times 100 \div (206) $ $ (216)m = \{ [(98)m \times (204)] \} \times 100 \div (206) $ $ (217)m = \{ [(98)m \times (204)] \} \times 100 \div (206) $ $ (218)m = \{ [(98)m \times (204)] \} \times 100 \div (206) $ $ (219)m = \{ [($
Total (kWh/year) = Sum(211) _{15,1012} = 978.99 (211)
Space heating fuel (secondary), kWh/month
$= \{[(98) \text{m x } (201)]\} \times 100 \div (208)$
(215)m= 0 0 0 0 0 0 0 0 0 0 0 0 0
Total (kWh/year) = Sum(215) _{15,1012} = 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)_{112} = 1948.16 $ $LVMb tree = 1948.16 $ $LVMb tree = 1948.16 $
Annual totals kWh/year kWh/year Space heating fuel used, main system 1 978.99
5 1 2 2 3 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3

Water heating fuel used			1948.16
Electricity for pumps, fans and electric keep-h	not		_
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 × 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) Energy for lighting	separately as applicable ar	nd apply fuel price according to	
Additional standing charges (Table 12)			120 (251)
	one of (233) to (235) x)	13 10 X 0.01:	= 0 (252)
Appendix Q items: repeat lines (253) and (254)		13.19 × 0.01	0 (252)
	(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 sys	stems including micro-CHP		
	Energy	Emission factor	Emissions
	kWh/year	kg CO2/kWh	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) + (2	264) =	632.26 (265)
Electricity for pumps, fans and electric keep-h	not (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)

CO2 emissions per m ²	(272) ÷ (4) =	10.38	(273)
El 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) ÷ (4) =		58.09	(273)



Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+(1n)				loor De	staile.						
Software Name: Stroma FSAP 2012 Software Version: Version: 1.0.3.15	Access		<u> </u>								
Address: 1. Overall divelling dimensions: Area(m²)		Ctromo FCAD 2012							Varaia		
Address: 1. Overall divolling climensions: Area(m²) Av. Height(m) Volume(m³) (3a)	Software Name:	Stroma FSAP 2012							versio	on: 1.0.3.15	
Area(m²)	Addross :		Piop	репу А	laaress.	rial 10					
Stream File		nsions:									
Control floor				Area	(m²)		Av. He	ight(m)		Volume(m	³)
2 Ventilation rate:	Ground floor				<u> </u>	(1a) x			(2a) =		<u> </u>
2 Ventilation rate:	Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)-	ا ا (1n)+	47	7.8	(4)			J		
2. Ventilation rate: main heating heating heating Number of chimneys 0	·	, (-, (-, (-, (-,	` ')+(3c)+(3c	d)+(3e)+	.(3n) =	04.70	(E)
Number of chimneys						(00)1(00	71 (00) 1 (00	a)	.(011) =	91.78	(5)
Number of chimneys	2. Ventilation rate:	main see	condary	C	other		total			m³ per hou	ır
Number of open flues	N	heating he	ating			, ,			40	-	_
Number of intermittent fans 2	ŕ	0 +	0	†	0]	0			0	(6a)
Number of passive vents 0	Number of open flues	0 +	0	+	0	_ = _	0	x 2	20 =	0	(6b)
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) Additional infiltration 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 If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 Percentage of windows and doors draught stripped Window infiltration 0.25 - [0.2 x (14) + 100] = 0.15 Infiltration rate (a) + (10) + (11) + (12) + (13) + (15) = 0.16 Air permeability value, q.50, 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) Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used Number of sides sheltered Shelter factor (20) = 1 - [0.075 x (19)] = 0.78 (21) - (18) - (20) - (18) - (21) - (18) - (21) -	Number of intermittent fan	S					2	X ·	10 =	20	(7a)
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 (76) Number of storeys in the dwelling (ns) Additional infiltration 0.25 for steel or timber frame or 0.35 for masonry construction (9) to (76) Structural infiltration 0.25 for steel or timber frame or 0.35 for masonry construction (9) to (76) If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 If no draught lobby, enter 0.05, else enter 0 Percentage of windows and doors draught stripped Window infiltration atte (8) + (10) + (11) + (12) + (13) + (15) = 0 (15) Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area (9) (17) If based on air permeability value, then (18) = (17) + 20)+(8), otherwise (18) = (16) Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used Number of sides sheltered Shelter factor (20) = 1 - [0.075 x (19)] = 0.78 (20) 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	Number of passive vents						0	χ.	10 =	0	(7b)
Infiltration due to chimneys, flues and fans = (88)+(6b)+(7a)+(7b)+(7c) = 20	Number of flueless gas fire	es				Ē	0	X 4	40 =	0	(7c)
Infiltration due to chimneys, flues and fans = (88)+(6b)+(7a)+(7b)+(7c) = 20											
Number of storeys in the dwelling (ns) 0 (9)									Air ch	nanges <mark>per</mark> h	our
Number of storeys in the dwelling (ns) Additional infiltration (9) -1 x0.1 = 0 (10) (10)	Infiltration due to chimney	s, flues and fans = (6a)	+(6b)+(7a)+	+(7 b)+(7 c	c) =		20		÷ (5) =	0.22	(8)
Additional 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 If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 If no draught lobby, enter 0.05, else enter 0 Percentage of windows and doors draught stripped Window infiltration 0.25 · [0.2 × (14) ÷ 100] = Infiltration rate Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (18) Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used Number of sides sheltered Shelter factor (20) = 1 - [0.075 × (19)] = 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			l, proceed to	(17), ot	herwise d	ontinue fi	rom (9) to	(16)			_
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 If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 O (12) If no draught lobby, enter 0.05, else enter 0 Percentage of windows and doors draught stripped Window infiltration O (14) Window infiltration rate (B) + (10) + (11) + (12) + (13) + (15) = O (15) Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area (b) If based on air permeability value, then (18) = [(17) + 20]+(8), otherwise (18) = (16) Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used Number of sides sheltered Shelter factor (20) = 1 - [0.075 × (19)] = O (15) O (16) O (16) O (17) O (15) O (16) O (16) O (17) O (18) O (19) O		e dwelling (ns)						[(0)	11,0 1		─
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 If no draught lobby, enter 0.05, else enter 0 Percentage of windows and doors draught stripped Window infiltration O.25 - [0.2 × (14) ÷ 100] = 0 Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used Number of sides sheltered Shelter factor (20) = 1 - [0.075 × (19)] = 0.78 (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		25 for steel or timber fr	ame or 0	35 for 1	masonr	v consti	ruction	[(9)	-1]XU.1 =		= ' '
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 If no draught lobby, enter 0.05, else enter 0 Percentage of windows and doors draught stripped 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 of envelope area of the sased on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used Number of sides sheltered Shelter factor (20) = 1 - [0.075 x (19)] = 0.78 (20) Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.36 (21) 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						•	dollori				(\\
If no draught lobby, enter 0.05, else enter 0											_
Percentage of windows and doors draught stripped Window infiltration 0.25 - [0.2 × (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 If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used Number of sides sheltered Shelter factor (20) = 1 - [0.075 × (19)] = 0.78 (20) Infiltration rate incorporating shelter factor (21) = (18) × (20) = 0.36 (21) 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	·	•	d) or 0.1 ((sealed	d), else	enter 0				0	= ' '
Window infiltration $0.25 - [0.2 \times (14) \div 100] = 0 (15)$ 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 of the based on air permeability value, then $(18) = [(17) \div 20] + (8), \text{ otherwise } (18) = (16)$ Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used Number of sides sheltered $(20) = 1 - [0.075 \times (19)] = 0.78 (20)$ Infiltration rate incorporating shelter factor $(21) = (18) \times (20) = 0.36 (21)$ 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 $(22a)m = (22)m \div 4$	•										= '
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 (17) (18) Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used Number of sides sheltered $(20) = 1 - [0.075 \times (19)] = 0.78$ (20) Infiltration rate incorporating shelter factor $(21) = (18) \times (20) = 0.36$ (21) Infiltration rate modified for monthly wind speed Monthly average wind speed from Table 7 Mind Factor $(22a)m = (22)m \div 4$	-	and doors draught stri	ppea	0	25 - [0 2	x (14) ÷ 1	1001 =				= ```
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area $\begin{array}{c ccccccccccccccccccccccccccccccccccc$						` '		+ (15) =			= ' '
If based on air permeability value, then $(18) = [(17) \div 20] + (8)$, otherwise $(18) = (16)$ Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used Number of sides sheltered Shelter factor $(20) = 1 - [0.075 \times (19)] = $ $(20) = 1 - [0.075 \times (19)] = $ $(21) = (18) \times (20) = $ Infiltration rate incorporating shelter factor $(21) = (18) \times (20) = $ $(22) = (18) \times (20) = $ $(23) = (21) \times (20) = $ $(24) = (22) \times (20) = $ $(22) = (22) \times (20) = $ $(23) = (22) \times (20) = $ $(24) = (22) \times (20) = $ $(25) = (22) \times (20) = $ $(26) = (21) \times (20) = $ $(27) = (22) \times (20) = $ $(28) = (22) \times (20) = $ $(29) = (22) \times (20) = $ $(29) = (20) \times (20) = $ $(21) = (20) \times (20) = $ $(22) = (20) \times (20) = $ $(23) = (20) \times (20) = $ $(24) = (20) \times (20) = $ $(25) = (20) \times (20) = $ $(25) = (20) \times (20) = $ $(27) = (20) \times (20) = $ $(28) = (20) \times (20) = $ $(29) = (20) \times (20) = $ $(20) = (20) \times (20) = $ $(2$		150. expressed in cubic	c metres r						area		= ` `
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used Number of sides sheltered 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	•	•			•	•					= ' '
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	Air permeability value applies	if a pressurisation test has I	been done o	or a degr	ee air pei	meability	is being u	sed			
Infiltration rate incorporating shelter factor Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec		d		,,	00) 4 1	:0 0 7 E (-	40\1			3	─
Infiltration rate modified for monthly wind speed Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec							19)] =			0.78	=
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 3.7 4 4.3 4.5 4.7 Wind Factor (22a)m = (22)m ÷ 4	·			(2	21) = (18)	(20) =				0.36	(21)
Monthly average wind speed from Table 7 (22)m= 5.1 5 4.9 4.4 4.3 3.8 3.7 4 4.3 4.5 4.7 Wind Factor (22a)m = (22)m ÷ 4			l l	I. I	Δ	0	0-4	Nave		1	
			Jun	Jui	Aug	Sep	Oct	INOV	Dec]	
Wind Factor (22a)m = (22)m ÷ 4	 		20	20 T	27	<i>A</i>	4.2	A F	17	1	
	(22)111= 0.1 0	+.9 4.4 4.3	٥.٥	3.0	J.1	4	I 4.3	4.0	<u> </u>	J	
(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	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		

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 effec		-	rate for t	he appli	cable ca	se	!	!		!	!	<u>.</u>	
If mechanical If exhaust air he			andiv N (2	3h) - (23a	a) v Emy (e	aguation (N	VSV) othe	rwica (23h) = (23a)			0	
If balanced with) = (23a)			0	
		-	-	_					0l-\ /	005) [4 (00-)	0	
a) If balance	a mecn	anicai ve	ntilation	with ne	at recove	ery (IVIVI	1R) (248	$\frac{1}{1} = \frac{2}{2}$	2b)m + (0	23b) × [$\frac{1 - (23c)}{0}$) ÷ 100]]	
	_											J	
b) If balance	o mech	anicai ve	niliation 0	without	neat red		0	$\int_{0}^{\infty} \int_{0}^{\infty} dx = (22)$	2b)m + (.	230)	0	1	
												J	
c) If whole h if (22b)n				•	•				5 x (23h	n)			
4c)m= 0	0	0	0	0	0	0	0	0	0 / (20)	0	0	1	
d) If natural	ventilatio	n or wh	ole hous	e nositiv	/e input	L ventilatio	n from I	L		<u> </u>	<u>!</u>	J	
if (22b)n					•				0.5]				
4d)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]	
Effective air	change	rate - er	nter (24a	or (24b	o) or (24	c) or (24	d) in box	x (25)		•	•	-	
5)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		
B. Heat losse	and be	et less i	oromot) r									
	Gros		Openin		Net Ar	00	U-val	110	AXU		k-valu	0	ΑXk
LEMENT	area		operiiri		A ,r		W/m2		(W/I	K)	kJ/m ² ·		kJ/K
oors					2	x	1.5	= [3				
in <mark>dows</mark> Type	1				1.63	x1.	/[1/(1.3)+	0.04] =	2.01	Ħ			
indows Type	2				3.87	x1.	/[1/(1.3)+	0.04] =	4.78	Ħ			
alls Type1	45.4	18	5.5		39.98	x	0.15] = [6	٦,			
alls Type2	17.3	33	2	=	15.33	=	0.24	=	3.62	≓ ¦		=	
oof	40.7		0	=	40.79	=	0.1	<u>-</u>	4.08	=		ᅱ ㅏ	
otal area of e					103.6	=	0.1	[4.00				
or windows and			effective wi	ndow I I-va			ı formula 1	/[(1/Ll-valu	ıe)±0 041 a	as aiven in	naragrani	h 32	
include the area						atou uomg	TOTTIGIA 1	7 <u>[</u> (170	0,10.01,0	io givoii iii	paragrapi	7 0.2	
abric heat los	s, W/K :	= S (A x	U)				(26)(30)) + (32) =				23.	49
eat capacity	Cm = S((A x k)						((28)	.(30) + (32	2) + (32a).	(32e) =	6450).77
hermal mass	parame	ter (TMF	P = Cm -	- TFA) ir	n kJ/m²K			Indica	tive Value	: Medium		25	0
or design assess				construct	ion are no	t known pr	ecisely the	e indicative	values of	TMP in T	able 1f		
n be used inste						,							
nermal bridge	•	,			•	(10	.4
details of therma otal fabric he		are not kn	own (36) =	= 0.15 X (3	11)			(33) +	(36) =			33.	89
entilation hea		alculated	monthly	/						[25)m x (5])		,,,
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	1	
3)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	†	
		<u> </u>	L		L	L	I	<u> </u>	<u> </u>		1	1	
eat transfer of 52.27	52.15	52.02	51.45	51.34	50.83	50.83	50.74	51.03	= (37) + (3 51.34	51.56	51.79	1	
//···- UC.CI	02.10	1 02.02	I 01.70	01.07	I 00.00	1 00.00	I 50.77	1 01.00	I 51.57	1 01.00	1 01.70	1	

Hoot loss no	romotor (Ш D) \/\	/m21/					(40)m	= (39)m ÷	(4)			
Heat loss pa (40)m= 1.09	`	1.09	1.08	1.07	1.06	1.06	1.06	1.07	1.07	1.08	1.08		
(40)111= 1.00	1.00	1.00	1.00	1.07	1.00	1.00	1.00	<u> </u>		Sum(40) ₁ .		1.08	(40)
Number of d	lays in mo	onth (Tab	le 1a)										` ′
Jar	n 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 he	eating ene	rgy requ	irement:								kWh/ye	ear:	
Assumed od if TFA > 1 if TFA £ 1:	3.9, N = 1		: [1 - exp	0.0003	349 x (TF	FA -13.9)2)] + 0.0	0013 x (TFA -13		63		(42)
Annual avera Reduce the and not more that 1	nual average	e hot water	usage by	5% if the α	lwelling is	designed i			se target o		.81		(43)
Jar	n Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usag	e in litres pe	r day for ea	ach month	Vd,m = fa	ctor from	Table 1c x	(43)		!			l.	
(44)m= 80.09	9 77.18	74.26	71.35	68.44	65.53	65.53	68.44	71.35	74.26	77.18	80.09		
_		,		41	400 1//	_	T (200			ım(44) ₁₁₂ =		873.69	(44)
Energy content													
(45)m= 118.7	7 103.88	107.19	93.45	89.67	77.38	71.7	82.28	83.26	97.03	105.92	115.02		(45)
If inst <mark>antane</mark> ous	s water heat	ing at point	t of use (no	o hot water	storage),	enter 0 in	boxes (46)		Total = Su	ım(45) ₁₁₂ =		1145.54	(45)
(46)m= 17.82		16.08	14.02	13.45	11.61	10.76	12.34	12.49	14.55	15.89	17.25		(46)
Water storage		Vipoludir	on on v	olor or M	MUDC	otorogo	within or	2000	ool				(47)
Storage volu		•						allie ves	Sei		0		(47)
If community Otherwise if	_			_				ers) ente	er '0' in <i>(</i>	(47)			
Water storage			. (o. o, o		()			
a) If manufa	acturer's d	eclared l	oss fact	or is kno	wn (kWł	n/day):					0		(48)
Temperature	e factor fro	om Table	2b								0		(49)
Energy lost	from wate	r storage	, kWh/y	ear			(48) x (49)) =			0		(50)
b) If manufa			-									' 	
Hot water st	•			ie 2 (KVV	n/litre/da	ay)					0		(51)
Volume fact	_		0114.5								0		(52)
Temperature			2b							_	0		(53)
Energy lost	from wate	r storage	. kWh/v	ear			(47) x (51)) x (52) x (53) =		0		(54)
Enter (50) c		_	, ,							-	0		(55)
Water storag	ge loss ca	Iculated	for each	month			((56)m = (55) × (41)	m			l	
(56)m= 0	0	0	0	0	0	0	0	0	0	0	0		(56)
If cylinder conta	ins dedicate	ed solar sto	rage, (57)	m = (56)m	x [(50) – (<u>I</u> H11)] ÷ (5	0), else (5	7)m = (56)	m where ((H11) is fro	m Append	ix H	
(57)m= 0	0	0	0	0	0	0	0	0	0	0	0		(57)
Primary circ	uit loss (aı	nnual) fro	om Table	e 3							0		(58)
Primary circ	•	,			59)m = ((58) ÷ 36	65 × (41)	m					
(modified	by factor f	from Tab	le H5 if t	here is s	olar wat	ter heati	ng and a	cylinde	r thermo	stat)		ı	
(59)m= 0	0	0	0	0	0	0	0	0	0	0	0		(59)

On mahi lana and				(04)	(00) - 0	OF (44)	\						
Combi loss cald					,	- ` `		1 05 40	T 07.04	T 00 00	T 40.04	1	(61)
(61)m= 40.81	35.52	37.84	35.19	34.88	32.31	33.39	34.88		37.84	38.06	40.81	(50)	(61)
Total heat requ							`		` 	ì ´	`	· (59)m + (61)m 1	(60)
(62)m= 159.58	139.4	145.03	128.64	124.54	109.69	105.09	117.1		134.88	143.98	155.83		(62)
Solar DHW input ca									r contribut	ion to wate	er heating)		
(add additional						 	i 		<u> </u>	1 0		1	(63)
(63)m= 0	0	0	0	0	0	0	0	0	0	0	0]	(63)
Output from wa			100.04	404.54	400.00	T 405.00		- 440.45	1,04,00	1 40 00	1.55.00	1	
(64)m= 159.58	139.4	145.03	128.64	124.54	109.69	105.09	117.15		134.88	143.98	155.83	4500.07	7(64)
					_ ,	- (,-)		utput from w				1582.27	(64)
Heat gains fron						1 ` ´ 	- ` `	-	- ` 	- ` 	- ` 	1] 1	(05)
(65)m= 49.69	43.42	45.1	39.87	38.53	33.81	32.19	36.08		41.72	44.73	48.45]	(65)
include (57)n	n in calcu	ulation o	of (65)m	only if c	ylinder	is in the	dwellin	g or hot w	ater is f	rom com	munity h	neating	
5. Internal gai	ins (see	Table 5	and 5a):									
Metabolic gains	s (Table	5), Wat	ts			_						-	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep 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)
Ligh <mark>ting g</mark> ains (calculate	ed in Ap	pendix	L, equ <mark>at</mark>	ion L9 d	or L9a), <mark>a</mark>	lso see	Table 5					
(67)m= 35.34	31.39	2 5.52	19.32	14.44	12.19	13.18	17.13	22.99	29.19	34.07	36.32		(67)
App <mark>liance</mark> s gair	ns (ca <mark>lcu</mark>	ılated in	Append	dix L, eq	uation L	.13 or L1	3a), al	so see Ta	ble 5				
(68)m= 211.23	213.42	207.9	196.14	181.29	167.34	158.02	155.83	3 161.36	173.11	187.96	201.91		(68)
Cooking gains	(calculat	ed in A	pendix	L, equat	ion 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 fan	s gains ((Table 5	ia)				•				•	-	
(70)m= 3	3	3	3	3	3	3	3	3	3	3	3		(70)
Losses e.g. eva	aporation	n (negat	ive valu	es) (Tab	le 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 (Ta	able 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	1	(72)
Total internal	gains =				(66	5)m + (67)m	n + (68)n	n + (69)m +	(70)m + (7	'1)m + (72))m	•	
(73)m= 395.25	391.31	375.93	352.73	329.42	308.38	296.36	303.34	1 316.9	340.28	366.05	385.24	1	(73)
6. Solar gains	:					1							
Solar gains are ca	alculated u	sing solaı	flux from	Table 6a	and asso	ciated equa	ations to	convert to th	ne applical	ole orienta	tion.		
Orientation: A	ccess Fa	actor	Area		Flu			g_		FF		Gains	
Ta	able 6d		m²		Ta	ble 6a		Table 6b	Т	able 6c		(W)	
Southwest _{0.9x}	0.77	X	1.6	3	x	36.79		0.63	х	0.7	=	18.33	(79)
Southwest _{0.9x}	0.77	X	1.6	3	x	62.67		0.63	x	0.7	=	31.22	(79)
Southwest _{0.9x}	0.77	x	1.6	33	х	85.75	j F	0.63	x	0.7	=	42.72	(79)
Southwest _{0.9x}	0.77	X	1.6	3	x ·	106.25	įΓ	0.63	x	0.7		52.93	(79)
Southwest _{0.9x}	0.77	х	1.6	33	x -	119.01	įΓ	0.63	x	0.7	=	59.29	(79)
			_										_

_		_											
Southwest _{0.9x}	0.77	X	1.63	x	1	18.15		0.63	X	0.7	=	58.86	(79)
Southwest _{0.9x}	0.77	X	1.63	3 ×	1	13.91		0.63	X	0.7	=	56.74	(79)
Southwest _{0.9x}	0.77	X	1.63	3 ×	1	04.39]	0.63	X	0.7	=	52	(79)
Southwest _{0.9x}	0.77	X	1.63	3 ×	g	92.85]	0.63	X	0.7	=	46.25	(79)
Southwest _{0.9x}	0.77	X	1.63	3 ×	6	69.27]	0.63	X	0.7	=	34.51	(79)
Southwest _{0.9x}	0.77	x	1.63	3 ×	4	14.07		0.63	X	0.7	=	21.95	(79)
Southwest _{0.9x}	0.77	x	1.63	3 ×	3	31.49		0.63	X	0.7	=	15.69	(79)
Northwest 0.9x	0.77	x	3.87	, x	1	11.28	X	0.63	×	0.7	=	13.34	(81)
Northwest 0.9x	0.77	x	3.87	×	2	22.97	X	0.63	X	0.7	=	27.16	(81)
Northwest 0.9x	0.77	x	3.87	×	4	11.38	X	0.63	X	0.7	=	48.94	(81)
Northwest 0.9x	0.77	x	3.87	, X	6	67.96	x	0.63	x	0.7	=	80.37	(81)
Northwest _{0.9x}	0.77	x	3.87	, x	9	91.35	X	0.63	x	0.7	=	108.04	(81)
Northwest _{0.9x}	0.77	x	3.87	, x	9	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	7	72.63	x	0.63	x	0.7	_	85.9	(81)
Northwest 0.9x	0.77	×	3.87	, x	5	50.42	x	0.63	×	0.7	_	59.63	(81)
Northwest 0.9x	0.77	×	3.87	, X	2	28.07	x	0.63	×	0.7		33.2	(81)
Northwest 0.9x	0.77	x	3.87	7 X		14.2	Х	0.63	X	0.7	=	16.79	(81)
Northwest 0.9x	0.77	X	3.87	×		9.21	х	0.63	х	0.7	_	10.9	(81)
Solar gains in	watts, calcu	ılated	for each	month			(83)m	= Sum(74)m .	(82)m	-			
(83)m= 31.67	58.38 9°	1.66	133.3	167.32	174.04	164.49	137	.9 105.89	67.7	38.74	26.58]	(83)
								.00.00	07.7	00.74	20.00		(00)
Total gains – ir	nternal and		(84)m =	(73)m +	(83)m			.0 100.00	07.7	00.74	20.30		(00)
Total gains – ir (84)m= 426.92			· /		(83)m 482.42		441.		407.98		411.82		(84)
	449.69 46	solar 67.59	486.03	496.74		, watts					<u> </u>		
(84)m= 426.92	449.69 46	solar 67.59	486.03 heating s	496.74 season)	482.42	, watts 460.85	441.	24 422.79			<u> </u>	21	
(84)m= 426.92 7. Mean intern	449.69 46 nal tempera during heat	solar 67.59 ature (486.03 heating seriods in	496.74 season)	482.42 g area	, watts 460.85	441.	24 422.79			<u> </u>	21	(84)
7. Mean interr Temperature	449.69 46 nal tempera during heat tor for gains	solar 67.59 ature (486.03 heating seriods in	496.74 season)	482.42 g area	, watts 460.85	441.	24 422.79 Th1 (°C)		8 404.79	<u> </u>	21	(84)
7. Mean interruption Temperature Utilisation fac	449.69 46 nal tempera during heat tor for gains Feb I	solar 67.59 ature (ting pe	486.03 heating seriods in ving area	496.74 season) the living a, h1,m (482.42 g area see Ta	, watts 460.85 from Tabable 9a)	441 ole 9,	24 422.79 Th1 (°C)	407.9	8 404.79 Nov	411.82	21	(84)
7. Mean interrupted Temperature Utilisation facular Jan (86)m= 0.99	during heat tor for gains Feb 1 0.98 0	solar 67.59 ature (ting pe s for li Mar	486.03 Cheating seriods in ving area Apr 0.93	season) the living a, h1,m (May 0.82	g area see Ta Jun 0.65	from Tabable 9a) Jul 0.48	441 ole 9,	24 422.79 Th1 (°C) ug Sep 2 0.76	407.96 Oct	8 404.79 Nov	411.82 Dec	21	(84)
7. Mean interrupted Temperature Utilisation factors	during heat tor for gains Feb I 0.98 0	solar 67.59 ature (ting pe s for li Mar	486.03 Cheating seriods in ving area Apr 0.93	season) the living a, h1,m (May 0.82	g area see Ta Jun 0.65	from Tabable 9a) Jul 0.48	441 ole 9,	24 422.79 Th1 (°C) ug Sep 2 0.76 able 9c)	407.96 Oct	8 404.79 Nov 0.98	411.82 Dec	21	(84)
7. Mean interror Temperature Utilisation fac Jan (86)m= 0.99 Mean internal (87)m= 20.1	anal temperaturing heat tor for gains Feb I 0.98 0 I temperature 20.21 2	solar 67.59 ature (ting pe s for li Mar 9.97 re in li	486.03 Cheating seriods in a ving area Apr 0.93 iving area 20.66	season) the living a, h1,m (May 0.82 a T1 (foll 20.86	y area see Ta Jun 0.65 ow ste 20.97	, watts 460.85 from Tabable 9a) Jul 0.48 pps 3 to 7	441. ole 9, Au 0.57 in T 20.9	24 422.79 Th1 (°C) ug Sep 2 0.76 able 9c) 99 20.94	Oct 0.93	8 404.79 Nov 0.98	Dec 0.99	21	(84)
7. Mean internal Temperature Utilisation fac Jan (86)m= 0.99 Mean internal	during heat tor for gains Feb I 0.98 0 I temperatu 20.21 2 during heat	solar 67.59 ature (ting pe s for li Mar 9.97 re in li	486.03 Cheating seriods in a ving area Apr 0.93 iving area 20.66	season) the living a, h1,m (May 0.82 a T1 (foll 20.86	y area see Ta Jun 0.65 ow ste 20.97	, watts 460.85 from Tabable 9a) Jul 0.48 pps 3 to 7	441. ole 9, Au 0.57 in T 20.9	24 422.79 Th1 (°C) ug	Oct 0.93	8 404.79 Nov 0.98	Dec 0.99	21	(84)
7. Mean interrection Temperature Utilisation factors (86)m= 0.99 Mean internal (87)m= 20.1 Temperature (88)m= 20.01	during heat tor for gains Feb I 0.98 0 I temperatu 20.21 2 during heat 20.01 20	solar 67.59 ature (ting person of the second of the secon	486.03 Cheating seriods in ving area Apr 0.93 civing area 20.66 eriods in 20.02	season) the living a, h1,m (May 0.82 a T1 (foll 20.86 rest of drawn 20.02	g area see Ta Jun 0.65 ow stee 20.97 welling 20.03	ywatts 460.85 from Takable 9a) Jul 0.48 pps 3 to 7 21 from Takable 9a)	441 ole 9, 0.5 7 in T 20.9	24 422.79 Th1 (°C) ug	Oct 0.93	8 404.79 Nov 0.98	Dec 0.99	21	(84) (85) (86) (87)
7. Mean interraction factors (84)m= 426.92 7. Mean interraction factors (86)m= 0.99 Mean internaction factors (87)m= 20.1 Temperature (88)m= 20.01 Utilisation factors	anal temperature during heaf tor for gains temperature 20.21 2 during heaf 20.01 20 tor for gains	solar 67.59 ature (ting pe s for li Mar 0.97 re in li 0.04 ting pe 0.01	heating seriods in ving area 20.66 eriods in 20.02 est of dw	season) the living a, h1,m (May 0.82 a T1 (foll 20.86 rest of decent of dec	g area see Ta Jun 0.65 ow ste 20.97 welling 20.03	from Table 9a) Jul 0.48 pps 3 to 7 21 from Table 20.03	441 ole 9, 0.5 7 in T 20.9 able 9 20.0	24 422.79 Th1 (°C) ug Sep 2 0.76 able 9c) 99 20.94 0, Th2 (°C) 03 20.03	Oct 0.93 20.69	Nov 0.98 20.36	Dec 0.99 20.08	21	(84) (85) (86) (87) (88)
7. Mean interraction factors (84)m= 426.92 7. Mean interraction factors (86)m= 0.99 Mean internaction factors (87)m= 20.1 Temperature (88)m= 20.01 Utilisation factors (89)m= 0.98	anal temperature during heaf tor for gains temperature 20.21 2 during heaf 20.01 20 tor for gains 0.98 0	solar 67.59 ature (ting pe s for li Mar 0.97 re in li 20.4 ting pe 0.01	heating seriods in ving area 20.66 eriods in 20.02 est of dw	welling, h2 0.77	y area see Ta Jun 0.65 ow ste 20.97 welling 20.03 2,m (se 0.56	, watts 460.85 from Takable 9a) Jul 0.48 pps 3 to 7 21 from Takable 9a) 21 from Takable 9a) 0.48	441 ole 9, 0.5 7 in T 20.9 able 9 20.0 9a)	24 422.79 Th1 (°C) ug Sep 2 0.76 able 9c) 99 20.94 0, Th2 (°C) 03 20.03	Oct 0.93 20.69 20.02	8 404.79 Nov 0.98	Dec 0.99	21	(84) (85) (86) (87)
7. Mean internation of the control o	during heat tor for gains Feb I 0.98 0 I temperatu 20.21 2 during heat 20.01 20 tor for gains 0.98 0	solar 67.59 ature (ting person of the second of the secon	486.03 Cheating seriods in ving area Apr 0.93 civing area 20.66 eriods in 20.02 est of dw 0.9 he rest of	496.74 season) the living a, h1,m (May 0.82 a T1 (foll 20.86 rest of dr 20.02 velling, h2 0.77 of dwelling	g area see Ta Jun 0.65 ow stee 20.97 welling 20.03 2,m (see 0.56 g T2 (fee	from Table 9a) Jul 0.48 ps 3 to 7 21 from Table 9a 0.38 ollow ste	441. Ole 9, O.5 7 in T 20.9 Able 9 0.4 eps 3	24 422.79 Th1 (°C) ug Sep 2 0.76 able 9c) 99 20.94 0, Th2 (°C) 03 20.03 2 0.68 to 7 in Tabl	Oct 0.93 20.69 20.02 0.9 e 9c)	Nov 0.98 20.36 2 20.02	Dec 0.99 20.08 20.01	21	(84) (85) (86) (87) (88) (89)
7. Mean interraction factors (84)m= 426.92 7. Mean interraction factors (86)m= 0.99 Mean internaction factors (87)m= 20.1 Temperature (88)m= 20.01 Utilisation factors (89)m= 0.98	during heat tor for gains Feb I 0.98 0 I temperatu 20.21 2 during heat 20.01 20 tor for gains 0.98 0	solar 67.59 ature (ting pe s for li Mar 0.97 re in li 20.4 ting pe 0.01	heating seriods in ving area 20.66 eriods in 20.02 est of dw	welling, h2 0.77	y area see Ta Jun 0.65 ow ste 20.97 welling 20.03 2,m (se 0.56	, watts 460.85 from Takable 9a) Jul 0.48 pps 3 to 7 21 from Takable 9a) 21 from Takable 9a) 0.48	441 ole 9, 0.5 7 in T 20.9 able 9 20.0 9a)	24 422.79 Th1 (°C) ug Sep 2 0.76 able 9c) 99 20.94 0, Th2 (°C) 03 20.03 2 0.68 to 7 in Table 03 19.98	Oct 0.93 20.69 20.02 0.9 19.69	Nov 0.98 20.36 20.02 0.97	Dec 0.99 20.08 20.01 0.99		(84) (85) (86) (87) (88) (89)
7. Mean internation factors (84)m= 426.92 7. Mean internation factors (86)m= 0.99 Mean internation factors (88)m= 20.01 Utilisation factors (89)m= 0.98 Mean internation factors (90)m= 18.84	during heat tor for gains 1 temperatu 20.21 2 during heat 20.01 20 tor for gains 0.98 0 temperatu 18.99 15	solar 67.59 ature (ting pe s for li Mar 0.97 re in li 0.04 ting pe 0.01 s for re 0.96 re in t	486.03 Cheating seriods in ving area Apr 0.93 Eving area 20.66 Evinods in 20.02 Evinods in 20.02 Evinods in 20.03 Evinods in 20.03	496.74 the living a, h1,m (a) May 0.82 a T1 (foll 20.86 rest of do 20.02 velling, h2 0.77 of dwelling	y area see Ta Jun 0.65 ow ste 20.97 welling 20.03 2,m (se 0.56 g T2 (fr 20.01	from Table 9a) Jul 0.48 pps 3 to 7 21 from Table 20.03 pee Table 0.38 ollow stee	441. ole 9, O.5 7 in T 20.9 able 9 0.4 eps 3 20.0	24 422.79 Th1 (°C) ug Sep 2 0.76 able 9c) 99 20.94 0, Th2 (°C) 03 20.03 2 0.68 to 7 in Table 03 19.98	Oct 0.93 20.69 20.02 0.9 19.69	Nov 0.98 20.36 2 20.02	Dec 0.99 20.08 20.01 0.99	21	(84) (85) (86) (87) (88) (89)
7. Mean internal (86)m= 20.1 Temperature Utilisation fac Jan (86)m= 0.99 Mean internal (87)m= 20.1 Temperature (88)m= 20.01 Utilisation fac (89)m= 0.98 Mean internal (90)m= 18.84	during heat tor for gains Feb I 0.98 0 I temperatu 20.21 2 during heat 20.01 20 tor for gains 0.98 0 I temperatu 18.99 19	solar 67.59 ature (ting person of the second of the secon	486.03 Cheating seriods in ving area 20.66 eriods in 20.02 est of dw 0.9 he rest of 19.63	496.74 season) the living a, h1,m (May 0.82 a T1 (foll 20.86 rest of dr 20.02 velling, h2 0.77 of dwelling 19.89	g area see Ta Jun 0.65 ow stee 20.97 welling 20.03 2,m (see 0.56 g T2 (fr 20.01	, watts 460.85 from Take able 9a) Jul 0.48 ps 3 to 7 21 from Take 20.03 ee Table 0.38 ollow stee 20.03	441 ole 9, 0.5 7 in T 20.9 able 9 20.0 9a) 0.4 eps 3 20.0	24 422.79 Th1 (°C) ug Sep 2 0.76 able 9c) 99 20.94 0, Th2 (°C) 03 20.03 2 0.68 to 7 in Table 03 19.98 fraction of the second of the	Oct 0.93 20.69 20.02 0.9 e 9c) 19.69 LA = Liv	Nov 0.98 20.36 20.02 0.97 19.22 ving area ÷ (-	Dec 0.99 20.08 20.01 0.99 18.81 4) =		(84) (85) (86) (87) (88) (89) (90) (91)
7. Mean internation of the control o	449.69 46 nal temperature during heat tor for gains Feb I 0.98 0 I temperature 20.21 2 I during heat 20.01 20 I tor for gains 0.98 0 I temperature 18.99 19 I temperature 19.91 20	solar 67.59 ature (ting person of the second of the secon	theating seriods in ving area 20.66 ceriods in 20.02 cest of dw 0.9 cest of dw 19.63 cest of dw 20.4	weekson) the living a, h1,m (a) May 0.82 a T1 (follows) 20.86 rest of do 20.02 velling, h2 0.77 of dwelling 19.89 ble dwelling	g area see Ta Jun 0.65 ow ste 20.97 welling 20.03 2,m (se 0.56 g T2 (f) 20.01	, watts 460.85 from Table 9a) Jul 0.48 pps 3 to 7 21 from Table 20.03 ee Table 0.38 ollow stee 20.03 LA × T1 20.75	441 ole 9, 0.5 7 in T 20.9 able 9 20.0 9a) 0.4 eps 3 20.0 + (1	24 422.79 Th1 (°C) ug	Oct 0.93 20.69 20.02 0.9 19.69 LA = Liv	Nov 0.98 20.36 2 20.02 0.97 19.22 ving area ÷ (-	Dec 0.99 20.08 20.01 0.99		(84) (85) (86) (87) (88) (89)

						·	1				1	l	
(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 hea						_							
Set Ti to the the utilisation			•		ed at ste	ep 11 of	Table 9	o, so tha	t Ti,m=(76)m an	d re-calc	ulate	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation fac	<u> </u>			iviay	Odii	<u> </u>	l mag	СОР	000	1101	200		
(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	1)m x (84	4)m		<u>!</u>				<u> </u>		l	
(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 aver	age exte	rnal tem	perature	from Ta	able 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 rat	e for me	an intern	al tempe	erature,	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	i i				Wh/mont	th = 0.02	24 x [(97)m – (95)m] x (4	1)m	,	ı	
(98)m= 290.1	230.92	193.58	107.02	43.08	0	0	0	0	97.7	198.67	297.65		_
							Tota	l per year	(kWh/yeaı	r) = Sum(9	8) _{15,912} =	1458.72	(98)
Space heating	ng require	ement in	kWh/m²	/year								30.52	(99)
9a. Energy re	quiremer	nts – Indi	vidual h	eating sy	ystems i	ncluding	micro-C	CHP)					
Space heati	ng:					J		,					
Fraction of s	pace hea	it from s	econdar	//supple	mentary	system						0	(201)
Fraction of s	oace hea	at from m	nain syst	em(s)			(202) = 1	(201) =				1	(202)
Fraction of to	tal heati	ng from	main sys	stem 1			(204) = (2	02) × [1 –	(203)] =			1	(204)
Efficiency of	main spa	ace heat	ing syste	em 1								90.8	(206)
Efficiency of					system	n %						0	(208)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/yea	」 ` ′
Space heating						Oui	Aug	ССР	Oot	1101	_ DC0	ikwii, y ok	۸۱
290.1	230.92	193.58	107.02	43.08	0	0	0	0	97.7	198.67	297.65		
(211)m = {[(98	3)m x (20)4)] } x 1	00 ÷ (20	16)		l							(211)
319.49	254.32	213.19	117.86	47.44	0	0	0	0	107.6	218.8	327.8		()
<u> </u>	Į.	!					Tota	l (kWh/yea	ar) =Sum(2	1 211) _{15,1012}	<u>. </u>	1606.52	(211)
Space heatir	na fuel (s	econdar	v). kWh/	month									_
$= \{[(98)m \times (26)]\}$	•												
(215)m= 0	0	0	0	0	0	0	0	0	0	0	0		
	•	•					Tota	l (kWh/yea	ar) =Sum(2	215) _{15,101}	<u></u>	0	(215)
Water heating	g												_
Output from w	ater hea	ter (calc	ulated al	oove)								ı	
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 w	ater hea	iter										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	•												
(219)m = (64) (219)m = 182.87	m x 100 160.12) ÷ (217) 167.54	m 150.5	148.79	134.59	128.95	143.75	145.33	158.37	166.17	178.35		
(210)111= 102.07	100.12	107.04	130.3	140.78	134.38	120.90		I = Sum(2°		100.17	170.33	1865.32	(210)
Annual totals							1010	34111(2		Wh/yeaı			(219)
Space heating		ed, main	system	1					ĸ	••ii/yedi		kWh/year 1606.52	7
		•	-										_

Water heating fuel used			1865.32	
Electricity for pumps, fans and electric keep-hot				
central heating pump:	1.400	30		230c)
Total electricity for the above, kWh/year	sum of (23	0a)(230g) =		231)
Electricity for lighting				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 (2	240)
Space heating - main system 2	(213) x	0 x 0.01	= 0 (2	241)
Space heating - secondary	(215) x	13.19 × 0.01	= 0 (2	242)
Water heating cost (other fuel)	(219)	3.48 × 0.01	= 64.91 (2	247)
Pumps, fans and electric keep-hot	(231)	13.19 × 0.01	= 3.96 (2	249)
(if off-peak tariff, list each of (230a) to (230g) sep				
Energy for lighting	(232)	13.19 × 0.01	32.93	250)
Additional standing charges (Table 12)			120 (2	251)
	one of (233) to (235) x)	13.19 × 0.01	= 0 (2	252)
Appendix Q items: repeat lines (253) and (254) a			(0)	
0.7	7) + (250)(254) =		277.7	255)
11a. SAP rating - individual heating systems				
Energy cost deflator (Table 12)	550N - 1/4) - 45 0I			256)
g, ()	(256)] ÷ [(4) + 45.0] =			257)
SAP rating (Section 12) 12a. CO2 emissions – Individual heating system	as including micro CHP		82.47	258)
12a. CO2 emissions – mulvidual healing system	<u> </u>			
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216 =	347.01 (2	261)
Space heating (secondary)	(215) x	0.519 =	0 (2	263)
Water heating	(219) x	0.216 =	402.91 (2	264)
Space and water heating	(261) + (262) + (263) + (264) =	=	749.92 (2	265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	15.57 (2	267)
Electricity for lighting	(232) x	0.519 =	129.55 (2	268)
Energy saving/generation technologies				
Item 1		0.519 =		269)
Total CO2, kg/year	Su	ım of (265)(271) =	658.22	272)

CO2 emissions per m ²	(272) ÷ (4) =	13.77	(273)
El 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



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

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

None

Thermal mass parameter: Indicative Value Medium

Night ventilation: False Blinds, curtains, shutters: None

Ventilation rate during hot weather (ach): 6 (Windows fully open)

Summer ventilation heat loss coefficient: (P1) 314.27

Transmission heat loss coefficient: 45

Summer heat loss coefficient: 359.31 (P2)

Overhangs:

Overhangs:

South West (W1) 0 1	
North West (W2) 0	
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)

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)

	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

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

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

None

Thermal mass parameter: Indicative Value Medium

Night ventilation: False Blinds, curtains, shutters: None

Ventilation rate during hot weather (ach): 6 (Windows fully open)

Summer ventilation heat loss coefficient: (P1) 199.2

Transmission heat loss coefficient: 29.1

Summer heat loss coefficient: 228.26 (P2)

Overhangs:

Overhangs:

Orientation:	Ratio:	Z_overhangs:			
South East (W1)	0	1			
North West (W2)	0	1			
Nort <mark>h Eas</mark> t (W3)	O	1			
Solar shading:					
	L				
Orie <mark>ntati</mark> on:	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)

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)

	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

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

Property Details: Flat 9

Dwelling type:FlatLocated in:EnglandRegion:Thames valley

Cross ventilation possible: Yes **Number of storeys:** 1

Front of dwelling faces: Unspecified

Overshading: Average or unknown

None

Thermal mass parameter: Indicative Value Medium

Night ventilation:FalseBlinds, 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:

Overhangs:

Orientation:	Ratio:	Z_overhangs:			
South East (W1)	0	1			
South West (W2)	0	1			
Solar shading:					
Orie <mark>ntati</mark> on:	Z blinds:	Solar access:	Overhangs:	Z summer:	
Orientation: South East (W1)	Z blinds:	Solar access:	Overhangs:	Z summer: 0.9	(P8)
	Z blinds:		Overhangs: 1 1		(P8) (P8)
South East (W1)	Z blinds:	0.9	Overhangs: 1	0.9	

Orientation		Area	Flux	\mathbf{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

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

Property Details: Flat 10

Dwelling type:FlatLocated in:EnglandRegion:Thames valley

Cross ventilation possible: Yes **Number of storeys:** 1

Front of dwelling faces: Unspecified

Overshading: Average or unknown

None

Thermal mass parameter: Indicative Value Medium

Night ventilation:FalseBlinds, 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:

Overhangs:

Orientation:	Ratio:	Z_overhangs :			
South West (W1)	0	1			
North West (W2)	0	1			
Solar shading:					
Orientation:	Z blinds:	Solar access:	Overbones	7 aummarı	
Officiation.	Z billius.	Solar access.	Overhangs:	Z summer:	
South West (W1)	2 billius.	0.9	1	0.9	(P8)
	1 1		1		(P8) (P8)
South West (W1)	1 1	0.9	Overnangs:	0.9	

Orientation		Area	Flux	\mathbf{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