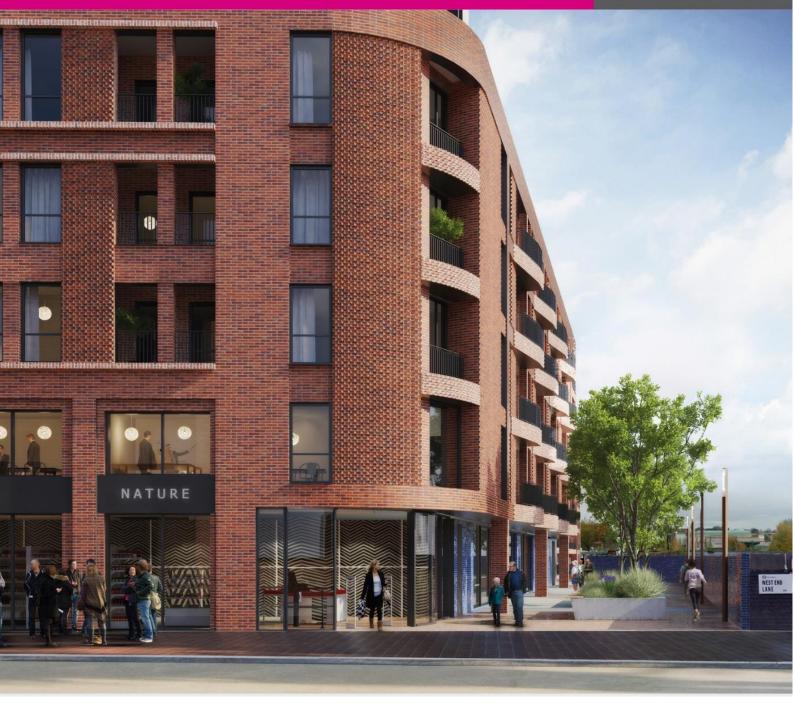
156 West End Lane





Revised Energy Statement

June 2016

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A2Dominion Developments Limited



156 West End Lane, Camden Revised Energy Statement

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Executive Summary

This revised Energy Statement reflects the design revisions made as a result of the feedback received and further information requested by the London Borough of Camden officers and Greater London Authority (GLA) officers, following the November 2015 planning application submission. The revised scheme has been reassessed to consider the changes and suggestions to the proposals together with their potential environmental impacts.

This Energy Statement describes the details of the energy strategy proposed by A2Dominion Developments Limited (A2Dominion) for the proposed redevelopment of 156 West End Lane, Camden, in response to the London Plan and Camden Borough Council energy policies.

The energy statement describes the design and technology options appraised, and the preferred energy strategy option in line with the London Plan (2015) and Camden Council policies. The proposed energy solution for the development follows and responds to the Be Lean, Be Clean, Be Green principles (London Plan Policy 5.2A) and includes various energy efficiency measures as well as low-carbon and renewable energy technologies as summarised in the table below.

Energy Principles	Energy Strategy Response
Be Lean: Use less energy. Minimise energy demand through efficient design and the incorporation of passive measures	Passive design Optimised orientation to enable controlled solar gain and improved direct and indirect natural lighting. Incorporation of balconies into the design which provide shading to reduce risks of overheating in summer. Integration of green roofs which will keep the buildings warm/cool. Building Fabric Use of optimal building fabric standards.
	 Energy Efficiency 100% energy efficient lighting and appropriate controls Variable speed heating system with high delta T and low return temperatures High efficiency motors and variable speed pumps for heating and extraction systems High efficiency heating system Appropriate controls for heating system Temperature and time zoning Appropriate insulation of heating distribution system
Be Clean: Supply energy efficiently. Reduce energy consumption through use of low-carbon technology	Provision of energy efficient white goods Energy efficient energy supply On-site CHP system connected to on-site heat network to supply domestic hot water and space heating to the entire development



Energy Principles	Energy Strategy Response
	Energy efficient multi-split (VRF) systems to supply comfort cooling to private residential and the non-residential units
Be Green: Use renewable energy systems	Photovoltaics (PV) system to supply renewable electricity to the non-residential units.

The development will significantly reduce the generated CO_2 emissions by incorporating a range of passive design and energy efficiency measures throughout the site, including improved building fabric standards beyond the requirements of Building Regulations and energy efficient mechanical and electrical plant. The implementation of all passive design and energy efficiency measures can reduce the CO_2 emissions by circa 3.7% and simultaneously lessen the future energy costs for the residents.

Once energy demand has been reduced, the strategy proposes implementation of a gas-fired Combined Heat and Power (CHP) engine and efficient gas-fired boilers connected to a site-wide district heating network (DHN), which will supply heating and hot water for the entire development. It is anticipated that the use of the CHP engine and DHN would help to reduce the regulated CO₂ emissions by approximately 27.3%.

In addition, it is proposed to provide a dedicated Photovoltaics (PV) system for the non-residential units in order to achieve the required CO_2 reductions for the entire development. The renewable electricity can reduce the regulated CO_2 emissions of the site by circa 6.2%. The regulated energy CO_2 savings expressed in terms of actual and percentage reduction after each stage of the energy hierarchy are presented in the table below.

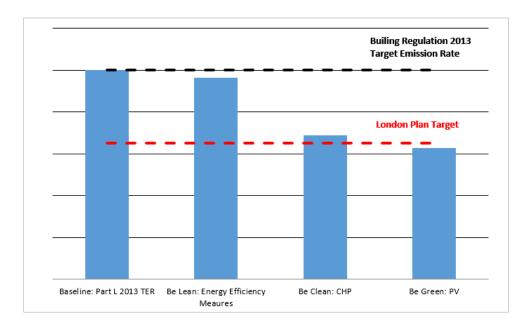
	Regulated Energy CO₂ savings	
	Tonnes per annum	%
Savings from energy demand reduction	7.9	3.7%
Savings from CHP	58.3	27.3%
Savings from renewables	13.1	6.2%
Total cumulative savings	79.3	37.2%
Total Target Savings	74.7	35%
Annual Surplus	4.6	2.2%

The table shows that the proposed strategy can achieve regulated CO₂ savings of 79.3 tCO₂ which is equivalent to circa 37.2% reduction when compared to the baseline. The table also shows the annual CO₂ savings surplus which is expected to be 4.6 tCO₂.

The increased CO₂ reduction compared to the previous planning application scheme is a result of the following actions. The improved figures in the generic specification of the CHP according to the current market availability can increase the savings from the CHP. While the utilisation of greater



amount of roof space for the application of PV panels will help to provide a further reduction in CO₂ emissions from renewables.



A summary of the overall reduction in CO₂ emissions after each stage of the energy hierarchy is presented in the following table.

	CO₂ emissions (tonnes per year)		
	Regulated	Unregulated	Total
Residential CO ₂ Emissions Baseline	213.4	239.5	452.9
After energy demand reduction	205.5	213.4	418.9
After use of CHP technology	147.1	213.4	360.5
After use of PV technology	134.0	213.4	347.4

This table shows that the overall CO₂ emissions from both regulated and unregulated energy can be reduced by circa 105.5 tCO₂ per annum which is equivalent to circa 23.3% reduction.

In summary, the proposed energy solution for the development:

- 1. Informs the built form and orientation of the buildings to respond to daylight and overheating issues.
- 2. Includes optimal fabric standards, energy efficient design of building services and energy efficient appliances.
- 3. Complies with Part L 2013 Building Regulations and meets TFEE requirements.
- 4. Includes an efficient on-site heating network with a CHP system designed to meet the hot water and space heating demands of the development.
- 5. Includes PV renewable technology.
- 6. Meets the 35% regulated energy CO₂ emissions reduction requirement.



7. Achieves BREEAM 'Very Good' energy section requirements.



1. Introduction

The revised Energy Statement has been prepared following the reassessment of the proposal following design revisions to the planning application (November 2015) as a result of feedback and requests received from Camden Council and to address comments made in the Mayor's Stage One Report.

1.1 Background

Silver has been instructed by A2Dominion to prepare an Energy Statement focusing on the proposed energy strategy for the proposed redevelopment of 156 West End Lane, Camden. The Energy Statement is prepared to support the full planning application in response to the local, regional and national legislation.

To support the planning application this document identifies and describes the energy efficiency design and low carbon and renewable technology options that were explored for this proposal and describes the preferred option for achieving the carbon emissions and renewable energy targets. The document is produced to demonstrate how the development can fulfil the relevant national, the London Plan and the Camden's Local Plan policies.

In order to achieve the energy and sustainability objectives defined by national, regional and local policies, research has been undertaken to identify and present the most appropriate commercially viable technology to achieve the carbon and renewable reductions targets. The energy options have been considered in this report at a strategic level only.

This second version of the Energy Statement has been prepared to address and accommodate the comments received from the council and GLA.

1.2 Description of the Development

The proposals are for demolition of all existing buildings and redevelopment of the site to provide 163 mixed-tenure homes (Use Class C3), new floor space for town centre uses (Use Classes A1, A2, A3, D1 or D2), new employment floor space (including four dedicated units for start-up businesses) (Use Class B1), a community meeting room and new and improved public open spaces, together with associated new landscaping, on-site access, servicing and disabled car parking.

The residential element proposes 163 mixed tenure units, with 50% of the residential floor area allocated for affordable housing. The affordable rented element includes a high proportion of family units.



2. Planning Requirements

This section summarises the relevant energy policy context for the proposed development. The national, regional and local policies and regulations related to energy and sustainability are summarised below.

2.1 National Planning Policy Framework

The National Planning Policy Framework (NPPF) document sets out the Government's planning policies for England and was published on 27th March 2012.

The NPPF is designed to consolidate circulars and guidance documents into a single document, making the planning system more user-friendly and transparent. The primary objective of the NPPF is sustainable development, therefore focusing on the 3 pillars of sustainability. The framework is split into three sections; planning for prosperity (Economic), planning for people (Social) and planning for places (Environmental), each of which outline guidance to tackle issues such as housing, transport infrastructure, business and economic development, climate change, etc.

In regard to climate change, the NPPF supports reduction in greenhouse gas emissions and the delivery of renewable and low carbon energy. Climate change is covered in section 10 'Meeting the challenge of climate change, flooding and coastal change'. In summary the framework advises the following:

To support the move to a low carbon future, local planning authorities should:

- plan for new developments in locations and ways which reduce greenhouse gas emissions;
- actively support energy efficiency improvements to existing buildings; and
- adopting nationally described standards when setting any local requirement for a building's sustainability.

In determining planning applications, local planning authorities should expect new development to:

- comply with adopted Local Plan policies on local requirements for decentralised energy supply, unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable; and
- take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption.

2.2 The London Plan (2015)

As a major development in London, the planning application will be governed by the London Plan (2015).

The London Plan requires all developments to actively tackle climate change through their design as an integral part of sustainable development. Chapter 5 (London's Response to Climate Change) of the London Plan contains the following crosscutting policies supporting London as an exemplar city in adapting to climate change.

1. Policy 5.1 - Climate change mitigation



- 2. Policy 5.2 Minimising carbon dioxide emissions
- 3. Policy 5.3 Sustainable design and construction
- 4. Policy 5.5 Decentralised energy networks
- 5. Policy 5.6 Decentralised energy in development proposals
- 6. Policy 5.7 Renewable energy
- 7. Policy 5.8 Innovative energy technologies
- 8. Policy 5.9 Overheating and cooling

The London Plan requires that developments include energy assessments with the planning applications explaining the strategy for carbon emissions reduction based on the energy hierarchy.

The London Plan requires that major development proposals include a detailed energy assessment to demonstrate how the targets for carbon dioxide emissions reduction outlined below are to be met within the framework of the energy hierarchy.

Policy 5.2 of the London Plan requires carbon dioxide emissions to be minimised 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

Policy 5.2 also requires that major developments meet the following targets for carbon dioxide emission reduction in buildings. The targets are expressed in the tables below as minimum improvements over Target Emission Rate (TER) outlined in the national Building Regulations.

Residential Buildings

Year	Improvement on 2010 Building Regulations
2013 - 2016	40% CO ₂ emissions reduction
2016 - 2031	Zero Carbon

Non-Residential Buildings

Year	Improvement on 2010 Building Regulations
2013 - 2016	40 % CO ₂ emissions reduction
2016 - 2019	As per the Building Regulation requirements
2019 - 2031	Zero Carbon

London Plan Policy 5.6 requires development proposals to select energy systems in accordance with the following hierarchy:

- 1. Connection to existing heating or cooling networks.
- Connection to site wide CHP network.



3. Development of communal heating and cooling networks.

London Plan Policy 5.7 requires major developments to provide a reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation where feasible.

In April 2014 the Greater London Authority (GLA) published a revised Sustainable Design and Construction SPG and Energy Planning Guidance, which provide guidance on how the energy targets need to be assessed and met over Part L 2013 that came into force on the 6th of April 2014.

As outlined in the Sustainable Design and Construction SPG, from 6th April 2014 a 35% carbon reduction target beyond Part L 2013 of the Building Regulations needs to be met which deemed to be broadly equivalent to the 40% target beyond Part L 2010, as set out in London Plan Policy 5.2 for 2013-2016. This target applies to all Stage 1 applications received by the Mayor on or after 6th April 2014.

Generally, the carbon dioxide reduction targets should be met on-site. Where it is clearly demonstrated that the specific targets cannot be fully achieved on-site, any shortfall may be provided off-site or through a cash in lieu contribution to the relevant Borough. Guidance in the SPG can be used, including the suggested price of £60 per tonne, to form the basis of the carbon off-setting fund or develop a locally specific fund. Contributions will be secured by a S106 agreement.

The Greater London Authority Guidance (March 2016) on preparing energy assessments document guidance notes define that the 'Be Lean' case should assume that the heating is provided by gas boilers and that any active cooling will be provided by electrically powered equipment. The boilers should be assumed to have an efficiency of 89.5% for residential and 91% for non-residential together with controls aligned with the Part L notional building assumptions. Higher efficiencies should only be used if gas boilers will be part of the final strategy (i.e. after the 'be clean' and 'be green' tiers of the hierarchy have been addressed), in which case the gross efficiency of the gas boiler model to be specified can be used.

2.3 Local Policy - Camden Local Plan

The site is located in the London Borough of Camden and therefore the development should comply with local planning policies set out within Camden's adopted Development Plan. The Development Plan comprises, but is not limited to, the Camden Core Strategy (2010), Development Policies (2010) and Camden Planning Guidance documents.

2.3.1 Core Strategy

The energy related requirements of the Core Strategy Policy CS13 - Tackling climate change through promoting higher environmental standards are as follows:

Reducing the effects of and adapting to climate change

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

- ensuring patterns of land use that minimise the need to travel by car and help support local energy networks;
- promoting the efficient use of land and buildings;
- minimising carbon emissions from the redevelopment, construction and occupation of buildings by implementing, in order, all of the elements of the following energy hierarchy:



- ensuring developments use less energy,
- making use of energy from efficient sources, such as the King's Cross, Gower Street, Bloomsbury and proposed Euston Road decentralised energy networks;
- generating renewable energy on-site; and
- 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.

Local energy generation

The Council will promote local energy generation and networks by:

- working with our partners and developers to implement local energy networks in the parts of Camden most likely to support them, i.e. in the vicinity of:
 - housing estates with community heating or the potential for community heating and other uses with large heating loads;
 - the growth areas of King's Cross, Euston; Tottenham Court Road; West Hampstead Interchange and Holborn;
 - schools to be redeveloped as part of Building Schools for the Future programme;
 - existing or approved combined heat and power/local energy networks.
- protecting existing local energy networks where possible (e.g. at Gower Street and Bloomsbury) and safeguarding potential network routes (e.g. Euston Road).

2.3.2 Development Policies (2010)

Development Policies (2010) Policy DP22 - Promoting sustainable design and construction

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

- demonstrate how sustainable development principles have been incorporated into the design and proposed implementation; and
- incorporate green or brown roofs and green walls wherever suitable.

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

- expecting new build housing to meet Code for Sustainable Homes Level 3 by 2010 and Code Level 4 by 2013 and encouraging Code Level 6 (zero carbon) by 2016;
- expecting non-domestic developments of 500sqm of floorspace or above to achieve "very good" in BREEAM assessments and "excellent" from 2016 and encouraging zero carbon from 2019.

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

- summer shading and planting;
- limiting run-off;
- reducing water consumption;



- reducing air pollution; and
- not locating vulnerable uses in basements in flood-prone areas.

2.3.3 Camden Planning Guidance 3 - Sustainability

Camden Council prepared Camden Planning Guidance 3 to support the energy and sustainability policies in the Local Development Framework (LDF). This guidance forms a Supplementary Planning Document (SPD) which is an additional "material consideration" in planning decisions.

The Camden Planning Guidance provides information regarding a range of topics as well as sustainability (such as design, housing, amenity and planning obligations). This guidance provides information on ways to achieve carbon reductions and more sustainable developments. It also highlights the Council's requirements and guidelines which support the relevant Local Development Framework (LDF) policies:

- CS13 Tackling climate change through promoting higher environmental standards
- DP22 Promoting sustainable design and construction
- DP23 Water

Among other sustainable development issues the guidance covers the following aspects:

- Energy efficiency in new and existing buildings
- Decentralised energy and combined heat and power (CHP)
- Renewable energy

2.4 Sustainability Requirements

2.4.1 Code for Sustainable Homes

Camden's Development Plan Policy DP22 requires all new residential developments to be rated against Code for Sustainable Homes. However, the Deregulation Act 2015, which received Royal Assent on the 26th March 2015, has withdrawn the Code for Sustainable Homes.

The Council has confirmed that it will not require compliance against the Code for Sustainable Homes in-line with the Deregulation Act.

2.4.2 BREEAM

BREEAM (Building Research Establishment's Environmental Assessment Method) is a standard assessment method established by the Building Research Establishment (BRE) and used to assess the environmental impact of non-domestic buildings.

The first BREEAM version for assessing new office buildings was launched in 1990 and was followed by versions for other buildings including superstores, industrial units and existing offices. The latest major update in 2011 resulted in the launch of BREEAM New Construction. The current version of BREEAM New Construction was published in May 2014 and should be used to assess and certify all new non-residential buildings in the UK.

Overall BREEAM covers a range of issues and credits which are awarded where a building achieves a benchmark performance. BREEAM is a voluntary standard although central government and some planning authorities require compliance.



The Development Policies Document requires all non-residential development to achieve BREEAM "Very Good" rating. The Deregulation Act 2015 does not have an impact on the BREEAM requirements.

2.5 Part L Building Regulations

The development will need to comply with the current version of Part L (2013) which came into force on the 6th of April 2014. Residential units will need to comply with Part L1A and non-residential with Part L2A.

2.5.1 Part L1A 2013

Approved Document Part L1A 2013 incorporates a number of changes and additions compared to Part L1A 2010. Part L1A 2013 requires new homes to reduce their carbon emissions by a further 6% across the build mix, compared to Part L1A 2010. In addition to achieving an overall carbon emission target, (i.e. TER or Target Emission Rate), there is a further requirement to achieve or better fabric energy efficiency targets (TFEE: "Target Fabric Energy Efficiency"). This means the thermal performance of the building fabric now has its own standards which cannot be compensated by services strategy or renewable features.

Approved Document Part L1A 2013 also includes the notional dwelling specification. The document states that if the actual dwelling is constructed entirely to the notional dwelling specification, it will meet the carbon dioxide and fabric energy efficiency targets and the limiting values for individual fabric elements and building services. The summary of the notional dwelling specification is provided in Table 2.1.

Table 2.1 Notional dwelling specification

Element or System	Values
Opening areas (windows and doors)	Same as actual dwelling up to a maximum proportion of 25% of total floor area
External walls U-value	0.18 W/(m ² K)
Party walls U-value	0.0 W/(m ² K)
Floor U-value	0.13 W/(m ² K)
Roof U-value	0.13 W/(m ² K)
Windows U-value (whole window U-value)	1.4 W/(m ² K)
Windows g-value	0.63
Opaque doors U-value	1.0 W/(m ² k)
Semi glazed doors u-value	1.2 W/(m ² k)
Airtightness	5.0 m ³ /(hm ²) at 50 Pa
Linear thermal transmittance	Standard Psi values as per SAP 2012 Appendix R expect use of ψ =0.05 W/(m²K) if default value of ψ =0.15 W/(m²K) is used in the actual dwelling



Element or System	Values
Ventilation type	Natural with intermittent extract fans
Air-conditioning	None
Heating system	Main gas, combi or regular boiler and radiators. Room sealed, fan flue, efficiency - 89.5%
Heading controls	Time and temperature zone control, weather compensation, modulating boiler with interlock
Primary pipework	Fully insulated
Hot water cylinder	If combi boiler no cylinder otherwise 150 litres (declared loss factor = $0.85 \times (0.2 + 0.051 \text{ V}^{2/3})$ kWh/day, where V is the volume of the cylinder in litres
Secondary space heating	None
Low-energy lighting	100%
Thermal mass parameter (TMP)	Medium – 250

Developers are free to vary the specification, provided the same overall level of carbon emissions and fabric energy efficiency performance are achieved or bettered.

2.5.2 Part L2A 2013

Approved Document Part L2A 2013 incorporates a number of changes and additions compared to Part L2A 2010. Part L2A 2013 requires new non-domestic buildings to reduce their carbon emissions by a further 9% across the build mix, compared to Part L2A 2010.

Part L2A 2010 was based on comparing the actual building against a notional building. This approach remains the same for Part L2A 2013. However, the notional building has been modified to have more energy efficient building fabric and air permeability. Similarly to Part L 2010, the notional building standards will change depending on the type of the non-domestic building.

Contrary to Part L2A 2010, in Part L2A 2013 not only the efficacy of the light fittings is controlled, but also the level of the lighting provided. In addition, lighting in new and existing buildings should meet the minimum standard.

There are also various other changes on minimum standards for HVAC system.

2.6 Summary of Policy Requirements

The following section provides a summary of local and national planning policy requirements which should be met to achieve compliance.

• Comply with Part L 2013 Building Regulations.



- Achieve a minimum of 35% reduction in carbon emissions (against current 2013 Building Regulations) to comply with the London Plan by following Lean, Clean and Green principles.
- Expect to select energy systems in accordance with the following hierarchy:
 - 1. Connection to existing heating or cooling networks;
 - 2. Connection to site wide CHP network;
 - 3. Development of communal heating and cooling networks.
- Provide a reduction in expected carbon dioxide emissions through the use of onsite renewable energy generation, where feasible.
- Meet BREEAM "Very Good" energy requirement for non-residential units.



3. Approach to the Energy Strategy Development

3.1 Energy Strategy Development Principles

In accordance with the London Plan and the Camden planning requirements, the proposed energy strategy for the development should focus on three key principles:

- 1. **Be Lean:** Use less energy. Minimise energy demand through efficient design and the incorporation of passive measures;
- 2. **Be Clean:** Supply energy efficiently. Reduce energy consumption through use of low-carbon technology; and
- 3. **Be Green:** Use renewable energy systems.

The first principle stresses the primacy of seeking to reduce energy consumption. Within the built environment this comprises of energy efficiency measures in both the design and construction of new buildings.

The second principle addresses the efficiency of energy supply. This will require 'decarbonising' and improving efficiency in the generation and distribution of energy.

The third principle comprises the use of 'green' energy systems. These are renewable sources of energy with low or zero carbon emissions and include, amongst others, solar generated heat and power, wind energy and biomass.

The suggested approach to energy and carbon has been proposed in line with the overall approach to climate change, reflecting requirements of the London Plan, Local Policies, Building Regulations Part L and BREEAM Very Good.

The proposed low carbon and renewable energy supply solutions match energy profiles of the development, ensuring effective use of these technologies. The solutions also take into consideration viability and flexibility of the scheme from a technical and economic point of view by identifying an optimal combination of energy efficiency measures, decentralised energy and renewable energy.

Applying these principles, A2Dominion is aiming to achieve the following objectives:

- Comply with the relevant regulatory requirements;
- Improve viability of the scheme by developing a technically robust and cost effective energy strategy; and
- Improve feasibility, operation and management of the energy systems by promoting holistic design methods and solutions.

The proposed energy strategy aims to achieve the required 35% CO₂ reductions on-site.

3.2 CO₂ Emissions Reduction Assessment Methodology

The CO_2 emissions reduction methodology requires separate energy assessments for the residential and non-residential floor space. The results from these assessments will be combined to provide the overall CO_2 emissions reduction for the entire development.



3.2.1 Residential

The Standard Assessment Procedure (SAP) 2012 methodology has been used to assess to evaluate an initial CO_2 performance of the residential development. To assess energy performance of the entire residential development, an energy and carbon assessment model has been produced to predict the regulated energy consumption and CO_2 performance of the residential development.

The BREEAM methodology has been used to estimate the unregulated CO₂ emissions of the residential development.

3.2.2 Non-residential

An initial assessment of CO₂ performance of the non-residential units is carried out using the standard National Calculation Methodology (NCM).

The assessment of the energy performance of the development considers regulated energy usage for different building services such as cooling, heating, lighting and ventilation. An estimate is also provided of unregulated electricity use (equipment) associated with computers, small power, security systems, etc.



4. Energy Assessment

4.1 Baseline CO₂ Emissions

In order to assess CO₂ performance of the proposed energy strategy, a CO₂ emissions baseline needs to be established. This section sets out the approach adopted to calculate the baseline CO₂ emissions for the residential and the non-residential parts of the development.

Baseline emissions have been calculated for both regulated CO_2 emissions covered by Part L Building Regulations 2013 as well as the unregulated CO_2 emissions not covered by Part L, 2013. However, the unregulated CO_2 emissions should be excluded from the calculation of compliance with the planning policy.

Further to the feedback received from the GLA in its Stage One Report dated 20th January 2016, Sample DER and TER sheets and BRUKL sheets (including efficiency measures alone i.e excluding CHP and PV) have been provided in Appendix B to support the savings that have been calculated.

4.1.1 Residential Baseline

Baseline emissions have been calculated for both regulated (space heating, hot water, fans and pumps and fixed lighting) CO₂ emissions covered by Part L Building Regulations 2013 as well as the unregulated (cooking and appliances) CO₂ emissions not covered by Part L. The regulated CO₂ emissions baseline is based on the Part L 2013 Target Emission Rate (TER).

The unregulated CO₂ emissions have been calculated separately using BREDEM methodology. The regulated, unregulated and total baseline CO₂ emissions for the residential units of the development are summarised in Table 4.1.

Table 4.1 Residential baseline CO₂ emissions

	CO ₂ emissions (tonnes/year)		
	Regulated Unregulated Total		
Residential CO ₂ Emissions Baseline	159.1	217.5	376.6

4.1.2 Non-residential Baseline

The baseline CO₂ emissions are based on the calculation of the energy consumption of a 'notional' building under the standard National Calculation Methodology (NCM). The regulated, unregulated and total baseline CO₂ emissions for the non-residential floor space are summarised in Table 4.2.

Table 4.2 Non-residential baseline CO₂ emissions

	CO₂ emissions (kg/year)		
	Regulated	Unregulated	Total
Non-residential CO ₂ Emissions Baseline	54.3	21.9	76.2



4.1.3 Total Baseline

For the entire development (residential and non-residential), the CO₂ emissions baseline is determined by adding the CO₂ emissions baselines for the residential and the non-residential parts of the development. The regulated, unregulated and total baseline CO₂ emissions for the entire development are summarised in Table 4.3.

Table 4.3 Total baseline CO₂ emissions

	CO ₂ emissions (kg/year)		
	Regulated Unregulated Total		Total
Total CO ₂ Emissions Baseline	213.4	239.5	452.9

4.2 Energy Demand Reduction (Be Lean)

The key focus for the proposed energy strategy is to reduce the energy demands of the development as much as practically and cost effectively possible by implementing various energy demand reduction measures.

Reducing the energy demand is the most effective way to reduce the CO₂ emissions associated with energy use. Energy efficiency measures can be adopted to reduce energy demand without making a significant impact on the design, appearance or character of the building. Reducing energy demand also helps to reduce fuel demand and hence reduces the future energy costs for the residents.

A range of measures to reduce CO₂ emissions and increase resilience to climate change will be incorporated into the design of the building. This will include good building fabric standards as well as an energy efficient M&E systems and lighting.

4.2.1 Residential

4.2.1.1 Passive Design

Policy 5.3 of the London Plan requires the development to demonstrate that passive design and energy efficiency have been considered from the beginning and all the way through the design process. In addition, Policy 5.9 requires the development to reduce potential overheating and reliance on air conditioning systems.

Through adopting best practice in design, and in response to these policies, the development has considered sustainable design and construction standards to reduce potential overheating and reliance on air conditioning systems through the following approaches and measures.

The development will incorporate a number of passive solar design measures, presented below. The layout of the building (S, U shape and different roof height) allows for self-shading between its parts. Furthermore, balconies and external corridors provide shading to the development. The proposed windows aim to maximise daylight and again minimise overheating. The glazing specification will be selected to provide a balance of solar control and access to passive solar gain.

The inclusion of green roofs in the development will enhance biodiversity, absorb rainfall, improve the performance of the building, reduce the urban heat island effect and improve the appearance of a development. All the above, contribute to the greening of the infrastructure and have similar cooling effects on the air surrounding the buildings they are installed on. They also add an additional insulation value on the building elements they are applied to, although this will depend on the construction and the level of moisture content in the living element.



Taking into consideration building fabric and low carbon energy proposals, it is assumed that an appropriate mechanical ventilation strategy with heat recovery (MVHR) will likely be provided as continuous background ventilation to ensure compliance with Part F Building Regulations. Natural ventilation in order to provide the desired Indoor Air Quality (IAQ) to the dwelling has been considered but due to the high energy efficiency requirements and CO₂ reduction targets as well as noise sources arising from the surroundings, it may be difficult to implement this strategy all around the year. While, on the other hand, natural ventilation is proposed as a purge ventilation during the summer period to deal with the warm spells.

The majority of the units are dual aspect which will maximise daylight. Openable windows are proposed despite the fact that they will not be essential to provide the essential fresh air supply to the rooms. They will, however, provide some further allowance to residents and occupiers to control their environment during spring and summer and thus, increase their adaptive approach to comfort. The openable windows will also be used for purge natural ventilation to reduce the risk of overheating.

The ventilation strategy will be reviewed as the design progresses to ensure compliance with all the relevant regulations and standards.

The development reflects the cooling hierarchy as set out in the London Plan Policy 5.9 and has been assessed, from an early stage, against the performance criteria of this policy. An Overheating Assessment has been prepared and is submitted as further information following feedback and requests from the GLA Stage One Report.

The results of the modelling showed that if the proposed strategies and assumptions are adopted the building can meet the TM52 Adaptive Overheating criteria without the use of active cooling and as a result, can comply with the Cooling hierarchy of London Plan Policy 5.9.

Thus, the proposed passive design will minimise the risk of overheating. All units have adequate natural ventilation, especially the dual aspect affordable units which also benefit from the overshadowing of recessed balconies on the southern elevation.

Despite the aforementioned, a mechanical comfort cooling system in the private dwellings is also incorporated within the design in order to satisfy predominantly the market expectations.

The supply of comfort cooling to private dwellings will enable residents to achieve a more controlled and pleasant internal environment during hot days in summer. The ability to create a more controlled and pleasant internal environment will particularly benefit the residents who are intolerant to high temperatures and vulnerable residents with health issues.

It is anticipated that the affordable block dwellings will have better cross ventilation than the dwellings within the private blocks, due to the proposed architectural design. Therefore it is not proposed to provide comfort cooling to the affordable block dwellings.

4.2.1.2 Building Fabric

In order to achieve the Part L 2013 Target Fabric Energy Efficiency (TFEE) targets, good building fabric standards will be used. The use of good fabric standards is one of the most cost-effective measures to reduce CO₂ emissions; it can also help to improve the cost effectiveness of all other energy and CO₂ reduction measures. Good standards of insulation can pay for itself in the reduction in running costs and also reduce the costs of low carbon and renewable energy systems.



In order to achieve this, it is necessary to go beyond the Part L1A 2013 minimum building fabric standards. The minimum building fabric requirements for Part L1A 2013 and the proposed specification for individual building elements for the residential part of the development are presented in Table 4.4.

Table 4.4 Proposed fabric energy efficiency targets for individual building elements

Element	U-values W/m ² K		
	Part L1A 2013 minimum fabric requirements	Proposed specification for the development	
External walls	0.30	0.18	
Roof	0.20	0.15	
First floor	0.25	0.15	
Windows [1]	2.00	1.30	
Airtightness	10 (m ³ /(hm ²) at 50 Pa)	4 (m ³ /(hm ²) at 50 Pa	
y - value	0.15	0.04 [2]	

^[1] Glazing performance will need to be reviewed alongside acoustic performance as the design is developed.

Implementing these (or similar) building fabric standards will help to deliver substantial reductions in CO₂ emissions compared with the current building performance and regulations and meet the TFEE. The proposed specification should be viewed as guidance and may change subject to detailed design.

Following the GLA Stage One Report which states that; "The applicant is targeting high performance with regards to thermal bridging. It is recommended that modelling is carried out early on in the design process to confirm that such high targets are achievable in practice." We can confirm that the values used are indicative and represent good market building practice. Modelling which will provide further clarification is suggested to be carried out early on the design process.

4.2.1.3 Energy Efficient Systems

Energy demand can be significantly reduced by using energy efficient M&E systems. Some of the proposed key measures for the non-residential development are listed below:

- 100% energy efficient lighting and appropriate controls
- Variable flow rate heating system with high delta T and low return temperatures
- High efficiency motors and variable speed pumps for heating
- Energy efficient ventilation system with heat recovery
- Appropriate controls for heating
- Appropriate temperature and time zoning
- Enhanced insulation of heating pipework and valves
- Energy efficient cooling systems for private dwellings with seasonal energy efficiency ratio (SEER) of 5 or higher
- Appropriate smart energy metering and monitoring

Implementing these or similar energy efficiency measures will help to deliver substantial reductions in CO₂ emissions compared with the baseline.

^[2] Target value. It is proposed to use 'Accredited Construction Details' or the equivalent standard on all junctions.



The overarching principle for final selection of the building fabric standards and energy efficient systems is to achieve compliance with Part L1A 2013 requirements through energy demand reduction measures alone.

Mechanical Ventilation with Heat Recovery

An important component of the design is to provide an appropriate ventilation system for the dwellings. At this stage an MVHR system is proposed for each dwelling of the residential development.

MVHR systems are balanced whole home ventilation systems which are intended to work continuously all year round. MVHR systems recycle the heat from exhaust air by passing it to incoming air. This is a passive process that relies on heat exchangers with large surface areas and it requires no additional energy input. There are also other benefits using MVHR systems including filtration of incoming air, improvement of hourly air changes in air tight dwellings and replacement of window trickle vents in dwellings where windows must remain closed for acoustic or pollutant reasons. In addition, MVHR systems warm up the cold incoming outside air in winter helping to avoid cold draughts.

There is a risk that in summer months MVHR systems will keep returning heat into the building. This would compound rather than reduce overheating risk. Therefore, it will be required to specify MVHR systems which include measures to overcome this issue. These measures can include purge ventilation, controls and summer by-pass. The MVHR system should be specified to have purge ventilation or boost. When systems are in boost mode they cannot recover heat efficiently due to the volume of air flow through them and can help to quickly remove heat from overheated rooms. In addition, the MVHR systems should be selected to meet Specific Fan Power of 0.5 W/l/s or less. This can be achieved by using systems with high efficiency fan motors and radiused bends and turning vanes in ductwork.

Metering Systems and Energy Display Devices

Use of intelligent controls and a high degree of sub metering / monitoring will be used to optimise the efficiency of energy systems through analysis of empiric data. Smart metering systems including smart in-home displays are proposed for dwellings to assist occupiers in reducing energy consumption and to control the cost energy.

Energy Efficient Appliances

The unregulated energy demand and the associated CO₂ emissions can be reduced by providing energy efficient white goods. It is assumed that energy efficient white goods will be provided in dwellings.

It is estimated that provision of the energy efficient appliances can reduce the total unregulated CO_2 emissions associated with the residential development by circa 26.1 t CO_2 per annum, which equates to approximately 12.0%.

4.2.2 Non-residential

4.2.2.1 Passive Design

The design of the non-residential unit proposes to incorporate a number of passive design measures to reduce CO₂ emissions and improve indoor climate. The unit has been designed to optimise the amount of direct sunlight which will help to minimise the use of energy-intensive artificial lighting.

The passive solar design will incorporate measures which enable controlled solar gain and improved direct and indirect natural lighting. Internal glare control measures such as occupant controlled



devises and internal blinds should be considered and introduced as required by the non-residential tenants. These devises can also be used to limit overheating of the non-residential floor space.

The glazing will be selected aiming to maximise daylight and minimise overheating. In addition, the glazing specification will be selected to provide a balance of solar control and access of direct and indirect natural lighting.

It is assumed at this stage that the non-residential units will not have openable widows. Therefore, energy efficient mechanical ventilation will need to be provided in line with Part F Building Regulations. The ventilation strategy needs to be constantly under review when fit-out design develops to ensure compliance with all the relevant regulations and standards.

4.2.2.2 Building Fabric

Part L of the 2013 Building Regulations for non-residential buildings highlights the need to ensure energy efficiency in design. The introduction of BREEAM has moved this agenda further forward and has focused on ensuring buildings are well insulated and airtight which will help to reduce the space heating and cooling demand and associated primary energy.

The use of good fabric standards for non-residential floor space is one of the most cost-effective measures to reduce CO_2 emissions and can also help to improve the cost effectiveness of all other energy and CO_2 reduction measures.

Correct selection of good fabric standards can pay for itself in the reductions in running costs and also reduce the costs of low carbon and renewable energy systems. The use of good building fabric standards will help to deliver substantial reductions in CO₂ emissions and to achieve the BREEAM energy requirements.

The minimum building fabric requirements for Part L2A 2013 and the proposed specification for individual building elements for the non-residential floor space are presented in Table 4.5.

Table 4.5 Proposed fabric energy efficiency targets for individual building elements

Element	U-values W/m²K		
	Part L2A 2013 minimum fabric requirements Proposed specification the development		
External walls	0.35	0.18	
Ground floor	0.25	0.15	
Windows [1]	2.2	1.30	
Airtightness	10 (m³/(hm²) at 50 Pa)	4 (m ³ /(hm ²) at 50 Pa)	
ψ - value	0.15	0.04 [2]	

^[1] Glazing performance will need to be reviewed alongside acoustic performance as the design is developed.

Implementing these (or similar) building fabric standards will help to deliver substantial reductions in CO₂ emissions compared with the current building performance and regulations. The proposed specification should be viewed as guidance and may change subject to detailed design.

4.2.2.3 Energy Efficient Systems

Energy demand can be significantly reduced by using energy efficient M&E systems. The recommended indicative energy efficiency measures for the proposed non-residential units which

^[2] Target value. It is proposed to use 'Accredited Construction Details' or the equivalent standard on all junctions.



have been used to carry out the energy and carbon modelling are provided below. As the non-residential units will be provided as shell and core, it will be the responsibility of the future tenants to review the proposed energy efficiency measures and incorporate them into the final design as required to meet the regulatory requirements. The proposed strategy sets out attainable measures to achieve compliance by the future tenants. The future tenants may vary, according to their preference, the proposed energy efficiency measures/specification for specific requirements and needs.

For the purposes of final BREEAM shell and core energy modelling, green fit-out agreement will be required to enable the design team to substitute the minimum energy efficiency standards or backstop levels required by the relevant national building regulations with more realistic and appropriate energy efficiency measures.

The overarching principle for the final selection of building fabric standards and energy efficient systems is to achieve compliance with the BREEAM energy requirements and Part L2A 2013 requirements (if possible) through energy demand reduction measures alone.

Heating

The following design specifications are proposed to achieve energy efficient heating system:

- Optimised plant start/stop times;
- Variable flow rate heating system with high delta T and low return temperatures;
- High efficiency motors and variable speed pumps for heating;
- Appropriate controls for heating;
- Appropriate temperature and time zoning;
- Enhanced insulation of heating pipework and valves;
- Appropriate smart energy metering and monitoring.

Lighting

High efficiency internal and external lighting should be used throughout the development in conjunction with a lighting control system incorporating daylight and presence detection as appropriate. This will ensure that lights are switched off when not required. Energy efficient lighting with appropriate controls should be considered and provided to the non-residential areas as required.

Ventilation

It is proposed to consider an energy efficient ventilation system for the non-residential units. Mechanical ventilation with heat recovery system with low Specific Fan Powers (SFP) is recommended. This can be achieved by using systems with high efficiency fan motors and radiused bends and turning vanes in ductwork.

It is suggested that the ventilation system is specified to meet highest standards of air leakage and to ensure heat recovery complies with the Enhanced Capital Allowance (ECA) criteria for efficiency and low pressure drops.

A more detailed ventilation strategy will be developed during the detailed design with the aim to specify the most appropriate ventilation system and achieve pleasant indoor climate in non-residential areas.

The overall ventilation strategy approach needs to be constantly reviewed as the design progresses to ensure cost effectiveness and compliance with all the relevant regulations and standards.



Cooling

Cooling will need to be provided for the non-residential units. The cooling systems will need to be specified to the following minimum energy efficiency standards:

- Energy efficient cooling systems with seasonal energy efficiency ratio (SEER) of 5 or higher;
- High efficiency motors, variable speed pumps and energy efficient compressors for circulation of refrigerant in the cooling system;
- Enhanced insulation of distribution pipework and valves; and
- Appropriate controls, temperature and time zoning.

The specification of the cooling system will be defined during the detailed design stage or the fit-out by the future tenants.

Energy Metering and Monitoring

Sub metering of major energy consuming systems together with an accessible energy monitoring and management system or separate accessible energy sub-meters with pulsed or other open protocol systems will be provided. The energy metering and monitoring strategy will be fully compliant with the BREEAM energy monitoring requirements.

4.2.3 Summary of CO₂ Savings after Energy Demand Reduction

4.2.3.1 Residential CO₂ Savings from Energy Demand Reduction Measures

The regulated energy and carbon baselines were calculated by extrapolating the Dwelling Emission Rates (DER) of the typical dwellings across the entire residential development. The total energy demand and the CO₂ emissions for the residential development were calculated using the energy and carbon assessment model. DERs do not include the unregulated energy use for appliances and cooking and these CO₂ emissions have been calculated separately using the BREDEM methodology.

The energy assessment shows that by implementing the energy efficient design, by incorporating enhanced building fabric standards and by using energy efficient systems, the regulated CO_2 emissions can be reduced by circa 4.0 tCO_2 per annum, which equates to circa 2.5% reduction in total CO_2 emissions over the baseline. The regulated, unregulated and total emissions after energy demand reduction are summarised in Table 4.6.

Table 4.6 Residential CO₂ emissions after energy demand reduction

	CO ₂ emissions (kg/year)		
	Regulated	Unregulated	Total
Residential CO ₂ Emissions Baseline	159.1	217.5	376.6
After energy demand reduction	155.1	191.4	346.5

4.2.3.2 Non-residential CO₂ Savings from Energy Demand Reduction Measures

The Building Emission Rate (BER) has been used to determine anticipated CO₂ emissions of an 'actual' building under the standard National Calculation Methodology (NCM). The total energy demand and the CO₂ emissions for the non-residential units were calculated using the energy and carbon assessment model.



The energy assessment shows that by implementing the energy efficient design, by incorporating enhanced building fabric standards and by using energy efficient systems, the regulated CO₂ emissions can be reduced by circa 3.9 tCO₂ per annum, which equates to circa 7.2% reduction in regulated emissions over the baseline.

Table 4.7 Anticipated CO₂ emissions after non-residential demand reduction

	CO₂ emissions (kg/year)		
	Regulated	Unregulated	Total
Non-residential CO ₂ Emissions Baseline	54.3	21.9	76.2
After energy demand reduction	50.4	21.9	72.3

4.2.3.3 Total Anticipated CO₂ Savings from Energy Demand Reduction Measures

The CO_2 assessment shows that by implementing the energy efficient design, the CO_2 can be reduced by circa 7.9 t CO_2 per annum for the entire development, which equates to circa 3.7% reduction in regulated CO_2 emissions over the baseline.

The summary of regulated, unregulated and total CO₂ emissions and anticipated savings are presented in Table 4.8.

Table 4.8 Summary of CO₂ emissions after energy demand reduction

	CO ₂ emissions (kg/year)		
	Regulated	Unregulated	Total
Total CO ₂ Emissions Baseline	213.4	239.5	452.9
After energy demand reduction	205.5	213.4	418.9

The CO₂ emissions reduction is slightly lower than the previous planning application scheme due to GLA's Guidance requirement to assess the 'be lean' case against gas boilers with the relatively low efficiency of 89.5%. The common commercially available gas boilers have higher efficiencies, thus this result should be read as a means of assessing the building fabric efficiency and not the actual case.

4.3 Energy Efficient Supply (Be Clean)

London Plan Policy 5.6 and Camden Planning Guidance 3 require all major development proposals to evaluate and where appropriate select decentralised energy options systems in accordance with the following hierarchy:

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

4.3.1 Residential Energy Demand

The residential space heating, hot water and cooling demands have been estimated based on SAP methodology.



The estimated residential hot water demand is expected to present a consistent load throughout the year, although there will be peaks and troughs in daily use. These peaks and troughs can be managed through use of a thermal store that will transform the hot water load into a consistent base load which can potentially be delivered by a CHP technology connected to a district heating network.

During the summer months the space heating may not be needed or its requirement will be relatively low. The space heating demand during colder months of the year can also be delivered by the CHP technology. The remaining space heating demand can effectively be supplied by gas boilers which work well in conjunction with the CHP technology.

It is proposed that all private residential units will include mechanical comfort cooling. This cooling can be supplied effectively by Variable Refrigerant Flow (VRF) systems or conventional air or water cooled chillers. The VRF systems are generally more efficient than conventional cooling systems.

Therefore, where appropriate, the VRF systems should be used over the conventional cooling systems. It is considered that the use of absorption chillers is unsuitable in this instance due to the relatively small anticipated cooling load and low efficiencies.

4.3.2 Non-residential Energy Demand

The non-residential space heating, hot water and cooling demands have been estimated based on NCM methodology.

It is more difficult to assess non-residential heat demand because the non-residential units will be provided as shell and core and tenants of the units are currently unknown.

However, it is anticipated that the space heating and hot water demand of the non-residential units will be relatively low. The non-residential space heating and hot water demand alone would not have justified the use of the CHP technology but if combined with the residential heat demand, it can make use of the CHP technology effective as it will boost the normalisation of the heat demand.

The estimated non-residential cooling load is expected to be apparent all year round, but predominantly during the summer months. This relatively small load can be supplied effectively by either multi-split (VRF) systems or conventional air or water cooled chillers. It is considered that use of absorption chillers is unsuitable in this instance due to the relatively small anticipated cooling load and low efficiencies.

The VRF systems are generally more efficient than conventional cooling systems. Therefore, where appropriate, the VRF systems should be used over the conventional cooling systems.

4.3.3 Energy Supply Options Assessment

Policy 5.5 and Policy 5.6 of the London Plan as well as Camden Core Strategy Policy CS13 encourage development of decentralised energy networks. Policy 5.6 requires all major development proposals to evaluate, and where appropriate, select energy systems in accordance with the following hierarchy:

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

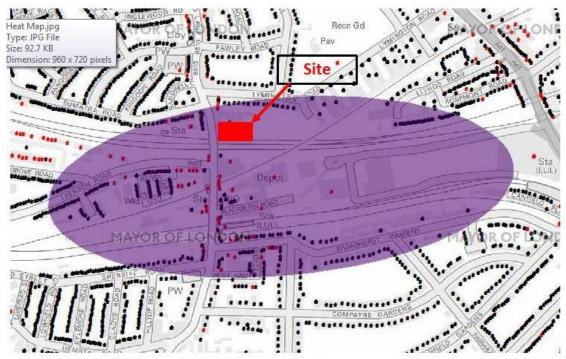


4.3.3.1 Connection to Existing Heating or Cooling Networks

In response to the London Plan Policy 5.6 hierarchy, an investigation using the London Heat Map was carried out to identify existing and planned district heating networks in the vicinity of the site. The London Heat Map indicates that there are no existing or planned district heating networks around the site.

However, the snapshot of the London Heat Map provided in Figure 4.1 indicates that the site is located within the district heating opportunity area which is shown in violet colour on the map.





This means that district heating or community heating schemes may potentially be developed within the opportunity area and there may be a possibility to connect the development to the district heating or community heating schemes in the future if site-wide heating network for the site is provided.

4.3.3.2 Site-wide Heating Network

As there could be a possibility in the future to connect the development to a wider heat network, investigation into on-site decentralised energy is required for the site.

The development has reasonably high density which makes site-wide heating network justifiable. The provision of an on-site district heating system will provide an opportunity for the proposed development to be 'future proofed' to make the best use of efficient energy generation with current and future technologies. In particular, such a system will enable the necessary infrastructure to be brought forward to link with other potential decentralised energy generation schemes which may be developed in the area after completion of the proposed development.

Site-wide CCHP/CHP system is favoured by Policy 5.5 and Policy 5.6. A CHP technology requires a relatively consistent heat demand throughout the year and the estimated total hot water demand (residential and non-residential) is expected to be high enough to justify the use of this technology. It will also help to deliver significant CO₂ savings which can help to achieve the CO₂ reduction targets.



Therefore, it is proposed to develop a site-wide heating network with CHP to supply hot water and space heating to both residential and non-residential parts of the development.

The CCHP system was considered but due to an anticipated relatively small non-residential cooling demand and low efficiencies of absorption chillers as well as space and practical constraints, this system is considered to be unsuitable to supply cooling for the development.

Heating Network Design

The proposed design of the development's on-site heating system will incorporate:

- 1. gas-fired CHP engine;
- 2. thermal store(s) for hot water storage; and
- 3. gas-fired boilers as back-up/top-up.

These systems together with all the associated ancillary equipment will be located in the basement in the energy centre with a total floor area of circa 205 m². This size of energy centre will be sufficient for the size development and the proposed design. The gas intake and the controls will be located in different basement plantrooms. Figure 4.2 provides the proposed location and layout of the energy centre in the lower ground floor.

Capped pipework connections will be provided to enable physical connection of the on-site heat network to the near-site energy generation facilities and networks should they become available and feasible in the future.

This arrangement will enable connection of the development to near-site energy generation facilities and networks by providing capped connections, should these options become available in the future. This will also allow installation of emerging low carbon/renewable energy technologies such as biofuel CHP and fuel cells in the future should they become technically and economically feasible.

Capped pipework connections will be provided to enable physical connection of the on-site heat network to the near-site energy generation facilities and networks should they become available and feasible in the future, as requested by the council comments. The safeguarded route for a future heat pipe to deliver heat to the development plant room from the road is demonstrated in Appendix D through an outline sketch of the future pipework layout demonstrating the designated location and route.

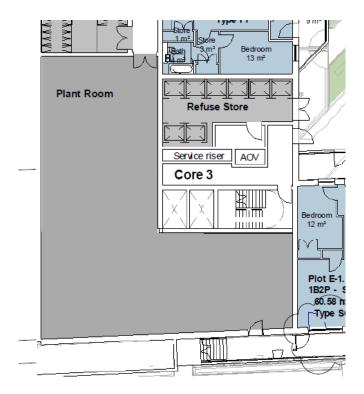
It is expected that the space heating to all dwellings will be provided via radiator heating systems. The space heating to the non-residential units will be either provided via radiator, underfloor or air heating systems.

The design of the proposed site-wide heating system will be developed during the detailed design stage. However, the overarching design principle is to design the system in accordance with standards and design recommendations provided within emerging Heat Networks Code of Practice, the London Heat Network Manual, CIBSE AM12 Combined Heat and Power for Buildings and other relevant publications.

The design of the site-wide heating system needs to ensure that heat distribution pipework runs are minimised, particularly lateral pipework in the corridors, and the heating infrastructure including distribution pipework and Hydraulic Interface Units (HIUs) are insulated to the highest possible standards to minimise heat losses.

Figure 4.2 Location of Energy Centre





Choice of Fuel for CHP

Most CHP systems in the UK run on natural gas or diesel but there are other fuels which are technically feasible, such as biomass and biogas.

Specially designed CHP engines can run on biogas, however, it would not be possible to produce biogas on site (e.g. via anaerobic digestion) due to space and technical (food stock etc.) constraints. In addition, there are a limited number of biogas suppliers, therefore there are concerns regarding the fuel supply security and fuel cost. Taking into consideration the above, this option has been ruled out.

Small biomass CHP systems are in development. However, this technology is still unproven, representing high technical risks at this time.

Liquid biofuels can be used to run biodiesel CHP engines however there are similar concerns with biogas regarding security of supply and over the sustainability of liquid biofuel production. In addition, delivery of liquid biofuels will be an issue for the site.

Taking into account the aforementioned issues, biofuel CHP is neither reliable nor cost effective and has been disregarded for the application. It is therefore proposed to use proven and reliable gasfired CHP units.

CHP System Sizing and Selection

Based on the assessment of the space heating and hot water demand profiles, it is proposed to size the CHP system to supply up to 80% of the total heat demand of the development. It is assumed that the CHP system will supply all annual domestic water demand of the development. Some of the space heating demand will also be supplied by the CHP. The remaining space heating load will be covered by energy efficient gas boilers, installed in parallel to the CHP unit in the energy centre.

Based on the available information, a preliminary CHP sizing has been carried out which indicates that the CHP engine should be 80 kWth (40 kWel) as a minimum to supply the targeted demand.



The performance of CHP units vary significantly across manufacturer's and unit models. In undertaking the assessment generic performance figures for the CHP have been used which can be achieved and bettered within commercially available plants. The efficiency and energy output figures utilised for the purpose of the calculations are:

Heat output ratio: 66%;

Electrical output ratio: 34%

CHP efficiency: 87%.

To facilitate achievement of the heat supply contribution from the CHP system, a sufficiently sized thermal store should be provided. The size of the thermal store must be such that the operation of the CHP is maximised and a full assessment must be undertaken at detail design stage. At present the thermal store is considered to be in the region of 2,000 litres with the defined above CHP performance.

Sizing and selection of the CHP system should be carried out during detailed design stage. The underlining principle for sizing and selecting the CHP system will be to maximise CO₂ reduction and reduce life cycle costs as well as achieve all other requirements such as NOx emissions and noise levels.

In April 2014, the GLA published specific NOx requirements related to the CHP engines which are provided in the Sustainable Design and Construction SPG. The CHP engine will be selected to comply with these requirements.

In addition, the CHP system will be selected to facilitate minimum 5,000 operating hours per year and should improve the financial viability of the heating system operation whilst maintaining the technical ability of the system to meet variations in hot water and space heating demand.

In response to Guidance note 55 - GLA Stage One Report the monthly load profiles of the simulated CHP are demonstrated in Appendix C. Furthermore, the estimated proportion of heat demand addressed by the CHP was calculated as 83.7% and its average daily operating hours 16.1, resulting in 5,876 operational hours.

Heating System Operation and Management

The detailed design of the heating system is to be completed during the detailed design stage but the intention is that the CHP engine will act as a primary heat source followed by the thermal store and top-up gas boilers. Heat will be provided from the CHP engine to meet the demand from the development and / or to charge the thermal storage vessel. If the heat demand of the building cannot be met by the CHP, the thermal store will discharge heat into the heating system. If the thermal store contains insufficient heat to meet the required heat demand which exceeds that provided by the CHP, the gas-fired boilers will operate.

The inclusion of a thermal store allows the CHP to run when there is low demand to build up a reserve of heat energy in the stored hot water. This energy can be released to provide heat at periods of peak demand. Releasing stored heat energy in this way means that the use of the top-up gas boilers is reduced and the proportion of heat supplied from the CHP increased. There are other benefits from the thermal store in that the CHP system will run at optimum output for the majority of the time. An optimum run time also reduces the size and life cycle cost of CHP required to meet a given energy load and increases CO₂ savings.

The gas boiler system will be sized to provide full hot water demand backup in the event of failure or maintenance of the CHP units.



When there is an electricity demand in the landlord areas, the electrical output of the CHP system will be fully utilised on site with no export to the grid. If the electricity demand is lower than the electricity supplied by the CHP unit, the surplus will be exported to the grid. To improve the viability of the system operation, a possibility to supply electricity from the CHP directly to the non-residential areas should be investigated during detailed design.

It is not possible to provide specific details regarding the electricity export arrangements due to the lack of available technical information at this stage. In addition, the utility companies do not generally engage with potential electricity exporters at early project stages or provide site specific information related to electricity export arrangements.

Even if it is possible to supply the CHP electricity to the non-residential units, it is envisaged that some of the CHP electricity will need to be exported to the grid. Therefore, an import and export electricity meter will be installed on site and the G59 requirements met to enable the electricity to be exported.

Currently, it is not possible to confirm an operator of the site-wide energy system; once more it is early in the design process. However, at this stage, it is expected that it will not be less viable to operate the site-wide energy system with CHP than without CHP. In addition, site-wide energy system operators will more likely favour an energy centre with CHP as it would provide an additional financial incentive regarding the potential electricity sale and export. As requested by the Guidance note 56 the discussions with possible operators at the earliest convenience after this stage.

As required, the electricity export contractual arrangements should be discussed and agreed with a DNO during later stages of the project. The electricity demand of the landlord areas will also be determined during later stages of the project when more details about the M&E design of the development is available.

Management of the Heating Network

It is expected that A2Dominion Developments Limited will own and operate the heating system with a commitment to deliver heat to all residential and non-residential customers. The CHP system will be monitored and the evidence of continued compliance with emissions limits will be provided annually in the form of an annual maintenance report.

4.3.4 Summary of Anticipated CO₂ Reductions from CHP system

4.3.4.1 Anticipated CO₂ Savings from CHP System - Residential

The energy assessment shows that by use of the proposed site-wide heating network with CHP, it is possible to achieve a reduction of CO₂ emissions of approximately 56.9 tCO₂ per annum for the residential part of the development. This is equivalent to a reduction in the regulated CO₂ emissions from the energy efficient building of circa 36.7%. The regulated, unregulated and total regulated emissions savings through use of CHP technology is summarised in Table 4.9.

Table 4.9 Residential CO₂ emissions after use of CHP technology

	CO ₂ emissions (kg/year)			
	Regulated Unregulated Total			
Residential CO ₂ Emissions Baseline	159.1	217.5	376.6	
After energy demand reduction	155.1	191.4	346.5	



After use of CHP technology 98.2 191.4 289.6
--

Table 4.9 shows that the building fabric and energy efficiency measures combined with the use of the district heating network can achieve 38.3% CO₂ reduction over the residential baseline. This means that the London Plan target of 35% can be met without contribution from additional low carbon or renewable energy technologies. Therefore, the use of additional low carbon or renewable energy technologies is not required for the residential development.

4.3.4.2 Anticipated CO₂ Savings from CHP System – Non-residential

The energy assessment shows that by use of the proposed site-wide heating network with CHP, it is possible to achieve a further reduction of CO₂ emissions of approximately 1.4 tCO₂ per annum for the non-residential unit. This is equivalent to a reduction in the regulated CO₂ emissions from the energy efficient building of circa 2.8%. The anticipated CO₂ savings are low due to low hot water and space heating demands associated with the non-residential units. The regulated, unregulated and total regulated emissions savings through use of CHP technology is summarised in Table 4.10.

Table 4.10 Non-residential CO₂ emissions after use of CHP technology

	CO₂ emissions (kg/year)		
	Regulated	Unregulated	Total
Non-residential CO2 Emissions Baseline	54.3	21.9	76.2
After energy demand reduction	50.4	21.9	72.3
After use of CHP technology	49	21.9	70.9

4.3.4.3 Anticipated CO₂ Savings from CHP System – Entire Development

The energy assessment shows that by use of the proposed site-wide heating network with CHP, it is possible to achieve a further reduction of CO₂ emissions of approximately 58.4 tCO₂ per annum for the entire development. This is equivalent to a reduction in the regulated CO₂ emissions from the energy efficient building of circa 28.4%. The regulated, unregulated and total regulated emissions savings through use of CHP technology is summarised in Table 4.11.

Table 4.11 Total CO₂ emissions after use of CHP technology

	CO₂ emissions (kg/year)		
	Regulated	Unregulated	Total
Total CO ₂ Emissions Baseline	213.4	239.5	452.9
After energy demand reduction	205.5	213.4	418.9
After use of CHP technology	147.1	213.4	360.5

4.4 Renewable Energy

Policy 5.7 of the London Plan requires providing a reduction in expected CO₂ emissions through the use of on-site renewable energy generation, where feasible.

The likely energy use of the proposed development allows for a feasibility assessment of the renewable energy technology options to determine which are most favourable for this particular



development. The following technologies have been assessed for their potential to meet the renewable energy target:

- Biomass boilers
- Ground source heat pumps
- Air source heat pumps
- Wind turbines
- Solar thermal systems
- Photovoltaic (PV) systems

The assessment of these technologies shows that the installation of PV systems is considered to be the most suitable renewable energy technology option for the development. All other renewable energy technology options are considered to be less suitable (or unsuitable) for this development. A summary of the assessment of the renewable technology options is provided in Appendix A. The preferred PV option is further discussed below.

4.4.1.1 Photovoltaic (PV) Systems

The renewable energy assessment shows that PV systems can be provided to generate renewable power. The technology can work well with all the other proposed technologies (e.g. CHP and gas boilers) and can supply the remaining required CO₂ reduction for the non-residential units.

PV systems are suitable for any type of building but they require significant un-shaded south facing space, as even a small shadow may significantly reduce output. PV systems can be incorporated into the units in various ways: on sloped roofs and flat roofs, or in facades, atria and shading devices.

Currently, there are four types of solar PV cells available: mono-crystalline, poly-crystalline, thin film and hybrid. Mono-crystalline and hybrid cells are the most expensive to produce but are 12-20%, poly-crystalline cells are cheaper but their efficiency is 9-15% and thin film cells are only 5-8% efficient but can be produced as thin flexible sheets.

Generally, PV systems should ideally face south with an incline of 30°, although orientations within 45° of south and other angles can still generate high outputs. The panels should be ideally mounted on the roof of the building to facilitate correct orientation and minimise shading.

The technology is easily scalable, which means that the required amount can be installed to meet the renewable energy requirements and the required CO₂ reduction targets. The only technically limiting factor on the maximum size of PV system is the available south facing un-shaded roof area, as surplus electricity can be fed back into the grid.

Optimum design of the PV installation is required to ensure maximum electrical output, per kWp installed, is achieved. There are a number of design considerations to be made to ensure the best use of the system.

The key design considerations are:

- Design of PV installation to optimise inclination and orientation;
- Ensure that all parts of the PV panels are un-shaded (as much as possible);
- Ensure correct installation of PV arrays for good ventilation;
- Ensure that the electrical wiring from PV arrays to inverters is kept to minimum to reduce electrical losses;



- Provide sufficient space around PV installations for safe access and maintenance of the modules and other equipment installed on the roof;
- Ensure that inverter performance is monitored to ensure consistent electrical generation in line with the strategy.

A preliminary assessment to define the feasible capacity of the PV systems for all the non-residential areas has been carried out. The assessment shows that circa 31.7 kWp of total PV capacity is required for the non-residential units to achieve the London Plan target reduction and achieve Camden's council minimum Energy Standards.

It is assumed that 1 kWp of PV will require circa 15 m² of unobstructed roof area (including access) if energy efficient PV panels (e.g. mono-crystalline) are used. Therefore, 475.5 m² of unshaded suitable roof area will be required to accommodate the required PV capacity. Assuming that 1 kWp of PV panels can generate circa 800 kWh per annum, the PV plant can produce circa 25,360 kWh/year renewable electricity. A Roof Plan indicating the layout and the location of PV panels is attached in Appendix D to this report as requested by Camden Council and the GLA.

The PV system design and layout will be developed during the detailed design stage. The design will ensure that the visual impact of the PV panels is minimised.

The total system capacity, indicative available roof area and the estimated total electricity production for the development are provided in Table 4.5.

Table 4.12 Proposed PV system capacity and anticipated CO₂ emissions reduction

Building Type	Total PV system capacity (kW)	Total indicative roof area covered with PV panels (m²)	Estimated total electricity production kWh/year)
Non-Residential	31.7	475.5	25,360

The required PV capacity and roof area should be re-assessed and confirmed during detailed design stage.

It is proposed to connect the PV system to the non-residential units through a private wire arrangement, as described in Ene 01 issue of the BREEAM technical manual. This arrangement will benefit future non-residential tenants as most of the produced PV electricity can be used in the non-residential units reducing their reliance on the grid electricity. In addition, applying this arrangement will help achieve BREEAM "Very Good" rating as the CO₂ savings associated with the dedicated PV systems will be directly related to the non-residential areas.

4.4.2 Summary of Anticipated CO₂ Savings from Renewable Systems

4.4.2.1 Anticipated CO₂ Savings from Renewable Systems – Non-residential

The energy assessment shows that PV may result in circa 13.2 tCO₂ further reduction of regulated CO₂ emissions per annum which equates to circa 26.9% reduction. The regulated, unregulated and total emissions after use of PV technology is summarised in Table 4.13.



Table 4.13 Non-residential CO₂ emissions after use of PV technologies

	(CO ₂ emissions (kg/year	•)
	Regulated	Unregulated	Total
Non-residential CO ₂ Emissions Baseline	54.3	21.9	76.2
After energy demand reduction	50.4	21.9	72.3
After use of CHP technology	49.0	21.9	70.9
After use of PV technology	35.8	21.9	57.8

4.4.2.2 Anticipated CO₂ Savings from Renewable Systems – Entire Development

The energy assessment shows that by use of the proposed renewable energy technologies, it is possible to achieve a further reduction of CO₂ emissions of approximately 13.1 tCO₂ per annum for the entire development. This is equivalent to a reduction in the regulated CO₂ emissions from the energy efficient building of circa 9.0%. The regulated, unregulated and total regulated emissions savings through use of the renewable energy technologies are also tabulated in Table 4.14.

Table 4.14 Total CO₂ emissions after use of renewable technologies

	(CO ₂ emissions (kg/year	')
	Regulated	Unregulated	Total
Total CO ₂ Emissions Baseline	213.4	239.5	452.9
After energy demand reduction	205.5	213.4	418.9
After use of CHP technology	147.1	213.4	360.5
After use of PV technology	134.0	213.4	347.4

As requested by the GLA Guidance "Energy Planning" (March 2016) document, the separated energy hierarchy for the domestic and non-domestic parts of the development is illustrated below.

Figure 4.3 Domestic Energy Hierarchy

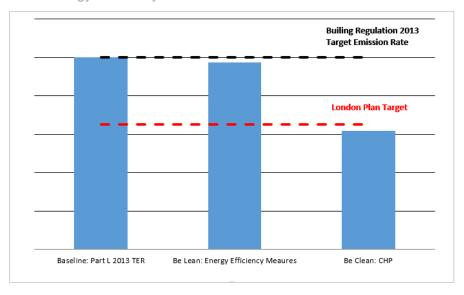
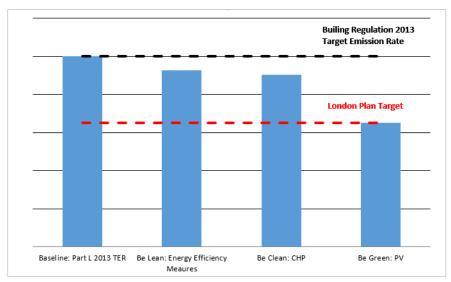




Figure 4.4 Non-Domestic Energy Hierarchy





5. Summary and Conclusions

The proposed strategy is to reduce the overall energy demand as far as practically and economically possible, relative to the policy requirements, by implementing energy efficiency measures before applying low carbon and renewable energy technologies.

The strategy follows and responds to the Be Lean, Be Clean and Be Green energy hierarchy principles as summarised and presented in Table 5.1.

Table 5.1 The Energy Strategy: Be Lean, Be Clean and Be Green principles

Energy Principles	Energy Strategy Response
Be Lean: Use less energy.	Passive design
Minimise energy demand through efficient design and	 Optimised orientation to enable controlled solar gain and improved direct and indirect natural lighting.
the incorporation of passive measures	 Incorporation of balconies into the design which provide shading to reduce risks of overheating in summer.
	 Integration of green roofs which will keep the buildings warm/cool.
	Building Fabric
	Use of optimal building fabric standards.
	Energy Efficiency
	100% energy efficient lighting and appropriate controls
	Variable speed heating system with high delta T and low return temperatures
	 High efficiency motors and variable speed pumps for heating and extraction systems
	High efficiency heating system
	Appropriate controls for heating system
	Temperature and time zoning
	Appropriate insulation of heating distribution system
	Provision of energy efficient white goods
Be Clean: Supply energy	Energy efficient energy supply
efficiently. Reduce energy consumption through use of low-carbon technology	On-site CHP system connected to on-site heating network to supply domestic hot water and space heating to the development
	Energy efficient multi-split (VRF) systems to supply comfort cooling to private residential and the non-residential units
Be Green: Use renewable	Renewable energy
energy systems	Photovoltaics (PV) system to supply renewable electricity to the non-residential units.



The regulated CO₂ savings expressed in terms of actual and percentage reduction after each stage of the energy hierarchy are presented in Table 5.2.

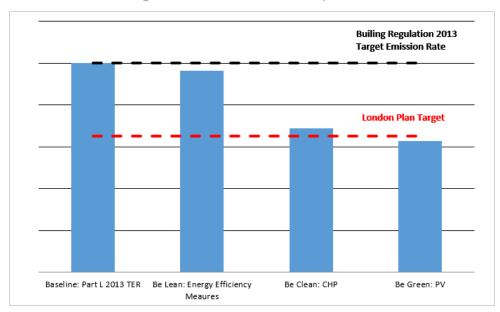
Table 5.2 Summary of CO₂ savings from each stage of the Energy Hierarchy

	Regulated Ener	gy CO₂ savings
	Tonnes per annum	%
Savings from energy demand reduction	7.9	3.7%
Savings from CHP	58.3	27.3%
Savings from renewables	13.1	6.2%
Total cumulative savings	79.3	37.2%
Total Target Savings	74.7	35%
Annual Shortage	4.6	2.2%

Table 5.2 shows that the proposed strategy can achieve regulated CO₂ savings of 79.3 tCO₂ which is equivalent to circa 37.2% reduction when compared to the baseline. The table also shows the annual CO₂ savings surplus which is expected to be 4.6 tCO₂.

The overall reduction in regulated carbon emissions associated with the proposed design is graphically illustrated in Figure 5.1.

Figure 5.1 Overall reduction in regulated CO₂ emissions compared to Part L baseline emissions



The summary of the overall reduction in CO₂ emissions after each stage of the energy hierarchy is presented in Table 5.3.



Table 5.3 Summary of CO₂ emissions after each stage of the Energy Hierarchy

	CO ₂ e	missions (tonnes pe	r year)
	Regulated	Unregulated	Total
Residential CO ₂ Emissions Baseline	213.4	239.5	452.9
After energy demand reduction	205.5	213.4	418.9
After use of CHP technology	147.1	213.4	360.5
After use of PV technology	134.0	213.4	347.4

Table 5.3 shows that the overall CO₂ emissions from both regulated and unregulated energy can be reduced by 105.5 tCO₂ per annum which is equivalent to circa 23.3%.

In summary, the proposed energy solution for the development:

- 1. Informs the built form and orientation of the buildings to respond to daylight and overheating issues.
- 2. Includes optimal fabric standards, energy efficient design of building services and energy efficient appliances
- 3. Complies with Part L 2013 Building Regulations and meets TFEE requirements.
- 4. Includes an efficient on-site heating network with a CHP system designed to meet the hot water and space heating demands of the development.
- 5. Includes PV renewable technology.
- 6. Meets the 35% regulated energy CO₂ emissions reduction requirement.
- 7. Achieves BREEAM 'Very Good' energy requirements.



Appendix A - Assessment of Renewable Energy Options

This appendix presents an assessment of the renewable technology options relative to site. This assessment demonstrates that the installation of PV systems is considered to be the most suitable renewable energy technology option for the development. All other renewable energy technology options are considered to be less suitable (or unsuitable).

Biomass Boilers

Biomass boilers are now regarded as a conventional form of technology with a wide range of sizes and types to meet renewable targets. Biomass boilers use biomass as a fuel source, which is an alternative solid fuel to the conventional fossil fuels and has carbon emissions close to zero. Various types of biomass fuel are in use, the most common being wood chips and pellets.

Although pellets are more expensive than chips, they have greater energy content per unit of weight and require a lower storage volume. Pellet boilers also require less maintenance and produce considerably less ash residue.

There are some local/regional as well as national biomass suppliers who can supply biomass for the site. Biomass would need to be delivered to site in large trucks and the arrangements for supply and storage of the biomass fuel would need careful consideration. It would also require a suitable biomass storage space, which given the space constraints on this site is likely to be restrictive.

Biomass boilers could provide heat for a community heating scheme supplying the remaining 20% thermal demand (space heating) after CHP.

The potential reduction in carbon emissions from the installation of biomass boilers can be considerable and this would likely meet the GLA's target for carbon emissions reduction from renewable energy sources. Also, biomass boilers are compatible with CHP units due to similarity in operating temperatures. However, although biomass systems have a number of advantages, in the context of this development, the following issues prevent the installation of biomass boilers:

- Potential negative effect on air quality;
- No space availability for fuel delivery and storage;
- Significantly higher capital costs in comparison with gas boiler system;
- Requirements of additional resources for management of the operation;
- The location of the development may not be suitable for large-scale fuel delivery; and.
- Security of biomass supply.

The conclusion is that biomass boilers can deliver additional CO₂ reductions but the solution is considered to be unsuitable and not cost effective for this development.

Air Source Heat Pumps

The Air Source Heat pumps (ASHP) can be used as both a source of heating and a source for cooling. ASHP use the same principle operation as GSHPs but the use air as a heat source. The downside is that the air temperature and therefore efficiency of the heat pump is reduced in cold weather when the heat is most needed. This means that one either needs to oversize ASHPs to take into account degradation in performance or, alternatively, provide an auxiliary electric heater.



Provision of an auxiliary heater reduces capital cost but adds to running costs and reduces carbon savings.

Outdoor air systems are widely implemented in the form of split systems, with indoor and outdoor units linked by refrigerant pipes running through the wall. Packaged air systems where outdoor air is ducted to an indoor package are also available.

Theoretically, ASHPs could provide heat for a community heating scheme supplying a portion of thermal demand by preheating the district heating water.

However because the ASHPs should be placed on the roofs of the building, it will likely have significant negative aesthetic impact on the development.

Installation of the ASHPs on the roofs would require higher installation costs associated with support and access to the plant and greater need to consider noise impacts.

In addition, they are not very compatible with higher temperature technologies and systems such as CHP systems. Integration of ASHPs in one system with CHP units has significant technical challenges and risks. Therefore, the ASHP system should ideally be installed separately from the CHP system. In either option, the overall heating supply system could become unnecessarily complicated, which would likely increase the costs of the system. Because of the aforementioned issues, this arrangement is unlikely be practical and cost effective and therefore, it is not recommended to provide heating for this development.

However, the VRF technology is using heat pump operational principles and has been proposed to supply cooling for the non-residential units.

Ground Source Heat Pumps

The ground can be used as both a source of heating and a source for cooling. Ground source heating involves heat pumps, drawing heat from underground, whereas ground source cooling can either use heat pumps or make use of low temperature groundwater directly. Ground Source Heat Pumps (GSHP) are a relatively mature technology and utilise the energy in the ground through a refrigeration cycle. Where GSHP are used for both heating and cooling, depending on the season, this can be a very efficient solution. GSHP can be open loop or closed loop.

Closed loop GSHP system comprises a sealed system of buried pipes normally containing brine or water/antifreeze solution. The solution is circulated continuously around a closed system.

Open Loop GSHP system uses groundwater which is taken from an aquifer to supply heating or cooling. The water is then returned to the ground (sometimes via a borehole or sometimes via storm water drainage). Open loop systems require abstraction and discharge licences from the Environment Agency (EA).

There should be sufficient area within the development to accommodate a sufficient number of boreholes to meet the heating demand with a closed-loop system. However, the ground conditions are currently unknown and may not be suitable to use an open-loop system.

GSHP systems which provide heating are most efficient when warming water to 35-40°C. Theoretically, GSHPs could provide heat for a community heating scheme supplying the remaining 50% thermal demand by preheating the district heating water.

However, as the GSHPs operate at low temperatures, they are not very compatible with higher temperature technologies and systems such as CHP system. Integration of GSHPs in one system with CHP units has significant technical challenges and risks. The overall heating supply system



may become unnecessarily complicated, which will likely to significantly increase the costs of the system and maintenance risks. In addition, due to space constraints it is unlikely be possible to accommodate the system within the proposed plantroom area. Because of the aforementioned issues, this arrangement is unlikely be practical and cost effective and therefore, it is not recommended for this development.

Wind turbines

The capacity of wind turbines can range from 500W to more than 2.5MW. Generally speaking, the larger the turbine, the more cost-effective, but also the more complex it is to find suitable space and obtain planning permission.

Installation of large/medium scale wind turbine(s) could meet the renewable energy and carbon reduction targets, however there is no appropriate space for installation of large/medium scale wind turbines within the site. The installation is unlikely to be permitted due to close proximity of the Heathrow airport.

Effective energy generation through small scale roof mounted wind turbines is not feasible due to the following:

- Location of the development in a densely populated area.
- The average wind speed at the site is estimated to be circa 5.6 m/s at 25 m above ground which is based on NOABLE Wind Map (the wind speed was taken from the Rensmart Wind Map). The wind speed is marginal for effective operation of a wind turbine.
- Issues such as noise, telecoms interference proximity to Heathrow airport and visual impact are likely to restrict installation of wind turbines.

Therefore, wind energy is not recommended for this development.

Solar Thermal systems

Solar water heating systems use the energy from the sun to heat water, most commonly for domestic hot water needs. Solar heating systems use a heat collector that is usually mounted on a roof in which a fluid is heated by the sun.

The use of solar thermal panels is inappropriate for this development on the basis that the technology is not compatible with the use of CHP as both technologies compete for the same summertime hot water load.

In addition, the system will produce relatively small CO_2 savings but will have significant negative impact of the cost of the heating system and its practicability. Therefore, solar thermal systems are not recommended for this development.



Appendix B - Sample SAP TERs and DERs, BRUKL output documents

The table below shows the simulated, sample flats selected as representative of the development:

Dwelling Ref.	Level	Orientation	Size (m²)
GF 2B4P PS East Building	0	South / West	74
GF 1B2P SO West Building	0	East	52
MF 1B2P PS East Building	1-4	West	59
MF 2B4P SO West Building	1-4	North / West	79
MF 1B2P AR West Building	1-2	South / North	59
MF 3B6P AR West Building	2-4	West / East	100
TF 1B2P PS East Building	4	South	59
TF 2B4P SO West Building	5	East	70
TF 3B5P AR West Building	5	South / East	88

The average weighted formula has been devised to combine the TER and DER and produce the residential percentage reduction from the baseline for efficiency measures.

				User D	etails:						
Assessor Name:					Strom						
Software Name:	Stroma FS	SAP 201			Softwa					n: 1.0.3.4	
A dalama a a			Р	roperty.	Address	: GF 2B4	4P PS E	ast Build	ding		
Address: 1. Overall dwelling dime	ansions.										
1. Overall awelling aime	priorio.			Area	a(m²)		Av. He	ight(m)		Volume(m	3)
Ground floor						(1a) x		2.5	(2a) =	185	, (3a
Total floor area TFA = (1	a)+(1b)+(1c)+	-(1d)+(1e	e)+(1r	n)	74	(4)			_		
Dwelling volume	-, (12)	() - (,	′	7-7)+(3c)+(3d	l)+(3e)+	.(3n) =	185	(5)
						(==) - (==	, , () , (,, (,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		100	
2. Ventilation rate:	main		econda	у	other		total			m³ per hou	ır
Number of chimneys	heating		eating 0	7 + 6	0	1 = Г	0	x	40 =	0	(6a
Number of open flues	0	╡╻┝	0	┧╻┝	0]	0	x	20 =	0	(6k
·		`	0	J	0	Ţ					╡`
Number of intermittent fa						Ĺ	0		10 =	0	(7a
Number of passive vents						L	0	X '	10 =	0	(7t
Number of flueless gas f	ires						0	X 4	40 =	0	(70
									Δir ch	nanges per he	our
Infiltration due to chimne	vo fluor and	fono – (6)	a)+(6b)+(7	7a)+(7b)+(70) -	_					_
If a pressurisation test has b						continue fr	0 rom (9) to (÷ (5) =	0	(8)
Number of storeys in t			,,,				(2) 22 (-/		0	(9)
Additional infiltration								[(9)	-1]x0.1 =	0	(10
Structural infiltration: 0						•	ruction			0	(11
if both types of wall are p deducting areas of openi			ponding to	the great	er wall are	a (after					
If suspended wooden			ed) or 0	.1 (seale	ed), else	enter 0				0	(12
If no draught lobby, en	iter 0.05, else	enter 0								0	(13
Percentage of window	s and doors d	raught st	ripped							0	(14
Window infiltration					0.25 - [0.2	, ,	-			0	(15
Infiltration rate					(8) + (10)					0	(16
Air permeability value, If based on air permeabi	•			•	•	•	etre of e	nvelope	area	4	(17
Air permeability value applie	-						is beina u:	sed		0.2	(18
Number of sides sheltere			, 2001. uc.		y. 00 a po		io somig at			2	(19
Shelter factor					(20) = 1 -	[0.0 75 x (1	19)] =			0.85	(20
nfiltration rate incorpora	ting shelter fa	ctor			(21) = (18) x (20) =				0.17	(2
nfiltration rate modified t	for monthly wi	nd speed	l						· · · · · · · · · · · · · · · · · · ·	1	
Jan Feb	Mar Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind sp	peed from Tab	le 7								1	
(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 = (2	2)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]	

0.22	0.21	e (allowi _{0.21}	0.19	0.18	0.16	0.16	0.16	0.17	0.18	0.19	0.2	l	
Calculate effec	-	l '	l			l	0.10	0.17	0.10	0.15	0.2	l	
If mechanica	ıl ventila	ition:										0.5	(23
If exhaust air he	eat pump	using Appe	endix N, (2	3b) = (23a	a) × Fmv (e	equation (N	N5)) , othe	wise (23b)) = (23a)			0.5	(23
If balanced with	heat reco	overy: effic	iency in %	allowing f	or in-use f	actor (fron	n Table 4h) =				0	(23
a) If balance	d mech	anical ve	entilation	with he	at recove	ery (MVI	HR) (24a)m = (22	2b)m + (2	23b) × [1 – (23c)	÷ 100]	
24a)m= 0	0	0	0	0	0	0	0	0	0	0	0		(24
b) If balance	d mech	anical ve	entilation	without	heat red	overy (N	ЛV) (24b)m = (22	2b)m + (2	23b)			
24b)m= 0	0	0	0	0	0	0	0	0	0	0	0		(24
c) If whole he if (22b)m				•	•				5 × (23b))			
24c)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		(2
d) If natural v				•	•				0.5]		•	ı	
24d)m= 0	0	0	0	0	0	0	0	0	0	0	0	[(24
Effective air	change	rate - er	nter (24a	or (24k	o) or (24	c) or (24	d) in box	(25)			•	ı	
25)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		(2
3. Heat losses	and he	at lose i	naram e t	or.									
LEMENT	Gros area	SS	Openin	gs	Net Ar A ,r		U-valı W/m2		A X U (W/I	<)	k-value		A X k kJ/K
/in <mark>dows</mark> Type					7.95		/[1/(1.3)+	_	9.82				(2
/indows Type	2				8.38	x1,	/[1/(1.3)+	0.04] =	10.36	Ħ			(2
loor					74	X	0.15	- L	11.1	Ħ r			(2
/alls Type1	22.0	16	7.95		14.11	X	0.18		2.54	븍 ;		╡ ⊨	(2
/alls Type2	24.2	=	8.38	=	15.85	=	0.18	╡┇	2.85	륵 ;		╡	(2
otal area of e			0.50			=	0.10		2.00				(3
for windows and			effective wi	ndow U-va	120.2 alue calcul		ı formula 1	/[(1/U-valu	e)+0.041 a	ns aiven in	paragraph	132	(0
include the area								2(), 2 1 1 1	-, · · · · · · · · · · · · · · · · · · ·	J	J		
abric heat los	s, W/K :	= S (A x	U)				(26)(30)	+ (32) =				36.67	7 (3
eat capacity (Cm = S((Axk)						((28)	.(30) + (32	2) + (32a).	(32e) =	9594.	2 (3
hermal mass	parame	ter (TMF	P = Cm -	- TFA) ir	n kJ/m²K			Indica	tive Value:	Medium		250	(3
or design assess				construct	ion are no	t known pr	ecisely the	indicative	values of	TMP in Ta	able 1f		
an be used instea hermal bridge				ısina Δr	nandiy l	<i>(</i>						0.4	(3
details of therma	•	,		• .	•	`						9.1	(0
otal fabric hea			()		•/			(33) +	(36) =			45.77	7 (3
entilation hea	t loss ca	alculated	l monthly	/				(38)m	= 0.33 × (25)m x (5))		
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	1	
8)m= 30.52	30.52	30.52	30.52	30.52	30.52	30.52	30.52	30.52	30.52	30.52	30.52		(3
eat transfer c	oefficie	nt, W/K	-		-	-	-	(39)m	= (37) + (3	 38)m	-	•	
		,						, ,				1	
9)m= 76.3	76.3	76.3	76.3	76.3	76.3	76.3	76.3	76.3	76.3	76.3	76.3	[

Heat loss para	ımeter (l	HLP), W	/m²K					(40)m	= (39)m ÷	- (4)			
(40)m= 1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03		
	!	!			<u> </u>	ļ	<u>l</u>		Average =	Sum(40) ₁	12 /12=	1.03	(40)
Number of day	s in mo	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. Water hea	ting ene	rgy requi	irement:								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		34		(42)
Annual average Reduce the annual not more that 125	al average	hot water	usage by	5% if the c	lwelling is	designed i			se target o		.76		(43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage i	n litres per	day for ea	ach month	Vd,m = fa	ctor from	Table 1c x	(43)			•			
(44)m= 98.73	95.14	91.55	87.96	84.37	80.78	80.78	84.37	87.96	91.55	95.14	98.73		
						•				m(44) ₁₁₂ =		1077.07	(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= 146.42	128.06	132.14	115.21	110.54	95.39	88.39	101.43	102.64	119.62	130.57	141.8		_
If inst <mark>antane</mark> ous w	vater heati	na at noint	of use (no	hot water	r storage)	enter () in	hoves (46		Total = Su	m(45) ₁₁₂ =		1412.21	(45)
				-									(40)
(46)m= 21.96 Water storage	19.21	19.82	17.28	16.58	14.31	13.26	15.21	15.4	17.94	19.59	21.27		(46)
Storage volum		includir	ng any so	olar or W	/WHRS	storage	within sa	ame ves	sel		5		(47)
If community h	,										-		` '
Otherwise if no	•			•			` '	ers) ente	er '0' in ((47)			
Water storage	loss:												
a) If manufact	turer's d	eclared I	oss facto	or is kno	wn (kWł	n/day):					0		(48)
Temperature f	actor fro	m Table	2b								0		(49)
Energy lost fro		•					(48) x (49)) =			5		(50)
b) If manufactHot water store			-								1		(54)
If community h	•			e z (KVV	ii/iiiie/ua	iy <i>)</i>				0.	03		(51)
Volume factor	-		011 110							2.	88		(52)
Temperature f	actor fro	m Table	2b							-	.6		(53)
Energy lost fro	m watei	· storage	, kWh/ye	ear			(47) x (51)) x (52) x (53) =	0.	24		(54)
Enter (50) or	(54) in (5	55)	·							0.	24		(55)
Water storage	loss cal	culated t	for each	month			((56)m = (55) × (41)	m				
(56)m= 7.49	6.76	7.49	7.25	7.49	7.25	7.49	7.49	7.25	7.49	7.25	7.49		(56)
If cylinder contains	s dedicate	d solar sto	rage, (57)	m = (56)m		H11)] ÷ (5	0), else (5	7)m = (56)	m where (m Append	ix H	
(57)m= 7.49	6.76	7.49	7.25	7.49	7.25	7.49	7.49	7.25	7.49	7.25	7.49		(57)
Primary circuit	loss (ar	nual) fro	m Table	 e 3							0		(58)
Primary circuit	•	•			59)m = ((58) ÷ 36	65 × (41)	m					
(modified by				,	•	` '	, ,		r thermo	stat)			
(59)m= 23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)

On male: James		f l		(04)	(00) - 0	OF (44)	\						
Combi loss (61)m= 0	calculated	for each		(61)m =	(60) ÷ 30	05 × (41))m 0	T 0	0	0	0	1	(61)
				<u> </u>			<u> </u>	ļ.	<u> </u>	ļ	<u> </u>	(50) (64)	(01)
(62)m= 177.1		162.89	144.96	141.29	125.15	119.14	132.18		150.37	160.33	172.55	(59)m + (61)m 1	(62)
Solar DHW inp			<u> </u>									J	(02)
(add additio									ir contribu	ion to wate	er neaung)		
(63)m= 0	0		0	0	0	0	0	T 0	0	0	0	1	(63)
Output from								1				l	, ,
(64)m= 177.1		162.89	144.96	141.29	125.15	119.14	132.18	132.4	150.37	160.33	172.55	1	
			l				Ou	tput from w	ater heate	<u>r</u> (annual)₁	l12	1774.28	(64)
Heat gains f	rom water	heating,	kWh/m	onth 0.2	5 ′ [0.85	× (45)m	ı + (61)ı	m] + 0.8 x	x [(46)m	+ (57)m	+ (59)m	. 1	•
(65)m= 73.28	1	68.54	62.11	61.36	55.52	53.99	58.33	57.94	64.37	67.22	71.75	ĺ	(65)
	7)m in cal	culation (of (65)m	only if c	vlinder i	s in the o	dwelling	or hot w	ater is f	rom com	munity h	ı neating	
5. Internal	<u> </u>		. ,		,						• •	Jan y	
Metabolic ga													
Jar		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(66)m= 116.9	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96		(66)
Lighting gair	ns (calcula	ted in Ap	pendix	L, equ <mark>at</mark>	ion L9 o	r L9a), <mark>a</mark>	lso see	Table 5					
(67)m= 18.4	1 16.35	13.3	10.07	7.53	6.35	6.86	8.92	11.98	15.21	17.75	18.92		(67)
App <mark>liance</mark> s (gains (ca <mark>lc</mark>	ulated ir	Append	dix L, eq	uation L	13 or L1	3a), als	o see Ta	ble 5				
(68)m= 206.4	5 208.59	203.19	191.7	177.19	163.56	154.45	152.3	157.7	169.2	183.7	197.34		(68)
Cooking gai	ns (calcula	ated in A	ppendix	L, equat	ion L15	or L15a)), also s	ee Table	5				
(69)m= 34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7		(69)
Pumps and	fans gains	(Table 5	 5a)					-		-			
(70)m= 0	0	0	0	0	0	0	0	0	0	0	0		(70)
Losses e.g.	evaporation	n (nega	tive valu	es) (Tab	le 5)		-						
(71)m= -93.5	7 -93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57		(71)
Water heatir	ng gains (1	Table 5)	-	-		-	-	-	-	-	-		
(72)m= 98.5	96.43	92.12	86.27	82.47	77.12	72.57	78.4	80.47	86.53	93.37	96.44		(72)
Total intern	al gains =	:	•		(66))m + (67)m	n + (68)m	+ (69)m +	(70)m + (7	(1)m + (72))m		
(73)m= 381.4	379.46	366.7	346.12	325.27	305.11	291.97	297.71	308.23	329.02	352.91	370.78		(73)
6. Solar ga	ins:	•				•	•		•				
Solar gains ar	e calculated	using sola	r flux from	Table 6a	and assoc	iated equa	itions to d	onvert to th	ne applical	ole orientat	tion.		
Orientation:			Area		Flu			g_ Tabla Ch	_	FF		Gains	
	Table 6d		m²		Ta	ble 6a	. –	Table 6b	_ '	able 6c		(W)	_
South 0.9	× 0.77	X	8.3	38	X	16.75	X	0.63	x	0.7	=	119.73	(78)
South 0.9	× 0.77	X	8.3	38	X 7	76.57	X	0.63	X	0.7	=	196.09	(78)
South 0.9	× 0.77	х	8.3	38	x 9	97.53	x	0.63	x	0.7	=	249.79	(78)
South 0.9	× 0.77	X	8.3	38	x 1	10.23	x	0.63	x	0.7	=	282.31	(78)
South 0.9	× 0.77	X	8.3	38	x 1	14.87	x	0.63	x	0.7	=	294.19	(78)

					_		, ,		_				_
South	0.9x 0.77	×	8.38	8	x	110.55	X	0.63	X	0.7	=	283.12	(78)
South	0.9x 0.77	x	8.38	8	x	108.01	X	0.63	X	0.7	=	276.62	(78)
South	0.9x 0.77	×	8.38	8	X	104.89	X	0.63	X	0.7	=	268.64	(78)
South	0.9x 0.77	×	8.38	8	x	101.89	X	0.63	X	0.7	=	260.93	(78)
South	0.9x 0.77	×	8.38	8	х	82.59	X	0.63	X	0.7	=	211.5	(78)
South	0.9x 0.77	×	8.38	8	x	55.42	X	0.63	X	0.7	=	141.93	(78)
South	0.9x 0.77	×	8.38	8	x	40.4	x	0.63	X	0.7	=	103.46	(78)
West	0.9x 0.77	×	7.95	5	x	19.64	x	0.63	X	0.7	=	47.72	(80)
West	0.9x 0.77	×	7.95	5	x	38.42	x	0.63	X	0.7	=	93.35	(80)
West	0.9x 0.77	×	7.95	5	x	63.27	x	0.63	X	0.7	=	153.73	(80)
West	0.9x 0.77	×	7.95	5	x	92.28	x	0.63	X	0.7	=	224.21	(80)
West	0.9x 0.77	· x	7.95	5	X	113.09	X	0.63	X	0.7	=	274.77	(80)
West	0.9x 0.77	· x	7.95	5	X	115.77	x	0.63	x	0.7	=	281.28	(80)
West	0.9x 0.77	· x	7.95	5	x	110.22	x	0.63	X	0.7	=	267.79	(80)
West	0.9x 0.77	· x	7.95	5	x	94.68	x	0.63	X	0.7	=	230.03	(80)
West	0.9x 0.77	· x	7.95	5	x	73.59	x	0.63	x	0.7	=	178.79	(80)
West	0.9x 0.77	· x	7.95	5	x =	45.59	х	0.63	x	0.7	=	110.76	(80)
West	0.9x 0.77	×	7.95	5	x 🔚	24.49	Х	0.63	Х	0.7	=	59.5	(80)
West	0.9x 0.77	×	7.95	5	x	16.15	х	0.63	х	0.7		39.24	(80)
Sola <mark>r gai</mark>	ins in watts, c	alculated	for each	n month			(83)m	= Sum(74)m .	(82)m				
(83)m= 1	67.45 289.44	403.52	506.52	568.96	564.4	544.41	498	67 439.73	322.27	7 201.42	142.7		(83)
													()
Total gair	ns – internal a	and solar	(84)m =	(73)m +	(83)m	n , watts							(5.5)
	ns – internal a 548.9 668.9	and solar	(84)m = 852.64	(73)m + 894.23	- (83)m 869.51		796		651.29		513.49		(84)
(84)m= 5		770.22	852.64	894.23	, ,		796						
(84)m= 5	548.9 668.9	770.22 perature	852.64 (heating	894.23 season)	869.51	836.38	l	38 747.96				21	
7. Mean Temper	548.9 668.9 n internal tem	770.22 perature heating p	852.64 (heating eriods in	894.23 season)	869.51 ng area	836.38 from Tal	l	38 747.96				21	(84)
7. Mean Temper Utilisatio	548.9 668.9 n internal tem rature during l	770.22 perature heating p	852.64 (heating eriods in	894.23 season)	869.51 ng area	836.38 from Tal	ble 9,	38 747.96		9 554.33		21	(84)
7. Mean Temper Utilisatio	n internal tem rature during l	perature heating p	852.64 (heating eriods in iving are	season) the livinga, h1,m	869.51 ag area (see T	836.38 from Tal	ble 9,	38 747.96 Th1 (°C)	651.29	9 554.33 Nov	513.49	21	(84)
7. Mean Temper Utilisatio	n internal tem rature during l on factor for g Jan Feb 0.99 0.98	perature heating p gains for I Mar 0.95	(heating eriods in iving are Apr 0.88	season) the livings, h1,m May 0.73	ag area (see T Jun 0.55	836.38 from Talable 9a) Jul 0.4	ble 9,	38 747.96 Th1 (°C) ug Sep 4 0.67	651.29 Oct	9 554.33 Nov	513.49 Dec	21	(84)
7. Mean Temper Utilisatio	n internal tem rature during l on factor for g Jan Feb	perature heating p gains for I Mar 0.95	(heating eriods in iving are Apr 0.88	season) the livings, h1,m May 0.73	ag area (see T Jun 0.55	836.38 from Talable 9a) Jul 0.4	ble 9,	38 747.96 Th1 (°C) ug Sep 4 0.67 able 9c)	651.29 Oct	9 554.33 Nov 0.99	513.49 Dec	21	(84)
7. Mean Temper Utilisatio (86)m= Mean in (87)m=	n internal temperature during lon factor for good on the control of the control o	perature heating p gains for l Mar 0.95 rature in l 20.52	(heating eriods in iving are 0.88	season) the livin ea, h1,m May 0.73 ea T1 (fo	869.51 ag area (see T Jun 0.55 llow ste 20.99	836.38 a from Tale (able 9a) Jul 0.4 eps 3 to 7	Au 0.4	38 747.96 Th1 (°C) ug Sep 4 0.67 able 9c) 1 20.97	Oct 0.92	9 554.33 Nov 0.99	513.49 Dec 1	21	(84)
7. Mean Temper Utilisatio (86)m= Mean in (87)m= 2 Temper	rature during lon factor for guarante during long 0.99 0.98 hternal tempe 20.06 20.26 rature during l	perature heating p gains for l Mar 0.95 rature in l 20.52	(heating eriods in iving are 0.88	season) the livin ea, h1,m May 0.73 ea T1 (fo	869.51 ag area (see T Jun 0.55 llow ste 20.99	836.38 a from Tale (able 9a) Jul 0.4 eps 3 to 7	Au 0.4	38 747.96 Th1 (°C) ug Sep 4 0.67 able 9c) 1 20.97 9, Th2 (°C)	Oct 0.92	9 554.33 Nov 0.99	513.49 Dec 1	21	(84)
7. Mean Temper Utilisatio (86)m= Mean in (87)m= 2 Temper (88)m= 2	rature during lon factor for guarante during long 0.99 0.98 nternal tempe 20.06 20.26 rature during long long long long long long long lo	perature heating p gains for I Mar 0.95 rature in I 20.52 heating p 20.06	(heating eriods in iving are 0.88 living are 20.77 eriods in 20.06	season) the living a, h1,m May 0.73 ea T1 (for 20.93) rest of crest of cres	ag area (see T Jun 0.55 Illow str 20.99 dwellin 20.06	836.38 a from Tal able 9a) Jul 0.4 eps 3 to 7 21 g from Tal 20.06	Au 0.47 in T 2° able 9	38 747.96 Th1 (°C) ug Sep 4 0.67 able 9c) 1 20.97 9, Th2 (°C)	Oct 0.92	9 554.33 Nov 0.99	Dec 1	21	(84) (85) (86) (87)
7. Mean Temper Utilisatio (86)m= Mean in (87)m= Z Temper (88)m= 2 Utilisatio	rature during long factor for grature during long long long long long long long lo	perature heating p gains for I Mar 0.95 rature in 20.52 heating p 20.06	(heating eriods in iving are 0.88 living are 20.77 eriods in 20.06	season) the living a, h1,m May 0.73 ea T1 (for 20.93 rest of c20.06 welling, h	g area (see T Jun 0.55 Illow ste 20.99 dwellin 20.06	836.38 from Tal able 9a) Jul 0.4 eps 3 to 7 21 g from Tal 20.06 see Table	Au 0.4 7 in T 2° able 9 20.0 9a)	38 747.96 Th1 (°C) ug Sep 4 0.67 able 9c) 1 20.97 0, Th2 (°C) 06 20.06	Oct 0.92 20.74	9 554.33 Nov 0.99 20.33	Dec 1 20 20.06	21	(84) (85) (86) (87) (88)
7. Mean Temper Utilisatio (86)m= Mean in (87)m= Z Temper (88)m= Utilisatio (89)m=	rature during land process on factor for grature during land process of the land proce	perature heating p gains for I Mar 0.95 rature in I 20.52 heating p 20.06 gains for r 0.94	(heating eriods in iving are 0.88 living are 20.77 eriods in 20.06 rest of dw 0.85	season) the living a, h1,m May 0.73 ea T1 (for 20.93 rest of 6 20.06 welling, h 0.68	869.51 ag area (see T Jun 0.55 llow ste 20.99 dwellin 20.06 a2,m (s	836.38 a from Tal able 9a) Jul 0.4 eps 3 to 7 21 g from Tal 20.06 see Table 0.32	Au 0.4 7 in T 2° able 9 20.0 9a) 0.3	38 747.96 Th1 (°C) ug Sep 4 0.67 table 9c) 1 20.97 0, Th2 (°C) 06 20.06	Oct 0.92 20.74 20.06	9 554.33 Nov 0.99	Dec 1	21	(84) (85) (86) (87)
7. Mean Temper Utilisatio (86)m= Mean in (87)m= 2 Temper (88)m= 2 Utilisatio (89)m= Mean in	rature during long factor for grature during long 0.99 0.98 nternal temperature during long 1.00 (20.06) 20.06 rature during long 1.00 (20.06) 20.06 on factor for grature during long 1.00 (20.06) 20.06 on factor for grature during long 1.00 (20.06) 20.06 on factor for grature during long 1.00 (20.06) 20.06 on factor for grature during long 1.00 (20.06) 20.08	perature heating p gains for I Mar 0.95 rature in I 20.52 heating p 20.06 gains for r 0.94 rature in I	(heating eriods in iving are 0.88 living are 20.77 eriods in 20.06 est of dw 0.85 living are the rest of dw 1.85 living are 20.77 eriods in 20.06 living are 20.77 eriods in 20.06 living are 20.77 eriods in 20.06 living are 20.77 living are 20.7	season) the living a, h1,m May 0.73 ea T1 (for 20.93 rest of crest	869.51 ag area (see T Jun 0.55 Illow str 20.99 dwellin 20.06 n2,m (s 0.47	sale 9a) Jul 0.4 eps 3 to 7 21 g from Tal 20.06 see Table 0.32 follow ste	Au 0.4 7 in T 2 able 9 20.0 9a) 0.3 eps 3	38	Oct 0.92 20.74 20.06 0.89 e 9c)	9 554.33 Nov 0.99 20.33 5 20.06	Dec 1 20 20.06 0.99	21	(84) (85) (86) (87) (88) (89)
7. Mean Temper Utilisatio (86)m= Mean in (87)m= 2 Temper (88)m= 2 Utilisatio (89)m= Mean in	rature during land process on factor for grature during land process of the land proce	perature heating p gains for I Mar 0.95 rature in I 20.52 heating p 20.06 gains for r 0.94	(heating eriods in iving are 0.88 living are 20.77 eriods in 20.06 rest of dw 0.85	season) the living a, h1,m May 0.73 ea T1 (for 20.93 rest of 6 20.06 welling, h 0.68	869.51 ag area (see T Jun 0.55 llow ste 20.99 dwellin 20.06 a2,m (s	836.38 a from Tal able 9a) Jul 0.4 eps 3 to 7 21 g from Tal 20.06 see Table 0.32	Au 0.4 7 in T 2° able 9 20.0 9a) 0.3	38 747.96 Th1 (°C) ug Sep 4 0.67 able 9c) 1 20.97 0, Th2 (°C) 20.06 5 0.59 to 7 in Table 20.03	Oct 0.92 20.74 20.06 0.89 e 9c) 19.78	9 554.33 Nov 0.99 20.33 5 20.06	Dec 1 20 20.06 0.99		(84) (85) (86) (87) (88) (89)
7. Mean Temper Utilisatio (86)m= Mean in (87)m= 2 Temper (88)m= 2 Utilisatio (89)m= Mean in	rature during long factor for grature during long 0.99 0.98 nternal temperature during long 1.00 (20.06) 20.06 rature during long 1.00 (20.06) 20.06 on factor for grature during long 1.00 (20.06) 20.06 on factor for grature during long 1.00 (20.06) 20.06 on factor for grature during long 1.00 (20.06) 20.06 on factor for grature during long 1.00 (20.06) 20.08	perature heating p gains for I Mar 0.95 rature in I 20.52 heating p 20.06 gains for r 0.94 rature in I	(heating eriods in iving are 0.88 living are 20.77 eriods in 20.06 est of dw 0.85 living are the rest of dw 1.85 living are 20.77 eriods in 20.06 living are 20.77 eriods in 20.06 living are 20.77 eriods in 20.06 living are 20.77 living are 20.7	season) the living a, h1,m May 0.73 ea T1 (for 20.93 rest of crest	869.51 ag area (see T Jun 0.55 Illow str 20.99 dwellin 20.06 n2,m (s 0.47	sale 9a) Jul 0.4 eps 3 to 7 21 g from Tal 20.06 see Table 0.32 follow ste	Au 0.4 7 in T 2 able 9 20.0 9a) 0.3 eps 3	38 747.96 Th1 (°C) ug Sep 4 0.67 able 9c) 1 20.97 0, Th2 (°C) 20.06 5 0.59 to 7 in Table 20.03	Oct 0.92 20.74 20.06 0.89 e 9c) 19.78	9 554.33 Nov 0.99 20.33 5 20.06	Dec 1 20 20.06 0.99	0.43	(84) (85) (86) (87) (88) (89)
7. Mean Temper Utilisatio (86)m= Mean in (87)m= 2 Temper (88)m= 2 Utilisatio (89)m= Mean in (90)m=	rature during long factor for grature during long 0.99 0.98 nternal temperature during long 1.00 (20.06) 20.06 rature during long 1.00 (20.06) 20.06 on factor for grature during long 1.00 (20.06) 20.06 on factor for grature during long 1.00 (20.06) 20.06 on factor for grature during long 1.00 (20.06) 20.06 on factor for grature during long 1.00 (20.06) 20.08	perature heating p gains for I 0.95 rature in 1 20.52 heating p 20.06 gains for r 0.94 rature in 1 19.47	(heating eriods in iving are 0.88 living are 20.77 eriods in 20.06 rest of dw 0.85 living are 19.81	season) the living the	869.51 ag area (see T Jun 0.55 Illow str 20.99 dwellin 20.06 n2,m (s 0.47 ng T2 (20.05	see Table 0.32 follow ster	Au 0.4 7 in T 2 able 9 20.0 9a) 0.3 eps 3	38 747.96 Th1 (°C) ug Sep 4 0.67 able 9c) 1 20.97 0, Th2 (°C) 106 20.06 5 0.59 to 7 in Table 106 20.03	Oct 0.92 20.74 20.06 0.89 e 9c) 19.78	9 554.33 Nov 0.99 20.33 5 20.06	Dec 1 20 20.06 0.99		(84) (85) (86) (87) (88) (89)
7. Mean Temper Utilisatio (86)m= Mean in (87)m= 2 Temper (88)m= Utilisatio (89)m= Mean in (90)m= 1 Mean in (90)m= 1	rature during lon factor for grature during long 0.98 Internal temperature during long 0.99 Internal temperature during long 1.006 Internal temperature during long 1.009 Internal temperature during 1.00	perature heating p gains for I 0.95 rature in I 20.52 heating p 20.06 gains for r 0.94 rature in 1 19.47	(heating eriods in iving are 0.88 living are 20.77 eriods in 20.06 rest of dw 0.85 living are 19.81 rest of dw 20.23	season) the livin ea, h1,m May 0.73 ea T1 (for 20.93 erest of crest of crest of dwelling, h 0.68 of dwelling 20 ole dwel 20.4	869.51 ag area (see T Jun 0.55 Illow str 20.99 dwellin 20.06 n2,m (s 0.47 ng T2 (20.05	836.38 a from Takable 9a) Jul 0.4 eps 3 to 7 21 g from Takable 20.06 see Table 0.32 follow stee 20.06 fLA × T1 20.46	ble 9, O.4 7 in T 20 9a) 0.3 9ps 3 20.0 + (1	38 747.96 Th1 (°C) ug Sep 4 0.67 able 9c) 1 20.97 0, Th2 (°C) 16 20.06 5 0.59 to 7 in Table 16 20.03 f fLA) x T2 16 20.44	Oct 0.92 20.74 20.06 0.89 e 9c) 19.78 LA = Liv	9 554.33 Nov 0.99 20.33 20.06 0.98 19.21 ving area ÷ (Dec 1 20 20.06 0.99		(84) (85) (86) (87) (88) (89)

(22)		T	T		l	T				l			(00)
(93)m= 19.35	19.6	19.92	20.23	20.4	20.46	20.46	20.46	20.44	20.2	19.7	19.28		(93)
8. Space hea				ro obtair	and at et	on 11 of	Table 0	n so tha	t Ti m-(76)m an	d re-calci	ulato	
the utilisation			•		icu ai sii	ър птог	i abic 3i	J, 50 IIIa		rojili ali	u re-caic	ulate	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation fac	tor for g	ains, hm	1:										
(94)m= 0.99	0.98	0.94	0.85	0.7	0.51	0.35	0.39	0.62	0.89	0.98	0.99		(94)
Useful gains,		<u> </u>		4)m		T							
(95)m= 543.87	652.53	722.79	726.05	624.88	441.09	294.19	308.95	467	580.25	542.57	510.08		(95)
Monthly avera		r											(00)
(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	1121.85	an intern	864.14	663.84	Lm , vv =	=[(39)m] 294.81	x [(93)m	- (96)m 483.56	732.35	961.14	1150.49		(97)
(97)m= 1148.08 Space heatin		<u> </u>	<u> </u>			<u> </u>		l			1150.49		(97)
(98)m= 449.53	315.38	224.17	99.43	28.98	0	0.02	0	0	113.16	301.37	476.47		
(00)=	010.00		00.10	20.00) = Sum(9		2008.49	(98)
Canan hantin			L(\A/b) /2003	2/			7010	ii poi youi	(RVVIII) y Cal) = Ca m(c	C)15,912 —		╡``
Space heatin	• .										L	27.14	(99)
9b. Energy red	•		The state of the s	Ĭ									
This part is use Fraction of spa										unity sch	neme. [0	(301)
							(Table I	1) 0 11 11	OHC			0	=
Fraction of spa					•						[1	(302)
The c <mark>ommu</mark> nity so inclu <mark>des boi</mark> lers, h									up to four	other heat	sources; th	ne latter	
Fraction of hea					ioni powei	Stations.	осс Аррсі	idix O.			Г	1	(303a)
Fraction of total	al space	heat fro	m Comn	nunity be	nilers				(3	02) x (303	a) = [1	(304a)
Factor for cont						r commu	unity hea	ating sys		02) X (000	ω, – [1	(305)
Distribution los	ss factor	(Table 1	2c) for (commun	ity heatii	ng syste	m				Ī	1.05	(306)
Space heating	q											kWh/yea	_ r
Annual space	_	requiren	nent								Γ	2008.49	
Space heat fro	m Comr	munity b	oilers					(98) x (30	04a) x (30	5) x (306) :	<u> </u>	2108.91	(307a)
Efficiency of se	econdary	y/supple	mentary	heating	system	in % (fro	m Table	4a or A	ppendix	E)	[0	(308
Space heating	require	ment fro	m secon	dary/suլ	oplemen	tary syst	tem	(98) x (30	01) x 100 ·	÷ (308) =		0	(309)
Water heating	1												
Annual water h	-	equirem	ent									1774.28	
If DHW from c		•									-		-
Water heat fro	m Comn	nunity bo	oilers					(64) x (30	03a) x (30	5) x (306) :	= [1862.99	(310a)
Electricity used	d for hea	ıt distribu	ution				0.01	× [(307a).	(307e) +	· (310a)((310e)] =	39.72	(313)
Cooling Syster	m Energ	y Efficie	ncy Rati	0							Ĺ	0	(314)
Space cooling	(if there	is a fixe	d coolin	g systen	n, if not e	enter 0)		= (107) ÷	(314) =			0	(315)
Electricity for p mechanical ve							outside				Γ	49.88	(330a)
moonamoar ve	·············	Salant	.ou, onli	act of pc		P 41 11 O111	Jatoluc				L	73.00	(3000)

warm air heating system fans			0	(330b)
pump for solar water heating			0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b	b) + (330g) =	49.88	(331)
Energy for lighting (calculated in Appendix L)			325.12	(332)
12b. CO2 Emissions – Community heating scheme				
	Energy kWh/year	Emission factor kg CO2/kWh	or Emissions kg CO2/yea	r
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%) If there is CHP using to	two fuels repeat (363) to	(366) for the second t	fuel 89.5	(367a)
CO2 associated with heat source 1 [(307b)+(3	310b)] x 100 ÷ (367b) x	0	= 958.58	(367)
Electrical energy for heat distribution [(3	313) x	0.52	= 20.61	(372)
Total CO2 associated with community systems (3	363)(366) + (368)(372	2)	979.2	(373)
CO2 associated with space heating (secondary) (3	809) x	0	= 0	(374)
CO2 associated with water from immersion heater or instantaneo	ous heater (312) x	0.22	= 0	(375)
Total CO2 associated with space and water heating (3	373) + (374) + (375) =		979.2	(376)
CO2 associated with electricity for pumps and fans within dwelling	g (331)) x	0.52	= 25.89	(378)
CO2 associated with electricity for lighting (3	332))) x	0.52	= 168.74	(379)
Total CO2, kg/year sum of (376)(382) =			1173.82	(383)
Dwelling CO2 Emission Rate (383) ÷ (4) =			15.86	(384)
El rating (section 14)			86.78	(385)

Assessor Name: Stroma FSAP 2012 Software Version: Version: 1,0,3,4				User D	etails:						
Address: Area(m²)		Stroma FSAP 20	012						Versic	on: 1.0.3.4	
Area(m²)			Р	roperty	Address	: GF 2B	4P PS E	ast Build	ding		
Area(m²) Av. Height(m) Volume(m²)											
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+(1n) Total floor area TFA = (1a)+(1b)+(1c)+(1e)+(1n) Total floor area TFA = (1a)+(1b)+(1c)+(1e)+(1e)+(1e)+(1e)+(1e)+(1e)+(1e)+(1e	Overall dwelling dimer	nsions:			(0)						. `
Develling volume (3a)+(3b)+(3c)+(3d)+(3e)+(3n) = 185	Ground floor			Area	<u> </u>	(1a) x			(2a) =	· `	3) (3a
2. Ventilation rate: Main Secondary Number of chimneys 0	Total floor area TFA = (1a	a)+(1b)+(1c)+(1d)+(1e)+(1r	1)	74	(4)					
Number of chimneys	Dwelling volume					(3a)+(3b	o)+(3c)+(3c	d)+(3e)+	.(3n) =	185	(5)
Number of chimneys	2. Ventilation rate:										
Number of open flues	Number of chimneys	heating	heating			7 ₌ [x	40 =		ır (6a
Number of intermittent fans Number of passive vents Number of flueless gas fires Air changes per hou Inflitration due to chimneys, flues and fans = (\$8)+(\$6)+(7a)+(7b)+(7c) =	ŕ			╛╘		<u> </u>			20 -		=
Number of passive vents 0	·	U	0	J ' L	0	J ŪĻ					(6b
Number of flueless gas fires 0		1S				Ĺ	3			30	(7a)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = 30	·					L	0	X	10 =	0	(7b)
Infiltration due to chimneys, flues and fans = (88)+(6b)+(7a)+(7b)+(7c) = 30	Number of flueless gas fir	res					0	X	40 =	0	(7c
Infiltration due to chimneys, flues and fans = (88)+(6b)+(7a)+(7b)+(7c) = 30									Air ch	nanges per h	our
Number of storeys in the dwelling (ns) 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 Percentage of windows and doors draught stripped Window infiltration 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)] = 0.35 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)me 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	Infiltration due to chimney	ys flues and fans –	(6a)+(6b)+(7	(a)+(7h)+(7c) =	Г	00				_
Number of storeys in the dwelling (ns) Additional infiltration [(9)-1]x0.1 = 0						continue f			÷(5) =	0.16	(8)
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 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] = 0.1 Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0.2 Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area and the 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)] = 0.85 Infiltration rate incorporating shelter factor (21) = (18) × (20) = 1. Infiltration rate modified for monthly wind speed 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										0	(9)
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 Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 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)] = 0.85 Infiltration rate incorporating shelter factor (21) = (18) × (20) = 1 - [0.075 × (19)] = 0.35 Monthly average wind speed from Table 7 (22)m= 5.1								[(9)	-1]x0.1 =	0	(10
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0						•	ruction			0	(11
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			responding to	the great	er wall are	a (atter					
Percentage of windows and doors draught stripped 0 Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 5 If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) 0.41 Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used 2 Number of sides sheltered 2 Shelter factor (20) = 1 - [0.075 x (19)] = 0.85 Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.35 Infiltration rate modified for monthly wind speed 5 0.35 Monthly average wind speed from Table 7 4.3 4.3 3.8 3.7 4 4.3 4.5 4.7 Wind Factor (22a)m = (22)m ÷ 4			ealed) or 0.	.1 (seale	ed), else	enter 0				0	(12
Window infiltration $0.25 - [0.2 \times (14) \div 100] = 0$ Infiltration rate $(8) + (10) + (11) + (12) + (13) + (15) = 0$ Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area If based on air permeability value, then $(18) = [(17) \div 20] + (8)$, otherwise $(18) = (16)$ 0.41 Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used Number of sides sheltered $(20) = 1 - [0.075 \times (19)] = 0.85$ Infiltration rate incorporating shelter factor $(21) = (18) \times (20) = 0.35$ 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 $(22a)m = (22)m \div 4$	If no draught lobby, ent	er 0.05, else enter ()							0	(13
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 $(18) = [(17) \div 20] + (8)$, 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 $(20) = 1 - [0.075 \times (19)] =$ Onumber of sides sheltered Infiltration rate incorporating shelter factor $(21) = (18) \times (20) =$ 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 $(22a)m = (22)m \div 4$	•	and doors draught	stripped							0	(14
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)] = Infiltration rate incorporating shelter factor (21) = (18) × (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					•	. ,	-	(4.5)		0	(15
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)] = 0.85 Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.35 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		-50									(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)] = 0.85 Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.35 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	•	•		•	•	•	ietre oi e	envelope	area		(17
2		-					is being u	sed		0.41	(18
Infiltration rate incorporating shelter factor Solution Columbia Colum				·	,	·	ŭ			2	(19
Infiltration rate modified for monthly wind speed Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	Shelter factor				(20) = 1 -	[0.075 x (19)] =			0.85	(20
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	Infiltration rate incorporati	ng shelter factor			(21) = (18) x (20) =				0.35	(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	Infiltration rate modified for	or monthly wind spe	ed			T		_	1	7	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Jan Feb	Mar Apr Ma	y Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Wind Factor (22a)m = (22)m ÷ 4	Monthly average wind spe	eed from Table 7							,	1	
	(22)m= 5.1 5	4.9 4.4 4.3	3.8	3.8	3.7	4	4.3	4.5	4.7]	
	Wind Factor (22a)m = (22	?)m ÷ 4									
(22a)m= 1.27 1.25 1.23 1.1 1.08 0.95 0.95 0.92 1 1.08 1.12 1.18		·	0.95	0.95	0.92	1	1.08	1.12	1.18	1	

Adjusted infiltr	ation rat	e (allowi	ng for sh	nelter an	d wind s	speed) =	(21a) x	(22a)m				_	
0.45	0.44	0.43	0.39	0.38	0.33	0.33	0.32	0.35	0.38	0.39	0.41		
Calculate effect If mechanica		_	rate for t	he appli	cable ca	se	-		-	-	-		
If exhaust air h			endix N. (2	3b) = (23a	a) × Fmv (e	eguation (N	N5)) othe	wise (23b) = (23a)			0	(23
If balanced with) — (20 0)			0	
		•	•	ŭ		`		•	26\m . /	22h) v [1 (220)	0 . 1001	(2:
a) If balance	0	0	0	0	0	0	0	0	0	0	0	- 100] 	(24
b) If balance									<u> </u>			J	(-
24b)m= 0	0	0	0	0	0	0	0	0	0	0	0	1	(2
c) If whole h					<u> </u>							J	(-
if (22b)n				•	•				5 × (23b	o)			
24c)m= 0	0	0	0	0	0	0	0	0	0	0	0]	(2
d) If natural	ventilatio	n or wh	ole hous	e positiv	/e input	ventilatio	n from l	oft				J	
if (22b)n									0.5]				
24d)m= 0.6	0.6	0.59	0.57	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.58		(24
Effective air	change	rate - er	nter (24a	or (24b	o) or (24	c) or (24	d) in box	(25)				•	
25)m= 0.6	0.6	0.59	0.57	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.58		(2
3. Heat losse	a and he	et loca i	o comot	0 F.									
LEMENT	Gros		Openin		Net Ar	00	U-valu	10	AXU		k-value		ΑΧk
LEIVIEN	area		m		A ,r		W/m2		(W/	K)	kJ/m ² -	-	kJ/K
Vin <mark>dows</mark> Type	e 1				7.95	x1.	/[1/(1.4)+	0.04] =	10.54				(2
Vin <mark>dows</mark> Type	2				8.38	x1.	/[1/(1.4)+	0.04] =	11.11	Ħ			(2
loor					74	X	0.13	<u> </u>	9.62	Ħг			(2
Valls Type1	22.0	16	7.95		14.11	x	0.18		2.54	븍 ;		₹ =	(2
/alls Type2	24.2	_	8.38	=	15.85	=	0.18	-	2.85	룩 ;		╡ ⊨	(2
otal area of e			0.30			=	0.10	[2.03				
for windows and		•	offoctivo wi	ndow I I ve	120.2		ı formula 1	/[/1/ L valu	(0) 1 0 041 4	ne aivon in	naraaranl	. 2 2	(3
include the area						ateu using	TOTTIUIA I	/[((C)+ 0.04]	is giveri iii	paragrapi	1 3.2	
abric heat los	s, W/K :	= S (A x	U)				(26)(30)	+ (32) =				36.66	(3
eat capacity	Cm = S((Axk)						((28)	.(30) + (32	2) + (32a).	(32e) =	9594.	2 (3
hermal mass	parame	ter (TMF	c = Cm -	- TFA) ir	n kJ/m²K			Indica	tive Value	: Medium		250	(3
or design assess	sments wh	ere the de	tails of the	construct	ion are no	t known pr	ecisely the	indicative	values of	TMP in Ta	able 1f		
an be used inste													
hermal bridge	`	,		٠.	•	<						4.6	(3
details of therma		are not kn	own (36) =	= 0.15 x (3	11)			(22)	(26) -				
otal fabric he		aloudet -	المامصطارا						(36) =	'OE\ · · · (E\		41.26	(3
entilation hea	i	i	· ·		1	1, .1	Λ			(25)m x (5)	Ī _	1	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		(0
8)m= 36.62	36.38	36.15	35.06	34.85	33.91	33.91	33.73	34.27	34.85	35.27	35.7	J	(3
eat transfer of	coefficier	nt, W/K						· · ·	= (37) + (38)m	1	1	
9)m= 77.88	77.64	77.41	76.32	76.12	75.17	75.17	74.99	75.53	76.12	76.53	76.96		
										Sum(39) ₁		76.32	(3

Heat loss para	ımeter (I	HLP), W	/m²K					(40)m	= (39)m ÷	- (4)			
(40)m= 1.05	1.05	1.05	1.03	1.03	1.02	1.02	1.01	1.02	1.03	1.03	1.04		
	!		<u>. </u>	!		!	!		Average =	Sum(40) ₁ .	12 /12=	1.03	(40)
Number of day	1	<u> </u>	<u> </u>						<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	irement:								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		34		(42)
Annual average Reduce the annual not more that 125	al average	hot water	usage by	5% if the c	lwelling is	designed i			se target o		.76		(43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage i	n litres pe	r day for ea				Table 1c x				•	•		
(44)m= 98.73	95.14	91.55	87.96	84.37	80.78	80.78	84.37	87.96	91.55	95.14	98.73		
					400 144		- (aaa			m(44) ₁₁₂ =		1077.07	(44)
Energy content of													
(45)m= 146.42	128.06	132.14	115.21	110.54	95.39	88.39	101.43	102.64	119.62	130.57	141.8	1110.01	(45)
If inst <mark>antane</mark> ous w	vater heati	ng at point	of use (no	hot water	storage),	enter 0 in	boxes (46		Total = Su	m(45) ₁₁₂ =		1412.21	(45)
(46)m= 21.96	19.21	19.82	17.28	16.58	14.31	13.26	15.21	15.4	17.94	19.59	21.27		(46)
Water storage	loss:												
Storage volum	ne (litres)	includir)	ng any so	olar or W	WHRS	storage	within sa	ame ves	sel		150		(47)
If community h	•			•			` '		(01 :	(A=7)			
Otherwise if no Water storage		not wate	er (tnis ir	iciudes i	nstantar	ieous co	iiod idmo	ers) ente	er o in ((47)			
a) If manufact		eclared I	oss facto	or is kno	wn (kWł	n/day):				0	.3		(48)
Temperature f	actor fro	m Table	2b							0.	54		(49)
Energy lost fro	m wate	r storage	, kWh/ye	ear			(48) x (49)) =		0.	16		(50)
b) If manufact			-										
Hot water store If community h	-			le 2 (KVV	n/litre/da	ay)					0		(51)
Volume factor	•		011 4.5								0		(52)
Temperature f	actor fro	m Table	2b								0		(53)
Energy lost fro	m watei	r storage	, kWh/ye	ear			(47) x (51)) x (52) x (53) =		0		(54)
Enter (50) or	(54) in (5	55)								0.	16		(55)
Water storage	loss cal	culated t	for each	month			((56)m = ((55) × (41)	m				
(56)m= 4.97	4.49	4.97	4.81	4.97	4.81	4.97	4.97	4.81	4.97	4.81	4.97		(56)
If cylinder contains	s dedicate	d solar sto	rage, (57)ı	m = (56)m	x [(50) – (H11)] ÷ (5	0), else (5	7)m = (56)	m where (H11) is fro	m Append	ix H	
(57)m= 4.97	4.49	4.97	4.81	4.97	4.81	4.97	4.97	4.81	4.97	4.81	4.97		(57)
Primary circuit	loss (ar	nnual) fro	m Table	= 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	ter heati	ng and a	cylinde	r thermo	stat)			
(59)m= 23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)

Combi loca	oloulotod	for oach	month	(61)m –	(60) · 2(SE (41)	\m						
Combi loss (61)m= 0	alculated 0	or each	0	0	(6U) ÷ 30	05 × (41))m 0	Το	0	Ιο	0	1	(61)
			<u> </u>	<u> </u>			ļ			<u> </u>	<u> </u>	(E0)m + (61)m	(01)
(62)m= 174.6		160.37	142.52	138.77	122.71	116.62	129.66		147.85	157.89	170.03	· (59)m + (61)m]	(62)
Solar DHW input		<u> </u>		<u> </u>		<u> </u>				ļ]	(02)
(add addition									i contribu	ion to wate	or ricating)		
(63)m= 0	0	0	0	0	0	0	0	0	0	0	0]	(63)
Output from	water hea	ter		<u>I</u>				Į.		<u> </u>		1	
(64)m= 174.6	_	160.37	142.52	138.77	122.71	116.62	129.66	129.96	147.85	157.89	170.03]	
	-1	<u> </u>	ļ.	<u> </u>			Ot	Itput from w	ater heate	r (annual)₁	l12	1744.6	(64)
Heat gains f	om water	heating,	kWh/m	onth 0.2	5 ´ [0.85	× (45)m	ı + (61)	m] + 0.8 x	k [(46)m	+ (57)m	+ (59)m	 n]	_
(65)m= 71.2	1	66.52	60.16	59.34	53.57	51.97	56.31	55.98	62.36	65.27	69.73	1	(65)
include (5	7)m in cal	culation	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	e Table 5	and 5a):									
Metabolic ga	•			,									
Jar		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec]	
(66)m= 116.9	6 116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96		(66)
Ligh <mark>ting g</mark> air	s (calcula	ted in Ap	pendix	L, equ <mark>at</mark>	on L9 o	r L9a), <mark>a</mark>	lso see	Table 5					
(67)m= 18.4°	16.35	13.3	10.07	7.53	6.35	6.86	8.92	11.98	15.21	17.75	18.92		(67)
App <mark>liance</mark> s (gains (ca <mark>lc</mark>	ulated ir	Append	dix L, eq	uation L	13 or L1	3a), al	so see Ta	ble 5			1	
(68)m= 206.4	5 208.59	203.19	191.7	177.19	163.56	154.45	152.3	157.7	169.2	183.7	197.34		(68)
Cooking gain	ns (calcula	ited in A	ppendix	L, equat	ion L15	or L15a)), also	see Table	5			•	
(69)m= 34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7		(69)
Pumps and	ans gains	(Table 5	5a)									-	
(70)m= 3	3	3	3	3	3	3	3	3	3	3	3]	(70)
Losses e.g.	evaporatio	n (nega	tive valu	es) (Tab	le 5)								
(71)m= -93.5	7 -93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57]	(71)
Water heatir	ng gains (T	able 5)										_	
(72)m= 95.79	93.72	89.41	83.56	79.76	74.41	69.86	75.69	77.76	83.81	90.66	93.72]	(72)
Total intern	al gains =				(66))m + (67)m	n + (68)m	n + (69)m +	(70)m + (7	'1)m + (72))m	_	
(73)m= 381.7	3 379.74	366.99	346.41	325.56	305.4	292.26	298	308.52	329.31	353.2	371.07]	(73)
6. Solar ga													
Solar gains ar		•					tions to		ne applical		tion.		
Orientation:	Access F Table 6d		Area m²		Flu Tal	ıx ble 6a		g_ Table 6b	т	FF able 6c		Gains (W)	
Courth							1 -						1,
South 0.9		X	8.3			16.75]	0.63	_ ×	0.7	=	119.73	(78)
South 0.9		X	8.3			76.57]	0.63	×	0.7	=	196.09	(78)
South 0.9		X	8.3			97.53) X	0.63	×	0.7	=	249.79	(78)
		X	8.3	==	—	10.23]	0.63	×	0.7	=	282.31	(78)
South 0.9	0.77	X	8.3	38	x 1	14.87	X	0.63	x	0.7	=	294.19	(78)

	_									_				_
South	0.9x	0.77	X	8.3	8	X	110.55	X	0.63	X	0.7	=	283.12	(78)
South	0.9x	0.77	X	8.3	8	X	108.01	X	0.63	X	0.7	=	276.62	(78)
South	0.9x	0.77	X	8.3	8	X	104.89	X	0.63	X	0.7	=	268.64	(78)
South	0.9x	0.77	X	8.3	8	X	101.89	X	0.63	X	0.7	=	260.93	(78)
South	0.9x	0.77	X	8.3	8	X	82.59	X	0.63	X	0.7	=	211.5	(78)
South	0.9x	0.77	X	8.3	8	x	55.42	X	0.63	X	0.7	=	141.93	(78)
South	0.9x	0.77	X	8.3	8	x	40.4	X	0.63	X	0.7	=	103.46	(78)
West	0.9x	0.77	x	7.9	5	X	19.64	X	0.63	x	0.7	=	47.72	(80)
West	0.9x	0.77	X	7.9	5	X	38.42	X	0.63	x	0.7	=	93.35	(80)
West	0.9x	0.77	X	7.9	5	X	63.27	X	0.63	x	0.7	=	153.73	(80)
West	0.9x	0.77	x	7.9	5	X	92.28	X	0.63	x	0.7	=	224.21	(80)
West	0.9x	0.77	x	7.9	5	X	113.09	X	0.63	x	0.7	=	274.77	(80)
West	0.9x	0.77	x	7.9	5	X	115.77	x	0.63	x	0.7	=	281.28	(80)
West	0.9x	0.77	×	7.9	5	X	110.22	×	0.63	x	0.7	_ =	267.79	(80)
West	0.9x	0.77	×	7.9	5	X	94.68	×	0.63	x	0.7	=	230.03	(80)
West	0.9x	0.77	×	7.9	5	X	73.59	×	0.63	x	0.7	=	178.79	(80)
West	0.9x	0.77	×	7.9	5	X	45.59	×	0.63	x	0.7	_ =	110.76	(80)
West	0.9x	0.77	×	7.9	5	X	24.49	×	0.63	Х	0.7	=	59.5	(80)
West	0.9x	0.77	×	7.9	5	Х	16.15	x	0.63	x	0.7	=	39.24	(80)
			7											
Solar g	ains in	watts, <mark>calc</mark> i	ulated	for each	n month	1		(83)n	n = Sum(74)m	(82)m				
(83)m=	167.45	289.44 4	03.52	506.52	568.96	5	64.4 544.4	41 498	439.73	322.27	201.42	142.7		(83)
		nternal and	solar	(84)m =	: (73)m	3) +	33)m , watt	S						
(84)m=	549.19	669.19 7	70.5	852.93	894.52	8	69.8 836.6	796	748.25	651.5	554.62	513.77		(84)
7. Me	an inter	nal temper	ature	(heating	seasor	า)								
Temp	erature	during hea	iting p	eriods in	the liv	ing	area from ⁻	Table 9	, Th1 (°C)				21	(85)
Utilisa	ation fac	tor for gain	s for I	iving are	a, h1,n	า (ธ	ee Table 9	a)						
	Jan	Feb	Mar	Apr	May		Jun Ju	I A	ug Sep	Oct	Nov	Dec		
(86)m=	0.99	0.98	0.96	0.88	0.73	(0.39	0.4	13 0.67	0.92	0.99	1		(86)
Mean	interna	l temperatu	ıre in I	iving are	ea T1 (f	ollo	w steps 3 t	o 7 in 7	Table 9c)					
(87)m=	20.03	20.24	20.5	20.77	20.93	2	0.99 21	2	1 20.97	20.75	20.33	19.99		(87)
Temp	erature	during hea	ıtina p	eriods in	rest of	dw	ellina from	Table	9, Th2 (°C)	•	-			
			····· 9 F			_	0.07 20.0	-	07 20.07	20.06	20.05	20.05		(88)
(88)m=	20.04	20.04 2	20.05	20.06	20.06	2	0.07 20.0	' 20	I					
(88)m=	20.04		!								<u>.</u>	•		
(88)m=	20.04 ation fac	tor for gain	ıs for r	est of dy	welling,	h2,	m (see Tal	ole 9a)			0.98	0.99		(89)
(88)m= Utilisa (89)m=	20.04 ation fac 0.99	tor for gain	ns for r	est of dv 0.85	welling, 0.68	h2,	m (see Tal	ole 9a)	35 0.59	0.89	0.98	0.99		(89)
(88)m= Utilisa (89)m= Mean	20.04 ation fac 0.99 interna	tor for gain 0.98 (ns for r 0.94 ure in t	est of dv 0.85	welling, 0.68 of dwel	h2,	m (see Tal 0.47 0.31 T2 (follow	ole 9a) 0.: steps 3	35 0.59 3 to 7 in Tab	0.89 le 9c)				` '
(88)m= Utilisa (89)m=	20.04 ation fac 0.99	tor for gain 0.98 (ns for r	est of dv 0.85	welling, 0.68	h2,	m (see Tal	ole 9a) 0.: steps 3	35 0.59 3 to 7 in Tab 07 20.04	0.89 le 9c)	19.21	18.71	0.42	(90)
(88)m= Utilisa (89)m= Mean	20.04 ation fac 0.99 interna	tor for gain 0.98 (ns for r 0.94 ure in t	est of dv 0.85	welling, 0.68 of dwel	h2,	m (see Tal 0.47 0.31 T2 (follow	ole 9a) 0.: steps 3	35 0.59 3 to 7 in Tab 07 20.04	0.89 le 9c)		18.71	0.43	` '
(88)m= Utilisa (89)m= Mean (90)m=	20.04 ation fac 0.99 interna 18.75	tor for gain 0.98 temperatu 19.06 temperatu	us for r 0.94 ure in t 9.43	est of dv 0.85 the rest of 19.81	welling, 0.68 of dwel 20	h2,	m (see Tal 0.47 0.3° T2 (follow 0.06 20.0 g) = fLA ×	ole 9a) 1 0.: steps 3 7 20	35 0.59 3 to 7 in Tab 07 20.04 - fLA) × T2	0.89 le 9c) 19.79 fLA = Liv	19.21 ring area ÷ (-	18.71	0.43	(90) (91)
(88)m= Utilisa (89)m= Mean (90)m= Mean (92)m=	20.04 ation fac 0.99 interna 18.75 interna 19.3	tor for gain 0.98 temperatu 19.06 temperatu 19.57	ure in 1 9.43 ure (fo	est of dv 0.85 the rest of 19.81 r the who	velling, 0.68 of dwel 20 ole dwe 20.4	h2,	m (see Tal 0.47 0.3° T2 (follow 0.06 20.0 g) = fLA × 0.46 20.4	ole 9a) steps 3 7 20 T1 + (1 7 20	35 0.59 3 to 7 in Tab 07 20.04 - fLA) × T2	0.89 le 9c) 19.79 fLA = Liv	19.21 ring area ÷ (-	18.71	0.43	(90)

												l	
(93)m= 19.3	19.57	19.9	20.23	20.4	20.46	20.47	20.47	20.44	20.2	19.69	19.26		(93)
8. Space he													
Set Ti to the the utilisatio			•		ed at ste	ep 11 of	Table 9	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 fa				Way	Odii	<u> </u>	<u> </u>	СОР	000	1101	200		
(94)m= 0.99	0.98	0.94	0.85	0.7	0.5	0.35	0.38	0.62	0.89	0.98	0.99		(94)
Useful gains	, hmGm	, W = (9 ⁴	4)m x (84	4)m	<u> </u>	ļ				<u>I</u>			
(95)m= 544.21	653.12	724.1	726.25	624.05	435.75	290.46	304.45	463.76	580.13	542.87	510.37		(95)
Monthly ave	rage exte	ernal 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 ra	te for me	an intern	al tempe	erature,	Lm , W =	=[(39)m	x [(93)m	– (96)m]		-		
` ′	6 1138.71	1036.9	864.39	662.43	440.79	291	305.36	479.23	730.88	963.64	1159.04		(97)
Space heati	 	1	r each n		Wh/mon	th = 0.02	24 x [(97)m – (95		r -		l	
(98)m= 464.37	326.32	232.72	99.46	28.55	0	0	0	0	112.16	302.96	482.61		_
							Tota	l per year	(kWh/yeaı	r) = Sum(9	8) _{15,912} =	2049.15	(98)
Space heati	ng requir	ement in	kWh/m²	/year								27.69	(99)
9a. Energy re	quiremer	nts – Indi	vidual h	eating sy	ystems i	ncluding	micro-C	CHP)					
Space heat	ing:					J		,					
Fraction of s	pace hea	t from s	econdar	y/supple	mentary	system						0	(201)
Fraction of s	pace hea	at from m	nain syst	em(s)			(202) = 1	(201) =				1	(202)
Fraction of t	otal heati	ng from	main sys	stem 1			(204) = (2	02) × [1 –	(203)] =			1	(204)
Efficiency of	main spa	ace heat	ina svste	em 1								93.5	(206)
Efficiency of					system	n %						0	(208)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/yea	」` ′
Space heati						Jui	L	Seh	Oct	INOV	Dec	KVVII/ye	aı
464.37		232.72	99.46	28.55	0	0	0	0	112.16	302.96	482.61		
(211)m = {[(9	8)m v (20	1 <u> </u>	00 <u>-</u> (20	16)				<u>!</u>			<u> </u>		(211)
496.65	 	248.9	106.37	30.54	0	0	0	0	119.96	324.02	516.16		(211)
								l (kWh/yea				2191.61	(211)
Space heati	na fuel (s	econdar	v) k\//h/	month						10,101			`
$= \{[(98) \text{m x } (28)]\}$	•		• •	111011111									
(215)m= 0	0	0	0	0	0	0	0	0	0	0	0		
						Į.	Tota	l (kWh/yea	ar) =Sum(2	215) _{15,1012}	<u></u>	0	(215)
Water heatir	ıq												_
Output from v	•	ter (calc	ulated al	oove)									
174.65	153.55	160.37	142.52	138.77	122.71	116.62	129.66	129.96	147.85	157.89	170.03		
Efficiency of	water hea	ater										79.8	(216)
(217)m= 87.3	86.78	85.81	83.88	81.44	79.8	79.8	79.8	79.8	84.09	86.53	87.45		(217)
Fuel for wate	•												
(219)m = (64) (219)m = 200.05		0 ÷ (217) 1 _{86.9}	m 169.92	170.39	153.77	146.14	162.48	162.86	175.83	182.48	194.44		
(219)111= 200.03	170.93	100.9	103.32	110.38	133.77	140.14		I = Sum(2		102.40	134.44	2002.22	(210)
Annual total	•						1010	– Juiii(Z		Wh/yeaı		2082.22	(219)
Space heating		ed, main	system	1					ĸ	• • i i / y C di		kWh/year 2191.61	٦
•	_		•										_

			_		_
Water heating fuel used				2082.22	
Electricity for pumps, fans and electric keep-hot					
central heating pump:			30		(230c)
boiler with a fan-assisted flue			45		(230e)
Total electricity for the above, kWh/year	sum of (23	30a)(230g) =		75	(231)
Electricity for lighting				325.12	(232)
12a. CO2 emissions – Individual heating systems	including micro-CHP				
	Energy kWh/year	Emission factor kg CO2/kWh	or	Emissions kg CO2/yea	r
Space heating (main system 1)	(211) x	0.216	=	473.39	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	449.76	(264)
Space and water heating	(261) + (262) + (263) + (264) =	=		923.15	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	= [168.74	(268)
Total CO2, kg/year	St	um of (265)(271) =		1130.81	(272)
TER =				15.28	(273)

			User E	Details:						
Assessor Name: Software Name:	Stroma FSAP 20)12		Strom Softwa				Versic	on: 1.0.3.4	
		Р	roperty	Address	: MF 2B	4P SO V	Vest Bui	lding		
Address :										
1. Overall dwelling dimer	nsions:		_	4 0						<u>.</u> ,
Ground floor			Are	a(m²) 79	(1a) x		2.5	(2a) =	Volume(m)	3) (3a
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1	1e)+(1r	۱)	79	(4)					
Dwelling volume					(3a)+(3b	o)+(3c)+(3c	d)+(3e)+	.(3n) =	197.5	(5)
2. Ventilation rate:										
Number of chimneys	main heating	secondar heating	'y □ + □	other 0	7 = F	total 0	x	40 =	m³ per hou	ır ☐(6a
Number of open flues			」]			20 =		╡`
·	0	0	J ' L	0	J ŪĻ	0			0	(6b
Number of intermittent fan	IS .				Ĺ	0		10 =	0	(7a
Number of passive vents					L	0	X	10 =	0	(7b
Number of flueless gas fire	es					0	X	40 =	0	(7c
								Δir ch	nanges per h	our
Infiltration due to chimney	a flyes and fans	(62) (6b) (7	7a) ı (7b) ı ((70) -	Г		_			_
Infiltration due to chimney If a pressurisation test has be					continue f	0 rom (9) to		÷ (5) =	0	(8)
Number of storeys in the		μ	(11)			(2)	(1.5)		0	(9)
Additional infiltration							[(9)	-1]x0.1 =	0	(10
Structural infiltration: 0.2	25 for steel or timbe	r frame or	0.35 fo	r mason	y const	ruction			0	(11
if both types of wall are pre deducting areas of opening		esponding to	the grea	ter wall are	a (after					
If suspended wooden flo		aled) or 0	.1 (seale	ed), else	enter 0				0	(12
If no draught lobby, ente	er 0.05, else enter 0)							0	(13
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 and the Air permeability value, or air permeabilit	•		•	•	•	netre of e	envelope	area	4	(17
Air permeability value applies	-					is beina u	sed		0.2	(18
Number of sides sheltered				g. 00 a po		.o .og u	000		2	(19
Shelter factor				(20) = 1 -	[0.075 x (19)] =			0.85	(20
Infiltration rate incorporation	ng shelter factor			(21) = (18) x (20) =				0.17	(21
Infiltration rate modified fo	r monthly wind spec	ed					_		_	
Jan Feb I	Mar Apr May	y Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind spe	ed from Table 7								_	
(22)m= 5.1 5	4.4 4.3	3.8	3.8	3.7	4	4.3	4.5	4.7		
Wind Factor (22a)m = (22)m ÷ 4									
	.23 1.1 1.08	0.95	0.95	0.92	1	1.08	1.12	1.18	1	
	1.00		L	1 3.02	<u> </u>	1	12		J	

Calculate effec	0.21	0.21	0.19	0.18	0.16	0.16	0.16	0.17	0.18	0.19	0.2		
If mechanica		_	rate for t	he appli	cable ca	se	•	•					
If exhaust air h			endix N. (2	3b) = (23a) × Fmv (e	equation (N	N5)) . othe	rwise (23b) = (23a)			0.5	(2
If balanced with									, (200)			0.5	(2
a) If balance		-	-	_					2h)m + (23h) x [1 – (23c)		(2
4a)m= 0	0	0	0	0	0	0	0	0	0	0	0]	(2
b) If balance	ed mech	anical ve	ntilation	without	heat rec	covery (N	л ЛV) (24b	m = (22)	2b)m + (23b)	<u> </u>	J	
4b)m= 0	0	0	0	0	0	0	0	0	0	0	0]	(
c) If whole h	ouse ex	tract ver	tilation o	or positiv	e input v	/entilatio	n from o	outside	l .			_	
if (22b)n	n < 0.5 ×	(23b), t	hen (24	c) = (23b); otherv	wise (24	c) = (22k	o) m + 0.	5 × (23b)		_	
lc)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5]	(
d) If natural				•	•								
	n = 1, the	r ` í	<u> </u>		<u> </u>		 					1	,
d)m= 0		0	0	0	0	0	0	0	0	0	0]	(
Effective air			<u> </u>	, ,	$\stackrel{\cdot}{\longrightarrow}$			`			1 0.5	1	,
i)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		(
. Heat l <mark>osse</mark>	s and he	at loss	oaramete	er:									
EMENT	Gros		Openin		Net Ar		U-val		AXU		k-value		AXk
	area	(m²)	m	2	A ,n		W/m2		(W/I	K)	kJ/m²-	K	kJ/K
indows Type					7.14		/[1/(1.3)+		8.82				(
indows Type) 2				13.2	x1,	/[1/(1.3)+	0.04] =	16.31	빝.			(:
alls Type1	20.6	2	13.2		7.42	X	0.18	=	1.34	∐ l			(
alls Type2	18.0)4	7.14		10.9	X	0.18	=	1.96				(
tal area of e	lements	, m²			38.66	5							(
or windows and						ated using	formula 1	/[(1/U-valu	ıe)+0.04] a	as given in	paragrapl	h 3.2	
nclude the erec				s and part	itions								
		- C // V	1.17				(26) (30)	1 + (32) =				00.40	
bric heat los		•	U)				(26)(30)		(30) + (3)	2) ı (22a)	(320) -	28.43	
bric heat los	Cm = S((A x k)	·	TEA\ in	de 1/m216		(26)(30)	((28)	(30) + (32	, , ,	(32e) =	2472.79	9 (3
bric heat lose eat capacity ermal mass	Cm = S(parame	(A x k) ter (TMF	P = Cm +	,				((28)	tive Value	: Medium	, ,		9 (
abric heat los eat capacity nermal mass r design assess	Cm = S(parame sments wh	(A x k) eter (TMF	P = Cm ÷	,				((28)	tive Value	: Medium	, ,	2472.79	9 (3
abric heat lose eat capacity termal mass or design assess to be used inste	Cm = S(parame sments wh	(A x k) eter (TMF ere the de tailed calcu	P = Cm ÷ tails of the	constructi	ion are not	t known pr		((28)	tive Value	: Medium	, ,	2472.79	9 (
abric heat los eat capacity termal mass or design assess to be used inste	Cm = S(s parame sments wh rad of a dec es : S (L	(A x k) eter (TMF ere the de tailed calcu x Y) cale	P = Cm ÷ tails of the ulation. culated t	constructi	on are not pendix l	t known pr		((28)	tive Value	: Medium	, ,	2472.79 250	9 (
bric heat los eat capacity ermal mass of design assess to be used inste ermal bridge etails of thermal tal fabric he	Cm = S(a parame sments wh had of a dec es : S (L hal bridging that loss	(A x k) eter (TMF ere the de tailed calcu x Y) calcu are not kn	P = Cm : tails of the ulation. culated (own (36) =	constructiusing Ap	on are not pendix l	t known pr		((28) Indica	tive Value	: Medium	, ,	2472.79 250	9 (
bric heat los eat capacity ermal mass of design assess to be used inste ermal bridge etails of thermal tal fabric he	Cm = S(a parame sments wh had of a dec es : S (L hal bridging that loss	(A x k) eter (TMF ere the de tailed calcu x Y) calcu are not kn	P = Cm : tails of the ulation. culated (own (36) =	constructiusing Ap	on are not pendix l	t known pr		((28) Indica indicative	tive Value	: Medium	able 1f	2472.79 250 2.7	9 (
bric heat los eat capacity ermal mass of design assess to be used inste ermal bridge etails of thermal tal fabric he	Cm = S(a parame sments wh had of a dec es : S (L hal bridging that loss	(A x k) eter (TMF ere the de tailed calcu x Y) calcu are not kn	P = Cm : tails of the ulation. culated (own (36) =	constructions are constructed using Ap = 0.15 x (3)	pendix k	t known pr		((28) Indica e indicative (33) + (38)m	tive Value values of (36) = = 0.33 × (: Medium	able 1f	2472.79 250 2.7	Э ((
eat capacity eat capacity ermal mass r design assess n be used inste ermal bridge details of therma stal fabric he entilation hea	Cm = S(parame sments wh had of a dei es : S (L al bridging eat loss at loss ca	(A x k) ter (TMF ere the de tailed calcu x Y) calc are not kn	P = Cm : tails of the ulation. culated to own (36) =	constructions and constructions are constructed using Ap	on are not pendix h	t known pr	recisely the	((28) Indica e indicative (33) + (38)m	tive Value e values of (36) = = 0.33 × (: Medium : TMP in T	able 1f	2472.79 250 2.7	Э ((
eat capacity ermal mass or design assess on be used inste ermal bridge details of thermal tal fabric he entilation hea Jan 32.59	Cm = S(parame sments wh had of a der es : S (L hal bridging hat loss at loss ca Feb 32.59	(A x k) eter (TMF ere the de tailed calcu x Y) calc are not kn alculated Mar 32.59	P = Cm : tails of the ulation. culated to own (36) =	constructions are constructed using Ap = 0.15 x (3)	pendix k	known pr	ecisely the	((28) Indica e indicative (33) + (38)m Sep 32.59	tive Value values of (36) = = 0.33 × (25)m x (5 Nov 32.59	able 1f	2472.79 250 2.7	Э ((
eat capacity nermal mass or design assess on be used instendermal bridge details of thermal otal fabric he entilation hea Jan 32.59 eat transfer of	Cm = S(parame sments wh had of a der es : S (L hal bridging hat loss at loss ca Feb 32.59	(A x k) eter (TMF ere the de tailed calcu x Y) calc are not kn alculated Mar 32.59	P = Cm : tails of the ulation. culated to own (36) =	constructions are constructed using Ap = 0.15 x (3)	pendix k	known pr	ecisely the	((28) Indica e indicative (33) + (38)m Sep 32.59	(36) = = 0.33 × (Oct	25)m x (5 Nov 32.59	able 1f	2472.79 250 2.7	(i) (c) (d) (d)
eat capacity eat capacity eat capacity eat mass r design assess n be used inste eat bridge details of therma stal fabric he entilation hea Jan 32.59 eat transfer comments of the stall fabric hea eat transfer comments of the stall fabric heat eat transfer comments of	Cm = S(parame sments wh had of a det es : S (L had bridging that loss at loss ca Feb 32.59 coefficier 63.72	(A x k) ter (TMF ere the de tailed calcu x Y) calc are not kn alculated Mar 32.59 nt, W/K 63.72	P = Cm - tails of the ulation. culated to own (36) = 1 monthly Apr 32.59	constructions and constructions are constructed using Ap = 0.15 x (3 / May 32.59	pendix k Jun 32.59	t known pr	Aug 32.59	((28) Indicative indicative (33) + (38)m Sep 32.59 (39)m 63.72	(36) = = 0.33 × (Oct 32.59 = (37) + (36) = (37) + (36) = (37) =	25)m x (5 Nov 32.59 38)m 63.72 Sum(39),	Dec 32.59	2472.79 250 2.7	(c)
32.59 eat transfer o	Cm = S(parame sments wh had of a det es : S (L had bridging that loss at loss ca Feb 32.59 coefficier 63.72	(A x k) ter (TMF ere the de tailed calcu x Y) calc are not kn alculated Mar 32.59 nt, W/K 63.72	P = Cm - tails of the ulation. culated to own (36) = 1 monthly Apr 32.59	constructions and constructions are constructed using Ap = 0.15 x (3 / May 32.59	pendix k Jun 32.59	t known pr	Aug 32.59	((28) Indicative indicative (33) + (38)m Sep 32.59 (39)m 63.72	(36) = = 0.33 × (Oct 32.59 = (37) + (36)	25)m x (5 Nov 32.59 38)m 63.72 Sum(39),	Dec 32.59	2472.79 250 2.7 31.13) ((

Number of days in month (Table 1a)

Numbe	er or day	s in mor	ıın (Tab	ie ra)		1	1	,		1			1	
	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)
							•	•	•	•	•		l	
4 \\/o	tor boot	ing oner	av roau	romonti								kWh/ye	201	
4. ۷۷	ilei neal	ing ener	gy requi	rement.								KVVII/y	ear.	
Assum	ed occu	pancy, I	N								2.	44		(42)
			+ 1.76 x	[1 - exp	(-0.0003	849 x (TF	FA -13.9)2)] + 0.0	0013 x (TFA -13.	.9)		l	
	A £ 13.9	-											•	
								(25 x N)	+ 36 a water us	se target o		.24		(43)
		_		day (all w		_	-	io aomovo	a water ac	oo targot o	,			
	Jan	Feb	Mar	Λnr	Mov	Jun	Jul	Δυσ	Sep	Oct	Nov	Dec		
Hot wate				Apr ach month	May $Vd.m = fa$	l .		Aug (43)	Sep	l Oct	INOV	Dec		
			-	-				· <i>'</i>					1	
(44)m=	101.46	97.77	94.08	90.39	86.7	83.01	83.01	86.7	90.39	94.08	97.77	101.46		7,,,,
Energy (content of	hot water	used - cal	culated mo	onthly = 4	190 x Vd r	тхптхГ)Tm / 3600			m(44) ₁₁₂ = ables 1b, 1		1106.83	(44)
-						1	ı	ı		,		,	1	
(45)m=	150.46	131.59	135.79	118.39	113.6	98.02	90.83	104.23	105.48	122.93	134.18	145.71		7(45)
If instant	taneous w	ater heatir	na at point	of use (no	hot water	storage).	enter 0 in	boxes (46		Total = Su	m(45) ₁₁₂ =		1451.23	(45)
		_				-				10.44	00.40	04.00		(46)
(46)m= Water	2 ^{2.57} storage	19.74	20.37	17.76	17.04	14.7	13.63	15.64	15.82	18.44	20.13	21.86		(46)
	_		includin	ng any so	olar or W	WHRS	storage	within sa	ame ves	sel		5		(47)
		,		nk in dw					ATTIO VOO	001		<u> </u>		(41)
	-	7							ers) ente	er 'O' in <i>(</i>	47)			
	storage		not wate	, (uno m	iciaacs i	Hotaritar	icous cc	// DOI	CIS) CITE	51 0 111 (,,			
			eclared I	oss facto	or is kno	wn (kWł	n/day):					0		(48)
,			m Table			`	,					0		(49)
•				, kWh/ye	oor			(48) x (49)	١ _					, ,
• • • • • • • • • • • • • • • • • • • •			•	ylinder l		or is not	known:	(40) X (43)	, –			5		(50)
				om Tabl							0.	03		(51)
			ee secti		`		• /						l	` '
Volum	e factor	from Tal	ble 2a								2.	88		(52)
Tempe	rature fa	actor fro	m Table	2b							0	.6		(53)
Energy	lost fro	m water	storage	, kWh/ye	ear			(47) x (51)) x (52) x (53) =	0.	24		(54)
Enter	(50) or (54) in (5	55)								0.	24		(55)
Water	storage	loss cal	culated f	or each	month			((56)m = (55) × (41)ı	m			'	
(56)m=	7.49	6.76	7.49	7.25	7.49	7.25	7.49	7.49	7.25	7.49	7.25	7.49		(56)
		dedicated	d solar sto	rage, (57)r	n = (56)m	<u> </u>	<u>I</u> H11)] ÷ (5	1 0), else (5	1 7)m = (56)	n where (L H11) is fro	m Append	l ix H	, ,
(F7) m	7.40	6.76	7.40	7.05	7.40	7.05	7.40	7 40	7.05	7.40	7.05	7.40	1	(57)
(57)m=	7.49	6.76	7.49	7.25	7.49	7.25	7.49	7.49	7.25	7.49	7.25	7.49		(37)
Primar	y circuit	loss (an	inual) fro	m Table	3							0		(58)
	•				,	•	` '	65 × (41)						
,									cylinde		<u> </u>		ı	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)
Combi	loss cal	culated	for each	month (61)m =	(60) ÷ 36	65 × (41)m						
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0		(61)
						•	•		•	•	•		1	

Total heat required for wate	heating o	alculated	I for eac	h month	(62)m =	= 0.85 × ((45)m +	(46)m +	(57)m +	(59)m + (61)m	
(62)m= 181.21 159.37 166.5			127.78	121.59	134.99	135.24	153.68	163.94	176.47		(62)
Solar DHW input calculated using	Appendix G	or Appendix	H (negati	ve quantity	/) (enter '(D' if no sola	r contribut	tion to wate	er heating)	•	
(add additional lines if FGH	RS and/or	WWHRS	applies	, see Ap	pendix	G)					
(63)m= 0 0 0	0	0	0	0	0	0	0	0	0		(63)
Output from water heater	-	-	-	-	-		-		-		
(64)m= 181.21 159.37 166.5	148.15	144.35	127.78	121.59	134.99	135.24	153.68	163.94	176.47		_
			-	-	Out	put from wa	ater heate	r (annual) ₁	12	1813.3	(64)
Heat gains from water heati	ng, kWh/n	nonth 0.2	5 ´ [0.85	× (45)m	+ (61)r	n] + 0.8 x	د [(46)m	+ (57)m	+ (59)m]	
(65)m= 74.63 65.98 69.7	5 63.17	62.37	56.4	54.8	59.26	58.88	65.47	68.42	73.05		(65)
include (57)m in calculation	on of (65)r	n only if c	ylinder i	s in the	dwelling	or hot w	ater is f	rom com	munity h	eating	
5. Internal gains (see Tabl	e 5 and 5	a):									
Metabolic gains (Table 5), V	/atts										
Jan Feb Ma		May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(66)m= 122.18 122.18 122.1	122.18	122.18	122.18	122.18	122.18	122.18	122.18	122.18	122.18		(66)
Lighting gains (calculated in	Appendix	L, equat	ion L9 o	r L9a), a	lso see	Table 5	-		-		
(67)m= 19.38 17.21 14	10.6	7.92	6.69	7.23	9.39	12.61	16.01	18.68	19.91		(67)
Appliances gains (calculated	d in Apper	ıdix L, eq	uation L	13 or L1	3a), als	o see Ta	ble <mark>5</mark>				
(68)m= 217.34 219.59 213.9	201.81	186.54	172.18	162.59	160.34	166.02	178.12	193.39	207.75		(68)
Cooking gains (calculated in	Appendi	L, equat	ion L15	or L15a	, also s	ee Table	5				
(69)m= 35.22 35.22 35.2	2 35.22	35.22	35.22	35.22	35.22	35.22	35.22	35.22	35.22		(69)
Pumps and fans gains (Tab	e 5a)										
(70)m= 0 0 0	О	0	0	0	0	0	0	0	0		(70)
Losses e.g. evaporation (ne	gative val	ues) (Tab	le 5)								
(71)m= -97.74 -97.74 -97.7	4 -97.74	-97.74	-97.74	-97.74	-97.74	-97.74	-97.74	-97.74	-97.74		(71)
Water heating gains (Table	5)	=	=	=	=			-	=		
(72)m= 100.31 98.18 93.7	5 87.74	83.83	78.33	73.66	79.65	81.78	88	95.03	98.19		(72)
Total internal gains =			(66)	m + (67)m	ı + (68)m	+ (69)m + ((70)m + (7	71)m + (72)	m	•	
(73)m= 396.68 394.63 381.3	359.8	337.95	316.86	303.13	309.03	320.06	341.78	366.76	385.5		(73)
6. Solar gains:											
Solar gains are calculated using s	olar flux fror	n Table 6a	and assoc	iated equa	tions to c	onvert to th	e applicat	ole orientat	ion.		
Orientation: Access Factor			Flu		_	g_ 	_	FF		Gains	
Table 6d	m²		ı aı	ole 6a		Table 6b	_ '	able 6c		(W)	_
North 0.9x 0.77	x 7	.14	X 1	0.63	х	0.63	x	0.7	=	23.2	(74)
North 0.9x 0.77	x 7	.14	x 2	0.32	Х	0.63	x	0.7	=	44.34	(74)
North 0.9x 0.77	x 7	.14	x 3	34.53	х	0.63	x	0.7	=	75.35	(74)
North 0.9x 0.77	x 7	.14	X 5	5.46	Х	0.63	x	0.7	=	121.03	(74)
North 0.9x 0.77	x 7	.14	x 7	4.72	x	0.63	x	0.7	=	163.04	(74)
North 0.9x 0.77	x 7	.14	x 7	9.99	х	0.63	x	0.7	=	174.53	(74)
North 0.9x 0.77	x 7	.14	x 7	'4.68	x	0.63	x [0.7	=	162.95	(74)
North 0.9x 0.77	x 7	.14	X 5	9.25	Х	0.63	x	0.7	=	129.28	(74)

North	0.9x	0.77	X	7.14	4	x	41.52	x	0.63	X	0.7		90.59	(74)
North	0.9x	0.77	x	7.14	4	x	24.19	X	0.63	х	0.7	=	52.78	(74)
North	0.9x	0.77	x	7.14	4	X	13.12	x	0.63	x	0.7	_	28.62	(74)
North	0.9x	0.77	×	7.14	4	x	8.86	X	0.63	x	0.7	=	19.34	(74)
South	0.9x	0.77	x	13.2	2	X	46.75	X	0.63	x	0.7		188.6	(78)
South	0.9x	0.77	x	13.2	2	X	76.57	X	0.63	x	0.7	=	308.88	(78)
South	0.9x	0.77	x	13.2	2	x	97.53	X	0.63	x	0.7	=	393.46	(78)
South	0.9x	0.77	x	13.2	2	x	110.23	X	0.63	×	0.7		444.7	(78)
South	0.9x	0.77	х	13.2	2	x	114.87	X	0.63	x	0.7	=	463.4	(78)
South	0.9x	0.77	x	13.2	2	x	110.55	X	0.63	x	0.7		445.96	(78)
South	0.9x	0.77	x	13.2	2	x	108.01	X	0.63	x	0.7		435.73	(78)
South	0.9x	0.77	x	13.2	2	x	104.89	X	0.63	x	0.7	=	423.15	(78)
South	0.9x	0.77	x	13.2	2	x	101.89	X	0.63	x	0.7		411.02	(78)
South	0.9x	0.77	x	13.2	2	X	82.59	X	0.63	x	0.7		333.16	(78)
South	0.9x	0.77	X	13.2	2	x	55.42	X	0.63	x	0.7		223.56	(78)
South	0.9x	0.77	x	13.2	2	x	40.4	X	0.63	x	0.7		162.97	(78)
	_													
Solar g	ains in	watts, calc	culated	for each	month			(83)m	Sum(74)m	(8 <mark>2</mark>)m				
(83)m=	211.8		168.81	565.72	626.44		20.49 598.68	552	.43 501.61	385.9	252.18	182.31		(83)
Total g	ains – ii	nternal and	solar	(84)m =	(73)m	+ (8	33)m , watts							
г				_									1	
(84)m=	608.48	747.86 8	350.12	925.52	964.38	93	37.35 901.81	861	.47 821.67	727.7	618.94	567.82		(84)
` ' L		_					37.35 901.81	861	47 821.67	727.7	618.94	567.82		(84)
7. Mea	an inter	nal temper	rature (heating	seasor	1)				727.7	618.94	567.82	21	
7. Mea	an inter erature	nal temper	rature (ating pe	heating eriods in	seasor the livi	i) ing	area from Ta			727.7	618.94	567.82	21	(84)
7. Mea	an inter erature tion fac	nal temper during hea tor for gair	rature (ating pe	heating eriods in ving are	seasor the livi	ing	area from Ta	ble 9,	Th1 (°C)				21	
7. Mea	an inter erature tion fac Jan	nal temper during hea tor for gain Feb	rature (ating pe ns for li Mar	heating eriods in ving are Apr	season the livi a, h1,m May	n) ing a	area from Ta ee Table 9a) Jun Jul	ble 9,	Th1 (°C)	Oct	Nov	Dec	21	(85)
7. Mea Tempe Utilisa (86)m=	erature tion fac Jan 0.99	nal temper during hea tor for gair Feb 0.96	nature (ating pens for li Mar 0.9	heating eriods in ving are Apr	the livi a, h1,n May	ing (so	area from Ta ee Table 9a) Jun Jul 0.43 0.31	Al 0.3	Th1 (°C) ug Sep 4 0.53				21	
7. Mea Tempo Utilisa (86)m=	an interesture tion facure Jan 0.99	nal temper during hea tor for gair Feb 0.96	nature (ating pens for li Mar 0.9	heating eriods in ving are Apr 0.78	season the livi a, h1,m May 0.61	ing (so	area from Ta ee Table 9a) Jun Jul 0.43 0.31 w steps 3 to	ble 9, 0.3 7 in T	Th1 (°C) ug Sep 4 0.53 Table 9c)	Oct 0.83	Nov 0.97	Dec 0.99	21	(85)
7. Mea Tempe Utilisa (86)m=	erature tion fac Jan 0.99	nal temper during hea tor for gair Feb 0.96	nature (ating pens for li Mar 0.9	heating eriods in ving are Apr	the livi a, h1,n May	ing (so	area from Ta ee Table 9a) Jun Jul 0.43 0.31	Al 0.3	Th1 (°C) ug Sep 4 0.53 Table 9c)	Oct	Nov 0.97	Dec	21	(85)
7. Mea Tempo Utilisa (86)m= Mean (87)m=	an interestion factors and the control of the contr	nal temper during hea tor for gair Feb 0.96	mature (ating pens for li Mar 0.9 ure in li 20.8	heating eriods in ving are Apr 0.78 iving are	season the livi a, h1,m May 0.61 ea T1 (f	ing (so	area from Ta ee Table 9a) Jun Jul 0.43 0.31 w steps 3 to	Al 0.3	Th1 (°C) ug Sep 4 0.53 Table 9c) 1 21	Oct 0.83	Nov 0.97	Dec 0.99	21	(85)
7. Mea Tempo Utilisa (86)m= Mean (87)m=	an interestion factors and the control of the contr	nal temper during hea tor for gair Feb 0.96 I temperatu 20.61	mature (ating pens for li Mar 0.9 ure in li 20.8	heating eriods in ving are Apr 0.78 iving are	season the livi a, h1,m May 0.61 ea T1 (f	ollo	area from Ta ee Table 9a) Jun Jul 0.43 0.31 w steps 3 to 21 21	Al 0.3	Th1 (°C) ug Sep 4 0.53 able 9c) 1 21 9, Th2 (°C)	Oct 0.83	Nov 0.97	Dec 0.99	21	(85)
7. Mea Tempe Utilisa (86)m= Mean (87)m= Tempe (88)m=	interna Jan 0.99 interna 20.41 erature 20.25	nal temper during hea etor for gair Feb 0.96 I temperatu 20.61 during hea 20.25	mature (mating persons for li mating persons li	heating eriods in ving are 0.78 iving are 20.94 eriods in 20.25	season the livina, h1,m May 0.61 ea T1 (fr 20.99 rest of 20.25	ng (se	area from Ta ee Table 9a) Jun Jul 0.43 0.31 w steps 3 to 21 21 elling from T	Al 0.3 7 in T 2 able 9	Th1 (°C) ug Sep 4 0.53 able 9c) 1 21 9, Th2 (°C)	Oct 0.83	Nov 0.97	Dec 0.99	21	(85)
7. Mea Tempe Utilisa (86)m= Mean (87)m= Tempe (88)m=	interna Jan 0.99 interna 20.41 erature 20.25	nal temper during heater for gair Feb 0.96 I temperate 20.61 during heater 20.25 eter for gair	mature (mating persons for li mating persons li	heating eriods in ving are 0.78 iving are 20.94 eriods in 20.25	season the livina, h1,m May 0.61 ea T1 (fr 20.99 rest of 20.25	n) (si) (si) (dw) (dw) (dw) (dw) (dw) (dw) (dw) (dw	area from Ta ee Table 9a) Jun Jul 0.43 0.31 w steps 3 to 21 21 elling from T 0.25 20.25	Al 0.3 7 in T 2 able 9	Th1 (°C) ug Sep 4 0.53 table 9c) 1 21 9, Th2 (°C) 25 20.25	Oct 0.83	Nov 0.97	Dec 0.99	21	(85)
7. Mea Tempo Utilisa (86)m= Mean (87)m= Tempo (88)m= Utilisa (89)m=	interna 20.41 erature 20.25 tion fac	nal temper during heater for gair Feb 0.96 I temperatu 20.61 during heater 20.25 etor for gair 0.96	mature (ating pens for li Mar 0.9 ure in li 20.8 ating pens for re 0.88	heating eriods in ving are 0.78 iving are 20.94 eriods in 20.25 est of dv 0.74	season the livi a, h1,m May 0.61 ea T1 (fi 20.99 rest of 20.25 velling, 0.56	ollo h2,	area from Ta ee Table 9a) Jun Jul 0.43 0.31 w steps 3 to 21 21 elling from T 0.25 20.25 m (see Table 0.38 0.26	Au 0.3 7 in T 2 able 9 20.3 20.3 0.2	Th1 (°C) ug Sep 4 0.53 Table 9c) 1 21 0, Th2 (°C) 25 20.25	Oct 0.83 20.92 20.25 0.79	Nov 0.97 20.64	Dec 0.99 20.36	21	(85) (86) (87) (88)
7. Mea Tempo Utilisa (86)m= Mean (87)m= Tempo (88)m= Utilisa (89)m=	interna 20.41 erature 20.25 tion fac	nal temper during heater for gair Feb 0.96 I temperate 20.61 during heater 20.25 eter for gair 0.96 I temperate	mature (ating pens for li Mar 0.9 ure in li 20.8 ating pens for re 0.88	heating eriods in ving are 0.78 iving are 20.94 eriods in 20.25 est of dv 0.74	season the livi a, h1,m May 0.61 ea T1 (fi 20.99 rest of 20.25 velling, 0.56	n) ing: (solloollo) h2, (gillon)	area from Ta ee Table 9a) Jun Jul 0.43 0.31 w steps 3 to 21 21 elling from T 0.25 20.25 m (see Table	Au 0.3 7 in T 2 able 9 20.3 20.3 0.2	Th1 (°C) ug Sep 4 0.53 fable 9c) 1 21 0, Th2 (°C) 25 20.25 8 0.48 to 7 in Tab	Oct 0.83 20.92 20.25 0.79	Nov 0.97 20.64 20.25	Dec 0.99 20.36	21	(85) (86) (87) (88)
7. Mea Tempo Utilisa (86)m= Mean (87)m= Tempo (88)m= Utilisa (89)m= Mean	interna 20.41 erature 20.25 tion fac 0.99 interna	nal temper during heater for gair Feb 0.96 I temperate 20.61 during heater 20.25 eter for gair 0.96 I temperate	mature (mating persons for li mating persons for re mating person	heating eriods in 20.94 eriods in 20.74 he rest of	the livina, h1,m May 0.61 ea T1 (fr 20.99 rest of 20.25 velling, 0.56 of dwell	n) ing: (solloollo) h2, (gillon)	area from Ta ee Table 9a) Jun Jul 0.43 0.31 w steps 3 to 21 21 elling from T 0.25 20.25 m (see Table 0.38 0.26 T2 (follow st	Ai 0.3 7 in T 2 able 9 20.2 eps 3	Th1 (°C) ug Sep 4 0.53 Table 9c) 1 21 0, Th2 (°C) 25 20.25 8 0.48 to 7 in Tab 25 20.25	Oct 0.83 20.92 20.25 0.79 e 9c) 20.17	Nov 0.97 20.64 20.25	Dec 0.99 20.36 20.25 0.99	21	(85) (86) (87) (88) (89)
7. Mea Tempo Utilisa (86)m= Mean (87)m= Tempo (88)m= Utilisa (89)m= Mean (90)m=	interna 20.25 tion factors of the control of the co	nal temper during heat tor for gair Feb 0.96 I temperate 20.61 during heat 20.25 ctor for gair 0.96 I temperate 19.76 2	mature (ating pens for li Mar 0.9 ure in li 20.8 ating pens for re 0.88 ure in t 20.02	heating eriods in ving are 0.78 iving are 20.94 eriods in 20.25 est of dv 0.74 he rest of 20.18	season the livi a, h1,n May 0.61 ea T1 (f 20.99 rest of 20.25 velling, 0.56 of dwell 20.24	ollo h2,	area from Ta ee Table 9a) Jun Jul 0.43 0.31 w steps 3 to 21 21 elling from T 0.25 20.25 m (see Table 0.38 0.26 T2 (follow st 0.25 20.25	Ai 0.3 7 in T 2 able 9 20.3 9 9a) 0.2 eps 3	Th1 (°C) ug Sep 4 0.53 table 9c) 1 21 9, Th2 (°C) 25 20.25 8 0.48 to 7 in Tab 25 20.25	Oct 0.83 20.92 20.25 0.79 e 9c) 20.17	Nov 0.97 20.64 20.25 0.96	Dec 0.99 20.36 20.25 0.99		(85) (86) (87) (88) (89)
7. Mea Tempo Utilisa (86)m= Mean (87)m= Tempo (88)m= Utilisa (89)m= Mean (90)m=	interna 20.41 erature 20.25 tion fac 0.99 interna 19.48	nal temper during heater for gair Feb 0.96 I temperate 20.61 during heat 20.25 eter for gair 0.96 I temperate 19.76 I temperate 20.76	mature (mating persons for li mating persons for re mating persons for li mating person	heating eriods in ving are 20.94 eriods in 20.25 est of dv 0.74 he rest of 20.18	the living, has been seen to the living as t	h2, (see ling)	area from Ta ee Table 9a) Jun Jul 0.43 0.31 w steps 3 to 21 21 elling from T 0.25 20.25 m (see Table 0.38 0.26 T2 (follow st 0.25 20.25 g) = fLA × T1	Ai 0.3 7 in T 2 able 9 20.3 9a) 0.2 eps 3 20.3	Th1 (°C) ug Sep 4 0.53 able 9c) 1 21 0, Th2 (°C) 25 20.25 8 0.48 to 7 in Tab 25 20.25 - fLA) × T2	Oct 0.83 20.92 20.25 0.79 le 9c) 20.17 fLA = Liv	Nov 0.97 20.64 20.25 0.96 19.8 ring area ÷ (4	Dec 0.99 20.36 20.25 0.99 19.39		(85) (86) (87) (88) (89) (90) (91)
7. Mea Tempo Utilisa (86)m= Mean (87)m= Tempo (88)m= Utilisa (89)m= Mean (90)m= Mean (92)m=	interna 20.41 erature 20.25 tion fac 0.99 interna 19.48 interna 19.86	nal temper during heater for gair Feb 0.96 I temperatu 20.61 during heater 19.76 2 I temperatu 19.76 2	mature (ating pens for li Mar 0.9 ure in li 20.8 ating pens for re 0.88 ure in t 20.02 ure (for 20.33	heating eriods in ving are Apr 0.78 iving are 20.94 eriods in 20.25 est of dv 0.74 he rest of 20.18 the who 20.49	season the livina, h1,m May 0.61 ea T1 (fr 20.99 rest of 20.25 velling, 0.56 of dwell 20.24	n) ing (see all of the line) ing 2 h2, ing 2	area from Ta ee Table 9a) Jun Jul 0.43 0.31 w steps 3 to 21 21 elling from T 0.25 20.25 m (see Table 0.38 0.26 T2 (follow st 0.25 20.25 g) = fLA × T1 0.55 20.55	Ai 0.3 7 in T 2 able 9 20.3 9 9a) 0.2 eps 3 20.3	Th1 (°C) ug Sep 4 0.53 able 9c) 1 21 9, Th2 (°C) 25 20.25 8 0.48 to 7 in Tab 25 20.25	Oct 0.83 20.92 20.25 0.79 le 9c) 20.17 fLA = Liv	Nov 0.97 20.64 20.25 0.96 19.8 ring area ÷ (4	Dec 0.99 20.36 20.25 0.99		(85) (86) (87) (88) (89)
7. Mea Tempo Utilisa (86)m= Mean (87)m= Tempo (88)m= Utilisa (89)m= Mean (90)m= Mean (92)m= Apply	interna 20.41 erature 20.25 tion fac 0.99 interna 19.48 interna 19.86 adjustn	nal temper during heater for gair Feb 0.96 I temperate 20.61 during heater 20.25 eter for gair 0.96 I temperate 19.76 I temperate 19.76 I temperate 20.11 20.11 20.11 20.11	mature (ating persons for li Mar 0.9 ure in li 20.8 ating persons for re 0.88 ure in t 20.02 ure (for 20.33	heating eriods in ving are 20.94 eriods in 20.25 est of dv 0.74 he rest of 20.18 the who 20.49 internal	the living, has been seen to the living as t	h2, (Cling 2	area from Ta ee Table 9a) Jun Jul 0.43 0.31 w steps 3 to 21 21 elling from T 0.25 20.25 m (see Table 0.38 0.26 T2 (follow st 0.25 20.25 g) = fLA × T1 0.55 20.55 re from Table	Ai 0.3 7 in T 2 able 9 20 e 9a) 0.2 eps 3 20 + (1 20 e 4e,	Th1 (°C) ug Sep 4 0.53 fable 9c) 1 21 0, Th2 (°C) 25 20.25 8 0.48 to 7 in Tab 25 20.25 — fLA) × T2 55 20.55 where approx	Oct 0.83 20.92 20.25 0.79 e 9c) 20.47 ppriate	Nov 0.97 20.64 20.25 0.96 19.8 ring area ÷ (4	Dec 0.99 20.36 20.25 0.99 19.39 19.78		(85) (86) (87) (88) (89) (90) (91)
7. Mean (86)m= [Mean (87)m= [Tempo (88)m= [Utilisa (89)m= [Mean (90)m= [Mean (92)m= [Apply (93)m=	interna 20.25 tion fac 0.99 interna 20.25 tion fac 0.99 interna 19.48 interna 19.86 adjustn 19.86	nal temper during heat tor for gair Feb 0.96 I temperatu 20.61 during heat 20.25 ctor for gair 0.96 I temperatu 19.76 2 I temperatu 20.11 2 nent to the 20.11 2	ating pens for line of the lin	heating eriods in ving are Apr 0.78 iving are 20.94 eriods in 20.25 est of dv 0.74 he rest of 20.18 the who 20.49	season the livina, h1,m May 0.61 ea T1 (fr 20.99 rest of 20.25 velling, 0.56 of dwell 20.24	h2, (Cling 2	area from Ta ee Table 9a) Jun Jul 0.43 0.31 w steps 3 to 21 21 elling from T 0.25 20.25 m (see Table 0.38 0.26 T2 (follow st 0.25 20.25 g) = fLA × T1 0.55 20.55	Ai 0.3 7 in T 2 able 9 20.3 9 9a) 0.2 eps 3 20.3	Th1 (°C) ug Sep 4 0.53 fable 9c) 1 21 0, Th2 (°C) 25 20.25 8 0.48 to 7 in Tab 25 20.25 — fLA) × T2 55 20.55 where appre	Oct 0.83 20.92 20.25 0.79 le 9c) 20.17 fLA = Liv	Nov 0.97 20.64 20.25 0.96 19.8 ring area ÷ (4	Dec 0.99 20.36 20.25 0.99 19.39		(85) (86) (87) (88) (89) (90) (91)
7. Mea Tempo Utilisa (86)m= Mean (87)m= Tempo (88)m= Utilisa (89)m= Mean (90)m= Mean (92)m= Apply (93)m= 8. Spa	interna 20.41 erature 20.25 tion fac 0.99 interna 19.48 interna 19.86 adjustn 19.86	nal temper during heater for gair Feb 0.96 I temperate 20.61 during heater 19.76 2 determinent to the 20.11 2 ting require	mature (ating pens for limited pens for record	heating eriods in ving are 20.94 eriods in 20.25 est of dv 0.74 he rest of 20.18 the who 20.49 internal 20.49	season the livina, h1,m May 0.61 ea T1 (fr 20.99 rest of 20.25 velling, 0.56 of dwell 20.24 ble dwe 20.54 temper 20.54	h2, (colling 2 ratu 2	area from Ta ee Table 9a) Jun Jul 0.43 0.31 w steps 3 to 21 21 elling from T 0.25 20.25 m (see Table 0.38 0.26 T2 (follow st 0.25 20.25 g) = fLA × T1 0.55 20.55 re from Table	All 0.3 7 in T 2: able 9 20.: 9a) 0.2 eps 3 20.: + (1 20.: e 4e, 20.:	Th1 (°C) ug Sep 4 0.53 fable 9c) 1 21 0, Th2 (°C) 25 20.25 8 0.48 to 7 in Tab 25 20.25 — fLA) × T2 55 20.55 where appre	Oct 0.83 20.92 20.25 0.79 e 9c) 20.47 ppriate 20.47	Nov 0.97 20.64 20.25 0.96 19.8 ring area ÷ (4	Dec 0.99 20.36 20.25 0.99 19.39 1) =	0.41	(85) (86) (87) (88) (89) (90) (91)

Mar

Apr

May

Jun

Jul

Aug

Sep

Oct

Nov

Dec

Jan

Feb

Litilization factor for gains, hm:						
Utilisation factor for gains, hm: (94)m=	0.31 0.5	0.8	0.96	0.99		(94)
Useful gains, hmGm , W = (94)m x (84)m	0.0	1 3.5	1 0.00	0.00		, ,
(95)m= 599.51 713.43 753.24 698.95 557.07 378.72 251.81	264.52 409.0	581.91	594.77	562.12		(95)
Monthly average external temperature from Table 8						
(96)m= 4.3 4.9 6.5 8.9 11.7 14.6 16.6	16.4 14.1	10.6	7.1	4.2		(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x		n]		, , ,		
(97)m= 991.22 968.88 881.53 738.38 563.42 379.23 251.84	264.58 410.9		830.82	993.03		(97)
Space heating requirement for each month, kWh/month = 0.02		í - `				
(98)m= 291.43 171.66 95.45 28.39 4.73 0 0	0 0	35.19	169.96	320.6	4447.40	7(00)
	Total per year	ar (kvvn/yea	r) = Sum(9	18) _{15,912} = [1117.42	<u> </u> (98)
Space heating requirement in kWh/m²/year				L	14.14	(99)
9b. Energy requirements – Community heating scheme						
This part is used for space heating, space cooling or water heating fraction of space heat from secondary/supplementary heating (unity sch	neme. Г		(301)
, , , , , , , , , , , , , , , , , , , ,	Table II) U II	none		Ĺ	0	
Fraction of space heat from community system 1 – (301) =				L	1	(302)
The community scheme may obtain heat from several sources. The procedure a includes boilers, heat pumps, geothermal and waste heat from power stations.		d up to four	other heat	sources; th	e latter	
Fraction of heat from Community boilers	эее <i>Аррени</i> х С.			- 1	1	(303a)
Fraction of total space heat from Community boilers		(3	302) x (303	La) = [1	_ ☐(304a)
Factor for control and charging method (Table 4c(3)) for commu	unity booting cy		, , , , , , , , , , , , , , , , , , , 			(305)
		Sterri		Į	1	_
Distribution loss factor (Table 12c) for community heating system	n			L	1.05	(306)
Space heating Annual space heating requirement				[kWh/year 1117.42]
Space heat from Community boilers	(98) x	(304a) x (30	5) x (306)	= [1173.29	(307a)
Efficiency of secondary/supplementary heating system in % (fro	m Table 4a or	Appendix	(E)	Ī	0	(308
Space heating requirement from secondary/supplementary systematics	em (98) x	(301) x 100	÷ (308) =	֓֞֞֜֞֜֜֓֓֓֓֓֓֓֓֓֓֓֓֓֡֟	0	(309)
Water heating				L		_
Water heating Annual water heating requirement				Γ	1813.3	1
If DHW from community scheme:				_		_ _
Water heat from Community boilers	(64) x	(303a) x (30	5) x (306)	= [1903.96	(310a)
Electricity used for heat distribution	0.01 × [(307	a)(307e) -	+ (310a)((310e)] =	30.77	(313)
Cooling System Energy Efficiency Ratio				Ī	0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107	÷ (314) =		Ī	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from	outside			[57.35](330a)
warm air heating system fans				[0	(330b)
pump for solar water heating				[0	(330g)
Total electricity for the above, kWh/year	=(330a	ı) + (330b) +	· (330a) =	L [57.35	(331)
. Stat. Stockholdy for the above, iterrity your	-(550)	, : (5555)	(-208)	L	07.00	

Energy for lighting (calculated in Appendix L) (332)342.18 12b. CO2 Emissions – Community heating scheme Energy **Emission factor Emissions** kWh/year kg CO2/kWh kg CO2/year CO2 from other sources of space and water heating (not CHP) If there is CHP using two fuels repeat (363) to (366) for the second fuel Efficiency of heat source 1 (%) 89.5 (367a) CO2 associated with heat source 1 $[(307b)+(310b)] \times 100 \div (367b) \times$ 742.67 (367)0 Electrical energy for heat distribution (372)[(313) x]0.52 15.97 Total CO2 associated with community systems (363)...(366) + (368)...(372)(373)758.64 CO2 associated with space heating (secondary) (309) x (374)0 0 CO2 associated with water from immersion heater or instantaneous heater (312) x (375)0.22 0 Total CO2 associated with space and water heating (373) + (374) + (375) =758.64 (376)CO2 associated with electricity for pumps and fans within dwelling (331)) x (378)0.52 29.76 CO2 associated with electricity for lighting (332))) x (379)0.52 177.59 sum of (376)...(382) =Total CO2, kg/year (383)965.99 $(383) \div (4) =$ **Dwelling CO2 Emission Rate** 12.23 (384)El rating (section 14) (385)89.56

			User D	Details:						
Assessor Name: Software Name:	Stroma FSAP 2	012		Strom Softwa				Versic	on: 1.0.3.4	
		Р	roperty	Address	: MF 2B	4P SO V	Vest Bui	lding		
Address :										
1. Overall dwelling dimer	nsions:		_							<u>.</u> ,
Ground floor			Are	a(m²) 79	(1a) x		2.5	(2a) =	Volume(m)	3) (3a
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+((1e)+(1r	ገ)	79	(4)					
Dwelling volume					(3a)+(3b	o)+(3c)+(3c	d)+(3e)+	(3n) =	197.5	(5)
2. Ventilation rate:										
Number of chimneys	main heating	secondar heating	ry □ + □	other 0	7 = F	total 0	x	40 =	m³ per hou	ır ☐(6a
•			」]			20 =		╡`
Number of open flues	U	0	」 ' L	0] ⁻	0			0	(6b
Number of intermittent fan	IS .				Ĺ	3		10 =	30	(7a
Number of passive vents					L	0	X	10 =	0	(7b
Number of flueless gas fire	es					0	X	40 =	0	(7c
								Δir ch	nanges per he	our
Infiltration due to chimney	o fluor and fans —	(63)+(6b)+(7	7a)+(7b)+((76) -		-	_			_
If a pressurisation test has be					continue f	30 from (9) to		\div (5) =	0.15	(8)
Number of storeys in the		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	(11)			(5) 55	() -)		0	(9)
Additional infiltration							[(9)	-1]x0.1 =	0	(10
Structural infiltration: 0.2					•	ruction			0	(11
if both types of wall are pre deducting areas of opening		responding to	the grea	ter wall are	a (after					
If suspended wooden flo		ealed) or 0	.1 (seale	ed), else	enter 0				0	(12
If no draught lobby, ente	er 0.05, else enter	0							0	(13
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 and the Air permeability value, or air permeabilit	•		•	•	•	netre of e	envelope	area	5	(17
Air permeability value applies	-					is beina u	ısed		0.4	(18
Number of sides sheltered				g. 00 a po					2	(19
Shelter factor				(20) = 1 -	[0.075 x (19)] =			0.85	(20
Infiltration rate incorporation	ng shelter factor			(21) = (18) x (20) =				0.34	(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	ed from Table 7								_	
(22)m= 5.1 5	4.4 4.3	3.8	3.8	3.7	4	4.3	4.5	4.7		
Wind Factor (22a)m = (22)m ÷ 4									
	.23 1.1 1.08	0.95	0.95	0.92	1	1.08	1.12	1.18	1	
	1 1	1 5.00		1 5.52	<u> </u>	1	1		J	

0.44	0.43	0.42	ing for sh 0.38	0.37	0.32	0.32	0.32	0.34	0.37	0.38	0.4]	
Calculate effe		•	rate for t	he appli	cable ca	se	!	<u> </u>		<u>l</u>	!		
If mechanica			andiv NL (C	12h) (22a) Fm. /	auation (NEN otho	muiaa (22h	\ (225)			0	(2
If exhaust air h) = (23a)			0	(2
If balanced with		-	-	_					N.)	001.)	4 (00.1	0	(2
a) If balance	ed mecha	anical ve	entilation 0	with he	at recove	ery (MVI	HR) (24a 	$\frac{a)m = (22)}{0}$	2b)m + (2 0	23b) × [- ` ` `) ÷ 100] 7	(2
24a)m= 0				<u> </u>							0		(2
b) If balance	ea mecna 0	anicai ve	entilation 0	without	neat red	overy (r	VIV) (246 1 0	$\int_{0}^{\infty} \int_{0}^{\infty} dt = (22)$	2b)m + (2 0	23D) 0	0	1	(2
	<u> </u>		<u> </u>	<u> </u>					U	U 0			(2
c) If whole h			itilation o then (24d	-	-				5 v (23h	.)			
4c)m = 0	0.07	0	0	0	0	0	0) = (22)	0	0	0	0	1	(2
d) If natural	ventilation	on or wh	ole hous	L nositiv	/e innut	L ventilatio	on from I	loft				J	·
,			m = (221)	•	•				0.5]				
4d)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 (24k	o) or (24	c) or (24	d) in box	x (25)		•	•	-	
(5)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
l loot loos	a cod la	at loos											-
B. Heat losse					Not An		Uvel		A V I I		برامير يا		A V I
LEMENT	Gros area		Openin m		Net Ar A ,r		U-valı W/m2		A X U (W/ł	<)	k-valu kJ/m²·		A X k kJ/K
in <mark>dows</mark> Type					6.93		/[1/(1.4)+		9.19				(2
/indows Type					12.82	=	/[1/(1.4)+	<u> </u>	17	Ħ			(2
/alls Type1	20.6	2	12.8	2	7.8	X	0.18		1.4	Ħ,			(2
/alls Type2			_	= \						븍 ;		╡ ⊨	
• •	18.0		6.93	<u> </u>	11.11	=	0.18	[2				(2
otal area of e			effootivo w	indow I I ve	38.66		r formula 1	1/[/1/ Lyolu	10 1 1 0 0 1 1 0	o airan in	norogran	h 2 2	(3
include the area						ateu usirig	j iorriula i	/[(I/ U- valu	e)+0.04j a	is giveri iri	рагаугарі	11 3.2	
abric heat los	ss, W/K :	= S (A x	U)				(26)(30)) + (32) =				29.5	9 (3
eat capacity	Cm = S((A x k)						((28)	.(30) + (32	2) + (32a).	(32e) =	2552.	45 (3
hermal mass	parame	ter (TMF	o = Cm -	- TFA) ir	n kJ/m²K			Indica	tive Value:	: Medium		250	(3
or design assess	sments wh	ere the de	tails of the	construct	ion are no	t known pr	recisely the	e indicative	values of	TMP in Ta	able 1f		
n be used inste													
nermal bridg	`	,		О.	•	<						1.5	(3
details of therma otal fabric he		are not kn	own (36) =	= 0.15 x (3	1)			(22)	(26)				- 1,
		م مدما در ما	الطائمة محمد الم						(36) =	OE) ·· (E)		31.0	9 (3
	1						Ι	1	= 0.33 × (1	7	
	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	-	15
Jan		38.29	37.19	36.98	36.02	36.02	35.84	36.39	36.98	37.4	37.84	J	(3
38.77	38.53							(39)m	= (37) + (3	38)m		_	
8)m= 38.77 eat transfer of	coefficier	nt, W/K	1			1							
8)m= 38.77	<u> </u>	nt, W/K 69.38	68.28	68.07	67.11	67.11	66.93	67.48	68.07	68.49	68.92		
Jan 38.77 eat transfer (9)m= 69.86	coefficier 69.62	69.38		68.07	67.11	67.11	66.93	,	Average =	Sum(39) ₁	<u> </u>	68.2	8 (3
Jan 8)m= 38.77 eat transfer of	coefficier 69.62	69.38		68.07	67.11	67.11 0.85	66.93	,		Sum(39) ₁	<u> </u>	68.2	8 (3

Number of days in month (Table 1a)

Numbe	er of day	s in mo	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	ter heat	ing ene	rgy requi	rement:								kWh/ye	ear:	
•													I	
	ed occu		N + 1.76 x	[1 - exp	(-0 0003	849 v (TF	-Δ -13 Q	1211 + 0 (1013 x (ΓFΔ -13		44		(42)
	A £ 13.9		11.70 X	[ι Ολρ	(0.0000	/ X (11	71 10.0	<i>)</i> 2)] 1 0.0) X 010 Z	1170 10.	J)			
			ater usag									.24		(43)
		_	hot water person per			_	-	to achieve	a water us	se target o	f		•	
not more					i	i .	·						1	
Hot water	Jan Tusago ir	Feb	Mar day for ea	Apr	May	Jun	Jul Table 10 x	Aug	Sep	Oct	Nov	Dec		
i								· ·		ı			I	
(44)m=	101.46	97.77	94.08	90.39	86.7	83.01	83.01	86.7	90.39	94.08	97.77	101.46		
Eneray o	content of	hot water	used - cal	culated me	onthly = 4 .	190 x Vd.r	n x nm x E	OTm / 3600		Total = Su oth (see Ta	. ,		1106.83	(44)
	150.46	131.59	135.79	118.39	113.6	98.02	90.83	104.23	105.48	122.93	134.18	145.71		
(45)m=	130.46	131.39	133.79	110.39	113.0	90.02	90.03	104.23		Total = Su			1451.23	(45)
If instant	aneous w	ater heati	ng at point	of use (no	hot water	storage),	enter 0 in	boxes (46)		rotal = Su	II(45) ₁₁₂ =		1451.25	(40)
(46)m=	2 2.57	19.74	20.37	17.76	17.04	14.7	13.63	15.64	15.82	18.44	20.13	21.86		(46)
` '	storage		20.07	17.70	17.01		10.00	10.01	10.02	10.11	20.10	21.00		(- /
Storag	e volum	e (litre <mark>s</mark>)	inc <mark>ludir</mark>	ig any s	olar or W	WHRS	storage	within sa	ame ves	sel		150		(47)
If comr	<mark>nu</mark> nity h	eating a	nd no ta	nk in dw	elling, e	nter 110	litres in	(47)						
Otherw	<mark>ise</mark> if no	stored	hot wate	e <mark>r (th</mark> is ir	icludes i	nstantar	neous co	mbi boil	ers) ente	er '0' in (47)			
	storage													
a) If m	anufact	urer's d	eclared l	oss facto	or is kno	wn (kWł	n/day):				0	.3		(48)
Tempe	rature fa	actor fro	m Table	2b							0.	54		(49)
• • • • • • • • • • • • • • • • • • • •			storage	-				(48) x (49)) =		0.	16		(50)
•			eclared of factor fr	-								0		(51)
		•	ee secti		C 2 (KVV	11/11110/00	<i>y)</i>					0		(51)
	e factor	_										0		(52)
Tempe	rature fa	actor fro	m Table	2b								0		(53)
Energy	lost fro	m watei	storage	, kWh/ye	ear			(47) x (51)) x (52) x (53) =		0		(54)
Enter	(50) or (54) in (5	55)								0.	16		(55)
Water	storage	loss cal	culated f	or each	month			((56)m = (55) × (41)ı	m			•	
(56)m=	4.97	4.49	4.97	4.81	4.97	4.81	4.97	4.97	4.81	4.97	4.81	4.97		(56)
If cylinde	er contains	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 Append	I lix H	
(57)m=	4.97	4.49	4.97	4.81	4.97	4.81	4.97	4.97	4.81	4.97	4.81	4.97		(57)
			<u> </u>				1	1						. ,
	•	,	nual) fro			50)	(50) - 0(SE (44)				0		(58)
	•		culated trom Tab		,	•		, ,		r thormo	ctat)			
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	1	(59)
						Į			22.01	20.20	22.01	20.20		(00)
1			for each		<u> </u>	ì ´	- ` 	<u></u>					1	
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0		(61)

i Otal III	eat require	d for v	water he	eating ca	alculated	for ea	ch month	(62)m	$= 0.85 \times 0$	(45)m +	(46)m +	(57)m +	(59)m + (61)m	
(62)m=		7.09	164.02	145.71	141.83	125.3		132.46		151.16	161.5	173.94		(62)
Solar DH	IW input calcu	ulated u	using App	endix G or	Appendix	H (neg	ative quantity	y) (enter	'0' if no sola	r contribut	ion to wate	er heating)		
(add ad	ditional lin	es if F	GHRS	and/or V	VWHRS	applie	s, see Ap	pendix	G)					
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0		(63)
Output	from water	r heate	er						•		•			
(64)m=	178.69 15	7.09	164.02	145.71	141.83	125.3	119.06	132.46	132.8	151.16	161.5	173.94		
_	•	•					•	Ou	tput from w	ater heate	r (annual)₁	12	1783.62	(64)
Heat ga	ains from w	vater h	neating,	kWh/mo	onth 0.2	3.0] ` 5	85 × (45)m	+ (61)	m] + 0.8 x	k [(46)m	+ (57)m	+ (59)m]	
(65)m=	72.61 64	4.15	67.74	61.22	60.35	54.45	52.79	57.24	56.93	63.46	66.47	71.03		(65)
includ	de (57)m ir	n calcı	ulation o	of (65)m	only if c	ylinde	is in the	dwelling	g or hot w	ater is f	rom com	munity h	eating	
5. Inte	ernal gains	(see	Table 5	and 5a):									
Metabo	olic gains (Fable:	5), Wat	ts										
		-eb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(66)m=	122.18 12	2.18	122.18	122.18	122.18	122.1	3 122.18	122.18	122.18	122.18	122.18	122.18		(66)
Lighting	g gains (ca	lculate	ed in Ap	pendix	L, equati	ion L9	or L9a), a	lso see	Table 5	•	•			
(67)m=	19.38	7.21	14	10.6	7.92	6.69	7.23	9.39	12.61	16.01	18.68	19.91		(67)
Applian	ces gains	(calcu	lated in	Append	dix L, eq	uation	L13 or L1	3a), als	o see Ta	ble 5				
		$\overline{}$	213.91	201.81	186.54	172.1		160.34	_	178.12	193.39	207.75		(68)
Cooking	g gains (ca	alculat	ed in A	pendix	L, equat	ion L1	5 or L15a), also	see Table	5				
(69)m=	35.22 35	5.22	35.22	35.22	35.22	35.22	35.22	35.22	35.22	35.22	35.22	35.22		(69)
Pumps	and fans	gains ((Table 5	ia)										
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3		(70)
Losses	e.g. evapo	oration	า (negat	ive valu	es) (Tab	le 5)								
(71)m=		7.74	-97.74	-97.74	-97.74	-97.74	-97.74	-97.74	-97.74	-97.74	-97.74	-97.74		(71)
Water h	neating gai	ns (Ta	able 5)						•				l	
(72)m=	97.6 95	5.47	91.04	85.03	81.12	75.62	70.95	76.94	79.07	85.29	92.32	95.48		(72)
Total ir	nternal ga	ins =				(6	66)m + (67)n	n + (68)m	+ (69)m +	(70)m + (7	'1)m + (72)	m	ı	
(73)m=	396.97 39	4.92	381.6	360.09	338.23	317.1	5 303.42	309.32	320.35	0.40.07	367.05	385.79		(73)
6. Sola	o						I	1 000.02	1 320.33	342.07	307.03	303.73		
	ar gains:							000.02	320.33	342.07	307.03	303.79		
	ar gains: ains are calcu	ılated u	sing solar	flux from	Table 6a	and ass								
Solar ga	ains are calcu	ess Fa	Ü	Area		F	ociated equa	ations to	convert to th	I ne applicat	ole orientat		Gains	
Solar ga	ains are calcu		Ü			F	ociated equa	ations to	convert to th	I ne applicat	ole orientat		Gains (W)	
Solar ga	ains are calcu	ess Fa	Ü	Area		F	ociated equa	ations to	convert to th	I ne applicat	ole orientat](74)
Solar ga Orienta	ains are calcu ation: Acco Tab	ess Fa le 6d	actor	Area m²	13	F	ociated equa lux able 6a	ations to o	convert to the g_ Table 6b	ne applicat	ole orientat FF able 6c	ion.	(W)](74)](74)
Solar ga Orienta North	ains are calcu ation: Acco Tab	ess Fa le 6d	actor	Area m²	13	×	ociated equa lux able 6a	ations to o	convert to the g_ Table 6b	ne applicat	FF able 6c	ion.	(W) 22.52]
Solar ga Orienta North North	ains are calculation: According Tab	ess Fa le 6d 0.77	actor	Area m ² 6.9	3 3 3	x	lux able 6a 10.63	x X	Convert to the Gamma Table 6b	T x X	FF able 6c	= = = = = = = = = = = = = = = = = = =	(W) 22.52 43.04	(74)
Solar ga Orienta North North North	ains are calculation: According Tab	ess Fa le 6d 0.77 0.77	actor x x x	Area m² 6.9 6.9 6.9	3 3 3 3 3 3 3	x	lux able 6a 10.63 20.32 34.53	x X	0.63 0.63	T X X X	FF able 6c 0.7 0.7	= = = = = = = = = = = = = = = = = = =	(W) 22.52 43.04 73.13	(74) (74)
Solar ga Orienta North North North	ains are calculation: According Tab	0.77 0.77 0.77	actor × × × ×	Area m² 6.9 6.9 6.9	13 13 13 13	X X X X	ociated equal lux able 6a 10.63 20.32 34.53	x X X X X X X X X X X X X X X X X X X X	0.63 0.63 0.63	T X X X X X X X X X X X X X X X X X X X	FF cable 6c 0.7 0.7 0.7 0.7	= = = = = = = = = = = = = = = = = = =	(W) 22.52 43.04 73.13 117.47	(74) (74) (74)
Solar ga Orienta North North North North	ains are calculation: According Tab	0.77 0.77 0.77 0.77 0.77	actor x x x x x x	Area m² 6.9 6.9 6.9 6.9 6.9	3 3 3 3 3 3	X X X X X X	ociated equal lux able 6a 10.63 20.32 34.53 55.46	x	Convert to the Garage Table 6b 0.63 0.63 0.63 0.63 0.63	x X X X X X X X X X X X X X X X X X X X	0.7 0.7 0.7 0.7 0.7	= = = = = = = = = = = = = = = = = = =	(W) 22.52 43.04 73.13 117.47 158.24	(74) (74) (74) (74)
Solar ga Orienta North North North North North	ains are calculation: According Tab 0.9x 0.9x 0.9x 0.9x 0.9x 0.9x 0.9x	0.77 0.77 0.77 0.77 0.77	x x x x x x	Area m² 6.9 6.9 6.9 6.9 6.9 6.9	3 3 3 3 3 3 3	X X X X X X X X	ociated equal lux able 6a 10.63 20.32 34.53 55.46 74.72	x	0.63 0.63 0.63 0.63 0.63	x X X X X X X X X X X X X X X X X X X X	Die orientat FF able 6c 0.7 0.7 0.7 0.7 0.7 0.7	ion.	(W) 22.52 43.04 73.13 117.47 158.24 169.4	(74) (74) (74) (74) (74)

North	0.9x	0.77	X	6.9	93	x	41	.52	x	0.63	x	0.7		= [87.93	(74)
North	0.9x	0.77	X	6.9	93	X	24	.19	x	0.63	x	0.7		= [51.23	(74)
North	0.9x	0.77	X	6.9	93	x	13	3.12	x	0.63	x	0.7		= [27.78	(74)
North	0.9x	0.77	X	6.9	93	X	8.	.86	x	0.63	x	0.7		= [18.77	(74)
South	0.9x	0.77	X	12.	82	X	46	5.75	x	0.63	x	0.7		= [183.17	(78)
South	0.9x	0.77	X	12.	82	x	76	5.57	x	0.63	X	0.7		= [299.99	(78)
South	0.9x	0.77	X	12.	82	X	97	'.53	x	0.63	X	0.7		= [382.13	(78)
South	0.9x	0.77	X	12.	82	X	110	0.23	x	0.63	x	0.7		= [431.89	(78)
South	0.9x	0.77	X	12.	82	X	114	4.87	x	0.63	X	0.7		= [450.06	(78)
South	0.9x	0.77	X	12.	82	X	110	0.55	x	0.63	x	0.7		= [433.12	(78)
South	0.9x	0.77	X	12.	82	X	108	8.01	x	0.63	x	0.7		= [423.19	(78)
South	0.9x	0.77	X	12.	82	X	104	4.89	x	0.63	X	0.7		= [410.97	(78)
South	0.9x	0.77	X	12.	82	X	101	1.89	x	0.63	x	0.7		= [399.18	(78)
South	0.9x	0.77	X	12.	82	X	82	2.59	x	0.63	X	0.7		= [323.57	(78)
South	0.9x	0.77	X	12.	82	X	55	5.42	x	0.63	X	0.7		= [217.12	(78)
South	0.9x	0.77	X	12.	82	X	40	0.4	x	0.63	x	0.7		= [158.28	(78)
Solar g	ains in	watts, cal	culated	for eacl	h monti	1			(83)m	Sum(74)m .	(82)m					
(83)m=	205.69	343.03	455.27	549.36	608.3	60	02.52	581.34	536.4	487.11	374.8	244.9	177.0)5		(83)
Total g	ains – ii	nternal an	nd solar	(84)m =	= (73)m	+ (8	33)m ,	watts								
(84)m=	602.66	737.95	926 97	909.45	046 F 4		19.67						ECO 0			(84)
(01)111	002.00	131.93	836.87	909.45	946.54	9	19.07	884.77	845.	77 807.46	716.8	7 611.95	562.8	84		(04)
` ′		nal tempe					19.07	884.77	845.	77 807.46	716.8	7 611.95	562.8	34	•	(04)
7. Me	an inter		erature ((hea <mark>ting</mark>	seaso	n)					716.8	7 611.95	562.8	₃₄]	21	(85)
7. Me	an inter erature	nal tempe	erature ((heating eriods ir	season the liv	n) ing	area fr	om Tab			716.8	7 611.95	562.8	[21	
7. Me	an inter erature	nal tempe during he	erature ((heating eriods ir iving are	season the liv	n) ring n (s	area fr	om Tab	ole 9,	Th1 (°C)	716.8°				21	
7. Me	an inter erature ation fac	nal tempe during he tor for gai	erature (eating points for li	(heating eriods ir	season the live ea, h1,r	n) ring m (se	area fr	om Tab		Th1 (°C)			De 0.99		21	
7. Me Temp Utilisa (86)m=	an interestation factors Jan 0.99	nal tempe during he tor for gai Feb	eating points for line Mar	heating eriods ir iving are Apr 0.82	season the livea, h1,r May	n) ing n (s	area froe Tab Jun	om Tab ble 9a) Jul 0.33	ole 9,	Th1 (°C) g Sep 5 0.57	Oct	Nov	De		21	(85)
7. Me Temp Utilisa (86)m= Mean	an interestant interestation factors and the control of the contro	nal temper during he tor for gain Feb 0.97	erature (eating poins for limited Mar 0.93	(heating eriods ir iving are Apr 0.82 iving are	season the live ea, h1,r May 0.65	n) ing n (s	area fro ee Tab Jun 0.47 w step	om Tab ble 9a) Jul 0.33	ole 9, Au 0.36	Th1 (°C) g Sep 6 0.57 able 9c)	Oct 0.86	Nov 0.98	De 0.99		21	(85)
7. Me Temp Utilisa (86)m= Mean (87)m=	an interestation factors at the second of th	nal temper during he tor for gain Feb 0.97 I tempera 20.5	eating poins for li Mar 0.93 ture in l	heating eriods ir iving are Apr 0.82 iving are 20.9	season the livea, h1,r May 0.65	ing (sefollo	area from the control of the control	om Tab ble 9a) Jul 0.33 es 3 to 7	ole 9, Au 0.36 7 in Ta 21	Th1 (°C) g Sep 6 0.57 able 9c) 20.99	Oct	Nov 0.98	De		21	(85)
7. Me Temp Utilisa (86)m= Mean (87)m= Temp	an interesture erature Jan 0.99 interna 20.29 erature	nal temper during he tor for gain Feb 0.97 I temperat 20.5 during he	eating points for line Mar 0.93 ture in leating poating points.	heating eriods ir iving are 0.82 iving are 20.9 eriods ir	season the livea, h1,r May 0.65 ea T1 (the 20.98	ing (set of following)	area from the ee Tab Jun 0.47 w step 21 relling f	om Tab ble 9a) Jul 0.33 es 3 to 7 21	Au 0.36 7 in Ta	Th1 (°C) g Sep 6 0.57 able 9c) 20.99 , Th2 (°C)	Oct 0.86	Nov 0.98	De 0.99	c c 5	21	(85) (86) (87)
7. Me Temp Utilisa (86)m= Mean (87)m= Temp (88)m=	an interest ation factors ation factors at the second seco	nal temperature during he tor for gain feb 0.97 l temperature 20.5 during he 20.18	eating points for line Mar 0.93 ture in l 20.71 eating points 20.19	heating eriods ir o.82 iving are 20.9 eriods ir 20.2	season the livea, h1,r May 0.65 ea T1 (t 20.98 or rest or 20.2	n) ing (solution) follo	area from the ee Tab Jun 0.47 w step 21 elling f 0.21	om Tab ble 9a) Jul 0.33 os 3 to 7 21 from Ta	Ole 9, Au 0.36 in Ta 21 able 9 20.2	Th1 (°C) g Sep 6 0.57 able 9c) 20.99 , Th2 (°C)	Oct 0.86	Nov 0.98	De 0.99	c c 5	21	(85)
7. Me Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa	an interestation factors at the second of th	nal temper during he tor for gain Feb 0.97 I temperar 20.5 during he 20.18	eating poins for line of the control	heating eriods ir iving are 0.82 iving are 20.9 eriods ir 20.2 est of decrease.	season the livea, h1,r May 0.65 ea T1 (t 20.98 or rest or 20.2	n) ing (solution) follo	area from the ee Tab Jun 0.47 w step 21 elling f 0.21	om Table 9a) Jul 0.33 es 3 to 7 21 from Ta 20.21	Ole 9, Au 0.36 in Ta 21 able 9 20.2	Th1 (°C) g Sep 6 0.57 able 9c) 20.99 , Th2 (°C) 1 20.21	Oct 0.86	Nov 0.98 20.56	De 0.99	c 5 5	21	(85) (86) (87) (88)
7. Me Temp Utilisa (86)m= Mean (87)m= Temp (88)m=	an interest ation factors ation factors at the second seco	nal temperature during he tor for gain feb 0.97 l temperature 20.5 during he 20.18	eating points for line Mar 0.93 ture in l 20.71 eating points 20.19	heating eriods ir o.82 iving are 20.9 eriods ir 20.2	season the livea, h1,r May 0.65 ea T1 (t 20.98 or rest or 20.2	n) ing (some state of the state	area from the ee Tab Jun 0.47 w step 21 elling f 0.21	om Tab ble 9a) Jul 0.33 os 3 to 7 21 from Ta	Ole 9, Au 0.36 in Ta 21 able 9 20.2	Th1 (°C) g Sep 6 0.57 able 9c) 20.99 , Th2 (°C) 1 20.21	Oct 0.86	Nov 0.98	De 0.99	c 5 5	21	(85) (86) (87)
7. Me Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m=	an interestation factors at the second of th	nal temper during he tor for gain Feb 0.97 I temperar 20.5 during he 20.18 tor for gain	eating poins for line ating poins for rough	heating eriods ir iving are 20.9 eriods ir 20.2 est of do 0.78	season the livea, h1,r May 0.65 ea T1 (1 20.98 n rest of 20.2 welling, 0.6	n) iing iing follo follo h2,	area from the ee Tab Jun 0.47 w step 21 relling f 0.21 m (see	om Table 9a) Jul 0.33 es 3 to 7 21 from Ta 20.21 e Table 0.27	ole 9, Au 0.36 7 in Ta 21 able 9 20.2 9a) 0.3	Th1 (°C) g Sep 6 0.57 able 9c) 20.99 , Th2 (°C) 1 20.21	Oct 0.86 20.88 20.2	Nov 0.98 20.56	De 0.99	c 5 5	21	(85) (86) (87) (88)
7. Me Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m=	an interestation factors at the second of th	nal temper during he tor for gain Feb 0.97 I temperar 20.5 during he 20.18 tor for gain	eating poins for line ating poins for rough	criods ir iving are 0.82 iving are 20.9 eriods ir 20.2 est of do 0.78	season the livea, h1,r May 0.65 ea T1 (1 20.98 n rest of 20.2 welling, 0.6	n) ing (sing) follo f dw 2 h2,	area from the ee Tab Jun 0.47 w step 21 relling f 0.21 m (see	om Table 9a) Jul 0.33 es 3 to 7 21 from Ta 20.21 e Table 0.27	ole 9, Au 0.36 7 in Ta 21 able 9 20.2 9a) 0.3	Th1 (°C) g Sep 5 0.57 able 9c) 20.99 , Th2 (°C) 1 20.21 0.51 to 7 in Tab	Oct 0.86 20.88 20.2	Nov 0.98 20.56 20.2	De 0.99	55 99 P	21	(85) (86) (87) (88)
7. Me Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m= Mean	an interest ation factors ation factors at the control of the cont	nal temperature during he tor for gain during he 20.18 tor for gain 0.97	eating poins for line in leating poins for rough	heating eriods ir 0.82 iving are 20.9 eriods ir 20.2 est of do 0.78 the rest	season the livea, h1,r May 0.65 ea T1 (to 20.98 en rest or 20.2 welling, 0.6 of dwell	n) ing (sing) follo f dw 2 h2,	area from the ee Tab Jun 0.47 w step 21 relling f 0.21 m (see 0.41 T2 (fol	om Table 9a) Jul 0.33 os 3 to 7 21 from Ta 20.21 e Table 0.27	ole 9, Au 0.36 in Ta able 9 20.2 9a) 0.3 eps 3	Th1 (°C) g Sep 6 0.57 able 9c) 20.99 , Th2 (°C) 1 20.21 0.51 to 7 in Table 1 20.2	Oct 0.86 20.88 20.2 0.82 e 9c) 20.08	Nov 0.98 20.56 20.2	De 0.99 20.29 20.19 0.99	55 99 P	0.41	(85) (86) (87) (88) (89)
7. Me Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m= Mean (90)m=	an interestation factors at the second of th	nal temperature during he tor for gain 20.5 during he 20.18 tor for gain 0.97 ltemperature 19.54	eating poins for line ating poins for rough	criods ir iving are 20.9 eriods ir 20.2 est of do 0.78 the rest 20.09	season the livea, h1,r May 0.65 ea T1 (1 20.98 n rest of 20.2 welling, 0.6 of dwel 20.18	n) ing (s follo h2, h2, c ling 2	area free Tab Jun 0.47 w step 21 relling f 0.21 m (see 0.41 T2 (fol 0.21	om Tak ble 9a) Jul 0.33 es 3 to 7 21 from Ta 20.21 e Table 0.27 llow ste	ole 9, O.36 7 in Ta 21 able 9 20.2 9a) O.3 eps 3	Th1 (°C) g Sep 6 0.57 able 9c) 20.99 , Th2 (°C) 1 20.21 0.51 to 7 in Tab 1 20.2	Oct 0.86 20.88 20.2 0.82 e 9c) 20.08	Nov 0.98 20.56 20.2 0.97	De 0.99 20.29 20.19 0.99	55 99 P		(85) (86) (87) (88) (89) (90)
7. Me Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m= Mean (90)m=	an interestation factors at the second of th	nal temperature during he tor for gain 20.5 during he 20.18 tor for gain 0.97 ltemperature 19.54	eating poins for line ating poins for rough	criods ir iving are 20.9 eriods ir 20.2 est of do 0.78 the rest 20.09	season the livea, h1,r May 0.65 ea T1 (1 20.98 n rest of 20.2 welling, 0.6 of dwel 20.18	n) ing (sing) follo f dw 2 h2, (ling) elling	area free Tab Jun 0.47 w step 21 relling f 0.21 m (see 0.41 T2 (fol 0.21	om Tak ble 9a) Jul 0.33 es 3 to 7 21 from Ta 20.21 e Table 0.27 llow ste	ole 9, O.36 7 in Ta 21 able 9 20.2 9a) O.3 eps 3	Th1 (°C) g Sep 5 0.57 able 9c) 20.99 , Th2 (°C) 1 20.21 to 7 in Table 1 20.2	Oct 0.86 20.88 20.2 0.82 e 9c) 20.08	Nov 0.98 20.56 20.2 0.97 19.64 ving area ÷ (De 0.99 20.29 20.19 0.99	55 99 99 P		(85) (86) (87) (88) (89) (90)
7. Me Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m= Mean (90)m=	an interestation factors at the second of th	nal temperaduring heter for gaing heter for ga	eating poins for line ating poins for rough ture in table 19.84 ture (for 20.2	criods ir iving are 20.9 eriods ir 20.2 est of do 0.78 the rest 20.09 er the wh	season the livea, h1,r May 0.65 ea T1 (1 20.98 on rest of 20.2 welling, 0.6 of dwell 20.18	n) ing (s follo follo h2, c h2, c elling 2	area from the ee Tab Jun 0.47 w step 21 relling f 0.21 T2 (fol 0.21 g) = fL/ 0.53	om Take ble 9a) Jul 0.33 es 3 to 7 21 from Ta 20.21 e Table 0.27 llow ste 20.21 A × T1 20.53	ole 9, Au 0.36 7 in Ta 21 able 9 20.2 9a) 0.3 eps 3 20.2 + (1 - 20.5	Th1 (°C) g Sep 5 0.57 able 9c) 20.99 , Th2 (°C) 1 20.21 to 7 in Table 1 20.2	Oct 0.86 20.88 20.2 0.82 e 9c) 20.08 £LA = Liv	Nov 0.98 20.56 20.2 0.97 19.64 ring area ÷ (De 0.99 20.29 20.19 0.99 19.19 4) =	55 99 99 P		(85) (86) (87) (88) (89) (90) (91)
7. Me Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m= Mean (90)m=	an interestation factors at the second of th	nal temperaduring heter for gaing heter for ga	eating poins for line ating poins for rough ture in table 19.84 ture (for 20.2	criods ir iving are 20.9 eriods ir 20.2 est of do 0.78 the rest 20.09 er the wh	season the livea, h1,r May 0.65 ea T1 (1 20.98 on rest of 20.2 welling, 0.6 of dwell 20.18	n) ing (sing) (follo) h2, (gilling) 2 ellling 2	area from the ee Tab Jun 0.47 w step 21 relling f 0.21 T2 (fol 0.21 g) = fL/ 0.53	om Take ble 9a) Jul 0.33 es 3 to 7 21 from Ta 20.21 e Table 0.27 llow ste 20.21 A × T1 20.53	ole 9, Au 0.36 7 in Ta 21 able 9 20.2 9a) 0.3 eps 3 20.2 + (1 - 20.5	Th1 (°C) g Sep 5 0.57 able 9c) 20.99 Th2 (°C) 1 20.21 to 7 in Table 1 20.2 -fLA) × T2 3 20.52 where approximates a series of the content of the conten	Oct 0.86 20.88 20.2 0.82 e 9c) 20.08 £LA = Liv	Nov 0.98 20.56 20.2 0.97 19.64 ving area ÷ (De 0.99 20.29 20.19 0.99 19.19 4) =	5 5 9		(85) (86) (87) (88) (89) (90) (91)
7. Me Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m= Mean (90)m= Mean (92)m= Apply (93)m=	an interestation factors at the second of th	nal temperature during heator for gain and temperature during heator for gain and the during	eating poins for I on I	heating eriods in one of the iving are 20.9 eriods in 20.2 est of do 0.78 the rest 20.09 er the who 20.42 internal	season the livea, h1,r May 0.65 ea T1 (1 20.98 n rest or 20.2 welling, 0.6 of dwel 20.18 ole dwe 20.5 tempe	n) ing (sing) (follo) h2, (gilling) 2 ellling 2	area from a	om Table one Table 0.33 os 3 to 7 21 from Ta 20.21 e Table 0.27 llow ste 20.21 A × T1 20.53 n Table	ole 9, Au 0.36 7 in Ta 21 able 9 20.2 9a) 0.3 eps 3 20.2 + (1 - 20.5 4e, v	Th1 (°C) g Sep 5 0.57 able 9c) 20.99 Th2 (°C) 1 20.21 to 7 in Table 1 20.2 -fLA) × T2 3 20.52 where approximates a series of the content of the conten	Oct 0.86 20.88 20.2 0.82 e 9c) 20.08 £LA = Liv	Nov 0.98 20.56 20.2 0.97 19.64 ving area ÷ (De 0.999 20.29 20.19 0.99 19.19 4) =	5 5 9		(85) (86) (87) (88) (89) (90) (91) (92)
7. Me Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m= Mean (90)m= Mean (92)m= Apply (93)m= 8. Spa	an interest erature disconnection factors and an internation factors are also as a factor factors and an internation factors and	nal tempera during he tor for gai Feb 0.97 I tempera 20.5 during he 20.18 tor for gai 0.97 I tempera 19.54 I tempera 19.93 nent to the 19.93 ting requi	eating poins for rough of ture in to 19.84 ture (for 20.2) e mean 20.2 rement	heating eriods in iving are 20.9 eriods in 20.2 est of do 0.78 the rest 20.09 r the wh 20.42 internal 20.42	season the livea, h1,r May 0.65 ea T1 (1 20.98 n rest of 20.2 welling, 0.6 of dwel 20.18 ole dwe 20.5 tempe 20.5	n) ing (sing) (h2,) (lling) 2 elling 2 rratu 2	area from a fro	om Table on	ole 9, Au 0.36 7 in Ta 21 able 9 20.2 9a) 0.3 20.2 + (1 - 20.5 4e, v 20.5	Th1 (°C) g Sep 5 0.57 able 9c) 20.99 Th2 (°C) 1 20.21 to 7 in Table 1 20.2 -fLA) × T2 3 20.52 where approximates a series of the content of the conten	Oct 0.86 20.88 20.2 0.82 e 9c) 20.08 £LA = Livitation private 20.41	Nov 0.98 20.56 20.2 0.97 19.64 ving area ÷ (De 0.999 20.25 20.15 0.99 19.15 4) = 19.62	5 5 9 9 2	0.41	(85) (86) (87) (88) (89) (90) (91) (92)

Mar

Apr

May

Jun

Jul

Aug

Sep

Oct

Nov

Dec

Jan

Feb

Utilisation factor for gains, hm: (94)m= 0.99 0.96 0.91 0.79 0.62 0.43 0.3 0.33 0.53 0.83 0.97 0.99 Useful gains, hmGm , W = (94)m x (84)m (95)m= 595.32 711.33 762.21 722.1 586.95 396.84 263.67 276.37 429.61 596.2 592.37 558 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)
(95)m= 595.32 711.33 762.21 722.1 586.95 396.84 263.67 276.37 429.61 596.2 592.37 558 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)
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)
(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= 1073.45 1046.24 950.19 786.38 599.32 397.86 263.75 276.5 433.34 667.52 884.22 1062.99 (97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m
(98)m= 355.73 225.06 139.86 46.29 9.2 0 0 0 53.06 210.13 375.72
Total per year (kWh/year) = Sum(98) _{15,912} = 1415.05 (98)
Space heating requirement in kWh/m²/year 17.91 (99)
9a. Energy requirements – Individual heating systems including micro-CHP)
Space heating:
Fraction of space heat from secondary/supplementary system 0 (201
Fraction of space heat from main system(s) $(202) = 1 - (201) = 1$ (202)
Fraction of total heating from main system 1 $(204) = (202) \times [1 - (203)] = 1$ (204)
Efficiency of main space heating system 1
Efficiency of secondary/supplementary heating system, %
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec kWh/year
Space heating requirement (calculated above)
355.73 225.06 139.86 46.29 9.2 0 0 0 53.06 210.13 375.72
$(211)m = \{[(98)m \times (204)] \} \times 100 \div (206) $ (211)
380.46 240.7 149.58 49.5 9.84 0 0 0 0 56.75 224.74 401.84
Total (kWh/year) =Sum(211) _{15,1012} = 1513.42 (211)
Space heating fuel (secondary), kWh/month
$= \{[(98)m \times (201)] \} \times 100 \div (208)$
(215)m= 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)
178.69 157.09 164.02 145.71 141.83 125.34 119.06 132.46 132.8 151.16 161.5 173.94
Efficiency of water heater 79.8 (216
(217)m= 86.62 85.77 84.39 82.14 80.38 79.8 79.8 79.8 82.33 85.52 86.82 (217
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m
(219)m= 206.3 183.15 194.36 177.39 176.45 157.07 149.2 166 166.41 183.6 188.85 200.36
Total = Sum(219a) ₁₁₂ = 2149.14 (219
Annual totals kWh/year kWh/year
Space heating fuel used, main system 1 1513.42
Water heating fuel used 2149.14
Electricity for pumps, fans and electric keep-hot

central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)(230g) =		75	(231)
Electricity for lighting			342.18	(232)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216 =	326.9 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	464.21 (264)
Space and water heating	(261) + (262) + (263) + (264) =		791.11 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	38.93 (267)
Electricity for lighting	(232) x	0.519 =	177.59 (268)
Total CO2, kg/year	sum	of (265)(271) =	1007.63 (272)



				User D	Details:						
Assessor Name: Software Name:	Stroma FS	AP 201:			Strom Softwa	are Ve	rsion:			on: 1.0.3.4	
			Р	roperty	Address	TF 3B5	5P AR W	est Build	ding		
Address: 1. Overall dwelling dime	ncione:										
1. Overall dwelling diffle	:11510115.			Δτο	a(m²)		Δν Ηρ	ight(m)		Volume(m	3)
Ground floor				Aic		(1a) x		2.5	(2a) =	220	(3a)
Total floor area TFA = (1	a)+(1b)+(1c)+(′1d)+(1e	\+ (1r	, <u> </u>	88	(4)]` ′		`
	α) ((15) ((15) (((14)1(10)	,	.,	00)T(3C)T(3C	d)+(3e)+	(3n) -		
Dwelling volume						(3a) + (3b)+(30)+(30	л) т (Зе)т	.(311) =	220	(5)
2. Ventilation rate:	main	Se	condar	'V	other		total			m³ per hou	ır
N	heating	<u>_h</u>	eating	- –		, ,			40		
Number of chimneys	0	_] +	0	<u></u>]	0	<u> </u>	0		40 =	0	(6a)
Number of open flues	0	+	0	+	0] = [0	X :	20 =	0	(6b)
Number of intermittent fa	ns						0	X	10 =	0	(7a)
Number of passive vents	i						0	X	10 =	0	(7b)
Number of flueless gas fi	res					Ī	0	X e	40 =	0	(7c)
						_					
									Air ch	nanges per h	our
Infilt <mark>ration</mark> due to chi <mark>mne</mark>							0		÷ (5) =	0	(8)
If a pressurisation test has b			d, procee	d to (17),	otherwise (continue fi	rom (9) to	(16)			— (0)
Number of storeys in the Additional infiltration	ne aweiling (ns	9)						[(9)	-1]x0.1 =	0	(9) (10)
Structural infiltration: 0	.25 for steel or	timber f	rame or	0.35 fo	r masoni	v consti	ruction	[(0)	1,10.1 -	0	(11)
if both types of wall are p						•					` ′
deducting areas of openii	• / .		ad) ar 0	1 (222)	ممار مامم	antar O				_	— (40)
If suspended wooden for the suspended wooden f		`	ea) or o	. i (Seai	ea), eise	enter 0				0	(12)
Percentage of windows			rinned							0	(14)
Window infiltration	o ana accio an	augiii oii	ippou		0.25 - [0.2	x (14) ÷ 1	100] =			0	(15)
Infiltration rate					(8) + (10)	+ (11) + (⁻	12) + (13)	+ (15) =		0	(16)
Air permeability value,	q50, expresse	d in cub	ic metre	s per ho	our per s	quare m	etre of e	envelope	area	4	(17)
lf based on air permeabil	ity value, then	(18) = [(17	7) ÷ 20]+(8), otherw	rise (18) = (16)				0.2	(18)
Air permeability value applie		on test has	been dor	ne or a de	gree air pe	rmeability	is being u	sed			
Number of sides sheltere	ed				(20) = 1 -	0 075 v (10\1 _			2	(19)
Shelter factor	ing chalter for	tor			(20) = 13 (21) = (18)		19)] =			0.85	(20)
Infiltration rate incorporat	_				(21) = (10)	(20) =				0.17	(21)
Infiltration rate modified f Jan Feb	Mar Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	1	
L			Juli	l Jui	I Aug	Geb	1 001	1 1404	l pec	J	
Monthly average wind sp (22)m= 5.1 5	4.9 4.4	e /	3.8	3.8	3.7	4	4.3	4.5	4.7	1	
(,		7.0	<u> </u>	I 0.0	1	7		15	L'	J	
Wind Factor (22a)m = (2	2)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	I	

0.22	0.21	0.21	0.19	0.18	0.16	0.16	0.16	0.17	0.18	0.19	0.2]	
Calculate effec		-	rate for t	he appli	cable ca	se	!	!	!	!	!		
If mechanica			andiv N (2	3h) - (23s	a) × Fmv (e	aguation (1	NSN othe	rwisa (23h) <i>- (</i> 23a)			0.5	(2:
If balanced with		0		, ,	,	. ,	,, .	,) = (23a)			0.5	(2:
		•	•	_					2h\m . (22h) v [1 (220)	0	(2:
a) If balance		o 0	0	0	0	0	0	0	0	23b) x [0] - 100]	(2
b) If balance												J	•
4b)m= 0	0	0	0	0	0	0	0	0	0	0	0	1	(2
c) If whole h							<u> </u>					J	·
if (22b)n				•	•				.5 × (23b	o)			
4c)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5]	(2
d) If natural	ventilatio	on or wh	ole hous	e positiv	ve input	ventilatio	on from I	loft	l				
if (22b)n	n = 1, th	en (24d)	m = (22l	o)m othe	erwise (2	4d)m =	0.5 + [(2	2b)m² x	0.5]			_	
4d)m= 0	0	0	0	0	0	0	0	0	0	0	0		(2
Effective air	change	rate - er	iter (24a) or (24b	o) or (24	c) or (24	d) in bo	x (25)				_	
5)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		(2
B. Heat losse	s and he	eat loss	paramete	er:							_	_	
LEMENT	Gros		Openin		Net Ar	ea	U-val	ue	AXU		k-value	Э	ΑΧk
	area	(m²)	m		A ,r		W/m2		(W/	K)	kJ/m²-		kJ/K
oo <mark>rs</mark>					2.5	X	1	= [2.5				(2
/in <mark>dows</mark> Type	1				5.45	x1	/[1/(1.3)+	0.04] =	6.73				(2
indows Type	2				10.6	x1	/[1/(1.3)+	0.04] =	13.1				(2
/alls Type1	24.7	' 3	7.95		16.78	3 x	0.18	=	3.02	ר ר		\neg	(2
alls Type2	21.1	7	10.6		10.57	7 X	0.18		1.9	₹ i		\neg	(2
oof	59		0		59	x	0.15	= i	8.85	Ħ i			(3
otal area of e	lements	, m²			104.9								(;
or windows and	roof wind	ows, use e	ffective wi	ndow U-va	alue calcul	ated using	g formula 1	/[(1/U-valu	ıe)+0.04] a	as given in	paragraph	n 3.2	
include the area				ls and pan	titions							_	
abric heat los		•	U)				(26)(30)) + (32) =				36.11	1 (;
eat capacity								((28)	(30) + (32	2) + (32a).	(32e) =	4223.	11 (
nermal mass	parame	ter (TMF	P = Cm +	- TFA) ir	n kJ/m²K			Indica	tive Value	: Medium		250	(3
or design assess In be used inste				construct	ion are no	t known pr	recisely the	e indicative	values of	TMP in T	able 1f		
nermal bridge				ısina An	pendix l	<						0.66	(3
details of therma	•	,			-	•						0.00	(
otal fabric he			()	,	,			(33) +	(36) =			36.77	7 (3
entilation hea	at loss ca	alculated	l monthly	/				(38)m	= 0.33 × (25)m x (5)		
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec]	
8)m= 36.3	36.3	36.3	36.3	36.3	36.3	36.3	36.3	36.3	36.3	36.3	36.3]	(3
eat transfer o	coefficie	nt. W/K						(39)m	= (37) + (38)m		-	
cat transiti t													

Heat loss para	ımeter (I	HLP), W	′m²K					(40)m	= (39)m ÷	÷ (4)			
(40)m= 0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83		
				ı	ı	ı	l		Average =	Sum(40) ₁	12 /12=	0.83	(40)
Number of day	1	nth (Tab	le 1a)						1		ı	ı	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m= 31	28	31	30	31	30	31	31	30	31	30	31		(41)
4. Water heat	ting ene	rgy requ	irement:								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		6		(42)
Annual averag Reduce the annua not more that 125	al average	hot water	usage by	5% if the c	lwelling is	designed i			se target o		5.89		(43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage i	n litres pe	r day for ea	ach month	Vd,m = fa	ctor from	Table 1c x	(43)					l	
(44)m= 105.48	101.64	97.8	93.97	90.13	86.3	86.3	90.13	93.97	97.8	101.64	105.48		
										ım(44) ₁₁₂ =		1150.64	(44)
Energy content of	hot water	used - cal	culated m	onthly $= 4$.	190 x Vd,r	n x nm x E	Tm / 3600) kWh/mor	nth (see Ta	ables 1b, 1	c, 1d)		
(45)m= 156.42	136.8	141.17	123.07	118.09	101.91	94.43	108.36	109.65	127.79	139.49	151.48		_
If instantaneous w	vater heati	ng at noin	of use (no	hot water	r etoraga)	enter () in	hoves (46		Total = Su	ım(45) ₁₁₂ =	=	1 <mark>5</mark> 08.67	(45)
									10.47	00.00	00.70		(46)
(46)m= 23.46 Water storage	20.52 loss:	21.18	18.46	17.71	15.29	14.16	16.25	16.45	19.17	20.92	22.72		(46)
Storage volum) includir	ng any so	olar or W	WHRS	storage	within sa	ame ves	sel		5		(47)
If community h	neating a	and no ta	ınk 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					4.144							l	
a) If manufact				or is kno	wn (kVVI	n/day):					0		(48)
Temperature f											0		(49)
Energy lost fro b) If manufact		•			or io not		(48) x (49)) =			5		(50)
Hot water stor			-							0	.03		(51)
If community h	•			- (7,					.00		(- /
Volume factor	from Ta	ble 2a								2.	.88		(52)
Temperature f	actor fro	m Table	2b							0	.6		(53)
Energy lost fro		_	, kWh/ye	ear			(47) x (51)) x (52) x (53) =	0.	24		(54)
Enter (50) or ((54) in (55)								0.	24		(55)
Water storage	loss cal	culated	for each	month			((56)m = (55) × (41)	m				
(56)m= 7.49	6.76	7.49	7.25	7.49	7.25	7.49	7.49	7.25	7.49	7.25	7.49		(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 Append	ix H	
(57)m= 7.49	6.76	7.49	7.25	7.49	7.25	7.49	7.49	7.25	7.49	7.25	7.49		(57)
Primary circuit	loss (ar	nnual) fro	om Table	<u></u>							0		(58)
Primary circuit	,	•			59)m = ((58) ÷ 36	65 × (41)	m		-			
(modified by	factor f	rom Tab	le H5 if t	here is	solar wat	ter heati	ng and a	cylinde	r thermo	ostat)			
(59)m= 23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)

Cambilaga a	الم ما ما ما ما	fa., a a a b		(04)	(00) . 20	CE (44)	١						
Combi loss ca	o localizated	or each	month (01)m =	(60) ÷ 30	05 × (41)	0	0	0	Ιο	0]	(61)
							<u> </u>	<u> </u>	<u> </u>	ļ		(50)m + (61)m	(01)
(62)m= 187.17	`	171.92	152.83	148.84	131.66	125.18	139.11	139.41	158.54	169.25	182.23	(59)m + (61)m	(62)
Solar DHW input													(02)
(add addition									ii contribu	ion to wate	or ricating)		
(63)m= 0	0	0	0	0	0	0	0	0	0	0	0		(63)
Output from v	vater hea	ter					<u> </u>	<u>I</u>				l	
(64)m= 187.17	1	171.92	152.83	148.84	131.66	125.18	139.11	139.41	158.54	169.25	182.23		
	1		<u> </u>		<u> </u>	<u>!</u>	Out	put from w	ater heate	r (annual)₁	12	1870.75	(64)
Heat gains fro	om water	heating,	kWh/m	onth 0.2	5 ´ [0.85	× (45)m	+ (61)r	n] + 0.8 x	x [(46)m	+ (57)m	+ (59)m]	-
(65)m= 76.61	67.71	71.54	64.73	63.87	57.69	56	60.63	60.27	67.09	70.19	74.97	_	(65)
include (57)m in cal	culation of	of (65)m	only if c	ylinder i	s in the o	dwelling	or hot w	ater is f	rom com	munity h	neating	
5. Internal g	<i>'</i>			•	•						•		
Metabolic gai	Ì												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(66)m= 129.87	129.87	129.87	129.87	129.87	129.87	129.87	129.87	129.87	129.87	129.87	129.87		(66)
Lighting gains	s (calcula	ted in Ap	pendix	L, equati	ion L9 o	r L9a), <mark>a</mark>	lso see	Table 5					
(67)m= 21.39	18.99	15.45	11.69	8.74	7.38	7.97	10.37	13.91	17.67	20.62	21.98		(67)
App <mark>liance</mark> s ga	ains (ca <mark>lc</mark>	ulated ir	Append	dix L, eq	uation L	13 or L1	3a), als	see Ta	ble 5				
(68)m= 235.35	237.79	231.64	218.54	202	186.45	176.07	173.63	179.78	192.88	209.42	224.97		(68)
Cooking gain	s (calcula	ated in A	ppendix	L, equat	ion L15	or L15a)), also s	ee Table	5				
(69)m= 35.99	35.99	35.99	35.99	35.99	35.99	35.99	35.99	35.99	35.99	35.99	35.99		(69)
Pumps and fa	ans gains	(Table 5	5a)							-		•	
(70)m= 0	0	0	0	0	0	0	0	0	0	0	0		(70)
Losses e.g. e	vaporatio	n (nega	tive valu	es) (Tab	le 5)						-		
(71)m= -103.89	-103.89	-103.89	-103.89	-103.89	-103.89	-103.89	-103.89	-103.89	-103.89	-103.89	-103.89		(71)
Water heating	g gains (T	Table 5)										-	
(72)m= 102.97	100.76	96.16	89.9	85.84	80.13	75.27	81.49	83.7	90.18	97.49	100.76		(72)
Total interna	l gains =			-	(66))m + (67)m	n + (68)m	+ (69)m +	(70)m + (7	'1)m + (72))m		
(73)m= 421.67	419.5	405.2	382.09	358.54	335.92	321.27	327.45	339.36	362.69	389.49	409.67		(73)
6. Solar gair	ns:												
Solar gains are		Ü	r flux from	Table 6a			itions to c	onvert to th	ne applical		tion.		
Orientation:	Access F Table 6d		Area m²		Flu	ıx ble 6a	_	g_ Fable 6b	т	FF able 6c		Gains	
_					ı a	DIE Ga	. –	able ob	_ '	able 60		(W)	,
East 0.9x		X	5.4	1 5	X 1	19.64	×	0.63	X	0.7	=	32.71	(76)
East 0.9x		X	5.4	5	x 3	38.42	×	0.63	X	0.7	=	63.99	(76)
East 0.9x		X	5.4	15	x 6	63.27	×	0.63	X	0.7	=	105.39	(76)
East 0.9x		X	5.4	5	x 9	92.28	x	0.63	x	0.7	=	153.7	(76)
East 0.9x	1	X	5.4	15	x 1	13.09	X	0.63	Х	0.7	=	188.37	(76)

	_										_				
East	0.9x	1	X	5.4	15	X	115	5.77	X	0.63	X	0.7	=	192.83	(76)
East	0.9x	1	X	5.4	15	X	110).22	X	0.63	х	0.7	=	183.58	(76)
East	0.9x	1	X	5.4	15	X	94	.68	X	0.63	X	0.7	=	157.69	(76)
East	0.9x	1	X	5.4	15	X	73	.59	x	0.63	X	0.7	=	122.57	(76)
East	0.9x	1	X	5.4	15	X	45	.59	x	0.63	X	0.7	=	75.93	(76)
East	0.9x	1	X	5.4	15	X	24	.49	x	0.63	X	0.7	=	40.79	(76)
East	0.9x	1	X	5.4	15	X	16	.15	x	0.63	X	0.7	=	26.9	(76)
West	0.9x	0.77	X	10	.6	X	19	.64	x	0.63	x	0.7	=	63.62	(80)
West	0.9x	0.77	X	10	.6	X	38	.42	x	0.63	x	0.7	=	124.46	(80)
West	0.9x	0.77	X	10	.6	X	63	.27	x	0.63	x	0.7	=	204.97	(80)
West	0.9x	0.77	x	10	.6	X	92	.28	х	0.63	x	0.7	=	298.94	(80)
West	0.9x	0.77	X	10	.6	X	113	3.09	х	0.63	X	0.7	=	366.36	(80)
West	0.9x	0.77	x	10	.6	X	115	5.77	х	0.63	x	0.7	=	375.04	(80)
West	0.9x	0.77	x	10	.6	X	110).22	х	0.63	x	0.7	=	357.05	(80)
West	0.9x	0.77	x	10	.6	X	94	.68	х	0.63	X	0.7	=	306.7	(80)
West	0.9x	0.77	x	10	.6	X	73	.59	х	0.63	x	0.7	=	238.39	(80)
West	0.9x	0.77	×	10	.6	X	45	.59	х	0.63	×	0.7		147.69	(80)
West	0.9x	0.77	x	10	.6	X	24	.49	Х	0.63	X	0.7	=	79.33	(80)
West	0.9x	0.77	×	10	.6	Х	16	.15	х	0.63	x	0.7	=	52.32	(80)
			$\lceil \mid \mid$												
Sola <mark>r g</mark>	ains in	watts, calc	ulated	for eac	h month	1			(83)m	= Sum(74)m .	(8 <mark>2</mark>)m				
(83)m=	<mark>9</mark> 6.34	188.46 3	10.36	452.64	554.73	50	67.86	540.63	464.	39 360.96	223.6	2 120.12	79.22		(83)
Total g	ains – ir	nternal and		(84)m =	= (73)m	+ (8	33)m ,	watts					•		
(84)m=	518	607.96 7	15.56	834.74	913.27	90	03.79	861.9	791.	84 700.32	586.3	509.61	488.89		(84)
7. Mea	an inter	nal temper	ature ((heating	seasor	า)									
Temp	erature	during hea	ating p	eriods ir	n the liv	ing	area fr	om Tab	ole 9,	Th1 (°C)				21	(85)
Utilisa	tion fac	tor for gair	ns for li	iving are	ea, h1,n	n (s	ee Tab	le 9a)							
	Jan	Feb	Mar	Apr	May		Jun	Jul	Αι	ıg Sep	Oct	Nov	Dec		
(86)m=	1	0.99	0.97	0.89	0.71	(0.51	0.37	0.4	2 0.69	0.95	0.99	1		(86)
Mean	interna	temperatu	ure in I	iving are	ea T1 (f	ollo	w step	s 3 to 7	in T	able 9c)					
(87)m=	20.2	20.35 2	20.59	20.84	20.97		21	21	21	20.98	20.77	20.42	20.16		(87)
Temp	erature	during hea	atina p	eriods ir	n rest of	f dw	ellina f	rom Ta	ıble 9	. Th2 (°C)		-		•	
(88)m=	20.23		20.23	20.23	20.23	1	0.23	20.23	20.2	- 	20.23	20.23	20.23]	(88)
ı L Itilisa	tion fac	tor for gain	ns for r	est of d	welling	h2	m (see	Table	—— (او	!		!			
(89)m=	1		0.97	0.86	0.66	1	0.45	0.31	0.3	5 0.63	0.93	0.99	1]	(89)
L	:t.o. ##0.0	ļ.			<u> </u>	 } }	T0 /fal			!				J	
(90)m=	19.15		19.71	20.05	20.2	Ť	0.23	20.23	20.2	to 7 in Table 20.21	9C) 19.97	19.47	19.09]	(90)
(90)111=	19.15	19.37	19.71	20.03	20.2		.0.23	20.23	20.2			/ing area ÷ (4	<u> </u>	0.25	(91)
											_, , — ⊑	3	-/	0.25	(31)
Г					ole dwe	ellin		4 × T1	+ (1 -	- fLA) × T2				,	
					ـ ـ ا			'	_	ا ۔۔ ا					(00)
(92)m=	19.42		19.93	20.25	20.39		0.42	20.42	20.4	12 20.4 where appro	20.17		19.36		(92)

(93)m= 19.42	19.61	19.93	20.25	20.39	20.42	20.42	20.42	20.4	20.17	19.71	19.36		(93)
8. Space hea	iting requ	uirement	t										
Set Ti to the the utilisation					ned at ste	ep 11 of	Table 9	b, so tha	ıt Ti,m=(76)m an	d re-calcu	ulate	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation fac	L			iviay	Juli	Jui	Aug	Сер	<u> </u>	INOV	Dec		
(94)m= 1	0.99	0.96	0.87	0.67	0.47	0.32	0.37	0.64	0.93	0.99	1		(94)
Useful gains,	hmGm	, W = (9	4)m x (8	4)m	<u> </u>		!	l	l	<u> </u>	<u> </u>		
(95)m= 516.1	601.65	688.83	722.12	616.1	423.51	279.01	293.45	450.17	545.92	504.92	487.63		(95)
Monthly aver	age exte	rnal tem	perature	from T	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	e for me	an intern	al tempe	erature,	Lm , W =	=[(39)m	x [(93)m	– (96)m]				
` '	1075.15		829.2	635.05	425.1	279.13	293.72	460.64	699.13	921.51	1107.73		(97)
Space heatin		1	1	I		I	T		i 	·			
(98)m= 437.72	318.19	217.58	77.09	14.1	0	0	0	0	113.99	299.94	461.36		_
							Tota	l per year	(kWh/yea	r) = Sum(9	8)15,912 =	1939.97	(98)
Space heatin	g require	ement in	kWh/m²	² /year								22.05	(99)
9b. Energy red	quiremer	nts – Coi	mmunity	heating	scheme								
This part is us Fraction of spa					_		.	•		unity sch	neme.	0	(301)
							(100.0	., •	0110				=
Fraction of spa					•					L		1	(302)
The c <mark>ommu</mark> nity so includes boilers, h					-				up to four	other heat	sources; th	e latter	
Fraction of hea		_									Γ	1	(303a)
Fraction of total	al space	heat fro	m Comn	nunity be	oilers				(3	02) x (303	a) = [1	(304a)
Factor for conf						r commi	unity hea	ating sys			" L	1	(305)
Distribution los	ss factor	(Table 1	12c) for (commun	ity heatii	ng syste	m				Ĺ	1.05	(306)
Space heating	g										_	kWh/yea	r
Annual space	heating	requiren	nent									1939.97	
Space heat fro	om Comi	munity b	oilers					(98) x (30	04a) x (30	5) x (306)	= [2036.96	(307a)
Efficiency of se	econdar	y/supple	mentary	heating	system	in % (fro	om Table	4a or A	ppendix	E)		0	(308
Space heating	require	ment fro	m secon	dary/su	oplemen	tary sys	tem	(98) x (30	01) x 100 ·	÷ (308) =		0	(309)
Water heating											_		_
Annual water l	_	•										1870.75	
If DHW from c Water heat fro								(64) x (30	03a) x (30	5) x (306)	- [1964.28	(310a)
Electricity used	d for hea	at distribi	ution				0.01	× [(307a)	(307e) +	- (310a)	(310e)] =	40.04	(313)
												40.01	
Cooling Syster	m Energ			0							ŗ	0	(314)
Cooling System Space cooling	•	y Efficie	ncy Rati		n, if not e	enter 0)		= (107) ÷	- (314) =		[]		(314)
Space cooling Electricity for p	if there) oumps a	y Efficie is a fixe	ncy Rational Red cooling	g systen velling (⁻	Γable 4f)	:		= (107) ÷	- (314) =]	0	(315)
Space cooling	if there) oumps a	y Efficie is a fixe	ncy Rational Red cooling	g systen velling (⁻	Γable 4f)	:		= (107) ÷	- (314) =]]]	0	=

warm air heating system fans				0	(330b)
pump for solar water heating				0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330	b) + (330g) =		63.88	(331)
Energy for lighting (calculated in Appendix L)				377.67	(332)
12b. CO2 Emissions – Community heating scheme					
	Energy kWh/year	Emission fact kg CO2/kWh		nissions J CO2/year	
CO2 from other sources of space and water heating (not efficiency of heat source 1 (%)	CHP) HP using two fuels repeat (363) to	(366) for the second	d fuel	89.5	(367a)
CO2 associated with heat source 1	(307b)+(310b)] x 100 ÷ (367b) x	0	=	965.66	(367)
Electrical energy for heat distribution	[(313) x	0.52	=	20.77	(372)
Total CO2 associated with community systems	(363)(366) + (368)(372	2)	=	986.43	(373)
CO2 associated with space heating (secondary)	(309) x	0	=	0	(374)
CO2 associated with water from immersion heater or insta	antaneous heater (312) x	0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =			986.43	(376)
CO2 associated with electricity for pumps and fans within	dwelling (331)) x	0.52	=	33.15	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	196.01	(379)
Total CO2, kg/year sum of (376)(382)	=			1215.6	(383)
Dwelling CO2 Emission Rate (383) ÷ (4) =				13.81	(384)
El rating (section 14)				87.75	(385)

			User [Details:						
Assessor Name: Software Name:	Stroma FSAP 201	2		Stroma Softwa				Versic	on: 1.0.3.4	
		Pr	operty	Address	TF 3B	5P AR W	est Buil	ding		
Address :										
1. Overall dwelling dime	nsions:			(0)						•>
Ground floor			Are	a(m²) 88	(1a) x		2.5	(2a) =	Volume(m	3) (3a
Total floor area TFA = (1a	a)+(1b)+(1c)+(1d)+(1e	e)+(1n)	88	(4)					
Dwelling volume					(3a)+(3b	o)+(3c)+(3c	d)+(3e)+	.(3n) =	220	(5)
2. Ventilation rate:										
Number of chimneys	heating	econdary neating	у 7 + Г	other	7 ₌ F	total	x	40 =	m³ per hou	.ır ── _{(6a}
ŕ		0	╛╘	0	<u> </u>	0		20 =	0	╡`
Number of open flues	0 +	0] + [0] = [0			0	(6b)
Number of intermittent far	าร					3	X	10 =	30	(7a
Number of passive vents						0	Х	10 =	0	(7b
Number of flueless gas fir	res					0	X ·	40 =	0	(7c
								Air ch	nanges <mark>per</mark> he	our
Infilt <mark>ration</mark> due to chimney	s, flues and fans = 6	a)+(6b)+(7a	a)+(7b)+((7c) =	Г	30		÷ (5) =	0.14	(8)
If a pressurisation test has be		ed, proceed	I to (17),	otherwise o	ontinue fi	rom (9) to	(16)			
Number of storeys in th	e dwelling (ns)								0	(9)
Additional infiltration Structural infiltration: 0.	25 for stool or timber:	frame or	0.35 fo	r macani	v const	ruction	[(9)	-1]x0.1 =	0	(10
	esent, use the value corres				•	iuction			0	(11
deducting areas of opening	gs); if equal user 0.35									_
If suspended wooden fl	•	ed) or 0.	1 (seale	ed), else	enter 0				0	(12
If no draught lobby, ent		rinned							0	(13
Percentage of windows Window infiltration	and doors draught st	nppeu		0.25 - [0.2	x (14) ÷ 1	1001 =			0	(14
Infiltration rate				(8) + (10)	` '		+ (15) =		0	(16
Air permeability value,	q50, expressed in cub	oic metres	s per ho					area	5	(17
If based on air permeabili	•		•	•	•				0.39	(18
Air permeability value applies	s if a pressurisation test has	s been don	e or a de	gree air pe	rmeability	is being u	sed			
Number of sides sheltered	d			(00)	'0 07E (40)1			2	(19
Shelter factor				(20) = 1 -		19)] =			0.85	(20
Infiltration rate incorporati				(21) = (18)	(20) =				0.33	(21
Infiltration rate modified fo		1	11	Δ	0	0-4	Nan	D.,	1	
	Mar Apr May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind specification (22)m= 5.1 5		20	20	27	4	1 2	4.5	17	1	
(22)m= 5.1 5	4.9 4.4 4.3	3.8	3.8	3.7	4	4.3	4.5	4.7	J	
Wind Factor (22a)m = (22	?)m ÷ 4									

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.3	0.33	0.35	0.37	0.39		
alculate effec		•	rate for t	he appli	cable ca	se	l	l	l	l		1	
If mechanica			l' N. (0	al.) (aa	\ - /	<i>i</i> : (1)	15// (1	. (00)	\ (00 \			0	(2
If exhaust air he		0		, ,	,	. `	,, .	`) = (23a)			0	(2
If balanced with		•	•	•		,		,				0	(2
a) If balance		i			1	, ` ` 	- ^ `	ŕ	 	- 	<u>` </u>	÷ 100] I	(0
a)m= 0	0	0	0	0	0	0	0	0	0	0	0		(2
b) If balance						, 	<u> </u>	``	 		1	1	(5
b)m= 0	0	0	0	0	0	0	0	0	0	0	0		(2
c) If whole h				•	•				F (00l-	. \			
if (22b)m		<u> </u>	· ` `	ŕ	í 	wise (24)	ŕ	ŕ	· ` `			1	(2
c)m= 0	0	0	0	0	0		0	0	0	0	0		(2
d) If natural (if (22b)m				•	•				0.5]				
d)m= 0.59	0.58	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57		(2
ـــــــــ Effective air	change	rate - er	nter (24a	or (24b	o) or (24	c) or (24	d) in box	· (25)	<u> </u>	<u> </u>		l	
)m= 0.59	0.58	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57		(2
								l					
. Heat losse:													
<u>EME</u> NT	Gros are <mark>a</mark>		Openin		Net Ar A ,r		U-valı W/m2		A X U (W/I	K)	k-value kJ/m²-l		A X k kJ/K
ors		()	, i		2.5	x	1	= [2.5		,,,,,		(2
ndows Type	1				5.45	╡	 /[1/(1.4)+		7.23	Ħ			(2
indows Type					10.6		/[1/(1.4)+	1	14.05	Ħ			(2
alls Type1		,,	7.05							╡ ,			`
• •	24.7		7.95	=	16.78	=	0.18	= [3.02	륵 ¦			(2
alls Type2	21.1		10.6		10.57	7 X	0.18	=	1.9	亅 ¦		_	(2
oof	. 59		0		59	X	0.13	= [7.67	[(;
tal area of e					104.9								(;
or windows and nclude the area						lated using	formula 1	/[(1/U-valu	ıe)+0.04] a	as given in	paragraph	3.2	
bric heat los				is and pan	uuons		(26)(30)) + (32) =				36.37	(;
at capacity		•	O)					((28)	(30) + (32	2) + (32a).	(32e) =	4223.1	==
ermal mass	`	,	P = Cm =	- TFΔ) ir	n k.l/m²K			***	tive Value	, , ,	(020) =	250	<u>'</u> ('
r design assess	•	•		,			ecisely the				able 1f	230	(
be used instea				construct	1011 410 110	crarown pr	oolooly tile	marodavo	values of		abio 11		
ermal bridge	es : S (L	x Y) cal	culated ı	using Ap	pendix I	K						0.55	(
etails of therma		are not kn	own (36) =	= 0.15 x (3	31)								
tal fabric he								(33) +	(36) =			36.92	(3
ntilation hea		i	monthly	/	•	•	·		= 0.33 × (25)m x (5)) •	1	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
)m= 42.66	42.42	42.18	41.04	40.82	39.83	39.83	39.65	40.22	40.82	41.25	41.71		(;
,													
at transfer o	oefficier	nt, W/K						(39)m	= (37) + (3	38)m		_	

leat lo	ss para	meter (H	HLP), W	m²K					(40)m	= (39)m ÷	- (4)			
10)m=	0.9	0.9	0.9	0.89	0.88	0.87	0.87	0.87	0.88	0.88	0.89	0.89		
umbo	r of day	rc in moi	nth (Tab	lo 1a\						Average =	Sum(40) ₁	12 /12=	0.89	(40
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
l1)m=	31	28	31	30	31	30	31	31	30	31	30	31		(4
, I									<u> </u>	<u> </u>				`
4 Wa	ter heat	ing ener	rgy requi	irement								kWh/ye	ear:	
if TF.				[1 - exp	(-0.0003	349 x (TF	FA -13.9)2)] + 0.0	0013 x (TFA -13		.6		(4
								(25 x N)				5.89		(4
		_		usage by : day (all w		-	_	to achieve	a water us	se target d)Ť			
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
ot wate				ach month	,									
4)m=	105.48	101.64	97.8	93.97	90.13	86.3	86.3	90.13	93.97	97.8	101.64	105.48		
			, ,								m(44) ₁₁₂ =		1150.64	(4
								Tm / 3600		_				
5)m=	156.42	136.8	141.17	123.07	118.09	101.91	94.43	108.36	109.65	127.79	139.49	151.48	4500.07	— ,,
nstant	aneous w	ater heatii	ng at point	of use (no	hot water	storage),	enter 0 in	boxes (46)		rotar = Su	m(45) ₁₁₂ =		1508.67	(4
6)m=	23.46	20.52	21.18	18.46	17.71	15.29	14.16	16.25	16.45	19.17	20.92	22.72		(4
/ater	storage	loss:	7											
		,						within sa	ame ves	sel		150		(4
	-	_		ink in dw	_				ara) ante	or 'O' in /	′ 47 \			
	storage		not wate	er (unis ir	iciudes i	nstantar	ieous cc	mbi boil	ers) ente	er O in ((47)			
	-		eclared I	oss facto	or is kno	wn (kWh	n/day):				0	.3		(4
empe	rature fa	actor fro	m Table	2b							0.	54		(4
٠,			•	, kWh/ye				(48) x (49)) =		0.	16		(5
,				cylinder l										
		_	ee secti	om Tabl on 4.3	e z (KVV	n/iitre/ua	iy)					0		(5
	-	from Ta		011 1.0								0		(5
empe	rature fa	actor fro	m Table	2b								0		(5
nergy	lost fro	m water	storage	, kWh/ye	ear			(47) x (51)) x (52) x (53) =		0		(5
nter	(50) or (54) in (5	55)								0.	16		(!
ater :	storage	loss cal	culated f	for each	month			((56)m = (55) × (41)	m				
6)m=	4.97	4.49	4.97	4.81	4.97	4.81	4.97	4.97	4.81	4.97	4.81	4.97		(5
cylinde	r contains	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 Append	ix H	
7)m=	4.97	4.49	4.97	4.81	4.97	4.81	4.97	4.97	4.81	4.97	4.81	4.97		(5
imar	y circuit	loss (ar	nual) fro	m Table	 3							0		(5
		•				59)m = ((58) ÷ 36	65 × (41)	m					
(mod	lified by	factor f	rom Tab	le H5 if t	here is s	solar wat	er heati	ng and a	cylinde	r thermo	stat)			
9)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(!

Combilees	ام مغمان بمام	for oosh		(04)	(00) . 0	CE (44)	١						
Combi loss of (61) m= 0	alculated	for each		61)m =	(60) ÷ 30	05 × (41))m 0	0	0	0	0	1	(61)
							<u> </u>	<u> </u>		ļ.		(50) (64)	(01)
(62)m= 184.6	<u> </u>	169.4	150.39	146.32	129.22	122.66	136.59	136.97	156.02	(46)m + 166.81	179.71	(59)m + (61)m 1	(62)
Solar DHW inpu		l .	<u> </u>									J	(02)
(add addition									r contribu	iion io waie	er nealing)		
(63)m= 0	0		0	0	0	0	0	0	0	0	0	1	(63)
Output from		ļ										l	` '
(64)m= 184.6		169.4	150.39	146.32	129.22	122.66	136.59	136.97	156.02	166.81	179.71	1	
` '							Out	ut from w	ı ater heate	ır (annual)₁	12	1841.06	(64)
Heat gains fr	om water	heating.	kWh/m	onth 0.2	5 ′ [0.85	× (45)m	+ (61)r	nl + 0.8 x	k [(46)m	+ (57)m	+ (59)m	1	_
(65)m= 74.59	1	69.52	62.78	61.85	55.74	53.98	58.61	58.32	65.07	68.24	72.95	اً	(65)
include (57	L 7)m in cal	culation o	of (65)m	only if c	vlinder i	s in the o	dwelling	or hot w	ater is f	rom com	munity h	ı neating	
5. Internal	<u> </u>			•	,		z					.cag	
Metabolic ga				, .									
Jan		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	1	
(66)m= 129.8	7 129.87	129.87	129.87	129.87	129.87	129.87	129.87	129.87	129.87	129.87	129.87		(66)
Lighting gain	s (calcula	ted in Ap	pendix	L, equati	on L9 o	r L9a), a	lso see	Table 5					
(67)m= 21.39	18.99	15.45	11.69	8.74	7.38	7.97	10.37	13.91	17.67	20.62	21.98		(67)
Appliances g	ains (calc	ulated ir	Append	dix L, eq	uation L	13 or L1	3a), als	see Ta	ble 5			'	
(68)m= 235.3	1	231.64	218.54	202	186.45	176.07	173.63	179.78	192.88	209.42	224.97]	(68)
Cooking gair	ns (calcula	ated in A	ppendix	L, equat	ion L15	or L15a), also s	ee Table	5			'	
(69)m = 35.99	<u> </u>	35.99	35.99	35.99	35.99	35.99	35.99	35.99	35.99	35.99	35.99		(69)
Pumps and f	ans gains	(Table 5	5a)										
(70)m= 3	3	3	3	3	3	3	3	3	3	3	3]	(70)
Losses e.g.	evaporatio	n (nega	tive valu	es) (Tab	le 5)			Į.		·			
(71)m= -103.8	9 -103.89	-103.89	-103.89	-103.89	-103.89	-103.89	-103.89	-103.89	-103.89	-103.89	-103.89	1	(71)
Water heatin	g gains (1	rable 5)	!									•	
(72)m= 100.2	``	93.44	87.19	83.13	77.42	72.56	78.78	80.99	87.47	94.77	98.05]	(72)
Total interna	al gains =	•			(66))m + (67)m	ı + (68)m	+ (69)m +	(70)m + (7	'1)m + (72))m	1	
(73)m= 421.9	5 419.79	405.49	382.38	358.83	336.21	321.56	327.74	339.65	362.97	389.77	409.96]	(73)
6. Solar gai	ns:												
Solar gains are	e calculated	using sola	r flux from	Table 6a	and assoc	iated equa	itions to c	onvert to th	ne applical	ole orienta	tion.		
Orientation:			Area		Flu		_	g_ -	_	FF		Gains	
	Table 6d		m²		Ta	ble 6a		Table 6b	T	able 6c		(W)	_
East 0.9	1	X	5.4	15	x 1	19.64	х	0.63	x	0.7	=	32.71	(76)
East 0.9	1	X	5.4	1 5	x 3	38.42	х	0.63	x [0.7	=	63.99	(76)
East 0.9	1	X	5.4	ŀ5	x 6	3.27	х	0.63	x	0.7	=	105.39	(76)
East 0.9	1	Х	5.4	15	x 9	92.28	х	0.63	x [0.7	=	153.7	(76)
East 0.9x	1	X	5.4	15	x 1	13.09	x	0.63	×	0.7	=	188.37	(76)

	_										_				
East	0.9x	1	X	5.4	15	X	1	15.77	X	0.63	X	0.7	=	192.83	(76)
East	0.9x	1	X	5.4	15	X	1	10.22	X	0.63	X	0.7	=	183.58	(76)
East	0.9x	1	X	5.4	15	X	9	4.68	X	0.63	X	0.7	=	157.69	(76)
East	0.9x	1	X	5.4	15	X	7	3.59	X	0.63	X	0.7	=	122.57	(76)
East	0.9x	1	X	5.4	15	X	4	5.59	X	0.63	X	0.7	=	75.93	(76)
East	0.9x	1	X	5.4	15	X	2	4.49	X	0.63	X	0.7	=	40.79	(76)
East	0.9x	1	X	5.4	15	X	1	6.15	x	0.63	x	0.7	=	26.9	(76)
West	0.9x	0.77	X	10	.6	x	1	9.64	X	0.63	x	0.7	=	63.62	(80)
West	0.9x	0.77	X	10	.6	x	3	8.42	X	0.63	x	0.7	=	124.46	(80)
West	0.9x	0.77	X	10	.6	x	6	3.27	X	0.63	x	0.7	=	204.97	(80)
West	0.9x	0.77	X	10	.6	x	9	2.28	x	0.63	x	0.7		298.94	(80)
West	0.9x	0.77	X	10	.6	x	1	13.09	х	0.63	x	0.7	_ =	366.36	(80)
West	0.9x	0.77	X	10	.6	x	1	15.77	x	0.63	×	0.7	=	375.04	(80)
West	0.9x	0.77	X	10	.6	x	1	10.22	х	0.63	x	0.7	=	357.05	(80)
West	0.9x	0.77	X	10	.6	x	9	4.68	х	0.63	x	0.7	=	306.7	(80)
West	0.9x	0.77	X	10	.6	x	7	3.59	x	0.63	×	0.7	_ =	238.39	(80)
West	0.9x	0.77	X	10	.6	x	4	5.59	x	0.63	x	0.7		147.69	(80)
West	0.9x	0.77	X	10	.6	X	2	4.49	Х	0.63	Х	0.7	=	79.33	(80)
West	0.9x	0.77	x	10	.6	х	1	6.15	х	0.63	x	0.7	= -	52.32	(80)
	_														
Solar g	ains in	watts, <mark>cal</mark>	lculated	for eac	h mont	h	'		(83)m	= Sum(74)m .	(82)m				
(83)m=	96.34	188.46	310.36	452.64	554.73	5	67.86	540.63	464.	39 360.96	223.62	2 120.12	79.22		(83)
Total g	ains – iı	nternal ar	nd solar	(84)m =	= (73)m	1 + (83)m	, watts							
(84)m=	518.29	608.25	715.85	835.02	913.56	9	04.07	862.19	792.	700.61	586.5	509.9	489.18		(84)
7. Me	an inter	nal tempe	erature	(heating	seaso	n)									
Temp	erature	during he	eating p	eriods ir	n the liv	/ing	area t	from Tal	ole 9,	Th1 (°C)				21	(85)
Utilisa	tion fac	tor for ga	ins for I	iving are	ea, h1,ı	m (s	ee Ta	ble 9a)							_
	Jan	Feb	Mar	Apr	May	/	Jun	Jul	Αι	ug Sep	Oct	Nov	Dec		
(86)m=	1	0.99	0.98	0.91	0.74		0.54	0.39	0.4	4 0.72	0.96	1	1		(86)
Mean	interna	l tempera	ture in l	living are	ea T1 (follo	w ste	ps 3 to 7	7 in T	able 9c)					
(87)m=	20.09	20.25	20.5	20.79	20.95	2	20.99	21	21	20.97	20.72	20.35	20.07]	(87)
Temp	erature	durina he	eating p	eriods ir	n rest o	of dw	ellina	from Ta	able 9), Th2 (°C)				•	
(88)m=	20.16	20.17	20.17	20.18	20.18		20.19	20.19	20.	<u> </u>	20.18	20.18	20.17]	(88)
ı L İtilisə	tion fac	tor for ga	ins for r	est of d	welling	 h2	m (se	e Tahle	(9a)			!		_	
(89)m=	1	0.99	0.97	0.88	0.69		0.47	0.32	0.3	7 0.65	0.94	0.99	1]	(89)
	into we o	<u> </u>			!	 !!:.a.a.	TO /6						<u> </u>	J	
(90)m=	18.94	19.17	19.54	19.95	20.14	Ť	20.19	20.19	20.	to 7 in Tabl	e 90) 19.87	19.33	18.91	1	(90)
(90)111=	10.54	19.17	19.54	19.93	20.14		.0.19	20.19	20.		<u> </u>	/ing area ÷ (0.25	(91)
												g aroa . (-1	0.25	(31)
ı						_				– fLA) × T2	T _	<u>.</u>	l	1	(55)
(92)m=	19.23	19.44	19.78	20.16	20.34		20.39	20.39	20.3		20.08		19.2]	(92)
Annly	adjustn	nent to th	e mean	ınterna	ı tempe	eratu	ire tro	m rable	4e, ۱	where appro	opriate				

(93)m= 19.23	19.44	19.78	20.16	20.34	20.39	20.39	20.39	20.37	20.08	19.59	19.2		(93)
8. Space he	eating req	uirement											
Set Ti to the			•		ed at ste	ep 11 of	Table 9	o, so tha	t Ti,m=(76)m an	d re-cald	culate	
the utilisation	1	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation fa			•	iviay	Juli	Jui	L	Seb	Oct	INOV	Dec		
(94)m= 1	0.99	0.97	0.88	0.7	0.49	0.34	0.39	0.67	0.94	0.99	1		(94)
Useful gains	s, hmGm	, W = (9 ²	1)m x (84	4)m						l	<u> </u>		
(95)m= 516.40	6 602.52	692.79	736.57	642.56	441.79	290.93	305.37	467.79	550.96	505.54	487.94		(95)
Monthly ave	erage 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 ra		an intern	al tempe	erature,	Lm , W =	=[(39)m	x [(93)m	– (96)m				•	
(97)m= 1188.3		1050.24	877.64	671.84	444.37	291.13	305.82	483.4	737.03	976.09	1179.62		(97)
Space heat	Ť					i	<u> </u>	<u>`</u>		ŕ	1	1	
(98)m= 499.8	5 370.36	265.94	101.57	21.79	0	0	0	0	138.43	338.79	514.61		_
							Tota	l per year	(kWh/yeaı	r) = Sum(9	8) _{15,912} =	2251.34	(98)
Space heat	ing requir	ement in	kWh/m²	/year								25.58	(99)
9a. Energy re	equiremer	nts – Indi	vidual h	eating sy	ystems i	ncluding	micro-C	CHP)					
Space heat	ing:												
Fraction of	space hea	t from s	econdar	y/supple	mentary	system						0	(201)
Fraction of	space hea	at from m	nain syst	em(s)			(202) = 1 -	(201) =				1	(202)
Fraction of t	total hea <mark>ti</mark>	ng from	main sys	stem 1			(204) = (2	02) x [1 –	(203)] =			1	(204)
Effi <mark>cienc</mark> y o	f main s <mark>pa</mark>	ace heat	ing syste	em 1								93.5	(206)
Efficiency o	f seconda	ry/suppl	ementar	y heating	system	າ, %						0	(208)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/ye	⊒ ear
Space heat						- 4	1 3						
499.8	5 370.36	265.94	101.57	21.79	0	0	0	0	138.43	338.79	514.61		
(211)m = {[(9	98)m x (20)4)] } x 1	00 ÷ (20)6)			•						(211)
534.6	<u> </u>	284.43	108.63	23.3	0	0	0	0	148.06	362.35	550.38		
	!						Tota	l (kWh/yea	ar) =Sum(2	211) _{15,1012}	<u>. </u>	2407.85	(211)
Space heat	ing fuel (s	econdar	y), kWh/	month									
$= \{[(98)m \times (2)]\}$	201)] } x 1	00 ÷ (20	8)										
(215)m= 0	0	0	0	0	0	0	0	0	0	0	0		
							Tota	I (kWh/yea	ar) =Sum(2	215) _{15,1012}	₂ =	0	(215)
Water heating	ng												
Output from								ı				I	
184.6		169.4	150.39	146.32	129.22	122.66	136.59	136.97	156.02	166.81	179.71		7,
Efficiency of												79.8	(216)
(217)m= 87.34	_	86.01	83.79	81.04	79.8	79.8	79.8	79.8	84.5	86.67	87.46		(217)
Fuel for wate $(219)m = (64)$	_												
(219)m= 211.4		196.95	179.48	180.55	161.94	153.71	171.17	171.65	184.65	192.48	205.47		
							Tota	I = Sum(2	19a) ₁₁₂ =	1		2196.11	(219)
Annual total	ls								k'	Wh/yeaı	r	kWh/yea	
Space heating	ng fuel use	ed, main	system	1						-		2407.85	
													_

Water heating fuel used			2196.11	
Electricity for pumps, fans and electric keep-hot				
central heating pump:			30 (23)	0c)
boiler with a fan-assisted flue			45 (23)	0e)
Total electricity for the above, kWh/year	sum of (2	30a)(230g) =	75 (23	1)
Electricity for lighting			377.67 (23)	2)
12a. CO2 emissions – Individual heating systems	including micro-CHP			
	Energy kWh/year	Emission factor	r Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	520.1 (26)	1)
Space heating (secondary)	(215) x	0.519	0 (26:	3)
Water heating	(219) x	0.216	474.36 (264	4)
Space and water heating	(261) + (262) + (263) + (264)	=	994.45 (26	5)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	38.93 (26	7)
Electricity for lighting	(232) x	0.519	196.01 (268	8)
Total CO2, kg/year	s	um of (265)(271) =	1229.39 (27:	2)
TER =			13.97 (273	3)

BRUKL Output Document



Compliance with England Building Regulations Part L 2013

Project name

West End Lane_SBEM

As built

Date: Mon May 16 17:49:19 2016

Administrative information

Building Details

Address: Address 1, Address 2, City, Postcode

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.2.g.3

Interface to calculation engine: Virtual Environment

Interface to calculation engine version: v7.0.5

BRUKL compliance check version: v5.2.g.3

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Criterion 1: The calculated CO₂ emission rate for the building should not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	34.6
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	34.6
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	32.1
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and the building services should achieve reasonable overall standards of energy efficiency

Values not achieving standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

U a-Limit	Ua-Calc	Ui-Calc	Surface where the maximum value occurs*
0.35	0.18	0.18	GF000003_W11
0.25	0.08	0.15	GF000018_F1
0.25	0.15	0.15	1F000001_C1
2.2	1.31	1.31	GF000017_W2-W0
2.2	-	-	"No external personnel doors"
1.5	-	-	"No external vehicle access doors"
3.5	-	-	"No external high usage entrance doors"
	0.35 0.25 0.25 2.2 2.2 1.5	0.35 0.18 0.25 0.08 0.25 0.15 2.2 1.31 2.2 - 1.5 -	0.35 0.18 0.18 0.25 0.08 0.15 0.25 0.15 0.15 2.2 1.31 1.31 2.2 - - 1.5 - -

U_{a-Limit} = Limiting area-weighted average U-values [W/(m²K)]

Ua-Calc = Calculated area-weighted average U-values [W/(m²K)]

U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
m ³ /(h.m ²) at 50 Pa	10	4

^{*} There might be more than one surface where the maximum U-value occurs.

^{*} Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

^{***} Display windows and similar glazing are excluded from the U-value check.

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	>0.95

1- Main system

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(I/s)]	HR efficiency			
This system	0.91	3.35	-	-	-			
Standard value	0.91*	2.6	N/A	N/A	N/A			
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system YES								
* Standard shows in far goe single bailer avetage 2 MW output. For single bailer avetage > 2 MW or multi bailer avetage (averall) limiting								

^{*} Standard shown is for gas single boiler systems <= 2 MW output. For single boiler systems > 2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

1- SYST0000-DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	Hot water provided by HVAC system	-
Standard value	N/A	N/A

Local mechanical ventilation, exhaust, and terminal units

	•
ID	System type in Non-domestic Building Services Compliance Guide
Α	Local supply or extract ventilation units serving a single area
В	Zonal supply system where the fan is remote from the zone
С	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
Е	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
Н	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name		SFP [W/(I/s)]									
ID of system type	Α	В	С	D	Е	F	G	Н	I	HR efficiency	
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
GF_Office Entrance	-	-	-	-	-	-	-	-	-	-	N/A
GF_Community Room	-	-	-	1.4	-	-	-	-	-	0.7	0.5
GF_Community Room (Office)	-	-	-	1.4	-	-	-	-	-	0.7	0.5
GF_Community Room (Toilets)	0.3	-	-	-	-	-	-	-	-	-	N/A
GF_Community Room (Storage)	-	-	-	-	-	-	-	-	-	-	N/A
1F_Core	-	-	-	-	-	-	-	-	-	-	N/A
1F_Staircore	-	-	-	-	-	-	-	-	-	-	N/A
1F_Flexible Employment Space (Toile	t 6)3	-	-	-	-	-	-	-	-	-	N/A
1F_Flexible Employment Space (Stor	age)	-	-	-	-	-	-	-	-	-	N/A
1F_Flexible Employment Space (Mee	ting R	оөт)	-	1.4	-	-	-	-	-	0.7	0.5
1F_Flexible Employment Space	-	-	-	1.4	-	-	-	-	-	0.7	0.5
1F_Flexible Employment Space (Eatin	ng/Drir	king)	-	1.4	-	-	-	-	-	0.7	0.5
GF_Commercial Unit (Toilets)	0.3	-	-	-	-	-	-	-	-	-	N/A
GF_Commercial Unit (Storage)	-	-	-	-	-	-	-	-	-	-	N/A
GF_Commercial Unit (Office)	-	-	-	1.4	-	-	-	-	-	0.7	0.5

Zone name		SFP [W/(I/s)]							UD officionay		
ID of system type	Α	В	С	D	Е	F	G	Н	I	HR efficiency	
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
GF_Commercial Unit	-	-	-	1.4	-	-	-	-	-	0.7	0.5
GF_Start-up unit 4 (Storage)	-	-	-	-	-	-	-	-	-	-	N/A
GF_Start-up unit 4	-	-	-	1.4	-	-	-	-	-	0.7	0.5
GF_Start-up unit 3 (Storage)	-	-	-	-	-	-	-	-	-	-	N/A
GF_Start-up unit 3	-	-	-	1.4	-	-	-	-	-	0.7	0.5
GF_Start-up unit 2 (Storage)	-	-	-	-	-	-	-	-	-	-	N/A
GF_Start-up unit 2	-	-	-	1.4	-	-	-	-	-	0.7	0.5
GF_Start-up unit 1 (Storage)	-	-	-	-	-	-	-	-	-	-	N/A
GF_Start-up unit 1	-	-	-	1.4	-	-	-	-	-	0.7	0.5

General lighting and display lighting	Lumino	ous effic		
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
GF_Office Entrance	-	62	-	445
GF_Community Room	-	62	40	755
GF_Community Room (Office)	62	-	-	39
GF_Community Room (Toilets)	-	62	-	74
GF_Community Room (Storage)	63	-	-	31
1F_Core	-	63	-	432
1F_Staircore	-	62	-	60
1F_Flexible Employment Space (Toilets)	-	63	-	365
1F_Flexible Employment Space (Storage)	62	-	-	75
1F_Flexible Employment Space (Meeting Room)	63	-	-	134
1F_Flexible Employment Space	63	-	-	3239
1F_Flexible Employment Space (Eating/Drinking)	-	63	-	317
GF_Commercial Unit (Toilets)	-	62	-	218
GF_Commercial Unit (Storage)	62	-	-	86
GF_Commercial Unit (Office)	63	-	-	254
GF_Commercial Unit	-	63	40	14056
GF_Start-up unit 4 (Storage)	62	-	-	37
GF_Start-up unit 4	-	62	40	1311
GF_Start-up unit 3 (Storage)	62	-	-	34
GF_Start-up unit 3	-	63	40	1231
GF_Start-up unit 2 (Storage)	63	-	-	36
GF_Start-up unit 2	-	62	40	1292
GF_Start-up unit 1 (Storage)	62	-	-	26
GF_Start-up unit 1	-	63	40	1082

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
GF_Office Entrance	N/A	N/A
GF_Community Room	NO (-37.7%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
GF_Community Room (Office)	N/A	N/A
GF_Community Room (Toilets)	N/A	N/A
GF_Community Room (Storage)	N/A	N/A
1F_Core	N/A	N/A
1F_Staircore	N/A	N/A
1F_Flexible Employment Space (Toilets)	N/A	N/A
1F_Flexible Employment Space (Storage)	N/A	N/A
1F_Flexible Employment Space (Meeting Room)	N/A	N/A
1F_Flexible Employment Space	NO (-69.4%)	NO
1F_Flexible Employment Space (Eating/Drinking)	NO (-85.7%)	NO
GF_Commercial Unit (Toilets)	N/A	N/A
GF_Commercial Unit (Storage)	N/A	N/A
GF_Commercial Unit (Office)	N/A	N/A
GF_Commercial Unit	NO (-56.2%)	NO
GF_Start-up unit 4 (Storage)	N/A	N/A
GF_Start-up unit 4	NO (-61.9%)	NO
GF_Start-up unit 3 (Storage)	N/A	N/A
GF_Start-up unit 3	NO (-36.4%)	NO
GF_Start-up unit 2 (Storage)	N/A	N/A
GF_Start-up unit 2	NO (-41.5%)	NO
GF_Start-up unit 1 (Storage)	N/A	N/A
GF_Start-up unit 1	NO (-45.7%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	1653.5	1653.5
External area [m²]	2658.2	2658.2
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	4	3
Average conductance [W/K]	568.63	826.4
Average U-value [W/m²K]	0.21	0.31
Alpha value* [%]	26	14.21

^{*} Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
64	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
32	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Inst.: Hospitals and Care Homes
	C2 Residential Inst.: Residential schools
	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.
	Residential spaces

D1 Non-residential Inst.: Community/Day Centre

D1 Non-residential Inst.: Libraries, Museums, and Galleries

D1 Non-residential Inst.: Education

D1 Non-residential Inst.: Primary Health Care Building D1 Non-residential Inst.: Crown and County Courts

D2 General Assembly and Leisure, Night Clubs and Theatres

Others: Passenger terminals Others: Emergency services Others: Miscellaneous 24hr activities

Others: Car Parks 24 hrs

Others - Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	5.57	6.44
Cooling	13.73	14.85
Auxiliary	5.7	3.15
Lighting	40.27	46.25
Hot water	2.98	2.98
Equipment*	25.57	25.57
TOTAL**	68.25	73.68

^{*} Energy used by equipment does not count towards the total for calculating emissions.

** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO, Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	221.47	211.41
Primary energy* [kWh/m²]	189.12	203.83
Total emissions [kg/m²]	32.1	34.6

^{*} Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

ŀ	HVAC Systems Performance										
Sys	stem Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER	
[ST] Split or m	ulti-split sy	stem, [HS]	LTHW boile	er, [HFT] Na	tural Gas, [CFT] Electr	icity			
	Actual	17.9	203.6	5.6	13.7	5.7	0.89	4.12	0.91	5.51	
	Notional	19	192.4	6.4	14.8	3.2	0.82	3.6			

Key to terms

Heat dem [MJ/m2] = Heating energy demand
Cool dem [MJ/m2] = Cooling energy demand
Heat con [kWh/m2] = Heating energy consumption
Cool con [kWh/m2] = Cooling energy consumption
Aux con [kWh/m2] = Auxiliary energy consumption

Heat SSEFF = Heating system seasonal efficiency (for notional building, value depends on activity glazing class)

Cool SSEER = Cooling system seasonal energy efficiency ratio

Heat gen SSEFF = Heating generator seasonal efficiency

Cool gen SSEER = Cooling generator seasonal energy efficiency ratio

ST = System type
HS = Heat source
HFT = Heating fuel type
CFT = Cooling fuel type

Key Features

The BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

Element	U i-Тур	U _{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.18	GF000003_W11
Floor	0.2	0.07	GF000022_F1
Roof	0.15	0.15	1F000001_C1
Windows, roof windows, and rooflights	1.5	1.31	GF000017_W2-W0
Personnel doors	1.5	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"
U _{i-Typ} = Typical individual element U-values [W/(m²K)	j		U _{i-Min} = Minimum individual element U-values [W/(m ² K)]
* There might be more than one surface where the n	ninimum L	l-value oc	curs.

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	4

				User D	etails:						
Assessor Name:					Strom						
Software Name:	Stroma FS	SAP 201			Softwa					n: 1.0.3.4	
A dalama a a			Р	roperty.	Address	: GF 2B4	4P PS E	ast Build	ding		
Address: 1. Overall dwelling dime	ansions.										
1. Overall awelling aime	priorio.			Area	a(m²)		Av. He	ight(m)		Volume(m	3)
Ground floor						(1a) x		2.5	(2a) =	185	, (3a
Total floor area TFA = (1	a)+(1b)+(1c)+	-(1d)+(1e	e)+(1r	n)	74	(4)			_		
Dwelling volume	-, (12)	() - (,	′	7-7)+(3c)+(3d	l)+(3e)+	.(3n) =	185	(5)
						(==) - (==	, , () , (,, (,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		100	
2. Ventilation rate:	main		econda	у	other		total			m³ per hou	ır
Number of chimneys	heating		eating 0	7 + 6	0	1 = Г	0	x	40 =	0	(6a
Number of open flues	0	╡╻┝	0	┧╻┝	0]	0	x	20 =	0	(6k
·		`	0	J	0	Ţ					╡`
Number of intermittent fa						Ĺ	0		10 =	0	(7a
Number of passive vents						L	0	X '	10 =	0	(7t
Number of flueless gas f	ires						0	X 4	40 =	0	(70
									Δir ch	nanges per h	our
Infiltration due to chimne	vo fluor and	fono – (6)	a)+(6b)+(7	7a)+(7b)+(70) -	_					_
If a pressurisation test has b						continue fr	0 rom (9) to (÷ (5) =	0	(8)
Number of storeys in t			,,,				(2) 22 (-/		0	(9)
Additional infiltration								[(9)	-1]x0.1 =	0	(10
Structural infiltration: 0						•	ruction			0	(11
if both types of wall are p deducting areas of openi			ponding to	the great	er wall are	a (after					
If suspended wooden			ed) or 0	.1 (seale	ed), else	enter 0				0	(12
If no draught lobby, en	iter 0.05, else	enter 0								0	(13
Percentage of window	s and doors d	raught st	ripped							0	(14
Window infiltration					0.25 - [0.2	, ,	-			0	(15
Infiltration rate					(8) + (10)					0	(16
Air permeability value, If based on air permeabi	•			•	•	•	etre of e	nvelope	area	4	(17
Air permeability value applie	-						is beina u:	sed		0.2	(18
Number of sides sheltere			, 200 uc.		y. 00 a po		io somig at			2	(19
Shelter factor					(20) = 1 -	[0.0 75 x (1	19)] =			0.85	(20
nfiltration rate incorpora	ting shelter fa	ctor			(21) = (18) x (20) =				0.17	(2
nfiltration rate modified t	for monthly wi	nd speed	l						· · · · · · · · · · · · · · · · · · ·	1	
Jan Feb	Mar Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind sp	peed from Tab	le 7								1	
(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 = (2	2)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]	

0.22	0.21	e (allowi _{0.21}	0.19	0.18	0.16	0.16	0.16	0.17	0.18	0.19	0.2	l	
Calculate effec	-	l '	l			l	0.10	0.17	0.10	0.15	0.2	l	
If mechanica	ıl ventila	ition:										0.5	(23
If exhaust air he	eat pump	using Appe	endix N, (2	3b) = (23a	a) × Fmv (e	equation (N	N5)) , othe	wise (23b)) = (23a)			0.5	(23
If balanced with	heat reco	overy: effic	iency in %	allowing f	or in-use f	actor (fron	n Table 4h) =				0	(23
a) If balance	d mech	anical ve	entilation	with he	at recove	ery (MVI	HR) (24a)m = (22	2b)m + (2	23b) × [1 – (23c)	÷ 100]	
24a)m= 0	0	0	0	0	0	0	0	0	0	0	0		(24
b) If balance	d mech	anical ve	entilation	without	heat red	overy (N	ЛV) (24b)m = (22	2b)m + (2	23b)			
24b)m= 0	0	0	0	0	0	0	0	0	0	0	0		(24
c) If whole he if (22b)m				•	•				5 × (23b))			
24c)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		(2
d) If natural v				•	•				0.5]		•	ı	
24d)m= 0	0	0	0	0	0	0	0	0	0	0	0	[(24
Effective air	change	rate - er	nter (24a) or (24k	o) or (24	c) or (24	d) in box	(25)			•	ı	
25)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		(2
3. Heat losses	and he	at lose i	naram e t	or.									
LEMENT	Gros area	SS	Openin	gs	Net Ar A ,r		U-valı W/m2		A X U (W/I	<)	k-value kJ/m²-l		A X k kJ/K
/in <mark>dows</mark> Type					7.95		/[1/(1.3)+	_	9.82				(2
/indows Type	2				8.38	x1,	/[1/(1.3)+	0.04] =	10.36	Ħ			(2
loor					74	X	0.15	- L	11.1	Ħ r			(2
/alls Type1	22.0	16	7.95		14.11	X	0.18		2.54	븍 ;		╡ ⊨	(2
/alls Type2	24.2	=	8.38	=	15.85	=	0.18	╡┇	2.85	륵 ;		╡	(2
otal area of e			0.50			=	0.10		2.00				(3
for windows and			effective wi	ndow U-va	120.2 alue calcul		ı formula 1	/[(1/U-valu	e)+0.041 a	ns aiven in	paragraph	132	(0
include the area								2(), 2 1 1 1	-, · · · · · · · · · · · · · · · · · · ·	J	J		
abric heat los	s, W/K :	= S (A x	U)				(26)(30)	+ (32) =				36.67	7 (3
eat capacity (Cm = S((Axk)						((28)	.(30) + (32	2) + (32a).	(32e) =	9594.	2 (3
hermal mass	parame	ter (TMF	P = Cm -	- TFA) ir	n kJ/m²K			Indica	tive Value:	Medium		250	(3
or design assess				construct	ion are no	t known pr	ecisely the	indicative	values of	TMP in Ta	able 1f		
an be used instea hermal bridge				ısina Δr	nandiy l	<i>(</i>						0.4	(3
details of therma	•	,		• .	•	`						9.1	(0
otal fabric hea			()		•/			(33) +	(36) =			45.77	7 (3
entilation hea	t loss ca	alculated	l monthly	/				(38)m	= 0.33 × (25)m x (5))		
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	1	
8)m= 30.52	30.52	30.52	30.52	30.52	30.52	30.52	30.52	30.52	30.52	30.52	30.52		(3
eat transfer c	oefficie	nt, W/K	-		-	-	-	(39)m	= (37) + (3	 38)m	-	•	
		,						, ,				1	
9)m= 76.3	76.3	76.3	76.3	76.3	76.3	76.3	76.3	76.3	76.3	76.3	76.3	[

Heat loss para	ımeter (l	HLP), W	/m²K					(40)m	= (39)m ÷	- (4)			
(40)m= 1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03		
	!	!			<u> </u>	ļ	ļ		Average =	Sum(40) ₁	12 /12=	1.03	(40)
Number of day	s in mo	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. Water hea	ting ene	rgy requi	irement:								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		34		(42)
Annual average Reduce the annual not more that 125	al average	hot water	usage by	5% if the c	lwelling is	designed i			se target o		.76		(43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage i	n litres per	day for ea	ach month	Vd,m = fa	ctor from	Table 1c x	(43)			•			
(44)m= 98.73	95.14	91.55	87.96	84.37	80.78	80.78	84.37	87.96	91.55	95.14	98.73		
						•				m(44) ₁₁₂ =		1077.07	(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= 146.42	128.06	132.14	115.21	110.54	95.39	88.39	101.43	102.64	119.62	130.57	141.8		_
If inst <mark>antane</mark> ous w	vater heati	na at noint	of use (no	hot water	r storage)	enter () in	hoves (46		Total = Su	m(45) ₁₁₂ =		1412.21	(45)
				-									(40)
(46)m= 21.96 Water storage	19.21	19.82	17.28	16.58	14.31	13.26	15.21	15.4	17.94	19.59	21.27		(46)
Storage volum		includir	ng any so	olar or W	/WHRS	storage	within sa	ame ves	sel		5		(47)
If community h	,										-		` '
Otherwise if no	•			•			` '	ers) ente	er '0' in ((47)			
Water storage	loss:												
a) If manufact	turer's d	eclared I	oss facto	or is kno	wn (kWł	n/day):					0		(48)
Temperature f	actor fro	m Table	2b								0		(49)
Energy lost fro		•					(48) x (49)) =			5		(50)
b) If manufactHot water store			-								1		(54)
If community h	•			e z (KVV	ii/iiiie/ua	iy <i>)</i>				0.	03		(51)
Volume factor	-		011 110							2.	88		(52)
Temperature f	actor fro	m Table	2b							-	.6		(53)
Energy lost fro	m watei	· storage	, kWh/ye	ear			(47) x (51)) x (52) x (53) =	0.	24		(54)
Enter (50) or	(54) in (5	55)	·							0.	24		(55)
Water storage	loss cal	culated t	for each	month			((56)m = (55) × (41)	m				
(56)m= 7.49	6.76	7.49	7.25	7.49	7.25	7.49	7.49	7.25	7.49	7.25	7.49		(56)
If cylinder contains	s dedicate	d solar sto	rage, (57)	m = (56)m		H11)] ÷ (5	0), else (5	7)m = (56)	m where (m Append	ix H	
(57)m= 7.49	6.76	7.49	7.25	7.49	7.25	7.49	7.49	7.25	7.49	7.25	7.49		(57)
Primary circuit	loss (ar	nual) fro	m Table	 e 3							0		(58)
Primary circuit	•	•			59)m = ((58) ÷ 36	65 × (41)	m					
(modified by				,	•	` '	, ,		r thermo	stat)			
(59)m= 23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)

On mala: Jana		f l-		(04)	(00) - 0	OF (44)	\						
Combi loss (61)m= 0	calculated	for each		(61)m =	(60) ÷ 30	05 × (41))m 0	T 0	0	0	0	1	(61)
				<u> </u>			<u> </u>		<u> </u>	ļ	<u> </u>	(50) (64)	(01)
(62)m= 177.1		162.89	144.96	141.29	125.15	119.14	132.18		150.37	160.33	172.55	(59)m + (61)m 1	(62)
Solar DHW inp			<u> </u>									J	(02)
(add addition									ir contribu	ion to wate	er neaung)		
(63)m= 0	0		0	0	0	0	0		0	0	0	1	(63)
Output from								1				l	, ,
(64)m= 177.1		162.89	144.96	141.29	125.15	119.14	132.18	132.4	150.37	160.33	172.55	1	
			l				Ou	tput from w	ater heate	r (annual)₁	l12	1774.28	(64)
Heat gains f	rom water	heating,	kWh/m	onth 0.2	5 ′ [0.85	× (45)m	ı + (61)ı	m] + 0.8 x	x [(46)m	+ (57)m	+ (59)m	. 1	•
(65)m= 73.28	1	68.54	62.11	61.36	55.52	53.99	58.33	57.94	64.37	67.22	71.75	ĺ	(65)
	7)m in cal	culation (of (65)m	only if c	vlinder i	s in the o	dwelling	or hot w	ater is f	rom com	munity h	ı neating	
5. Internal	<u> </u>		. ,		,						• •	Jan J	
Metabolic ga													
Jar		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(66)m= 116.9	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96		(66)
Lighting gair	ns (calcula	ted in Ap	pendix	L, equ <mark>at</mark>	ion L9 o	r L9a), <mark>a</mark>	lso see	Table 5					
(67)m= 18.4	1 16.35	13.3	10.07	7.53	6.35	6.86	8.92	11.98	15.21	17.75	18.92		(67)
App <mark>liance</mark> s (gains (ca <mark>lc</mark>	ulated ir	Append	dix L, eq	uation L	13 or L1	3a), als	o see Ta	ble 5				
(68)m= 206.4	5 208.59	203.19	191.7	177.19	163.56	154.45	152.3	157.7	169.2	183.7	197.34		(68)
Cooking gai	ns (calcula	ated in A	ppendix	L, equat	ion L15	or L15a)), also s	ee Table	5				
(69)m= 34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7		(69)
Pumps and	fans gains	(Table 5	 5a)					-		-			
(70)m= 0	0	0	0	0	0	0	0	0	0	0	0		(70)
Losses e.g.	evaporation	n (nega	tive valu	es) (Tab	le 5)		-						
(71)m= -93.5	7 -93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57		(71)
Water heatir	ng gains (1	Table 5)	-	-		-	-	-	-	-	-		
(72)m= 98.5	96.43	92.12	86.27	82.47	77.12	72.57	78.4	80.47	86.53	93.37	96.44		(72)
Total intern	al gains =	:	•		(66))m + (67)m	n + (68)m	+ (69)m +	(70)m + (7	(1)m + (72))m		
(73)m= 381.4	379.46	366.7	346.12	325.27	305.11	291.97	297.71	308.23	329.02	352.91	370.78		(73)
6. Solar ga	ins:	•				•	•		•				
Solar gains ar	e calculated	using sola	r flux from	Table 6a	and assoc	iated equa	itions to d	onvert to th	ne applical	ole orientat	tion.		
Orientation:			Area		Flu			g_ Tabla Ch	_	FF		Gains	
	Table 6d		m²		Ta	ble 6a	. –	Table 6b	_ '	able 6c		(W)	_
South 0.9	× 0.77	X	8.3	38	X	16.75	X	0.63	x	0.7	=	119.73	(78)
South 0.9	× 0.77	X	8.3	38	X 7	76.57	X	0.63	X	0.7	=	196.09	(78)
South 0.9	× 0.77	х	8.3	38	x 9	97.53	x	0.63	x	0.7	=	249.79	(78)
South 0.9	× 0.77	X	8.3	38	x 1	10.23	x	0.63	x	0.7	=	282.31	(78)
South 0.9	× 0.77	X	8.3	38	x 1	14.87	x	0.63	x	0.7	=	294.19	(78)

					_		, ,		_				_
South	0.9x 0.77	×	8.38	8	×	110.55	X	0.63	X	0.7	=	283.12	(78)
South	0.9x 0.77	x	8.38	8	x	108.01	X	0.63	X	0.7	=	276.62	(78)
South	0.9x 0.77	×	8.38	8	X	104.89	X	0.63	X	0.7	=	268.64	(78)
South	0.9x 0.77	×	8.38	8	x	101.89	X	0.63	X	0.7	=	260.93	(78)
South	0.9x 0.77	×	8.38	8	х	82.59	X	0.63	X	0.7	=	211.5	(78)
South	0.9x 0.77	×	8.38	8	x	55.42	X	0.63	X	0.7	=	141.93	(78)
South	0.9x 0.77	×	8.38	8	x	40.4	x	0.63	X	0.7	=	103.46	(78)
West	0.9x 0.77	×	7.95	5	x	19.64	x	0.63	X	0.7	=	47.72	(80)
West	0.9x 0.77	×	7.95	5	x	38.42	x	0.63	X	0.7	=	93.35	(80)
West	0.9x 0.77	×	7.95	5	x	63.27	x	0.63	X	0.7	=	153.73	(80)
West	0.9x 0.77	×	7.95	5	x	92.28	x	0.63	X	0.7	=	224.21	(80)
West	0.9x 0.77	· x	7.95	5	X	113.09	X	0.63	X	0.7	=	274.77	(80)
West	0.9x 0.77	· x	7.95	5	X	115.77	x	0.63	x	0.7	=	281.28	(80)
West	0.9x 0.77	· x	7.95	5	x	110.22	x	0.63	X	0.7	=	267.79	(80)
West	0.9x 0.77	· x	7.95	5	x	94.68	x	0.63	X	0.7	=	230.03	(80)
West	0.9x 0.77	· x	7.95	5	x 🗔	73.59	x	0.63	x	0.7	=	178.79	(80)
West	0.9x 0.77	· x	7.95	5	x =	45.59	х	0.63	x	0.7	=	110.76	(80)
West	0.9x 0.77	×	7.95	5	x 🔚	24.49	Х	0.63	Х	0.7	=	59.5	(80)
West	0.9x 0.77	×	7.95	5	x	16.15	х	0.63	х	0.7		39.24	(80)
Sola <mark>r gai</mark>	ins in watts, c	alculated	for each	n month			(83)m	= Sum(74)m .	(82)m				
(83)m= 1	67.45 289.44	403.52	506.52	568.96	564.4	544.41	498	67 439.73	322.27	7 201.42	142.7		(83)
													()
Total gair	ns – internal a	and solar	(84)m =	(73)m +	(83)m	n , watts							(5.5)
	ns – internal a 548.9 668.9	and solar	(84)m = 852.64	(73)m + 894.23	- (83)m 869.51		796		651.29		513.49		(84)
(84)m= 5		770.22	852.64	894.23	, ,		796						
(84)m= 5	548.9 668.9	770.22 perature	852.64 (heating	894.23 season)	869.51	836.38	l	38 747.96				21	
7. Mean Temper	548.9 668.9 n internal tem	770.22 perature heating p	852.64 (heating eriods in	894.23 season)	869.51 ng area	836.38 from Tal	l	38 747.96				21	(84)
7. Mean Temper Utilisatio	548.9 668.9 n internal tem rature during l	770.22 perature heating p	852.64 (heating eriods in	894.23 season)	869.51 ng area	836.38 from Tal	ble 9,	38 747.96		9 554.33		21	(84)
7. Mean Temper Utilisatio	n internal tem rature during l	perature heating p	852.64 (heating eriods in iving are	season) the livinga, h1,m	869.51 ag area (see T	836.38 from Tal	ble 9,	38 747.96 Th1 (°C)	651.29	9 554.33 Nov	513.49	21	(84)
7. Mean Temper Utilisatio	n internal tem rature during l on factor for g Jan Feb 0.99 0.98	perature heating p gains for I Mar 0.95	(heating eriods in iving are Apr 0.88	season) the livings, h1,m May 0.73	ag area (see T Jun 0.55	836.38 from Talable 9a) Jul 0.4	ble 9,	38 747.96 Th1 (°C) ug Sep 4 0.67	651.29 Oct	9 554.33 Nov	513.49 Dec	21	(84)
7. Mean Temper Utilisatio	n internal tem rature during l on factor for g Jan Feb	perature heating p gains for I Mar 0.95	(heating eriods in iving are Apr 0.88	season) the livings, h1,m May 0.73	ag area (see T Jun 0.55	836.38 from Talable 9a) Jul 0.4	ble 9,	38 747.96 Th1 (°C) ug Sep 4 0.67 able 9c)	651.29 Oct	9 554.33 Nov 0.99	513.49 Dec	21	(84)
7. Mean Temper Utilisatio (86)m= Mean in (87)m=	n internal temperature during lon factor for good on the control of the control o	perature heating p gains for l Mar 0.95 rature in l 20.52	(heating eriods in iving are 0.88	season) the livin ea, h1,m May 0.73 ea T1 (fo	869.51 ag area (see T Jun 0.55 llow ste 20.99	836.38 a from Tale (able 9a) Jul 0.4 eps 3 to 7	Au 0.4	38 747.96 Th1 (°C) ug Sep 4 0.67 able 9c) 1 20.97	Oct 0.92	9 554.33 Nov 0.99	513.49 Dec 1	21	(84)
7. Mean Temper Utilisatio (86)m= Mean in (87)m= 2 Temper	rature during lon factor for guarante during long 0.99 0.98 hternal tempe 20.06 20.26 rature during l	perature heating p gains for l Mar 0.95 rature in l 20.52	(heating eriods in iving are 0.88	season) the livin ea, h1,m May 0.73 ea T1 (fo	869.51 ag area (see T Jun 0.55 llow ste 20.99	836.38 a from Tale (able 9a) Jul 0.4 eps 3 to 7	Au 0.4	38 747.96 Th1 (°C) ug Sep 4 0.67 able 9c) 1 20.97 9, Th2 (°C)	Oct 0.92	9 554.33 Nov 0.99	513.49 Dec 1	21	(84)
7. Mean Temper Utilisatio (86)m= Mean in (87)m= 2 Temper (88)m= 2	rature during lon factor for guarante during long 0.99 0.98 nternal tempe 20.06 20.26 rature during long long long long long long long lo	perature heating p gains for I Mar 0.95 rature in I 20.52 heating p 20.06	(heating eriods in iving are Apr 0.88 living are 20.77 eriods in 20.06	season) the living a, h1,m May 0.73 ea T1 (for 20.93) rest of crest of cres	ag area (see T Jun 0.55 Illow str 20.99 dwellin 20.06	836.38 a from Tal able 9a) Jul 0.4 eps 3 to 7 21 g from Tal 20.06	Au 0.47 in T 2° able 9	38 747.96 Th1 (°C) ug Sep 4 0.67 able 9c) 1 20.97 9, Th2 (°C)	Oct 0.92	9 554.33 Nov 0.99	Dec 1	21	(84) (85) (86) (87)
7. Mean Temper Utilisatio (86)m= Mean in (87)m= Z Temper (88)m= 2 Utilisatio	rature during long factor for grature during long long long long long long long lo	perature heating p gains for I Mar 0.95 rature in 20.52 heating p 20.06	(heating eriods in iving are 0.88 living are 20.77 eriods in 20.06	season) the living a, h1,m May 0.73 ea T1 (for 20.93 rest of c20.06 welling, h	g area (see T Jun 0.55 Illow ste 20.99 dwellin 20.06	836.38 from Tal able 9a) Jul 0.4 eps 3 to 7 21 g from Tal 20.06 see Table	Au 0.4 7 in T 2 able 9 20.0 9a)	38 747.96 Th1 (°C) ug Sep 4 0.67 able 9c) 1 20.97 0, Th2 (°C) 06 20.06	Oct 0.92 20.74	9 554.33 Nov 0.99 20.33	Dec 1 20 20.06	21	(84) (85) (86) (87) (88)
7. Mean Temper Utilisatio (86)m= Mean in (87)m= Z Temper (88)m= Utilisatio (89)m=	rature during land process on factor for grature during land process of the land proce	perature heating p gains for I Mar 0.95 rature in I 20.52 heating p 20.06 gains for r 0.94	(heating eriods in iving are 0.88 living are 20.77 eriods in 20.06 rest of dw 0.85	season) the living a, h1,m May 0.73 ea T1 (for 20.93 rest of 6 20.06 welling, h 0.68	869.51 ag area (see T Jun 0.55 llow ste 20.99 dwellin 20.06 a2,m (s	836.38 a from Tal able 9a) Jul 0.4 eps 3 to 7 21 g from Tal 20.06 see Table 0.32	Au 0.4 7 in T 2° able 9 20.0 9a) 0.3	38 747.96 Th1 (°C) ug Sep 4 0.67 table 9c) 1 20.97 0, Th2 (°C) 06 20.06	Oct 0.92 20.74 20.06	9 554.33 Nov 0.99	Dec 1	21	(84) (85) (86) (87)
7. Mean Temper Utilisatio (86)m= Mean in (87)m= 2 Temper (88)m= 2 Utilisatio (89)m= Mean in	rature during long factor for grature during long 0.99 0.98 nternal temperature during long 1.00 (20.06) 20.06 rature during long 1.00 (20.06) 20.06 on factor for grature during long 1.00 (20.06) 20.06 on factor for grature during long 1.00 (20.06) 20.06 on factor for grature during long 1.00 (20.06) 20.06 on factor for grature during long 1.00 (20.06) 20.08	perature heating p gains for I Mar 0.95 rature in I 20.52 heating p 20.06 gains for r 0.94 rature in I	(heating eriods in iving are 0.88 living are 20.77 eriods in 20.06 est of dw 0.85 living are the rest of dw 1.85 living are 20.77 eriods in 20.06 living are 20.77 eriods in 20.06 living are 20.77 eriods in 20.06 living are 20.77 living are 20.7	season) the living a, h1,m May 0.73 ea T1 (for 20.93 rest of crest	869.51 ag area (see T Jun 0.55 Illow str 20.99 dwellin 20.06 n2,m (s 0.47	sale 9a) Jul 0.4 eps 3 to 7 21 g from Tal 20.06 see Table 0.32 follow ste	Au 0.4 7 in T 2 able 9 20.0 9a) 0.3 eps 3	38	Oct 0.92 20.74 20.06 0.89 e 9c)	9 554.33 Nov 0.99 20.33 5 20.06	Dec 1 20 20.06 0.99	21	(84) (85) (86) (87) (88) (89)
7. Mean Temper Utilisatio (86)m= Mean in (87)m= 2 Temper (88)m= 2 Utilisatio (89)m= Mean in	rature during land process on factor for grature during land process of the land proce	perature heating p gains for I Mar 0.95 rature in I 20.52 heating p 20.06 gains for r 0.94	(heating eriods in iving are 0.88 living are 20.77 eriods in 20.06 rest of dw 0.85	season) the living a, h1,m May 0.73 ea T1 (for 20.93 rest of 6 20.06 welling, h 0.68	869.51 ag area (see T Jun 0.55 llow ste 20.99 dwellin 20.06 a2,m (s	836.38 a from Tal able 9a) Jul 0.4 eps 3 to 7 21 g from Tal 20.06 see Table 0.32	Au 0.4 7 in T 2° able 9 20.0 9a) 0.3	38 747.96 Th1 (°C) ug Sep 4 0.67 able 9c) 1 20.97 0, Th2 (°C) 20.06 5 0.59 to 7 in Table 20.03	Oct 0.92 20.74 20.06 0.89 e 9c) 19.78	9 554.33 Nov 0.99 20.33 5 20.06	Dec 1 20 20.06 0.99		(84) (85) (86) (87) (88) (89)
7. Mean Temper Utilisatio (86)m= Mean in (87)m= 2 Temper (88)m= 2 Utilisatio (89)m= Mean in	rature during long factor for grature during long 0.99 0.98 nternal temperature during long 1.00 (20.06) 20.06 rature during long 1.00 (20.06) 20.06 on factor for grature during long 1.00 (20.06) 20.06 on factor for grature during long 1.00 (20.06) 20.06 on factor for grature during long 1.00 (20.06) 20.06 on factor for grature during long 1.00 (20.06) 20.08	perature heating p gains for I Mar 0.95 rature in I 20.52 heating p 20.06 gains for r 0.94 rature in I	(heating eriods in iving are 0.88 living are 20.77 eriods in 20.06 est of dw 0.85 living are the rest of dw 1.85 living are 20.77 eriods in 20.06 living are 20.77 eriods in 20.06 living are 20.77 eriods in 20.06 living are 20.77 living are 20.7	season) the living a, h1,m May 0.73 ea T1 (for 20.93 rest of crest	869.51 ag area (see T Jun 0.55 Illow str 20.99 dwellin 20.06 n2,m (s 0.47	sale 9a) Jul 0.4 eps 3 to 7 21 g from Tal 20.06 see Table 0.32 follow ste	Au 0.4 7 in T 2 able 9 20.0 9a) 0.3 eps 3	38 747.96 Th1 (°C) ug Sep 4 0.67 able 9c) 1 20.97 0, Th2 (°C) 20.06 5 0.59 to 7 in Table 20.03	Oct 0.92 20.74 20.06 0.89 e 9c) 19.78	9 554.33 Nov 0.99 20.33 5 20.06	Dec 1 20 20.06 0.99	0.43	(84) (85) (86) (87) (88) (89)
7. Mean Temper Utilisatio (86)m= Mean in (87)m= 2 Temper (88)m= 2 Utilisatio (89)m= Mean in (90)m=	rature during long factor for grature during long 0.99 0.98 nternal temperature during long 1.00 (20.06) 20.06 rature during long 1.00 (20.06) 20.06 on factor for grature during long 1.00 (20.06) 20.06 on factor for grature during long 1.00 (20.06) 20.06 on factor for grature during long 1.00 (20.06) 20.06 on factor for grature during long 1.00 (20.06) 20.08	perature heating p gains for I 0.95 rature in 1 20.52 heating p 20.06 gains for r 0.94 rature in 1 19.47	(heating eriods in iving are 0.88 living are 20.77 eriods in 20.06 rest of dw 0.85 living are 19.81	season) the living the	869.51 ag area (see T Jun 0.55 Illow str 20.99 dwellin 20.06 n2,m (s 0.47 ng T2 (20.05	see Table 0.32 follow ster	Au 0.4 7 in T 2 able 9 20.0 9a) 0.3 eps 3	38 747.96 Th1 (°C) ug Sep 4 0.67 able 9c) 1 20.97 0, Th2 (°C) 106 20.06 5 0.59 to 7 in Table 106 20.03	Oct 0.92 20.74 20.06 0.89 e 9c) 19.78	9 554.33 Nov 0.99 20.33 5 20.06	Dec 1 20 20.06 0.99		(84) (85) (86) (87) (88) (89)
7. Mean Temper Utilisatio (86)m= Mean in (87)m= 2 Temper (88)m= Utilisatio (89)m= Mean in (90)m= 1 Mean in (90)m= 1	rature during lon factor for grature during long 0.98 Internal temperature during long 0.99 Internal temperature during long 1.006 Internal temperature during long 1.009 Internal temperature during 1.00	perature heating p gains for I 0.95 rature in I 20.52 heating p 20.06 gains for r 0.94 rature in 1 19.47	(heating eriods in iving are 0.88 living are 20.77 eriods in 20.06 rest of dw 0.85 living are 19.81 rest of dw 20.23	season) the livin ea, h1,m May 0.73 ea T1 (for 20.93 erest of crest of crest of dwelling, h 0.68 of dwelling 20 ole dwel 20.4	869.51 ag area (see T Jun 0.55 Illow str 20.99 dwellin 20.06 n2,m (s 0.47 ng T2 (20.05	836.38 a from Takable 9a) Jul 0.4 eps 3 to 7 21 g from Takable 20.06 see Table 0.32 follow stee 20.06 fLA × T1 20.46	ble 9, O.4 7 in T 20 9a) 0.3 9ps 3 20.0 + (1	38 747.96 Th1 (°C) ug Sep 4 0.67 able 9c) 1 20.97 0, Th2 (°C) 16 20.06 5 0.59 to 7 in Table 16 20.03 f fLA) x T2 16 20.44	Oct 0.92 20.74 20.06 0.89 e 9c) 19.78 LA = Liv	9 554.33 Nov 0.99 20.33 20.06 0.98 19.21 ving area ÷ (Dec 1 20 20.06 0.99		(84) (85) (86) (87) (88) (89)

							,	1	1				
(93)m= 19.35	19.6	19.92	20.23	20.4	20.46	20.46	20.46	20.44	20.2	19.7	19.28		(93)
8. Space hea									. —. ,				
Set Ti to the the utilisation					ed at ste	ep 11 of	l able 9	o, so tha	t II,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	<u> </u>	,									
(94)m= 0.99	0.98	0.94	0.85	0.7	0.51	0.35	0.39	0.62	0.89	0.98	0.99		(94)
Useful gains,	hmGm	, W = (9	4)m x (84	4)m									
(95)m= 543.87	652.53	722.79	726.05	624.88	441.09	294.19	308.95	467	580.25	542.57	510.08		(95)
Monthly aver	age exte	T T	·	from Ta							, ,		
(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	1	i	· ·				- ` 	- 			1450 40		(07)
` '	1121.85	l	864.14	663.84	446.78	294.81	310.01	483.56	732.35	961.14	1150.49		(97)
Space heatin (98)m= 449.53	g require 315.38	224.17	99.43	28.98	/vn/moni	n = 0.02	24 X [(97])m – (95 0)m] X (4 113.16	301.37	476.47		
(90)11= 449.55	313.36	224.17	99.43	20.90	0	0		l per year	<u> </u>		<u> </u>	2008.49	(98)
			134/1/				TOLA	ii pei yeai	(KVVII/yeai) = Sum(s	0)15,912 =		(99)
Space heating requirement in kWh/m²/year 27.14													
9b. Energy red	quiremer	nts – Coi	mmunity	heating	scheme								
This part is us Fraction of spa							.	•		unity sch	neme.	0	(301)
Fraction of spa								ĺ			[[1	(302)
The community so							allows for	CHP and	un to four	other heat	sources: th		
includes boilers, h									ир то тош	oliter neat	Sources, tr	ie ialiei	
Fraction of hea	at from C	Commun	ity CHP									0.8	(303a)
Fraction of cor	mmunity	heat fro	m heat s	source 2							Ī	0.2	(303b)
Fraction of total	al space	heat fro	m Comn	nunity C	HP				(3	02) x (303	a) =	0.8	(304a)
Fraction of total	al space	heat fro	m comm	unity he	at sourc	e 2			(3	02) x (303	b) =	0.2	(304b)
Factor for conf	trol and	charging	method	(Table	4c(3)) fo	r commu	unity hea	iting sys	tem			1	(305)
Distribution los	ss factor	(Table 1	12c) for d	commun	ity heatir	ng syste	m					1.05	(306)
Space heating	g										-	kWh/yea	r
Annual space	heating	requiren	nent									2008.49	
Space heat fro	om Comi	munity C	HP					(98) x (30	04a) x (30	5) x (306)	= [1687.13	(307a)
Space heat fro	m heat	source 2	2					(98) x (30	04b) x (30	5) x (306)	= [421.78	(307b)
Efficiency of se	econdar	y/supple	mentary	heating	system	in % (fro	om Table	4a or A	ppendix	E)		0	(308
Space heating	require	ment fro	m secon	dary/sup	plemen	tary syst	tem	(98) x (30	01) x 100 ·	÷ (308) =		0	(309)
Water heating Annual water heating requirement												7	
If DHW from c Water heat fro								(64) x (3)	03a) x <i>(</i> 30	5) x (306)	_ _ [1490.4	☐ (310a)
Water heat fro		•								5) x (306)	L	372.6	(310b)
Electricity use							0.01	× [(307a).			L	39.72	(313)
Lioutionly use	. 101 1106	GIGHIDI	-u				5.01	((oora)	(5575)	(5.54)((5.56)] =	J3.12	

Cooling System Energy Efficiency Ratio		Γ	0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	Ī	0	(315)
Electricity for pumps and fans within dwelling (Table 4f):		-		- -
mechanical ventilation - balanced, extract or positive input from o	outside		49.88	(330a)
warm air heating system fans		اِ	0	(330b)
pump for solar water heating			0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330b)	30g) =	49.88	(331)
Energy for lighting (calculated in Appendix L)			325.12	(332)
12b. CO2 Emissions – Community heating scheme		_		7
Electrical efficiency of CHP unit		L	30	<u>(361)</u>
Heat efficiency of CHP unit		L	57.5	(362)
	- 37	ssion factor E CO2/kWh k	missions g CO2/year	
Space heating from CHP) $(307a) \times 100 \div (362) =$	2934.14 X	0.22	633.77	(363)
less credit emissions for electricity $-(307a) \times (361) \div (362) =$	880.24 X	0.52	-456.84	(364)
Water heated by CHP $(310a) \times 100 \div (362) =$	2591.99 ×	0.22	559.87	(365)
less credit emissions for electricity —(310a) × (361) ÷ (362) =	777.6 ×	0.52	-403.57	(366)
Efficiency of heat source 2 (%)	two fuels repeat (363) to (366) fo	or the second fuel	89.5	(367b)
CO2 associated with heat source 2 [(307b)+(310b)] x 100 ÷ (367b) x	0.22	191.72	(368)
Electrical energy for heat distribution	(313) x	0.52	20.61	(372)
Total CO2 associated with community systems	363)(366) + (368)(372)	=	545.56	(373)
CO2 associated with space heating (secondary)	309) x	0 =	0	(374)
CO2 associated with water from immersion heater or instantanee	ous heater (312) x	0.22	0	(375)
Total CO2 associated with space and water heating	373) + (374) + (375) =		545.56	(376)
CO2 associated with electricity for pumps and fans within dwelling	ng (331)) x	0.52	25.89	(378)
CO2 associated with electricity for lighting	332))) x	0.52	168.74	(379)
Total CO2, kg/year sum of (376)(382) =			740.18	(383)
Dwelling CO2 Emission Rate (383) ÷ (4) =			10	(384)
El rating (section 14)			91.67	(385)

Assessor Name: Stroma FSAP 2012 Software Version: Version: 1,0,3,4				User D	etails:						
Address: Area(m²)		Stroma FSAP 20	012						Versic	on: 1.0.3.4	
Area(m²)			Р	roperty	Address	: GF 2B	4P PS E	ast Build	ding		
Area(m²) Av. Height(m) Volume(m²)											
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+(1n) Total floor area TFA = (1a)+(1b)+(1c)+(1e)+(1n) Total floor area TFA = (1a)+(1b)+(1c)+(1e)+(1e)+(1e)+(1e)+(1e)+(1e)+(1e)+(1e	Overall dwelling dimer	nsions:			(0)						. `
Develling volume (3a)+(3b)+(3c)+(3d)+(3e)+(3n) = 185	Ground floor			Area	<u> </u>	(1a) x			(2a) =	· `	3) (3a
2. Ventilation rate: Main Secondary Number of chimneys 0	Total floor area TFA = (1a	a)+(1b)+(1c)+(1d)+(1e)+(1r	1)	74	(4)					
Number of chimneys	Dwelling volume					(3a)+(3b	o)+(3c)+(3c	d)+(3e)+	.(3n) =	185	(5)
Number of chimneys	2. Ventilation rate:										
Number of open flues	Number of chimneys	heating	heating			7 ₌ [x	40 =		ır (6a
Number of intermittent fans Number of passive vents Number of flueless gas fires Air changes per hou Inflitration due to chimneys, flues and fans = (\$8)+(\$6)+(7a)+(7b)+(7c) =	ŕ			╛╘		<u> </u>			20 -		=
Number of passive vents 0	·	U	0	J ' L	0	J ŪĻ					(6b
Number of flueless gas fires 0		1S				Ĺ	3			30	(7a)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = 30	·					L	0	X	10 =	0	(7b)
Infiltration due to chimneys, flues and fans = (88)+(6b)+(7a)+(7b)+(7c) = 30	Number of flueless gas fir	res					0	X	40 =	0	(7c
Infiltration due to chimneys, flues and fans = (88)+(6b)+(7a)+(7b)+(7c) = 30									Air ch	nanges per h	our
Number of storeys in the dwelling (ns) 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 Percentage of windows and doors draught stripped Window infiltration 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)] = 0.35 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)me 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	Infiltration due to chimney	ys flugs and fans –	(6a)+(6b)+(7	(a)+(7h)+(7c) =	Г	00				_
Number of storeys in the dwelling (ns) Additional infiltration [(9)-1]x0.1 = 0						continue f			÷ (5) =	0.16	(8)
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 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] = 0.1 Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0.2 Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area and the 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)] = 0.85 Infiltration rate incorporating shelter factor (21) = (18) × (20) = 1. Infiltration rate modified for monthly wind speed 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										0	(9)
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 Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 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)] = 0.85 Infiltration rate incorporating shelter factor (21) = (18) × (20) = 1 - [0.075 × (19)] = 0.35 Monthly average wind speed from Table 7 (22)m= 5.1								[(9)	-1]x0.1 =	0	(10
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0						•	ruction			0	(11
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			responding to	the great	er wall are	a (atter					
Percentage of windows and doors draught stripped 0 Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 5 If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) 0.41 Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used 2 Number of sides sheltered 2 Shelter factor (20) = 1 - [0.075 x (19)] = 0.85 Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.35 Infiltration rate modified for monthly wind speed 5 0.35 Monthly average wind speed from Table 7 4.3 4.3 3.8 3.7 4 4.3 4.5 4.7 Wind Factor (22a)m = (22)m ÷ 4 4 <td></td> <td></td> <td>ealed) or 0.</td> <td>.1 (seale</td> <td>ed), else</td> <td>enter 0</td> <td></td> <td></td> <td></td> <td>0</td> <td>(12</td>			ealed) or 0.	.1 (seale	ed), else	enter 0				0	(12
Window infiltration $0.25 - [0.2 \times (14) \div 100] = 0$ Infiltration rate $(8) + (10) + (11) + (12) + (13) + (15) = 0$ Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area If based on air permeability value, then $(18) = [(17) \div 20] + (8)$, otherwise $(18) = (16)$ 0.41 Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used Number of sides sheltered $(20) = 1 - [0.075 \times (19)] = 0.85$ Infiltration rate incorporating shelter factor $(21) = (18) \times (20) = 0.35$ 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 $(22a)m = (22)m \div 4$	If no draught lobby, ent	er 0.05, else enter ()							0	(13
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 $(18) = [(17) \div 20] + (8)$, 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 $(20) = 1 - [0.075 \times (19)] =$ Onumber of sides sheltered Infiltration rate incorporating shelter factor $(21) = (18) \times (20) =$ 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 $(22a)m = (22)m \div 4$	•	and doors draught	stripped							0	(14
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)] = Infiltration rate incorporating shelter factor (21) = (18) × (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					•	. ,	-	(4.5)		0	(15
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)] = 0.85 Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.35 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		-50									(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)] = 0.85 Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.35 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	•	•		•	•	•	ietre oi e	envelope	area		(17
2		-					is being u	sed		0.41	(18
Infiltration rate incorporating shelter factor Solution Columbia Colum				·	,	·	ŭ			2	(19
Infiltration rate modified for monthly wind speed Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	Shelter factor				(20) = 1 -	[0.075 x (19)] =			0.85	(20
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	Infiltration rate incorporati	ng shelter factor			(21) = (18) x (20) =				0.35	(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	Infiltration rate modified for	or monthly wind spe	ed			.		_	1	7	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Jan Feb	Mar Apr Ma	y Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Wind Factor (22a)m = (22)m ÷ 4	Monthly average wind spe	eed from Table 7							,	1	
	(22)m= 5.1 5	4.9 4.4 4.3	3.8	3.8	3.7	4	4.3	4.5	4.7]	
	Wind Factor (22a)m = (22	?)m ÷ 4									
(22a)m= 1.27 1.25 1.23 1.1 1.08 0.95 0.95 0.92 1 1.08 1.12 1.18		·	0.95	0.95	0.92	1	1.08	1.12	1.18	1	

Adjusted infiltr	ation rat	e (allowi	ng for sh	nelter an	d wind s	speed) =	(21a) x	(22a)m				_	
0.45	0.44	0.43	0.39	0.38	0.33	0.33	0.32	0.35	0.38	0.39	0.41		
Calculate effect If mechanica		_	rate for t	he appli	cable ca	se	-		-	-	-		
If exhaust air h			endix N. (2	3b) = (23a	a) × Fmv (e	equation (N	N5)) othe	wise (23b) = (23a)			0	(23
If balanced with) — (20 0)			0	
		•	•	ŭ		`		•	26\m . /	22h) v [1 (220)	0 . 1001	(2:
a) If balance	0	0	0	0	0	0	0	0	0	0	0	- 100] 	(24
b) If balance									<u> </u>			J	(-
24b)m= 0	0	0	0	0	0	0	0	0	0	0	0	1	(2
c) If whole h					<u> </u>							J	(-
if (22b)n				•	•				5 × (23b	o)			
24c)m= 0	0	0	0	0	0	0	0	0	0	0	0]	(2
d) If natural	ventilatio	n or wh	ole hous	e positiv	/e input	ventilatio	n from l	oft				J	
if (22b)n									0.5]				
24d)m= 0.6	0.6	0.59	0.57	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.58		(24
Effective air	change	rate - er	nter (24a	or (24b	o) or (24	c) or (24	d) in box	(25)				•	
25)m= 0.6	0.6	0.59	0.57	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.58		(2
3. Heat losse	a and he	et loca i	o comot	0 F.									
LEMENT	Gros		Openin		Net Ar	00	U-valu	10	AXU		k-value		ΑΧk
LEIVIEN	area		m		A ,r		W/m2		(W/	K)	kJ/m ² -	-	kJ/K
Vin <mark>dows</mark> Type	e 1				7.95	x1.	/[1/(1.4)+	0.04] =	10.54				(2
Vin <mark>dows</mark> Type	2				8.38	x1.	/[1/(1.4)+	0.04] =	11.11	Ħ			(2
loor					74	X	0.13	<u> </u>	9.62	Ħг			(2
Valls Type1	22.0	16	7.95		14.11	x	0.18		2.54	븍 ;		₹ =	(2
/alls Type2	24.2	_	8.38	=	15.85	=	0.18	-	2.85	룩 ;		╡ ⊨	(2
otal area of e			0.30			=	0.10	[2.03				
for windows and		•	offoctivo wi	ndow I I ve	120.2		ı formula 1	/[/1/ L valu	(0) 1 0 041 4	ne aivon in	naraaranl	. 2 2	(3
include the area						ateu using	TOTTIUIA I	/[((C)+ 0.04]	is giveri iii	paragrapi	1 3.2	
abric heat los	s, W/K :	= S (A x	U)				(26)(30)	+ (32) =				36.66	(3
eat capacity	Cm = S((Axk)						((28)	.(30) + (32	2) + (32a).	(32e) =	9594.	2 (3
hermal mass	parame	ter (TMF	c = Cm -	- TFA) ir	n kJ/m²K			Indica	tive Value	: Medium		250	(3
or design assess	sments wh	ere the de	tails of the	construct	ion are no	t known pr	ecisely the	indicative	values of	TMP in Ta	able 1f		
an be used inste													
hermal bridge	`	,		٠.	•	<						4.6	(3
details of therma		are not kn	own (36) =	= 0.15 x (3	11)			(22)	(26) -				
otal fabric he		aloudet -	المامصطارا						(36) =	'OE\ · · · (E\		41.26	(3
entilation hea	i	i	· ·		1	1, .1	Λ			(25)m x (5)	Ī _	1	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		(0
8)m= 36.62	36.38	36.15	35.06	34.85	33.91	33.91	33.73	34.27	34.85	35.27	35.7	J	(3
eat transfer of	coefficier	nt, W/K						· · ·	= (37) + (38)m	1	1	
9)m= 77.88	77.64	77.41	76.32	76.12	75.17	75.17	74.99	75.53	76.12	76.53	76.96		
										Sum(39) ₁		76.32	(3

Heat loss para	ımeter (I	HLP), W	/m²K					(40)m	= (39)m ÷	- (4)			
(40)m= 1.05	1.05	1.05	1.03	1.03	1.02	1.02	1.01	1.02	1.03	1.03	1.04		
	!		<u>. </u>	!		!	!		Average =	Sum(40) ₁ .	12 /12=	1.03	(40)
Number of day	1	<u> </u>	<u> </u>						<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	irement:								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		34		(42)
Annual average Reduce the annual not more that 125	al average	hot water	usage by	5% if the c	lwelling is	designed i			se target o		.76		(43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage i	n litres pe	r day for ea				Table 1c x				•	•		
(44)m= 98.73	95.14	91.55	87.96	84.37	80.78	80.78	84.37	87.96	91.55	95.14	98.73		
					400 144		- (aaa			m(44) ₁₁₂ =		1077.07	(44)
Energy content of													
(45)m= 146.42	128.06	132.14	115.21	110.54	95.39	88.39	101.43	102.64	119.62	130.57	141.8	1110.01	(45)
If inst <mark>antane</mark> ous w	vater heati	ng at point	of use (no	hot water	storage),	enter 0 in	boxes (46)		Total = Su	m(45) ₁₁₂ =		1412.21	(45)
(46)m= 21.96	19.21	19.82	17.28	16.58	14.31	13.26	15.21	15.4	17.94	19.59	21.27		(46)
Wat <mark>er sto</mark> rage	loss:												
Storage volum	ne (litres)	includir)	ng any so	olar or W	WHRS	storage	within sa	ame ves	sel		150		(47)
If community h	•			•			` '		(01 :	(A=7)			
Otherwise if no Water storage		not wate	er (tnis ir	iciudes i	nstantar	ieous co	iiod idmo	ers) ente	er o in ((47)			
a) If manufact		eclared I	oss facto	or is kno	wn (kWł	n/day):				0	.3		(48)
Temperature f	actor fro	m Table	2b							0.	54		(49)
Energy lost fro	m wate	r storage	, kWh/ye	ear			(48) x (49)) =		0.	16		(50)
b) If manufact			-										
Hot water stor	-			le 2 (KVV	n/litre/da	ay)					0		(51)
Volume factor	•		011 4.5								0		(52)
Temperature f	actor fro	m Table	2b								0		(53)
Energy lost fro	m watei	r storage	, kWh/ye	ear			(47) x (51)) x (52) x (53) =		0		(54)
Enter (50) or	(54) in (5	55)								0.	16		(55)
Water storage	loss cal	culated t	for each	month			((56)m = ((55) × (41)	m				
(56)m= 4.97	4.49	4.97	4.81	4.97	4.81	4.97	4.97	4.81	4.97	4.81	4.97		(56)
If cylinder contains	s dedicate	d solar sto	rage, (57)ı	m = (56)m	x [(50) – (H11)] ÷ (5	0), else (5	7)m = (56)	m where (H11) is fro	m Append	ix H	
(57)m= 4.97	4.49	4.97	4.81	4.97	4.81	4.97	4.97	4.81	4.97	4.81	4.97		(57)
Primary circuit	loss (ar	nnual) fro	m Table	= 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	ter heati	ng and a	cylinde	r thermo	stat)			
(59)m= 23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)

Combi loca	oloulotod	for oach	month	(61)m -	(60) · 2(SE v. (41)	١m						
Combi loss (61)m= 0	alculated 0	or each	0	0	(6U) ÷ 30	05 × (41)	0	T 0	0	Ιο	0	1	(61)
			<u> </u>	<u> </u>			<u> </u>			<u> </u>	<u> </u>	(E0)m + (61)m	(01)
(62)m= 174.6		160.37	142.52	138.77	122.71	116.62	129.66		147.85	157.89	170.03	· (59)m + (61)m]	(62)
` '		<u> </u>		L		<u> </u>				ļ]	(02)
Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating) (add additional lines if FGHRS and/or WWHRS applies, see Appendix G)													
(63)m= 0	0	0	0	0	0	0	0		0	0	0]	(63)
Output from	water hea	ter		l			l			<u> </u>		1	
(64)m= 174.6	_	160.37	142.52	138.77	122.71	116.62	129.66	129.96	147.85	157.89	170.03]	
	-1	<u> </u>	ļ.	Į		<u>!</u>	Οι	Itput from w	ater heate	r (annual)₁	l12	1744.6	(64)
Heat gains f	om water	heating,	kWh/m	onth 0.2	5 ´ [0.85	× (45)m	+ (61)	m] + 0.8 x	k [(46)m	+ (57)m	+ (59)m	 n]	_
(65)m= 71.2	1	66.52	60.16	59.34	53.57	51.97	56.31	55.98	62.36	65.27	69.73	1	(65)
include (5	7)m in cal	culation	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	e Table 5	and 5a):									
Metabolic ga	Ŭ ,			,									
Jar		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec]	
(66)m= 116.9	6 116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96		(66)
Ligh <mark>ting g</mark> air	s (calcula	ted in Ap	pendix	L, equati	on L9 o	r L9a), <mark>a</mark>	lso see	Table 5					
(67)m= 18.4°	16.35	13.3	10.07	7.53	6.35	6.86	8.92	11.98	15.21	17.75	18.92		(67)
App <mark>liance</mark> s (gains (ca <mark>lc</mark>	ulated ir	Append	dix L, eq	uation L	13 or L1	3a), als	so see Ta	ble 5			1	
(68)m= 206.4	5 208.59	203.19	191.7	177.19	163.56	154.45	152.3	157.7	169.2	183.7	197.34		(68)
Cooking gain	ns (calcula	ited in A	ppendix	L, equat	ion L15	or L15a)), also	see Table	5			•	
(69)m= 34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7		(69)
Pumps and	ans gains	(Table 5	5a)									-	
(70)m= 3	3	3	3	3	3	3	3	3	3	3	3]	(70)
Losses e.g.	evaporatio	n (nega	tive valu	es) (Tab	le 5)								
(71)m= -93.5	7 -93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57]	(71)
Water heatir	ng gains (T	able 5)										_	
(72)m= 95.79	93.72	89.41	83.56	79.76	74.41	69.86	75.69	77.76	83.81	90.66	93.72]	(72)
Total intern	al gains =				(66))m + (67)m	n + (68)m	n + (69)m +	(70)m + (7	'1)m + (72))m	_	
(73)m= 381.7	3 379.74	366.99	346.41	325.56	305.4	292.26	298	308.52	329.31	353.2	371.07]	(73)
6. Solar ga													
Solar gains ar		•					itions to		ne applical		tion.		
Orientation:	Access F Table 6d		Area m²		Flu Tal	ıx ble 6a		g_ Table 6b	т	FF able 6c		Gains (W)	
Courth							. –						1,
South 0.9		X	8.3			16.75	X _	0.63	_ ×	0.7	=	119.73	(78)
South 0.9		X	8.3			76.57	X	0.63	×	0.7	=	196.09	(78)
South 0.9		X	8.3			97.53	X	0.63	×	0.7	=	249.79	(78)
		X	8.3	==	—	10.23	X _	0.63	×	0.7	=	282.31	(78)
South 0.9	0.77	X	8.3	38	x 1	14.87	X	0.63	x	0.7	=	294.19	(78)

	_										_				_
South	0.9x	0.77	X	8.3	8	X	110.	.55	X	0.63	X	0.7	=	283.12	(78)
South	0.9x	0.77	X	8.3	8	X	108.01		X	0.63	X	0.7	=	276.62	(78)
South	0.9x	0.77	X	8.3	8	X	104.	.89	X	0.63	X	0.7	=	268.64	(78)
South	0.9x	0.77	Х	8.3	8	X	101.	.89	x	0.63	X	0.7	=	260.93	(78)
South	0.9x	0.77	X	8.3	8	X	82.5	59	x	0.63	X	0.7	=	211.5	(78)
South	0.9x	0.77	X	8.3	8	x	55.4	42	x	0.63	X	0.7	=	141.93	(78)
South	0.9x	0.77	X	8.3	8	x	40.	4	x	0.63	X	0.7	=	103.46	(78)
West	0.9x	0.77	x	7.9	5	x	19.6	64	x	0.63	X	0.7	=	47.72	(80)
West	0.9x	0.77	x	7.9	5	x	38.4	42	x	0.63	X	0.7	=	93.35	(80)
West	0.9x	0.77	x	7.9	5	x	63.2	27	x	0.63	x	0.7	=	153.73	(80)
West	0.9x	0.77	x	7.9	5	x	92.2	28	x	0.63	x	0.7	=	224.21	(80)
West	0.9x	0.77	x	7.9	5	x	113.	.09	x	0.63	x	0.7	=	274.77	(80)
West	0.9x	0.77	x	7.9	5	x	115.	.77	x	0.63	x	0.7	=	281.28	(80)
West	0.9x	0.77	x	7.9	5	x	110.	22	x	0.63	x	0.7	=	267.79	(80)
West	0.9x	0.77	x	7.9	5	x	94.6	68	x	0.63	x	0.7		230.03	(80)
West	0.9x	0.77	x	7.9	5	x	73.5	59	x	0.63	x	0.7	-	178.79	(80)
West	0.9x	0.77	x	7.9	5	x	45.5	59	x	0.63	x	0.7		110.76	(80)
West	0.9x	0.77	x	7.9	5	X	24.49		Х	0.63	X	0.7	=	59.5	(80)
West	0.9x	0.77	x	7.9	5	x	16.1	15	x	0.63	х	0.7	-	39.24	(80)
								$\overline{}$							
Solar g	jains in	watts, calc	ulated	for each	mont	h		(83)m	= Sum(74)m .	(82)m				
(83)m=	<mark>16</mark> 7.45		103.52	506.52	568.96			544.41	498.	67 439.73	322.27	201.42	142.7		(83)
		nternal and	solar	(84)m =	(73)m	+ (8	33)m , v	vatts							
(84)m=	549.19	669.19	770.5	852.93	894.52	: 8	69.8	336.67	796.	67 748.25	651.57	554.62	513.77		(84)
7. Me	an inter	nal temper	rature	(heating	seaso	n)									
Temp	erature	during hea	ating p	eriods in	the liv	ing	area fro	m Tab	le 9,	Th1 (°C)				21	(85)
Utilisa	ation fac	tor for gair	ns for I	iving are	a, h1,r	n (s	ee Tabl	e 9a)							
	Jan	Feb	Mar	Apr	May	<u>' </u>	Jun	Jul	Αι	ıg Sep	Oct	Nov	Dec		
(86)m=	0.99	0.98	0.96	0.88	0.73		0.54	0.39	0.4	3 0.67	0.92	0.99	1		(86)
Mean	interna	temperati	ure in I	iving are	ea T1 (follo	w steps	3 to 7	in T	able 9c)					
(87)m=	20.03	20.24	20.5	20.77	20.93	2	0.99	21	21	20.97	20.75	20.33	19.99		(87)
Temp	erature	during hea	atina p	eriods in	rest o	f dw	ellina fr	om Tal	ble 9	. Th2 (°C)		-		•	
	20.04		20.05	20.06	20.06	_		20.07	20.0	1 ' '	20.06	20.05	20.05		(88)
(88)m=	20.04					<u> </u>	m (soo	Tahla !	02)		!		ļ.		
		tor for gair	ne for r	act of du	vallina				Ja)					_	
Utilisa	ation fac	tor for gair	ī				<u> </u>	1		5 0.59	0.89	0.98	0.99		(89)
Utilisa (89)m=	ation fac	0.98	0.94	0.85	0.68	(0.47	0.31	0.3	<u> </u>	0.89	0.98	0.99		(89)
Utilisa (89)m=	otion fac 0.99 interna	0.98 temperati	0.94 ure in t	0.85 he rest o	0.68 of dwe	lling	T2 (foll	0.31 ow ste	0.3 ps 3	to 7 in Tabl	le 9c)			1	
Utilisa (89)m=	ation fac	0.98 temperati	0.94	0.85	0.68	lling	T2 (foll	0.31	0.3	to 7 in Tabl	e 9c)	19.21	18.71		(90)
Utilisa (89)m=	otion fac 0.99 interna	0.98 temperati	0.94 ure in t	0.85 he rest o	0.68 of dwe	lling	T2 (foll	0.31 ow ste	0.3 ps 3	to 7 in Tabl	e 9c)		18.71	0.43	
Utilisa (89)m= Mean (90)m=	interna	0.98 temperatu	0.94 ure in t 19.43 ure (fo	0.85 he rest of 19.81 r the who	0.68 of dwe 20 ole dw	lling 2	72 (follo	0.31 ow ste 20.07	0.3 ps 3 20.0	to 7 in Tabl 07 20.04 f - fLA) × T2	le 9c) 19.79 fLA = Liv	19.21 ring area ÷ (-	18.71	0.43	(90)
Utilisa (89)m= Mean (90)m= Mean (92)m=	interna 19.3	0.98 temperatu 19.06 temperatu 19.57	0.94 ure in t 19.43 ure (fo	0.85 the rest of 19.81 r the who 20.23	0.68 of dwe 20 ole dw 20.4	lling 2	T2 (follows) (fo	0.31 ow ste 20.07 × T1 - 20.47	0.3 ps 3 20.0 + (1 -	to 7 in Tabl 07 20.04 f - fLA) × T2	le 9c) 19.79 FLA = Liv	19.21 ring area ÷ (-	18.71	0.43	(90)

(93)m=	19.3	19.57	19.9	20.23	20.4	20.46	20.47	20.47	20.44	20.2	19.69	19.26		(93)
8. Spac	e heati	ng requ	uirement											
				•		ed at ste	ep 11 of	Table 9	o, so tha	t Ti,m=(76)m an	d re-calc	culate	
				using Ta		l	11	A	0	0-4	N.			
<u> </u>	Jan	Feb	Mar ains, hm	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
	0.99	0.98	0.94	0.85	0.7	0.5	0.35	0.38	0.62	0.89	0.98	0.99		(94)
` ' _				1)m x (84		0.0	0.00	0.00	0.02	0.00	0.00	0.00		(0.7)
		653.12	724.1	726.25	624.05	435.75	290.46	304.45	463.76	580.13	542.87	510.37		(95)
· ·	/ avera	ae exte	rnal tem	perature	from Ta	able 8					<u> </u>			
(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 los	ss rate	for mea	an intern	al tempe	erature,	Lm , W =	=[(39)m	x [(93)m	– (96)m]				
(97)m= 1	168.36	1138.71	1036.9	864.39	662.43	440.79	291	305.36	479.23	730.88	963.64	1159.04		(97)
Space h	heating	require	ement fo	r each n	nonth, k\	Wh/mon	th = 0.02	24 x [(97))m – (95)m] x (4	1)m			
(98)m= 4	164.37	326.32	232.72	99.46	28.55	0	0	0	0	112.16	302.96	482.61		
								Tota	l per year	(kWh/yeaı) = Sum(9	8)15,912 =	2049.15	(98)
Space h	heating	require	ement in	kWh/m²	/year								27.69	(99)
9a. Ener	av tear	ıiremen	nts – Indi	vidual h	eating sy	vstems i	ncluding	ı micro-C	:HP)					
Space I			ito irrai	vidadi ii		y otorno r	rioraarrig		,					
-	`		t from s	econdar	y/supple	mentary	system						0	(201)
Fraction	of spa	ace hea	t from m	nain syst	em(s)			(202) = 1 -	(201) =				1	(202)
	· ·			main sys				(204) = (2	02) × [1 –	(203)] =			1	(204)
				ing syste									93.5	(206)
	ľ			ementar		cycton	0/					-	0	(208)
			, , ,											┛` ′
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/ye	ar
· —	Ť	326.32	232.72	alculate 99.46	28.55	0	0	0	0	112.16	302.96	482.61		
<u> </u>						0	0	0	U	112.10	302.90	402.01		
(211)m =	= {[(98)i _{196.65}	m x (20 349	4)] } x 1	00 ÷ (20 106.37	30.54				0	119.96	324.02	516.16		(211)
_4	190.05	349	246.9	100.37	30.54	0	0	0 Tota	0 I (kWh/yea				0404.04	(211)
0		6 -1 /-		\ 1\A/L./				Tota	ii (KVVIII yoc	ar) =0am(2	- 1 /15,1012		2191.61	(211)
Space r = {[(98)m	-	•		y), kWh/ Ձ\	montn									
(215)m=	0	0	00 + (20	0	0	0	0	0	0	0	0	0		
(= 10)			-						l (kWh/yea	_			0	(215)
Water he	eating									,	7 10,1012			``′
Output fr	_	ter heat	ter (calc	ulated al	oove)									
		153.55	160.37	142.52	138.77	122.71	116.62	129.66	129.96	147.85	157.89	170.03		
Efficienc	y of wa	ter hea	ter					•				•	79.8	(216)
(217)m=	87.3	86.78	85.81	83.88	81.44	79.8	79.8	79.8	79.8	84.09	86.53	87.45		(217)
Fuel for \	water h	eating,	kWh/mo	onth				•					•	
(219)m =							T .						I	
(219)m= 2	200.05	176.95	186.9	169.92	170.39	153.77	146.14	162.48	162.86	175.83	182.48	194.44		٦.
_								lota	I = Sum(21				2082.22	(219)
Annual to Space he		امارا العد	nd main	svetem	1					k'	Wh/year	「 	kWh/yea 2191.61	<u>r</u>
Opace III	caming I	aci ust	u, main	SySt C III	•								2191.01	

			_		_
Water heating fuel used				2082.22	
Electricity for pumps, fans and electric keep-hot					
central heating pump:			30		(230c)
boiler with a fan-assisted flue			45		(230e)
Total electricity for the above, kWh/year	sum of (23	30a)(230g) =		75	(231)
Electricity for lighting				325.12	(232)
12a. CO2 emissions – Individual heating systems	including micro-CHP				
	Energy kWh/year	Emission factors kg CO2/kWh	or	Emissions kg CO2/yea	r
Space heating (main system 1)	(211) x	0.216	=	473.39	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	449.76	(264)
Space and water heating	(261) + (262) + (263) + (264) =	=		923.15	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	= [168.74	(268)
Total CO2, kg/year	St	um of (265)(271) =		1130.81	(272)
TER =				15.28	(273)

			User E	Details:						
Assessor Name: Software Name:	Stroma FSAP 20)12		Strom Softwa				Versic	on: 1.0.3.4	
		Р	roperty	Address	: MF 2B	4P SO V	Vest Bui	lding		
Address :										
1. Overall dwelling dimer	nsions:		_	4 0						<u>.</u> ,
Ground floor			Are	a(m²) 79	(1a) x		2.5	(2a) =	Volume(m)	3) (3a
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1	1e)+(1r	۱)	79	(4)					
Dwelling volume					(3a)+(3b	o)+(3c)+(3c	d)+(3e)+	.(3n) =	197.5	(5)
2. Ventilation rate:										
Number of chimneys	main heating	secondar heating	'y □ + □	other 0	7 = F	total 0	x	40 =	m³ per hou	ır ☐(6a
Number of open flues			」]			20 =		╡`
·	0	0	J ' L	0	J ŪĻ	0			0	(6b
Number of intermittent fan	IS .				Ĺ	0		10 =	0	(7a
Number of passive vents					L	0	X	10 =	0	(7b
Number of flueless gas fire	es					0	X	40 =	0	(7c
								Δir ch	nanges per h	our
Infiltration due to chimney	a flyes and fans	(62) (6b) (7	7a) ı (7b) ı ((70) -	Г		_			_
Infiltration due to chimney If a pressurisation test has be					continue f	0 rom (9) to		÷ (5) =	0	(8)
Number of storeys in the		μ	(11)			(2)	(1.5)		0	(9)
Additional infiltration							[(9)	-1]x0.1 =	0	(10
Structural infiltration: 0.2	25 for steel or timbe	r frame or	0.35 fo	r mason	y const	ruction			0	(11
if both types of wall are pre deducting areas of opening		esponding to	the grea	ter wall are	a (after					
If suspended wooden flo		aled) or 0	.1 (seale	ed), else	enter 0				0	(12
If no draught lobby, ente	er 0.05, else enter 0)							0	(13
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 and the Air permeability value, or air permeabilit	•		•	•	•	netre of e	envelope	area	4	(17
Air permeability value applies	-					is beina u	sed		0.2	(18
Number of sides sheltered				g. 00 a po		.o .og u	000		2	(19
Shelter factor				(20) = 1 -	[0.075 x (19)] =			0.85	(20
Infiltration rate incorporation	ng shelter factor			(21) = (18) x (20) =				0.17	(21
Infiltration rate modified fo	r monthly wind spec	ed					_		_	
Jan Feb I	Mar Apr May	y Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind spe	ed from Table 7								_	
(22)m= 5.1 5	4.4 4.3	3.8	3.8	3.7	4	4.3	4.5	4.7		
Wind Factor (22a)m = (22)m ÷ 4									
	.23 1.1 1.08	0.95	0.95	0.92	1	1.08	1.12	1.18	1	
	1.00		L	1 3.02	<u> </u>	1	12		J	

Calculate effec	0.21	0.21	0.19	0.18	0.16	0.16	0.16	0.17	0.18	0.19	0.2		
If mechanica		_	rate for t	he appli	cable ca	se	•	•					
If exhaust air h			endix N. (2	3b) = (23a) × Fmv (e	equation (N	N5)) . othe	rwise (23b) = (23a)			0.5	(2
If balanced with									, (200)			0.5	(2
a) If balance		-	-	_					2h)m + (23h) x [1 – (23c)		(2
4a)m= 0	0	0	0	0	0	0	0	0	0	0	0]	(2
b) If balance	ed mech	anical ve	ntilation	without	heat rec	covery (N	л ЛV) (24b	m = (22)	2b)m + (23b)	<u> </u>	J	
4b)m= 0	0	0	0	0	0	0	0	0	0	0	0]	(
c) If whole h	ouse ex	tract ver	tilation o	or positiv	e input v	/entilatio	n from o	outside				_	
if (22b)n	n < 0.5 ×	(23b), t	hen (24	c) = (23b); otherv	wise (24	c) = (22k	o) m + 0.	5 × (23b)		_	
lc)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5]	(
d) If natural				•	•								
	n = 1, the	r ` í	<u> </u>		<u> </u>		 					1	,
d)m= 0		0	0	0	0	0	0	0	0	0	0]	(
Effective air			<u> </u>	, ,	$\stackrel{\cdot}{\longrightarrow}$			`			1 0.5	1	,
i)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		(
. Heat l <mark>osse</mark>	s and he	at loss	oaramete	er:									
EMENT	Gros		Openin		Net Ar		U-val		AXU		k-value		AXk
	area	(m²)	m	2	A ,n		W/m2		(W/I	K)	kJ/m²-	K	kJ/K
indows Type					7.14		/[1/(1.3)+		8.82				(
indows Type) 2				13.2	x1,	/[1/(1.3)+	0.04] =	16.31	빝.			(:
alls Type1	20.6	i2	13.2		7.42	X	0.18	=	1.34	∐ l			(
alls Type2	18.0)4	7.14		10.9	X	0.18	=	1.96				(
tal area of e	lements	, m²			38.66	5							(
or windows and						ated using	formula 1	/[(1/U-valu	ıe)+0.04] a	as given in	paragrapl	h 3.2	
nclude the erec				s and part	itions								
		- C // V	1.17				(26) (30)) + (32) =				00.40	
bric heat los		•	U)				(26)(30)		(30) + (3)	2) ı (22a)	(320) -	28.43	
bric heat los	Cm = S((A x k)	·	TEA\ in	de 1/m216		(26)(30)	((28)	(30) + (32	, , ,	(32e) =	2472.79	9 (3
bric heat lose eat capacity ermal mass	Cm = S(parame	(A x k) ter (TMF	P = Cm +	,				((28)	tive Value	: Medium	, ,		9 (
abric heat los eat capacity nermal mass r design assess	Cm = S(parame sments wh	(A x k) eter (TMF	P = Cm ÷	,				((28)	tive Value	: Medium	, ,	2472.79	9 (3
abric heat lose eat capacity termal mass or design assess to be used inste	Cm = S(parame sments wh	(A x k) eter (TMF ere the de tailed calcu	P = Cm ÷ tails of the	constructi	ion are not	t known pr		((28)	tive Value	: Medium	, ,	2472.79	9 (
abric heat los eat capacity termal mass or design assess to be used inste	Cm = S(s parame sments wh rad of a dec es : S (L	(A x k) eter (TMF ere the de tailed calcu x Y) cal	P = Cm ÷ tails of the ulation. culated t	constructi	on are not pendix l	t known pr		((28)	tive Value	: Medium	, ,	2472.79 250	9 (
bric heat lose eat capacity ermal mass of design assess to be used instevermal bridge ermal bridge etails of thermatal fabric he	Cm = S(a parame sments wh had of a dec es : S (L hal bridging that loss	(A x k) eter (TMF ere the de tailed calcu x Y) calcu are not kn	P = Cm : tails of the ulation. culated (own (36) =	constructiusing Ap	on are not pendix l	t known pr		((28) Indica	tive Value	: Medium	, ,	2472.79 250	9 (
bric heat lose eat capacity ermal mass of design assess to be used instevermal bridge ermal bridge etails of thermatal fabric he	Cm = S(a parame sments wh had of a dec es : S (L hal bridging that loss	(A x k) eter (TMF ere the de tailed calcu x Y) calcu are not kn	P = Cm : tails of the ulation. culated (own (36) =	constructiusing Ap	on are not pendix l	t known pr		((28) Indica indicative	tive Value	: Medium	able 1f	2472.79 250 2.7	9 (
bric heat lose eat capacity ermal mass of design assess to be used instevermal bridge ermal bridge etails of thermatal fabric he	Cm = S(a parame sments wh had of a dec es : S (L hal bridging that loss	(A x k) eter (TMF ere the de tailed calcu x Y) calcu are not kn	P = Cm : tails of the ulation. culated (own (36) =	constructions are constructed using Ap = 0.15 x (3)	pendix h	t known pr		((28) Indica e indicative (33) + (38)m	tive Value values of (36) = = 0.33 × (: Medium	able 1f	2472.79 250 2.7	Э ((
eat capacity eat capacity ermal mass r design assess n be used inste ermal bridge details of therma stal fabric he entilation hea	Cm = S(parame sments wh had of a dei es : S (L al bridging eat loss at loss ca	(A x k) ter (TMF ere the de tailed calcu x Y) calc are not kn	P = Cm : tails of the ulation. culated to own (36) =	constructions and constructions are constructed using Ap	on are not pendix h	t known pr	recisely the	((28) Indica e indicative (33) + (38)m	tive Value e values of (36) = = 0.33 × (: Medium : TMP in T	able 1f	2472.79 250 2.7	Э ((
eat capacity ermal mass or design assess on be used inste ermal bridge details of thermal tal fabric he entilation hea Jan 32.59	Cm = S(parame sments wh had of a der es : S (L hal bridging hat loss at loss ca Feb 32.59	(A x k) eter (TMF ere the de tailed calcu x Y) calc are not kn alculated Mar 32.59	P = Cm : tails of the ulation. culated to own (36) =	constructions are constructed using Ap = 0.15 x (3)	pendix h	known pr	ecisely the	((28) Indica e indicative (33) + (38)m Sep 32.59	tive Value values of (36) = = 0.33 × (25)m x (5 Nov 32.59	able 1f	2472.79 250 2.7	Э ((
eat capacity nermal mass or design assess on be used instendermal bridge details of thermal otal fabric he entilation hea Jan 32.59 eat transfer of	Cm = S(parame sments wh had of a der es : S (L hal bridging hat loss at loss ca Feb 32.59	(A x k) eter (TMF ere the de tailed calcu x Y) calc are not kn alculated Mar 32.59	P = Cm : tails of the ulation. culated to own (36) =	constructions are constructed using Ap = 0.15 x (3)	pendix h	known pr	ecisely the	((28) Indica e indicative (33) + (38)m Sep 32.59	(36) = = 0.33 × (Oct	25)m x (5 Nov 32.59	able 1f	2472.79 250 2.7	(i) (c) (d) (d)
eat capacity eat capacity eat capacity eat mass r design assess n be used inste eat bridge details of therma stal fabric he entilation hea Jan 32.59 eat transfer comments of the mass eat transfer comments of t	Cm = S(parame sments wh had of a det es : S (L had bridging that loss at loss ca Feb 32.59 coefficier 63.72	(A x k) ter (TMF ere the de tailed calcu x Y) calc are not kn alculated Mar 32.59 nt, W/K 63.72	P = Cm - tails of the ulation. culated to own (36) = 1 monthly Apr 32.59	constructions and constructions are constructed using Ap = 0.15 x (3 / May 32.59	pendix k Jun 32.59	t known pr	Aug 32.59	((28) Indicative indicative (33) + (38)m Sep 32.59 (39)m 63.72	(36) = = 0.33 × (Oct 32.59 = (37) + (36) = (37) + (36) = (37) =	25)m x (5 Nov 32.59 38)m 63.72 Sum(39),	Dec 32.59	2472.79 250 2.7	(c)
32.59 eat transfer o	Cm = S(parame sments wh had of a det es : S (L had bridging that loss at loss ca Feb 32.59 coefficier 63.72	(A x k) ter (TMF ere the de tailed calcu x Y) calc are not kn alculated Mar 32.59 nt, W/K 63.72	P = Cm - tails of the ulation. culated to own (36) = 1 monthly Apr 32.59	constructions and constructions are constructed using Ap = 0.15 x (3 / May 32.59	pendix k Jun 32.59	t known pr	Aug 32.59	((28) Indicative indicative (33) + (38)m Sep 32.59 (39)m 63.72	(36) = = 0.33 × (Oct 32.59 = (37) + (36)	25)m x (5 Nov 32.59 38)m 63.72 Sum(39),	Dec 32.59	2472.79 250 2.7 31.13) ((

Number of days in month (Table 1a)

Numbe	er or day	s in mor	ıın (Tab	ie ra)		1	1	,		1			1	
	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)
							•	•	•	•	•		l	
4 \\/o	tor boot	ing oner	av roau	romonti								kWh/ye	201	
4. ۷۷	ilei neal	ing ener	gy requi	rement.								KVVII/y	ear.	
Assum	ed occu	pancy, I	N								2.	44		(42)
			+ 1.76 x	[1 - exp	(-0.0003	849 x (TF	FA -13.9)2)] + 0.0	0013 x (TFA -13.	.9)		l	
	A £ 13.9	-											•	
								(25 x N)	+ 36 a water us	se target o		.24		(43)
		_		day (all w		_	-	io aomovo	a water ac	oo targot o	,			
	Jan	Feb	Mar	Λnr	Mov	Jun	Jul	Δυσ	Sep	Oct	Nov	Dec		
Hot wate				Apr ach month	May $Vd.m = fa$	l .		Aug (43)	Sep	l Oct	INOV	Dec		
			-	-				· <i>'</i>					1	
(44)m=	101.46	97.77	94.08	90.39	86.7	83.01	83.01	86.7	90.39	94.08	97.77	101.46		7,,,,
Total = $Sum(44)_{112}$ = Energy content of hot water used - calculated monthly = $4.190 \times Vd$, $m \times nm \times DTm / 3600 \times Wh/month$ (see Tables 1b, 1c, 1d)													1106.83	(44)
-						1	ı	ı		,		,	1	
(45)m=	150.46	131.59	135.79	118.39	113.6	98.02	90.83	104.23	105.48	122.93	134.18	145.71		7(45)
If instant	taneous w	ater heatir	na at point	of use (no	hot water	storage).	enter 0 in	boxes (46		Total = Su	m(45) ₁₁₂ =		1451.23	(45)
		_				-				10.44	00.40	04.00		(46)
(46)m= Water	2 ^{2.57} storage	19.74	20.37	17.76	17.04	14.7	13.63	15.64	15.82	18.44	20.13	21.86		(46)
	_		includin	ng any so	olar or W	WHRS	storage	within sa	ame ves	sel		5		(47)
		,		nk in dw					ATTIO VOO	001		<u> </u>		(41)
	-	7							ers) ente	er 'O' in <i>(</i>	47)			
	storage		not wate	, (uno m	iciaacs i	Hotaritar	icous cc	// DOI	CIS) CITE	51 0 111 (, ,			
			eclared I	oss facto	or is kno	wn (kWł	n/day):					0		(48)
,			m Table			`	,					0		(49)
•				, kWh/ye	oor			(48) x (49)	١ _					, ,
• • • • • • • • • • • • • • • • • • • •			•	ylinder l		or is not	known:	(40) X (43)	, –			5		(50)
				om Tabl							0.	03		(51)
			ee secti		`		• /						l	` '
Volum	e factor	from Tal	ble 2a								2.	88		(52)
Tempe	rature fa	actor fro	m Table	2b							0	.6		(53)
Energy	lost fro	m water	storage	, kWh/ye	ear			(47) x (51)) x (52) x (53) =	0.	24		(54)
Enter	(50) or (54) in (5	55)								0.	24		(55)
Water	storage	loss cal	culated f	or each	month			((56)m = (55) × (41)ı	m			'	
(56)m=	7.49	6.76	7.49	7.25	7.49	7.25	7.49	7.49	7.25	7.49	7.25	7.49		(56)
		dedicated	d solar sto	rage, (57)r	n = (56)m	<u> </u>	<u>I</u> H11)] ÷ (5	1 0), else (5	1 7)m = (56)	n where (L H11) is fro	m Append	l ix H	, ,
(F7) m	7.40	6.76	7.40	7.05	7.40	7.05	7.40	7 40	7.05	7.40	7.05	7.40	1	(57)
(57)m=	7.49	6.76	7.49	7.25	7.49	7.25	7.49	7.49	7.25	7.49	7.25	7.49		(37)
Primar	y circuit	loss (an	inual) fro	m Table	3							0		(58)
	•				,	•	` '	65 × (41)						
,									cylinde		<u> </u>		ı	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)
Combi	loss cal	culated	for each	month (61)m =	(60) ÷ 36	65 × (41)m						
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0		(61)
						•	•		•	•	•		1	

Total heat required for wate	heating o	alculated	I for eac	h month	(62)m =	= 0.85 × ((45)m +	(46)m +	(57)m +	(59)m + (61)m	
(62)m= 181.21 159.37 166.5			127.78	121.59	134.99	135.24	153.68	163.94	176.47		(62)
Solar DHW input calculated using	Appendix G	or Appendix	H (negati	ve quantity	/) (enter '(D' if no sola	r contribut	tion to wate	er heating)	•	
(add additional lines if FGH	RS and/or	WWHRS	applies	, see Ap	pendix	G)					
(63)m= 0 0 0	0	0	0	0	0	0	0	0	0		(63)
Output from water heater	-	-	-	-	-		-		-		
(64)m= 181.21 159.37 166.5	148.15	144.35	127.78	121.59	134.99	135.24	153.68	163.94	176.47		_
			-	-	Out	put from wa	ater heate	r (annual) ₁	12	1813.3	(64)
Heat gains from water heati	ng, kWh/n	nonth 0.2	5 ´ [0.85	× (45)m	+ (61)r	n] + 0.8 x	د [(46)m	+ (57)m	+ (59)m]	
(65)m= 74.63 65.98 69.7	5 63.17	62.37	56.4	54.8	59.26	58.88	65.47	68.42	73.05		(65)
include (57)m in calculation	on of (65)r	n only if c	ylinder i	s in the	dwelling	or hot w	ater is f	rom com	munity h	eating	
5. Internal gains (see Tabl	e 5 and 5	a):									
Metabolic gains (Table 5), V	/atts										
Jan Feb Ma		May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(66)m= 122.18 122.18 122.1	122.18	122.18	122.18	122.18	122.18	122.18	122.18	122.18	122.18		(66)
Lighting gains (calculated in	Appendix	L, equat	ion L9 o	r L9a), a	lso see	Table 5	-		-		
(67)m= 19.38 17.21 14	10.6	7.92	6.69	7.23	9.39	12.61	16.01	18.68	19.91		(67)
Appliances gains (calculated	d in Apper	ıdix L, eq	uation L	13 or L1	3a), als	o see Ta	ble <mark>5</mark>				
(68)m= 217.34 219.59 213.9	201.81	186.54	172.18	162.59	160.34	166.02	178.12	193.39	207.75		(68)
Cooking gains (calculated in	Appendi	L, equat	ion L15	or L15a	, also s	ee Table	5				
(69)m= 35.22 35.22 35.2	2 35.22	35.22	35.22	35.22	35.22	35.22	35.22	35.22	35.22		(69)
Pumps and fans gains (Tab	e 5a)										
(70)m= 0 0 0	О	0	0	0	0	0	0	0	0		(70)
Losses e.g. evaporation (ne	gative val	ues) (Tab	le 5)								
(71)m= -97.74 -97.74 -97.7	4 -97.74	-97.74	-97.74	-97.74	-97.74	-97.74	-97.74	-97.74	-97.74		(71)
Water heating gains (Table	5)	=	=	=	=			-	=		
(72)m= 100.31 98.18 93.7	5 87.74	83.83	78.33	73.66	79.65	81.78	88	95.03	98.19		(72)
Total internal gains =			(66)	m + (67)m	ı + (68)m	+ (69)m + ((70)m + (7	71)m + (72)	m	•	
(73)m= 396.68 394.63 381.3	359.8	337.95	316.86	303.13	309.03	320.06	341.78	366.76	385.5		(73)
6. Solar gains:											
Solar gains are calculated using s	olar flux fror	n Table 6a	and assoc	iated equa	tions to c	onvert to th	e applicat	ole orientat	ion.		
Orientation: Access Factor			Flu		_	g_ 	_	FF		Gains	
Table 6d	m²		ı aı	ole 6a		Table 6b	_ '	able 6c		(W)	_
North 0.9x 0.77	x 7	.14	X 1	0.63	х	0.63	x	0.7	=	23.2	(74)
North 0.9x 0.77	x 7	.14	x 2	0.32	Х	0.63	x	0.7	=	44.34	(74)
North 0.9x 0.77	x 7	.14	x 3	34.53	х	0.63	x	0.7	=	75.35	(74)
North 0.9x 0.77	x 7	.14	X 5	5.46	Х	0.63	x	0.7	=	121.03	(74)
North 0.9x 0.77	x 7	.14	x 7	4.72	x	0.63	x	0.7	=	163.04	(74)
North 0.9x 0.77	x 7	.14	x 7	9.99	х	0.63	x	0.7	=	174.53	(74)
North 0.9x 0.77	x 7	.14	x 7	'4.68	x	0.63	x [0.7	=	162.95	(74)
North 0.9x 0.77	x 7	.14	X 5	9.25	Х	0.63	x	0.7	=	129.28	(74)

North	0.9x	0.77	X	7.1	4	x	41.52	x	0.63	X	0.7	=	90.59	(74)
North	0.9x	0.77	x	7.1	4	x	24.19	x	0.63	X	0.7	=	52.78	(74)
North	0.9x	0.77	x	7.1	4	X	13.12	×	0.63	X	0.7	=	28.62	(74)
North	0.9x	0.77	x	7.1	4	x	8.86	X	0.63	×	0.7		19.34	(74)
South	0.9x	0.77	x	13.:	2	X	46.75	T x	0.63	x	0.7	=	188.6	(78)
South	0.9x	0.77	x	13.:	2	X	76.57	X	0.63	x	0.7	=	308.88	(78)
South	0.9x	0.77	x	13.	2	x	97.53	i x	0.63	x	0.7	=	393.46	(78)
South	0.9x	0.77	x	13.	2	x	110.23	Īx	0.63	x	0.7		444.7	(78)
South	0.9x	0.77	х	13.	2	x	114.87	X	0.63	x	0.7	=	463.4	(78)
South	0.9x	0.77	x	13.:	2	x	110.55	i x	0.63	x	0.7	=	445.96	(78)
South	0.9x	0.77	x	13.:	2	x	108.01	Īx	0.63	x	0.7	=	435.73	(78)
South	0.9x	0.77	x	13.:	2	x	104.89	X	0.63	x	0.7	=	423.15	(78)
South	0.9x	0.77	x	13.:	2	x	101.89	X	0.63	x	0.7	=	411.02	(78)
South	0.9x	0.77	x	13.:	2	X	82.59	X	0.63	x	0.7		333.16	(78)
South	0.9x	0.77	X	13.:	2	x	55.42	X	0.63	X	0.7	=	223.56	(78)
South	0.9x	0.77	x	13.:	2	x	40.4	X	0.63	x	0.7	=	162.97	(78)
	_							_						_
Solar g	ains in	watts, calc	culated	for each	month			(83)m	= Sum(74)m	(8 <mark>2</mark>)m				
(83)m=	211.8		168.81	565.72	626.44		20.49 598.68	552	.43 501.61	385.9	4 252.18	182.31		(83)
Total g	ains – ii	nternal and	solar	(84)m =	(73)m	+ (8	33)m , watts							
г													1	
(84)m=	608.48	747.86 8	350.12	925.52	964.38	93	37.35 901.81	861	.47 821.67	727.7	2 618.94	567.82		(84)
` ' L		_					37.35 901.81	861	.47 821.67	727.7	618.94	567.82		(84)
7. Mea	an inter	nal temper	rature (heating	seasor	1)				727.7	618.94	567.82	21	
7. Mea	an inter erature	nal temper	rature (ating pe	heating eriods in	seasor the livi	i) ing	area from Ta			727.7	618.94	567.82	21	(84)
7. Mea	an inter erature tion fac	nal temper during hea tor for gair	rature (ating pe	heating eriods in ving are	seasor the livi	ing	area from Ta	ble 9	Th1 (°C)				21	
7. Mea	an inter erature tion fac Jan	nal temper during hea tor for gain Feb	rature (ating pe ns for li Mar	heating eriods in ving are	season the livi a, h1,m May	n) ing a	area from Ta ee Table 9a) Jun Jul	ble 9	Th1 (°C)	Oct	Nov	Dec	21	(85)
7. Mea Tempe Utilisa (86)m=	erature tion fac Jan 0.99	nal temper during hea tor for gair Feb 0.96	nature (ating pens for li Mar 0.9	heating eriods in ving are Apr 0.78	the livi a, h1,n May	ing (so	area from Ta ee Table 9a) Jun Jul 0.43 0.31	A 0.3	Th1 (°C) ug Sep 4 0.53				21	
7. Mea Tempo Utilisa (86)m=	an interesture tion facution f	nal temper during heat tor for gair Feb 0.96	nature (ating pens for li Mar 0.9	heating eriods in ving are Apr 0.78	season the livi a, h1,m May 0.61	ing (so	area from Ta ee Table 9a) Jun Jul 0.43 0.31 w steps 3 to	A 0.3	Th1 (°C) ug Sep 4 0.53 Table 9c)	Oct 0.83	Nov 0.97	Dec 0.99	21	(85)
7. Mea Tempe Utilisa (86)m=	erature tion fac Jan 0.99	nal temper during heat tor for gair Feb 0.96	nature (ating pens for li Mar 0.9	heating eriods in ving are Apr 0.78	the livi a, h1,n May	ing (so	area from Ta ee Table 9a) Jun Jul 0.43 0.31	A 0.3	Th1 (°C) ug Sep 4 0.53 Table 9c)	Oct	Nov 0.97	Dec	21	(85)
7. Mea Tempo Utilisa (86)m= Mean (87)m=	an interestion factors and the control of the contr	nal temper during heater for gair Feb 0.96	mature (ating pens for li Mar 0.9 ure in li 20.8	heating eriods in ving are 0.78 iving are 20.94	season the livi a, h1,m May 0.61 ea T1 (f	ing (so	area from Ta ee Table 9a) Jun Jul 0.43 0.31 w steps 3 to	Al 0.3	Th1 (°C) ug Sep 4 0.53 Table 9c) 1 21	Oct 0.83	Nov 0.97	Dec 0.99	21	(85)
7. Mea Tempo Utilisa (86)m= Mean (87)m=	an interestion factors and the control of the contr	nal temper during hea tor for gair Feb 0.96 I temperatu 20.61	mature (ating pens for li Mar 0.9 ure in li 20.8	heating eriods in ving are 0.78 iving are 20.94	season the livi a, h1,m May 0.61 ea T1 (f	ollo	area from Ta ee Table 9a) Jun Jul 0.43 0.31 w steps 3 to 21 21	Al 0.3	Th1 (°C) ug Sep 4 0.53 Table 9c) 1 21 9, Th2 (°C)	Oct 0.83	Nov 0.97	Dec 0.99	21	(85)
7. Mea Tempe Utilisa (86)m= Mean (87)m= Tempe (88)m=	un interestion factors Jan 0.99 interna 20.41 erature 20.25	nal temper during hea etor for gair Feb 0.96 I temperatu 20.61 during hea 20.25	mature (mating persons for li mating persons li	heating eriods in ving are 0.78 iving are 20.94 eriods in 20.25	season the livina, h1,m May 0.61 ea T1 (fr 20.99 rest of 20.25	ng (se	area from Table 9a) Jun Jul 0.43 0.31 w steps 3 to 21 21 elling from T	A 0.3 7 in T 2 able 9	Th1 (°C) ug Sep 4 0.53 Table 9c) 1 21 9, Th2 (°C)	Oct 0.83	Nov 0.97	Dec 0.99	21	(86)
7. Mea Tempe Utilisa (86)m= Mean (87)m= Tempe (88)m=	un interestion factors Jan 0.99 interna 20.41 erature 20.25	nal temper during heater for gair Feb 0.96 I temperate 20.61 during heater 20.25 eter for gair	mature (mating persons for li mating persons li	heating eriods in ving are 0.78 iving are 20.94 eriods in 20.25	season the livina, h1,m May 0.61 ea T1 (fr 20.99 rest of 20.25	n) (si) (si) (dw) (dw) (dw) (dw) (dw) (dw) (dw) (dw	area from Table 9a) Jun Jul 0.43 0.31 w steps 3 to 21 21 elling from T 0.25 20.25	Ai 0.3 7 in T 2 able 9	Th1 (°C) ug Sep 4 0.53 Table 9c) 1 21 9, Th2 (°C) 25 20.25	Oct 0.83	Nov 0.97	Dec 0.99	21	(86)
7. Mea Tempo Utilisa (86)m= Mean (87)m= Tempo (88)m= Utilisa (89)m=	interna 20.41 erature 20.25 tion fac	nal temper during heater for gair Feb 0.96 I temperatu 20.61 during heater 20.25 etor for gair 0.96	mature (ating pens for li Mar 0.9 ure in li 20.8 ating pens for re 0.88	heating eriods in ving are 0.78 iving are 20.94 eriods in 20.25 est of dv 0.74	season the livi a, h1,m May 0.61 ea T1 (fi 20.99 rest of 20.25 velling, 0.56	ollo h2,	area from Ta ee Table 9a) Jun Jul 0.43 0.31 w steps 3 to 21 21 elling from T 0.25 20.25 m (see Table 0.38 0.26	Al 0.3 7 in T 2 able 9 20. 9a) 0.2	Th1 (°C) ug Sep 4 0.53 Table 9c) 1 21 0, Th2 (°C) 25 20.25	Oct 0.83 20.92 20.25 0.79	Nov 0.97 20.64	Dec 0.99 20.36	21	(85) (86) (87) (88)
7. Mea Tempo Utilisa (86)m= Mean (87)m= Tempo (88)m= Utilisa (89)m=	interna 20.41 erature 20.25 tion fac	nal temper during heater for gair Feb 0.96 I temperate 20.61 during heater 20.25 eter for gair 0.96 I temperate	mature (ating pens for li Mar 0.9 ure in li 20.8 ating pens for re 0.88	heating eriods in ving are 0.78 iving are 20.94 eriods in 20.25 est of dv 0.74	season the livi a, h1,m May 0.61 ea T1 (fi 20.99 rest of 20.25 velling, 0.56	n) ing : (solloollo) h2, (ting)	area from Ta ee Table 9a) Jun Jul 0.43 0.31 w steps 3 to 21 21 elling from T 0.25 20.25 m (see Table	Al 0.3 7 in T 2 able 9 20. 9a) 0.2	Th1 (°C) ug Sep 4 0.53 Table 9c) 1 21 9, Th2 (°C) 25 20.25 8 0.48 to 7 in Tab	Oct 0.83 20.92 20.25 0.79	Nov 0.97 20.64 20.25	Dec 0.99 20.36	21	(85) (86) (87) (88)
7. Mea Tempo Utilisa (86)m= Mean (87)m= Tempo (88)m= Utilisa (89)m= Mean	interna 20.41 erature 20.25 tion fac 0.99 interna	nal temper during heater for gair Feb 0.96 I temperate 20.61 during heater 20.25 eter for gair 0.96 I temperate	mature (mating persons for li mating persons for re mating persons for li mating person	heating eriods in 20.94 eriods in 20.74 he rest of	the livina, h1,m May 0.61 ea T1 (fr 20.99 rest of 20.25 velling, 0.56 of dwell	n) ing : (solloollo) h2, (ting)	area from Table 9a) Jun Jul 0.43 0.31 w steps 3 to 21 21 elling from T 0.25 20.25 m (see Table 0.38 0.26 T2 (follow st	Ai 0.3 7 in T 2 able 9 20. e 9a) 0.2 eps 3	Th1 (°C) ug Sep 4 0.53 Table 9c) 1 21 0, Th2 (°C) 25 20.25 8 0.48 to 7 in Tab 25 20.25	Oct 0.83 20.92 20.25 0.79 le 9c) 20.17	Nov 0.97 20.64 20.25	Dec 0.99 20.36 20.25 0.99	21	(85) (86) (87) (88)
7. Mea Tempo Utilisa (86)m= Mean (87)m= Tempo (88)m= Utilisa (89)m= Mean (90)m=	interna 20.25 tion factors interna 19.48	nal temper during heat tor for gair Feb 0.96 I temperate 20.61 during heat 20.25 ctor for gair 0.96 I temperate 19.76 2	mature (ating pens for li Mar 0.9 ure in li 20.8 ating pens for re 0.88 ure in t 20.02	heating eriods in ving are 0.78 iving are 20.94 eriods in 20.25 est of dw 0.74 he rest of 20.18	season the livi a, h1,n May 0.61 ea T1 (f 20.99 rest of 20.25 velling, 0.56 of dwell 20.24	ollo h2,	area from Ta ee Table 9a) Jun Jul 0.43 0.31 w steps 3 to 21 21 elling from T 0.25 20.25 m (see Table 0.38 0.26 T2 (follow st 0.25 20.25	Al 0.3 7 in T 2 able 9 20. e 9a) 0.2 eps 3	Th1 (°C) ug Sep 4 0.53 Table 9c) 1 21 9, Th2 (°C) 25 20.25 8 0.48 to 7 in Tab 25 20.25	0.83 20.92 20.25 0.79 le 9c) 20.17 fLA = Liv	Nov 0.97 20.64 20.25 0.96	Dec 0.99 20.36 20.25 0.99		(85) (86) (87) (88) (89)
7. Mea Tempo Utilisa (86)m= Mean (87)m= Tempo (88)m= Utilisa (89)m= Mean (90)m=	interna 20.41 erature 20.25 tion fac 0.99 interna 19.48	nal temper during heater for gair Feb 0.96 I temperate 20.61 during heat 20.25 eter for gair 0.96 I temperate 19.76 I temperate 20.76	mature (mating persons for li mating persons for re mating persons for li mating person	heating eriods in 20.94 eriods in 20.25 est of dv 0.74 he rest of 20.18	the living, has been seen to the living as t	h2, (see ling)	area from Ta ee Table 9a) Jun Jul 0.43 0.31 w steps 3 to 21 21 elling from T 0.25 20.25 m (see Table 0.38 0.26 T2 (follow st 0.25 20.25 g) = fLA × T1	Al 0.3 7 in T 2 able 9 20. eps 3 20. + (1	Th1 (°C) ug Sep 4 0.53 Table 9c) 1 21 2, Th2 (°C) 25 20.25 8 0.48 to 7 in Tab 25 20.25 - fLA) × T2	Oct 0.83 20.92 20.25 0.79 le 9c) 20.17 fLA = Liv	Nov 0.97 20.64 20.25 0.96 19.8 ving area ÷ (4	Dec 0.99 20.36 20.25 0.99 19.39		(85) (86) (87) (88) (89) (90) (91)
7. Mea Tempo Utilisa (86)m= Mean (87)m= Tempo (88)m= Utilisa (89)m= Mean (90)m= Mean (92)m=	interna 20.41 erature 20.25 tion fac 0.99 interna 19.48 interna 19.86	nal temper during heater for gair Feb 0.96 I temperatu 20.61 during heater 19.76 2 I temperatu 19.76 2	mature (ating pens for li Mar 0.9 ure in li 20.8 ating pens for re 0.88 ure in t 20.02 ure (for 20.33	heating are Apr 0.78 iving are 20.94 eriods in 20.25 est of dw 0.74 he rest of 20.18	the living, has been seen to the living as t	ollo h2, h2, colling 2	area from Ta ee Table 9a) Jun Jul 0.43 0.31 w steps 3 to 21 21 elling from T 0.25 20.25 m (see Table 0.38 0.26 T2 (follow st 0.25 20.25 g) = fLA × T1 0.55 20.55	All 0.3 7 in T 2 able 9 20. e 9a) 0.2 eps 3 20. + (1 20.	Th1 (°C) ug Sep 4 0.53 Table 9c) 1 21 9, Th2 (°C) 25 20.25 8 0.48 to 7 in Tab 25 20.25	Oct 0.83 20.92 20.25 0.79 le 9c) 20.17 fLA = Liv 20.47	Nov 0.97 20.64 20.25 0.96 19.8 ving area ÷ (4	Dec 0.99 20.36 20.25 0.99		(85) (86) (87) (88) (89)
7. Mea Tempo Utilisa (86)m= Mean (87)m= Tempo (88)m= Utilisa (89)m= Mean (90)m= Mean (92)m= Apply	interna 20.41 erature 20.25 tion fac 0.99 interna 19.48 interna 19.86 adjustn	nal temper during heater for gair Feb 0.96 I temperate 20.61 during heater 20.25 eter for gair 0.96 I temperate 19.76 I temperate 19.76 I temperate 20.11 20.11 20.11 20.11	mature (ating pens for limited	heating eriods in ving are 20.94 eriods in 20.25 est of dv 0.74 he rest of 20.18 the who 20.49 internal	the living, has a rest of 20.25 velling, 0.56 of dwell 20.24 ole dwere 20.54 temper	h2, (Cling 2	area from Ta ee Table 9a) Jun Jul 0.43 0.31 w steps 3 to 21 21 elling from T 0.25 20.25 m (see Table 0.38 0.26 T2 (follow st 0.25 20.25 g) = fLA × T1 0.55 20.55 re from Table	All 0.3 7 in T 2 able 9 20. e 9a) 0.2 eps 3 20. + (1 20. e 4e,	Th1 (°C) ug Sep 4 0.53 Table 9c) 1 21 2, Th2 (°C) 25 20.25 8 0.48 to 7 in Tab 25 20.25 — fLA) × T2 55 20.55 where appr	Oct 0.83 20.92 20.25 0.79 le 9c) 20.47 opriate	Nov 0.97 20.64 20.25 0.96 19.8 ving area ÷ (4	Dec 0.99 20.36 20.25 0.99 19.39 4) =		(85) (86) (87) (88) (89) (90) (91)
7. Mean (86)m= [Mean (87)m= [Tempo (88)m= [Utilisa (89)m= [Mean (90)m= [Mean (92)m= [Apply (93)m=	interna 20.25 tion fac 0.99 interna 20.25 tion fac 0.99 interna 19.48 interna 19.86 adjustn 19.86	nal temper during heat tor for gair Feb 0.96 I temperatu 20.61 during heat 20.25 ctor for gair 0.96 I temperatu 19.76 2 I temperatu 20.11 2 nent to the	ating pens for line ating pens for reconstruction because the second	heating are Apr 0.78 iving are 20.94 eriods in 20.25 est of dw 0.74 he rest of 20.18	season the livina, h1,m May 0.61 ea T1 (fr 20.99 rest of 20.25 velling, 0.56 of dwell 20.24	h2, (Cling 2	area from Ta ee Table 9a) Jun Jul 0.43 0.31 w steps 3 to 21 21 elling from T 0.25 20.25 m (see Table 0.38 0.26 T2 (follow st 0.25 20.25 g) = fLA × T1 0.55 20.55	All 0.3 7 in T 2 able 9 20. e 9a) 0.2 eps 3 20. + (1 20.	Th1 (°C) ug Sep 4 0.53 Table 9c) 1 21 2, Th2 (°C) 25 20.25 8 0.48 to 7 in Tab 25 20.25 — fLA) × T2 55 20.55 where appr	Oct 0.83 20.92 20.25 0.79 le 9c) 20.17 fLA = Liv 20.47	Nov 0.97 20.64 20.25 0.96 19.8 ving area ÷ (4	Dec 0.99 20.36 20.25 0.99 19.39		(85) (86) (87) (88) (89) (90) (91)
7. Mea Tempo Utilisa (86)m= Mean (87)m= Tempo (88)m= Utilisa (89)m= Mean (90)m= Mean (92)m= Apply (93)m= 8. Spa	interna 20.41 erature 20.25 tion fac 0.99 interna 19.48 interna 19.86 adjustn 19.86	nal temper during heater for gair Feb 0.96 I temperate 20.61 during heater 19.76 2 determinent to the 20.11 2 ting require	mature (ating pens for limited pens for reconstruction) at the construction of the con	heating are Apr 0.78 iving are 20.94 eriods in 20.25 est of dv 0.74 he rest of 20.18 the who 20.49 internal 20.49	season the livina, h1,m May 0.61 ea T1 (fr 20.99 rest of 20.25 velling, 0.56 of dwell 20.24 ble dwe 20.54 temper 20.54	h2, (c) (d) (d) (d) (d) (e) (d) (e) (d) (e) (e	area from Ta ee Table 9a) Jun Jul 0.43 0.31 w steps 3 to 21 21 elling from T 0.25 20.25 m (see Table 0.38 0.26 T2 (follow st 0.25 20.25 g) = fLA × T1 0.55 20.55 re from Table	All 0.3 7 in T 2 able 9 20. e 9a) 0.2 eps 3 20. + (1 20. e 4e, 20.	Th1 (°C) ug Sep 4 0.53 Table 9c) 1 21 0, Th2 (°C) 25 20.25 8 0.48 to 7 in Tab 25 20.25 — fLA) × T2 55 20.55 where appr 55 20.55	Oct 0.83 20.92 20.25 0.79 le 9c) 20.47 opriate 20.47	Nov 0.97 20.64 20.25 0.96 19.8 ving area ÷ (4	Dec 0.99 20.36 20.25 0.99 19.39 1) =	0.41	(85) (86) (87) (88) (89) (90) (91)

Mar

Apr

May

Jun

Jul

Aug

Sep

Oct

Nov

Dec

Jan

Feb

Utilisation factor for gains, hm: (94)m=	0.58 0.4	0.20	0.24	0.5	0.0	0.06	0.00	1	(94)				
(94)m= 0.99 0.95 0.89 0.76 Useful gains, hmGm , W = (94)m x (84)		0.28	0.31	0.5	0.8	0.96	0.99		(34)				
	557.07 378.72	251.81	264.52	409.01	581.91	594.77	562.12		(95)				
Monthly average external temperature	from Table 8	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>							
(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 temper		-``	-``	- 	i —			Ī					
` '	563.42 379.23	251.84	264.58	410.95	629.2	830.82	993.03		(97)				
Space heating requirement for each mo (98)m= 291.43 171.66 95.45 28.39	$\frac{\text{onth, kVVh/mont}}{4.73} 0$	h = 0.02	24 x [(97])m - (95 0)m] x (4 35.19	1)m 169.96	320.6						
(50)1112 251.45 171.00 35.45 25.55	4.73		<u> </u>	l per year	<u> </u>		<u> </u>	1117.42	(98)				
Space heating requirement in kWh/m²/y	voor		7010	ii poi youi	(KVVIII) y Gai) = Gam(G	715,912	14.14	(99)				
								14.14	(99)				
9b. Energy requirements – Community h This part is used for space heating, space			ting prov	idad by	a comm	unity och	nomo						
Fraction of space heat from secondary/s						urnity Sci	ienie.	0	(301)				
Fraction of space heat from community s	system 1 – (30°	1) =						1	(302)				
The community scheme may obtain heat from seve	reral sources. The p	orocedure	allows for	CHP and	up to four	other heat	sources; ti	he latter					
The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.													
Fraction of heat from Community CHP								0.8	(303a)				
Fraction of community heat from heat so	ource 2							0.2	(303b)				
Fraction of total space heat from Commu	unity CHP				(3	02) x (303	a) =	0.8	(304a)				
Fraction of total space heat from commu	ınity heat sourc	e 2			(3	02) x (303	b) =	0.2	(304b)				
Factor for control and charging method ((Table 4c(3)) fo	r commu	unity hea	ating sys	tem			1	(305)				
Distribution loss factor (Table 12c) for co	mmunity heati	ng syste	m					1.05	(306)				
Space heating								kWh/yea	 r				
Annual space heating requirement								1117.42					
Space heat from Community CHP				(98) x (30	04a) x (30	5) x (306)	=	938.63	(307a)				
Space heat from heat source 2				(98) x (30	04b) x (30	5) x (306) :	=	234.66	(307b)				
Efficiency of secondary/supplementary h	neating system	in % (fro	m Table	4a or A	ppendix	E)		0	(308)				
Space heating requirement from second	ary/supplemen	tary syst	tem	(98) x (30	01) x 100 -	÷ (308) =		0	(309)				
Water heating Annual water heating requirement								1813.3					
If DHW from community scheme:									_ _				
Water heat from Community CHP				(64) x (30	03a) x (30	5) x (306)	=	1523.17	(310a)				
Water heat from heat source 2				(64) x (30	03b) x (30	5) x (306)	=	380.79	(310b)				
Electricity used for heat distribution			0.01	× [(307a)	(307e) +	· (310a)((310e)] =	30.77	(313)				
Cooling System Energy Efficiency Ratio								0	(314)				
Space cooling (if there is a fixed cooling	system, if not e	enter 0)		= (107) ÷	(314) =			0	(315)				
Electricity for pumps and fans within dwe	elling (Table 4f)	:											
mechanical ventilation - balanced, extract			outside					57.35	(330a)				

warm air heating system fans		0 (330b)
pump for solar water heating		0 (330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	57.35 (331)
Energy for lighting (calculated in Appendix L)		342.18 (332)
12b. CO2 Emissions – Community heating scheme		
Electrical efficiency of CHP unit		30 (361)
Heat efficiency of CHP unit		57.5 (362)
	Energy Emission factor kWh/year kg CO2/kWh	or Emissions kg CO2/year
Space heating from CHP) $(307a) \times 100 \div (362) =$	1632.4 × 0.22	352.6 (363)
less credit emissions for electricity $-(307a) \times (361) \div (362) =$	489.72 × 0.52	-254.17 (364)
Water heated by CHP $(310a) \times 100 \div (362) =$	2648.99 × 0.22	572.18 (365)
less credit emissions for electricity $-(310a) \times (361) \div (362) =$	794.7 × 0.52	-412.45 (366)
Efficiency of heat source 2 (%) If there is CHP using two	o fuels repeat (363) to (366) for the second	fuel 89.5 (367b)
CO2 associated with heat source 2 [(307b)+(310	(b)] x 100 ÷ (367b) x 0.22	= 148.53 (368)
Electrical energy for heat distribution [(31	3) x 0.52	= 15.97 (372)
Total CO2 associated with community systems (363	3)(366) + (368)(372)	= 422.67 (373)
CO2 associated with space heating (secondary) (30s	0 O	= 0 (374)
CO2 associated with water from immersion heater or instantaneous	s heater (312) x 0.22	= 0 (375)
Total CO2 associated with space and water heating (373	3) + (374) + (375) =	422.67 (376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x 0.52	= 29.76 (378)
CO2 associated with electricity for lighting (332	?))) x 0.52	= 177.59 (379)
Total CO2, kg/year sum of (376)(382) =		630.03 (383)
Dwelling CO2 Emission Rate (383) ÷ (4) =		7.98 (384)
El rating (section 14)		93.19 (385)

			User D	Details:						
Assessor Name: Software Name:	Stroma FSAP 2	012		Strom Softwa				Versio	on: 1.0.3.4	
		Р	roperty	Address	: MF 2B	4P SO V	Vest Bui	lding		
Address :										
1. Overall dwelling dimer	nsions:		_	4 0						<u>.</u> ,
Ground floor			Are	a(m²) 79	(1a) x		2.5	(2a) =	Volume(m)	3) (3a
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+((1e)+(1r	۱)	79	(4)					
Dwelling volume					(3a)+(3b	o)+(3c)+(3c	d)+(3e)+	(3n) =	197.5	(5)
2. Ventilation rate:										
Number of chimneys	main heating	secondar heating	'y □ + □	other 0	7 = F	total 0	x	40 =	m³ per hou	ır ☐(6a
•			」]			20 =		╡`
Number of open flues	U	0	」	0] ⁻	0			0	(6b
Number of intermittent fan	IS .				Ĺ	3		10 =	30	(7a
Number of passive vents					L	0	X	10 =	0	(7b
Number of flueless gas fire	es					0	X	40 =	0	(7c
								Δir ch	nanges per h	our
Infiltration due to chimney	o fluor and fans —	(63)+(6b)+(7	7a)+(7b)+((70) -			_			_
If a pressurisation test has be					continue f	30 rom (9) to		\div (5) =	0.15	(8)
Number of storeys in the		, , , , , , ,	(, ,),			(2) 32	() -)		0	(9)
Additional infiltration							[(9)	-1]x0.1 =	0	(10
Structural infiltration: 0.2					•	ruction			0	(11
if both types of wall are pre deducting areas of opening		responding to	the grea	ter wall are	a (after					
If suspended wooden flo		ealed) or 0	.1 (seale	ed), else	enter 0				0	(12
If no draught lobby, ente	er 0.05, else enter	0							0	(13
Percentage of windows	and doors draught	t 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 being u	ısed		0.4	(18
Number of sides sheltered				5	,	J			2	(19
Shelter factor				(20) = 1 -	[0.075 x (19)] =			0.85	(20
Infiltration rate incorporation	ng shelter factor			(21) = (18) x (20) =				0.34	(21
Infiltration rate modified fo	r monthly wind spe	eed		•	•			•	,	
Jan Feb I	Mar Apr Ma	ay Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind spe	ed from Table 7								1	
(22)m= 5.1 5	4.4 4.3	3.8	3.8	3.7	4	4.3	4.5	4.7		
Wind Factor (22a)m = (22)m ÷ 4									
	.23 1.1 1.08	3 0.95	0.95	0.92	1	1.08	1.12	1.18]	
,	1.00	1 3.33			<u> </u>	1			J	

0.44	0.43	e (allowi	0.38	0.37	0.32	0.32	0.32	0.34	0.37	0.38	0.4		
Calculate effe		•	rate for t	he appli	cable ca	se	!	<u>!</u>		<u>l</u>	!		
If mechanica			andin N. (O	ah) (aa-	· \		NE\\ -4b-		\ (00-\			0	(2
If exhaust air h) = (23a)			0	(2
If balanced with		-	-	_					21.) (001.)	4 (00.1	0	(2
a) If balance	ed mecha	anical ve	entilation 0	with he	at recove	ery (MVI	HR) (24a 	$\frac{a)m = (22)}{0}$	2b)m + ()	23b) × [- ` ` `) ÷ 100] 7	(2
24a)m= 0											0		(2
b) If balance	ea mecna 0	anicai ve	entilation 0	without	neat red	overy (r	VIV) (246 1 0	$\int_{0}^{\infty} \int_{0}^{\infty} dx = (22)$	2b)m + (2 0	23D) 0	0	1	(2
			<u> </u>						U	U	0		(2
c) If whole h		tract ven ∢(23b), t		•	-				5 v (23h	.)			
4c)m = 0	0.07	0	0	0	0	0	0) = (22)	0	0 7 (200	0	0	7	(2
d) If natural	ventilatio	on or wh	ole hous	e nositiv	/e innut	L ventilatio	on from I	loft				_	·
,		en (24d)			•				0.5]				
4d)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 (24k	o) or (24	c) or (24	d) in box	x (25)		•	•	-	
(5)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
l loot loos	and b	at loss	0 0 0 0 0 0 0 0					•					_
B. Heat losse					Not An		Uvel		A V I I		برامير يا		A V I.
LEMENT	Gros area		Openin m		Net Ar A ,r		U-valı W/m2		A X U (W/I	<)	k-valu kJ/m²·		A X k kJ/K
in <mark>dows</mark> Type					6.93		/[1/(1.4)+		9.19				(2
/indows Type					12.82	=	/[1/(1.4)+		17	Ħ			(2
/alls Type1	20.6	2	12.8		7.8	X	0.18		1.4	Ħ,			(2
/alls Type2		_	_	= \						븍 ;		╡╞	
• •	18.0		6.93		11.11	=	0.18	= [2				(2
otal area of e		•	effootivo wi	ndow II w	38.66		r formula 1	/[/1/ vol	(0) (0 0 41 6	o airan in	norogran	h 2 2	(3
include the area						ateu usirig	j iorriula i	/[(1/ U- valu	le)+0.04j a	is giveri iri	рагаугарі	11 3.2	
abric heat los	ss, W/K :	= S (A x	U)				(26)(30)) + (32) =				29.5	9 (3
eat capacity	Cm = S((Axk)						((28)	.(30) + (32	2) + (32a).	(32e) =	2552.	45 (3
hermal mass	parame	ter (TMF	P = Cm -	- TFA) ir	n kJ/m²K			Indica	tive Value:	: Medium		250	(3
or design assess	sments wh	ere the de	tails of the	construct	ion are no	t known pr	recisely the	e indicative	values of	TMP in Ta	able 1f		
n be used inste													
nermal bridg	,	,		• .	•	<						1.5	(3
details of therma		are not kn	own (36) =	= 0.15 x (3	1)			(22)	(26)				- (
otal fabric he			را طائمت مصا						(36) =	OE) ·· (E)		31.0	9 (3
entilation hea	i	1					Ι	1	= 0.33 × (1	1	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		15
00 ===	38.53	38.29	37.19	36.98	36.02	36.02	35.84	36.39	36.98	37.4	37.84		(3
´	coefficier	nt, W/K						(39)m	= (37) + (3	38)m		7	
8)m= 38.77 eat transfer of	JOETHCIEI	$\overline{}$		000	67.11	67.11	66.93	67.48	68.07	68.49	68.92		
´	69.62	69.38	68.28	68.07	07.11		<u> </u>			<u> </u>			
eat transfer (9)m= 69.86	69.62			68.07	07.11		!		Average =		12 /12=	68.2	8 (3
eat transfer	69.62			0.86	0.85	0.85	0.85		Average = (39)m ÷ 0.86		0.87	68.2	8 (3

Number of days in month (Table 1a)

Numbe	er or day	s in mor	ıın (Tab	ie ra)		1	1	,		1	1		1	
	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)
						•	•	•		•			ı	
1 \\/-	tor boot	ing oner	av roqui	romont:								kWh/ye	oor:	
4. 000	ilei ileai	ing ener	gy requi	rement.								KVVII/yt	ear.	
Assum	ed occu	pancy, I	N								2.	44		(42)
			+ 1.76 x	[1 - exp	(-0.0003	849 x (TF	FA -13.9)2)] + 0.0	0013 x (ΓFA -13.	9)		l	
	A £ 13.9	-						(O.F. N.I.)	. 00				ı	
				ge in litre					+ 36 a water us	se target o		.24		(43)
		_		day (all w		_	-			Ü				
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot wate				ach month		l .			Гоор	1 001	1101	200		
(44)m=	101.46	97.77	94.08	90.39	86.7	83.01	83.01	86.7	90.39	94.08	97.77	101.46		
(11)	101110	07.77	0 1.00	00.00	00.1	00.01	00.01	1 00.7		l			1106.83	(44)
Total = Sum(44) ₁₁₂ = 1106.83 Energy content of hot water used - calculated monthly = $4.190 \times Vd$, $m \times nm \times DTm / 3600 \times Wh/month$ (see Tables 1b, 1c, 1d)													1100.00	
(45)m=	150.46	131.59	135.79	118.39	113.6	98.02	90.83	104.23	105.48	122.93	134.18	145.71		
										<u> </u>	m(45) ₁₁₂ =		1451.23	(45)
If inst <mark>an</mark>	taneous w	ater heatin	ng at point	of use (no	hot water	storage),	enter 0 in	boxes (46			()2			
(46)m=	2 2.57	19.74	20.37	17.76	17.04	14.7	13.63	15.64	15.82	18.44	20.13	21.86		(46)
	storage	loss:												
Storag	<mark>e v</mark> olum	e (litre <mark>s)</mark>	inc <mark>ludir</mark>	ig any so	olar or W	WHRS	storage	within sa	ame ves	sel		150		(47)
If co <mark>m</mark> r	<mark>mu</mark> nity h	eating a	nd no ta	nk in dw	elling, e	nter 110	litres in	(47)						
Otherv	vise if no	stored	hot wate	er (th <mark>is in</mark>	cludes i	nstantar	neous co	mbi boil	ers) ente	er '0' in (47)			
	storage													
a) If m	nanufact	urer's de	eclared I	oss facto	or is kno	wn (kWl	n/day):				0	.3		(48)
Tempe	erature fa	actor fro	m Table	2b							0.	54		(49)
•			•	, kWh/ye				(48) x (49)) =		0.	16		(50)
				ylinder l									· 	
			ee secti	om Tabl	e∠(KVV	n/litre/da	iy)					0		(51)
	e factor	•		011 4.3								0		(52)
			m Table	2b								0		(53)
-				, kWh/ye	ear			(47) x (51)) x (52) x (53) =		0		(54)
	(50) or (_	, 10001111190	Jul			(11)11(01)	,		-	16		(55)
	. , ,	, ,	•	or each	month			((56)m = (55) × (41)ı	m	<u> </u>	10		()
(56)m=	4.97	4.49	4.97	4.81	4.97	4.81	4.97	4.97	4.81	4.97	4.81	4.97		(56)
		-									H11) is fro		ix H	(00)
						1	1							(==)
(57)m=	4.97	4.49	4.97	4.81	4.97	4.81	4.97	4.97	4.81	4.97	4.81	4.97		(57)
Primar	y circuit	loss (an	nual) fro	m Table	3							0		(58)
Primar	y circuit	loss cal	culated t	for each	month (59)m = 0	(58) ÷ 36	65 × (41)	m					
(mod	dified by	factor fr	om Tab	le H5 if t	here is s	solar wat	ter heati	ng and a	cylinde	r thermo	stat)		•	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)
Combi	loss cal	culated	for each	month (61)m =	(60) ÷ 36	65 × (41))m						
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0		(61)

Total h	eat requ	uired for	water h	eating ca	alculated	l for e	ach month	(62)r	n = 0.85 ×	(45)m +	(46)m +	(57)m +	(59)m + (61)m	
(62)m=	178.69	157.09	164.02	145.71	141.83	125.		132.		151.16	` 	173.94		(62)
Solar DH	IW input o	calculated	using App	endix G or	· Appendix	H (ne	gative quantit	y) (ente	er '0' if no sola	ar contribu	tion to wate	er heating)		
(add ad	dditional	l lines if	FGHRS	and/or \	WWHRS	appl	ies, see Ap	pend	ix G)					
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0		(63)
Output	from wa	ater hea	ter	•							•		•	
(64)m=	178.69	157.09	164.02	145.71	141.83	125.	34 119.06	132.	46 132.8	151.16	161.5	173.94		
_				•			•		Output from v	vater heate	er (annual) ₁	12	1783.62	(64)
Heat ga	ains fror	m water	heating	, kWh/m	onth 0.2	5 ´[0	.85 × (45)m	า + (6	1)m] + 0.8	x [(46)m	+ (57)m	+ (59)m]	
(65)m=	72.61	64.15	67.74	61.22	60.35	54.4	52.79	57.2	4 56.93	63.46	66.47	71.03		(65)
inclu	de (57)r	m in calc	culation	of (65)m	only if c	ylind	er is in the	dwelli	ng or hot v	water is f	rom com	munity h	eating	
5. Inte	ernal ga	ains (see	Table 5	5 and 5a):									
Metabo	olic gain	s (Table	5), Wat	tts										
	Jan	Feb	Mar	Apr	May	Ju	n Jul	Αι	ıg Sep	Oct	Nov	Dec		
(66)m=	122.18	122.18	122.18	122.18	122.18	122.	18 122.18	122.	18 122.18	122.18	122.18	122.18		(66)
Lighting	g gains	(calculat	ted in A	ppendix	L, equat	ion L	9 or L9a), a	also s	ee Table 5	•		•	•	
(67)m=	19.38	17.21	14	10.6	7.92	6.6	9 7.23	9.3	9 12.61	16.01	18.68	19.91		(67)
Applian	nces gai	ns (calc	ulated ir	n Append	dix L, eq	uatio	ո L13 or L <mark>1</mark>	3a), a	ilso see Ta	able 5				
	217.34	219.59	213.91	201.81	186.54	172.		160.			193.39	207.75		(68)
Cookin	g gains	(calcula	ted in A	ppendix	L, equat	tion L	15 or L15a), also	see Table	e 5				
(69)m=	35.22	35.22	35.22	35.22	35.22	35.2	22 35.22	35.2	2 35.22	35.22	35.22	35.22		(69)
Pumps	and far	ns gains	(Table	5a)										
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3		(70)
Losses	e.g. ev	aporatio	n (nega	tive valu	es) (Tab	le 5)		•		1				
(71)m=	-97.74	-97.74	-97.74	-97.74	-97.74	-97.	74 -97.74	-97.	74 -97.74	-97.74	-97.74	-97.74		(71)
Water h	neating	gains (T	able 5)				!	•	!	_ I	· l		l	
(72)m=	97.6	95.47	91.04	85.03	81.12	75.6	2 70.95	76.9	4 79.07	85.29	92.32	95.48		(72)
Total in	nternal	gains =				!	(66)m + (67)r	n + (68)m + (69)m +	· (70)m + (71)m + (72))m		
(73)m=	396.97	394.92	381.6	360.09	338.23	317.	15 303.42	309.	32 320.35	342.07	367.05	385.79		(73)
6. Sol	ar gains	S:						•						
Solar ga	ains are c	alculated (using sola	r flux from	Table 6a	and as	sociated equa	ations t	o convert to t	the applica	ble orientat	tion.		
Orienta		Access F		Area			Flux		g_		FF		Gains	
	Т	able 6d		m²			Table 6a		Table 6b) 7	able 6c		(W)	
North	0.9x	0.77	X	6.9	93	x	10.63] x [0.63	X	0.7	=	22.52	(74)
North	0.9x	0.77	X	6.9	93	x	20.32] x	0.63	X	0.7	=	43.04	(74)
North	0.9x	0.77	X	6.9	93	x	34.53	x[0.63	x	0.7	=	73.13	(74)
North	0.9x	0.77	х	6.9	93	x	55.46	x	0.63	x	0.7	=	117.47	(74)
North	0.9x	0.77	x	6.9	93	x	74.72	x	0.63	x	0.7	=	158.24	(74)
North	=					=	70.00	ī	0.00	─	0.7		400.4	(74)
NOILII	0.9x	0.77	X	6.9	93	X	79.99	X	0.63	X	0.7		169.4	(1-1)
North	0.9x 0.9x	0.77	x			x L	79.99]	0.63		0.7	=	158.16	(74)
	-			6.9	93	 		-		≓				╡

North	0.9x	0.77	X	6.9	93	X	41.	.52	x	0.63	X	0.7	7	=	87	.93	(74)
North	0.9x	0.77	Х	6.9	93	x	24.	.19	×	0.63	x	0.7	7	=	51	.23	(74)
North	0.9x	0.77	х	6.9	93	X	13.	.12	x	0.63	x	0.7	7] =	27	.78	(74)
North	0.9x	0.77	X	6.9	93	x	8.8	86	x	0.63	x	0.7	7	=	18	.77	(74)
South	0.9x	0.77	x	12.	82	x	46.	.75	x	0.63	x	0.7	7] =	183	3.17	(78)
South	0.9x	0.77	x	12.	82	x	76.	.57	x	0.63	x	0.7	7] =	299	9.99	(78)
South	0.9x	0.77	x	12.	82	x	97.	.53	x	0.63	×	0.7	7	<u> </u>	382	2.13	(78)
South	0.9x	0.77	x	12.	82	x	110	0.23	x	0.63	x	0.7	7] =	43′	1.89	(78)
South	0.9x	0.77	X	12.	82	x	114	1.87	x	0.63	x	0.7	7	=	450	0.06	(78)
South	0.9x	0.77	X	12.	82	x	110	0.55	x	0.63	x	0.7	,	=	433	3.12	(78)
South	0.9x	0.77	X	12.	82	x	108	3.01	x	0.63	x	0.7	7	=	423	3.19	(78)
South	0.9x	0.77	X	12.	82	x	104	1.89	x	0.63	X	0.7	7	=	410).97	(78)
South	0.9x	0.77	X	12.	82	x	101	1.89	x	0.63	x	0.7	,	=	399	9.18	(78)
South	0.9x	0.77	X	12.	82	x	82.	.59	x	0.63	X	0.7	7	=	323	3.57	(78)
South	0.9x	0.77	X	12.	82	x	55.	.42	x	0.63	X	0.7	7	=	217	7.12	(78)
South	0.9x	0.77	X	12.	82	x	40).4	x [0.63	x	0.7	7	=	158	3.28	(78)
Solar g	ains in	watts, cal	lculated	for eacl	h mont	h			(83)m	Sum(74)m .	(82)m						
(83)m=	205.69	343.03	455.27	549.36	608.3	6	02.52	581.34	536.4	487.11	374.8	3 244.9	17	77.05			(83)
Total g	ains – i	nternal ar	nd solar	(84)m =	= (73)m	+ (8	33)m , v	watts									
(84)m=	602.66	737.95	836.87	909.45	946.54	. 9	19.67	884.77	845.	77 807.46	716.8	7 611.9	5 56	52.84			(84)
` ′			000.07	000.10	0 10.0 1			007.77	045.1	007.46	7 10.0	7 011.3	~ ~`	2.04			` '
7. Me								004,11	043.1	77 807.46	710.0	7 011.8		JZ.04		٠.	
	an inter	nal tempe	erature ((hea <mark>ting</mark>	seaso	n)					710.0	7 011.8		2.04	2	21	(85)
Temp	an inter erature	nal tempe during he	erature ((heating eriods ir	season the liv	n) ving	area fro	om Tab			710.0	7 011.8		72.04	2	21	(85)
Temp	an inter erature ation fac	nal tempe during he tor for ga	erature (eating points for li	(heating eriods ir iving are	season the lives	n) ving m (s	area fro	om Tab	ole 9,	Th1 (°C)					2	21	(85)
Temp	an inter erature	nal tempe during he	erature ((heating eriods ir	season the liv	n) ring m (s	area fro	om Tab		Th1 (°C)	Oct	i No	v	Dec 0.99	2	21	(85)
Temp Utilisa (86)m=	an interestation factors Jan 0.99	nal tempe during he tor for ga Feb	eating poins for li Mar	(heating eriods ir iving are Apr 0.82	season the livea, h1,r May	n) ving m (s	area fro ee Tab Jun 0.47	om Tab le 9a) Jul 0.33	ole 9,	Th1 (°C)	Oct	i No	v	Dec	2	21	
Temp Utilisa (86)m= Mean	an interestation factors and the second of t	nal tempe during he stor for ga Feb 0.97	erature (eating points for line Mar 0.93	(heating eriods ir iving are Apr 0.82 iving are	season the livea, h1,r May 0.65	n) ving m (s	area fro ee Tab Jun 0.47	om Tab le 9a) Jul 0.33 s 3 to 7	Au 0.36	Th1 (°C) 1g Sep 15 0.57 1able 9c)	Oct 0.86	t No	V	Dec	2	21	(86)
Temp Utilisa (86)m= Mean (87)m=	an interest erature dition factor of the second of the sec	nal temper during he stor for ga Feb 0.97 I tempera	eating poins for line Mar 0.93 otture in l	(heating eriods ir iving are Apr 0.82 iving are 20.9	season the livea, h1,r May 0.65	n) ving m (s	area fro ee Tabl Jun 0.47 w steps	om Tab lle 9a) Jul 0.33 s 3 to 7	ole 9, Au 0.36 7 in Ta 21	Th1 (°C) 1g Sep 15 0.57 1able 9c) 20.99	Oct	t No	V	Dec	2	21	
Temp Utilisa (86)m= Mean (87)m= Temp	an interest at a constant of the constant of t	nal tempe during he tor for ga Feb 0.97 I tempera 20.5 during he	eating points for line Mar 0.93 atture in line 20.71	(heating eriods ir iving are 0.82 iving are 20.9 eriods ir	season the livea, h1,r May 0.65 ea T1 (*20.98**) rest o	n) ring n (s follo	area fro ee Tabl Jun 0.47 w steps 21	om Tab le 9a) Jul 0.33 s 3 to 7 21	ole 9, Au 0.36 7 in Ta 21 able 9	Th1 (°C) g Sep 6 0.57 able 9c) 20.99 , Th2 (°C)	Oct 0.86	No 0.98	v (Dec 0.99	2	21	(86)
Temp Utilisa (86)m= Mean (87)m=	an interest erature dition factor of the second of the sec	nal temper during he stor for ga Feb 0.97 I tempera	eating poins for line Mar 0.93 otture in l	(heating eriods ir iving are Apr 0.82 iving are 20.9	season the livea, h1,r May 0.65	n) ring n (s follo	area fro ee Tabl Jun 0.47 w steps 21	om Tab lle 9a) Jul 0.33 s 3 to 7	ole 9, Au 0.36 7 in Ta 21	Th1 (°C) g Sep 6 0.57 able 9c) 20.99 , Th2 (°C)	Oct 0.86	No 0.98	v (Dec	2	21	(86)
Temp Utilisa (86)m= Mean (87)m= Temp (88)m=	an interest of the control of the co	nal tempe during he tor for ga Feb 0.97 I tempera 20.5 during he	eating points for line Mar 0.93 liture in l 20.71 eating points 20.19	(heating eriods ir iving are 20.9 eriods ir 20.2	season the livea, h1,r May 0.65 ea T1 (* 20.98*) rest o	n) ring m (s	area from the control of the control	om Tab le 9a) Jul 0.33 s 3 to 7 21 from Ta	ole 9, Au 0.36 7 in Ta 21 able 9 20.2	Th1 (°C) g Sep 6 0.57 able 9c) 20.99 , Th2 (°C)	Oct 0.86	No 0.98	v (Dec 0.99	2	21	(86)
Temp Utilisa (86)m= Mean (87)m= Temp (88)m=	an interest of the control of the co	nal temper during he stor for ga Feb 0.97 I tempera 20.5 during he 20.18	eating points for line Mar 0.93 liture in l 20.71 eating points 20.19	(heating eriods ir iving are 20.9 eriods ir 20.2	season the livea, h1,r May 0.65 ea T1 (* 20.98*) rest o	n) ring m (s follo	area from the control of the control	om Tab le 9a) Jul 0.33 s 3 to 7 21 from Ta	ole 9, Au 0.36 7 in Ta 21 able 9 20.2	Th1 (°C) g Sep 6 0.57 able 9c) 20.99 , Th2 (°C) 11 20.21	Oct 0.86	No 0.98 20.56 20.2	V (Dec 0.99	2	21	(86)
Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m=	an interestation factors at the second secon	nal temperature during heater for garage durin	eating poins for line ating poins for rough	criods ir iving are 0.82 iving are 20.9 eriods ir 20.2 eest of do 0.78	season the livea, h1,r May 0.65 ea T1 (1 20.98 n rest o 20.2 welling, 0.6	n) m (s follo	area from the control of the control	om Table 9a) Jul 0.33 s 3 to 7 21 from Ta 20.21 e Table 0.27	ole 9, Au 0.36 7 in Ta 21 able 9 20.2 9a) 0.3	Th1 (°C) g Sep 6 0.57 able 9c) 20.99 , Th2 (°C) 11 20.21	Oct 0.86 20.88 20.2	No 0.98 20.56 20.2	V (Dec 0.99 0.25	2	21	(86) (87) (88)
Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m=	an interestation factors at the second secon	nal temperature during heater for garage durin	eating poins for line ating poins for rough	criods ir iving are 0.82 iving are 20.9 eriods ir 20.2 eest of do 0.78	season the livea, h1,r May 0.65 ea T1 (1 20.98 n rest o 20.2 welling, 0.6	n) ving m (s follo	area from the control of the control	om Table 9a) Jul 0.33 s 3 to 7 21 from Ta 20.21 e Table 0.27	ole 9, Au 0.36 7 in Ta 21 able 9 20.2 9a) 0.3	Th1 (°C) g Sep 6 0.57 able 9c) 20.99 , Th2 (°C) 1 20.21 0.51 to 7 in Table	Oct 0.86 20.88 20.2	No 0.98 20.50 20.2	V (Dec 0.99 0.25		21	(86) (87) (88)
Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m= Mean	an interest ation factors ation factors at the control of the cont	nal temper during he tor for ga Feb 0.97 I tempera 20.5 during he 20.18 etor for ga 0.97 I tempera	eating points for line ating points for rough	criods ir 0.82 iving are 20.9 eriods ir 20.2 est of do 0.78 the rest	season the livea, h1,r May 0.65 ea T1 (* 20.98 * 20.2 welling, 0.6 of dwell	n) ving m (s follo	area from the control of the control	om Table 9a) Jul 0.33 s 3 to 7 21 from Ta 20.21 e Table 0.27	ole 9, Au 0.36 in Ta 21 able 9 20.2 9a) 0.3 eps 3	Th1 (°C) g Sep 5 0.57 able 9c) 20.99 , Th2 (°C) 1 20.21 0.51 to 7 in Table 1 20.2	Oct 0.86 20.88 20.2 0.82 e 9c) 20.08	No 0.98 20.50 20.2	V (() () () () () () () () ()	Dec 0.99 0.25 0.19		21	(86) (87) (88) (89)
Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m= Mean (90)m=	an interest ation factors at 19.24	nal temperature during heater for garage durin	eating poins for line ating poins for rough	criods ir iving are 20.9 eriods ir 20.2 est of do 0.78 the rest 20.09	season the livea, h1,r May 0.65 ea T1 (120.98 n rest of 20.2 welling 0.6 of dwel 20.18	n) ving m (s follo	area from the control of the control	om Table 9a) Jul 0.33 s 3 to 7 21 crom Table 20.21 e Table 0.27	ole 9, Au 0.36 7 in Ta 21 able 9 20.2 9a) 0.3 eps 3	Th1 (°C) g Sep 6 0.57 able 9c) 20.99 , Th2 (°C) 1 20.21 to 7 in Table 1 20.2	Oct 0.86 20.88 20.2 0.82 e 9c) 20.08	20.2 0.97	V (() () () () () () () () ()	Dec 0.99 0.25 0.19			(86) (87) (88) (89)
Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m= Mean (90)m=	an interest ation factors at 19.24	nal temperature during heater for garage durin	eating poins for line ating poins for rough	criods ir iving are 20.9 eriods ir 20.2 est of do 0.78 the rest 20.09	season the livea, h1,r May 0.65 ea T1 (120.98 n rest of 20.2 welling 0.6 of dwel 20.18	n) ving (s follo	area from the control of the control	om Table 9a) Jul 0.33 s 3 to 7 21 crom Table 20.21 e Table 0.27	ole 9, Au 0.36 7 in Ta 21 able 9 20.2 9a) 0.3 eps 3	Th1 (°C) g Sep 6 0.57 able 9c) 20.99 , Th2 (°C) 1 20.21 to 7 in Table 1 20.2 -fLA) × T2	Oct 0.86 20.88 20.2 0.82 e 9c) 20.08	20.2 20.2 0.97 3 19.6-ving area	V ((() () () () () () () () (Dec 0.99 0.25 0.19			(86) (87) (88) (89)
Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m= Mean (90)m=	an interest erature erature of the second of	nal temperal during heater for garage 20.5 during heater for garage 20.18 etcor for garage 19.54 l temperal 19.93	eating poins for line ating poins for rough of the control of the	criods ir iving are 20.9 eriods ir 20.2 est of do 0.78 the rest 20.09 er the who 20.42	season the livea, h1,r May 0.65 ea T1 (1 20.98 n rest of 20.2 welling 0.6 of dwel 20.18	n) ving m (s follo follo glilling 2 ellin 2	area from the control of the control	om Table 9a) Jul 0.33 s 3 to 7 21 from Table 0.27 llow stee 20.21 A × T1 20.53	ole 9, Au 0.36 7 in Ta 21 able 9 20.2 9a) 0.3 eps 3 20.2 + (1 - 20.5	Th1 (°C) g Sep 6 0.57 able 9c) 20.99 , Th2 (°C) 1 20.21 to 7 in Table 1 20.2 -fLA) × T2	Oct 0.86 20.88 20.2 0.82 e 9c) 20.08 LA = Li	20.2 20.2 0.97 3 19.6- ving area	V (((((((((((((((((((Dec).99 0.25 0.19 0.99			(86) (87) (88) (89) (90) (91)
Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m= Mean (90)m=	an interest erature erature of the second of	nal temperal during heater for garage 20.5 during heater for garage 20.18 etcor for garage 19.54 l temperal 19.93	eating poins for line ating poins for rough of the control of the	criods ir iving are 20.9 eriods ir 20.2 est of do 0.78 the rest 20.09 er the who 20.42	season the livea, h1,r May 0.65 ea T1 (1 20.98 n rest of 20.2 welling 0.6 of dwel 20.18	n) ving m (s follo follo generation generation n) n) n n n n n n n n n n n n n n n n	area from a	om Table 9a) Jul 0.33 s 3 to 7 21 from Table 0.27 llow stee 20.21 A × T1 20.53	ole 9, Au 0.36 7 in Ta 21 able 9 20.2 9a) 0.3 eps 3 20.2 + (1 - 20.5	Th1 (°C) g Sep 6 0.57 able 9c) 20.99 , Th2 (°C) 1 20.21 to 7 in Table 1 20.2 -fLA) × T2 3 20.52 where approximates a second content of the content of	Oct 0.86 20.88 20.2 0.82 e 9c) 20.08 LA = Li	20.2 20.2 20.97 3 19.6- ving area	V (((((((((((((((((((Dec).99 0.25 0.19 0.99			(86) (87) (88) (89) (90) (91)
Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m= Mean (90)m= Mean (92)m= Apply (93)m=	an interest at a control of the cont	nal temperal during heater for garage 20.5 during heater for garage 20.18 etcor for garage 19.54 l temperal 19.93 ment to the 19.93	eating poins for I atture in I 19.84 atture (for 20.2) e mean 20.2	criods ir one of the what internal	season the livea, h1,r May 0.65 ea T1 (120.98 n rest of 20.2 welling 0.6 of dwel 20.18 ole dwel 20.5 tempe	n) ving m (s follo follo generation generation n) n) n n n n n n n n n n n n n n n n	area from a	om Table	ole 9, Au 0.36 7 in Ta 21 able 9 20.2 9a) 0.3 eps 3 20.2 + (1 - 20.5 4e, v	Th1 (°C) g Sep 6 0.57 able 9c) 20.99 Th2 (°C) 1 20.21 to 7 in Table 1 20.2 -fLA) × T2 3 20.52 where approximates a series of the content of the conten	Oct 0.86 20.88 20.2 0.82 e 9c) 20.08 20.41 ppriate	20.2 20.2 20.97 3 19.6- ving area	V (((((((((((((((((((Dec 0.99 0.25 0.19 0.99 9.19			(86) (87) (88) (89) (90) (91)
Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m= Mean (90)m= Mean (92)m= Apply (93)m= 8. Spa	an interest erature erature description factors and a constant of the constant	nal temperature during heater for garen 20.5 during heater for garen 20.18 during heater for for garen 20.97	eating points for rough ins fo	criods ir one of the whole of t	season the livea, h1,r May 0.65 ea T1 (120.98 n rest of 20.2 welling 0.6 of dwel 20.18 ole dwel 20.5 tempe 20.5	n) ving m (s follo follo generation generati	area from 20.47 Jun 20.47 w steps 21 relling from (see 20.41 T2 (follows) = fLA 20.53 re from 20.53	om Table Jul 0.33 s 3 to 7 21 from Ta 20.21 Table 0.27 A × T1 20.53 Table 20.53	ole 9, Au 0.36 7 in Ta 21 able 9 20.2 9a) 0.3 20.2 + (1 - 20.5 4e, v 20.5	Th1 (°C) g Sep 6 0.57 able 9c) 20.99 Th2 (°C) 1 20.21 to 7 in Table 1 20.2 -fLA) × T2 3 20.52 where approximates a series of the content of the conten	Oct 0.86 20.88 20.2 0.82 e 9c) 20.08 20.41	20.2 20.2 0.97 3 19.6- ving area 20.0	V (((((((((((((((((((Dec 0.99 0.25 0.19 0.99 9.19	0.		(86) (87) (88) (89) (90) (91)

Mar

Apr

May

Jun

Jul

Aug

Sep

Oct

Nov

Dec

Jan

Feb

Utilisation factor for gains, hm: (94)m= 0.99 0.96 0.91 0.79 0.62 0.43 0.3 0.33 0.53 0.83 0.97 0.99 Useful gains, hmGm , W = (94)m x (84)m (95)m= 595.32 711.33 762.21 722.1 586.95 396.84 263.67 276.37 429.61 596.2 592.37 558 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)
(95)m= 595.32 711.33 762.21 722.1 586.95 396.84 263.67 276.37 429.61 596.2 592.37 558 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)
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)
(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= 1073.45 1046.24 950.19 786.38 599.32 397.86 263.75 276.5 433.34 667.52 884.22 1062.99 (97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m
(98)m= 355.73 225.06 139.86 46.29 9.2 0 0 0 53.06 210.13 375.72
Total per year (kWh/year) = Sum(98) _{15,912} = 1415.05 (98)
Space heating requirement in kWh/m²/year 17.91 (99)
9a. Energy requirements – Individual heating systems including micro-CHP)
Space heating:
Fraction of space heat from secondary/supplementary system 0 (201
Fraction of space heat from main system(s) $(202) = 1 - (201) = 1$ (202)
Fraction of total heating from main system 1 $(204) = (202) \times [1 - (203)] = 1$ (204)
Efficiency of main space heating system 1
Efficiency of secondary/supplementary heating system, %
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec kWh/year
Space heating requirement (calculated above)
355.73 225.06 139.86 46.29 9.2 0 0 0 53.06 210.13 375.72
$(211)m = \{[(98)m \times (204)] \} \times 100 \div (206) $ (211)
380.46 240.7 149.58 49.5 9.84 0 0 0 0 56.75 224.74 401.84
Total (kWh/year) =Sum(211) _{15,1012} = 1513.42 (211)
Space heating fuel (secondary), kWh/month
$= \{[(98)m \times (201)] \} \times 100 \div (208)$
(215)m= 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)
178.69 157.09 164.02 145.71 141.83 125.34 119.06 132.46 132.8 151.16 161.5 173.94
Efficiency of water heater 79.8 (216
(217)m= 86.62 85.77 84.39 82.14 80.38 79.8 79.8 79.8 82.33 85.52 86.82 (217
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m
(219)m= 206.3 183.15 194.36 177.39 176.45 157.07 149.2 166 166.41 183.6 188.85 200.36
Total = Sum(219a) ₁₁₂ = 2149.14 (219
Annual totals kWh/year kWh/year
Space heating fuel used, main system 1 1513.42
Water heating fuel used 2149.14
Electricity for pumps, fans and electric keep-hot

central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)(230g) =		75	(231)
Electricity for lighting			342.18	(232)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216 =	326.9 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	464.21 (264)
Space and water heating	(261) + (262) + (263) + (264) =		791.11 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	38.93 (267)
Electricity for lighting	(232) x	0.519 =	177.59 (268)
Total CO2, kg/year	sum	of (265)(271) =	1007.63 (272)



				User D	Details:						
Assessor Name: Software Name:	Stroma FS	AP 201:			Strom Softwa	are Ve	rsion:			on: 1.0.3.4	
			Р	roperty	Address	TF 3B5	5P AR W	est Build	ding		
Address: 1. Overall dwelling dime	ncione:										
1. Overall dwelling diffle	:11510115.			Δτο	a(m²)		Δν Ηρ	ight(m)		Volume(m	3)
Ground floor				Aic		(1a) x		2.5	(2a) =	220	(3a)
Total floor area TFA = (1	a)+(1b)+(1c)+(′1d)+(1e	\+ (1r	, <u> </u>	88	(4)]` ′		`
	α) ((15) ((15) (((14)1(10)	,	.,	00)T(3C)T(3C	d)+(3e)+	(3n) -		
Dwelling volume						(3a) + (3b)+(30)+(30	л) т (Зе)т	.(311) =	220	(5)
2. Ventilation rate:	main	Se	condar	'V	other		total			m³ per hou	ır
N	heating	<u>_h</u>	eating	- –		, ,			40		
Number of chimneys	0	_] +	0	<u></u>]	0	<u> </u>	0		40 =	0	(6a)
Number of open flues	0	+	0	+	0] = [0	X :	20 =	0	(6b)
Number of intermittent fa	ns						0	X	10 =	0	(7a)
Number of passive vents	i						0	X	10 =	0	(7b)
Number of flueless gas fi	res					Ī	0	X e	40 =	0	(7c)
						_					
									Air ch	nanges per h	our
Infilt <mark>ration</mark> due to chi <mark>mne</mark>							0		÷ (5) =	0	(8)
If a pressurisation test has b			d, procee	d to (17),	otherwise o	continue fi	rom (9) to	(16)			— (0)
Number of storeys in the Additional infiltration	ne aweiling (ns	9)						[(9)	-1]x0.1 =	0	(9) (10)
Structural infiltration: 0	.25 for steel or	timber f	rame or	0.35 fo	r masoni	v consti	ruction	[(0)	1,10.1 -	0	(11)
if both types of wall are p						•					` ′
deducting areas of openii	• / .		ad) ar 0	1 (222)	ممار مامم	antar O				_	— (40)
If suspended wooden for the suspended wooden f		`	ea) or o	. i (Seai	ea), eise	enter 0				0	(12)
Percentage of windows			rinned							0	(14)
Window infiltration	o ana accio an	augiii oii	ippou		0.25 - [0.2	x (14) ÷ 1	100] =			0	(15)
Infiltration rate					(8) + (10)	+ (11) + (⁻	12) + (13)	+ (15) =		0	(16)
Air permeability value,	q50, expresse	d in cub	ic metre	s per ho	our per s	quare m	etre of e	envelope	area	4	(17)
lf based on air permeabil	ity value, then	(18) = [(17	7) ÷ 20]+(8), otherw	rise (18) = (16)				0.2	(18)
Air permeability value applie		on test has	been dor	ne or a de	gree air pe	rmeability	is being u	sed			
Number of sides sheltere	ed				(20) = 1 -	0 075 v (10\1 _			2	(19)
Shelter factor	ing chalter for	tor			(20) = 13 (21) = (18)		19)] –			0.85	(20)
Infiltration rate incorporat	-				(21) = (10)	(20) =				0.17	(21)
Infiltration rate modified f Jan Feb	Mar Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	1	
L			Juli	l Jui	I Aug	Geb	1 001	1 1404	l pec	J	
Monthly average wind sp (22)m= 5.1 5	4.9 4.4	e /	3.8	3.8	3.7	4	4.3	4.5	4.7	1	
(,		7.0	<u> </u>	I 0.0	1	7		15	L'	J	
Wind Factor (22a)m = (2	2)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	I	

0.22	0.21	0.21	0.19	0.18	0.16	0.16	0.16	0.17	0.18	0.19	0.2]	
Calculate effec		-	rate for t	he appli	cable ca	se	!	!	!	!	!		
If mechanica			andiv N (2	3h) - (23s	a) × Fmv (e	aguation (1	NSN othe	rwisa (23h) <i>- (</i> 23a)			0.5	(2:
If balanced with		0		, ,	,	. ,	,, .	,) = (23a)			0.5	(2:
		•	•	_					2h\m . (22h) v [1 (220)	0	(2:
a) If balance		o 0	0	0	0	0	0	0	0	23b) x [0] - 100]	(2
b) If balance												J	•
4b)m= 0	0	0	0	0	0	0	0	0	0	0	0	1	(2
c) If whole h							<u> </u>					J	·
if (22b)n				•	•				.5 × (23b	o)			
4c)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5]	(2
d) If natural	ventilatio	on or wh	ole hous	e positiv	ve input	ventilatio	on from I	loft	l				
if (22b)n	n = 1, th	en (24d)	m = (22l	o)m othe	erwise (2	4d)m =	0.5 + [(2	2b)m² x	0.5]			_	
4d)m= 0	0	0	0	0	0	0	0	0	0	0	0		(2
Effective air	change	rate - er	iter (24a) or (24b	o) or (24	c) or (24	d) in bo	x (25)				_	
5)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		(2
B. Heat losse	s and he	eat loss	paramete	er:							_	_	
LEMENT	Gros		Openin		Net Ar	ea	U-val	ue	AXU		k-value	Э	ΑΧk
	area	(m²)	m		A ,r		W/m2		(W/	K)	kJ/m²-		kJ/K
oo <mark>rs</mark>					2.5	X	1	= [2.5				(2
/in <mark>dows</mark> Type	1				5.45	x1	/[1/(1.3)+	0.04] =	6.73				(2
indows Type	2				10.6	x1	/[1/(1.3)+	0.04] =	13.1				(2
/alls Type1	24.7	' 3	7.95		16.78	3 x	0.18	=	3.02	ר ר		\neg	(2
alls Type2	21.1	7	10.6		10.57	7 X	0.18		1.9	₹ i		\neg	(2
oof	59		0		59	x	0.15	= i	8.85	Ħ i			(3
otal area of e	lements	, m²			104.9								(;
or windows and	roof wind	ows, use e	ffective wi	ndow U-va	alue calcul	ated using	g formula 1	/[(1/U-valu	ıe)+0.04] a	as given in	paragraph	n 3.2	
include the area				ls and pan	titions							_	
abric heat los		•	U)				(26)(30)) + (32) =				36.11	1 (;
eat capacity								((28)	(30) + (32	2) + (32a).	(32e) =	4223.	11 (
nermal mass	parame	ter (TMF	P = Cm +	- TFA) ir	n kJ/m²K			Indica	tive Value	: Medium		250	(3
or design assess In be used inste				construct	ion are no	t known pr	recisely the	e indicative	values of	TMP in T	able 1f		
nermal bridge				ısina An	pendix l	<						0.66	(3
details of therma	•	,			-	•						0.00	(
otal fabric he			()	,	,			(33) +	(36) =			36.77	7 (3
entilation hea	at loss ca	alculated	l monthly	/				(38)m	= 0.33 × (25)m x (5)		
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec]	
8)m= 36.3	36.3	36.3	36.3	36.3	36.3	36.3	36.3	36.3	36.3	36.3	36.3]	(3
eat transfer o	coefficie	nt. W/K						(39)m	= (37) + (38)m		-	
cat transiti t													

Heat loss para	ımeter (I	HLP), W	′m²K					(40)m	= (39)m ÷	÷ (4)			
(40)m= 0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83		
				ı	ı	ı	l		Average =	Sum(40) ₁	12 /12=	0.83	(40)
Number of day	1	nth (Tab	le 1a)						1		ı	ı	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m= 31	28	31	30	31	30	31	31	30	31	30	31		(41)
4. Water heat	ting ene	rgy requ	irement:								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		6		(42)
Annual averag Reduce the annua not more that 125	al average	hot water	usage by	5% if the c	lwelling is	designed i			se target o		5.89		(43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage i	n litres pe	r day for ea	ach month	Vd,m = fa	ctor from	Table 1c x	(43)					l	
(44)m= 105.48	101.64	97.8	93.97	90.13	86.3	86.3	90.13	93.97	97.8	101.64	105.48		
		•								ım(44) ₁₁₂ =		1150.64	(44)
Energy content of	hot water	used - cal	culated m	onthly $= 4$.	190 x Vd,r	n x nm x E	Tm / 3600) kWh/mor	nth (see Ta	ables 1b, 1	c, 1d)		
(45)m= 156.42	136.8	141.17	123.07	118.09	101.91	94.43	108.36	109.65	127.79	139.49	151.48		_
If instantaneous w	vater heati	ng at noin	of use (no	hot water	r etoraga)	enter () in	hoves (46		Total = Su	ım(45) ₁₁₂ =	=	1 <mark>5</mark> 08.67	(45)
									10.47	00.00	00.70		(46)
(46)m= 23.46 Water storage	20.52 loss:	21.18	18.46	17.71	15.29	14.16	16.25	16.45	19.17	20.92	22.72		(46)
Storage volum) includir	ng any so	olar or W	WHRS	storage	within sa	ame ves	sel		5		(47)
If community h	neating a	and no ta	ınk 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					4.144							l	
a) If manufact				or is kno	wn (kVVI	n/day):					0		(48)
Temperature f											0		(49)
Energy lost fro b) If manufact		•			or io not		(48) x (49)) =			5		(50)
Hot water stor			-							0	.03		(51)
If community h	•			- (7,					.00		(- /
Volume factor	from Ta	ble 2a								2.	.88		(52)
Temperature f	actor fro	m Table	2b							0	.6		(53)
Energy lost fro		_	, kWh/ye	ear			(47) x (51)) x (52) x (53) =	0.	24		(54)
Enter (50) or ((54) in (55)								0.	24		(55)
Water storage	loss cal	culated	for each	month			((56)m = (55) × (41)	m				
(56)m= 7.49	6.76	7.49	7.25	7.49	7.25	7.49	7.49	7.25	7.49	7.25	7.49		(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 Append	ix H	
(57)m= 7.49	6.76	7.49	7.25	7.49	7.25	7.49	7.49	7.25	7.49	7.25	7.49		(57)
Primary circuit	loss (ar	nnual) fro	om Table	<u></u>							0		(58)
Primary circuit	,	•			59)m = ((58) ÷ 36	65 × (41)	m		-			
(modified by	factor f	rom Tab	le H5 if t	here is	solar wat	ter heati	ng and a	cylinde	r thermo	ostat)			
(59)m= 23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)

Cambilaga a	الم ما ما ما ما	fa., a a a b		(04)	(00) . 20	CE (44)	١						
Combi loss ca	o localizated	or each	month (01)m =	(60) ÷ 30	05 × (41)	0	0	0	Ο	0]	(61)
							<u> </u>	<u> </u>	<u> </u>	ļ		(50)m + (61)m	(01)
(62)m= 187.17	`	171.92	152.83	148.84	131.66	125.18	139.11	139.41	158.54	169.25	182.23	(59)m + (61)m	(62)
Solar DHW input													(02)
(add addition									ii contribu	ion to wate	or ricating)		
(63)m= 0	0	0	0	0	0	0	0	0	0	0	0		(63)
Output from v	vater hea	ter					<u> </u>	<u>I</u>				l	
(64)m= 187.17	1	171.92	152.83	148.84	131.66	125.18	139.11	139.41	158.54	169.25	182.23		
	1		<u> </u>		<u> </u>	<u>!</u>	Out	put from w	ater heate	r (annual)₁	12	1870.75	(64)
Heat gains fro	om water	heating,	kWh/m	onth 0.2	5 ´ [0.85	× (45)m	+ (61)r	n] + 0.8 x	x [(46)m	+ (57)m	+ (59)m]	-
(65)m= 76.61	67.71	71.54	64.73	63.87	57.69	56	60.63	60.27	67.09	70.19	74.97	_	(65)
include (57)m in cal	culation of	of (65)m	only if c	ylinder i	s in the o	dwelling	or hot w	ater is f	rom com	munity h	neating	
5. Internal g	<i>,</i>			•	•						•		
Metabolic gai	Ì												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(66)m= 129.87	129.87	129.87	129.87	129.87	129.87	129.87	129.87	129.87	129.87	129.87	129.87		(66)
Lighting gains	s (calcula	ted in Ap	pendix	L, equati	ion L9 o	r L9a), <mark>a</mark>	lso see	Table 5					
(67)m= 21.39	18.99	15.45	11.69	8.74	7.38	7.97	10.37	13.91	17.67	20.62	21.98		(67)
App <mark>liance</mark> s ga	ains (ca <mark>lc</mark>	ulated ir	Append	dix L, eq	uation L	13 or L1	3a), als	see Ta	ble 5				
(68)m= 235.35	237.79	231.64	218.54	202	186.45	176.07	173.63	179.78	192.88	209.42	224.97		(68)
Cooking gain	s (calcula	ated in A	ppendix	L, equat	ion L15	or L15a)), also s	ee Table	5				
(69)m= 35.99	35.99	35.99	35.99	35.99	35.99	35.99	35.99	35.99	35.99	35.99	35.99		(69)
Pumps and fa	ans gains	(Table 5	5a)							-		•	
(70)m= 0	0	0	0	0	0	0	0	0	0	0	0		(70)
Losses e.g. e	vaporatio	n (nega	tive valu	es) (Tab	le 5)						-		
(71)m= -103.89	-103.89	-103.89	-103.89	-103.89	-103.89	-103.89	-103.89	-103.89	-103.89	-103.89	-103.89		(71)
Water heating	g gains (T	Table 5)										-	
(72)m= 102.97	100.76	96.16	89.9	85.84	80.13	75.27	81.49	83.7	90.18	97.49	100.76		(72)
Total interna	l gains =			-	(66))m + (67)m	n + (68)m	+ (69)m +	(70)m + (7	'1)m + (72))m		
(73)m= 421.67	419.5	405.2	382.09	358.54	335.92	321.27	327.45	339.36	362.69	389.49	409.67		(73)
6. Solar gair	ns:												
Solar gains are		Ü	r flux from	Table 6a			itions to c	onvert to th	ne applical		tion.		
Orientation:	Access F Table 6d		Area m²		Flu	ıx ble 6a	_	g_ Fable 6b	т	FF able 6c		Gains	
_					ı a	DIE Ga	. –	able ob	_ '	able 60		(W)	,
East 0.9x		X	5.4	1 5	X 1	19.64	×	0.63	X	0.7	=	32.71	(76)
East 0.9x		X	5.4	5	x 3	38.42	×	0.63	X	0.7	=	63.99	(76)
East 0.9x		X	5.4	15	x 6	63.27	×	0.63	X	0.7	=	105.39	(76)
East 0.9x		X	5.4	5	x 9	92.28	x	0.63	x	0.7	=	153.7	(76)
East 0.9x	1	X	5.4	15	x 1	13.09	X	0.63	Х	0.7	=	188.37	(76)

	_										_				
East	0.9x	1	X	5.4	15	X	115	5.77	X	0.63	X	0.7	=	192.83	(76)
East	0.9x	1	X	5.4	15	X	110).22	X	0.63	х	0.7	=	183.58	(76)
East	0.9x	1	X	5.4	15	X	94	.68	X	0.63	X	0.7	=	157.69	(76)
East	0.9x	1	X	5.4	15	X	73	.59	x	0.63	X	0.7	=	122.57	(76)
East	0.9x	1	X	5.4	15	X	45	.59	x	0.63	X	0.7	=	75.93	(76)
East	0.9x	1	X	5.4	15	X	24	.49	x	0.63	X	0.7	=	40.79	(76)
East	0.9x	1	X	5.4	15	X	16	.15	x	0.63	X	0.7	=	26.9	(76)
West	0.9x	0.77	X	10	.6	X	19	.64	x	0.63	x	0.7	=	63.62	(80)
West	0.9x	0.77	X	10	.6	X	38	.42	x	0.63	x	0.7	=	124.46	(80)
West	0.9x	0.77	X	10	.6	X	63	.27	x	0.63	x	0.7	=	204.97	(80)
West	0.9x	0.77	x	10	.6	X	92	.28	х	0.63	x	0.7	=	298.94	(80)
West	0.9x	0.77	X	10	.6	X	113	3.09	х	0.63	X	0.7	=	366.36	(80)
West	0.9x	0.77	x	10	.6	X	115	5.77	х	0.63	x	0.7	=	375.04	(80)
West	0.9x	0.77	x	10	.6	X	110).22	х	0.63	x	0.7	=	357.05	(80)
West	0.9x	0.77	X	10	.6	X	94	.68	х	0.63	X	0.7	=	306.7	(80)
West	0.9x	0.77	x	10	.6	X	73	.59	х	0.63	x	0.7	=	238.39	(80)
West	0.9x	0.77	×	10	.6	X	45	.59	х	0.63	×	0.7		147.69	(80)
West	0.9x	0.77	x	10	.6	X	24	.49	Х	0.63	X	0.7	=	79.33	(80)
West	0.9x	0.77	×	10	.6	Х	16	.15	х	0.63	x	0.7	=	52.32	(80)
			$\lceil \mid \mid$												
Sola <mark>r g</mark>	ains in	watts, calc	ulated	for eac	h month	1			(83)m	= Sum(74)m .	(8 <mark>2</mark>)m				
(83)m=	<mark>9</mark> 6.34	188.46 3	10.36	452.64	554.73	50	67.86	540.63	464.	39 360.96	223.6	2 120.12	79.22		(83)
Total g	ains – ir	nternal and		(84)m =	= (73)m	+ (8	33)m ,	watts					•		
(84)m=	518	607.96 7	15.56	834.74	913.27	90	03.79	861.9	791.	84 700.32	586.3	509.61	488.89		(84)
7. Mea	an inter	nal temper	ature ((heating	seasor	า)									
Temp	erature	during hea	ating p	eriods ir	n the liv	ing	area fr	om Tab	ole 9,	Th1 (°C)				21	(85)
Utilisa	tion fac	tor for gair	ns for li	iving are	ea, h1,n	n (s	ee Tab	le 9a)							
	Jan	Feb	Mar	Apr	May		Jun	Jul	Αι	ıg Sep	Oct	Nov	Dec		
(86)m=	1	0.99	0.97	0.89	0.71	(0.51	0.37	0.4	2 0.69	0.95	0.99	1		(86)
Mean	interna	temperatu	ure in I	iving are	ea T1 (f	ollo	w step	s 3 to 7	in T	able 9c)					
(87)m=	20.2	20.35 2	20.59	20.84	20.97		21	21	21	20.98	20.77	20.42	20.16		(87)
Temp	erature	during hea	atina p	eriods ir	n rest of	f dw	ellina f	rom Ta	ıble 9	. Th2 (°C)		-		•	
(88)m=	20.23		20.23	20.23	20.23	1	0.23	20.23	20.2	 	20.23	20.23	20.23]	(88)
ı L Itilisa	tion fac	tor for gain	ns for r	est of d	welling	h2	m (see	Table	—— (او	!		!			
(89)m=	1		0.97	0.86	0.66	1	0.45	0.31	0.3	5 0.63	0.93	0.99	1]	(89)
L	:t.o. ##0.0	ļ.			<u> </u>	 } }	T0 /fal			!				J	
(90)m=	19.15		19.71	20.05	20.2	Ť	0.23	20.23	20.2	to 7 in Table 20.21	9C) 19.97	19.47	19.09]	(90)
(90)111=	19.15	19.37	19.71	20.03	20.2		.0.23	20.23	20.2			/ing area ÷ (4	<u> </u>	0.25	(91)
											_, , — 💷	3	-/	0.25	(31)
Г					ole dwe	ellin		4 × T1	+ (1 -	- fLA) × T2				,	
					ـ ـ ا			'	_	ا ۔۔ ا					(00)
(92)m=	19.42		19.93	20.25	20.39		0.42	20.42	20.4	12 20.4 where appro	20.17		19.36		(92)

(93)m= 19.42 19.61 19.93 20.25 20.39 20.42 20.42	20.42 20.4 20.1	7 19.71	19.36		(93)
8. Space heating requirement					
Set Ti to the mean internal temperature obtained at step 11 of the utilisation factor for gains using Table 9a	able 9b, so that Ti,m	=(76)m and	l re-calcul	ate	
Jan Feb Mar Apr May Jun Jul	Aug Sep Oc	t Nov	Dec		
Utilisation factor for gains, hm:	Tag Sap Sa				
(94)m= 1 0.99 0.96 0.87 0.67 0.47 0.32	0.37 0.64 0.93	0.99	1		(94)
Useful gains, hmGm , W = (94)m x (84)m					
(95)m= 516.1 601.65 688.83 722.12 616.1 423.51 279.01	293.45 450.17 545.9	504.92	487.63		(95)
Monthly average external temperature from Table 8					
(96)m= 4.3 4.9 6.5 8.9 11.7 14.6 16.6	16.4 14.1 10.6	7.1	4.2		(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m (97)m= 1104.44 1075.15 981.27 829.2 635.05 425.1 279.13		2 024 54	4407.70		(07)
` '			1107.73		(97)
Space heating requirement for each month, kWh/month = 0.02 (98)m= 437.72 318.19 217.58 77.09 14.1 0 0	0 0 113.9	<u> </u>	461.36		
(66)///- 10///2 016/10 21//60 17//60 17//	Total per year (kWh/y			1939.97	(98)
Space heating requirement in kWh/m²/year	. otal por your (ittiny)		715,512		╡``
				22.05	(99)
9b. Energy requirements – Community heating scheme					
This part is used for space heating, space cooling or water heat Fraction of space heat from secondary/supplementary heating.		imunity sche	eme.	0	(301)
Fraction of space heat from community system 1 – (301) =				1	(302)
The community scheme may obtain heat from several sources. The procedure	lows for CHR and up to fo	ur other heat a	L Poursos: the		
includes boilers, heat pumps, geothermal and waste heat from power stations.		ur otrier rieat s	sources, the	ialler	
Fraction of heat from Community CHP				0.8	(303a)
Fraction of community heat from heat source 2				0.2	(303b)
Fraction of total space heat from Community CHP		(302) x (303a	1) =	0.8	(304a)
Fraction of total space heat from community heat source 2		(302) x (303b) =	0.2	(304b)
Factor for control and charging method (Table 4c(3)) for commu	nity heating system			1	(305)
Distribution loss factor (Table 12c) for community heating syste	1			1.05	(306)
Space heating				kWh/year	
Annual space heating requirement				1939.97	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =		1629.57	(307a)
Space heat from heat source 2	(98) x (304b) x (305) x (306) =		407.39	(307b)
Efficiency of secondary/supplementary heating system in % (from	n Table 4a or Append	dix E)		0	(308
Space heating requirement from secondary/supplementary syst	(98) x (301) x 10	00 ÷ (308) =		0	(309)
Water heating Annual water heating requirement			Г	1870.75	7
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =		1571.43	
Water heat from heat source 2	(64) x (303b) x (392.86	(310b)
Electricity used for heat distribution	0.01 × [(307a)(307e			40.01	(313)
Electricity account float distribution	0.0 1 × [(0014)(0016	., . (0104)(0		40.01	

Cooling System Energy Efficiency Ratio			0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	Ī	0	(315)
Electricity for pumps and fans within dwelling (Table 4f):				-
mechanical ventilation - balanced, extract or positive input from c	outside		63.88	(330a)
warm air heating system fans			0	(330b)
pump for solar water heating			0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (350b)	30g) =	63.88	(331)
Energy for lighting (calculated in Appendix L)			377.67	(332)
12b. CO2 Emissions – Community heating scheme		_		7
Electrical efficiency of CHP unit			30	(361)
Heat efficiency of CHP unit			57.5	(362)
	. 57	ssion factor CO2/kWh	Emissions kg CO2/year	
Space heating from CHP) $(307a) \times 100 \div (362) =$	2834.04 X	0.22	612.15	(363)
less credit emissions for electricity $-(307a) \times (361) \div (362) =$	850.21 X	0.52	-441.26	(364)
Water heated by CHP $(310a) \times 100 \div (362) =$	2732.92 X	0.22	590.31	(365)
less credit emissions for electricity —(310a) × (361) ÷ (362) =	819.87 ×	0.52	-425.51	(366)
Efficiency of heat source 2 (%) If there is CHP using	two fuels repeat (363) to (366) f	or the second fuel	89.5	(367b)
CO2 associated with heat source 2 [(307b)+(3	310b)] x 100 ÷ (367b) x	0.22	193.13	(368)
Electrical energy for heat distribution	313) x	0.52	20.77	(372)
Total CO2 associated with community systems	363)(366) + (368)(372)	=	549.59	(373)
CO2 associated with space heating (secondary)	309) x	0 =	0	(374)
CO2 associated with water from immersion heater or instantaneo	ous heater (312) x	0.22	0	(375)
Total CO2 associated with space and water heating (3	373) + (374) + (375) =		549.59	(376)
CO2 associated with electricity for pumps and fans within dwelling	g (331)) x	0.52	33.15	(378)
CO2 associated with electricity for lighting	332))) x	0.52	196.01	(379)
Total CO2, kg/year sum of (376)(382) =		[778.75	(383)
Dwelling CO2 Emission Rate (383) ÷ (4) =		[8.85	(384)
El rating (section 14)			92.15	(385)

			User [Details:						
Assessor Name: Software Name:	Stroma FSAP 201	2		Stroma Softwa				Versic	on: 1.0.3.4	
		Pr	operty	Address	TF 3B	5P AR W	est Buil	ding		
Address :										
Overall dwelling dimensional	nsions:			(0)						•>
Ground floor			Are	a(m²) 88	(1a) x		2.5	(2a) =	Volume(m	3) (3a
Total floor area TFA = (1a	a)+(1b)+(1c)+(1d)+(1e	e)+(1n)	88	(4)					
Dwelling volume					(3a)+(3b	o)+(3c)+(3c	d)+(3e)+	.(3n) =	220	(5)
2. Ventilation rate:										
Number of chimneys	heating	econdary neating	у 7 + Г	other	7 ₌ F	total	x	40 =	m³ per hou	.ır ── _{(6a}
ŕ		0	╛╘	0	<u> </u>	0		20 =	0	╡`
Number of open flues	0 +	0] + [0] = [0			0	(6b)
Number of intermittent far	าร					3	X	10 =	30	(7a
Number of passive vents						0	Х	10 =	0	(7b
Number of flueless gas fir	res					0	X ·	40 =	0	(7c
								Air ch	nanges <mark>per</mark> he	our
Infilt <mark>ration</mark> due to chimney	s, flues and fans = 6	a)+(6b)+(7a	a)+(7b)+((7c) =	Г	30		÷ (5) =	0.14	(8)
If a pressurisation test has be		ed, proceed	I to (17),	otherwise o	ontinue fi	rom (9) to	(16)			
Number of storeys in th	e dwelling (ns)								0	(9)
Additional infiltration Structural infiltration: 0.	25 for stool or timber:	frame or	0.35 fo	r macanr	v const	ruction	[(9)	-1]x0.1 =	0	(10
	esent, use the value corres				•	iuction			0	(11
deducting areas of opening	gs); if equal user 0.35									_
If suspended wooden fl	•	ed) or 0.	1 (seale	ed), else	enter 0				0	(12
If no draught lobby, ent		rinned							0	(13
Percentage of windows Window infiltration	and doors draught st	nppeu		0.25 - [0.2	x (14) ÷ 1	1001 =			0	(14
Infiltration rate				(8) + (10)	` '		+ (15) =		0	(16
Air permeability value,	q50, expressed in cub	oic metres	s per ho					area	5	(17
If based on air permeabili	•		•	•	•				0.39	(18
Air permeability value applies	s if a pressurisation test has	s been don	e or a de	gree air pe	rmeability	is being u	sed			
Number of sides sheltered	d			(00)	'0 07E (40)1			2	(19
Shelter factor				(20) = 1 -		19)] =			0.85	(20
Infiltration rate incorporati				(21) = (18)	(20) =				0.33	(21
Infiltration rate modified fo		1	11	Δ	0	0-4	Nan	D.,	1	
	Mar Apr May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind specification (22)m= 5.1 5		20	20	27	4	1 2	4.5	17	1	
(22)m= 5.1 5	4.9 4.4 4.3	3.8	3.8	3.7	4	4.3	4.5	4.7	J	
Wind Factor (22a)m = (22	?)m ÷ 4									

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.3	0.33	0.35	0.37	0.39		
alculate effec		•	rate for t	he appli	cable ca	se	l	l	l	l		1	
If mechanica			l' N. (0	al.) (aa	\ - /	<i>i</i> : (1)	15// (1	. (00)	\ (00 \			0	(2
If exhaust air he		0		, ,	,	. `	,, .	`) = (23a)			0	(2
If balanced with		•	•	•		,		,				0	(2
a) If balance		i			1	, ` ` 	- ^ `	ŕ	 	- 	<u>`</u>	÷ 100] I	(0
a)m= 0	0	0	0	0	0	0	0	0	0	0	0		(2
b) If balance						, 	- ^ `	``	 		1	1	(5
b)m= 0	0	0	0	0	0	0	0	0	0	0	0		(2
c) If whole h				•	•				F (00l-	. \			
if (22b)m		<u> </u>	· ` `	ŕ	í 	wise (24)	ŕ	ŕ	· ` `			1	(2
c)m= 0	0	0	0	0	0		0	0	0	0	0		(2
d) If natural (if (22b)m				•	•				0.5]				
d)m= 0.59	0.58	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57		(2
ـــــــــ Effective air	change	rate - er	nter (24a	or (24b	o) or (24	c) or (24	d) in box	· (25)	<u> </u>	<u> </u>		l	
)m= 0.59	0.58	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57		(2
								l					
. Heat losse:													
EMENT	Gros are <mark>a</mark>		Openin		Net Ar A ,r		U-valı W/m2		A X U (W/I	K)	k-value kJ/m²-l		A X k kJ/K
ors		()	, i		2.5	x	1	= [2.5		,,,,,		(2
ndows Type	1				5.45	╡	 /[1/(1.4)+		7.23	Ħ			(2
indows Type					10.6		/[1/(1.4)+	1	14.05	Ħ			(2
alls Type1		,,	7.05							╡ ,			`
• •	24.7		7.95	=	16.78	=	0.18	= [3.02	륵 ¦			(2
alls Type2	21.1		10.6		10.57	7 X	0.18	=	1.9	亅 ¦		_	(2
oof	. 59		0		59	X	0.13	= [7.67	[(;
tal area of e					104.9								(;
or windows and nclude the area						lated using	formula 1	/[(1/U-valu	ıe)+0.04] a	as given in	paragraph	3.2	
bric heat los				is and pan	uuons		(26)(30)) + (32) =				36.37	(;
at capacity		•	O)					((28)	(30) + (32	2) + (32a).	(32e) =	4223.1	==
ermal mass	`	,	P = Cm =	- TFΔ) ir	n k.l/m²K			***	tive Value	, , ,	(020) =	250	<u>'</u> (
r design assess	•	•		,			ecisely the				able 1f	230	(
be used instea				construct	1011 410 110	crarown pr	oolooly tile	marodavo	values of		abio 11		
ermal bridge	es : S (L	x Y) cal	culated ı	using Ap	pendix I	K						0.55	(
etails of therma		are not kn	own (36) =	= 0.15 x (3	31)								
tal fabric he								(33) +	(36) =			36.92	(3
ntilation hea		i	monthly	/	•	•	·		= 0.33 × (25)m x (5)) •	1	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
)m= 42.66	42.42	42.18	41.04	40.82	39.83	39.83	39.65	40.22	40.82	41.25	41.71		(;
,													
at transfer o	oefficier	nt, W/K						(39)m	= (37) + (3	38)m		_	

leat lo	ss para	meter (H	HLP), W	m²K					(40)m	= (39)m ÷	- (4)			
10)m=	0.9	0.9	0.9	0.89	0.88	0.87	0.87	0.87	0.88	0.88	0.89	0.89		
umbo	r of day	rc in moi	nth (Tab	lo 1a\						Average =	Sum(40) ₁	12 /12=	0.89	(40
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
l1)m=	31	28	31	30	31	30	31	31	30	31	30	31		(4
, I									<u> </u>	<u> </u>				`
4 Wa	ter heat	ing ener	rgy requi	irement								kWh/ye	ear:	
if TF.				[1 - exp	(-0.0003	349 x (TF	FA -13.9)2)] + 0.0	0013 x (TFA -13		.6		(4
								(25 x N)				5.89		(4
		_		usage by : day (all w		-	_	to achieve	a water us	se target d)Ť			
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
ot wate				ach month	,			_						
4)m=	105.48	101.64	97.8	93.97	90.13	86.3	86.3	90.13	93.97	97.8	101.64	105.48		
			, ,								m(44) ₁₁₂ =		1150.64	(4
								Tm / 3600		_				
5)m=	156.42	136.8	141.17	123.07	118.09	101.91	94.43	108.36	109.65	127.79	139.49	151.48	4500.07	— ,,
nstant	aneous w	ater heatii	ng at point	of use (no	hot water	storage),	enter 0 in	boxes (46)		rotar = Su	m(45) ₁₁₂ =		1508.67	(4
6)m=	23.46	20.52	21.18	18.46	17.71	15.29	14.16	16.25	16.45	19.17	20.92	22.72		(4
/ater	storage	loss:	7											
		,						within sa	ame ves	sel		150		(4
	-	_		ink in dw	_				ara) ante	or 'O' in /	′ 47 \			
	storage		not wate	er (unis ir	iciudes i	nstantar	ieous cc	mbi boil	ers) ente	er o in ((47)			
	-		eclared I	oss facto	or is kno	wn (kWh	n/day):				0	.3		(4
empe	rature fa	actor fro	m Table	2b							0.	54		(4
٠.			•	, kWh/ye				(48) x (49)) =		0.	16		(5
,				cylinder l										
		_	ee secti	om Tabl on 4.3	e z (KVV	n/iitre/ua	iy)					0		(5
	-	from Ta		011 1.0								0		(5
empe	rature fa	actor fro	m Table	2b								0		(5
nergy	lost fro	m water	storage	, kWh/ye	ear			(47) x (51)) x (52) x (53) =		0		(5
nter	(50) or (54) in (5	55)								0.	16		(!
ater :	storage	loss cal	culated f	for each	month			((56)m = (55) × (41)	m				
6)m=	4.97	4.49	4.97	4.81	4.97	4.81	4.97	4.97	4.81	4.97	4.81	4.97		(5
cylinde	r contains	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 Append	ix H	
7)m=	4.97	4.49	4.97	4.81	4.97	4.81	4.97	4.97	4.81	4.97	4.81	4.97		(5
imar	y circuit	loss (ar	nual) fro	m Table	 3							0		(5
		•				59)m = ((58) ÷ 36	65 × (41)	m					
(mod	lified by	factor f	rom Tab	le H5 if t	here is s	solar wat	er heati	ng and a	cylinde	r thermo	stat)			
9)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(!

Combilees	ام مغمان بمام	for oosh		(04)	(00) . 0	CE (44)	١						
Combi loss of (61) m= 0	alculated	for each		61)m =	(60) ÷ 30	05 × (41))m 0	0	0	0	0	1	(61)
							<u> </u>	<u> </u>		ļ.		(50) (61)	(01)
(62)m= 184.6	<u> </u>	169.4	150.39	146.32	129.22	122.66	136.59	136.97	156.02	(46)m + 166.81	179.71	(59)m + (61)m 1	(62)
Solar DHW inpu		l .	<u> </u>									J	(02)
(add addition									r contribu	iion io waie	er nealing)		
(63)m= 0	0		0	0	0	0	0	0	0	0	0	1	(63)
Output from		ļ										I	` '
(64)m= 184.6		169.4	150.39	146.32	129.22	122.66	136.59	136.97	156.02	166.81	179.71	1	
` '							Out	ut from w	ı ater heate	ır (annual)₁	12	1841.06	(64)
Heat gains fr	om water	heating.	kWh/m	onth 0.2	5 ′ [0.85	× (45)m	+ (61)r	nl + 0.8 x	k [(46)m	+ (57)m	+ (59)m	1	_
(65)m= 74.59	1	69.52	62.78	61.85	55.74	53.98	58.61	58.32	65.07	68.24	72.95	اً	(65)
include (57	L 7)m in cal	culation o	of (65)m	only if c	vlinder i	s in the ${\mathfrak c}$	dwelling	or hot w	ater is f	rom com	munity h	ı neating	
5. Internal	<u> </u>			•	,		z					.cag	
Metabolic ga				, .									
Jan		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	1	
(66)m= 129.8	7 129.87	129.87	129.87	129.87	129.87	129.87	129.87	129.87	129.87	129.87	129.87		(66)
Lighting gain	s (calcula	ted in Ap	pendix	L, equati	on L9 o	r L9a), a	lso see	Table 5					
(67)m= 21.39	18.99	15.45	11.69	8.74	7.38	7.97	10.37	13.91	17.67	20.62	21.98		(67)
Appliances g	ains (calc	ulated ir	Append	dix L, eq	uation L	13 or L1	3a), als	see Ta	ble 5			'	
(68)m= 235.3	1	231.64	218.54	202	186.45	176.07	173.63	179.78	192.88	209.42	224.97]	(68)
Cooking gair	ns (calcula	ated in A	ppendix	L, equat	ion L15	or L15a), also s	ee Table	5			'	
(69)m = 35.99	<u> </u>	35.99	35.99	35.99	35.99	35.99	35.99	35.99	35.99	35.99	35.99		(69)
Pumps and f	ans gains	(Table 5	5a)										
(70)m= 3	3	3	3	3	3	3	3	3	3	3	3]	(70)
Losses e.g.	evaporatio	n (nega	tive valu	es) (Tab	le 5)			Į.		·			
(71)m= -103.8	9 -103.89	-103.89	-103.89	-103.89	-103.89	-103.89	-103.89	-103.89	-103.89	-103.89	-103.89	1	(71)
Water heatin	g gains (1	rable 5)	!									•	
(72)m= 100.2	``	93.44	87.19	83.13	77.42	72.56	78.78	80.99	87.47	94.77	98.05]	(72)
Total interna	al gains =	•			(66))m + (67)m	ı + (68)m	+ (69)m +	(70)m + (7	'1)m + (72))m	1	
(73)m= 421.9	5 419.79	405.49	382.38	358.83	336.21	321.56	327.74	339.65	362.97	389.77	409.96]	(73)
6. Solar gai	ns:												
Solar gains are	e calculated	using sola	r flux from	Table 6a	and assoc	iated equa	itions to c	onvert to th	ne applical	ole orienta	tion.		
Orientation:			Area		Flu		_	g_ -	_	FF		Gains	
	Table 6d		m²		Ta	ble 6a		Table 6b	T	able 6c		(W)	_
East 0.9	1	X	5.4	15	x 1	19.64	х	0.63	x	0.7	=	32.71	(76)
East 0.9	1	X	5.4	1 5	x 3	38.42	х	0.63	x [0.7	=	63.99	(76)
East 0.9	1	X	5.4	ŀ5	x 6	3.27	х	0.63	x	0.7	=	105.39	(76)
East 0.9	1	Х	5.4	15	x 9	92.28	х	0.63	x [0.7	=	153.7	(76)
East 0.9x	1	X	5.4	15	x 1	13.09	x	0.63	x	0.7	=	188.37	(76)

	_										_				
East	0.9x	1	X	5.4	15	X	1	15.77	X	0.63	X	0.7	=	192.83	(76)
East	0.9x	1	X	5.4	15	X	1	10.22	X	0.63	X	0.7	=	183.58	(76)
East	0.9x	1	X	5.4	15	X	9	4.68	X	0.63	X	0.7	=	157.69	(76)
East	0.9x	1	X	5.4	15	X	7	3.59	X	0.63	X	0.7	=	122.57	(76)
East	0.9x	1	X	5.4	15	X	4	5.59	X	0.63	X	0.7	=	75.93	(76)
East	0.9x	1	X	5.4	15	X	2	4.49	X	0.63	X	0.7	=	40.79	(76)
East	0.9x	1	X	5.4	15	X	1	6.15	x	0.63	X	0.7	=	26.9	(76)
West	0.9x	0.77	X	10	.6	x	1	9.64	X	0.63	x	0.7	=	63.62	(80)
West	0.9x	0.77	X	10	.6	x	3	8.42	X	0.63	x	0.7	=	124.46	(80)
West	0.9x	0.77	X	10	.6	x	6	3.27	X	0.63	x	0.7	=	204.97	(80)
West	0.9x	0.77	X	10	.6	x	9	2.28	x	0.63	x	0.7		298.94	(80)
West	0.9x	0.77	X	10	.6	x	1	13.09	х	0.63	x	0.7	_ =	366.36	(80)
West	0.9x	0.77	X	10	.6	x	1	15.77	x	0.63	×	0.7	=	375.04	(80)
West	0.9x	0.77	X	10	.6	x	1	10.22	х	0.63	x	0.7	=	357.05	(80)
West	0.9x	0.77	X	10	.6	x	9	4.68	х	0.63	x	0.7	=	306.7	(80)
West	0.9x	0.77	X	10	.6	x	7	3.59	x	0.63	×	0.7	_ =	238.39	(80)
West	0.9x	0.77	X	10	.6	x	4	5.59	x	0.63	x	0.7		147.69	(80)
West	0.9x	0.77	X	10	.6	X	2	4.49	Х	0.63	Х	0.7	=	79.33	(80)
West	0.9x	0.77	x	10	.6	х	1	6.15	х	0.63	x	0.7	= -	52.32	(80)
	_														
Solar g	ains in	watts, <mark>cal</mark>	lculated	for eac	h mont	h	'		(83)m	= Sum(74)m .	(82)m				
(83)m=	96.34	188.46	310.36	452.64	554.73	5	67.86	540.63	464.	39 360.96	223.62	2 120.12	79.22		(83)
Total g	ains – iı	nternal ar	nd solar	(84)m =	= (73)m	1 + (83)m	, watts							
(84)m=	518.29	608.25	715.85	835.02	913.56	9	04.07	862.19	792.	700.61	586.5	509.9	489.18		(84)
7. Me	an inter	nal tempe	erature	(heating	seaso	n)									
Temp	erature	during he	eating p	eriods ir	n the liv	/ing	area t	from Tal	ole 9,	Th1 (°C)				21	(85)
Utilisa	tion fac	tor for ga	ins for I	iving are	ea, h1,ı	m (s	ee Ta	ble 9a)							
	Jan	Feb	Mar	Apr	May	/	Jun	Jul	Αι	ug Sep	Oct	Nov	Dec		
(86)m=	1	0.99	0.98	0.91	0.74		0.54	0.39	0.4	4 0.72	0.96	1	1		(86)
Mean	interna	l tempera	ture in l	living are	ea T1 (follo	w ste	ps 3 to 7	7 in T	able 9c)					
(87)m=	20.09	20.25	20.5	20.79	20.95	2	20.99	21	21	20.97	20.72	20.35	20.07]	(87)
Temp	erature	durina he	eating p	eriods ir	n rest o	of dw	ellina	from Ta	able 9), Th2 (°C)				•	
(88)m=	20.16	20.17	20.17	20.18	20.18		20.19	20.19	20.	<u> </u>	20.18	20.18	20.17]	(88)
ı L İtilisə	tion fac	tor for ga	ins for r	est of d	welling	 h2	m (se	e Tahle	(9a)			!		_	
(89)m=	1	0.99	0.97	0.88	0.69		0.47	0.32	0.3	7 0.65	0.94	0.99	1]	(89)
	into we o	<u> </u>			!	 !!:.a.a.	TO /6						<u> </u>	J	
(90)m=	18.94	19.17	19.54	19.95	20.14	Ť	20.19	20.19	20.	to 7 in Tabl	e 90) 19.87	19.33	18.91	1	(90)
(90)111=	10.54	19.17	19.54	19.93	20.14		.0.19	20.19	20.		<u> </u>	/ing area ÷ (0.25	(91)
												g aroa . (-1	0.25	(31)
ı						_				– fLA) × T2	T _	<u>.</u>	l	1	(55)
(92)m=	19.23	19.44	19.78	20.16	20.34		20.39	20.39	20.3		20.08		19.2]	(92)
Annly	adjustn	nent to th	e mean	ınterna	ı tempe	eratu	ire tro	m rable	4e, ۱	where appro	opriate				

(93)m= 19.23	19.44	19.78	20.16	20.34	20.39	20.39	20.39	20.37	20.08	19.59	19.2		(93)
8. Space he	eating req	uirement											
Set Ti to the			•		ed at ste	ep 11 of	Table 9	o, so tha	t Ti,m=(76)m an	d re-cald	culate	
the utilisation	1	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation fa			•	iviay	Juli	Jui	L	Seb	Oct	INOV	Dec		
(94)m= 1	0.99	0.97	0.88	0.7	0.49	0.34	0.39	0.67	0.94	0.99	1		(94)
Useful gains	s, hmGm	, W = (9 ²	1)m x (84	4)m						l	<u> </u>		
(95)m= 516.40	6 602.52	692.79	736.57	642.56	441.79	290.93	305.37	467.79	550.96	505.54	487.94		(95)
Monthly ave	erage 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 ra		an intern	al tempe	erature,	Lm , W =	=[(39)m	x [(93)m	– (96)m				•	
(97)m= 1188.3		1050.24	877.64	671.84	444.37	291.13	305.82	483.4	737.03	976.09	1179.62		(97)
Space heat	Ť					i	<u> </u>	<u>`</u>		ŕ	1	1	
(98)m= 499.8	5 370.36	265.94	101.57	21.79	0	0	0	0	138.43	338.79	514.61		_
							Tota	l per year	(kWh/yeaı	r) = Sum(9	8) _{15,912} =	2251.34	(98)
Space heat	ing requir	ement in	kWh/m²	/year								25.58	(99)
9a. Energy re	equiremer	nts – Indi	vidual h	eating sy	ystems i	ncluding	micro-C	CHP)					
Space heat	ing:												
Fraction of	space hea	t from s	econdar	y/supple	mentary	system						0	(201)
Fraction of	space hea	at from m	nain syst	em(s)			(202) = 1 -	(201) =				1	(202)
Fraction of t	total hea <mark>ti</mark>	ng from	main sys	stem 1			(204) = (2	02) x [1 –	(203)] =			1	(204)
Effi <mark>cienc</mark> y o	f main s <mark>pa</mark>	ace heat	ing syste	em 1								93.5	(206)
Efficiency o	f seconda	ry/suppl	ementar	y heating	system	າ, %						0	(208)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/ye	⊒ ear
Space heat						- 4	1 3						
499.8	5 370.36	265.94	101.57	21.79	0	0	0	0	138.43	338.79	514.61		
(211)m = {[(9	98)m x (20)4)] } x 1	00 ÷ (20)6)			•						(211)
534.6	<u> </u>	284.43	108.63	23.3	0	0	0	0	148.06	362.35	550.38		
	!						Tota	l (kWh/yea	ar) =Sum(2	211) _{15,1012}	<u>. </u>	2407.85	(211)
Space heat	ing fuel (s	econdar	y), kWh/	month									
$= \{[(98)m \times (2)]\}$	201)] } x 1	00 ÷ (20	8)										
(215)m= 0	0	0	0	0	0	0	0	0	0	0	0		
							Tota	I (kWh/yea	ar) =Sum(2	215) _{15,1012}	₂ =	0	(215)
Water heating	ng												
Output from								ı				I	
184.6		169.4	150.39	146.32	129.22	122.66	136.59	136.97	156.02	166.81	179.71		7,
Efficiency of	_											79.8	(216)
(217)m= 87.34	_	86.01	83.79	81.04	79.8	79.8	79.8	79.8	84.5	86.67	87.46		(217)
Fuel for wate $(219)m = (64)$	_												
(219)m= 211.4		196.95	179.48	180.55	161.94	153.71	171.17	171.65	184.65	192.48	205.47		
							Tota	I = Sum(2	19a) ₁₁₂ =	1		2196.11	(219)
Annual total	ls								k'	Wh/yeaı	r	kWh/yea	
Space heating	ng fuel use	ed, main	system	1						-		2407.85	
													_

Water heating fuel used			2196.11	
Electricity for pumps, fans and electric keep-hot				
central heating pump:			30 (23)	0c)
boiler with a fan-assisted flue			45 (23)	0e)
Total electricity for the above, kWh/year	sum of (2	30a)(230g) =	75 (23	1)
Electricity for lighting			377.67 (23)	2)
12a. CO2 emissions – Individual heating systems	including micro-CHP			
	Energy kWh/year	Emission factor	r Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	520.1 (26)	1)
Space heating (secondary)	(215) x	0.519	0 (26:	3)
Water heating	(219) x	0.216	474.36 (264	4)
Space and water heating	(261) + (262) + (263) + (264)	=	994.45 (26	5)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	38.93 (26	7)
Electricity for lighting	(232) x	0.519	196.01 (268	8)
Total CO2, kg/year	s	um of (265)(271) =	1229.39 (27:	2)
TER =			13.97 (273	3)

BRUKL Output Document



Compliance with England Building Regulations Part L 2013

Project name

West End Lane_SBEM

As built

Date: Tue May 17 11:59:24 2016

Administrative information

Building Details

Address: Address 1, Address 2, City, Postcode

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.2.g.3

Interface to calculation engine: Virtual Environment

Interface to calculation engine version: v7.0.5

BRUKL compliance check version: v5.2.g.3

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Criterion 1: The calculated CO₂ emission rate for the building should not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	34.6
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	34.6
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	31.2
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and the building services should achieve reasonable overall standards of energy efficiency

Values not achieving standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red. **Building fabric**

U a-Limit	Ua-Calc	Ui-Calc	Surface where the maximum value occurs*
0.35	0.18	0.18	GF000003_W11
0.25	0.08	0.15	GF000018_F1
0.25	0.15	0.15	1F000001_C1
2.2	1.31	1.31	GF000017_W2-W0
2.2	-	-	"No external personnel doors"
1.5	-	-	"No external vehicle access doors"
3.5	-	-	"No external high usage entrance doors"
	0.35 0.25 0.25 2.2 2.2 1.5	0.35 0.18 0.25 0.08 0.25 0.15 2.2 1.31 2.2 - 1.5 -	0.35 0.18 0.18 0.25 0.08 0.15 0.25 0.15 0.15 2.2 1.31 1.31 2.2 - - 1.5 - -

Ja-Limit = Limiting area-weighted average U-values [W/(m²K)]

Ua-Calc = Calculated area-weighted average U-values [W/(m²K)]

U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
m ³ /(h.m ²) at 50 Pa	10	4

^{*} There might be more than one surface where the maximum U-value occurs.

^{**} Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

^{***} Display windows and similar glazing are excluded from the U-value check.

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	>0.95

1- Main system

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(I/s)]	HR efficiency			
This system	0.91	3.35	-	-	-			
Standard value	0.91*	2.6	N/A	N/A	N/A			
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system YES								
* Standard shows in far goe single bailer evetame 2 MW output. For single bailer evetame > 2 MW or multi bailer evetame. (everall) limiting								

^{*} Standard shown is for gas single boiler systems <= 2 MW output. For single boiler systems > 2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

1- SYST0000-DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	Hot water provided by HVAC system	-
Standard value	N/A	N/A

1- CCHP Generator

	CHPQA quality index	CHP electrical efficiency
This building	-	0.3
Standard value	Not provided	N/A

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide					
Α	Local supply or extract ventilation units serving a single area					
В	Zonal supply system where the fan is remote from the zone					
С	Zonal extract system where the fan is remote from the zone					
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery					
Е	Local supply and extract ventilation system serving a single area with heating and heat recovery					
F	Other local ventilation units					
G	Fan-assisted terminal VAV unit					
Н	Fan coil units					
1	Zonal extract system where the fan is remote from the zone with grease filter					

Zone name ID of system type		SFP [W/(I/s)]							UD officionay		
		В	С	D	Е	F	G	Н	I	пке	HR efficiency
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
GF_Office Entrance	-	-	-	-	-	-	-	-	-	-	N/A
GF_Community Room	-	-	-	1.4	-	-	-	-	-	0.7	0.5
GF_Community Room (Office)	-	-	-	1.4	-	-	-	-	-	0.7	0.5
GF_Community Room (Toilets)	0.3	-	-	-	-	-	-	-	-	-	N/A
GF_Community Room (Storage)	-	-	-	-	-	-	-	-	-	-	N/A
1F_Core	-	-	-	-	-	-	-	-	-	-	N/A
1F_Staircore	-	-	-	-	-	-	-	-	-	-	N/A
1F_Flexible Employment Space (Toile	t 6)3	-	-	-	-	-	-	-	-	-	N/A
1F_Flexible Employment Space (Stor	age)	-	-	-	-	-	-	-	-	-	N/A
1F_Flexible Employment Space (Mee	ting R	oem)	-	1.4	-	-	-	-	-	0.7	0.5

Zone name		SFP [W/(I/s)]							LID officions.		
ID of system type	Α	В	С	D	Е	F	G	Н	I	HR efficiency	
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
1F_Flexible Employment Space	-	-	-	1.4	-	-	-	-	-	0.7	0.5
1F_Flexible Employment Space (Eati	ng/Drii	ıking)	-	1.4	-	-	-	-	-	0.7	0.5
GF_Commercial Unit (Toilets)	0.3	-	-	-	-	-	-	-	-	-	N/A
GF_Commercial Unit (Storage)	-	-	-	-	-	-	-	-	-	-	N/A
GF_Commercial Unit (Office)	-	-	-	1.4	-	-	-	-	-	0.7	0.5
GF_Commercial Unit	-	-	-	1.4	-	-	-	-	-	0.7	0.5
GF_Start-up unit 4 (Storage)	-	-	-	-	-	-	-	-	-	-	N/A
GF_Start-up unit 4	-	-	-	1.4	-	-	-	-	-	0.7	0.5
GF_Start-up unit 3 (Storage)	-	-	-	-	-	-	-	-	-	-	N/A
GF_Start-up unit 3	-	-	-	1.4	-	-	-	-	-	0.7	0.5
GF_Start-up unit 2 (Storage)	-	-	-	-	-	-	-	-	-	-	N/A
GF_Start-up unit 2	-	-	-	1.4	-	-	-	-	-	0.7	0.5
GF_Start-up unit 1 (Storage)	-	-	-	-	-	-	-	-	-	-	N/A
GF_Start-up unit 1	-	-	-	1.4	-	-	-	-	-	0.7	0.5

General lighting and display lighting	Lumino	ous effic		
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
GF_Office Entrance	-	62	-	445
GF_Community Room	-	62	40	755
GF_Community Room (Office)	62	-	-	39
GF_Community Room (Toilets)	-	62	-	74
GF_Community Room (Storage)	63	-	-	31
1F_Core	-	63	-	432
1F_Staircore	-	62	-	60
1F_Flexible Employment Space (Toilets)	-	63	-	365
1F_Flexible Employment Space (Storage)	62	-	-	75
1F_Flexible Employment Space (Meeting Room)	63	-	-	134
1F_Flexible Employment Space	63	-	-	3239
1F_Flexible Employment Space (Eating/Drinking)	-	63	-	317
GF_Commercial Unit (Toilets)	-	62	-	218
GF_Commercial Unit (Storage)	62	-	-	86
GF_Commercial Unit (Office)	63	-	-	254
GF_Commercial Unit	-	63	40	14056
GF_Start-up unit 4 (Storage)	62	-	-	37
GF_Start-up unit 4	-	62	40	1311
GF_Start-up unit 3 (Storage)	62	-	-	34
GF_Start-up unit 3	-	63	40	1231
GF_Start-up unit 2 (Storage)	63	-	-	36
GF_Start-up unit 2	-	62	40	1292
GF_Start-up unit 1 (Storage)	62	-	-	26
GF_Start-up unit 1	-	63	40	1082

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
GF_Office Entrance	N/A	N/A
GF_Community Room	NO (-37.7%)	NO
GF_Community Room (Office)	N/A	N/A
GF_Community Room (Toilets)	N/A	N/A
GF_Community Room (Storage)	N/A	N/A
1F_Core	N/A	N/A
1F_Staircore	N/A	N/A
1F_Flexible Employment Space (Toilets)	N/A	N/A
1F_Flexible Employment Space (Storage)	N/A	N/A
1F_Flexible Employment Space (Meeting Room)	N/A	N/A
1F_Flexible Employment Space	NO (-69.4%)	NO
1F_Flexible Employment Space (Eating/Drinking)	NO (-85.7%)	NO
GF_Commercial Unit (Toilets)	N/A	N/A
GF_Commercial Unit (Storage)	N/A	N/A
GF_Commercial Unit (Office)	N/A	N/A
GF_Commercial Unit	NO (-56.2%)	NO
GF_Start-up unit 4 (Storage)	N/A	N/A
GF_Start-up unit 4	NO (-61.9%)	NO
GF_Start-up unit 3 (Storage)	N/A	N/A
GF_Start-up unit 3	NO (-36.4%)	NO
GF_Start-up unit 2 (Storage)	N/A	N/A
GF_Start-up unit 2	NO (-41.5%)	NO
GF_Start-up unit 1 (Storage)	N/A	N/A
GF_Start-up unit 1	NO (-45.7%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?					
Is evidence of such assessment available as a separate submission?	NO				
Are any such measures included in the proposed design?	NO				

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	1653.5	1653.5
External area [m²]	2658.2	2658.2
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	4	3
Average conductance [W/K]	568.63	826.4
Average U-value [W/m²K]	0.21	0.31
Alpha value* [%]	26	14.21

^{*} Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
64	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
32	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Inst.: Hospitals and Care Homes
	C2 Residential Inst.: Residential schools
	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.

D1 Non-residential Inst.: Community/Day Centre

D1 Non-residential Inst.: Libraries, Museums, and Galleries

D1 Non-residential Inst.: Education

Residential spaces

D1 Non-residential Inst.: Primary Health Care Building D1 Non-residential Inst.: Crown and County Courts

D2 General Assembly and Leisure, Night Clubs and Theatres

Others: Passenger terminals Others: Emergency services Others: Miscellaneous 24hr activities

Others: Car Parks 24 hrs Others - Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	8.03	6.44
Cooling	13.73	14.85
Auxiliary	5.7	3.15
Lighting	40.27	46.25
Hot water	4.48	2.98
Equipment*	25.57	25.57
TOTAL**	68.83	73.68

^{*} Energy used by equipment does not count towards the total for calculating emissions.

** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	3.38	0
Solar thermal systems	0	0

Energy & CO, Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	221.47	211.41
Primary energy* [kWh/m²]	183.58	203.83
Total emissions [kg/m²]	31.2	34.6

^{*} Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

F	HVAC Systems Performance										
System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER	
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity											
	Actual	3.6	203.6	1.1	13.7	5.7	0.89	4.12	0.91	5.51	
	Notional	19	192.4	6.4	14.8	3.2	0.82	3.6			

Key to terms

Heat dem [MJ/m2] = Heating energy demand
Cool dem [MJ/m2] = Cooling energy demand
Heat con [kWh/m2] = Heating energy consumption
Cool con [kWh/m2] = Cooling energy consumption
Aux con [kWh/m2] = Auxiliary energy consumption

Heat SSEFF = Heating system seasonal efficiency (for notional building, value depends on activity glazing class)

Cool SSEER = Cooling system seasonal energy efficiency ratio

Heat gen SSEFF = Heating generator seasonal efficiency

Cool gen SSEER = Cooling generator seasonal energy efficiency ratio

ST = System type
HS = Heat source
HFT = Heating fuel type
CFT = Cooling fuel type

Key Features

The BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

Element	U i-Тур	U _{i-Min}	Surface where the minimum value occurs*		
Wall	0.23	0.18	GF000003_W11		
Floor	0.2	0.07	GF000022_F1		
Roof	0.15	0.15	1F000001_C1		
Windows, roof windows, and rooflights	1.5	1.31	GF000017_W2-W0		
Personnel doors	1.5	-	"No external personnel doors"		
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"		
High usage entrance doors	1.5	-	"No external high usage entrance doors"		
U _{i-Typ} = Typical individual element U-values [W/(m²K)]			U _{i-Min} = Minimum individual element U-values [W/(m ² K)]		
* There might be more than one surface where the minimum U-value occurs.					

Air Permeability	Typical value	This building
m ³ /(h.m ²) at 50 Pa	5	4

BRUKL Output Document



Compliance with England Building Regulations Part L 2013

Project name

West End Lane_SBEM

As built

Date: Tue May 17 12:06:40 2016

Administrative information

Building Details

Address: Address 1, Address 2, City, Postcode

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.2.g.3

Interface to calculation engine: Virtual Environment

Interface to calculation engine version: v7.0.5

BRUKL compliance check version: v5.2.g.3

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Criterion 1: The calculated CO₂ emission rate for the building should not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	34.6
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	34.6
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	23.9
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and the building services should achieve reasonable overall standards of energy efficiency

Values not achieving standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red. **Building fabric**

Element	U _{a-Limit}	Ua-Calc	U i-Calc	Surface where the maximum value occurs*
Wall**	0.35	0.18	0.18	GF000003_W11
Floor	0.25	0.08	0.15	GF000018_F1
Roof	0.25	0.15	0.15	1F000001_C1
Windows***, roof windows, and rooflights	2.2	1.31	1.31	GF000017_W2-W0
Personnel doors	2.2	-	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"
U _{a-Limit} = Limiting area-weighted average U-values IV	V/(m²K)1			

Ua-Calc = Calculated area-weighted average U-values [W/(m²K)]

U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
m ³ /(h.m ²) at 50 Pa	10	4

^{*} There might be more than one surface where the maximum U-value occurs.

^{**} Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

^{***} Display windows and similar glazing are excluded from the U-value check.

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	>0.95

1- Main system

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(I/s)]	HR efficiency		
This system	0.91	3.35	-	-	-		
Standard value	0.91*	2.6	N/A	N/A	N/A		
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system YES							
* Standard shows in far and single beiler systems . 2 MW output For single beiler systems . 2 MW or multi beiler systems (averall) limiting							

^{*} Standard shown is for gas single boiler systems <= 2 MW output. For single boiler systems > 2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

1- SYST0000-DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	Hot water provided by HVAC system	-
Standard value	N/A	N/A

1- CCHP Generator

	CHPQA quality index	CHP electrical efficiency
This building	-	0.3
Standard value	Not provided	N/A

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
Α	Local supply or extract ventilation units serving a single area
В	Zonal supply system where the fan is remote from the zone
С	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
Е	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
Н	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(I/s)]			UD officionav							
ID of system type	Α	В	С	D	Е	F	G	Н	I	HR efficiency	
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
GF_Office Entrance	-	-	-	-	-	-	-	-	-	-	N/A
GF_Community Room	-	-	-	1.4	-	-	-	-	-	0.7	0.5
GF_Community Room (Office)	-	-	-	1.4	-	-	-	-	-	0.7	0.5
GF_Community Room (Toilets)	0.3	-	-	-	-	-	-	-	-	-	N/A
GF_Community Room (Storage)	-	-	-	-	-	-	-	-	-	-	N/A
1F_Core	-	-	-	-	-	-	-	-	-	-	N/A
1F_Staircore	-	-	-	-	-	-	-	-	-	-	N/A
1F_Flexible Employment Space (Toile	t 6)3	-	-	-	-	-	-	-	-	-	N/A
1F_Flexible Employment Space (Stor	age)	-	-	-	-	-	-	-	-	-	N/A
1F_Flexible Employment Space (Mee	ting R	oem)	-	1.4	-	-	-	-	-	0.7	0.5

Zone name	SFP [W/(I/s)]			UP officionay								
ID of system type	Α	В	С	D	Е	F	G	Н	I	HRE	HR efficiency	
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard	
1F_Flexible Employment Space	-	-	-	1.4	-	-	-	-	-	0.7	0.5	
1F_Flexible Employment Space (Eati	ng/Drii	ıking)	-	1.4	-	-	-	-	-	0.7	0.5	
GF_Commercial Unit (Toilets)	0.3	-	-	-	-	-	-	-	-	-	N/A	
GF_Commercial Unit (Storage)	-	-	-	-	-	-	-	-	-	-	N/A	
GF_Commercial Unit (Office)	-	-	-	1.4	-	-	-	-	-	0.7	0.5	
GF_Commercial Unit	-	-	-	1.4	-	-	-	-	-	0.7	0.5	
GF_Start-up unit 4 (Storage)	-	-	-	-	-	-	-	-	-	-	N/A	
GF_Start-up unit 4	-	-	-	1.4	-	-	-	-	-	0.7	0.5	
GF_Start-up unit 3 (Storage)	-	-	-	-	-	-	-	-	-	-	N/A	
GF_Start-up unit 3	-	-	-	1.4	-	-	-	-	-	0.7	0.5	
GF_Start-up unit 2 (Storage)	-	-	-	-	-	-	-	-	-	-	N/A	
GF_Start-up unit 2	-	-	-	1.4	-	-	-	-	-	0.7	0.5	
GF_Start-up unit 1 (Storage)	-	-	-	-	-	-	-	-	-	-	N/A	
GF_Start-up unit 1	-	-	-	1.4	-	-	-	-	-	0.7	0.5	

General lighting and display lighting	Lumino	us effic		
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
GF_Office Entrance	-	62	-	445
GF_Community Room	-	62	40	755
GF_Community Room (Office)	62	-	-	39
GF_Community Room (Toilets)	-	62	-	74
GF_Community Room (Storage)	63	-	-	31
1F_Core	-	63	-	432
1F_Staircore	-	62	-	60
1F_Flexible Employment Space (Toilets)	-	63	-	365
1F_Flexible Employment Space (Storage)	62	-	-	75
1F_Flexible Employment Space (Meeting Room)	63	-	-	134
1F_Flexible Employment Space	63	-	-	3239
1F_Flexible Employment Space (Eating/Drinking)	-	63	-	317
GF_Commercial Unit (Toilets)	-	62	-	218
GF_Commercial Unit (Storage)	62	-	-	86
GF_Commercial Unit (Office)	63	-	-	254
GF_Commercial Unit	-	63	40	14056
GF_Start-up unit 4 (Storage)	62	-	-	37
GF_Start-up unit 4	-	62	40	1311
GF_Start-up unit 3 (Storage)	62	-	-	34
GF_Start-up unit 3	-	63	40	1231
GF_Start-up unit 2 (Storage)	63	-	-	36
GF_Start-up unit 2	-	62	40	1292
GF_Start-up unit 1 (Storage)	62	-	-	26
GF_Start-up unit 1	-	63	40	1082

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
GF_Office Entrance	N/A	N/A
GF_Community Room	NO (-37.7%)	NO
GF_Community Room (Office)	N/A	N/A
GF_Community Room (Toilets)	N/A	N/A
GF_Community Room (Storage)	N/A	N/A
1F_Core	N/A	N/A
1F_Staircore	N/A	N/A
1F_Flexible Employment Space (Toilets)	N/A	N/A
1F_Flexible Employment Space (Storage)	N/A	N/A
1F_Flexible Employment Space (Meeting Room)	N/A	N/A
1F_Flexible Employment Space	NO (-69.4%)	NO
1F_Flexible Employment Space (Eating/Drinking)	NO (-85.7%)	NO
GF_Commercial Unit (Toilets)	N/A	N/A
GF_Commercial Unit (Storage)	N/A	N/A
GF_Commercial Unit (Office)	N/A	N/A
GF_Commercial Unit	NO (-56.2%)	NO
GF_Start-up unit 4 (Storage)	N/A	N/A
GF_Start-up unit 4	NO (-61.9%)	NO
GF_Start-up unit 3 (Storage)	N/A	N/A
GF_Start-up unit 3	NO (-36.4%)	NO
GF_Start-up unit 2 (Storage)	N/A	N/A
GF_Start-up unit 2	NO (-41.5%)	NO
GF_Start-up unit 1 (Storage)	N/A	N/A
GF_Start-up unit 1	NO (-45.7%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?			
Is evidence of such assessment available as a separate submission?	NO		
Are any such measures included in the proposed design?	NO		

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	1653.5	1653.5
External area [m²]	2658.2	2658.2
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	4	3
Average conductance [W/K]	568.63	826.4
Average U-value [W/m²K]	0.21	0.31
Alpha value* [%]	26	14.21

^{*} Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
64	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
32	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Inst.: Hospitals and Care Homes
	C2 Residential Inst.: Residential schools
	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.
	Residential spaces

D1 Non-residential Inst.: Community/Day Centre

D1 Non-residential Inst.: Libraries, Museums, and Galleries

D1 Non-residential Inst.: Education

D1 Non-residential Inst.: Primary Health Care Building D1 Non-residential Inst.: Crown and County Courts

D2 General Assembly and Leisure, Night Clubs and Theatres

Others: Passenger terminals Others: Emergency services Others: Miscellaneous 24hr activities

Others: Car Parks 24 hrs Others - Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	8.03	6.44
Cooling	13.73	14.85
Auxiliary	5.7	3.15
Lighting	40.27	46.25
Hot water	4.48	2.98
Equipment*	25.57	25.57
TOTAL**	68.83	73.68

^{*} Energy used by equipment does not count towards the total for calculating emissions.

** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	14.03	0
Wind turbines	0	0
CHP generators	3.38	0
Solar thermal systems	0	0

Energy & CO, Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	221.47	211.41
Primary energy* [kWh/m²]	183.58	203.83
Total emissions [kg/m²]	23.9	34.6

^{*} Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

F	HVAC Systems Performance									
Sys	System Type Heat dem MJ/m2 MJ/m2 Heat con kWh/m2					Cool gen SEER				
[ST] Split or m	ulti-split sy	stem, [HS]	LTHW boile	er, [HFT] Na	tural Gas, [CFT] Electr	icity		
	Actual	3.6	203.6	1.1	13.7	5.7	0.89	4.12	0.91	5.51
	Notional	19	192.4	6.4	14.8	3.2	0.82	3.6		

Key to terms

Heat dem [MJ/m2] = Heating energy demand
Cool dem [MJ/m2] = Cooling energy demand
Heat con [kWh/m2] = Heating energy consumption
Cool con [kWh/m2] = Cooling energy consumption
Aux con [kWh/m2] = Auxiliary energy consumption

Heat SSEFF = Heating system seasonal efficiency (for notional building, value depends on activity glazing class)

Cool SSEER = Cooling system seasonal energy efficiency ratio

Heat gen SSEFF = Heating generator seasonal efficiency

Cool gen SSEER = Cooling generator seasonal energy efficiency ratio

ST = System type
HS = Heat source
HFT = Heating fuel type
CFT = Cooling fuel type

Key Features

The BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

Element	U i-Тур	U _{i-Min}	Surface where the minimum value occurs*	
Wall	0.23	0.18	GF000003_W11	
Floor	0.2	0.07	GF000022_F1	
Roof	0.15	0.15	1F000001_C1	
Windows, roof windows, and rooflights	1.5	1.31	GF000017_W2-W0	
Personnel doors	1.5	-	"No external personnel doors"	
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"	
High usage entrance doors	1.5	-	"No external high usage entrance doors"	
U _{i-Typ} = Typical individual element U-values [W/(m²K)]		U _{i-Min} = Minimum individual element U-values [W/(m²K)]	
* There might be more than one surface where the minimum U-value occurs.				

Air Permeability	Typical value	This building
m ³ /(h.m ²) at 50 Pa	5	4

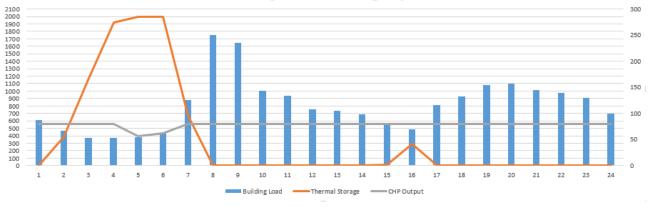


Appendix C – CHP Preliminary sizing and Technical Details

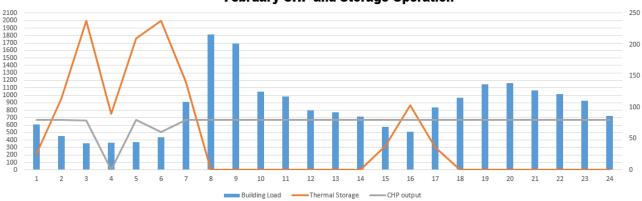
	Jan	Feb	Mar	Apr	May
Daily Total Output	1879.12	1819.48	1698.81	1332.34	915.66
Maximum output from CHP	1920.00	1920.00	1920.00	1920.00	1920.00
Utilisation	0.98	0.95	0.88	0.69	0.48
Days	31	28	31	30	31
Monthly Total Output	58253	50946	52663	39970	28385
Maximum monthly output from CHP	59520	53760	59520	57600	59520
	Jun	Jul	Aug	Sep	Oct
Daily Total Output	726.07	683.63	738.01	757.36	1249.69
Maximum output from CHP	1920.00	1920.00	1920.00	1920.00	1920.00
Utilisation	0.38	0.36	0.38	0.39	0.65
Days	30	31	31	30	31
Monthly Total Output	21782	21193	22878	22721	38740
Maximum monthly output from CHP	57600	59520	59520	57600	59520
		Nov		Dec	Total
Daily Total Output		1730.2	.7	1871.98	
Maximum output from CHP		1920.0	00	1920.00	
Utilisation		0.90		0.97	0.67
Days		30		31	
Monthly Total Output		51908		58031	467471
Maximum monthly output fro	m CHP	57600)	59520	700800



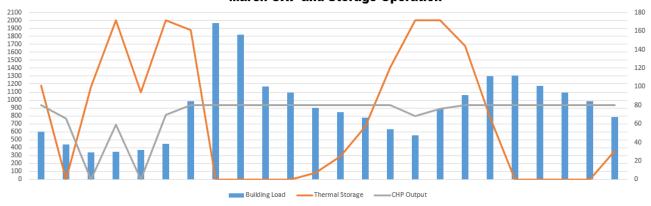


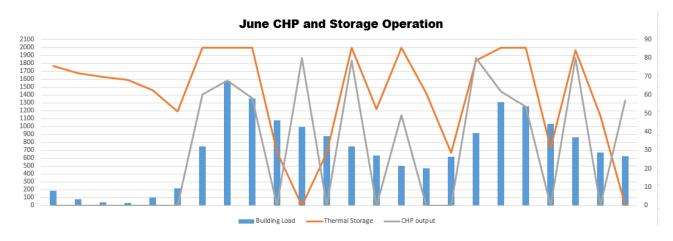


February CHP and Storage Operation

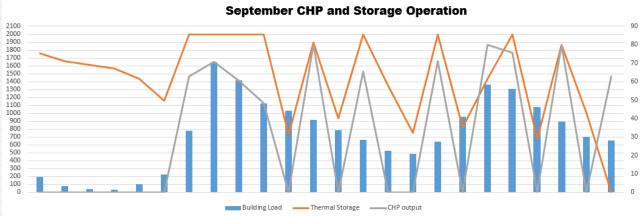






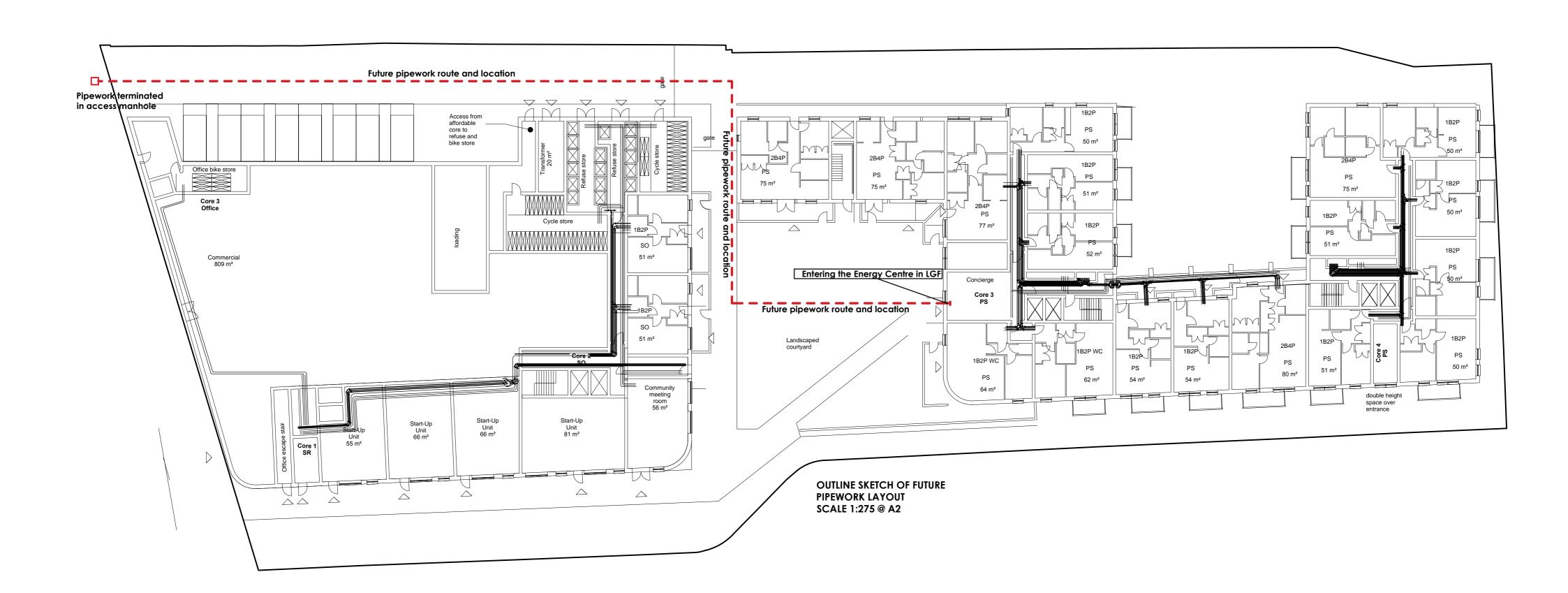


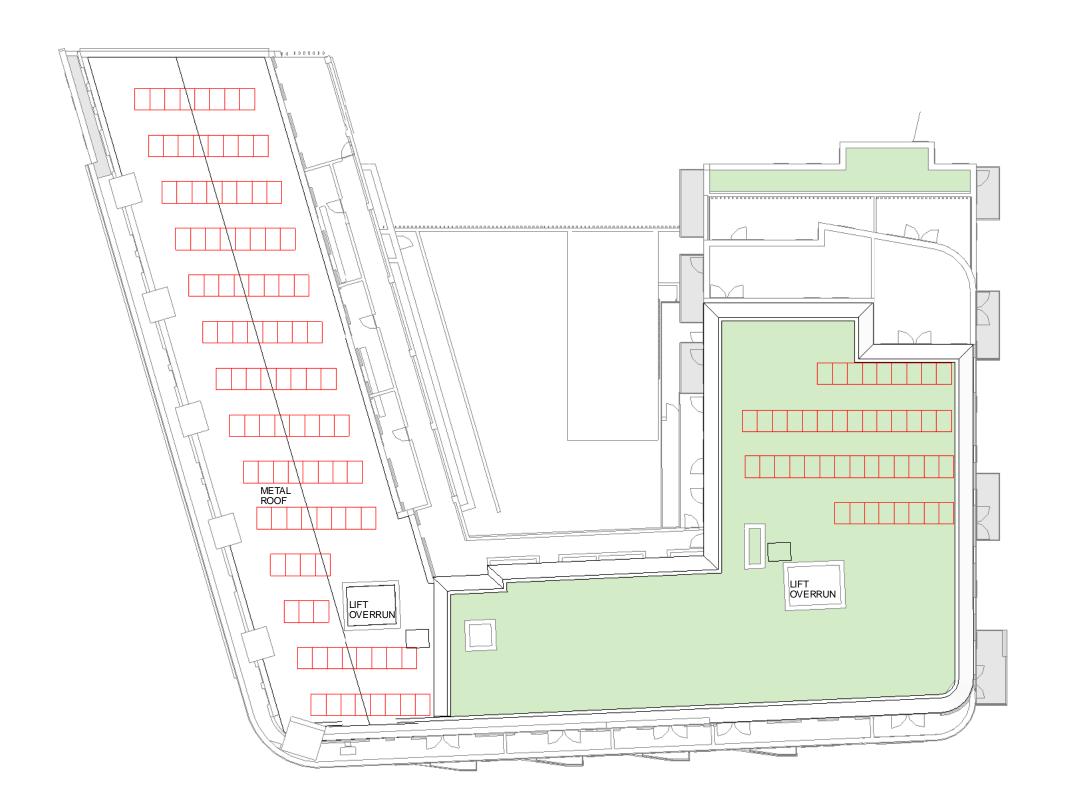






Appendix D – Outline Sketch of future pipework AND PV layouts

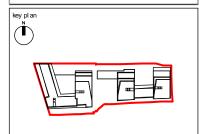




NOTES

Do not scale from this drawing , except for planning purpose -Check all dimensions on site.
 Subject to survey.
 Subject to site inspection.
 Site boundary lines are indicative only.

| - | 13/11/15 | AB | Planning Issue | Rev | Date | By | Description | Revision Schedule





156 WEST END LANE WEST HAMPSTEAD

ROOF PLAN - WEST BUILDING

drawing status PLANNING			
contract no.		scale 1: 250 @ A	3
dient ref. A2 DOMINION		date 11/05/15	
drawn by Author		checked by Checker	
project no.	drawing num	ber	revision
13119	PL(06)P026	P-

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