# MECSERVE

# Energy & Sustainability Statement

for

# **IMPERIAL LONDON HOTELS**

**64-65 Guilford Street** London Borough of Camden London WC1N 1DD

Issue No:	03
Issue Date:	June 2018
Reference:	P18-078



# ISSUE

lssue No.	Date of issue	Purpose of issue	Prepared by	Checked by	Changes
01	29.05.2018	Draft report for comments	P Dalapas/ S Kamath	N Dabidian	
02	31.05.2018	Second draft for comments	P Dalapas/ S Kamath	N Dabidian	Revised according to comments received from the design team
03	04.06.2018	Final issue	P Dalapas/ S Kamath	N Dabidian	Revised according to comments received from the design team



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# **EXECUTIVE SUMMARY**

Mecserve Ltd has been appointed by Imperial London Hotels Ltd to prepare an Energy and Sustainability Statement to support the planning application for demolition, renovations and additions to existing properties at 64-65 Guilford Street in the London Borough of Camden.

This Energy Statement has been prepared in line with the Greater London Authority guidance on preparing energy assessments (March 2016) as well as the Camden Planning Guidance 3 on Sustainability (March 2018). The following sections outline the key features and strategies adopted by the development team to enhance the energy and sustainability performance of the proposed development at 64-65 Guilford Street. The building is grade II listed and therefore there are various restrictions applicable to the development, preventing major changes to the building. Sections 2 and 3 review these policies and demonstrate how design meets all relevant planning targets and requirements.

The strategy for reducing energy use and associated carbon emissions through the design of the scheme follows the London Plan energy hierarchy, namely:

- Be Lean: Reduce energy demand through passive design strategies and best practice design of building services, lighting and controls;
- Be Clean: Reduce energy consumption further by connecting to an existing district heating system and exploit provision of Combined Heat and Power (CHP) systems;
- Be Green: Generate power on site through renewable energy technologies.

The following passive and active energy efficiency features have been considered in the proposed strategy for 64-65 Guilford Street:

- The existing building fabric will be thermally upgraded in line with the Part L standards in terms of U-values to reduce heating demand;
- Where possible, existing single-glazed windows will be replaced with new double-glazed units;
- The new built extensions will be well insulated thus achieving low U-values that exceed the minimum Part L requirements;
- Accredited Construction Details will be used in the extensions to eliminate thermal bridging;
- The new built extension will achieve a low air tightness rate to reduce heat losses further;
- Individual gas-fired condensing combi boilers of high efficiency will provide heating to the new extension;
- Light fittings will be of low energy types i.e. LED lighting will be installed throughout the scheme.



• Installation of CHP or other LZC and renewable technologies solutions has been investigated but were not feasible for this development.

Following the proposed energy strategy, the proposal achieves significant carbon savings that exceed the 35% reduction target over the Baseline Emission Rate set by the London Plan, i.e. CO<sub>2</sub> emissions of the unrefurbished, existing building for the refurbished elements and Part L1A Target Emission Rate (TER) for the extension.

Due to the historic nature of the building (Grade II listed) and its location as well as other restrictions such as area, access and existing site constraints, completing a BREEAM assessment and achieving the relevant rating is too onerous and challenging. However, Camden sustainability policies are addressed within this report where relevant.

Table 1 below demonstrates the overall reduction in the regulated and unregulated carbon emissions of the development after each stage of the London Plan Energy Hierarchy. Estimating reductions in non-regulated carbon dioxide emissions is challenging, as energy consumption will generally be based on the operational regime of the site and users' behaviour. However, by using energy efficiency appliances e.g. A-rated white goods, it is estimated that a reduction of at least 10% can be achieved in unregulated energy use.

64-65 Guilford Street		Carbon dioxide emissions (Tonnes CO <sub>2</sub> per annum)	
		Regulated	Unregulated
Baseline Emission Rate		34.5	16.5
Be Lean	After energy demand reduction	20.3	14.8
Be Clean After heat network/CHP		20.3	14.8
Be Green After renewable energy		20.3	14.8

Table 1 Total CO<sub>2</sub> emissions from each stage of the Energy Hierarchy

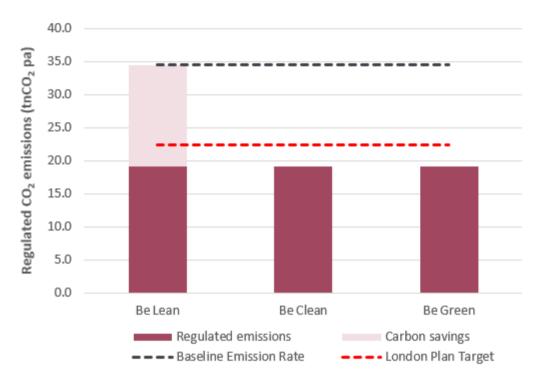
An overall reduction of 41.2% in regulated carbon emissions can be achieved over the baseline emission rate set by GLA when applying the proposed strategy, which exceeds the 35% reduction required by the London Plan. Table 2 demonstrates the total regulated CO<sub>2</sub> savings from each stage of the Energy Hierarchy.

Table 2 Total CO<sub>2</sub> savings from each stage of the Energy Hierarchy

64-65 Guilford Street	Regulated carbon dioxide savings		
	(Tonnes CO <sub>2</sub> per annum)	(%)	
Savings from energy demand reduction	14.2	41.2%	
Savings from CHP	0.0	0.0%	
Savings from renewable energy	0.0	0.0%	
Cumulative on-site savings	14.2	41.2%	
Total Target Savings	12.1	35.0%	
Annual Surplus	2.1		



Figure 1 illustrates the carbon savings achieved for the 64-65 Guilford Street scheme over the Baseline Emission Rate at each stage of the London Plan's Energy Hierarchy. Due to the energy efficiency measures applied to the scheme the achieved reduction exceeds the carbon reduction target as set in the London Plan.



## London Plan Energy Hierarchy and Targets

Figure 1 Total carbon savings achieved over Baseline Emissions



# 1. INTRODUCTION

Over recent years, global public opinion has been increasingly concerned with the state of the environment and the impact of climate change. Buildings are responsible for a significant proportion of the world's energy consumption. In the United Kingdom, domestic, commercial buildings and industry contribute 43%<sup>1</sup> of the total CO<sub>2</sub> emissions. These figures highlight the need for building owners, developers and designers to design environmentally sustainable buildings.

This report provides a review of the sustainability and efficiency benchmarks for the scheme and sets out targets for the development in terms of both sustainability and energy. An overview of different sustainability and energy-efficiency technologies that are likely to be appropriate for the development are also included in this statement.

As the design progresses, the strategies outlined in this report will be further developed and subjected to detailed financial feasibility studies. The environmental strategies and options outlined in this report are based on the current information available and are likely to evolve with the design.

The energy calculations presented in this report will need to be continually updated through the detailed design stages to reflect any changes. The energy analysis presented here should be treated as preliminary information based on the currently available data.

# 1.1 **PROPOSED DEVELOPMENT**

The proposed development, consisting of two Grade II listed buildings, is located within the Bloomsbury conservation area in the London Borough of Camden.

The proposals aim to refurbish and revert the existing buildings at 64-65 Guilford Street back to two separate terrace buildings comprising in total 18 No. one-bedroom flats. Building works to be undertaken also include the demolition of the rear closet wings and reconstruction of a three-storey extension as well as provision of a rooftop extension.

For a detailed description of the proposed design, please refer to the Design and Access Statement prepared by IPA Architects.

<sup>&</sup>lt;sup>1</sup> Department for Environment, Food and Rural Affairs, http://www.defra.gov.uk/, 2008





Figure 2 Bird's eye view of existing Building



Figure 3 Proposed 64-65 Guilford Street scheme (Front façade – IPA Architects)



# 2. OVERVIEW OF ENVIRONMENTAL STANDARDS, TARGETS AND POLICIES

# 2.1 NATIONAL POLICIES

#### **ENERGY WHITE PAPER**

The Energy White Paper: Our Energy Future – Creating a Low Carbon Economy<sup>2</sup> is an energy policy in response to the increasing challenges faced by the UK, including climate change, decreasing domestic supplies of fossil fuel and escalating energy prices. The Energy White Paper sets four priorities:

- Cutting the UK's carbon dioxide emissions the main contributor to global warming by some 60% by about 2050, with real progress by 2020;
- Security of supply;
- A competitive market for the benefit of businesses, industries and households;
- Affordable energy for the poor.

#### CLIMATE CHANGE ACT 2008

Published in 2008 by the UK Government, Climate Change Act<sup>3</sup> is the world's first long-term legally binding framework to mitigate against climate change. The Act sets legally binding targets to increase greenhouse gas emission reductions through action in the UK and abroad from the 60% target to 80% by 2050.

In addition to the standards, targets and policies discussed above, the relevant British Standards and CIBSE Guidelines were used to assist in determining the most appropriate Ecologically Sustainable Design (ESD) initiatives for the development.

 <sup>&</sup>lt;sup>2</sup> Dti, (2003); Energy White Paper Our Energy Future - Creating a Low Carbon Economy. TSO.
 <sup>3</sup> OPSI, (2008); Climate Change Act. HMSO.

# NATIONAL PLANNING POLICY FRAMEWORK (NPPF) (MARCH 2012)

The Government has developed the National Planning Policy Framework (NPPF) which plays a key role in delivering the Government's objectives on sustainable development. The framework encourages ownership at the local level and provides guidance to promote effective environmental protection, economic growth and ensuring a better quality of life for all, both now and in future generations. Some of the main objectives of the Governments planning framework in relation to sustainability are:

- Build prosperous communities with opportunities for employment and economic growth across all areas of society;
- Reduce the need for car dependency and provide easy access to public transport;
- Maintain, and enhance or restore biodiversity and geological interests;
- Protect the condition of land, its use, and its development from potential hazards;
- Ensure that all new developments contribute to the Governments targets of carbon emission reductions.

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RESPONSE TO CLIMATE CHANGE

# 2.2 REGIONAL POLICY

#### THE LONDON PLAN (MARCH 2016)

The London Plan, prepared by the Mayor of London's office, deals with matters that are of strategic importance to Greater London. The London Plan is the overall strategic plan setting out an integrated social, economic and environmental framework for the future development of London, looking forward until 2036.

Chapter 5 of the London Plan deals with matters related to climate change.

Supplementary Planning Guidance, Sustainable Design

and Construction (April 2014) provides framework for implementing the London policies.







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## 2.3 LOCAL POLICIES

#### CAMDEN LOCAL PLAN (2017)

The Camden Local Plan (adopted in 2017) sets out the Council's planning policies and replaces the Core Strategy and Development Policies planning documents. The Local Plan, covering the period from 2016-2031, will help deliver the objectives of creating the conditions for harnessing the benefits of economic growth, reducing inequality and securing sustainable neighbourhoods.

Section 8 of the Local Plan sets the Council's targets and objectives with regards to Sustainability and Climate Change for developments to reduce energy use and, therefore, cut carbon emissions.

The following section provides review of the London Plan and the Local Plan policies for Climate Change mitigation and Climate Change Adaptation followed by measures implemented in the proposed development to meet the applicable policy requirements.



# 3. CLIMATE CHANGE MITIGATION AND ADAPTATION STRATEGY

Climate Change is the rise in average global temperature due to increasing levels of greenhouse gases in the earth's atmosphere (primarily  $CO_2$ ) that prevent the radiation of heat into space.

Buildings and spaces built today should respond to climate change issues and adapt to mitigation and adaptation measures. The London Plan through its policies addresses these issues and will require London Boroughs to consider how their developments will function in the future in the context of changing climate.

Through the Camden Planning Guidance (CPG 3) on Sustainability (adopted on April 2011 and updated on March 2018), the Council provides information on ways to achieve carbon reductions and more sustainable developments across the borough. It also highlights the Council's requirements and guidelines which support the relevant Local Development Framework (LDF) policies with regards to the following environmental issues:

 Tackling climate change through sustainable construction, energy efficiency, use of renewable energy and retrofitting;



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- Adapting to a changing climate, in particular to an increased likelihood
  of flooding, higher temperatures and the need for cooling and recognising the
  environmental and social benefits of green infrastructure including living roofs;
- Protecting water resources and making provision for water and sewerage.



# 3.1 CLIMATE CHANGE MITIGATION

As per the definition of United Nations Environment Programme (UNEP), Climate Change Mitigation refers to efforts to reduce or prevent emission of greenhouse gases. Mitigation can mean using new technologies and renewable energies, making older equipment more energy efficient, or changing management practices or consumer behaviour.

The following policies from the London Plan and London Borough of Camden local policies relate to Climate Change Mitigation, in the context of this proposed development.

#### LONDON PLAN 2016

- Policy 5.2 Minimising carbon dioxide emissions;
- Policy 5.3 Sustainable design and construction;
- Policy 5.6 Decentralised energy in development proposals;
- Policy 5.7 Renewable energy;

#### CAMDEN'S COUNCIL LOCAL PLAN: DEVELOPMENT MANAGEMENT DPD 2013

• Policy CC1 Climate Change Mitigation

The policies above are explained and reviewed in detail below providing a response on measures implemented for this proposed development.



# 3.2 CLIMATE CHANGE MITIGATION – REVIEW AND MEASURES IMPLEMENTED

#### London Plan – Policy 5.2 Minimising Carbon Dioxide Emissions

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

**Residential buildings:** 

Year	Improvement on 2010 Building Regulations	
2010 - 2013	25 per cent	
2013 – 2016	40 per cent	
2016 - 2031	Zero Carbon <sup>4</sup>	

Non-domestic buildings

Year	Improvement on 2010 Building Regulations	
2010 - 2013	25 per cent	
2013 – 2016	40 per cent	
2016 – 2019	As per building regulations requirements	
2019 – 2031	Zero Carbon	

- C. Major development proposals should include a detailed energy assessment to demonstrate how the targets for carbon dioxide emissions reduction outlined above are to be met within the framework of the energy hierarchy.
- D. As a minimum, energy assessments should include the following details:

<sup>&</sup>lt;sup>4</sup> 'Zero carbon' homes are homes forming part of major development applications where the residential element of the application achieves at least a 35 per cent reduction in regulated carbon dioxide emissions (beyond Part L 2013) on-site. The remaining regulated carbon dioxide emissions, to 100 per cent, are to be off-set through a cash in lieu contribution to the relevant borough to be ring fenced to secure delivery of carbon dioxide savings elsewhere (in line with policy 5.2E).



- a. calculation of the energy demand and carbon dioxide emissions covered by Building Regulations and, separately, the energy demand and carbon dioxide emissions from any other part of the development, including plant or equipment, that are not covered by the Building Regulations (see paragraph 5.22) at each stage of the energy hierarchy;
- b. proposals to reduce carbon dioxide emissions through the energy efficient design of the site, buildings and services;
- c. proposals to further reduce carbon dioxide emissions through the use of decentralised energy where feasible, such as district heating and cooling and combined heat and power (CHP);
- d. proposals to further reduce carbon dioxide emissions through the use of on-site renewable energy technologies.
- E. 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 to be ring fenced to secure delivery of carbon dioxide savings elsewhere.

#### Measures being considered in the project to meet the above policy requirements

The proposed scheme, comprising 19 one-bedroom flats, is classified as a major development according to London Plan. Building works on site include the refurbishment of the existing two Grade II listed buildings and provision of a rear three-storey extension.

The energy strategy proposed follows the London Plan Energy Hierarchy and this report is written in line with GLA guidance on reporting energy assessments (March 2016) and the Camden Council relevant guidance.

Our approach to reducing the energy demand and cut carbon emissions, the following have been considered where technically feasible without compromising the historic character of the buildings:

- The building fabric of the existing buildings will be thermally upgraded and where possible the single glazed windows will be replaced with double glazed units. The new built extensions will also exceed the current building regulations' requirements in terms of Uvalues;
- Efficient building services and low energy lighting are proposed to reduce energy consumption;
- The design team has carried out a feasibility study to assess the potential of connecting the scheme to a district heating network or provide a Combined Heat and Power to meet heating demand;
- Renewable energy technologies are explored and the most feasible options are proposed the development.



This report also covers the non-regulated energy use due to appliances and cooking and lists a number of strategies in order to reduce this. As a result of the proposed strategy, the scheme achieves an overall reduction in excess of the 35% target set by GLA and the Council. In line with GLA's definition of Zero Carbon homes, the remaining regulated carbon dioxide emissions, to 100 per cent, are to be off-set through a cash in lieu contribution to the borough.

#### London Plan – Policy 5.3 Sustainable Design and Construction

- A. The highest standards of sustainable design and construction should be achieved in London to improve the environmental performance of new developments and to adapt to the effects of climate change over their lifetime.
- B. Development proposals should demonstrate that sustainable design standards are integral to the proposal, including its construction and operation, and ensure that they are considered at the beginning of the design process.
- C. Major development proposals should meet the minimum standards outlined in the Mayor's supplementary planning guidance and this should be clearly demonstrated within a design and access statement. The standards include measures to achieve other policies in this Plan and the following sustainable design principles:
  - a. minimising carbon dioxide emissions across the site, including the building and services (such as heating and cooling systems)
  - b. avoiding internal overheating and contributing to the urban heat island effect
  - c. efficient use of natural resources (including water), including making the most of natural systems both within and around buildings
  - d. minimising pollution (including noise, air and urban runoff)
  - e. minimising the generation of waste and maximising reuse or recycling
  - f. avoiding impacts from natural hazards (including flooding)
  - g. ensuring developments are comfortable and secure for users, including avoiding the creation of adverse local climatic conditions
  - h. securing sustainable procurement of materials, using local supplies where feasible, and
  - i. promoting and protecting biodiversity and green infrastructure.

#### Measures being considered in the project to meet the above policy requirements

As a major development, the scheme achieves a carbon reduction greater than 35% over the Baseline emission rate set by GLA, in accordance with London Plan's Policy 5.2.

The energy section of this report provide details on how significant carbon savings can be achieved across the site and which measures will be considered to tackle overheating. Passive design measures, including building fabric of enhanced thermal performance, double glazed windows,



Accredited Construction Details and low air tightness rate for the new extension, will reduce the annual heating demand. Condensing gas-fired boilers of high efficiency and low energy use light fittings of LED lighting will reduce energy use further. Low water use fittings will be installed to minimise water consumption on site, targeting a daily consumption less than 105 litres per person.

The newly created dwellings will rely mainly on natural cross ventilation through fully openable windows to remove excessive solar gains and eliminate the risk of overheating. Materials of low environmental impact, which will be responsibly resourced, will be used for the construction of the new extension. By retaining the majority of the existing building structure and existing construction materials, the overall embodied carbon of the proposed refurbishment will be kept to a minimum in comparison to a newly constructed building.

More information can be found on the Design and Access Statement prepared by IPA Architects.

#### London Plan – Policy 5.6 Decentralised Energy in Development Proposals

- A. Development proposals should evaluate the feasibility of Combined Heat and Power (CHP) systems, and where a new CHP system is appropriate also examine opportunities to extend the system beyond the site boundary to adjacent sites.
- B. Major development proposals should select energy systems in accordance with the following hierarchy:
  - 1. Connection to existing heating or cooling networks;
  - 2. Site wide CHP network;
  - 3. Communal heating and cooling.
- C. Potential opportunities to meet the first priority in this hierarchy are outlined in the London Heat Map tool. Where future network opportunities are identified, proposals should be designed to connect to these networks.

#### Measures being considered in the project to meet the above policy requirements

According to the London Heat Map (Figure 4) and Camden's energy network map (Map 5, Camden Local Plan), there is neither a district heating system currently available in close proximity to the site nor any proposed district heating system in the future. Due to the small number of units (18 No. 1-Bed flats), even if a network is to become available, the cost of connecting to this would be significant, therefore, such a connection would not be considered financially viable. Therefore, given the small scale of the scheme and the current lack of a district heating network in close proximity, it is not feasible or viable to connect to a district heating system.

Given the scale of the proposed scheme, installation of a Combined Heat and Power (CHP) unit is not considered to be feasible either. The heating demand is expected to be low and not constant throughout the year and the hot water demand is not high enough to justify installing a CHP unit.



The CHP unit would need to run continuously for long periods to ensure maximum carbon and cost savings. Therefore, given the low heating load, this would not be feasible. As per GLA guidance on energy assessments, a higher number of residential units is required to justify installation of a CHP unit.

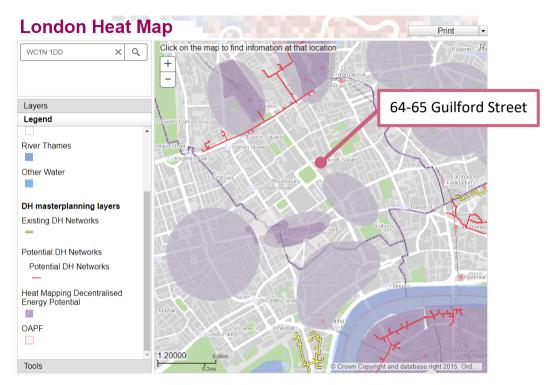


Figure 4 Image of London Heat Map (www.londonheatmap.org.uk)

#### London Plan – Policy 5.7 Renewable Energy

- A. The Mayor seeks to increase the proportion of energy generated from renewable sources and expects that the projections for installed renewable energy capacity outlined in the Climate Change Mitigation and Energy Strategy and in supplementary planning guidance will be achieved in London.
- B. Within the framework of the energy hierarchy (see Policy 5.2), major development proposals should provide a reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation, where feasible.
- C. Within LDFs boroughs should, and other agencies may wish to, develop more detailed policies and proposals to support the development of renewable energy in London in particular, to identify broad areas where specific renewable energy technologies, including large scale systems and the large-scale deployment of small scale systems, are appropriate. The identification of areas should be consistent with any guidelines and criteria outlined by the Mayor.



D. All renewable energy systems should be located and designed to minimise any potential adverse impacts on biodiversity, the natural environment and historical assets, and to avoid any adverse impacts on air quality.

#### Measures being considered in the project to meet the above policy requirements

A feasibility study has been carried out to identify those renewable energy technologies that are appropriate for the proposed development.

The most suitable renewable energy technologies for a residential scheme would be photovoltaic or solar thermal panels that would generate electricity on site or provide hot water to the newly created flats.

However, the roof of the new-built extension, where panels could be installed, is heavily overshadowed by the existing buildings located on the south side of the site. In addition, given that the existing buildings are Grade II listed and located within a conservation area, both technologies would have a negative impact on the aesthetics of the surrounding neighbourhood and the historic character of the scheme. Therefore, we would not recommend any renewable energy technology for the proposed scheme.

Section 4.8 summarises the findings of the feasibility study carried out for the above and other renewable energy technologies.

#### Camden Local Plan – Policy CC1 Climate Change Mitigation

The Council will require all development to minimise the effects of climate change and encourage all developments to meet the highest feasible environmental standards that are financially viable during construction and occupation.

We will:

- a. promote zero carbon development and require all development to reduce carbon dioxide emissions through following the steps in the energy hierarchy;
- b. require all major development to demonstrate how London Plan targets for carbon dioxide emissions have been met;
- c. ensure that the location of development and mix of land uses minimise the need to travel by car and help to support decentralised energy networks;
- d. support and encourage sensitive energy efficiency improvements to existing buildings;
- e. require all proposals that involve substantial demolition to demonstrate that it is not possible to retain and improve the existing building; and
- f. expect all developments to optimise resource efficiency.



For decentralised energy networks, we will promote decentralised energy by:

- g. working with local organisations and developers to implement decentralised energy networks in the parts of Camden most likely to support them;
- h. protecting existing decentralised energy networks (e.g. at Gower Street, Bloomsbury, King's Cross, Gospel Oak and Somers Town) and safeguarding potential network routes; and
- i. requiring all major developments to assess the feasibility of connecting to an existing decentralised energy network, or where this is not possible establishing a new network.

To ensure that the Council can monitor the effectiveness of renewable and low carbon technologies, major developments will be required to install appropriate monitoring equipment.

#### Measures being considered in the project to meet the above policy requirements

Our response to the London Plan Policies, described above, demonstrates that all the proposed scheme meets all the planning requirements set by the Camden Council.



## **3.3 CLIMATE CHANGE ADAPTATION**

For a long time, the main focus of climate change has been on mitigation, making sure we minimise our impact on the environment. Adaptation strategies are those that take into account climate change and ensure that the building is capable of dealing with future change in climate. Given the time lag associated with climate change, even if we change the way we live, there is likely to be noticeable change in the climate during the life of the building.

To ensure that buildings maintain their relevance, it is essential that adaptation strategies are addressed during the design phase. Adoption of these strategies will mean that, even as we undergo climate change, the buildings can still function as required.

The following policies from the London Plan and London Borough of Camden local policies relate to Climate Change Adaptation, in the context of this proposed development.

#### LONDON PLAN 2016

- Policy 5.9 Overheating and cooling;
- Policy 5.11 Green roofs and development site environs;
- Policy 5.12 Flood risk management;
- Policy 5.13 Sustainable drainage;
- Policy 5.15 Water use and supplies

#### CAMDEN'S COUNCIL LOCAL PLAN: DEVELOPMENT MANAGEMENT DPD 2013

- Policy CC2 Adapting to climate change
- Policy CC3 Water and flooding

Above policies are described and reviewed in detail below providing a response on measures implemented for this proposed development.



# 3.4 CLIMATE CHANGE ADAPTATION – POLICY REVIEW AND MEASURES IMPLEMENTED

#### London Plan – Policy 5.9 Overheating and Cooling

- A. The Mayor seeks to reduce the impact of the urban heat island effect in London and encourages the design of places and spaces to avoid overheating and excessive heat generation, and to reduce overheating due to the impacts of climate change and the urban heat island effect on an area wide basis.
- B. Major development proposals should reduce potential overheating and reliance on air conditioning systems and demonstrate this in accordance with the following cooling hierarchy:
  - 1. minimise internal heat generation through energy efficient design;
  - 2. reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls;
  - 3. manage the heat within the building through exposed internal thermal mass and high ceilings;
  - 4. passive ventilation;
  - 5. mechanical ventilation;
  - 6. active cooling systems (ensuring they are the lowest carbon options).
- C. Major development proposals should demonstrate how the design, materials, construction and operation of the development would minimise overheating and also meet its cooling needs. New development in London should also be designed to avoid the need for energy intensive air conditioning systems as much as possible. Further details and guidance regarding overheating and cooling are outlined in the London Climate Change Adaptation Strategy.
- D. Within LDFs boroughs should develop more detailed policies and proposals to support the avoidance of overheating and to support the cooling hierarchy.

#### Measures being considered in the project to meet the above policy requirements:

Measures to eliminate the risk of overheating have been considered and integrated in the design of the newly created flats. The following will be applied to ensure comfort during summer within the main living areas of the units:

- Windows can be fully open to allow for cross ventilation, which is the most efficient means of natural ventilation in removing excessive heat that builds up indoors;
- Windows left open at night could benefit of free night time cooling to cool down the structure;

• Internal shading devices of low shading coefficient, e.g. light-coloured curtains will be used for solar control;

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- All new double-glazed windows will be of low g-value, compared to the existing single glazed units, to avoid heat transmittance during summer but allow for passive heating in the winter;
- Tenants will be advised to use A-rated appliances of low energy consumption to reduce internal heat gains;
- Energy efficiency light fittings that emit less heat than standard types thus reducing overheating will be also specified.

#### London Plan – Policy 5.11 Green roofs and development site environs

- A. Major development proposals should be designed to include roof, wall and site planting, especially green roofs and walls where feasible, to deliver as many of the following objectives as possible:
  - a. adaptation to climate change (i.e. aiding cooling)
  - b. sustainable urban drainage
  - c. mitigation of climate change (i.e. aiding energy efficiency)
  - d. enhancement of biodiversity
  - e. accessible roof space
  - f. improvements to appearance and resilience of the building
  - g. growing food.
- B. Within LDFs boroughs may wish to develop more detailed policies and proposals to support the development of green roofs and the greening of development sites. Boroughs should also promote the use of green roofs in smaller developments, renovations and extensions where feasible.

#### Measures being considered in the project to meet the above policy requirements:

The site is mainly occupied by the existing retained buildings, therefore, there is limited scope for providing green areas. Due to the Grade II listed character of the buildings, it would not possible to install a green wall as this would alter the facades significantly. The existing retained structure would not be able to support the installation of a green roof either. Where possible though, planters will be provided on the ground floor.

Further information with regards to the landscape design can be found in the Design and Access Statement prepared by IPA Architects.



#### London Plan – Policy 5.12 Flood Risk Management

- B. Development proposals must comply with the flood risk assessment and management requirements set out in the NPPF and the associated technical Guidance on flood risk over the lifetime of the development and have regard to measures proposed in Thames Estuary 2100 (TE2100 – see paragraph 5.55) and Catchment Flood Management Plans.
- C. Developments which are required to pass the Exceptions Test set out in the NPPF and the Technical Guidance will need to address flood resilient design and emergency planning by demonstrating that:
  - a. the development will remain safe and operational under flood conditions;
  - b. strategy of either safe evacuation and/or safely remaining in the building is followed under flood conditions;
  - c. key services including electricity, water etc. will continue to be provided under flood conditions;
  - d. buildings are designed for quick recovery following a flood.
- D. Development adjacent to flood defences will be required to protect the integrity of existing flood defences and wherever possible should aim to be set back from the banks of watercourses and those defences to allow their management, maintenance and upgrading to be undertaken in a sustainable and cost effective way.

#### Measures being considered in the project to meet the above policy requirements

The site is located in a low flood risk zone according to the Flood Map for Planning (Figure 5).



Figure 5 Flood Map for Planning (https://flood-map-for-planning.service.gov.uk/)



#### London Plan – Policy 5.13 Sustainable Drainage

- A. Development should utilise sustainable urban drainage systems (SUDS) unless there are practical reasons for not doing so, and should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible in line with the following drainage hierarchy:
  - 1. store rainwater for later use;
  - 2. use infiltration techniques, such as porous surfaces in non-clay areas;
  - 3. attenuate rainwater in ponds or open water features for gradual release;
  - 4. attenuate rainwater;
  - 5. discharge rainwater direct to a watercourse;
  - 6. discharge rainwater to a surface water sewer/drain;
  - 7. discharge rainwater to the combined sewer.

Drainage should be designed and implemented in ways that deliver other policy objectives of this Plan, including water use efficiency and quality, biodiversity, amenity and recreation.

#### Measures being considered in the project to meet the above policy requirements:

Given that the existing buildings occupy the majority of the site there is limited opportunity for proposing SUDS techniques to reduce and delay the discharge of rainfall run-off. Where possible use of permeable paving will be used for delaying water at surface before discharging all surface water to ground via soakaways.

#### London Plan – Policy 5.15 Water Use Supplies

- B. Development should minimise the use of mains water by:
  - a. incorporating water saving measures and equipment;
  - b. designing residential development so that mains water consumption would meet a target of 105 litres or less per head per day.

#### Measures being considered in the project to meet the above policy requirements:

All new extension will have low water use fittings to reduce water consumption. Low flow rate showers, taps and dual flush toilets together with smaller baths will mean that all apartments will achieve a daily internal water use lower than 105 litres per person.



#### Camden Local Plan – Policy CC2 Adapting to Climate Change

The Council will require development to be resilient to climate change.

All development should adopt appropriate climate change adaptation measures such as:

- a. the protection of existing green spaces and promoting new appropriate green infrastructure;
- b. not increasing, and wherever possible reducing, surface water runoff through increasing permeable surfaces and use of Sustainable Drainage Systems;
- c. incorporating bio-diverse roofs, combination green and blue roofs and green walls where appropriate; and
- d. measures to reduce the impact of urban and dwelling overheating, including application of the cooling hierarchy.

Any development involving 5 or more residential units or 500 sqm or more of any additional floorspace is required to demonstrate the above in a Sustainability Statement.

#### Sustainable design and construction measures

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

- e. ensuring development schemes demonstrate how adaptation measures and sustainable development principles have been incorporated into the design and proposed implementation;
- f. encourage new build residential development to use the Home Quality Mark and Passivhaus design standards;
- g. encouraging conversions and extensions of 500 sqm of residential floorspace or above or five or more dwellings to achieve "excellent" in BREEAM domestic refurbishment; and
- expecting non-domestic developments of 500 sqm of floorspace or above to achieve "excellent" in BREEAM assessments and encouraging zero carbon in new development from 2019.

#### Measures being considered in the project to meet the above policy requirements:

Where technically possible, sustainable development principles have been incorporated into the proposed design. Site ecology will be enhanced where feasible. Measures to eliminate the risk of overheating have been considered and integrated in the design of the new extension. Where possible use of permeable paving will be used for delaying the discharge of surface water run off. Due to the historic nature of the building (Grade II listed) and its location as well as other restrictions such as area, access and existing site constraints, it is too onerous to complete a BREEAM assessment and achieve the relevant ratings. Sustainability measures such as addressing overheating, specifying low embodied materials, providing planters, sourcing materials responsibly and specifying low water use fittings have been incorporated.



#### Camden Local Plan – Policy CC3 Water and flooding

The Council will seek to ensure that development does not increase flood risk and reduces the risk of flooding where possible.

We will require development to:

- a. incorporate water efficiency measures;
- b. avoid harm to the water environment and improve water quality;
- c. consider the impact of development in areas at risk of flooding (including drainage);
- d. incorporate flood resilient measures in areas prone to flooding;
- e. utilise Sustainable Drainage Systems (SuDS) in line with the drainage
- f. hierarchy to achieve a greenfield run-off rate where feasible; and
- g. not locate vulnerable development in flood-prone areas.

Where an assessment of flood risk is required, developments should consider surface water flooding in detail and groundwater flooding where applicable.

The Council will protect the borough's existing drinking water and foul water infrastructure, including the reservoirs at Barrow Hill, Hampstead Heath, Highgate and Kidderpore.

#### Measures being considered in the project to meet the above policy requirements:

The site is located in low flood risk zone. As described previously all apartments will have low water use fittings to reduce water consumption to achieve a daily internal water use lower than 105 litres per person and where possible use of permeable paving will be used for delaying discharge of surface water runoff.



# 4. ENERGY ASSESSMENT

The energy assessment of the proposed scheme has been assessed following the Standard Assessment Procedure (SAP 2012). This section, prepared in line with the GLA Guidance on preparing energy assessments (March 2016), outlines the energy strategy developed for the scheme and shows how significant carbon savings can be achieved by integrating energy efficiency measures and using LZC technologies on site.

# 4.1 **BUILDING REGULATION COMPLIANCE**

Part L (Conservation of Fuel and Power) of the Building Regulations applies to all components of the development. The most recent version of the regulations came into effect on the 6th April 2014. In order to meet the performance requirements of Part L, the design of the building must comply with the prescriptive provisions laid out in the Compliance Checklist.

Part L is split into four sections that cover new and existing domestic and non-domestic buildings. The proposal includes the material change of use and extension of the existing buildings to provide 18 No. 1-Bed flats. Therefore, the scheme needs to comply with the minimum energy efficiency requirements set by the current Building Regulations:

- Approved Document L1A: Conservation of fuel and power in new dwellings (2013 edition inc. 2016 amendments);
- Approved Document L1B: Conservation of fuel and power in existing dwellings (2010 edition inc. 2018 amendments)

The development will comply with all the design limits on building fabric, building services systems and lighting, where feasible and practicable. The rear extension will need to comply with part L1A and the existing buildings with Part L1B. Detailed energy calculations using SAP have been completed to assess the energy performance of the development.

# 4.2 ENERGY MODELLING

For the purpose of this study, STROMA FSAP 2012 software (version 1.0.4.14), approved by BRE for full implementation of the SAP 2012 has been used to assess the energy performance and annual carbon emissions of the flats after energy efficient measures have been applied. The energy assessment has been completed by Mecserve's energy modelling team who are On Construction Domestic Energy Assessors.



# 4.3 BASELINE CARBON EMISSION RATE

According to Section 9 of the GLA Guidance on preparing energy assessments (March 2016), for developments consisting of a refurbishment with an extension, the baseline emission rate is the regulated  $CO_2$  emissions of the unrefurbished, existing building for the refurbished elements and the Target Emission Rate set by Part L1A for the extension. Therefore, the target is a combination of both targets on an area-weighted average basis.

The following table presents the Baseline Emission Rate of the scheme as calculated using SAP 2012 for the whole scheme.

 Table 3 Baseline Carbon Dioxide emissions

64-65 Guilford Street	Regulated Carbon dioxide emissions (Tonnes CO <sub>2</sub> per annum)
Baseline Emission Rate	34.5

From 6 April 2014, Approved Document L1A has also introduced a Fabric Energy Efficiency Target (TFEE) in addition to the TER. This is the maximum space heating and cooling energy demand for a dwelling. It is measured as the amount of energy which would normally be needed to maintain comfortable internal temperatures in a home and is measured in kWh per m<sup>2</sup> per annum. Table 4 presents the Target Fabric Energy Efficiency (TFEE) calculated by FSAP 2012 software for the extension.

Table 4 Target Fabric Energy Efficiency Rate

64-65 Guilford Street	Fabric Energy Efficiency (kWh per m <sup>2</sup> per annum)	
Part L1A Target Fabric Energy Efficiency (TFEE) Rate	68.1	



## 4.4 LONDON PLAN ENERGY HIERARCHY

To meet the requirements of Policy 5.2 Minimising Carbon Dioxide Emissions development proposals should minimise carbon dioxide emissions in accordance with the following energy hierarchy:

- Be Lean: use less energy;
- Be Clean: supply energy efficiently;
- Be Breen: use renewable energy.

The hierarchy provides the mechanism through which the carbon dioxide (CO<sub>2</sub>) emission reduction targets in Policy 5.2 of the London Plan are achieved. It also contributes to the implementation of strategic energy policies relating to decentralised networks and ensures opportunities for building occupants to receive efficient, secure and affordable energy.

GLA guidance of preparing Energy assessments (March 2016) states that the energy assessment must clearly identify the carbon footprint of the development after each stage of the energy hierarchy. Regulated emissions must be provided and, separately, those emissions associated with uses not covered by Building Regulations i.e. unregulated energy uses.

London Plan sets a zero-carbon target for residential units. 'Zero carbon' homes are homes forming part of major development applications which achieve at least a 35 per cent reduction in regulated carbon dioxide emissions (beyond Part L 2013) on-site. The remaining regulated carbon dioxide emissions, to 100 per cent, are to be off-set through a cash in lieu contribution to the borough to be ring fenced to secure delivery of carbon dioxide savings elsewhere.

The following sections indicate the performance of the extension flats in relation to the London Plan carbon reduction target set by GLA for major developments.

# 4.5 BE LEAN – DEMAND REDUCTION

Be Lean measures is the first stage of the Energy Hierarchy where energy demand of the building is reduced through architectural and building fabric measures (passive design) and energy efficient services (active design). Be Lean measures should demonstrate the extent to which the energy demand meets or exceeds Building Regulations. The following sections demonstrate how the proposed development will achieve energy and  $CO_2$  emissions reduction over the baseline emissions.

Given that the existing buildings are Grade II listed, only passive design measures, considered technically possible and financial viable without having any negative impact on the historic character of the scheme, are proposed.



#### **PASSIVE DESIGN**

Passive design measures, including optimising orientation and site layout, natural ventilation and lighting, thermal mass and solar shading.

This will be achieved through:

- **Building Orientation:** The building's orientation is largely dictated by the shape of the site and the location of the existing listed buildings. The main façade of the building is facing south;
- **Passive Solar Design and Daylight:** Internal layouts have been set out to maximise the number of habitable rooms that can take advantage of solar gain and natural light;
- **Thermal performance of the fabric:** the existing building fabric will be thermally upgraded in line with the minimum requirements set in the Part L. The new extension will exceed those standards in terms of U-values thus reducing heating demand;
- **High performance windows:** Where possible, single glazed windows will be replaced with double glazed units. High performance windows of low U-value will be installed in the new extension;
- **Thermal bridging**: Accredited Construction Details will be used in the rear extension to minimise the impact of thermal bridging thus reducing heat losses further;
- **Air-tightness**: Using enhanced construction skills and rigorous detailing to reduce the air permeability of the new extension and, therefore, eliminate heat losses through infiltration.

Table 5 below shows initial assumptions on building fabric specifications including air permeability. These will be thoroughly reviewed by the design team at later stage.

<b>Building Fabric</b>	U-value	Wall	0.18 – New built elements
	[W/m <sup>2</sup> K]		0.30 – Upgraded existing elements
		Floor	0.15 – New built elements
			0.25 – Upgraded existing elements
		Roof	0.15 – New built elements
		Windows	1.60 – Double glazing (g-value: 0.63)
			4.80 – Single glazing (g-value: 0.85)
		Doors	1.00 – New fittings
	Air perme	ability	4 m <sup>3</sup> /m <sup>2</sup> hr @50Pa (New extension only)
	Thermal B	ridging	Accredited Construction Details and high-performance lintel (psi-
			value < 0.05) will be used to eliminate thermal bridging
			(New extension only)

Table 5 Proposed building fabric specifications

Achieving the above values will reduce the energy demand of the development in advance of adding any active energy efficiency measures or renewable energy systems to the development.



#### ACTIVE DESIGN

After reducing the energy demand of the development, the next stage would be to use energy efficient building services, lighting and controls throughout the scheme to reduce fuel consumption. Our proposed energy strategy includes the following:

- Heating & Hot Water: Individual gas-fired condensing combi boilers of high efficiency are proposed for each unit;
- **Ventilation:** All residential units will be naturally ventilated with intermittent extract fans in the kitchen and bathroom;
- Lighting: All light fittings will be dedicated low energy types i.e. either LED or fluorescent.

 Table 6 Proposed building services systems

HVAC Systems	Heating System	All units will feature individual gas-fired condensing combi boilers with automatic ignition of 89.6% efficiency (e.g. Worcester Greenstar 25i)	
	Heating Controls	Time and temperature zone control	
		Weather Compensator	
	Ventilation	Intermittent extract only fans in kitchens and bathrooms	
	Comfort Cooling	Not provided	
	Water	Dwellings designed to achieve a water use target less than 105	
	consumption	litres/person/day	
Lighting	Installed lighting	All light fittings are dedicated low energy types i.e. LED lighting	

After implementing all the passive and active energy efficiency measures listed in the above sections, the regulated carbon dioxide emissions of the proposed scheme are reduced by 41.2% in comparison to the GLA baseline emission rate.

Table 7 Carbon Dioxide emissions (Be Lean stage)

64-65 Guilfe	ord Street	Regulated Carbon dioxide emissions (Tonnes CO <sub>2</sub> per annum)
Baseline Em	nission Rate	34.5
Be Lean After energy demand reduction		20.3
Carbon savi	ngs	14.2
Reduction		41.2%

Subsequently, the reduction in Fabric Energy Efficiency for the new extension is 14.4%, as the following table demonstrates.

#### Table 8 Fabric Energy Efficiency Rate

64-65 Guilford Street	Fabric Energy Efficiency (kWh per m <sup>2</sup> per annum)
Part L1A Target Fabric Energy Efficiency (TFEE) Rate	68.1
New Extension Dwelling Fabric Energy Efficiency (DFEE) Rate	58.3
Reduction	14.4%



# 4.6 NON-REGULATED ENERGY USE

The London Plan (March 2016) requires that the energy demand and carbon dioxide emissions of the non-regulated end uses should also be calculated and reported in the energy assessments. In accordance with the BRE calculation procedure for estimating the non-regulated carbon emissions, the carbon emissions from appliances and cooking for all dwellings are approximately 16.5 tonnes per year.

The following strategies are proposed to reduce the non-regulated energy demand of the development:

- A-rated appliances: The kitchens will be fitted out with highly efficient A-rated appliances or alternatively information about high efficiency units will be provided to future owners;
- Installation of energy meters with display monitors for each flat. This will encourage the occupants to become more interested and involved in how energy is being used in their flat;
- Information will be provided to occupants which will explain the operations of the installed systems and how energy efficient behaviour can reduce the cost/carbon emissions of the development.

It is estimated that proposed strategies may reduce the unregulated carbon emission by at least 10%. However, at this stage, this can only be an assumption as small power consumption depends mainly on occupant's behaviour.



# 4.7 BE CLEAN – SUPPLYING LOW CARBON ENERGY

In accordance with the Energy Hierarchy of London Plan 2016, connection to existing district heat networks, site wide Combined Heat and Power (CHP) and incorporation of CHP in the buildings has been considered for the scheme.

#### DISTRICT ENERGY NETWORK

In response to the second tier of the Energy Hierarchy and the GLA's requirement that developments seek to connect to optimise energy supply, a preliminary investigation into the adjacent heat loads and infrastructure has been undertaken. According to the London Heat Map and Camden Energy Networks Map, there is no district heating network in close proximity available currently. Therefore, given also the size and scale of the proposed scheme, connection to a district energy network is not considered feasible.

#### COMBINED HEAT AND POWER (CHP)

As there is not a viable source of heat that the development could connect to, the appropriateness of installing a Combined Heat and Power (CHP) engine within a communal heating system for the proposed development has been considered.

As CHP usually has significantly higher capital cost compared to conventional gas fired boilers, to maximise its efficiency it is it is important that the CHP plant operates for as many hours as possible and matches closely the base heat so that the generated heat is not wasted. Given the proposed number of units i.e. 18 No 1-Bed flats, the annual demand for space heating and domestic hot water for the scheme is expected to be low and variable throughout the year.

There are Micro CHP units available in the market that can serve development of this scale but their numbers are very limited. Also, the on-site performance of such Micro CHP units is not considered as reliable as that of larger CHP units and they are generally less efficient. According to GLA guidance, a higher number of flats is required to justify installation of a CHP unit in a residential building. For these reasons, a CHP led heating and hot water system is not recommended for the development. Instead, individual gas-fired condensing boilers of high efficiency are proposed for the residential units.



# 4.8 BE GREEN- RENEWABLE ENERGY TECHNOLOGIES

In order to further reduce emissions from the development in accordance with the local authority policies and London Plan Energy Hierarchy, it is necessary to consider the introduction of renewable energy systems on site.

A high-level assessment of the following renewable technologies was carried out as part of the feasibility study:

- Biomass Boilers;
- Wind Turbines;
- Heat Pumps (Ground/Water/Air);
- Solar Hot Water Heating (SHWH);
- Photovoltaics.

The following section summarises the findings of the renewable energy feasibility study carried out for the scheme:

#### **BIOMASS BOILER**

A biomass boiler works effectively against a consistent heating load, however, adequate space dedicated for storing the fuel is required. Within inner London areas, there are concerns about the effect of small scale biomass systems on air-quality particularly with respect to particulates released through the boiler flue. For this reason, we would not recommend a biomass boiler for this development.

#### WIND TURBINES

Wind turbines' performance in urban areas is normally not very good and unpredictable due to turbulences on air movement caused by the surrounding built environment. Wind turbines may also raise issues due to noise disturbance and their visual impact, especially for a listed building located within a conservation area. Therefore, this technology is not suitable for this scheme.

#### **GROUND SOURCE HEAT PUMP**

Ground source heat pumps with a closed underground loop borehole system take advantage of the constant temperature of the ground to extract heat during winter and transfer it indoors. However, given that the heating demand for this development is low, the cost of installing a ground source heat pump to an existing building would not make this system financially viable. Therefore, given that a ground source system would be complex, technically risky, costly and deliver limited carbon emissions savings, we would therefore not recommend this approach for the development.



#### **AIR SOURCE HEAT PUMP**

Air-source or aerothermal heat-pumps work on the same principals as a ground-source heating system but extract heat or coolth from the air. ASHPs perform better when connected to an underfloor heating system that requires lower water temperature. They also have low maintenance costs and they are simple to install compared to a GSHP. However, they tend to drop their efficiencies when ambient air temperature is low during wintertime as there is no heat to absorb. This combined with the fact that they consume electricity which is a more carbon intensive fuel compared to gas, can increase the carbon emissions of the scheme. Finally, the condenser units, which need to be located externally, would have a negative impact on the aesthetics of the building and the surrounding conservation area. For these reasons, we would not recommend ASHPs for this development.

#### SOLAR THERMAL PANELS/ PHOTOVOLTAIC (PV) PANELS

Both solar thermal panels and photovoltaic panels can work well on residential developments, making use of solar energy to provide hot water or electricity generated on site respectively.

However, given that the existing buildings are Grade II listed and located within a conservation area, both technologies would have a negative impact on the aesthetics of the surrounding neighbourhood and the historic character of the scheme. In addition, the roof of the new-extension, where panels could be installed, is heavily overshadowed by the existing buildings located on the south side of the site. Therefore, we would not recommend any renewable energy technology for the proposed scheme.



## 5. CONCLUSION

This Energy Statement outlines the key features and strategies adopted by the development team to reduce energy use and carbon emissions for the scheme and demonstrate compliance with the London Plan and the London Borough of Camden Climate Change Mitigation and Adaptation Policies.

The following passive and active energy efficiency features have been considered in the proposed strategy for 64-65 Guilford Street:

- The existing building fabric will be thermally upgraded in line with the Part L standards in terms of U-values to reduce heating demand;
- The new built extensions will be well insulated thus achieving low U-values that exceed the minimum Part L requirements;
- Accredited Construction Details will be used in the extension to eliminate thermal bridging and a low air tightness rate will be achieved to reduce heat losses further;
- Individual gas-fired condensing combi boilers of high efficiency will provide heating to the new extension
- Light fittings will be of low energy types i.e. LED lighting will be installed throughout the scheme.

Installation of CHP or other LZC and renewable technologies solutions has been investigated but were not feasible for this development.

Following the proposed energy strategy, the proposal achieves significant carbon savings that exceed the 35% reduction target over the Baseline Emission Rate set by the London Plan, i.e. CO<sub>2</sub> emissions of the un refurbished, existing building for the refurbished elements and Part L1A Target Emission Rate (TER) for the new build elements.

Due to the historic nature of the building (Grade II listed) and location and other restrictions such as area, access and existing site constraints, it is too onerous to complete a BREEAM assessment and achieve the relevant ratings. Sustainability measures such as addressing overheating, specifying low embodied materials, sourcing materials responsibly and specifying low water use fittings have been incorporated as far as feasible as described in section 3.4.



Table 9 below demonstrates the overall reduction in the regulated and unregulated carbon emissions of the development after each stage of the London Plan Energy Hierarchy.

Table 9 Total CO<sub>2</sub> emissions from each stage of the Energy Hierarchy

64-65 Guilfo	ord Street		ide emissions 2 per annum)
		Regulated	Unregulated
Baseline Em	iission Rate	34.5	16.5
Be Lean	After energy demand reduction	20.3	14.8
Be Clean	After heat network/CHP	20.3	14.8
Be Green	After renewable energy	20.3	14.8

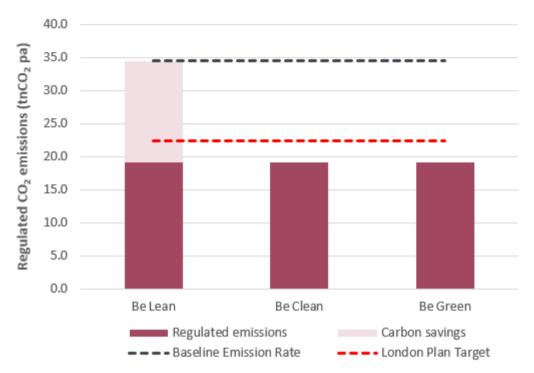
Table 10 demonstrates the total regulated CO<sub>2</sub> savings from each stage of the Energy Hierarchy. An overall reduction of 41.2% in regulated carbon emissions can be achieved over the baseline emission rate set by GLA when applying the proposed strategy, which exceeds the 35% reduction required by the London Plan.

Table 10 Total CO2 savings from each stage of the Energy Hierarchy

64-65 Guilford Street	Regulated carbon d	ioxide savings
	(Tonnes CO <sub>2</sub> per annum)	(%)
Savings from energy demand reduction	14.2	41.2%
Savings from CHP	0.0	0.0%
Savings from renewable energy	0.0	0.0%
Cumulative on-site savings	14.2	41.2%
Total Target Savings	12.1	35.0%
Annual Surplus	2.1	

Figure 6 illustrates the carbon savings achieved for the 64-65 Guilford Street scheme over the Baseline Emission Rate at each stage of the London Plan's Energy Hierarchy. Due to the energy efficiency measures applied to the scheme the achieved reduction exceeds the carbon reduction target as set in the London Plan.





London Plan Energy Hierarchy and Targets

Figure 6 Total carbon savings achieved over Baseline Emissions



## APPENDIX A DER WORKSHEET OF TYPICAL EXISTING UNIT

**APPENDICES** P18-078/Issue 03/04 June 2018



(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

			User	Details:						
Assessor Name:	Panagiotis Da	lapas		Strom	a Num	ber:		STRO	030082	
Software Name:	Stroma FSAP	•		Softwa					n: 1.0.4.14	
			Propert	y Addres	s: No 6	5-Plot 7-	Existing			
Address :	Plot 7, 65 Guilfo	ord Street, W	/C1N 1D	D			Ŭ			
1. Overall dwelling dimer	nsions:									
			Area	a(m²)		Av. He	ight(m)		Volume(m <sup>;</sup>	3)
Ground floor			4	0.26	(1a) x	2	.61	(2a) =	105.08	(3a)
Total floor area TFA = (1a	a)+(1b)+(1c)+(1d)	+(1e)+(1r	n) 4	0.26	(4)					
Dwelling volume					(3a)+(3b	)+(3c)+(3d	)+(3e)+	.(3n) =	105.08	(5)
2. Ventilation rate:								-		
	main heating	seconda heating	у	other		total			m³ per hou	ır
Number of chimneys		+ 0	] + [	0	=	0	x 4	40 =	0	(6a)
Number of open flues	0	+ 0	_ + _	0	] = [	0	x 2	20 =	0	(6b)
Number of intermittent far	ns				Ī	2	<b>x</b> 1	10 =	20	(7a)
Number of passive vents					Γ	0	x 1	0 =	0	(7b)
Number of flueless gas fir	es				Γ	0	x 4	40 =	0	(7c)
					L					
								Air ch	anges per ho	our
Infiltration due to chimney						20		÷ (5) =	0.19	(8)
If a pressurisation test has be		tended, procee	d to (17), (	otherwise o	ontinue fi	rom (9) to (	16)			
Number of storeys in th	e dwelling (ns)								0	(9)
Additional infiltration							[(9)-	-1]x0.1 =	0	(10)
Structural infiltration: 0.2					•	ruction		l	0	(11)
if both types of wall are pre deducting areas of opening			o the great	er wall are	a (after					
If suspended wooden fl			.1 (seale	ed), else	enter 0			[	0	(12)
If no draught lobby, ent	er 0.05, else ente	er O						ļ	0	(13)
Percentage of windows	and doors draug	ht stripped						l	0	(14)
Window infiltration	0			0.25 - [0.2	x (14) ÷ 1	100] =		ļ	0	(15)
Infiltration rate				(8) + (10)	+ (11) + ('	12) + (13) -	⊦ (15) =	l I	0	(16)
Air permeability value, o	n50 expressed in	cubic metre	s per ho	our per se	ouare m	netre of e	nvelope	area	15	(17)
If based on air permeabilit			•	•	•				0.94	(18)
Air permeability value applies	-					is being us	sed	l	0.94	(10)
Number of sides sheltered					,	0		[	3	(19)
Shelter factor				(20) = 1 -	0.075 x (	19)] =			0.78	(20)
Infiltration rate incorporati	ng shelter factor			(21) = (18)	x (20) =			ĺ	0.73	(21)
Infiltration rate modified for	or monthly wind s	peed						ľ	-	
Jan Feb	Mar Apr N	/lay Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind spe	eed from Table 7									
(22)m= 5.1 5	4.9 4.4 4	.3 3.8	3.8	3.7	4	4.3	4.5	4.7		
Wind Factor (22a)m = (22	?)m ∸ 4									



Mecserve Ltd Panagiotis Dalapas 020 3141 5800 DER WorkSheet: New dwelling created by change of use

Adjust	ed infiltr	ation rat	e (allow	ing for sh	nelter an	d wind s	peed) =	(21a) x	(22a)m					
	0.93	0.91	0.89	0.8	0.78	0.69	0.69	0.67	0.73	0.78	0.82	0.86		
		<i>ctive air</i> al ventila	-	rate for t	he appli	cable ca	se				-	-		
				ondix N (2	(2b) = (22c)	) x Emy (c	austion (N	N5)) , othei	nuico (22b	) = (22a)			0	(23a)
								n Table 4h)		) – (238)			0	(23b)
			-	-	_					<b>)</b>   , )  ,	006)	1 (00-)	0	(23c)
		i	i	1	i	<b>I</b>	r		ŕ	, ,	r	1 – (23c)	÷100]	(24a)
(24a)m=		0	0	0	0	0	0	0	0	0	0	0		(24d)
	r	r	r	r	r	r		ИV) (24b	, ,	, ,	<u>,</u>			(24b)
(24b)m=		0	0	0	0	0	0	0	0	0	0	0		(24b)
,					•	•		on from c c) = (22b		5 v (23h	.)			
(24c)m=	<u> </u>				$\frac{0}{0} = \frac{200}{200}$			0 = (22k)	0		,, 0	0		(24c)
		ventilativ	n or wh		<u> </u>		Ventilatio	on from I	oft	-		-		
,						•		0.5 + [(2		0.5]				
(24d)m=	0.93	0.91	0.9	0.82	0.81	0.74	0.74	0.73	0.77	0.81	0.84	0.87		(24d)
Effe	ctive air	change	rate - er	nter (24a	ı) or (24t	o) or (24	c) or (24	d) in box	(25)					
(25)m=	0.93	0.91	0.9	0.82	0.81	0.74	0.74	0.73	0.77	0.81	0.84	0.87		(25)
0.11-	atlasas								· · · · · ·					
		s and ne Gros		paramete Oponin		Net Ar	<u></u>	U-valı	10	AXU		k-value	、 /	A X k
ELEN	IENT	area		Openin m	-	A,r		W/m2		(W/I	K)	kJ/m <sup>2</sup> ·ł		J/K
Doors						2	x	3	=	6				(26)
Windo	ws Type	e 1				1.67	x1.	/[1/( 4.8 )+	0.04] =	6.72	=			(27)
Windo	ws Type	2				2.51	x1.	/[1/( 4.8 )+	0.04] =	10.11	=			(27)
Walls <sup>-</sup>	Type1	25.1	3	7.52	2	17.61	x	2.1	= [	36.98	_ آ			(29)
Walls <sup>-</sup>	Type2	19.	5	2		17.5	×	1.23		21.44			$\exists$	(29)
Total a	area of e	lements	, m²			44.63	3		L		J L			(31)
				effective wi	indow U-va			formula 1,	/[(1/U-valu	e)+0.04] a	as given in	paragraph	3.2	
** incluc	le the area	as on both	sides of in	nternal wal	ls and par	titions								
Fabric	heat los	ss, W/K :	= S (A x	U)				(26)(30)	+ (32) =				94.7	(33)
Heat c	apacity	Cm = S(	(A x k )						((28)	.(30) + (32	2) + (32a).	(32e) =	315.99	(34)
Therm	al mass	parame	ter (TMI	<sup>-</sup> = Cm <del>-</del>	÷ TFA) ir	n kJ/m²K			Indica	tive Value	: Medium		250	(35)
	•	sments wh ad of a de			construct	ion are not	t known pr	ecisely the	e indicative	values of	TMP in T	able 1f		
					using Ap	pendix ł	<						6.69	(36)
	-			nown (36) =	• •	•						I	0.00	()
	abric he			( )	·	,			(33) +	(36) =			101.4	(37)
Ventila	ation hea	at loss ca	alculated	d monthly	у				(38)m	= 0.33 × (	25)m x (5	)	-	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(38)m=	32.31	31.73	31.16	28.48	27.98	25.65	25.65	25.22	26.55	27.98	28.99	30.05		(38)
Heat ti	ransfer o	coefficier	nt, W/K						(39)m	= (37) + (3	38)m			
(39)m=	133.71	133.12	132.55	129.88	129.38	127.05	127.05	126.62	127.94	129.38	130.39	131.45		
	<b>I</b>								/	Average =	Sum(39)	12 /12=	129.88	(39)



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Heat loss para	ameter (H	HLP), W	/m²K					(40)m	= (39)m ÷	· (4)			
(40)m= 3.32	3.31	3.29	3.23	3.21	3.16	3.16	3.14	3.18	3.21	3.24	3.27		
		<u>ا</u>							Average =	Sum(40)1	.12 /12=	3.23	(40)
Number of day	1	· · ·	, ,			1.1	A	0.00	0.4	Neur			
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 requ	irement:								kWh/ye	ar:	
Assumed occu if TFA > 13. if TFA £ 13.	9, N = 1		: [1 - exp	(-0.0003	849 x (TF	FA -13.9	)2)] + 0.(	0013 x ( <sup>-</sup>	TFA -13.	<u>1.</u> .9)	41		(42)
Annual average Reduce the annuation of more that 125	al average	hot water	usage by	5% if the a	welling is	designed			se target o	71 f	.33		(43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage i			· ·	,				0ep			Dec		
(44)m= 78.46	75.61	72.76	69.9	67.05	64.2	64.2	67.05	69.9	72.76	75.61	78.46		
(44)112 70.40	70.01	12.10	00.0	07.00	04.2	04.2	07.00		I	m(44) <sub>112</sub> =		855.98	(44)
Energy content of	f hot water	used - ca	lculated mo	onthly $= 4$ .	190 x Vd,r	n x nm x E	0Tm / 3600					000.00	
(45)m= 116.36	101.77	105.02	91.56	87.85	75.81	70.25	80.61	81.57	95.07	103.77	112.69		
lf instantaneous v	vater heati	ng at point	t of use (no	hot water	· storage),	enter 0 in	boxes (46		Total = Su	m(45) <sub>112</sub> =		1122.32	(45)
(46)m= 17.45	15.27	15.75	13.73	13.18	11.37	10.54	12.09	12.24	14.26	15.57	16.9		(46)
Water storage	loss:												
Storage volum	ne (litres)	) includir	ng any so	olar or W	/WHRS	storage	within sa	ame ves	sel	(	C		(47)
If community h	•			•			· ,						
Otherwise if no		hot wate	er (this ir	icludes i	nstantar	neous co	mbi boil	ers) ente	er '0' in (	47)			
Water storage			ft-			· / -   - · · ) ·							
a) If manufact				or is kno	wn (kvvr	1/day):					2		(48)
Temperature f										(	2		(49)
Energy lost fro		-	•		or ic not		(48) x (49)	) =		(	C		(50)
Hot water stor											D C		(51)
If community h	-			(		- , ,				`			(01)
Volume factor	from Ta	ble 2a								(	D C		(52)
Temperature f	actor fro	m Table	2b							(	C		(53)
Energy lost fro	om watei	r storage	e, kWh/y€	ear			(47) x (51)	) x (52) x (	53) =		<u> </u>		(54)
Enter (50) or	(54) in (5	55)								(	)		(55)
Water storage	loss cal	culated	for each	month			((56)m = (	55) × (41)	m				
(56)m= 0	0	0	0	0	0	0	0	0	0	0	0		(56)
If cylinder contain	s dedicate	d solar sto	nage, (57)	n = (56)m	x [(50) – (	H11)] ÷ (5	0), else (5	7)m = (56)	m where (	H11) is fro	m Appendi	хH	
(57)m= 0	0	0	0	0	0	0	0	0	0	0	0		(57)
Primary circuit	t loss (ar	nual) fro	om Table	e 3							 C		(58)
Primary circuit					59)m = (	(58) ÷ 36	65 × (41)	m		L			-
(modified by				,		• •	• • •		r thermo	stat)			
(59)m= 0	0	0	0	0	0	0	0	0	0	0	0		(59)



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Combi	loss ca	lculated	for each	month (	(61)m =	(60) ÷ 36	65 × (41)	)m						
(61)m=	39.98	34.8	37.08	34.47	34.17	31.66	32.71	34.17	34.47	37.08	37.29	39.98		(61)
Total h	neat requ	uired for	water he	eating ca	alculated	for eacl	h month	(62)m =	0.85 × (	45)m +	(46)m +	(57)m +	(59)m + (61)m	
(62)m=	156.35	136.57	142.09	126.03	122.02	107.47	102.96	114.78	116.05	132.14	141.06	152.67		(62)
Solar DI	IW input o	calculated	using App	endix G or	Appendix	H (negati	ve quantity	/) (enter '0	' if no sola	r contributi	on to wate	er heating)		
(add a	dditiona	l lines if	FGHRS	and/or V	WWHRS	applies	, see Ap	pendix C	<del>3</del> )					
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0		(63)
Output	t from wa	ater hea	ter											
(64)m=	156.35	136.57	142.09	126.03	122.02	107.47	102.96	114.78	116.05	132.14	141.06	152.67		
								Outp	out from wa	ater heatei	(annual)₁	12	1550.2	(64)
Heat g	ains froi	m water	heating,	kWh/mo	onth 0.2	5 ´ [0.85	× (45)m	+ (61)m	n] + 0.8 x	c [(46)m	+ (57)m	+ (59)m	]	
(65)m=	48.69	42.54	44.19	39.06	37.75	33.12	31.54	35.35	35.74	40.88	43.83	47.47		(65)
inclu	ıde (57)ı	m in calo	culation of	of (65)m	only if c	ylinder is	s in the o	dwelling	or hot w	ater is fr	om com	munity h	eating	
5. In	ternal ga	ains (see	e Table 5	and 5a	):									
Metab	olic gain	s (Table	e 5), Wat	ts										
motab	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(66)m=	70.66	70.66	70.66	70.66	70.66	70.66	70.66	70.66	70.66	70.66	70.66	70.66		(66)
Lightin	g gains	(calcula	ted in Ap	pendix	L, equati	ion L9 oi	r L9a), a	lso see	Table 5					
(67)m=	16.86	14.97	. 12.18	9.22	6.89	5.82	6.29	8.17	10.97	13.93	16.25	17.33		(67)
Applia	nces dai	ins (calc	ulated ir	Append	dix L. ea	uation L <sup>-</sup>	13 or L1	3a), also	see Ta	ble 5				
(68)m=	122.19	123.46	120.26	113.46	104.87	96.8	91.41	90.14	93.34	100.14	108.73	116.8		(68)
Cookir	na aains	(calcula	ted in A	opendix	L. equat	ion L15	or L15a	), also se	e Table	5				
(69)m=	30.07	30.07	30.07	30.07	30.07	30.07	30.07	30.07	30.07	30.07	30.07	30.07		(69)
Pumps	and far	ns gains	ر (Table t	5a)										
(70)m=	10	10	10	10	10	10	10	10	10	10	10	10		(70)
	se.a. ev	aporatio	n (nega	tive valu	es) (Tab	le 5)								
	-56.53		<u> </u>	-56.53	-56.53	-56.53	-56.53	-56.53	-56.53	-56.53	-56.53	-56.53		(71)
		gains (T												
(72)m=	65.44	63.3	59.39	54.25	50.74	46	42.39	47.51	49.64	54.94	60.87	63.8		(72)
	nternal	gains =				(66)		l 1 + (68)m +	- (69)m + (	(70)m + (7	1)m + (72)	m		
(73)m=	258.68	255.93	246.03	231.13	216.71	202.82	194.28	200.02	208.15	223.21	240.05	252.12		(73)
	lar gains													
			using sola	r flux from	Table 6a	and assoc	iated equa	tions to co	nvert to th	e applicab	le orientat	ion.		

Orientat	tion:	Access Facto Table 6d	r	Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.54	x	2.51	x	10.63	×	0.85	x	0.7	=	7.72	(74)
North	0.9x	0.54	x	2.51	x	20.32	x	0.85	x	0.7	=	14.75	(74)
North	0.9x	0.54	x	2.51	x	34.53	x	0.85	x	0.7	=	25.06	(74)
North	0.9x	0.54	x	2.51	x	55.46	x	0.85	x	0.7	=	40.26	(74)
North	0.9x	0.54	x	2.51	x	74.72	x	0.85	x	0.7	=	54.23	(74)



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North	0.9x	0.54		x	2.5	1	x	7	9.99	x		0.85	x	0.7		=	58.05	(74)
North	0.9x	0.54		x	2.5	1	x	7	4.68	x		0.85	x	0.7		=	54.2	(74)
North	0.9x	0.54		x	2.5	1	x	5	9.25	x		0.85	x	0.7		=	43	(74)
North	0.9x	0.54		x	2.5	1	x	4	1.52	x		0.85	x	0.7		=	30.13	(74)
North	0.9x	0.54		x	2.5	1	x	2	4.19	x		0.85	x	0.7		=	17.56	(74)
North	0.9x	0.54		x	2.5	1	x	1	3.12	x		0.85	x	0.7		=	9.52	(74)
North	0.9x	0.54		x	2.5	1	x		8.86	x		0.85	×	0.7		=	6.43	(74)
South	0.9x	0.54	_	x	1.6	7	x	4	6.75	x		0.85	×	0.7		=	67.73	(78)
South	0.9x	0.54		x	1.6	7	x	7	6.57	x		0.85	x	0.7		=	110.93	(78)
South	0.9x	0.54		x	1.6	7	×	9	7.53	x		0.85	x	0.7		=	141.3	(78)
South	0.9x	0.54		x	1.6	7	x	1	10.23	x		0.85	x	0.7		=	159.7	(78)
South	0.9x	0.54		x	1.6	7	x	1	14.87	x		0.85	×	0.7		=	166.42	(78)
South	0.9x	0.54		x	1.6	7	x	1	10.55	x		0.85	×	0.7		=	160.16	(78)
South	0.9x	0.54		x	1.6	7	x	10	08.01	x		0.85	×	0.7		=	156.48	(78)
South	0.9x	0.54		x	1.6	7	x	10	04.89	x		0.85	×	0.7		=	151.97	(78)
South	0.9x	0.54		x	1.6	7	x	1(	01.89	x		0.85	×	0.7		=	147.61	(78)
South	0.9x	0.54		x	1.6	7	x	8	2.59	x		0.85	x	0.7		=	119.65	(78)
South	0.9x	0.54		x	1.6	7	x	5	5.42	x		0.85	x	0.7		=	80.29	(78)
South	0.9x	0.54		x	1.6	7	x	4	40.4	x		0.85	x	0.7		=	58.53	(78)
Solar g	gains in	watts, ca	alculat	ted	for eacl	n mon	th			(83)m	n = Su	m(74)m .	(82)m					
(83)m=	75.45	125.68	166.3	36	199.96	220.6	5 2	18.21	210.68	194	.97	177.74	137.2	89.81	64.	.96		(83)
Total g	jains – i	nternal a	and so	olar	(84)m =	= (73)n	n + (	83)m	, watts									
(84)m=	334.13	381.61	412.3	39	431.09	437.3	5 4	21.03	404.97	394	.99	385.89	360.4	1 329.86	317	7.08		(84)
7. Me	an inter	rnal temp	oeratu	re (	heating	seaso	on)											
Temp	erature	during h	eating	g pe	eriods ir	n the li	ving	area f	from Tab	ole 9	, Th1	(°C)					21	(85)
Utilisa	ation fac	ctor for g	ains fo	or liv	ving are	a, h1,	m (s	ee Ta	ble 9a)									
	Jan	Feb	Ma	ar	Apr	Ма	y	Jun	Jul	Α	ug	Sep	Oct	Nov	D	ec		
(86)m=	0.99	0.99	0.98	3	0.97	0.94		0.89	0.82	0.8	33	0.92	0.97	0.99	0.9	99		(86)
Mean	interna	l temper	ature	in li	ving are	ea T1	(follo	ow ste	ps 3 to 7	' in T	able	9c)						
(87)m=	17.82	18.04	18.4	_	19.05	19.66	<u>`                                    </u>	20.25	20.61	20.		20.1	19.31	18.49	17.	.81		(87)
Temp	erature	during h	eatin	a ne	eriods in	n rest o	n dv	/ellina	from Ta	ble (	 9 Th	 2 (°ር.)		-1	1		I	
(88)m=	19.34	19.35	19.3	<u> </u>	19.39	19.39	_	19.42	19.42	19.		19.41	19.39	19.38	19.	.37		(88)
		1														-		
(89)m=	0.99	otor for g	0.97	-	0.96	veiiing 0.92	_	,m (se 0.83	0.67	9a) 0.1	7	0.87	0.96	0.98	0.9	00		(89)
		1										I		0.98	0.3	99		(00)
		I temper		-					i	<u> </u>		i			1		I	()
(90)m=	16.53	16.75	17.1	7	17.78	18.39		18.97	19.27	19.	25	18.83	18.05			.54		(90)
												fl	LA = Liv	ving area ÷	(4) =		0.52	(91)
Mean	interna	l temper	ature	(for	the wh	ole dw	ellin	g) = fl	LA x T1	+ (1	– fL/	A) × T2						
(92)m=	17.2	17.43	17.8	4	18.44	19.05	1	19.64	19.97	19.	94	19.49	18.71	17.88	17	.2		(92)
Annh					internel	toma	a roti	uro fro	m Toblo	4.0			prioto	•				

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



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(93)m=	17.2	17.43	17.84	18.44	19.05	19.64	19.97	19.94	19.49	18.71	17.88	17.2		(93)
8. Spa	ace hea	ting requ	uirement											
			ernal ter or gains			ed at ste	ep 11 of	Table 9b	o, so tha	t Ti,m=(	76)m an	d re-calc	ulate	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisa	ation fac	tor for g	ains, hm	1:										
(94)m=	0.98	0.98	0.97	0.95	0.91	0.84	0.73	0.76	0.88	0.95	0.98	0.99		(94)
	<u> </u>	· · · · · ·	, W = (94	ŕ	ŕ		r				r			
(95)m=	328.82	373.01	398.91	409.02	399.27	354.2	296.09	298.26	338.8	342.52	322.35	312.67		(95)
	<u> </u>	<u> </u>	ernal tem	i i			10.0			40.0	- 4			(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 (97)m=		i	an intern 1503.26	· · · ·	951.33	∟m,vv = 640.62	=[(39)m 2 428.22	x [(93)m- 447.76	– (96)m 690.18	] 1049.18	1406.11	1709.35		(97)
								24 x [(97)				1709.55		(07)
(98)m=	1039.1	870 870	821.64	597.84	410.74	0	11 = 0.02	0	0	525.76	780.31	1039.13		
(00)11-	100011	010	021.01	001.01			Ŭ	-	-		) = Sum(9	L	6084.5	(98)
0				1.14/1- /				1010		(RVIII) your	) – Oum(o	<b>C</b> )15,912 <b>–</b>		]
		• •	ement in		•							l	151.13	(99)
			nts – Indi	ividual h	eating sy	ystems i	ncluding	micro-C	HP)					
-	e heatir	-	at from s	econdar	v/supple	montary	system					1	0	(201)
	-					mentary	-	(202) - 1	(201) -			l	0	l`´´
	-		at from m	-	. ,			(202) = 1 -		(000)]		ļ	1	(202)
			ng from	-				(204) = (20	02) × [1 – )	(203)] =		ļ	1	(204)
Efficie	ency of I	main spa	ace heat	ing syste	em 1								84	(206)
Efficie	ency of s	seconda	ry/suppl	ementar	y heating	g system	n, %						0	(208)
	Jan	Feb	Mar	Apr	Мау	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/yea	r
Space	e heatin	g require	ement (c	alculate	d above)	)	ſ			r	ſ	· · · · · ·		
	1039.1	870	821.64	597.84	410.74	0	0	0	0	525.76	780.31	1039.13		
(211)m	n = {[(98	)m x (20	4)] } x 1	00 ÷ (20	)6)									(211)
	1237.03	1035.71	978.14	711.71	488.97	0	0	0	0	625.9	928.94	1237.06		-
								Tota	l (kWh/yea	ar) =Sum(2	211) <sub>15,1012</sub>	=	7243.46	(211)
•		•	econdar		month									
	í – È	· · · ·	00 ÷ (20	, <u> </u>										
(215)m=	0	0	0	0	0	0	0	0 Toto	0	0	0	0		
								TOLA	г (күүп/уеа	ar) =5um(2	215) <sub>15,10</sub> 12	=	0	(215)
	heating		tor (oolo	مامدما ما										
Output	156.35	136.57	ter (calc 142.09	126.03	122.02	107.47	102.96	114.78	116.05	132.14	141.06	152.67		
Efficier		ater hea						-					75	(216)
(217)m=	82.7	82.65	82.54	82.28	81.75	75	75	75	75	82.02	82.48	82.73		(217)
			kWh/mo											. ,
		•	) ÷ (217)											
	189.05	165.23	172.15	153.17	149.25	143.29	137.28	153.04	154.73	161.1	171.01	184.55		_
								Tota	l = Sum(2 <sup>-</sup>	19a) <sub>112</sub> =			1933.87	(219)
	al totals									k	Wh/year		kWh/year	1
Space	heating	tuel use	ed, main	system	1								7243.46	J



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Water heating fuel used			1933.87
Electricity for pumps, fans and electric keep-hot			
central heating pump:		12	20 (230c)
boiler with a fan-assisted flue		4	5 (230e)
Total electricity for the above, kWh/year	sum of (230a	a)(230g) =	165 (231)
Electricity for lighting			297.73 (232)
12a. CO2 emissions – Individual heating systems	s including micro-CHP		
	<b>Energy</b> kWh/year	Emission factor kg CO2/kWh	<b>Emissions</b> kg CO2/year
Space heating (main system 1)	(211) x	0.216 =	1564.59 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	417.72 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1982.3 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	85.64 (267)
Electricity for lighting	(232) x	0.519 =	154.52 (268)
Total CO2, kg/year	sum	of (265)(271) =	2222.46 (272)
Dwelling CO2 Emission Rate	(272	e) ÷ (4) =	55.2 (273)
EI rating (section 14)			65 (274)



## APPENDIX B DER WORKSHEET OF TYPICAL REFURBISHED UNIT



(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

		Us	ser Details:						
Assessor Name: Software Name:	Panagiotis Dala Stroma FSAP 2		Strom Softwa					030082 n: 1.0.4.14	
		Prop	erty Addres	s: No 6	5-Plot 7-	Propose	d DG		
Address :	Plot 7, 65 Guilford	Street, WC1N	1DD						
1. Overall dwelling dimer	nsions:	-			A 11!			) / - I	
Ground floor		A	rea(m²)	(10)	Av. Hei		]( <sub>20</sub> ) [	Volume(m <sup>3</sup>	<i>.</i>
	· · · · · · · · · · · · · · · · · · ·			(1a) x	2.	61	(2a) =	105.08	(3a)
Total floor area TFA = (1a	i)+(1b)+(1c)+(1d)+(	1e)+(1n)	40.26	(4)					
Dwelling volume				(3a)+(3b	)+(3c)+(3d)	)+(3e)+	.(3n) =	105.08	(5)
2. Ventilation rate:									
	main heating	secondary heating	other		total			m <sup>3</sup> per hou	r
Number of chimneys	0 +	0 +	0	] = [	0	x 4	= 04	0	(6a)
Number of open flues	0 +	0 +	0	ī = Г	0	x 2	20 =	0	(6b)
Number of intermittent far	IS		L	- L	2	x 1	0 =	20	(7a)
Number of passive vents					0	x 1	0 =	0	(7b)
Number of flueless gas fir	es				0	x 4	10 = 01	0	(7c)
				L	0			0	(70)
							Air ch	anges per ho	bur
Infiltration due to chimney	s, flues and fans =	(6a)+(6b)+(7a)+(7b	o)+(7c) =	Г	20	-	÷ (5) =	0.19	(8)
If a pressurisation test has be	en carried out or is inter	nded, proceed to (1	7), otherwise o	continue fr	rom (9) to (	16)	L		
Number of storeys in th	e dwelling (ns)						[	0	(9)
Additional infiltration						[(9)-	1]x0.1 =	0	(10)
Structural infiltration: 0.2	25 for steel or timbe	er frame or 0.35	for mason	y constr	ruction		[	0	(11)
if both types of wall are pre deducting areas of opening		responding to the g	reater wall are	a (after					
If suspended wooden fl		ealed) or 0.1 (se	aled), else	enter 0			]	0	(12)
If no draught lobby, ent							ľ	0	(13)
Percentage of windows	and doors draught	stripped					ĺ	0	(14)
Window infiltration	-		0.25 - [0.2	x (14) ÷ 1	00] =		ĺ	0	(15)
Infiltration rate			(8) + (10)	+ (11) + (1	12) + (13) +	· (15) =	ľ	0	(16)
Air permeability value, o	50, expressed in c	ubic metres per	hour per s	quare m	etre of e	nvelope	area	15	(17)
If based on air permeabilit		•	•	•		•	l	0.94	(18)
Air permeability value applies	-				is being us	ed	L	0.01	
Number of sides sheltered	Ł						]	3	(19)
Shelter factor			(20) = 1 -	0.075 x (1	[9]] =			0.78	(20)
Infiltration rate incorporati	ng shelter factor		(21) = (18	) x (20) =			[	0.73	(21)
Infiltration rate modified for	or monthly wind spe	ed							
Jan Feb	Mar Apr Ma	y Jun Ju	I Aug	Sep	Oct	Nov	Dec		
Monthly average wind spe	eed from Table 7								
(22)m= 5.1 5	4.9 4.4 4.3	3.8 3.8	3.7	4	4.3	4.5	4.7		
Wind Factor (22a)m = (22	)m - 4								



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Adjust	ed infiltr	ation rat	e (allowi	ing for sł	nelter an	d wind s	speed) =	(21a) x	(22a)m					
	0.93	0.91	0.89	0.8	0.78	0.69	0.69	0.67	0.73	0.78	0.82	0.86		
			-	rate for t	he appli	cable ca	se						r	
		al ventila				. – .			. (22)				0	(23a)
			0 11		, (	, ,		N5)), othei		) = (23a)			0	(23b)
			-	-	-			n Table 4h)					0	(23c)
a) If	balance	ed mecha	anical ve	entilation	with he	at recove	ery (MVI	HR) (24a	a)m = (22	2b)m + (2	23b) × [′	1 – (23c)	÷ 100]	
(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24a)
b) If	balance	ed mecha	anical ve	entilation	without	heat rec	covery (N	MV) (24b	)m = (22	2b)m + (2	23b)	_		
(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24b)
					-	-		on from c c) = (22t		5 × (23b	<b>)</b> )			
(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24c)
,								on from l 0.5 + [(2		0.51	I		I	
(24d)m=	<u> </u>	0.91	0.9	0.82	0.81	0.74	0.74	0.73	0.77	0.81	0.84	0.87		(24d)
		L change	rate - er	i hter (24a	) or (24ł	1 a) or (24)	L c) or (24	d) in box	(25)				l	
(25)m=	0.93	0.91	0.9	0.82	0.81	0.74	0.74	0.73	0.77	0.81	0.84	0.87	1	(25)
()		1		1		1	•							
3. He	at losse	s and he	eat loss	paramete	er:									
ELEN	IENT	Gros area		Openin rr		Net Ar A ,r		U-valı W/m2		A X U (W/ł	≺)	k-value kJ/m²⊷ł		A X k kJ/K
Doors						2	x	1	=	2				(26)
Windo	ws Type	e 1				1.67	x1	/[1/( 1.6 )+	0.04] =	2.51				(27)
Windo	ws Type	e 2				2.51	x1	/[1/( 4.8 )+	0.04] =	10.11				(27)
Walls <sup>-</sup>	Type1	25.1	3	7.52	2	17.61	x	0.3		5.28	Ξ r			(29)
Walls -	Type2	19.	5	2		17.5	x	0.27		4.76	<b>-</b>		$\exists \vdash$	(29)
Total a	area of e	elements	, m²			44.63	3		เ					(31)
* for win	dows and	l roof wind	ows, use e	effective wi	ndow U-va	alue calcul	ated using	g formula 1,	/[(1/U-valu	e)+0.04] a	is given in	paragraph	3.2	
** inclua	le the area	as on both	sides of ir	nternal wal	ls and par	titions								
Fabric	heat los	ss, W/K :	= S (A x	U)				(26)(30)	) + (32) =				29.69	(33)
Heat c	apacity	Cm = S(	(Axk)						((28)	.(30) + (32	2) + (32a).	(32e) =	315.99	(34)
Therm	al mass	parame	ter (TMI	⊃ = Cm -	<del>:</del> TFA) ir	n kJ/m²K			Indica	tive Value:	Low		100	(35)
	0	sments wh ad of a de			construct	ion are noi	t known pr	ecisely the	e indicative	values of	TMP in Ta	able 1f		
Therm	al bridg	es : S (L	x Y) cal	culated	using Ap	pendix l	<						6.69	(36)
if details	of therma	al bridging	are not kr	nown (36) =	= 0.15 x (3	:1)								
Total f	abric he	at loss							(33) +	(36) =			36.38	(37)
Ventila	ation hea	at loss ca	alculated	d monthly	y				(38)m	= 0.33 × (	25)m x (5)	)		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(38)m=	32.31	31.73	31.16	28.48	27.98	25.65	25.65	25.22	26.55	27.98	28.99	30.05		(38)
Heat tr	ransfer o	coefficie	nt, W/K						(39)m	= (37) + (3	38)m			
(39)m=	68.69	68.11	67.54	64.86	64.36	62.03	62.03	61.6	62.93	64.36	65.37	66.43		
										Average =	Sum(39)1	12 /12=	64.86	(39)



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Heat loss para	Heat loss parameter (HLP), W/m <sup>2</sup> K $(40)m = (39)m \div (4)$													
(40)m= 1.71	1.69	1.68	1.61	1.6	1.54	1.54	1.53	1.56	1.6	1.62	1.65			
		<b>I</b>	<b></b>					<b>!</b> ,	I Average =	Sum(40)1	.12 /12=	1.61	(40)	
Number of day	ys in mo	nth (Tab	le 1a)		·	. <u> </u>	. <u> </u>	i	i					
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	iting ene	rgy requ	irement:								kWh/ye	ear:		
Assumed occu if TFA > 13. if TFA £ 13.	9, N = 1		: [1 - exp	(-0.0003	349 x (TF	FA -13.9	)2)] + 0.(	0013 x ( <sup>-</sup>	TFA -13.	1.4 .9)	41		(42)	
Annual average Reduce the annu	ge hot wa al average	hot water	usage by	5% if the c	welling is	designed	· ,		se target o	67. f	.77		(43)	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
Hot water usage	in litres pe	r day for ea	· ·	,	ctor from	Table 1c x								
(44)m= 74.54	71.83	69.12	66.41	63.7	60.99	60.99	63.7	66.41	69.12	71.83	74.54			
										m(44) <sub>112</sub> =		813.18	(44)	
Energy content of	f hot water	used - ca	lculated mo	onthly = 4.	190 x Vd,ı	n x nm x E	0Tm / 3600	) kWh/mor	nth (see Ta	ables 1b, 10	c, 1d)			
(45)m= 110.54	96.68	99.77	86.98	83.46	72.02	66.74	76.58	77.49	90.31	98.58	107.05		_	
lf instantaneous v	vater heati	ng at poin	t of use (no	hot wate	r storage),	enter 0 in	boxes (46		Total = Su	m(45) <sub>112</sub> =		1066.21	(45)	
(46)m= 16.58	14.5	14.97	13.05	12.52	10.8	10.01	11.49	11.62	13.55	14.79	16.06		(46)	
Water storage	e loss:													
Storage volum	ne (litres)	) includir	ng any so	olar or W	/WHRS	storage	within sa	ame ves	sel	(	0		(47)	
If community I	-			-			• •							
Otherwise if n		hot wate	er (this in	ICludes I	nstantar	neous co	mbi boil	ers) ente	er '0' in (	47)				
Water storage a) If manufac		eclared I	oss facto	or is kno	wn (kWł	n/dav):					)		(48)	
Temperature f					(	" ddy j i					2 <u></u>		(49)	
Energy lost fro				ar			(48) x (49)	) =			2 <u></u>		(50)	
b) If manufac		-	•		or is not			, –			5		(30)	
Hot water stor	-			e 2 (kW	h/litre/da	iy)				(	C		(51)	
If community I	-		on 4.3											
Volume factor			26								)		(52)	
Temperature f								(50) (	50)		2		(53)	
Energy lost fro Enter (50) or		-	e, kvvn/ye	ear			(47) x (51	) x (52) x (	53) =		)		(54) (55)	
Water storage	. , .	,	for each	month			((56)m - (	(55) × (41)	m	(	0		(55)	
													(EC)	
(56)m= 0 If cylinder contain	0 Is dedicate	0 d solar sto	0 prage, (57)	0 m = (56)m	0 x [(50) - (	0 H11)] ÷ (5	0 0), else (5	0 7)m = (56)	0 m where (	0 H11) is from	0 m Append	ix H	(56)	
(57)m= 0	0	0	0	0	0	0	0	0	0	0	0		(57)	
Primary circuit	t loss (ar	nual) fro	om Table			-	-	-	-		 C		(58)	
Primary circuit	•				59)m =	(58) ÷ 36	65 × (41)	m		L				
(modified by	y factor f	rom Tab	le H5 if t	here is s	solar wa	ter heati	ng and a	a cylinde	r thermo	stat)				
(59)m= 0	0	0	0	0	0	0	0	0	0	0	0		(59)	



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Combi	loss ca	lculated	for each	month (	(61)m =	(60) ÷ 36	65 × (41)	)m						
(61)m=	32.89	29.7	32.86	31.79	32.84	31.77	32.82	32.83	31.78	32.85	31.81	32.88		(61)
Total h	eat requ	uired for	water h	eating ca	alculated	for eacl	h month	(62)m =	0.85 × (	(45)m +	(46)m +	(57)m +	(59)m + (61)m	
(62)m=	143.43	126.38	132.63	118.77	116.3	103.79	99.55	109.41	109.27	123.17	130.39	139.94		(62)
Solar DH	IW input o	calculated	using App	endix G or	Appendix	H (negativ	ve quantity	/) (enter '0	' if no sola	r contribut	on to wate	er heating)		
(add a	dditiona	l lines if	FGHRS	and/or \	NWHRS	applies	, see Ap	pendix C	<u>3)</u>					
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0		(63)
Output	from wa	ater hea	ter	-	-	-	-	-	-	-		-		
(64)m=	143.43	126.38	132.63	118.77	116.3	103.79	99.55	109.41	109.27	123.17	130.39	139.94		-
								Outp	out from wa	ater heate	r (annual)₁	12	1453.03	(64)
Heat g	ains froi	m water	heating,	kWh/m	onth 0.2	5 ´ [0.85	× (45)m	+ (61)m	n] + 0.8 x	(46)m	+ (57)m	+ (59)m	]	
(65)m=	44.98	39.57	41.39	36.87	35.96	31.89	30.39	33.67	33.71	38.24	40.73	43.82		(65)
inclu	de (57)ı	m in calo	culation	of (65)m	only if c	ylinder is	s in the o	dwelling	or hot w	ater is fr	om com	munity h	eating	
5. Int	ernal ga	ains (see	e Table 5	5 and 5a	):									
Metab	olic gain	s (Table	e 5), Wat	ts										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(66)m=	70.66	70.66	70.66	70.66	70.66	70.66	70.66	70.66	70.66	70.66	70.66	70.66		(66)
Lightin	g gains	(calcula	ted in Ap	opendix	L, equat	ion L9 oi	r L9a), a	lso see	Table 5					
(67)m=	11.41	10.13	8.24	6.24	4.66	3.94	4.25	5.53	7.42	9.42	11	11.72		(67)
Applia	nces gai	ins (calc	ulated ir	Append	dix L, eq	uation L	13 or L1	3a), also	see Ta	ble 5		-		
(68)m=	122.19	123.46	120.26	113.46	104.87	96.8	91.41	90.14	93.34	100.14	108.73	116.8		(68)
Cookir	ig gains	(calcula	ted in A	ppendix	L, equat	tion L15	or L15a)	), also se	e Table	5				
(69)m=	30.07	30.07	30.07	30.07	30.07	30.07	30.07	30.07	30.07	30.07	30.07	30.07		(69)
Pumps	and far	ns gains	(Table &	5a)	•	•		•						
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3		(70)
Losses	s e.g. ev	aporatio	n (nega	tive valu	es) (Tab	le 5)								
(71)m=	-56.53	-56.53	-56.53	-56.53	-56.53	-56.53	-56.53	-56.53	-56.53	-56.53	-56.53	-56.53		(71)
Water	heating	gains (T	able 5)											
(72)m=	60.45	58.88	55.63	51.21	48.33	44.29	40.85	45.26	46.82	51.4	56.57	58.89		(72)
Total i	nternal	gains =	:	•	•	(66)	m + (67)m	n + (68)m +	+ (69)m + (	(70)m + (7	1)m + (72)	m		
(73)m=	241.25	239.67	231.33	218.1	205.07	192.23	183.72	188.13	194.78	208.16	223.49	234.61		(73)
6. So	lar gains	S:												
Solar	aine ara e	alculated		r flux from	Toble 60	and accord	isted oqua	tions to co	nvort to th	o opplicat	lo oriontat	ion		

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

Orienta	Orientation: Access Factor Table 6d			Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.54	x	2.51	x	10.63	x	0.85	x	0.7	=	7.72	(74)
North	0.9x	0.54	x	2.51	x	20.32	x	0.85	x	0.7	=	14.75	(74)
North	0.9x	0.54	x	2.51	x	34.53	x	0.85	x	0.7	=	25.06	(74)
North	0.9x	0.54	x	2.51	x	55.46	x	0.85	x	0.7	=	40.26	(74)
North	0.9x	0.54	x	2.51	x	74.72	x	0.85	x	0.7	=	54.23	(74)



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North	0.9x	0.54		x	2.5	1	×	7	9.99	x		0.85	x	0.7		] =	58.05	(74)
North	0.9x	0.54		x	2.5	1	x	7	4.68	x		0.85	×	0.7		=	54.2	(74)
North	0.9x	0.54		x	2.5	1	x	5	9.25	x		0.85	×	0.7		<b>-</b>	43	(74)
North	0.9x	0.54		x	2.5	1	x	4	1.52	x		0.85	×	0.7		<b>-</b>	30.13	(74)
North	0.9x	0.54		x	2.5	1	x	2	4.19	x		0.85	×	0.7		= [	17.56	(74)
North	0.9x	0.54		x	2.5	1	×	1	3.12	×		0.85	x	0.7		<b>-</b> -	9.52	(74)
North	0.9x	0.54		x	2.5	1	x	8	8.86	x		0.85	×	0.7		<b>-</b>	6.43	(74)
South	0.9x	0.54		x	1.6	7	x	4	6.75	x		0.63	×	0.7		=	50.2	(78)
South	0.9x	0.54		x	1.6	7	x	7	6.57	x		0.63	×	0.7		<b>-</b>	82.22	(78)
South	0.9x	0.54		x	1.6	7	x	9	7.53	x		0.63	×	0.7		<b>-</b>	104.73	(78)
South	0.9x	0.54		x	1.6	7	x	1	10.23	x		0.63	×	0.7		=	118.37	(78)
South	0.9x	0.54		x	1.6	7	x	1	14.87	x		0.63	×	0.7			123.35	(78)
South	0.9x	0.54		x	1.6	7	x	1	10.55	x		0.63	×	0.7		<b>-</b>	118.7	(78)
South	0.9x	0.54		x	1.6	7	x	10	08.01	x		0.63	x	0.7		<b>-</b> -	115.98	(78)
South	0.9x	0.54		x	1.6	7	×	10	04.89	×		0.63	x	0.7		<b>-</b> -	112.63	(78)
South	0.9x	0.54		x	1.6	7	×	1(	01.89	x		0.63	×	0.7		<b>- -</b>	109.4	(78)
South	0.9x	0.54		x	1.6	7	x	8	2.59	x		0.63	×	0.7		<b>-</b>	88.68	(78)
South	0.9x	0.54		x	1.6	7	×	5	5.42	x		0.63	×	0.7		<b>-</b> T	59.51	(78)
South	0.9x	0.54		x	1.6	7	x	4	40.4	x		0.63	x	0.7		7 =	43.38	(78)
(83)m=	Solar gains in watts, calculated for each month $(83)m = Sum(74)m \dots (82)m$ $(83)m = 57.92$ 96.97129.79158.62177.58176.76170.18155.63139.54106.2469.0349.81(83)Total gains – internal and solar (84)m = (73)m + (83)m , watts																	
-		1	-		. ,	. ,	`		1								1	
(84)m=	299.17	336.64	361.	12	376.72	382.64	4 3	68.98	353.9	343	.76	334.32	314.4	292.5	2 2	84.42		(84)
7. Me	an inter	nal temp	eratu	ure (	heating	seaso	on)											
Temp	erature	during h	eatin	g pe	eriods ir	n the liv	ving	area	from Tab	ole 9	, Th1	(°C)					21	(85)
Utilisa	ation fac	ctor for g	ains f	or li	ving are	ea, h1,	m (s		ble 9a)								1	
	Jan	Feb	Ма	ar	Apr	Ma	<u>/</u>	Jun	Jul		ug	Sep	Oct	Nov	/	Dec		
(86)m=	0.95	0.94	0.9	2	0.88	0.82		0.71	0.59	0.6	52	0.77	0.89	0.94		0.96	J	(86)
Mean	interna	l temper	ature	in li	ving are	ea T1	(follo	ow ste	ps 3 to 7	7 in T	able	9c)		_			_	
(87)m=	17.79	18.09	18.5	57	19.27	19.9	2	20.48	20.76	20.	72	20.31	19.5	18.58	1	17.81		(87)
Temp	erature	during h	eatin	g pe	eriods ir	n rest o	of dv	velling	from Ta	able 9	9, Th	2 (°C)						
(88)m=	19.54	19.55	19.5	56	19.61	19.61		19.66	19.66	19.	67	19.64	19.61	19.6	1	19.58	]	(88)
Utilisa	ation fac	ctor for g	ains f	or re	est of d	vellinc	ı, h2	,m (se	e Table	9a)							-	
(89)m=	0.95	0.93	0.9		0.86	0.77		0.63	0.46	0.4	19	0.7	0.86	0.93		0.95	]	(89)
Mean		l temper	ature	in t	he rest	of dwe	lling	1 T2 (f	nllow ste	- - -	to 7	in Table	2 9c)	_1			1	
(90)m=	15.4	15.82	16.5		17.53	18.42		19.19	19.51	19.	-	18.99	17.87	16.56	1	15.43	1	(90)
()				- 1						L	-			ving area -			0.52	(91)
• /				<i></i>				、	· · ·		<b>.</b> .			-			0.02	
		l temper	-	<u> </u>			-		1	r È	- T	ŕ	10 70	47.00		16.60	1	(92)
(92)m=	16.65	17	17.5	,a	18.44	19.2		19.86	20.16	20.	13	19.68	18.72	17.62		16.68	J	(32)

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



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<sup>as</sup> DER WorkSheet: New dwelling created by change of use

(93)m=	16.65	17	17.59	18.44	19.2	19.86	20.16	20.13	19.68	18.72	17.62	16.68		(93)
8. Spa	ace hea	ting requ	uirement											
			ernal ter or gains	•		ed at ste	ep 11 of	Table 9t	o, so tha	t Ti,m=(	76)m an	d re-calc	ulate	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisa	ation fac	tor for g	ains, hm	1:										
(94)m=	0.92	0.9	0.88	0.83	0.76	0.64	0.52	0.54	0.7	0.83	0.9	0.93		(94)
Usefu	ıl gains,	hmGm	, W = (94	4)m x (8-	4)m							· · · · · ·		
(95)m=	276.22	304.09	316.16	312.53	290.17	237.9	183.15	186.8	234.97	262.08	263.56	264.41		(95)
Month (96)m=	nly avera	age exte	ernal tem 6.5	perature 8.9	e from Ta	able 8 14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
		-									7.1	4.2		(30)
			1	· · · ·	1		- /	x [(93)m·	· ,		007.54			(07)
(97)m=	848.48	824.44	749.16	618.6	482.43	326.53	220.92	230.01	351.3	522.78	687.51	828.86		(97)
•		· ·	r	r				24 x [(97)	,		r in the second	440.05		
(98)m=	425.76	349.67	322.15	220.37	143.05	0	0	0	0	193.96	305.25	419.95	0000.40	
-					.,			lota	l per year	(kwh/year	) = Sum(9	8)15,912 =	2380.16	(98)
Space	e heatin	g require	ement in	kWh/m²	?/year								59.12	(99)
9a. En	ergy rec	luiremer	nts – Ind	ividual h	eating sy	ystems i	ncluding	micro-C	CHP)					
-	e heatir	-	t from a				a stan					ſ		
Fraction of space heat from secondary/supplementary system														
Fraction of space heat from main system(s) $(202) = 1 - (201) =$ 1(202)Fraction of total heating from main system 1 $(204) = (202) \times [1 - (202)] =$ (204)														
Fraction of total heating from main system 1 $(204) = (202) \times [1 - (203)] =$ 1(204)Efficiency of main space heating system 1(204)(202) $\times [1 - (203)] =$ (202)														(204)
Efficiency of main space heating system 1 93.5														(206)
Efficie	ency of s	seconda	ry/suppl	ementar	y heating	g system	ı, %						0	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/yea	ır
Space	e heatin		r ·	r	d above)			1						
	425.76	349.67	322.15	220.37	143.05	0	0	0	0	193.96	305.25	419.95		
(211)m			(4)] } x 1	· · ·	-									(211)
	455.36	373.98	344.54	235.69	152.99	0	0	0	0	207.45	326.47	449.14		-
								Tota	l (kWh/yea	ar) =Sum(2	211) <sub>15,1012</sub>	=	2545.62	(211)
		• ·	econdar		month									
	r i i i i i i i i i i i i i i i i i i i	/	00 ÷ (20	<u> </u>	0	0	0	0	0	0	0			
(215)m=	0	0	0	0	0	0	0	0 Tota	-	0	0 215) <sub>15,1012</sub>	0		(215)
								1014	i (kwii/yoo	() =0um(2	- 10) <sub>15,10</sub> 12	- I	0	(215)
	heating		tor (oolo											
Output	143.43	126.38	ter (calc 132.63	118.77	116.3	103.79	99.55	109.41	109.27	123.17	130.39	139.94		
Efficier		ater hea		1									86.6	(216)
(217)m=	-	89.43	89.33	89.09	88.71	86.6	86.6	86.6	86.6	88.94	89.3	89.49		(217)
		heating.	kWh/m	I onth										
		•	) ÷ (217)											
	160.28	141.31	148.48	133.31	131.1	119.85	114.96	126.34	126.18	138.48	146.02	156.37		-
								Tota	l = Sum(2 <sup>-</sup>	19a) <sub>112</sub> =			1642.68	(219)
	I totals									k	Wh/year		kWh/year	-
Space	heating	fuel use	ed, main	system	1								2545.62	



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Mecserve Ltd

Water heating fuel used			1642.68
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			201.44 (232)
12a. CO2 emissions – Individual heating systems	s including micro-CHP		
	<b>Energy</b> kWh/year	<b>Emission factor</b> kg CO2/kWh	<b>Emissions</b> kg CO2/year
Space heating (main system 1)	(211) x	0.216 =	549.85 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	354.82 (264)
Space and water heating	(261) + (262) + (263) + (264) =		904.67 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	38.93 (267)
Electricity for lighting	(232) x	0.519 =	104.55 (268)
Total CO2, kg/year	sum	of (265)(271) =	1048.15 (272)
Dwelling CO2 Emission Rate	(272	) ÷ (4) =	26.03 (273)
El rating (section 14)			84 (274)



## APPENDIX C TER WORKSHEET OF TYPICAL NEW-EXTENSION (BE LEAN)



(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

			User	Details:									
Assessor Name: Software Name:	Panagiotis D Stroma FSA	P 2012	Proper	Stroma Softwa	are Ve		Pronose	Versio	030082 n: 1.0.4.14				
Address :	Plot 4, 65 Gui	lford Street, W		·	5. NO 0	5-6101 4-1	FTOPOSE	iu					
1. Overall dwelling dime				.0									
			Are	a(m²)		Av. Hei	ght(m)		Volume(m <sup>3</sup> )				
Ground floor			5	51.22	(1a) x	2.	55	(2a) =	130.61	(3a)			
Total floor area TFA = (1a	a)+(1b)+(1c)+(1c	d)+(1e)+(1n	i) <u></u>	51.22	(4)					•			
Dwelling volume					(3a)+(3b	) <b>+(3c)+(3d</b> )	)+(3e)+	.(3n) =	130.61	(5)			
2. Ventilation rate:								•		-			
Number of chimneys	main heating	secondar heating + 0	у ] + [	other 0	] = [	total 0	X 4	40 =	m <sup>3</sup> per hour	(6a)			
Number of open flues	0	+ 0	] + [	0	] = [	0	x 2	20 =	0	(6b)			
Number of intermittent fai	ns				, г Г	2	x 1	0 =	20	(7a)			
Number of passive vents					Ľ	0	x 1	0 =	0	(7b)			
Number of flueless gas fi	res				Г	0	x 4	40 = [	0	(7c)			
Air changes per hournfiltration due to chimneys, flues and fans = $(6a)+(6b)+(7a)+(7b)+(7c) =$ 20 $\div (5) =$ 0.15(8)If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16) $(5) =$ 0.15(8)													
Number of storeys in th	ne dwelling (ns)							[	0	(9)			
Additional infiltration							[(9)-	1]x0.1 =	0	(10)			
Structural infiltration: 0. if both types of wall are pr deducting areas of openin If suspended wooden f	esent, use the value lgs); if equal user 0.3	e corresponding to 35	the great	ter wall area	a (after	ruction		ا ا	0	(11)			
If no draught lobby, ent	er 0.05, else en	ter 0						[	0	(13)			
Percentage of windows	s and doors drau	ight stripped							0	(14)			
Window infiltration				0.25 - [0.2					0	(15)			
Infiltration rate Air permeability value,	aEO overcoord	in oubio motro	o por br			12) + (13) +		oroo	0	(16)			
If based on air permeabili			•	•	•		nvelope	alea	5 0.4	(17) (18)			
Air permeability value applies	•					is being us	sed	l	0.4	(10)			
Number of sides sheltere Shelter factor	d			(20) = 1 - [	0.075 x (′	19)] =		[	4 0.7	(19) (20)			
Infiltration rate incorporat	ing shelter facto	r		(21) = (18)		-71		l I	0.7	(21)			
Infiltration rate modified for	-				× /			l	0.20	](-')			
	Mar Apr	May Jun	Jul	Aug	Sep	Oct	Nov	Dec					
Monthly average wind sp	eed from Table	ı 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 = $(22)$	2)m ÷ 4												



TER WorkSheet: New dwelling as built

Adjusted infiltration rate	(allowing for shelter a	nd wind speed) = $(21a) \times (22a)m$
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	0.36	0.35	0.35	0.31	0.3	0.27	0.27	0.26	0.28	0.3	0.32	0.33			
			-	rate for t	he appli	cable ca	se								<b>.</b>
		al ventila		un alius NL (O	2h) (00a	) <b>F</b> ann (a	auratian (N			(00-)				0	(23a)
				endix N, (2						) = (23a)				0	(23b)
				iency in %	Ū		``		, ,					0	(23c)
			i						ŕ	, ,		1 – (23c)	÷100]		(0, 1, z)
(24a)m=		0	0	0	0	0	0	0	0	0	0	0			(24a)
,				entilation			<b>,</b> ,	r í í	, <u>,</u>	, (	, 	I			<i>i</i>
(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0			(24b)
,				itilation c	•	•				- (00)	`				
1	· ,	r	r ,	hen (240	, ,	,	,	ŕ	ŕ	,	ŕ				(24a)
(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0			(24c)
,				ole hous m = (22t		•				0.5]					
(24d)m=	0.56	0.56	0.56	0.55	0.55	0.54	0.54	0.53	0.54	0.55	0.55	0.55			(24d)
Effe	ctive air	change	rate - er	nter (24a	) or (24b	) or (24	c) or (24	d) in box	(25)						
(25)m=	0.56	0.56	0.56	0.55	0.55	0.54	0.54	0.53	0.54	0.55	0.55	0.55			(25)
2 40	at locco	c and he	at loce r	paramete	or:										
						Not Ar	00	l Lvalı		ΔΥΠ		k-value	5	ΔΧ	k
$\begin{array}{c c c c c c c c c c c c c c c c c c c $															
area (m <sup>2</sup> ) m <sup>2</sup> A ,m <sup>2</sup> W/m2K (W/K) kJ/m <sup>2</sup> ·K kJ/K Doors 2 x 1 = 2 (26)														(26)	
Window	ws Type	e 1				1.89	x1/	/[1/( 1.4 )+	0.04] =	2.51	=				(27)
Window	ws Type	2				0.92	x1,	/[1/( 1.4 )+	0.04] =	1.22					(27)
Window	ws Type	93				3.84	x1/	/[1/( 1.4 )+	0.04] =	5.09	=				(27)
Window	ws Type	e 4				1.23	x1/	/[1/( 1.4 )+	0.04] =	1.63					(27)
Walls 7	Гуре1	80.7	'8	9.88		70.9	x	0.18	=	12.76					(29)
Walls 7	Гуре2	5.8	9	0		5.89	x	0.18	=	1.06					(29)
Roof		12.8	6	0		12.86	; x	0.13	=	1.67					(30)
Total a	rea of e	lements	, m²			99.53	3								(31)
				ffective wil ternal wall			ated using	formula 1,	/[(1/U-valu	e)+0.04] a	s given in	paragraph	3.2		
			= S (A x		o ana part			(26)(30)	+ (32) =				27	.94	(33)
		Cm = S(		- /					((28)	.(30) + (32	2) + (32a).	(32e) =		3.14	(34)
Therma	al mass	parame	ter (TMF	P = Cm ÷	- TFA) in	ı kJ/m²K			Indica	tive Value:	Medium			50	(35)
	-		ere the de tailed calc	tails of the	constructi	on are not	known pr	ecisely the	e indicative	values of	TMP in Ta	able 1f			
					usina Ap	pendix ł	<						7	25	(36)
	Thermal bridges : S (L x Y) calculated using Appendix K       7.25       (36)         f details of thermal bridging are not known (36) = 0.15 x (31)       (36)														
	abric he			. /	, -				(33) +	(36) =			35	.19	(37)
Ventila	tion hea	at loss ca	alculated	I monthly	/				(38)m	= 0.33 × (	25)m x (5)				
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
(38)m=	24.34	24.23	24.13	23.63	23.53	23.1	23.1	23.02	23.27	23.53	23.72	23.92			(38)

Heat transfer coefficient W/K

(39)m = (37) + (38)m



Heat lo	oss para	meter (H	HLP), W	/m²K					(40)m	= (39)m ÷	- (4)			
(40)m=	1.16	1.16	1.16	1.15	1.15	1.14	1.14	1.14	1.14	1.15	1.15	1.15		_
Numbe	er of day	/s in mo	nth (Tab	le 1a)						Average =	Sum(40)1	12 /12=	1.15	(40)
	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	ater hea	ting ene	rgy requ	irement:								kWh/ye	ear:	
if TF				([1 - exp	o(-0.0003	349 x (TF	<del>-</del> A -13.9	)2)] + 0.0	0013 x (	TFA -13		73		(42)
Reduce	the annua	al average	hot water	ge in litre usage by r day (all w	5% if the c	welling is	designed			se target o		5.19		(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot wate	er usage i	n litres pei	r day for ea	ach month	Vd,m = fa	ctor from	Table 1c x	(43)						
(44)m=	82.71	79.71	76.7	73.69	70.68	67.67	67.67	70.68	73.69	76.7	79.71	82.71		_
Enorm	contont of	bot wator	upod op	lculated m	onthly - 1	100 v Vd	т v рт v Г	)Tm / 2601			m(44) <sub>112</sub> =		902.33	(44)
	<b></b>	i	1	-		1	1	1	1			, 1		
(45)m=	122.66	107.28	110.7	96.51	92.61	79.91	74.05	84.98	85.99	100.21	109.39	118.79	1100.00	(45)
If instant	taneous v	vater heati	ng at poin	t of use (no	o hot wate	r storage),	enter 0 in	boxes (46		10tal = Su	m(45) <sub>112</sub> =	=	1183.09	(45)
(46)m=	18.4	16.09	16.61	14.48	13.89	11.99	11.11	12.75	12.9	15.03	16.41	17.82		(46)
	storage le volum		) includir	ng any se	olar or V	/WHRS	storage	within sa	ame ves	sel		0		(47)
-		. ,		ank in dw			-					•		()
	•	•		er (this ir	•			· ·	ers) ente	er '0' in (	(47)			
	storage													
				loss facto	or is kno	wn (kWł	n/day):					0		(48)
•		actor fro										0		(49)
			-	e, kWh/ye cylinder∣		or is not		(48) x (49	) =			0		(50)
,				rom Tabl								0		(51)
		neating s					• /							
		from Ta										0		(52)
•		actor fro										0		(53)
•••		om wateı (54) in (5	-	e, kWh/ye	ear			(47) x (51	) x (52) x (	53) =		0		(54)
	. ,	. , .	,	for oach	month			((EG)m - 1)	(A1)	~		0		(55)
				for each				((56)m = (						(50)
(56)m= If cylinde	0 er contain	0 s dedicate	0 d solar sto	0 prage, (57)	0 m = (56)m	0 x [(50) - (	0 [H11)] ÷ (5	0 0), else (5	0 7)m = (56)	0 m where (	0 H11) is fro	0 om Append	ix H	(56)
(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)
			ı nual) fr	ı om Table	<u> </u>	1	1	1	1	1		0		(58)
	•	•	,	for each		59)m = (	(58) ÷ 36	65 × (41)	m		L	-		x = /
	•			le H5 if t			. ,	. ,		r thermo	ostat)			
(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)



Combi	loss ca	lculated	for each	month (	61)m =	(60) ÷ 36	65 × (41)	)m						
(61)m=	42.15	36.69	39.08	36.34	36.02	33.37	34.49	36.02	36.34	39.08	39.31	42.15		(61)
Total h	eat req	uired for	water he	eating ca	alculated	for eacl	n month	(62)m =	0.85 × (	(45)m +	(46)m +	(57)m +	(59)m + (61)m	
(62)m=	164.81	143.97	149.79	132.85	128.63	113.29	108.54	120.99	122.33	139.3	148.7	160.94		(62)
Solar D	-IW input	calculated	using App	endix G or	Appendix	H (negativ	ve quantity	/) (enter '0	' if no sola	r contribut	ion to wate	er heating)		
(add a	dditiona	l lines if	FGHRS	and/or V	VWHRS	applies	, see Ap	pendix G	3)					
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0		(63)
Outpu	from w	ater hea	ter											
(64)m=	164.81	143.97	149.79	132.85	128.63	113.29	108.54	120.99	122.33	139.3	148.7	160.94		
		•						Outp	out from wa	ater heate	r (annual)₁	12	1634.13	(64)
Heat g	ains fro	m water	heating,	kWh/mo	onth 0.2	5 ´ [0.85	× (45)m	+ (61)m	n] + 0.8 x	(46)m	+ (57)m	+ (59)m	]	
(65)m=	51.32	44.84	46.58	41.18	39.8	34.91	33.24	37.26	37.68	43.09	46.2	50.04		(65)
inclu	ide (57)	m in calo	culation	of (65)m	only if c	ylinder i	s in the c	dwelling	or hot w	ater is fr	om com	munity h	eating	
5. In	ternal ga	ains (see	Table 5	and 5a	):									
		is (Table												
motab	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(66)m=	86.3	86.3	86.3	86.3	86.3	86.3	86.3	86.3	86.3	86.3	86.3	86.3		(66)
Lightir	g gains	(calcula	ted in Ap	pendix	L, equat	ion L9 oi	r L9a), a	lso see	Table 5					
(67)m=	14.77	13.12	10.67	8.08	6.04	5.1	5.51	7.16	9.61	12.2	14.24	15.18		(67)
Applia	nces ga	ins (calc	ulated ir	Append	dix L, eq	uation L <sup>-</sup>	13 or L1	3a), also	see Tal	ble 5				
(68)m=	150.4	151.96	148.03	139.66	129.09	119.15	112.52	110.96	114.89	123.26	133.83	143.77		(68)
Cookir	ng gains	(calcula	ted in A	opendix	L, equat	ion L15	or L15a)	, also se	e Table	5	1	1		
(69)m=	31.63	31.63	31.63	31.63	31.63	31.63	31.63	31.63	31.63	31.63	31.63	31.63		(69)
Pump	and fai	ns gains	(Table 5	5a)										
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3		(70)
	se.a. ev	u vaporatio	n (nega	tive valu	es) (Tab	le 5)								
		-69.04			, , ,		-69.04	-69.04	-69.04	-69.04	-69.04	-69.04		(71)
		I gains (T								I	I			
(72)m=	68.98	66.73	62.61	57.19	53.49	48.49	44.68	50.08	52.33	57.92	64.17	67.25		(72)
		gains =							+ (69)m + (					. ,
(73)m=	286.04	283.7	273.2	256.81	240.51	224.64	214.6	220.09	228.72	245.27	264.13	278.09		(73)
. ,	lar gains					,								< - <i>i</i>
		calculated	using sola	r flux from	Table 6a	and associ	ated equa	tions to co	onvert to th	e applicat	ole orientat	ion.		

Orienta	tion:	Access Facto Table 6d	r	Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	1	x	1.89	x	19.64	x	0.63	x	0.7	=	7.96	(76)
East	0.9x	1	x	0.92	x	19.64	x	0.63	x	0.7	=	3.87	(76)
East	0.9x	1	x	3.84	x	19.64	x	0.63	x	0.7	=	16.16	(76)
East	0.9x	1	x	1.23	x	19.64	x	0.63	x	0.7	=	5.18	(76)
East	0.9x	1	x	1.89	x	38.42	x	0.63	x	0.7	=	15.56	(76)



,	,												
East	0.9x	1	x	0.92	×	38.42	×	0.63	x	0.7	=	7.58	(76)
East	0.9x	1	x	3.84	x	38.42	x	0.63	x	0.7	=	31.62	(76)
East	0.9x	1	x	1.23	x	38.42	x	0.63	x	0.7	=	10.13	(76)
East	0.9x	1	x	1.89	x	63.27	x	0.63	x	0.7	=	25.63	(76)
East	0.9x	1	x	0.92	x	63.27	x	0.63	x	0.7	=	12.48	(76)
East	0.9x	1	x	3.84	x	63.27	x	0.63	x	0.7	=	52.07	(76)
East	0.9x	1	x	1.23	x	63.27	x	0.63	x	0.7	=	16.68	(76)
East	0.9x	1	x	1.89	x	92.28	x	0.63	x	0.7	=	37.38	(76)
East	0.9x	1	x	0.92	x	92.28	x	0.63	x	0.7	=	18.2	(76)
East	0.9x	1	x	3.84	x	92.28	×	0.63	x	0.7	=	75.95	(76)
East	0.9x	1	x	1.23	x	92.28	×	0.63	x	0.7	=	24.33	(76)
East	0.9x	1	x	1.89	x	113.09	x	0.63	x	0.7	=	45.81	(76)
East	0.9x	1	x	0.92	x	113.09	x	0.63	x	0.7	=	22.3	(76)
East	0.9x	1	x	3.84	x	113.09	x	0.63	x	0.7	=	93.08	(76)
East	0.9x	1	x	1.23	x	113.09	x	0.63	x	0.7	=	29.81	(76)
East	0.9x	1	x	1.89	x	115.77	×	0.63	x	0.7	=	46.9	(76)
East	0.9x	1	x	0.92	x	115.77	x	0.63	x	0.7	=	22.83	(76)
East	0.9x	1	x	3.84	x	115.77	x	0.63	x	0.7	=	95.28	(76)
East	0.9x	1	x	1.23	x	115.77	x	0.63	x	0.7	=	30.52	(76)
East	0.9x	1	x	1.89	x	110.22	x	0.63	x	0.7	=	44.65	(76)
East	0.9x	1	x	0.92	x	110.22	x	0.63	x	0.7	=	21.73	(76)
East	0.9x	1	x	3.84	×	110.22	×	0.63	x	0.7	=	90.71	(76)
East	0.9x	1	x	1.23	x	110.22	x	0.63	x	0.7	=	29.06	(76)
East	0.9x	1	x	1.89	x	94.68	x	0.63	x	0.7	=	38.35	(76)
East	0.9x	1	x	0.92	x	94.68	x	0.63	x	0.7	=	18.67	(76)
East	0.9x	1	x	3.84	x	94.68	×	0.63	x	0.7	=	77.92	(76)
East	0.9x	1	x	1.23	x	94.68	×	0.63	x	0.7	=	24.96	(76)
East	0.9x	1	x	1.89	x	73.59	x	0.63	x	0.7	=	29.81	(76)
East	0.9x	1	x	0.92	x	73.59	×	0.63	x	0.7	=	14.51	(76)
East	0.9x	1	x	3.84	x	73.59	×	0.63	x	0.7	=	60.56	(76)
East	0.9x	1	x	1.23	x	73.59	×	0.63	x	0.7	=	19.4	(76)
East	0.9x	1	x	1.89	x	45.59	×	0.63	x	0.7	=	18.47	(76)
East	0.9x	1	x	0.92	x	45.59	x	0.63	x	0.7	=	8.99	(76)
East	0.9x	1	x	3.84	x	45.59	×	0.63	x	0.7	=	37.52	(76)
East	0.9x	1	x	1.23	x	45.59	×	0.63	x	0.7	=	12.02	(76)
East	0.9x	1	x	1.89	x	24.49	x	0.63	x	0.7	=	9.92	(76)
East	0.9x	1	×	0.92	×	24.49	×	0.63	x	0.7	=	4.83	(76)
East	0.9x	1	x	3.84	×	24.49	×	0.63	x	0.7	=	20.15	(76)
East	0.9x	1	x	1.23	×	24.49	×	0.63	x	0.7	=	6.46	(76)
East	0.9x	1	x	1.89	×	16.15	×	0.63	x	0.7	=	6.54	(76)
East	0.9x	1	×	0.92	×	16.15	×	0.63	x	0.7	=	3.18	(76)



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East 0.9		x	3.8	34	×Г	16.15	٦ ×		0.63	⊐ × Г	0.7	=	13.29	(76)
East 0.9		x	1.2		×Г	16.15	」 】 x		0.63	╡╷┝	0.7		4.26	(76)
0.0	^	^	1.2	.0	^ L	10.15	<b>」</b> ^		0.05		0.7		4.20	(10)
Solar gains	in watte c	alculated	l for eac	h month			(83)m	- Si	um(74)m .	(82)m				
83)m= 33.1		106.86	155.85	191		5.52 186.15	159	- 1	124.28	(02)m 77	41.36	27.28	1	(83)
Total gains -														
84)m= 319.2		380.06	412.66	431.51	1 Ì	0.16 400.75	379	.98	353	322.27	305.49	305.37	]	(84)
7. Mean int	ernal temp	perature	(heating	seasor	n)	•					•	•	-	
Temperatu	re during h	neating p	eriods ir	n the livi	ng a	rea from Ta	ble 9	, Th′	1 (°C)				21	(85)
Utilisation f	actor for g	ains for l	living are	ea, h1,m	n (se	e Table 9a)								
Jar	n Feb	Mar	Apr	May	J	lun Jul	A	ug	Sep	Oct	Nov	Dec	]	
86)m= 1	1	0.99	0.97	0.92	0.	.78 0.61	0.6	6	0.89	0.98	1	1	1	(86)
Mean inter	hal temper	ature in	living ar	ea T1 (f		v steps 3 to	- 7 in T	able	9c)					
87)m= 19.7		20.11	20.43	20.72	T	0.92 20.98	20.	Т	20.83	20.46	20.06	19.74	7	(87)
·								I						
(1  emperatu) (8)m= 19.9		19.95	19.96	19.96	T	elling from T	19.		12 (°C) 19.97	19.96	19.96	19.96	1	(88)
·							-	97	19.97	19.90	19.90	19.90		(00)
		r			T	n (see Table	T			Ĺ			-	
9)m= 1	0.99	0.99	0.96	0.88	0.	.69 0.48	0.5	54	0.82	0.97	0.99	1		(89)
Mean inter	nal temper	ature in	the rest	of dwell	ing <sup>-</sup>	T2 (follow st	eps 3	to 7	' in Tabl	e 9c)				
0)m= 18.3	1 18.48	18.82	19.28	19.68	19	9.91 19.96	19.	96	19.83	19.33	18.74	18.27		(90)
									f	LA = Livin	g area ÷ (4	4) =	0.46	(91)
Mean inter	nal temper	ature (fo	r the wh	ole dwe	lling	) = fLA × T1	+ (1	– fL	A) × T2					
92)m= 18.9		19.41	19.8	20.16	-	).37 20.43	20.		, 20.29	19.84	19.34	18.94	7	(92)
Apply adju	stment to t	he mear	internal	tempei	ratur	e from Table	e 4e,	whe	re appro	opriate			J	
93)m= 18.9	7 19.12	19.41	19.8	20.16	20	0.37 20.43	20.	42	20.29	19.84	19.34	18.94	]	(93)
8. Space h	eating requ	uirement			-								_	
Set Ti to th	e mean int	ternal ter	nperatu	re obtaiı	ned	at step 11 of	<sup>-</sup> Tabl	e 9b	, so tha	t Ti,m=(	76)m an	d re-cal	culate	
the utilisation	1	or gains	using Ta	ble 9a			-						-	
Jar		Mar	Apr	May	J	lun Jul	A	ug	Sep	Oct	Nov	Dec		
Utilisation f		r ·		l.	<b>-</b>		<b>1</b>			Ĺ			-	
4)m= 1	0.99	0.98	0.96	0.89	0.	.73 0.54	0.5	59	0.84	0.97	0.99	1		(94)
Useful gair		ì	, <u>,</u>	,	-		-						7	
5)m= 317.8		374.2	395.46	382.76		7.06 217.88	225	.97	298.21	312.38	303.12	304.33		(95)
Monthly av		1			1								7	(00)
6)m= 4.3	4.9	6.5	8.9	11.7		4.6 16.6	16		14.1	10.6	7.1	4.2		(96)
	1	r		· · · · · · · · · · · · · · · · · · ·	T	, W =[(39)m	T	ŕ	. ,		704.40	074.5	7	(07)
07)m= 873.4		765.83	641.38	496.54		6.42 223.11	234		361.61	542.83	721.18	871.5		(97)
·	- <u> </u>	291.38			1	$\frac{\text{month} = 0.0}{0}$		<u> </u>		<u> </u>	, ,	101 07	7	
98)m= 413.3	335.38	291.38	177.06	84.65		0 0	C	I	0	171.46	301	421.97		
								Iotal	per year	(KVVh/year	) = Sum(9	8) <sub>15,912</sub> =	2196.25	(98)
Space hea	ting require	ement in	kWh/m <sup>2</sup>	/year									42.88	(99)
a. Energy r	equiremer	nts – Indi	vidual h	eating s	yste	ms including	g mic	ro-C	HP)					
Space hea	tina:													

Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)



# TER WorkSheet: New dwelling as built

Mecserve Ltd Panagiotis Dalapas

020 3141 5800

Total (kWh/year) =Sum(215) <sub>15,1012</sub> =       (215)         Water heating         Output from water heater (calculated above)       164.81       143.97       149.79       132.85       128.63       113.29       108.54       120.99       122.33       139.3       148.7       160.94         Efficiency of water heater       80.3       (216)	Fracti	on of sp	ace hea	at from n	nain syst	em(s)			(202) = 1 -	- (201) =				1	(202)	
Efficiency of secondary/supplementary heating system, %       0       C28         Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec       KWh/year         Space heating requirement (calculated above)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)	Fracti	on of to	tal heatii	ng from	main sys	stem 1			(204) = (20	02) × [1 –	(203)] =			1	(204)	
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Efficie	ency of	main spa	ace heat	ing syste	em 1								93.4	(206)	
Space heating requirement (calculated above)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (211)       (	Efficie	ency of	seconda	ry/suppl	ementar	y heating	g system	n, %						0	(208)	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/ye	ear	
(211)m = {[[(88)m x (204)] } x 100 ÷ (206)       (211)         442.55       359.06       311.97       189.57       90.64       0       0       183.57       322.27       451.79       2351.44       (211)         Total (WWhyear) =Sum(211),,,,,,,,	Space		ř. – –	, i	1	, ,	)							1		
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $							0	0	0	0	171.46	301	421.97			
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	(211)m		í	<u>,</u>	ì	, ,				0	400.57	000.07	454 70	1	(211)	
Space heating fuel (secondary), kWh/month = {{((98)m $\times (201)}} x 100 + (208)         (215)m       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       (215)       0       (217)       102.45       118.23       118.27       171.13       114.21       11932.45       (219)       11932.45       (219)       11932.45       (219)      $		442.55	359.08	311.97	189.57	90.64	0	0	-	-				2251.44	(211)	
$= ([(98) m \times (201)] \times 100 \div (208)$ (215) m 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Snace	, hoatin	a fuel (e	ocondar	ν) k\Λ/b/	month			1014	. (	ar) =00m(2	- ' ' /15,1012		2351.44	(211)	
Total (kWh/year) =Sum(215)_{1, x = 0, x^2}       0       (215)         Water heating         Output from water heater (calculated above)       (216)         164.81       143.97       132.85       128.63       113.29       108.54       120.99       122.33       139.3       148.7       160.94         Efficiency of water heater       80.3       80.3       80.3       80.3       85.58       86.79       87.37       (217)         Fuel for water heating, kWh/month       (219)m       188.85       165.27       172.77       154.89       153.08       141.08       135.17       150.68       152.34       162.78       171.33       184.21         Total (kWh/year         (219)m       188.85       165.27       172.77       154.89       153.08       141.08       135.17       150.68       152.34       162.78       171.33       184.21         Total = Sum(219a),, e       MM// Water         Sum(219a),, e       MM// Water         Sum(219a),, e       MM// Water         Sum(219a),, e       MM// Water         Colspan="2">Sum(219a),, e	•				• •	monun										
Water heating         Output from water heater (calculated above)         164.81       143.97       149.79       132.85       128.63       113.29       108.54       120.99       122.33       139.3       148.7       160.94         Efficiency of water heater       80.3       80.3       80.3       80.3       86.58       86.79       87.37       (217)         Fuel for water heating, KWh/month       (219)m = (64)m x 100 ÷ (217)m       (219)m m (219)e       (219)m m (219)e       (219)m m (219)e       (219)m m (219)e       (219)m (210)e       (219)m (210)e       (219)m (210)e       (219)m (210)e       (219)m (210)e       (210)m (210)e       (210)m (210)m (210)m       (210)m (210)m (210)m (210)m (210)m (210)m (210)m (210)m (210)m (210)m (210)m (210)m (210)m (210)m (210)m (210)m (210)m (210)m (210)m (210)m (210)m (210)m (210)m (210)m (210)m (210)m (210)m (210)m (210)m (210)m (210)m (210)m (210)m (210)m (210)m (210)m (210)m (210)m (210)m (210)m (210)m (210)m (210	(215)m=	0	0	0	0	0	0	0	0	0	0	0	0	]		
Output from vater heater (calculated above)       164.81       143.79       143.79       132.85       122.83       113.29       108.54       120.99       122.33       139.3       148.7       160.94         Efficiency of water heater       80.3       80.3       80.3       80.3       80.3       80.3       80.3       (216)         (217)m       87.27       87.11       85.78       84.03       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       (217)         Cuel for water heating, kWh/month       (217)m       (219)m       168.85       165.27       172.77       154.89       153.08       141.08       135.17       150.68       162.34       162.78       171.33       184.21         (219)m       168.85       165.27       172.77       154.89       153.08       141.08       135.17       150.68       152.34       162.78       171.33       184.21       1932.45       (219)         Annual totals       KWh/year       KWh/year       1932.45       (219)       KWh/year       1932.45       (219)       1932.45       (219)       1932.45       (219)       1932.45       (219)       1932.45       (230e)       1932.45									Tota	l (kWh/yea	ar) =Sum(2	2 <b>15)</b> <sub>15,1012</sub>	=	0	(215)	
I64.81       143.97       149.79       132.85       128.63       113.29       108.54       120.99       122.33       139.3       148.7       160.94         Efficiency of water heater       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3       80.3		ter heating tput from water heater (calculated above)														
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	Output	utput from water heater (calculated above) 164.81 143.97 149.79 132.85 128.63 113.29 108.54 120.99 122.33 139.3 148.7 160.94														
Fuel for water heating, kWh/month         (219)m = (64)m x 100 ÷ (217)m         (219)m = 188.85 165.27 172.77 154.89 153.08 141.08 135.17 150.68 152.34 162.78 171.33 184.21         Total = Sum(219a)z =         Annual totals         KWh/year         Space heating fuel used, main system 1         Water heating fuel used, main system 1         Water heating fuel used         Biolectricity for pumps, fans and electric keep-hot         central heating pump:         Joint (230a)(230g) =         T5         Call colspan="2">Emission factor         Remergy         KWin/year         Space heating (main system 1)         C216         Energy         Emission factor         KWh/year         Space heating (main system 1)         C216         Space heating (main system 1)         C216         Space heating (main system 1)         C216         Energy         KWh/year         Space heating (main system 1)	Efficier	Dutput from water heater (calculated above)           164.81         143.97         149.79         132.85         128.63         113.29         108.54         120.99         122.33         139.3         148.7         160.94           Efficiency of water heater         80.3         (216)														
$\begin{array}{c cl} (219) \text{m} = (64) \text{m} \times 100 \div (217) \text{m} \\ (219) \text{m} = 188.85 & 165.27 & 172.77 & 154.89 & 153.08 & 141.08 & 135.17 & 150.68 & 152.34 & 162.78 & 171.33 & 184.21 \\ \hline \text{Total} = \text{Sum}(219)_{1.52} = & 1932.45 & (219) \\ \hline \text{Annual totals} & & & & & & & & & & & & & & & & & & &$	(217)m=	Efficiency of water heater 217)m= 87.27 87.11 86.7 85.78 84.03 80.3 80.3 80.3 80.3 85.58 86.79 87.37													(217)	
(219)m-       188.85       165.27       172.77       154.89       153.08       141.08       135.17       150.68       152.34       162.78       171.33       184.21         Total = Sum(219a); =         kWh/year         Space heating fuel used, main system 1         Water heating fuel used       1932.45         Electricity for pumps, fans and electric keep-hot         central heating pump:       30       (230e)         bold electricity for the above, kWh/year       30       (230e)         Colspan="4">Total = Sum of (230a)(230g) =       75       (231)         Electricity for the above, kWh/year       sum of (230a)(230g) =       75       (231)         Electricity for lighting       260.84       (232)         152.44       1932.45       (230e)         Space heating (main system 1)       (211) x       sum of (230a)(230g) =       75       (231)         Electricity for lighting       260.84       (232)         122.       Electricity for lighting       260.84       (261)         Space heating (main system 1)       (211) x       0.216       =       507.			•											•		
Total = Sum(219a)_{1.22} =1932.45(219)Annual totalskWh/year2351.44Space heating fuel used, main system 12351.44Water heating fuel used1932.45Electricity for pumps, fans and electric keep-hotcentral heating pump:30(230c)boiler with a fan-assisted flue45(230c)total electricity for the above, kWh/yearsum of (230a)(230g) =75(231)Electricity for the above, kWh/yearsum of (230a)(230g) =75(231)Electricity for lighting260.84(232)12a. CO2 emissions – Individual heating systems including micro-CHPEmergy kWh/yearEmission factor kg CO2/kWhEmissions kg CO2/kWhSpace heating (main system 1)(211) ×0(261)Space heating (secondary)(215) ×0(263)Water heating(211) ×0(263)Water heating(261) + (262) + (263) + (264) =925.32(265)Electricity for pumps, fans and electric keep-hot(231) ×0(263) <td>· ·</td> <td></td> <td></td> <td></td> <td></td> <td>153.08</td> <td>141.08</td> <td>135.17</td> <td>150.68</td> <td>152.34</td> <td>162.78</td> <td>171.33</td> <td>184.21</td> <td>1</td> <td></td>	· ·					153.08	141.08	135.17	150.68	152.34	162.78	171.33	184.21	1		
Annual totalskWh/yearkWh/yearSpace heating fuel used, main system 1 $2351.44$ Water heating fuel used $1932.45$ Electricity for pumps, fans and electric keep-hot $30$ (230c)central heating pump: $30$ (230c)boiler with a fan-assisted flue $45$ (230e)Total electricity for the above, kWh/yearsum of (230a)(230g) =Total electricity for the above, kWh/year $sum of (230a)(230g) =$ Total electricity for lighting $260.84$ (232)12a. CO2 emissions – Individual heating systems including micro-CHPEmission factorEnergy kWh/yearEmission factor kg CO2/kWhEmissions kg CO2/yearSpace heating (main system 1) $(211) \times$ $0.216$ $=$ Space heating (secondary) $(215) \times$ $0.519$ $=$ $0$ <(263)	(,													1932.45	(219)	
Water heating fuel used1932.45Electricity for pumps, fans and electric keep-hot $30$ (230c)central heating pump: $30$ (230c)boiler with a fan-assisted flue $45$ (230e)Total electricity for the above, kWh/yearsum of (230a)(230g) =Total electricity for tighting $75$ (231)Electricity for lighting $260.84$ (232)12a. CO2 emissions – Individual heating systems including micro-CHPEnergy kWh/yearEmission factor kg CO2/kWhEmissions kg CO2/yearSpace heating (main system 1)(211) x $0.216$ = $507.91$ (261)Space heating (secondary)(215) x $0.519$ = $0$ (263)Water heating(219) x $0.216$ = $417.41$ (264)Space and water heating(261)+(262)+(263)+(264) = $925.32$ (265)Electricity for pumps, fans and electric keep-hot(231) x $0.519$ = $38.93$ (267)	Annua	l totals									k	Wh/year		kWh/yea	<u>r</u>	
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 $260.84$ (232) 12a. CO2 emissions – Individual heating systems including micro-CHP Energy KWh/year $g CO2/kWh$ $g CO2/year$ Space heating (main system 1) (211) x $0.216$ = $507.91$ (261) Space heating (secondary) (215) x $0.519$ = $0$ (263) Water heating (219) x $0.216$ = $417.41$ (264) Space and water heating (261) + (262) + (263) + (264) = $925.32$ (265) Electricity for pumps, fans and electric keep-hot (231) x $0.519$ = $38.93$ (267)	Space	heating	fuel use	ed, main	system	1								2351.44		
central heating pump: $30$ $(230c)$ boiler with a fan-assisted flue $45$ $(230e)$ Total electricity for the above, kWh/yearsum of $(230a)(230g) =$ $75$ $(231)$ Electricity for lighting $260.84$ $(232)$ 12a. CO2 emissions – Individual heating systems including micro-CHPEmergy kWh/yearEmission factor kg CO2/kWhEmissions kg CO2/yearSpace heating (main system 1) $(211) \times$ $0.216$ $=$ $507.91$ $(261)$ Space heating (secondary) $(215) \times$ $0.519$ $=$ $417.41$ $(264)$ Space and water heating $(261) + (262) + (263) + (264) =$ $925.32$ $(265)$ Electricity for pumps, fans and electric keep-hot $(231) \times$ $0.519$ $=$ $38.93$ $(267)$	Water	heating	fuel use	d										1932.45		
boiler with a fan-assisted flue $45$ (230e) Total electricity for the above, kWh/year sum of (230a)(230g) = $75$ (231) Electricity for lighting $260.84$ (232) <b>12a. CO2 emissions – Individual heating systems including micro-CHP</b> <b>Energy Emission factor Emissions</b> kWh/year $g CO2/kWh$ $kg CO2/year$ Space heating (main system 1) (211) x 0.216 = $507.91$ (261) Space heating (secondary) (215) x 0.519 = 0 (263) Water heating (219) x 0.216 = $417.41$ (264) Space and water heating (261) + (262) + (263) + (264) = $925.32$ (265) Electricity for pumps, fans and electric keep-hot (231) x 0.519 = $38.93$ (267)	Electric	city for p	oumps, fa	ans and	electric	keep-ho	t									
Total electricity for the above, kWh/yearsum of $(230a)(230g) =$ 75(231)Electricity for lighting260.84(232) <b>12a. CO2 emissions – Individual heating systems including micro-CHP</b> Energy kWh/yearEmission factor kg CO2/kWhEmissions kg CO2/yearSpace heating (main system 1)(211) x $0.216$ $=$ Space heating (secondary)(215) x $0.519$ $=$ $0$ Water heating(219) x $0.216$ $=$ $417.41$ (264)Space and water heating(261) + (262) + (263) + (264) = $925.32$ (265)Electricity for pumps, fans and electric keep-hot(231) x $0.519$ $=$ $38.93$ (267)	centra	al heatir	ig pump:	:									30	]	(230c)	
Electricity for lighting $260.84$ (232) 12a. CO2 emissions – Individual heating systems including micro-CHP Energy KWh/year $kg CO2/kWh$ $kg CO2/year$ Space heating (main system 1) (211) x $0.216$ = 507.91 (261) Space heating (secondary) (215) x $0.519$ = 0 (263) Water heating (219) x $0.216$ = 417.41 (264) Space and water heating (261) + (262) + (263) + (264) = 925.32 (265) Electricity for pumps, fans and electric keep-hot (231) x $0.519$ = $38.93$ (267)	boiler	with a f	an-assis	sted flue									45	j	(230e)	
12a. CO2 emissions – Individual heating systems including micro-CHPEnergy kWh/yearEmission factor kg CO2/kWhEmissions kg CO2/yearSpace heating (main system 1) $(211) \times$ $0.216$ = $507.91$ (261)Space heating (secondary) $(215) \times$ $0.519$ = $0$ (263)Water heating $(219) \times$ $0.216$ = $417.41$ (264)Space and water heating $(261) + (262) + (263) + (264) =$ $925.32$ (265)Electricity for pumps, fans and electric keep-hot $(231) \times$ $0.519$ =	Total e	lectricity	y for the	above,	kWh/yea	r			sum	of (230a).	(230g) =			75	(231)	
Energy kWh/yearEmission factor kg CO2/kWhEmissions kg CO2/yearSpace heating (main system 1) $(211) \times$ $0.216 =$ $507.91$ (261)Space heating (secondary) $(215) \times$ $0.519 =$ $0$ (263)Water heating $(219) \times$ $0.216 =$ $417.41$ (264)Space and water heating $(261) + (262) + (263) + (264) =$ $925.32$ (265)Electricity for pumps, fans and electric keep-hot $(231) \times$ $0.519 =$ $38.93$ (267)	Electric	city for l	ighting											260.84	(232)	
Energy kWh/yearEmission factor kg CO2/kWhEmissions kg CO2/yearSpace heating (main system 1) $(211) \times$ $0.216 =$ $507.91$ (261)Space heating (secondary) $(215) \times$ $0.519 =$ $0$ (263)Water heating $(219) \times$ $0.216 =$ $417.41$ (264)Space and water heating $(261) + (262) + (263) + (264) =$ $925.32$ (265)Electricity for pumps, fans and electric keep-hot $(231) \times$ $0.519 =$ $38.93$ (267)	12a. (	CO2 em	issions -	– Individ	lual heati	ing syste	ems inclu	uding mi	cro-CHP							
kWh/yearkg CO2/kWhkg CO2/yearSpace heating (main system 1) $(211) \times$ $0.216$ = $507.91$ $(261)$ Space heating (secondary) $(215) \times$ $0.519$ = $0$ $(263)$ Water heating $(219) \times$ $0.216$ = $417.41$ $(264)$ Space and water heating $(261) + (262) + (263) + (264) =$ $925.32$ $(265)$ Electricity for pumps, fans and electric keep-hot $(231) \times$ $0.519$ = $38.93$ $(267)$							Г.,				<b>F</b> unite o	ion foo	4	<b>Emission</b>	_	
Space heating (secondary) $(215) \times$ $0.519$ = $0$ $(263)$ Water heating $(219) \times$ $0.216$ = $417.41$ $(264)$ Space and water heating $(261) + (262) + (263) + (264) =$ $925.32$ $(265)$ Electricity for pumps, fans and electric keep-hot $(231) \times$ $0.519$ = $38.93$																
Space heating (secondary) $(215) \times$ $0.519$ = $0$ $(263)$ Water heating $(219) \times$ $0.216$ = $417.41$ $(264)$ Space and water heating $(261) + (262) + (263) + (264) =$ $925.32$ $(265)$ Electricity for pumps, fans and electric keep-hot $(231) \times$ $0.519$ = $38.93$	Space	heating	(main s	ystem 1	)		(21	1) x			0.2	16	=	507.91	(261)	
Water heating $(219) \times$ $0.216$ = $417.41$ $(264)$ Space and water heating $(261) + (262) + (263) + (264) =$ $925.32$ $(265)$ Electricity for pumps, fans and electric keep-hot $(231) \times$ $0.519$ = $38.93$ $(267)$	Space	heating	(second	dary)			(21:	5) x					=			
Space and water heating $(261) + (262) + (263) + (264) =$ $925.32$ $(265)$ Electricity for pumps, fans and electric keep-hot $(231) \times$ $0.519$ $=$ $38.93$ $(267)$	•	•	,	57			(219	9) x					=			
Electricity for pumps, fans and electric keep-hot (231) x $0.519 = 38.93$ (267)		-	ter heati	na					+ (263) + (	264) =	L0.2					
	•			•	alactric	kaon ha			、/・(	- /	<b>_</b>		_			
= 135.38  (268)			•	ans dhù	GIECUIC	veeh-uo										
		aty for I	ignang				(234	-, .			0.5	19	-	135.38	(268)	



#### Total CO2, kg/year

TER =

TER WorkSheet: New dwelling as built

sum of (265)...(271) =

1099.62 (272)

21.47 <mark>(273)</mark>



## APPENDIX D DER WORKSHEET OF TYPICAL NEW-EXTENSION (BE LEAN)



Mecserve Ltd Panagiotis Dalapas 020 3141 5800 Target Fabric Energy Efficiency WorkSheet: New dwelling as built panos.dalapas@mecserve.com

		User [	Details:				
Assessor Name:	Panagiotis Dalapas		Stroma Nur	nber:	STRC	030082	
Software Name:	Stroma FSAP 2012		Software Ve	ersion:	Versio	on: 1.0.4.14	
		Property	Address: No	65-Plot 4-P	roposed		
Address :	Plot 4, 65 Guilford Str	eet, WC1N 1DE	)				
1. Overall dwelling dimen	sions:						
		Area	(m²)	Av. Heig	ht(m)	Volume(m <sup>3</sup> )	
Ground floor		51	.22 (1a) x	2.55	5 (2a) =	130.61	(3a)
Total floor area TFA = (1a	)+(1b)+(1c)+(1d)+(1e)+	⊦(1n) 51	.22 (4)				
Dwelling volume			(3a)+(3	3b)+(3c)+(3d)+	(3e)+(3n) =	130.61	(5)
2. Ventilation rate:							
		condary c ating	other	total		m <sup>3</sup> per hour	
Number of chimneys		0 +	0 =	0	x 40 =	0	(6a)
Number of open flues	0 +	0 +	0 =	0	x 20 =	0	(6b)
Number of intermittent fan	s			2	x 10 =	20	(7a)
Number of passive vents				0	x 10 =	0	(7b)
Number of flueless gas fire	es			0	x 40 =	0	(7c)
					_		-
					Air cl	hanges per ho	ur
Infiltration due to chimney				20	÷ (5) =	0.15	(8)
If a pressurisation test has be		, proceed to (17), ot	herwise continue	from (9) to (16	5)	r	<b>-</b>
Number of storeys in the Additional infiltration	e aweiling (ns)					0	(9)
	)E for staal or timber fr	ama ar 0.25 far		truction	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.2	sent, use the value correspo			liuction		0	(11)
deducting areas of opening		finding to the greater	i wali area (allei				
If suspended wooden flo	oor, enter 0.2 (unsealed	d) or 0.1 (sealed	d), else enter (	)		0	(12)
If no draught lobby, ente	r 0.05, else enter 0					0	(13)
Percentage of windows	and doors draught strip	pped				0	(14)
Window infiltration		C	0.25 - [0.2 x (14) ÷	100] =		0	(15)
Infiltration rate		(	8) + (10) + (11) +	(12) + (13) + (	(15) =	0	(16)
Air permeability value, c	50, expressed in cubic	c metres per hou	ır per square ı	metre of env	velope area	5	(17)
If based on air permeabilit	y value, then (18) = [(17)	÷ 20]+(8), otherwis	e (18) = (16)			0.4	(18)
Air permeability value applies		been done or a degr	ee air permeabilit	y is being use	d		-
Number of sides sheltered Shelter factor	I	1	20) = 1 - [0.075 x	(10)] -		4	(19)
	a a baltan fastan					0.7	(20)
Infiltration rate incorporation	-	(.	21) = (18) x (20) =	-		0.28	(21)
Infiltration rate modified fo					Neu	1	
	Mar Apr May	Jun Jul	Aug Sep	Oct	Nov Dec	]	
Monthly average wind spe	<u> </u>		1	- <u> </u>	I	1	
(22)m= 5.1 5 4	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						

(22a)m=	1 27	1 25	1 2 2	11	1 0 8	0 05	0.95	0 0 2	1	1 0 8	1.12	1.18
( <u>22</u> a)III-	1.21	1.20	1.20	1 1.1	1.00	0.30	0.30	0.32		1.00	1.14	1.10



Mecserve Ltd Panagiotis Dalapas 020 3141 5800 Target Fabric Energy Efficiency WorkSheet: New dwelling as built

panos.dalapas@mecserve.com

Adjust	ed infiltr	ation rat	e (allowi	ng for sh	nelter an	d wind s	peed) =	(21a) x	(22a)m	-		-			
	0.36	0.35	0.35	0.31	0.3	0.27	0.27	0.26	0.28	0.3	0.32	0.33			
		<i>ctive air</i> al ventila	-	rate for t	he appli	cable ca	se								
				endix N, (2	3h) - (23a	) v Emv (e	auation (N	(15)) other	rwise (23h	) – (23a)			0		(23a)
				iency in %						) = (200)			0		(23b)
			-	-	_					2h)m i ('	00h) v [/	1 – (23c)	0		(23c)
a) ii (24a)m=					0			0	$\frac{1}{0} = \frac{1}{2}$		230) <b>x</b> [	1 - (230)	÷ 100]		(24a)
		-	_	_			_		-	-	-	0	l		(2.10)
0) II (24b)m=	r			ontilation				0 0	0 = (22)	0	230)	0	1		(24b)
										0	0	0	l		(240)
				tilation c hen (24c	•	•				5 × (23b	)				
(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0			(24c)
,				ole hous m = (22t	•					0.5]					
(24d)m=	0.56	0.56	0.56	0.55	0.55	0.54	0.54	0.53	0.54	0.55	0.55	0.55			(24d)
Effe	ctive air	change	rate - er	nter (24a	) or (24b	o) or (24	c) or (24	d) in boy	(25)						
(25)m=	0.56	0.56	0.56	0.55	0.55	0.54	0.54	0.53	0.54	0.55	0.55	0.55			(25)
3 Ho	at losso	s and he	at loss r	paramete	ar.				•	•		•	•		
	MENT	Gros		Openin		Net Ar	ea	U-valı	Ie	AXU		k-value	2	ΑX	k
		area	-	m	-	A ,r		W/m2		(W/I	<b>&lt;</b> )	kJ/m²·l		kJ/K	
Doors						2	x	1	=	2					(26)
Windo	ws Type	e 1				1.89	x1.	/[1/( 1.4 )+	0.04] =	2.51					(27)
Windo	ws Type	e 2				0.92	x1.	/[1/( 1.4 )+	0.04] =	1.22					(27)
Windo	ws Type	e 3				3.84	x1.	/[1/( 1.4 )+	0.04] =	5.09					(27)
Windo	ws Type	94				1.23	x1.	/[1/( 1.4 )+	0.04] =	1.63	=				(27)
Walls	Type1	80.7	8	9.88		70.9	x	0.18	= [	12.76					(29)
Walls	Type2	5.8	9	0		5.89	x	0.18	=	1.06					(29)
Roof		12.8	6	0		12.86	3 X	0.13	=	1.67			$\neg$		(30)
Total a	area of e	lements	, m²			99.53	3								(31)
				effective wil Internal wall			ated using	formula 1	/[(1/U-valu	ıe)+0.04] a	s given in	paragraph	3.2		
Fabric	heat los	ss, W/K :	= S (A x	U)				(26)(30)	) + (32) =				27.9	)4	(33)
Heat c	apacity	Cm = S(	Axk)						((28)	(30) + (32	2) + (32a).	(32e) =	4723	.14	(34)
Therm	al mass	parame	ter (TMF	• = Cm ÷	- TFA) ir	n kJ/m²K			Indica	tive Value	Medium		250	)	(35)
	•	sments wh ad of a dea		tails of the ulation.	constructi	ion are noi	t known pr	ecisely the	e indicative	e values of	TMP in Ta	able 1f			1
Therm	al bridge	es : S (L	x Y) cal	culated u	using Ap	pendix l	<						7.2	5	(36)
if details	s of therma	al bridging	are not kn	own (36) =	= 0.15 x (3	1)							·		_
Total f	abric he	at loss							(33) +	(36) =			35.1	9	(37)
Ventila	ation hea	at loss ca	alculated	l monthly	/		r		(38)m	= 0.33 × (	25)m x (5)	, T,	1		
	Jan	Feb	Mar	Apr	Мау	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
(38)m=	24.34	24.23	24.13	23.63	23.53	23.1	23.1	23.02	23.27	23.53	23.72	23.92			(38)

Heat transfer coefficient W/K

(39)m = (37) + (38)m



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Heat lo	oss para	ameter (H	HLP), W	/m²K					(40)m	= (39)m ÷	- (4)			
(40)m=	1.16	1.16	1.16	1.15	1.15	1.14	1.14	1.14	1.14	1.15	1.15	1.15		
Numbe	er of day	/s in mo	nth (Tab	le 1a)					,	Average =	Sum(40)₁.	.12 /12=	1.15	(40)
	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	ater hea	ting ene	rgy requ	irement:								kWh/ye	ear:	
if TF				([1 - exp	(-0.0003	349 x (Tł	FA -13.9	)2)] + 0.(	0013 x ( <sup>-</sup>	TFA -13		73		(42)
Reduce	the annua	al average	hot water	ge in litre usage by r day (all w	5% if the c	welling is	designed			se target o		.19		(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot wate	er usage i	n litres per	day for ea	ach month	Vd,m = fa	ctor from	Table 1c x	(43)		_	_			
(44)m=	82.71	79.71	76.7	73.69	70.68	67.67	67.67	70.68	73.69	76.7	79.71	82.71		_
Energy o	content of	hot water	used - ca	lculated m	onthly $= 4$ .	190 x Vd,ı	n x nm x D	0Tm / 3600			m(44) <sub>112</sub> = ables 1b, 1		902.33	(44)
(45)m=	122.66	107.28	110.7	96.51	92.61	79.91	74.05	84.98	85.99	100.21	109.39	118.79		
15 1		•								Total = Su	m(45) <sub>112</sub> =		1183.09	(45)
			· ·	t of use (no T	r			1	· · /	. <u> </u>				(10)
(46)m= Water	0 storage	0 loss:	0	0	0	0	0	0	0	0	0	0		(46)
Storag	e volum	e (litres)	includir	ng any se	olar or W	/WHRS	storage	within sa	ame ves	sel	(	C		(47)
	-	-		ank in dw	-			. ,						
			hot wate	er (this ir	ncludes i	nstantar	neous co	ombi boil	ers) ente	er '0' in (	(47)			
	storage		eclared I	loss facto	or is kno	wn (kWł	n/dav).					D C		(48)
		actor fro					" ddy ) !					<u>с</u>		(49)
				e, kWh/ye	ear			(48) x (49)	) =			,		(50)
b) If m	nanufact	turer's de	eclared	cylinder	loss fact							-		
		-		rom Tabl	le 2 (kW	h/litre/da	ay)					0		(51)
	•	neating s from Ta		on 4.3								D C		(52)
		actor fro		e 2b								, Э		(52)
Energy	/ lost fro	om water	storage	e, kWh/ye	ear			(47) x (51)	) x (52) x (	53) =				(54)
0,		(54) in (5	•									с С		(55)
Water	storage	loss cal	culated	for each	month			((56)m = (	55) × (41)ı	m				
(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
If cylinde	er contain	s dedicate	d solar sto	orage, (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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)
Primar	y circuit	loss (ar	nual) fro	om Table	e 3	_	_	_	_	_		C		(58)
	-			for each			. ,	. ,						
		1	i	le H5 if t	i	i	ter heati	<u> </u>	· ·	1	í			(50)
(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)



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Combi	loss cal	lculated	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	for eacl	n month	(62)m =	0.85 ×	(45)m +	(46)m +	(57)m +	(59)m + (61)m	
(62)m=	104.26	91.19	94.1	82.04	78.72	67.93	62.94	72.23	73.09	85.18	92.98	100.97		(62)
Solar DH	IW input o	calculated	using App	endix G or	Appendix	H (negativ	ve quantity	/) (enter '0	' if no sola	r contribut	ion to wate	er heating)		
(add a	dditiona	l lines if	FGHRS	and/or \	WWHRS	applies	, see Ap	pendix C	G)					
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0		(63)
Output	from wa	ater hea	ter											
(64)m=	104.26	91.19	94.1	82.04	78.72	67.93	62.94	72.23	73.09	85.18	92.98	100.97		
			-					Outp	out from w	ater heater	r (annual) <sub>1</sub>	12	1005.63	(64)
Heat g	ains froi	m water	heating,	kWh/m	onth 0.2	5 ´ [0.85	× (45)m	ı + (61)m	n] + 0.8 x	(46)m	+ (57)m	+ (59)m	]	
(65)m=	26.07	22.8	23.52	20.51	19.68	16.98	15.74	18.06	18.27	21.3	23.25	25.24		(65)
inclu	de (57)ı	m in calo	culation	of (65)m	only if c	ylinder is	s in the c	dwelling	or hot w	ater is fr	om com	munity h	eating	
5. Int	ernal ga	ains (see	e Table 5	and 5a	):									
Metabo	olic gain	s (Table	e 5), Wat	ts										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(66)m=	86.3	86.3	86.3	86.3	86.3	86.3	86.3	86.3	86.3	86.3	86.3	86.3		(66)
Lightin	g gains	(calcula	ted in Ap	pendix	L, equati	ion L9 oi	r L9a), a	lso see <sup>-</sup>	Table 5					
(67)m=	14.77	13.12	10.67	8.08	6.04	5.1	5.51	7.16	9.61	12.2	14.24	15.18		(67)
Applia	nces gai	ins (calc	ulated ir	Append	dix L, eq	uation L	13 or L1	3a), also	see Ta	ble 5				
(68)m=	150.4	151.96	148.03	139.66	129.09	119.15	112.52	110.96	114.89	123.26	133.83	143.77		(68)
Cookin	g gains	(calcula	ted in A	ppendix	L, equat	ion L15	or L15a)	), also se	e Table	5				
(69)m=	31.63	31.63	31.63	31.63	31.63	31.63	31.63	31.63	31.63	31.63	31.63	31.63		(69)
Pumps	and far	ns aains	(Table (	5a)		I		1	1	1	1	1		
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0		(70)
Losses	se.a. ev	aporatio	n (nega	tive valu	es) (Tab	le 5)								
		-69.04					-69.04	-69.04	-69.04	-69.04	-69.04	-69.04		(71)
Water	heating	gains (T	able 5)	I				1	1	1	1	1		
(72)m=	35.03	33.92	31.62	28.49	26.45	23.59	21.15	24.27	25.38	28.62	32.29	33.93		(72)
	nternal	gains =	I			(66)	m + (67)m	I 1 + (68)m +	L ⊦ (69)m + i	I (70)m + (7	1)m + (72)	m		
(73)m=	249.1	247.9	239.21	225.11	210.47	196.73	188.07	191.28	198.77	212.98	229.25	241.77		(73)
	ar gains		I					I		I		I		
Solar g	ains are c	alculated	using sola	r flux from	Table 6a a	and associ	ated equa	itions to co	onvert to th	e applicab	le orientat	ion.		

Orientat	tion:	Access Factor Table 6d	r	Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	1	x	1.89	x	19.64	×	0.63	x	0.7	=	7.96	(76)
East	0.9x	1	x	0.92	x	19.64	x	0.63	x	0.7	=	3.87	(76)
East	0.9x	1	x	3.84	x	19.64	x	0.63	x	0.7	=	16.16	(76)
East	0.9x	1	x	1.23	x	19.64	x	0.63	x	0.7	=	5.18	(76)
East	0.9x	1	x	1.89	x	38.42	×	0.63	x	0.7	=	15.56	(76)



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East	0.9x	1	×	0.92	x	38.42	×	0.63	x	0.7	=	7.58	(76)
East	0.9x	1	x	3.84	x	38.42	×	0.63	x	0.7	=	31.62	(76)
East	0.9x	1	x	1.23	x	38.42	×	0.63	x	0.7	=	10.13	(76)
East	0.9x	1	x	1.89	×	63.27	×	0.63	x	0.7	=	25.63	(76)
East	0.9x	1	x	0.92	x	63.27	×	0.63	x	0.7	=	12.48	(76)
East	0.9x	1	x	3.84	x	63.27	×	0.63	x	0.7	=	52.07	(76)
East	0.9x	1	x	1.23	x	63.27	x	0.63	x	0.7	=	16.68	(76)
East	0.9x	1	x	1.89	x	92.28	x	0.63	x	0.7	=	37.38	(76)
East	0.9x	1	x	0.92	x	92.28	x	0.63	x	0.7	=	18.2	(76)
East	0.9x	1	x	3.84	x	92.28	x	0.63	x	0.7	=	75.95	(76)
East	0.9x	1	x	1.23	x	92.28	x	0.63	x	0.7	=	24.33	(76)
East	0.9x	1	x	1.89	x	113.09	x	0.63	x	0.7	=	45.81	(76)
East	0.9x	1	x	0.92	×	113.09	×	0.63	x	0.7	=	22.3	(76)
East	0.9x	1	x	3.84	x	113.09	x	0.63	x	0.7	=	93.08	(76)
East	0.9x	1	x	1.23	x	113.09	×	0.63	x	0.7	=	29.81	(76)
East	0.9x	1	x	1.89	×	115.77	×	0.63	x	0.7	=	46.9	(76)
East	0.9x	1	x	0.92	x	115.77	×	0.63	x	0.7	=	22.83	(76)
East	0.9x	1	x	3.84	x	115.77	×	0.63	x	0.7	=	95.28	(76)
East	0.9x	1	x	1.23	×	115.77	×	0.63	x	0.7	=	30.52	(76)
East	0.9x	1	x	1.89	x	110.22	×	0.63	x	0.7	=	44.65	(76)
East	0.9x	1	x	0.92	x	110.22	x	0.63	x	0.7	=	21.73	(76)
East	0.9x	1	x	3.84	x	110.22	x	0.63	x	0.7	=	90.71	(76)
East	0.9x	1	x	1.23	x	110.22	x	0.63	x	0.7	=	29.06	(76)
East	0.9x	1	x	1.89	x	94.68	x	0.63	x	0.7	=	38.35	(76)
East	0.9x	1	x	0.92	x	94.68	x	0.63	x	0.7	=	18.67	(76)
East	0.9x	1	x	3.84	x	94.68	x	0.63	x	0.7	=	77.92	(76)
East	0.9x	1	x	1.23	x	94.68	x	0.63	x	0.7	=	24.96	(76)
East	0.9x	1	x	1.89	×	73.59	×	0.63	x	0.7	=	29.81	(76)
East	0.9x	1	x	0.92	x	73.59	x	0.63	x	0.7	=	14.51	(76)
East	0.9x	1	x	3.84	x	73.59	×	0.63	x	0.7	=	60.56	(76)
East	0.9x	1	x	1.23	x	73.59	x	0.63	x	0.7	=	19.4	(76)
East	0.9x	1	x	1.89	x	45.59	x	0.63	x	0.7	=	18.47	(76)
East	0.9x	1	x	0.92	x	45.59	x	0.63	x	0.7	=	8.99	(76)
East	0.9x	1	x	3.84	x	45.59	×	0.63	x	0.7	=	37.52	(76)
East	0.9x	1	x	1.23	x	45.59	×	0.63	x	0.7	=	12.02	(76)
East	0.9x	1	x	1.89	x	24.49	x	0.63	x	0.7	=	9.92	(76)
East	0.9x	1	x	0.92	x	24.49	×	0.63	x	0.7	=	4.83	(76)
East	0.9x	1	×	3.84	×	24.49	×	0.63	x	0.7	=	20.15	(76)
East	0.9x	1	x	1.23	x	24.49	×	0.63	x	0.7	=	6.46	(76)
East	0.9x	1	×	1.89	x	16.15	×	0.63	x	0.7	=	6.54	(76)
East	0.9x	1	×	0.92	×	16.15	×	0.63	x	0.7	=	3.18	(76)



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East	0.9x	1	x	3.8	34	<b>x</b> 1	6.15	x	0.63	x	0.7	=	13.29	(76)
East	0.9x	1	x	1.2	23	x 1	6.15	x 🗌	0.63	_ × [	0.7	=	4.26	(76)
Solar gains in watts, calculated for each month $(83)m = Sum(74)m(82)m$														
(83)m=	33.17	64.89	106.86	155.85	191	195.52	186.15	159.9	124.28	77	41.36	27.28		(83)
Total g	Total gains – internal and solar (84)m = (73)m + (83)m , watts													
(84)m= 282.27 312.78 346.07 380.96 401.47 392.25 374.21 351.18 323.05 289.97 270.61 269.04											269.04	]	(84)	
7. Mean internal temperature (heating season)														
Temperature during heating periods in the living area from Table 9, Th1 (°C)												21	(85)	
Utilisation factor for gains for living area, h1,m (see Table 9a)														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(86)m=	1	1	0.99	0.98	0.93	0.81	0.65	0.71	0.91	0.99	1	1		(86)
Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)														
(87)m=	19.7	19.82	20.05	20.38	20.69	20.9	20.98	20.96	20.8	20.4	19.99	19.67		(87)
Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)														
(88)m=	19.95	19.95	19.95	19.96	19.96	19.97	19.97	19.97	19.97	19.96	19.96	19.96	]	(88)
						L	I	(	1				]	
(89)m=		tor for g	0.99	0.97	0.9	h2,m (se 0.73		9a) 0.57	0.86	0.98	1	1	1	(89)
	Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)												J	
	18.76	1 temper	ature in 19.12	the rest	of dwell 19.74	19.92 (f	ollow ste	19.96	19.85	e 9C) 19.48	19.07	18.74	1	(90)
(90)m=	10.70	10.09	19.12	19.45	19.74	19.92	19.90	19.90				10.74		(00)
$fLA = Living area \div (4) = 0.46$ (91)												1) -	0.46	(01)
										iLA = Livin	g area ÷ (4	4) =	0.46	(91)
		· · ·	<u> </u>	1	1		1	<u> </u>	_A) × T2			, 	0.46	
(92)m=	19.19	19.31	19.55	19.87	20.17	20.37	20.43	20.42	_A) × T2 20.28	19.9	g area ÷ (4 19.49	4) = 19.17	0.46	(91)
(92)m= Apply	19.19 adjustn	19.31 nent to t	19.55 he mear	19.87 internal	20.17 temper	20.37 ature fro	20.43 m Table	20.42 4e, who	_A) × T2 20.28 ere appro	19.9 opriate	19.49	19.17	0.46	(92)
(92)m= Apply (93)m=	19.19 adjustn 19.19	19.31 nent to t 19.31	19.55 he mear 19.55	19.87 interna 19.87	20.17	20.37	20.43	20.42	_A) × T2 20.28	19.9		, 	0.46	
(92)m= Apply (93)m= 8. Spa	19.19 adjustn 19.19 ace hea	19.31 nent to ti 19.31 ting requ	19.55 he mean 19.55 uirement	19.87 n interna 19.87	20.17 temper 20.17	20.37 ature fro 20.37	20.43 m Table 20.43	20.42 4e, who 20.42	A) × T2 20.28 ere appro 20.28	19.9 opriate 19.9	19.49 19.49	19.17 19.17		(92)
(92)m= Apply (93)m= 8. Spa Set T	19.19 adjustn 19.19 ace hea i to the r	19.31 nent to ti 19.31 ting requ mean int	19.55 he mean 19.55 uirement	19.87 internal 19.87 mperatu	20.17 temper 20.17 re obtair	20.37 ature fro 20.37	20.43 m Table 20.43	20.42 4e, who 20.42	_A) × T2 20.28 ere appro	19.9 opriate 19.9	19.49 19.49	19.17 19.17		(92)
(92)m= Apply (93)m= 8. Spa Set T	19.19 adjustn 19.19 ace hea i to the r	19.31 nent to ti 19.31 ting requ mean int	19.55 he mean 19.55 uirement ternal ter	19.87 internal 19.87 mperatu	20.17 temper 20.17 re obtair	20.37 ature fro 20.37	20.43 m Table 20.43	20.42 4e, who 20.42	A) × T2 20.28 ere appro 20.28	19.9 opriate 19.9	19.49 19.49	19.17 19.17		(92)
(92)m= Apply (93)m= 8. Spa Set T the ut	19.19 adjustn 19.19 ace hea i to the r illisation Jan	19.31 nent to tl 19.31 ting requ mean int factor fo Feb	19.55 he mean 19.55 uirement ternal ter or gains	19.87 n internal 19.87 mperatur using Ta Apr	20.17 temper 20.17 re obtair able 9a	20.37 ature fro 20.37 ned at sto	20.43 m Table 20.43 ep 11 of	20.42 4e, who 20.42 Table 9	A) × T2 20.28 ere appro 20.28 b, so tha	19.9 opriate 19.9 t Ti,m=(	19.49 19.49 76)m and	19.17 19.17 d re-calo		(92)
(92)m= Apply (93)m= 8. Spa Set T the ut	19.19 adjustn 19.19 ace hea i to the r illisation Jan	19.31 nent to tl 19.31 ting requ mean int factor fo Feb	19.55 he mean 19.55 uirement ternal ter or gains Mar	19.87 n internal 19.87 mperatur using Ta Apr	20.17 temper 20.17 re obtair able 9a	20.37 ature fro 20.37 ned at sto	20.43 m Table 20.43 ep 11 of	20.42 4e, who 20.42 Table 9	A) × T2 20.28 ere appro 20.28 b, so tha	19.9 opriate 19.9 t Ti,m=(	19.49 19.49 76)m and	19.17 19.17 d re-calo		(92)
(92)m= Apply (93)m= 8. Spa Set T the ut Utilisa (94)m=	19.19adjustn19.19ace heai to the rilisationJanation fac1	19.31 nent to tl 19.31 ting requ mean int factor fo Feb tor for g 1	19.55 he mean 19.55 Jirement cernal ter or gains Mar ains, hm	19.87 n internal 19.87 mperatur using Ta Apr 1: 0.97	20.17 I temper 20.17 re obtair able 9a May 0.91	20.37 ature fro 20.37 ned at sto Jun	20.43 m Table 20.43 ep 11 of Jul	20.42 4e, who 20.42 Table 9 Aug	A) × T2 20.28 ere appro 20.28 b, so tha Sep	19.9 opriate 19.9 t Ti,m=( Oct	19.49 19.49 76)m and Nov	19.17 19.17 d re-calo Dec		(92) (93)
(92)m= Apply (93)m= 8. Spa Set T the ut Utilisa (94)m= Usefu (95)m=	19.19adjustn19.19ace heai to the rilisationJanation fac1gains,281.62	19.31 nent to ti 19.31 ting required mean int factor for Feb tor for g 1 hmGm 311.48	19.55 he mean 19.55 uirement cernal ter or gains Mar ains, hm 0.99 , W = (94 342.62	19.87 n internal 19.87 mperatur using Ta Apr 1: 0.97 4)m x (84 369.48	20.17 I temper 20.17 re obtair able 9a May 0.91 4)m 365.22	20.37 eature fro 20.37 ned at sta Jun 0.76	20.43 m Table 20.43 ep 11 of Jul	20.42 4e, who 20.42 Table 9 Aug	A) × T2 20.28 ere appro 20.28 b, so tha Sep	19.9 opriate 19.9 t Ti,m=( Oct	19.49 19.49 76)m and Nov	19.17 19.17 d re-calo Dec		(92) (93)
(92)m= Apply (93)m= 8. Spa Set T the ut Utilisa (94)m= Usefu (95)m= Month	19.19 adjustn 19.19 ace hea i to the r ilisation Jan Jan ation fac 1 ul gains, 281.62	19.31 nent to ti 19.31 ting requ mean int factor for Feb tor for g 1 hmGm 311.48 age exte	19.55 he mean 19.55 uirement ernal ter or gains Mar ains, hm 0.99 , W = (94 342.62 ernal tem	19.87 internal 19.87 mperatur using Ta Apr a: 0.97 4)m x (84 369.48 perature	20.17 I temper 20.17 Te obtain able 9a May 0.91 4)m 365.22 e from T	20.37 eature fro 20.37 ned at sto Jun 0.76 300.03 able 8	20.43 m Table 20.43 ep 11 of Jul 0.58 216.16	20.42 4e, who 20.42 Table 9 Aug 0.64 223.04	A) × T2 20.28 ere appro 20.28 b, so tha Sep 0.88 283.63	19.9 opriate 19.9 t Ti,m=( Oct 0.98 284.25	19.49 19.49 76)m and Nov 1 269.44	19.17 19.17 d re-calo Dec 1 268.56		(92) (93) (94) (95)
(92)m= Apply (93)m= 8. Spa Set T the ut Utilisa (94)m= Usefu (95)m= Month (96)m=	19.19adjustn19.19ace heai to the rilisationJanation fac1al gains,281.62nly avera4.3	19.31nent to ti19.31ting requireting requiremean intfactor forFebtor for g1hmGm311.48age exte4.9	19.55he mean19.55uirementcernal teror gainsMarains, hm $0.99$ , W = (94)342.62ornal tem6.5	19.87 internal 19.87 mperatur using Ta Apr : 0.97 4)m x (84 369.48 mperature 8.9	20.17 1 temper 20.17 re obtair able 9a May 0.91 4)m 365.22 e from T 11.7	20.37 eature fro 20.37 ned at sta Jun 0.76 300.03 able 8 14.6	20.43 m Table 20.43 ep 11 of Jul 0.58 216.16	20.42 4e, who 20.42 Table 9 Aug 0.64 223.04	A) × T2 20.28 ere appro 20.28 b, so tha Sep 0.88 283.63	19.9 opriate 19.9 t Ti,m=( Oct 0.98 284.25 10.6	19.49 19.49 76)m and Nov	19.17 19.17 d re-calo Dec 1		(92) (93) (94)
(92)m= Apply (93)m= 8. Spa Set T the ut Utilisa (94)m= Usefu (95)m= Month (96)m= Heat	19.19adjustn19.19ace heai to the riilisationJanation fac1gains,281.62nly avera4.3loss rate	19.31 nent to ti 19.31 ting required factor for Feb tor for g 1 hmGm 311.48 age exte 4.9 e for mea	19.55he mean19.55uirementcernal teror gainsMarains, hm0.99, W = (94)342.62ernal tem6.5an intern	19.87 internal 19.87 mperatur using Ta Apr a: 0.97 4)m x (84 369.48 sperature 8.9 nal tempe	20.17 I temper 20.17 Te obtain able 9a May 0.91 4)m 365.22 e from T 11.7 erature,	20.37 eature fro 20.37 ned at sto Jun 0.76 300.03 able 8 14.6 Lm , W =	20.43 m Table 20.43 ep 11 of Jul 0.58 216.16 16.6 =[(39)m	20.42 4e, who 20.42 Table 9 Aug 0.64 223.04 16.4 x [(93)m	A) × T2 20.28 ere appro 20.28 b, so tha Sep 0.88 283.63 14.1 b- (96)m	19.9 opriate 19.9 t Ti,m=( Oct 0.98 284.25 10.6 ]	19.49 19.49 76)m and Nov 1 269.44 7.1	19.17 19.17 d re-calo Dec 1 268.56 4.2		(92) (93) (94) (95) (96)
(92)m= Apply (93)m= 8. Spa Set T the ut Utilisa (94)m= Usefu (95)m= Month (96)m= Heat (97)m=	19.19adjustn19.19ace heai to the rilisationJanation fac1ation fac1ation s281.62nly avera4.3loss rate886.33	19.31 nent to ti 19.31 ting required mean int factor for Feb tor for g 1 hmGm 311.48 age exte 4.9 e for mea 856.42	19.55he mean19.55uirementuirementor gainsMarains, hm $0.99$ , W = (94)342.62ernal tem6.5an intern773.92	19.87 internal 19.87 mperatur using Ta Apr : 0.97 4)m x (84 369.48 mperature 8.9 nal tempe 645.37	20.17 1 temper 20.17 re obtair able 9a May 0.91 4)m 365.22 e from T 11.7 erature, 497.42	20.37 ature fro 20.37 ned at sta Jun 0.76 300.03 able 8 14.6 Lm , W = 336.22	20.43 m Table 20.43 ep 11 of Jul 0.58 216.16 16.6 =[(39)m 222.99	20.42 4e, who 20.42 Table 9 Aug 0.64 223.04 16.4 x [(93)m 233.89	_A) × T2 20.28 ere appro 20.28 b, so tha Sep 0.88 283.63 14.1 → (96)m 361.41	19.9 ppriate 19.9 t Ti,m=( Oct 0.98 284.25 10.6 ] 546.15	19.49 19.49 76)m and Nov 1 269.44 7.1 729.89	19.17 19.17 d re-calo Dec 1 268.56		(92) (93) (94) (95)
(92)m= Apply (93)m= 8. Spa Set T the ut Utilisa (94)m= Usefu (95)m= Month (96)m= Heat (97)m= Space	19.19adjustn19.19ace heai to the rilisationJanation fac11gains,281.62aly avera4.3loss rate886.33e heatin	19.31 nent to ti 19.31 ting required mean int factor for Feb tor for g 1 hmGm 311.48 age exte 4.9 e for mea 856.42 g required	19.55he mean19.55uirementcernal teror gainsMarains, hm $0.99$ , W = (94)342.62ernal tem6.5an intern773.92ement for	19.87 internal 19.87 mperatur using Ta Apr a: 0.97 4)m x (84 369.48 sperature 8.9 nal tempe 645.37 or each n	20.17 1 temper 20.17 re obtain able 9a May 0.91 4)m 365.22 a from T 11.7 erature, 497.42 nonth, k'	20.37 eature fro 20.37 ned at sto Jun 0.76 300.03 able 8 14.6 Lm , W = 336.22 Wh/mon	20.43 m Table 20.43 ep 11 of Jul 0.58 216.16 16.6 =[(39)m 222.99 th = 0.02	20.42 4e, who 20.42 Table 9 Aug 0.64 223.04 16.4 x [(93)m 233.89 24 x [(97	A) × T2 20.28 ere appro 20.28 b, so tha Sep 0.88 283.63 14.1 b- (96)m 361.41 ')m - (95	19.9 priate 19.9 t Ti,m=( Oct 0.98 284.25 10.6 ] 546.15 )m] x (4'	19.49 19.49 76)m and Nov 1 269.44 7.1 729.89 1)m	19.17 19.17 d re-calo Dec 1 268.56 4.2 884.74		(92) (93) (94) (95) (96)
(92)m= Apply (93)m= 8. Spa Set T the ut Utilisa (94)m= Usefu (95)m= Month (96)m= Heat (97)m=	19.19adjustn19.19ace heai to the rilisationJanation fac1ation fac1ation s281.62nly avera4.3loss rate886.33	19.31 nent to ti 19.31 ting required mean int factor for Feb tor for g 1 hmGm 311.48 age exte 4.9 e for mea 856.42	19.55he mean19.55uirementuirementor gainsMarains, hm $0.99$ , W = (94)342.62ernal tem6.5an intern773.92	19.87 internal 19.87 mperatur using Ta Apr : 0.97 4)m x (84 369.48 mperature 8.9 nal tempe 645.37	20.17 1 temper 20.17 re obtair able 9a May 0.91 4)m 365.22 e from T 11.7 erature, 497.42	20.37 ature fro 20.37 ned at sta Jun 0.76 300.03 able 8 14.6 Lm , W = 336.22	20.43 m Table 20.43 ep 11 of Jul 0.58 216.16 16.6 =[(39)m 222.99	20.42 4e, who 20.42 Table 9 Aug 0.64 223.04 16.4 x [(93)m 233.89 24 x [(97 0	A) × T2 20.28 ere appro 20.28 b, so tha Sep 0.88 283.63 14.1 h- (96)m 361.41 ')m - (95 0	19.9 opriate 19.9 t Ti,m=( Oct 0.98 284.25 10.6 ] 546.15 )m] x (4 <sup>2</sup> 194.86	19.49 19.49 76)m and Nov 1 269.44 7.1 729.89 1)m 331.52	19.17 19.17 d re-calo Dec 1 268.56 4.2 884.74 458.43	             	(92) (93) (94) (95) (96) (97)
(92)m= Apply (93)m= 8. Spa Set T the ut Utilisa (94)m= Usefu (95)m= Month (96)m= Heat (97)m= Space (98)m=	19.19adjustn19.19ace heai to the rilisationJanation fac1ation fac1ation s281.62nly avera4.3loss rate886.33e heatin449.9	19.31nent to ti19.31ting requiredting requiredmean interfactor forFebtor for g1hmGm311.48age extermed4.9e for mea856.42g required366.2	19.55he mean19.55uirementuirementcernal teror gainsMarains, hm $0.99$ , W = (94)342.62ernal tem6.5an intern773.92ement fo320.89	19.87           internal           19.87           mperatur           using Ta           Apr           :           0.97           4)m x (84           369.48           perature           8.9           nal tempe           645.37           or each n           198.64	20.17 I temper 20.17 Te obtain able 9a May 0.91 4)m 365.22 5 from T 11.7 erature, 497.42 nonth, k' 98.36	20.37 eature fro 20.37 ned at sto Jun 0.76 300.03 able 8 14.6 Lm , W = 336.22 Wh/mon	20.43 m Table 20.43 ep 11 of Jul 0.58 216.16 16.6 =[(39)m 222.99 th = 0.02	20.42 4e, who 20.42 Table 9 Aug 0.64 223.04 16.4 x [(93)m 233.89 24 x [(97 0	A) × T2 20.28 ere appro 20.28 b, so tha Sep 0.88 283.63 14.1 b- (96)m 361.41 ')m - (95	19.9 opriate 19.9 t Ti,m=( Oct 0.98 284.25 10.6 ] 546.15 )m] x (4 <sup>2</sup> 194.86	19.49 19.49 76)m and Nov 1 269.44 7.1 729.89 1)m 331.52	19.17 19.17 d re-calo Dec 1 268.56 4.2 884.74 458.43		(92) (93) (94) (95) (96) (97) (98)
(92)m= Apply (93)m= 8. Spa Set T the ut Utilisa (94)m= Usefu (95)m= Month (96)m= Heat (97)m= Space (98)m=	19.19adjustn19.19ace heai to the rilisationJanation fac1ation fac1ation s281.62nly avera4.3loss rate886.33e heatin449.9	19.31nent to ti19.31ting requiredting requiredmean interfactor forFebtor for g1hmGm311.48age extermed4.9e for mea856.42g required366.2	19.55he mean19.55uirementcernal teror gainsMarains, hm $0.99$ , W = (94)342.62ernal tem6.5an intern773.92ement for	19.87           internal           19.87           mperatur           using Ta           Apr           :           0.97           4)m x (84           369.48           perature           8.9           nal tempe           645.37           or each n           198.64	20.17 I temper 20.17 Te obtain able 9a May 0.91 4)m 365.22 5 from T 11.7 erature, 497.42 nonth, k' 98.36	20.37 eature fro 20.37 ned at sto Jun 0.76 300.03 able 8 14.6 Lm , W = 336.22 Wh/mon	20.43 m Table 20.43 ep 11 of Jul 0.58 216.16 16.6 =[(39)m 222.99 th = 0.02	20.42 4e, who 20.42 Table 9 Aug 0.64 223.04 16.4 x [(93)m 233.89 24 x [(97 0	A) × T2 20.28 ere appro 20.28 b, so tha Sep 0.88 283.63 14.1 h- (96)m 361.41 ')m - (95 0	19.9 opriate 19.9 t Ti,m=( Oct 0.98 284.25 10.6 ] 546.15 )m] x (4 <sup>2</sup> 194.86	19.49 19.49 76)m and Nov 1 269.44 7.1 729.89 1)m 331.52	19.17 19.17 d re-calo Dec 1 268.56 4.2 884.74 458.43	             	(92) (93) (94) (95) (96) (97)

Calculated for June, July and August. See Table 10b



Mecserve Ltd Panagiotis Dalapas 020 3141 5800 Target Fabric Energy Efficiency WorkSheet: New dwelling as built

[	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)														
(100)m=	0	0	0	0	0	547.93	431.35	442.39	0	0	0	0		(100)
Utilisation factor for loss hm														
(101)m=	0	0	0	0	0	0.84	0.91	0.88	0	0	0	0		(101)
Useful loss, hmLm (Watts) = (100)m x (101)m														
(102)m=	0	0	0	0	0	458.17	390.72	389.15	0	0	0	0		(102)
Gains (solar gains calculated for applicable weather region, see Table 10)														
(103)m=	0	0	0	0	0	549.23	525.76	496.65	0	0	0	0		(103)
Space cooling requirement for month, whole dwelling, continuous ( $kWh$ ) = 0.024 x [(103)m - (102)m ] x (41)m set (104)m to zero if (104)m < 3 x (98)m														
(104)m=	0	0	0	0	0	65.56	100.47	79.98	0	0	0	0		
	Total = Sum(104) =												246.01	(104)
	Cooled fraction $f C = cooled area \div (4) =$												1	(105)
r	,	actor (Ta		,	r	r	r							
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0		-
•	Total = Sum(104) = Space cooling requirement for month = (104)m × (105) × (106)m												0	(106)
· .		· ·			, <i>,</i>	, <u>,</u>	<u>`</u>							
(107)m=	0	0	0	0	0	16.39	25.12	19.99	0	0	0	0		
	Total = Sum(107) =												61.5	(107)
Space	Space cooling requirement in kWh/m <sup>2</sup> /year $(107) \div (4) =$												1.2	(108)
8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)														
Fabric Energy Efficiency(99) + (108) =													48.42	(109)
Target Fabric Energy Efficiency (TFEE)											55.69	(109)		



## APPENDIX E TFEE WORKSHEET OF TYPICAL NEW-EXTENSION



(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

### DER WorkSheet: New dwelling as built

		Use	er Details:						
Assessor Name:	Panagiotis Dalap	as	Strom	a Num	ber:		STRO	030082	
Software Name:	Stroma FSAP 20		Softwa				Versio	n: 1.0.4.14	
		Prope	rty Addres	s: No 6	5-Plot 4-I	Propose	d		
Address :	Plot 4, 65 Guilford	Street, WC1N 1	DD						
1. Overall dwelling dimen	isions:								
		Ar	ea(m²)		Av. Hei	ght(m)	_	Volume(m <sup>3</sup> )	_
Ground floor			51.22	(1a) x	2.	55	(2a) =	130.61	(3a)
Total floor area TFA = (1a	)+(1b)+(1c)+(1d)+(1	e)+(1n)	51.22	(4)					
Dwelling volume				(3a)+(3b	)+(3c)+(3d)	)+(3e)+	.(3n) =	130.61	(5)
2. Ventilation rate:									
		secondary heating	other		total			m <sup>3</sup> per hour	
Number of chimneys	0 +	0 +	0	] = [	0	x 4	40 =	0	(6a)
Number of open flues	0 +	0 +	0	] = [	0	x 2	20 =	0	(6b)
Number of intermittent fan	s			Γ	2	x 1	0 =	20	(7a)
Number of passive vents				Γ	0	x 1	0 =	0	(7b)
Number of flueless gas fire	es				0	x 4	40 =	0	(7c)
									-
							Air ch	anges per hou	ır
Infiltration due to chimney					20		÷ (5) =	0.15	(8)
If a pressurisation test has be		ded, proceed to (17)	, otherwise o	ontinue fr	rom (9) to (	16)	,		1
Number of storeys in the Additional infiltration	e aweiling (ns)					1(0)	41-04	0	(9)
	PE for staal or timber	frama ar 0.25 f	or mocon	voonotr	uction	[(9)-	-1]x0.1 =	0	(10)
Structural infiltration: 0.2 if both types of wall are pre				•	uction		l	0	(11)
deducting areas of opening		sponding to the gro		a (anoi					
If suspended wooden flo	oor, enter 0.2 (unsea	aled) or 0.1 (sea	led), else	enter 0			[	0	(12)
If no draught lobby, ente	er 0.05, else enter 0							0	(13)
Percentage of windows	and doors draught s	stripped					[	0	(14)
Window infiltration			0.25 - [0.2	x (14) ÷ 1	= [00		[	0	(15)
Infiltration rate			(8) + (10)	+ (11) + (1	12) + (13) +	- (15) =		0	(16)
Air permeability value, c			•	•	etre of e	nvelope	area	4	(17)
If based on air permeabilit	•							0.35	(18)
Air permeability value applies Number of sides sheltered	•	as been done or a d	legree air pe	meability	is being us	sed	ſ		
Shelter factor	I		(20) = 1 -	0.075 x (1	19)] =			4 0.7	(19) (20)
Infiltration rate incorporatir	na shelter factor		(21) = (18)		/-		l I		(21)
Infiltration rate modified fo	-	h		x - /			l	0.25	](-')
	Mar Apr May	т	Aug	Sep	Oct	Nov	Dec		
Monthly average wind spe			1,9						
	4.9 4.4 4.3	3.8 3.8	3.7	4	4.3	4.5	4.7		
, , <u> </u>									
Wind Factor $(22a)m = (22)$	)m ÷ 4								



(23a)

(23b)

(23c)

(24a)

(24b)

(24c)

(24d)

(25)

(26)

(27)

(27)

(27)

(27)

(29)

(29)

(30)

(31)

(33)

(34)

(35)

(36)

(37)

ΑX k kJ/K

Mecserve Ltd Panagiotis Dalapas 020 3141 5800 panos.dalapas@mecserve.com

DER WorkSheet: New dwelling as built

Adjusted infiltr	ation rat	e (allowi	ing for sh	elter an	nd wind s	speed) =	= (21a) x	(22a)m				
0.32 Calculate effe	0.31	0.3	0.27	0.27 ho annli	0.23	0.23	0.23	0.25	0.27	0.28	0.29	
If mechanica		-		ne appli		30						0
lf exhaust air h	eat pump (	using Appe	endix N, (2	3b) = (23a	a) × Fmv (e	equation (	N5)) , othe	erwise (23b	) = (23a)			0
If balanced with	h heat reco	overy: effic	iency in %	allowing	for in-use f	actor (fro	m Table 4ł	n) =				0
a) If balance	ed mecha	anical ve	entilation	with he	at recove	ery (MV	HR) (24	a)m = (2	2b)m + (	23b) × [	1 – (23c)	÷ 100]
(24a)m= 0	0	0	0	0	0	0	0	0	0	0	0	
b) If balance	ed mecha	anical ve	entilation	without	heat rec	covery (	MV) (24	b)m = (22	2b)m + (2	23b)		_
(24b)m= 0	0	0	0	0	0	0	0	0	0	0	0	
c) If whole h if (22b)r				•	•			outside b) m + 0	.5 × (23b	<b>)</b> )		
(24c)m= 0	0	0	0	0	0	0	0	0	0	0	0	
d) If natural if (22b)r				•				loft 22b)m² x	0.5]	-	-	-
<mark>(24d)</mark> m= 0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.54	
Effective air	change	rate - er	nter (24a	) or (24l	b) or (24	c) or (24	4d) in bo	x (25)		-		
(25)m= 0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.54	
3. Heat losse	es and he	eat loss i	paramete	er:								
ELEMENT	Gros area		Openin m		Net Ar A ,r		U-va W/m2		A X U (W/I	K)	k-value kJ/m²∙ł	
Doors					2	×	1	=	2			
Windows Type	e 1				1.89	x	1/[1/( 1.6 )-	+ 0.04] =	2.84			
Windows Type	e 2				0.92	X	1/[1/( 1.6 )-	+ 0.04] =	1.38			
Windows Type	e 3				3.84	X	1/[1/( 1.6 )-	+ 0.04] =	5.77			
Windows Type	e 4				1.23	X	1/[1/( 1.6 )-	+ 0.04] =	1.85			
Walls Type1	80.7	'8	9.88		70.9	x	0.18	=	12.76			
Walls Type2	5.8	9	0		5.89	x	0.17	=	1.01			
Roof	12.8	86	0		12.86	3 X	0.15	=	1.93			
Total area of e	elements	, m²			99.53	3						
* for windows and ** include the area						ated usin	g formula	1/[(1/U-valu	ıe)+0.04] a	as given in	n paragraph	3.2
Fabric heat los	ss, W/K :	= S (A x	U)				(26)(30	)) + (32) =				29.55
Heat capacity	Cm = S(	(Axk)						((28).	(30) + (32	2) + (32a)	(32e) =	4723.14
Thermal mass	•			,					tive Value			250
For design asses can be used inste	ad of a de	tailed calc	ulation.				recisely th	e indicative	e values of	TMP in T	able 1f	
Thermal bridg		,		• •		K						7.18
if details of therma Total fabric he		are not kn	nown (36) =	= 0.15 x (3	31)			(33) +	· (36) =			36.73
Ventilation her	at loss ca	alculated	d monthly	/				(38)m	$= 0.33 \times ($	25)m x (5	)	

ventila		1000000	lioulutee		у				(00)	- 0.00 A (	20)11 X (0)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	23.69	23.61	23.53	23.14	23.07	22.74	22.74	22.68	22.87	23.07	23.22	23.37

Heat transfer coefficient W/K

(39)m - (37) + (38)m

(38)



(59)

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(59)m=

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Heat Ic	oss para	ameter (H	HLP), W	/m²K					(40)m	= (39)m ÷	· (4)			
(40)m=	1.18	1.18	1.18	1.17	1.17	1.16	1.16	1.16	1.16	1.17	1.17	1.17		
Numbe	er of day	/s in mo	nth (Tab	le 1a)	-					Average =	Sum(40)1	12 /12=	1.17	(40)
- turno e	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	1	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)
(,	01				0.								]	
1 \//2	tor hoa	ting ene	ray roau	iromont.								kWh/y	oar:	
4. VVa	aler nea	ung ene	igy iequ	nement.								KVVII/ y	cal.	
		upancy, I		T4	( 0.000	10 · · /TI	- 40.0		040/			73	]	(42)
	A > 13. A £ 13.		+ 1.76 X	[1 - exp	(-0.0003	349 X (11	-A -13.9	)2)] + 0.0	JU13 X (	IFA -13.	.9)			
Annua	l averag	je hot wa						(25 x N)			75	5.19	]	(43)
		al average litres per		• •		-	-	to achieve	a water us	se target o	f		4	
notmore		1		- · ·		<u> </u>	· ·						1	
Hot wate	Jan	Feb	Mar day for ea	Apr Apr	May Vd.m.– fa	Jun	Jul Table 1c x	Aug	Sep	Oct	Nov	Dec		
		,	,	1	-			. <i>,</i>	72.60	76.7	70.74	00.74	1	
(44)m=	82.71	79.71	76.7	73.69	70.68	67.67	67.67	70.68	73.69	76.7	79.71	82.71	902.33	(44)
Energy o	content of	hot water	used - cal	culated mo	onthly $= 4$ .	190 x Vd,ı	m x nm x E	0Tm / 3600		Total = Su hth (see Ta			902.33	(44)
(45)m=	122.66	107.28	110.7	96.51	92.61	79.91	74.05	84.98	85.99	100.21	109.39	118.79	1	
										I Total = Su			1183.09	(45)
lf instant	taneous v	vater heati	ng at point	of use (no	o hot water	r storage),	enter 0 in	boxes (46			. ,			
(46)m=	18.4	16.09	16.61	14.48	13.89	11.99	11.11	12.75	12.9	15.03	16.41	17.82	]	(46)
	storage												-	
-							-	within sa	ame ves	sel		0		(47)
	•	-			-		) litres in	(47) mbi boil	ore) ont	or '()' in <i>(</i>	(17)			
	storage		not wate	er (unis n		nstanta	ieous cu		ers) erne		47)			
	•	turer's de	eclared I	oss facto	or is kno	wn (kWl	n/day):					0	1	(48)
Tempe	erature f	actor fro	m Table	2b								0	]	(49)
Energy	/ lost fro	om water	· storage	, kWh/ye	ear			(48) x (49)	) =			0	]	(50)
•		turer's de		•									J ~	
		age loss			e 2 (kW	h/litre/da	ay)					0		(51)
	•	neating s from Ta		on 4.3								0	1	(52)
		actor fro		2b								0	-	(52)
		om water			ear			(47) x (51)	x (52) x (	53) =		0	]	(54)
•••		(54) in (5	-	, .,								0	-	(55)
Water	storage	loss cal	culated t	for each	month			((56)m = (	55) × (41)	m			3	
(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	]	(56)
If cylinde	er contain	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	u dix H	
(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	]	(57)
Primar	v circuit	loss (ar	nual) fre	om Table	3	•	•	•		•	·	0	1	(58)
	•	•				59)m =	(58) ÷ 36	65 × (41)	m		L		J	
	•						. ,	ng and a		r thermo	stat)			



DER WorkSheet: New dwelling as built

Combi	loss cal	culated	for each	month (	(61)m =	(60) ÷ 36	65 × (41)	)m						
(61)m=	32.92	29.72	32.89	31.81	32.86	31.78	32.83	32.85	31.8	32.88	31.84	32.91		(61)
Total ŀ	eat requ	uired for	water he	eating ca	alculated	l for eacl	n month	(62)m =	0.85 × (	(45)m +	(46)m +	(57)m +	(59)m + (61)m	
(62)m=	155.58	137	143.59	128.33	125.47	111.7	106.89	117.83	117.79	133.09	141.23	151.7		(62)
Solar DI	-IW input o	calculated	using App	endix G or	Appendix	H (negativ	ve quantity	/) (enter '0	' if no sola	r contribut	ion to wate	er heating)		
(add a	dditiona	l lines if	FGHRS	and/or V	WWHRS	applies	, see Ap	pendix C	G)					
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0		(63)
Output	from wa	ater hea	ter											
(64)m=	155.58	137	143.59	128.33	125.47	111.7	106.89	117.83	117.79	133.09	141.23	151.7		
								Outp	out from w	ater heate	r (annual)₁	12	1570.19	(64)
Heat g	ains froi	m water	heating,	kWh/mo	onth 0.2	5 ´ [0.85	× (45)m	+ (61)m	n] + 0.8 x	k [(46)m	+ (57)m	+ (59)m	]	
(65)m=	49.01	43.1	45.03	40.04	39.01	34.52	32.83	36.47	36.54	41.54	44.33	47.73		(65)
inclu	ide (57)i	m in calo	culation of	of (65)m	only if c	ylinder is	s in the c	dwelling	or hot w	ater is fr	om com	munity h	eating	
5. In	ernal ga	ains (see	Table 5	and 5a	):									
Metab	olic gain	s (Table	5) Wat	ts										
ino tab	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(66)m=	86.3	86.3	86.3	86.3	86.3	86.3	86.3	86.3	86.3	86.3	86.3	86.3		(66)
Lightin	g gains	(calculat	ted in Ap	pendix l	L, equat	ion L9 oi	r L9a), a	lso see	Table 5					
(67)m=	14.77	13.12	10.67	8.08	6.04	5.1	5.51	7.16	9.61	12.2	14.24	15.18		(67)
Applia	nces gai	ins (calc	ulated in	Append	dix L, eq	uation L'	13 or L1	3a), also	see Ta	ble 5	-			
(68)m=	150.4	151.96	148.03	139.66	129.09	119.15	112.52	110.96	114.89	123.26	133.83	143.77		(68)
Cookir	ng gains	(calcula	ted in A	ppendix	L, equat	tion L15	or L15a)	), also se	e Table	5				
(69)m=	31.63	31.63	31.63	31.63	31.63	31.63	31.63	31.63	31.63	31.63	31.63	31.63		(69)
Pumps	and far	ns gains	(Table 5	5a)					•	-	•	•		
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3		(70)
Losse	s e.g. ev	aporatio	n (negat	tive valu	es) (Tab	ole 5)				-				
(71)m=	-69.04	-69.04	-69.04	-69.04	-69.04	-69.04	-69.04	-69.04	-69.04	-69.04	-69.04	-69.04		(71)
Water	heating	gains (T	able 5)											
(72)m=	65.88	64.14	60.53	55.62	52.43	47.94	44.13	49.01	50.75	55.83	61.57	64.15		(72)
Total i	nternal	gains =			-	(66)	m + (67)m	- n + (68)m +	⊦ (69)m + (	(70)m + (7	1)m + (72)	Im		
(70)	mornar	3												
(73)m=		281.11	271.12	255.24	239.45	224.08	214.04	219.02	227.14	243.19	261.54	274.99		(73)

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

Orienta	ition: Access Table (	s Factor 6d	Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	1 X	1.89	x	19.64	x	0.63	×	0.7	=	7.96	(76)
East	0.9x	1 ×	0.92	x	19.64	x	0.63	x	0.7	] =	3.87	(76)
East	0.9x	1 x	3.84	x	19.64	x	0.63	x	0.7	=	16.16	(76)
East	0.9x	1 ×	1.23	x	19.64	x	0.63	x	0.7	=	5.18	(76)
East	0.9x	1 ×	1.89	x	38.42	x	0.63	×	0.7	=	15.56	(76)



DER WorkSheet: New dwelling as built

East	0.9x		1	0.00	۱.,	00.40	1	0.00	۱.,	0.7	1	7.50	(76)
East		1	×	0.92	×	38.42	×	0.63	x	0.7	=	7.58	4
East	0.9x	1	×	3.84	X	38.42	X	0.63	x	0.7	=	31.62	(76)
East	0.9x	1	×	1.23	x	38.42	×	0.63	X	0.7	=	10.13	(76)
East	0.9x	1	×	1.89	X	63.27	×	0.63	X	0.7	=	25.63	(76)
	0.9x	1	×	0.92	X	63.27	X	0.63	X	0.7	=	12.48	(76)
East	0.9x	1	X	3.84	X	63.27	X	0.63	X	0.7	=	52.07	(76)
East	0.9x	1	×	1.23	X	63.27	X	0.63	x	0.7	=	16.68	(76)
East	0.9x	1	X	1.89	X	92.28	X	0.63	X	0.7	=	37.38	(76)
East	0.9x	1	X	0.92	x	92.28	X	0.63	X	0.7	=	18.2	(76)
East	0.9x	1	X	3.84	x	92.28	X	0.63	X	0.7	=	75.95	(76)
East	0.9x	1	X	1.23	X	92.28	X	0.63	X	0.7	=	24.33	(76)
East	0.9x	1	×	1.89	X	113.09	X	0.63	x	0.7	=	45.81	(76)
East	0.9x	1	×	0.92	x	113.09	X	0.63	x	0.7	=	22.3	(76)
East	0.9x	1	x	3.84	x	113.09	X	0.63	X	0.7	=	93.08	(76)
East	0.9x	1	×	1.23	x	113.09	x	0.63	x	0.7	=	29.81	(76)
East	0.9x	1	×	1.89	x	115.77	x	0.63	x	0.7	=	46.9	(76)
East	0.9x	1	×	0.92	x	115.77	x	0.63	X	0.7	=	22.83	(76)
East	0.9x	1	×	3.84	x	115.77	x	0.63	x	0.7	=	95.28	(76)
East	0.9x	1	×	1.23	x	115.77	×	0.63	x	0.7	=	30.52	(76)
East	0.9x	1	x	1.89	x	110.22	x	0.63	x	0.7	=	44.65	(76)
East	0.9x	1	x	0.92	x	110.22	x	0.63	x	0.7	=	21.73	(76)
East	0.9x	1	x	3.84	x	110.22	x	0.63	x	0.7	=	90.71	(76)
East	0.9x	1	x	1.23	x	110.22	x	0.63	x	0.7	=	29.06	(76)
East	0.9x	1	x	1.89	x	94.68	x	0.63	x	0.7	=	38.35	(76)
East	0.9x	1	x	0.92	x	94.68	x	0.63	x	0.7	=	18.67	(76)
East	0.9x	1	x	3.84	x	94.68	x	0.63	x	0.7	=	77.92	(76)
East	0.9x	1	x	1.23	x	94.68	x	0.63	x	0.7	=	24.96	(76)
East	0.9x	1	x	1.89	x	73.59	x	0.63	x	0.7	=	29.81	(76)
East	0.9x	1	x	0.92	x	73.59	x	0.63	x	0.7	=	14.51	(76)
East	0.9x	1	x	3.84	x	73.59	x	0.63	x	0.7	=	60.56	(76)
East	0.9x	1	x	1.23	x	73.59	x	0.63	x	0.7	=	19.4	(76)
East	0.9x	1	×	1.89	x	45.59	x	0.63	x	0.7	=	18.47	(76)
East	0.9x	1	×	0.92	x	45.59	x	0.63	x	0.7	=	8.99	(76)
East	0.9x	1	×	3.84	x	45.59	×	0.63	x	0.7	=	37.52	(76)
East	0.9x	1	x	1.23	x	45.59	x	0.63	x	0.7	=	12.02	(76)
East	0.9x	1	x	1.89	x	24.49	x	0.63	x	0.7	=	9.92	(76)
East	0.9x	1	×	0.92	x	24.49	×	0.63	x	0.7	=	4.83	(76)
East	0.9x	1	x	3.84	x	24.49	x	0.63	x	0.7	=	20.15	(76)
East	0.9x	1	×	1.23	x	24.49	×	0.63	x	0.7	=	6.46	(76)
East	0.9x	1	×	1.89	x	16.15	×	0.63	x	0.7	=	6.54	(76)
East	0.9x	1	x	0.92	x	16.15	x	0.63	x	0.7	=	3.18	(76)



DER WorkSheet: New dwelling as built

parios.	uaiapas	errecs	<i>EI VE.CUI</i>	11										
East	0.9x	1	x	3.8	34	x	16.15	x	0.63	×	0.7	=	13.29	(76)
East	0.9x	1	x	1.2	23	x	16.15	x	0.63	_ × [	0.7	=	4.26	(76)
	Ŀ													_
Solar o	ains in	watts, ca	alculated	d for eac	h month			(83)m = 5	Sum(74)m	(82)m				
(83)m=	33.17	64.89	106.86	155.85	191	195.52	186.15	159.9	124.28	77	41.36	27.28		(83)
Total g	jains – i	nternal a	nd sola	r (84)m =	= (73)m	+ (83)m	, watts	!	1				1	
(84)m=	316.11	346	377.98	411.09	430.45	419.61	400.19	378.92	351.43	320.18	302.89	302.26		(84)
7. Me	an inter	nal temp	perature	(heating	season	)			•				1	
							from Tal	ole 9. Th	ո1 (°C)				21	(85)
•		-	• •	living are		-		,	( - )					
Otinot	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	]	
(86)m=	1	1	0.99	0.97	0.92	0.79	0.62	0.68	0.89	0.98	1	1		(86)
										0.30		1	J	(00)
Mean	interna	l temper	ature in	living are	,	ollow ste	eps 3 to 7	7 in Tab	le 9c)				1	
(87)m=	19.74	19.86	20.09	20.41	20.71	20.91	20.98	20.97	20.82	20.44	20.03	19.71		(87)
Temp	erature	during h	eating p	eriods ir	n rest of	dwellin	g from Ta	able 9, T	h2 (°C)					
(88)m=	19.94	19.94	19.94	19.94	19.95	19.95	19.95	19.95	19.95	19.95	19.94	19.94		(88)
Litilior		tor for a	L	root of d	wolling	۱ <u>ــــــــــــــــــــــــــــــــــــ</u>	J	() () ()	•				1	
		0.99	0.99	0.96	0.88	nz,m (s	ee Table 0.49	9a) 0.54	0.83	0.97	0.99	1	1	(89)
(89)m=	I	0.99	0.99	0.96	0.00	0.7	0.49	0.54	0.83	0.97	0.99	I	J	(00)
Mean	interna	l temper	ature in	the rest	of dwell	ing T2 (	follow ste	eps 3 to	7 in Tab	le 9c)	-			
(90)m=	18.25	18.43	18.77	19.23	19.64	19.89	19.94	19.94	19.8	19.28	18.69	18.22		(90)
									1	fLA = Livin	ig area ÷ (4	4) =	0.46	(91)
Mean	interna	l temper	ature (fo	or the wh	ole dwe	llina) =	fLA × T1	+ (1 – fl	A) x T2					
(92)m=	18.93	19.08	19.37	19.77	20.13	20.35	20.42	20.41	20.26	19.81	19.3	18.9	]	(92)
							om Table						l	
(93)m=	18.93	19.08	19.37	19.77	20.13	20.35	20.42	20.41	20.26	19.81	19.3	18.9	1	(93)
		ting requ			20110	_0.00			1 -0.20			1010		
					ro obtair	ned at e	tep 11 of	Tahla 0	h so tha	t Ti m-(	76)m an	d re-calc	sulate	
				using Ta		icu at 5			b, 30 the		<i>i</i> 0)iii aii			
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisa		tor for g		· · ·			1						1	
(94)m=	1	0.99	0.99	0.96	0.89	0.74	0.55	0.6	0.85	0.97	0.99	1		(94)
Usefu	l gains,	hmGm .	, W = (9	4)m x (84	4)m		1						1	
(95)m=	314.83		372.32	394.51	, 383.4	309.82	220.92	228.86	298.94	310.74	300.64	301.27	]	(95)
	nly avera	age exte	rnal tem	perature	e from T	able 8	1	1	1	1	1	1	1	
(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)
							_[(39)m				I	I	1	
(97)m=	883.99	855.77	775.71	650.79	504.08	342.2	226.92	238.14	367.35	550.8	731.41	883.33		(97)
							1 = 0.02						1	
(98)m=	423.46	344.17	300.12	184.52	89.79	0	0	0		178.6	310.16	433.05	]	
<		L	L	1			1		al per year				2263.86	(98)
~								i Ola	a per yedi	www.yedi	) – Sun(9	⊂j15,912 =		
Space	e heatin	g require	ement in	kWh/m <sup>2</sup>	/year								44.2	(99)
9a. En	ergy rec	quiremer	nts – Ind	ividual h	eating s	ystems	including	micro-(	CHP)					
Spac	e heatir	ng:												
Freet	ion of or		+ from o	aaandan	Vounnle	montor	v ovotom							(201)

Fraction of space heat from secondary/supplementary system

0 (201)



# DER WorkSheet: New dwelling as built

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Fraction of s	pace hea	at from m	nain svst	em(s)			(202) = 1 -	- (201) =				1	(202)
Fraction of to	-		-				(204) = (2	02) × [1 –	(203)] =			1	(204)
Efficiency of		•										93.5	(206)
Efficiency of			• •		g systen	n, %						0	(208)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/ye	ar
Space heati	-			,		1		·				, ,	
423.46	344.17	300.12	184.52	89.79	0	0	0	0	178.6	310.16	433.05		
(211)m = {[(9	8)m x (20	4)] } x 1	00 ÷ (20	6)									(211)
452.9	368.09	320.99	197.35	96.03	0	0	0	0	191.02	331.72	463.15		_
							Tota	l (kWh/yea	ar) =Sum(2	211) <sub>15,1012</sub>	-	2421.24	(211)
Space heating	• ·		•	month									
= {[(98)m x (2				0	0		0	0	0	0	0	1	
(215)m= 0	0	0	0	0	0	0	0 Tota	0 L (kWb/yea	0	0 215) <sub>15.1012</sub>	0	0	(215)
Watar boatin	~						Tota	r (kwn#yoc	(2) –Oum(2	10,15,1012		0	(213)
Water heatin Output from v	•	ter (calc	ulated al	oove)									
155.58		143.59	128.33	125.47	111.7	106.89	117.83	117.79	133.09	141.23	151.7		
Efficiency of v	water hea	iter										86.6	(216)
(217)m= 89.42	89.35	89.2	88.86	88.19	86.6	86.6	86.6	86.6	88.79	89.24	89.45		(217)
Fuel for water	-												
(219)m = (64 (219)m= 173.99		) ÷ (217) 160.98	m 144.42	142.28	128.98	123.42	136.06	136.02	149.89	158.25	169.59		
()								l = Sum(2				1777.19	(219)
Annual total	s								k\	Nh/year		kWh/yea	
Space heatin		ed, main	system	1						,		2421.24	
Water heating	g fuel use	d										1777.19	
Electricity for	pumps, fa	ans and	electric	keep-hot	t								
central heati	ng pump	:									30		(230c)
boiler with a	fan-assis	sted flue									45		(230e)
Total electrici	ty for the	above, l	kWh/yea	r			sum	of (230a).	(230g) =			75	(231)
Electricity for	lighting											260.84	(232)
12a. CO2 er	nissions -	– Individ	ual heati	na svste	ems inclu	udina mi	cro-CHP	)					
				5,									
						ergy /h/year			Emiss kg CO	ion fact	tor	Emissions kg CO2/ye	
Space heatin	a (main a	votom 1	N			1) x					=		_
•		-	)						0.2			522.99	(261)
Space heatin	•	ary)				5) x			0.5	19	=	0	(263)
Water heating	-					9) x			0.2	16	=	383.87	(264)
Space and wa	ater heati	ng			(26	1) + (262)	+ (263) + (	264) =				906.86	(265)
Electricity for	pumps, fa	ans and	electric	keep-hot	t (23 <sup>-</sup>	1) x			0.5	19	=	38.93	(267)
Electricity for	lighting				(232	2) x			0.5	19	=	135.38	(268)



#### Total CO2, kg/year

#### **Dwelling CO2 Emission Rate**

EI rating (section 14)

DER WorkSheet: New dwelling as built

sum of (265)...(271) =

(272) ÷ (4) =

1081.16	(272)
21.11	(273)
85	(274)



## APPENDIX F DFEE WORKSHEET OF TYPICAL NEW-EXTENSION



			User	Details:						
Assessor Name:	Panagiotis Dal	-		Strom					030082	
Software Name:	Stroma FSAP			Softwa					n: 1.0.4.14	
A 1.1	Dist 4, 65 Ouilfa				S: NO 6	5-Plot 4-I	Propose	d		
Address :	Plot 4, 65 Guilfo	ord Street, vv	C1N 1D	U						
1. Overall dwelling dimer	ISIONS:		Area	n (m 2)			aht(m)		Valumo/m <sup>3</sup>	•
Ground floor				<b>a(m²)</b> 1.22	(1a) x	Av. Hei	<b>gnt(m)</b> 55	(2a) =	Volume(m <sup>3</sup> 130.61	(3a)
Total floor area TFA = (1a	)+(1b)+(1c)+(1d)·	+(1e)+(1r			(12) ×	2.	55	(2a) –	130.01	(3a)
Dwelling volume					(3a)+(3b	o)+(3c)+(3d)	)+(3e)+	(3n) =	130.61	(5)
2. Ventilation rate:								•		
	main heating	secondar heating	у	other		total			m <sup>3</sup> per hou	r
Number of chimneys		+ 0	+	0	] = [	0	x 4	0 =	0	(6a)
Number of open flues	0	+ 0	+ [	0	] = [	0	x 2	0 =	0	(6b)
Number of intermittent fan	s				Ī	2	x 1	0 =	20	(7a)
Number of passive vents					Ē	0	x 1	0 =	0	(7b)
Number of flueless gas fire	es				Γ	0	x 4	0 =	0	(7c)
					_			Air ch	anges per ho	bur
Infiltration due to chimney	s flues and fans	- (6a)+(6b)+(7	'a)+(7b)+('	7c) =	Г	20				
If a pressurisation test has be					ontinue fi	20		- (5) =	0.15	(8)
Number of storeys in the		ionaca, proces	<i>a to (11),</i> c			10111 (0) 10 (	10)	[	0	(9)
Additional infiltration	3(-)						[(9)-	1]x0.1 =	0	(10)
Structural infiltration: 0.2	25 for steel or tim	ber frame or	0.35 for	masonr	y const	ruction		1	0	(11)
if both types of wall are pre deducting areas of opening			the great	er wall are	a (after			I		
If suspended wooden flo	oor, enter 0.2 (un	sealed) or 0.	1 (seale	d), else	enter 0			[	0	(12)
If no draught lobby, ente	er 0.05, else ente	r 0							0	(13)
Percentage of windows	and doors draug	ht stripped						]	0	(14)
Window infiltration				0.25 - [0.2	x (14) ÷ 1	100] =		ĺ	0	(15)
Infiltration rate				(8) + (10)	+ (11) + (	12) + (13) +	· (15) =		0	(16)
Air permeability value, o	50, expressed in	cubic metre	s per ho	our per so	quare m	netre of ei	nvelope	area	4	(17)
If based on air permeabilit	y value, then <mark>(18)</mark>	$= [(17) \div 20] + (8)$	3), otherwi	se (18) = (	16)			[	0.35	(18)
Air permeability value applies		st has been don	e or a deg	gree air pei	meability	r is being us	ed			_
Number of sides sheltered	l					(0)]			4	(19)
Shelter factor				(20) = 1 -		19)] =		ļ	0.7	(20)
Infiltration rate incorporation	-			(21) = (18)	x (20) =				0.25	(21)
Infiltration rate modified fo	<u> </u>					,				
Jan Feb I	Mar Apr M	lay Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind spe	ed from Table 7									
(22)m= 5.1 5 4	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									

(00-)	4.07	1.25	1 22		4.00	0.05	0.95	0.00		4.00	4.40	4.40
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1 1	1.08	1.12	1.18



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Adjust	ed infiltr	ation rat	e (allowi	ng for sh	nelter an	d wind s	peed) =	(21a) x	(22a)m				_	
	0.32	0.31	0.3	0.27	0.27	0.23	0.23	0.23	0.25	0.27	0.28	0.29		
		<i>ctive air</i> al ventila	change i	rate for t	he appli	cable ca	se							
			using Appe	andix N (2	3h) - (23a		austion (N	(5)) other	wice (23h	) - (232)			0	(23a)
			• • •		, ,	, , ,				) = (23a)			0	(23b)
			overy: effic	-	-							(00.)	0	(23c)
		i	anical ve	i							1	1	) ÷ 100] 1	(24a)
(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24a)
,		· · · · · ·	anical ve				, , ,	, `	, (	, <u>,</u>	<u>,</u>		1	
(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24b)
,			tract ven < (23b), t		•	•				5 × (23b	))			
(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24c)
,			on or wh en (24d)			•				0.51	•	•		
(24d)m=	r í	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.54	]	(24d)
		ı change	rate - er	uter (24a	) or (24t	) or (24	c) or (24	d) in box	(25)				1	
(25)m=	0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.54	]	(25)
											I	I	1	
			eat loss p			NI / A								
ELEN	IENT	Gros area		Openin m		Net Ar A ,n		U-valı W/m2		A X U (W/I	K)	k-value kJ/m²·l		X k I/K
Doors			<b>、</b> ,			2	x	1	=	2				(26)
Windo	ws Type	e 1				1.89	x1/	/[1/( 1.6 )+	0.04] =	2.84	=			(27)
Windo	ws Type	2				0.92	x1/	/[1/( 1.6 )+	0.04] =	1.38	=			(27)
Windo	ws Type	e 3				3.84	x1/	/[1/( 1.6 )+	0.04] =	5.77				(27)
Windo	ws Type	<del>)</del> 4				1.23	x1/	/[1/( 1.6 )+	0.04] =	1.85				(27)
Walls -	Type1	80.7	78	9.88		70.9	x	0.18	= [	12.76				(29)
Walls -	Туре2	5.8	9	0		5.89	x	0.17	= [	1.01				(29)
Roof		12.8	36	0		12.86	; x	0.15	= [	1.93				(30)
Total a	rea of e	lements	s, m²			99.53	3							(31)
Total area of elements, m <sup>2</sup> 99.53       (31)         * for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2       ** include the areas on both sides of internal walls and partitions														
			= S (A x		,			(26)(30)	+ (32) =				29.55	(33)
Heat c	apacity	Cm = S(	(Axk)						((28)	.(30) + (32	2) + (32a).	(32e) =	4723.14	(34)
Therm	al mass	parame	eter (TMF	<sup>o</sup> = Cm ÷	- TFA) ir	∩ kJ/m²K			Indica	tive Value:	: Medium		250	(35)
For desi	gn asses	sments wh	ere the de	tails of the	construct	ion are not	known pr	ecisely the	indicative	values of	TMP in Ta	able 1f		
			tailed calcu				_						-	
	-		x Y) cal			-	<						7.18	(36)
	<i>of therma</i> abric he		are not kn	own (36) =	= 0.15 x (3	1)			(33) +	(36) -			00.70	(27)
			alculated	monthly	1						25)m x (5)		36.73	(37)
venulo	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	]	
(38)m=	23.69	23.61	23.53	23.14	23.07	22.74	22.74	22.68	22.87	23.07	23.22	23.37		(38)
(00)11-	20.00	20.01	20.00	20.14	20.01	22.14	22.14	22.00	22.01	20.07	20.22	20.07	J	(00)

Heat transfer coefficient W/K

(39)m - (37) + (38)m



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Heat Ic	oss para	meter (H	HLP), W	/m²K					(40)m	= (39)m ÷	· (4)				
(40)m=	1.18	1.18	1.18	1.17	1.17	1.16	1.16	1.16	1.16	1.17	1.17	1.17		_	
Numbe	er of day	/s in mo	nth (Tab	le 1a)	-	-				Average =	Sum(40)1.	12 /12=	1.17	(40)	
	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)	
I															
4. Wa	iter heat	ting ene	rgy requ	irement:								kWh/ye	ear:		
Assumed occupancy, N [1.73] if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9) if TFA £ 13.9, N = 1													(42)		
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)													(43)		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
Hot wate	er usage i	n litres pei	r day for ea	ach month		ctor from	Table 1c x								
(44)m=	82.71	79.71	76.7	73.69	70.68	67.67	67.67	70.68	73.69	76.7	79.71	82.71			
ļ							•				m(44) <sub>112</sub> =		902.33	(44)	
Energy content of hot water used - calculated monthly = $4.190 \times Vd$ , $m \times nm \times DTm / 3600 kWh/month$ (see Tables 1b, 1c, 1d)															
(45)m=	122.66	107.28	110.7	96.51	92.61	79.91	74.05	84.98	85.99	100.21	109.39	118.79		-	
lf instant	Total = Sum(45) <sub>112</sub> = $I$ finstantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)												1183.09	(45)	
(46)m=	0	0	0	0	0	0	0	0	0	0	0	0		(46)	
Water storage loss:															
Storage volume (litres) including any solar or WWHRS storage within same vessel													(47)		
	If community heating and no tank in dwelling, enter 110 litres in (47) Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)														
			hot wate	er (this ir	ICIUDES I	nstantar	neous co	indi idmo	ers) ente	er '0' in (	47)				
	storage anufact		eclared I	loss facto	or is kno	wn (kWł	n/dav):					0		(48)	
,			m Table				"aay).					0		(49)	
				e, kWh/ye	ar			(48) x (49)	) =			0		(50)	
•••			-	cylinder		or is not		( -/ ( -)	, 			0		(00)	
		-		rom Tab	e 2 (kW	h/litre/da	ay)					0		(51)	
	•	-	ee secti	on 4.3									I	()	
		from Ta	ble 2a m Table	2h								0		(52)	
•								(47) × (54)	(FO) y (	50)		0		(53)	
		(54) in (5	•	e, kWh/ye	al			(47) x (51)	) X (52) X (	53) =		0		(54) (55)	
	. ,	. , .	,	for each	month			((56)m = (	55) x (41)	m		0		(00)	
1	-			i	i	0						0	l	(56)	
(56)m= If cylinde	0 er contains	0 s dedicate	0 d solar sto	0 prage, (57)	0 m = (56)m	0 x [(50) - (	0 [H11)] ÷ (5	0 0), else (5	0 7)m = (56)	0 m where (	0 H11) is fro	0 m Append	ix H	(56)	
(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)	
Primar	v circuit	loss (ar	nual) fr	u om Table	• 3		•			•		0		(58)	
				for each		59)m = (	(58) ÷ 36	65 × (41)	m		L		I		
	•			le H5 if t		,	. ,	. ,		r thermo	stat)				
(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)	



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Combi	loss ca	lculated	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 he	eating ca	alculated	for eac	h month	(62)m =	0.85 × (	(45)m +	(46)m +	(57)m +	(59)m + (61)m	
(62)m=	104.26	91.19	94.1	82.04	78.72	67.93	62.94	72.23	73.09	85.18	92.98	100.97		(62)
Solar DH	-IW input of	calculated	using App	endix G or	Appendix	H (negati	ve quantity	/) (enter '0	' if no sola	r contribut	ion to wate	er heating)	1	
(add a	dditiona	l lines if	FGHRS	and/or \	VWHRS	applies	, see Ap	pendix (	G)				_	
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0		(63)
Output	from wa	ater hea	ter											
(64)m=	104.26	91.19	94.1	82.04	78.72	67.93	62.94	72.23	73.09	85.18	92.98	100.97		
			-					Outp	out from w	ater heate	r (annual)₁	12	1005.63	(64)
Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]														
(65)m=	26.07	22.8	23.52	20.51	19.68	16.98	15.74	18.06	18.27	21.3	23.25	25.24		(65)
inclu	ıde (57)ı	m in calo	culation	of (65)m	only if c	ylinder i	s in the c	dwelling	or hot w	ater is fr	om com	munity h	eating	
5. Int	ernal ga	ains (see	e Table 5	and 5a	):									
Metab	olic gain	s (Table	e 5), Wat	ts										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(66)m=	86.3	86.3	86.3	86.3	86.3	86.3	86.3	86.3	86.3	86.3	86.3	86.3		(66)
Lightin	g gains	(calcula	ted in Ap	pendix	L, equat	ion L9 o	r L9a), a	lso see <sup>·</sup>	Table 5				I	
(67)m=	14.77	13.12	10.67	8.08	6.04	5.1	5.51	7.16	9.61	12.2	14.24	15.18		(67)
Applia	nces gai	ins (calc	ulated ir	Append	lix L, eq	uation L	13 or L1	3a), also	see Ta	ble 5			I	
(68)m=	150.4	151.96	148.03	139.66	129.09	119.15	112.52	110.96	114.89	123.26	133.83	143.77		(68)
Cookir	ng gains	(calcula	ted in A	ppendix	L, equat	ion L15	or L15a)	), also se	e Table	5			I	
(69)m=	31.63	31.63	31.63	31.63	31.63	31.63	31.63	31.63	31.63	31.63	31.63	31.63		(69)
Pumps	and far	ns gains	(Table 5	5a)									I	
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0		(70)
Losses	s e.g. ev	aporatio	n (nega	tive valu	es) (Tab	le 5)							I	
(71)m=	-69.04	-69.04	-69.04	-69.04	-69.04	-69.04	-69.04	-69.04	-69.04	-69.04	-69.04	-69.04		(71)
Water	heating	gains (T	able 5)										I	
(72)m=	35.03	33.92	31.62	28.49	26.45	23.59	21.15	24.27	25.38	28.62	32.29	33.93		(72)
Total i	nternal	gains =				(66)	m + (67)m	ı + (68)m -	⊦ (69)m + (	(70)m + (7	1)m + (72)	)m	I	
(73)m=	249.1	247.9	239.21	225.11	210.47	196.73	188.07	191.28	198.77	212.98	229.25	241.77		(73)
6. So	lar gains	5:												
Solar g	jains are c	alculated	using sola	r flux from	Table 6a	and assoc	iated equa	tions to co	onvert to th	e applicat	ole orientat	tion.		

Orientation: Access Factor Flux FF Gains Area g\_ Table 6d Table 6b m² Table 6a Table 6c (W) East 0.9x x (76) 1 х 19.64 х х 0.7 = 7.96 1.89 0.63 East 0.9x (76) 1 x 0.92 х х х 0.7 = 3.87 19.64 0.63 East 0.9x (76) 1 х 3.84 х 19.64 х 0.63 х 0.7 = 16.16 East 0.9x x х х х = (76) 1 1.23 19.64 0.63 0.7 5.18 East 0.9x (76) 1 х 1.89 х 38.42 х 0.63 х 0.7 = 15.56



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East	0.9x	1	×	0.92	x	38.42	×	0.63	x	0.7	=	7.58	(76)
East	0.9x	1	×	3.84	x	38.42	×	0.63	x	0.7	<b>j</b> =	31.62	(76)
East	0.9x	1	x	1.23	x	38.42	×	0.63	x	0.7	] =	10.13	(76)
East	0.9x	1	x	1.89	x	63.27	x	0.63	x	0.7	=	25.63	(76)
East	0.9x	1	x	0.92	x	63.27	x	0.63	x	0.7	=	12.48	(76)
East	0.9x	1	x	3.84	x	63.27	x	0.63	x	0.7	=	52.07	(76)
East	0.9x	1	x	1.23	x	63.27	×	0.63	x	0.7	] =	16.68	(76)
East	0.9x	1	x	1.89	x	92.28	x	0.63	x	0.7	] =	37.38	(76)
East	0.9x	1	x	0.92	x	92.28	×	0.63	x	0.7	] =	18.2	(76)
East	0.9x	1	×	3.84	x	92.28	×	0.63	x	0.7	=	75.95	(76)
East	0.9x	1	x	1.23	x	92.28	×	0.63	x	0.7	] =	24.33	(76)
East	0.9x	1	x	1.89	x	113.09	x	0.63	x	0.7	=	45.81	(76)
East	0.9x	1	x	0.92	x	113.09	x	0.63	x	0.7	=	22.3	(76)
East	0.9x	1	x	3.84	x	113.09	x	0.63	x	0.7	=	93.08	(76)
East	0.9x	1	x	1.23	x	113.09	x	0.63	x	0.7	=	29.81	(76)
East	0.9x	1	x	1.89	x	115.77	x	0.63	x	0.7	=	46.9	(76)
East	0.9x	1	x	0.92	x	115.77	x	0.63	x	0.7	=	22.83	(76)
East	0.9x	1	x	3.84	x	115.77	x	0.63	x	0.7	=	95.28	(76)
East	0.9x	1	x	1.23	x	115.77	x	0.63	x	0.7	] =	30.52	(76)
East	0.9x	1	x	1.89	x	110.22	x	0.63	x	0.7	=	44.65	(76)
East	0.9x	1	×	0.92	x	110.22	×	0.63	x	0.7	=	21.73	(76)
East	0.9x	1	x	3.84	x	110.22	x	0.63	x	0.7	=	90.71	(76)
East	0.9x	1	x	1.23	x	110.22	x	0.63	x	0.7	=	29.06	(76)
East	0.9x	1	x	1.89	x	94.68	×	0.63	x	0.7	=	38.35	(76)
East	0.9x	1	x	0.92	x	94.68	x	0.63	x	0.7	=	18.67	(76)
East	0.9x	1	x	3.84	x	94.68	×	0.63	x	0.7	=	77.92	(76)
East	0.9x	1	×	1.23	x	94.68	×	0.63	x	0.7	=	24.96	(76)
East	0.9x	1	x	1.89	x	73.59	x	0.63	x	0.7	=	29.81	(76)
East	0.9x	1	x	0.92	x	73.59	x	0.63	x	0.7	=	14.51	(76)
East	0.9x	1	x	3.84	x	73.59	×	0.63	x	0.7	=	60.56	(76)
East	0.9x	1	x	1.23	x	73.59	×	0.63	x	0.7	=	19.4	(76)
East	0.9x	1	x	1.89	x	45.59	x	0.63	x	0.7	=	18.47	(76)
East	0.9x	1	×	0.92	x	45.59	×	0.63	x	0.7	=	8.99	(76)
East	0.9x	1	×	3.84	x	45.59	x	0.63	x	0.7	=	37.52	(76)
East	0.9x	1	×	1.23	x	45.59	×	0.63	x	0.7	=	12.02	(76)
East	0.9x	1	×	1.89	x	24.49	×	0.63	x	0.7	=	9.92	(76)
East	0.9x	1	×	0.92	x	24.49	x	0.63	x	0.7	=	4.83	(76)
East	0.9x	1	x	3.84	×	24.49	×	0.63	x	0.7	] =	20.15	(76)
East	0.9x	1	×	1.23	×	24.49	×	0.63	x	0.7	=	6.46	(76)
East	0.9x	1	×	1.89	×	16.15	×	0.63	x	0.7	=	6.54	(76)
East	0.9x	1	x	0.92	X	16.15	x	0.63	x	0.7	=	3.18	(76)



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East 0.9x 1 x 1.23 x 16.15 x 0.63 x 0.7 = 4.26 (76) Solar gains in watts, calculated for each month (83)m = Sum(74)m(82)m (83)m = 33.17 64.89 106.86 155.85 191 196.52 186.15 159.9 124.28 77 41.36 27.28 (83) Total gains - internal and solar (84)m = (73)m + (83)m , watts (84)m = 282.27 312.78 346.07 380.96 401.47 392.25 374.21 351.18 323.05 289.97 270.61 269.04 (84) 7. Mean Internal temperature (heating season) Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85) Utilisation factor for gains for living area, h1,m (see Table 9a) (86)m 1 1 0.99 0.98 0.94 0.82 0.66 0.71 0.92 0.99 1 1 (86) Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (87)m 19.67 19.8 20.03 20.36 20.67 20.89 20.97 20.96 20.79 20.39 19.97 19.65 (87) Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) (88)m 1 1 0.99 0.97 0.91 0.74 0.52 0.58 0.86 0.98 1 1 (89) Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a) Utilisation factor for gains for rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (90)m 1 1 0.99 0.97 0.91 0.74 0.52 0.58 0.86 0.98 1 1 (89) Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (90)m 1 1 0.99 0.97 0.91 0.74 0.52 0.58 0.96 0.98 1 1 (90) m 10.74 0.90 19.7 0.91 0.74 0.52 0.58 0.96 0.98 1 1 (90) m 10.74 0.52 0.58 0.96 0.98 1 1 (90) m 10.74 0.90 19.7 0.91 0.74 0.52 0.58 0.98 0.98 1 0.91 (90) m 10.74 0.90 19.7 0.91 0.74 0.52 0.58 0.98 0.98 1 0.90 (90) m 10.74 0.90 19.7 0.91 0.74 0.52 0.58 0.98 0.98 1 0.90 (90) m 10.74 0.90 19.7 0.91 0.74 0.92 (90) m 10.74 0.90 19.7 0.91 0.74 0.92 (90) m 10.74 0.90 19.7 0.91 0.74 0.90 19.7 0.91 0.94 0.90 (90) m 10.74 0.90 19.7 0.91 0.97 0.91 0.74 0.90 (90) m 10.74 0.90 19.7 0.91 0.97 0.91 0.74 0.92 0.98												
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7. Mean internal temperature (heating season)         Temperature during heating periods in the living area from Table 9, Th1 (°C)       21       (85)         Utilisation factor for gains for living area, h1,m (see Table 9a)         Mar       Apr       May       Jun       Jun       21       (85)         Utilisation factor for gains for living area, h1,m (see Table 9a)       Mar       Apr       May       Jun       Jun       Jun       Jun       Jun       Jun       Jun       Colspan="2">Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)         (86)me       19.94       19.94       19.94       19.94       19.95       19.95       19.95       19.95       19.95       19.95       19.94       19.94       (88)         Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)       (89)m=       1       1       1       0.97       0.91       0.74       0.58       0.86       0.98       1       1       0       (89)       (89)												
Temperature during heating periods in the living area from Table 9, Th1 (°C)       21       (85)         Utilisation factor for gains for living area, h1,m (see Table 9a)         Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec         Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec         (86)m=       1       1       0.99       0.94       0.82       0.66       0.71       0.92       0.99       1       1       (86)         Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec         (8)m=       19.67       19.8       0.93       0.94       0.82       0.66       0.71       0.92       0.99       1.97       19.65       (87)         Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)       (88)         Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)       (89) <td colspa<="" td=""></td>												
Utilisation factor for gains for living area, h1,m (see Table 9a)         Image: transformation to the mean internal temperature from Table 9a)       Image: transformation to the mean internal temperature in living area to the mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)       (86)         (86)m=       1       1       0.99       0.98       0.94       0.82       0.66       0.71       0.92       0.99       1       1       (86)         Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)       (87)       (87)       (87)         Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)       (88)       (88)       (88)         Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)       (89)       1       1       (89)         (89)m=       1       1       0.99       0.97       0.91       0.74       0.52       0.58       0.86       0.98       1       1       (89)         Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)       (90)       (90)       18.73       18.85       19.09       19.41       19.91       19.94       19.82       19.44       19.03       18.7       (90)         (90)m=       18.73       18.85       19.09       19.41       19.71												
Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec         1       1       0.99       0.98       0.94       0.82       0.66       0.71       0.92       0.99       1       1       (86)         Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)       (87)       1       1       (86)         (87)m=       19.67       19.8       20.03       20.36       20.67       20.89       20.97       20.36       20.79       20.39       19.97       19.65       (87)         Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)         (88)m=       19.94       19.94       19.95       19.95       19.95       19.95       19.95       19.94       19.94       (88)         Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)       (89)       1       1       (89)         (90)m=       1       1       0.99       0.97       0.91       0.74       0.52       0.58       0.86       0.98       1       1       (89)         (90)m=       18.73       18.85       19.09       19.41       19.71       19.94												
Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec           1         1         0.99         0.98         0.94         0.82         0.66         0.71         0.92         0.99         1         1         (86)           Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)         (87)         1         1         (86)           (87)m=         19.67         19.8         20.03         20.36         20.67         20.89         20.97         20.36         20.79         20.39         19.97         19.65         (87)           Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)         (88)         (88)         (88)         (88)           Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)         (89)m=         1         1         0.99         0.97         0.91         0.74         0.52         0.58         0.86         0.98         1         1         (89)           Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)         (90)         fLA = Living area $\div$ (4) =         0.46         (91)           Mean internal temperature (for the whole dwelling) = fLA x T1 + (1 - fLA) x T2												
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)         (88)m=       19.94       19.94       19.94       19.95       19.95       19.95       19.95       19.95       19.94       19.94       (88)         Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)       (89)m=       1       1       0.99       0.97       0.91       0.74       0.52       0.58       0.86       0.98       1       1       (89)         Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)       (90)       (90)       18.73       18.85       19.09       19.41       19.71       19.94       19.94       19.93       18.7       (90)         Mean internal temperature (for the whole dwelling) = fLA x T1 + (1 - fLA) x T2       (92)       (92)       19.16       19.28       19.52       19.84       20.15       20.35       20.41       20.26       19.87       19.46       19.14       (92)         Apply adjustment to the mean internal temperature from Table 4e, where appropriate       (92)       19.94       19.87       19.87       19.46       19.14       (92)												
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$												
Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)         (89)m=       1       1       0.99       0.97       0.91       0.74       0.52       0.58       0.86       0.98       1       1       (89)         Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)       (90)m=       18.73       18.85       19.09       19.41       19.71       19.9       19.94       19.94       19.03       18.7       (90)         Mean internal temperature (for the whole dwelling) = fLA x T1 + (1 - fLA) x T2         (92)m=       19.16       19.28       19.52       19.84       20.15       20.35       20.41       20.41       20.26       19.87       19.46       19.14       (92)         Apply adjustment to the mean internal temperature from Table 4e, where appropriate       (92)       (92)       19.41       19.42       20.41       20.46       19.44       19.46       19.14       (92)												
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$												
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) $(90)m =$ 18.73       18.85       19.09       19.41       19.71       19.9       19.94       19.82       19.44       19.03       18.7       (90)         FLA = Living area ÷ (4) =       0.46       (91)         Mean internal temperature (for the whole dwelling) = fLA x T1 + (1 - fLA) x T2         (92)m=       19.16       19.28       19.52       19.84       20.15       20.35       20.41       20.41       20.26       19.87       19.46       19.14       (92)         Apply adjustment to the mean internal temperature from Table 4e, where appropriate												
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$												
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$fLA = \text{Living area} \div (4) = 0.46  (91)$ Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$ $(92)m = 19.16  19.28  19.52  19.84  20.15  20.35  20.41  20.41  20.26  19.87  19.46  19.14  (92)$ Apply adjustment to the mean internal temperature from Table 4e, where appropriate												
(92)m=         19.16         19.28         19.52         19.84         20.15         20.35         20.41         20.26         19.87         19.46         19.14         (92)           Apply adjustment to the mean internal temperature from Table 4e, where appropriate         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92)         (92) <td< td=""></td<>												
(92)m=         19.16         19.28         19.52         19.84         20.15         20.35         20.41         20.26         19.87         19.46         19.14         (92)           Apply adjustment to the mean internal temperature from Table 4e, where appropriate         Image: Control of the second s												
Apply adjustment to the mean internal temperature from Table 4e, where appropriate												
8 Space heating requirement												
8. Space heating requirement Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate												
the utilisation factor for gains using Table 9a												
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec												
Utilisation factor for gains, hm:												
(94)m= 1 1 0.99 0.97 0.91 0.77 0.59 0.64 0.88 0.98 1 1 (94)												
Useful gains, hmGm , $W = (94)m \times (84)m$												
(95)m= 281.62 311.47 342.64 369.7 366.17 302.53 219.05 225.76 284.72 284.33 269.44 268.56 (95)												
Monthly average external temperature from Table 8												
(96)m= 4.3 4.9 6.5 8.9 11.7 14.6 16.6 16.4 14.1 10.6 7.1 4.2 (96)												
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m – (96)m ]												
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ]												
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m- (96)m] (97)m= 897.82 867.84 784.49 655.29 505.2 342.03 226.79 237.93 367.31 554.65 740.91 897.57 (97)												
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m – (96)m]         (97)m=       897.82       867.84       784.49       655.29       505.2       342.03       226.79       237.93       367.31       554.65       740.91       897.57       (97)         Space heating requirement for each month, kWh/month = $0.024 x [(97)m - (95)m] x (41)m$												
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m- (96)m]         (97)m=       897.82       867.84       784.49       655.29       505.2       342.03       226.79       237.93       367.31       554.65       740.91       897.57       (97)         Space heating requirement for each month, kWh/month = $0.024 x [(97)m - (95)m] x (41)m$ (98)m=       458.46       373.88       328.74       205.63       103.43       0       0       0       201.12       339.46       467.99												

Calculated for June, July and August. See Table 10b



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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Heat I	Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	559	440.07	451.49	0	0	0	0		(100)
Utilisa	tion fac	tor for lo	ss hm											
(101)m=	0	0	0	0	0	0.83	0.9	0.87	0	0	0	0		(101)
Usefu	Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	461.49	395.01	392.87	0	0	0	0		(102)
Gains (solar gains calculated for applicable weather region, see Table 10)														
(103)m=	0	0	0	0	0	549.23	525.76	496.65	0	0	0	0		(103)
Space cooling requirement for month, whole dwelling, continuous ( $kWh$ ) = 0.024 x [(103)m - (102)m ] x (41)m set (104)m to zero if (104)m < 3 x (98)m														
(104)m=	0	0	0	0	0	63.18	97.28	77.21	0	0	0	0		
	Total = Sum(104) =												237.67	(104)
Cooled fraction $f C = cooled area \div (4) =$												1	(105)	
Intermi	ttency f	actor (Ta	able 10b	)		-	-							
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0		_
									Tota	l = Sum(	104)	=	0	(106)
Space	cooling	requirer	nent for	month =	(104)m	× (105)	× (106)r	n						_
(107)m=	0	0	0	0	0	15.79	24.32	19.3	0	0	0	0		_
									Total	= Sum(	107)	=	59.42	(107)
Space	cooling	requirer	ment in k	(Wh/m²/y	/ear				(107)	) ÷ (4) =			1.16	(108)
8f. Fab	ric Enei	rgy Effici	iency (ca	alculated	l only un	der spec	cial cond	litions, se	ee sectio	on 11)				
Fabric Energy Efficiency										+ (108) =	=		49.55	(109)