

Energy & Sustainability Statement

For

26 Netherhall Gardens

London Borough of Camden London NW3 5TL

Prepared for

Dome Assets Ltd

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EXECUTIVE SUMMARY

Mecserve Ltd has been appointed by Atlas Property Lettings & Service Ltd to prepare an Energy and Sustainability Statement to support the planning application for the proposed scheme at 26 Netherhall Gardens in the London Borough of Camden. Building works on the site include the erection of a six-storey block of five residential units.

This Energy Statement, prepared in line with the Greater London Authority guidance on preparing energy assessments (March 2016), outlines the key features and strategies adopted by the development team to enhance the energy performance of the proposed redevelopment of 26 Netherhall Gardens. The scheme complies with all relevant policies in regards to Energy set by London Borough of Camden Local Plan. Sections 2 and 3 review these policies and demonstrate how design meets planning targets and requirements in terms of energy and carbon emissions.

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 26 Netherhall Gardens:

- High performance building fabric of low U-values that exceed Part L minimum standards;
- Excellent air tightness to reduce heat losses through infiltration;
- All junctions will conform to Accredited Construction Details thus eliminating thermal bridging;
- Individual gas-fired condensing boilers of high efficiency with well insulated hot water cylinders will provide domestic hot water and heating to ancillary areas;
- All apartments will feature Mechanical Ventilation with Heat Recovery to make use of wasted heat of exhaust air by preheat incoming air;
- Light fittings will be of low energy types.

The following Low/Zero Carbon Technologies proposed for the 26 Netherhall Gardens scheme will generate renewable energy on site:

 Reverse cycle Air-Source-Heat-Pumps will provide heating and cooling to the main living areas.



Following the proposed energy strategy, the new flats achieve significant carbon savings that exceed both the Target Emission Rate (TER) set by Part L of current Building Regulations and the Code for Sustainable Homes (CSH) Level 4 Target in terms of CO₂ emissions i.e. 20% reduction over 2013 TER. The following sections present the CO₂ savings for the new erected storey in 26 Netherhall Gardens.

Table 1 demonstrates the overall reduction in the regulated carbon emission of the development after each stage of the London Plan Energy Hierarchy.

Table 1 Total CO₂ emissions reduction for the development

		Carbon dioxide emissions (Tonnes CO ₂ per annum)
Baseline Emis	ssions	15.01
Be Lean	After energy demand reduction	14.56
Be Clean	After CHP	14.56
Be Green	After renewable energy	11.38

Table 2 demonstrates the total regulated CO₂ savings from each stage of the Energy Hierarchy. As demonstrated below, an overall 24.2% reduction in carbon emissions can be achieved over Part L 2013 TER when applying the proposed strategy, which exceeds the 20% reduction required for CSH Level 4. The scheme also achieves a reduction of 21.8% due to the use of renewable energy technologies, thus complying with Camden Council's requirements in terms of carbon emissions.

Table 2 Total regulated carbon dioxide savings from each stage of the Energy Hierarchy

	Regulated carbo	n dioxide savings
	(Tonnes CO2 per annum)	(%)
Savings from energy demand reduction	0.45	3.0
Savings from CHP	0.0	0.0
Savings from renewable energy	3.18	21.8
Total Cumulative Savings	3.63	24.2
Total Target Savings	3.00	20.0
Annual Surplus	0.63	



Figure 1 below illustrates the total carbon savings achieved at each stage of the London Plan Energy Hierarchy for 26 Netherhall Gardens. Overall, the scheme exceeds the carbon reduction required for a CSH Level 4 rating.

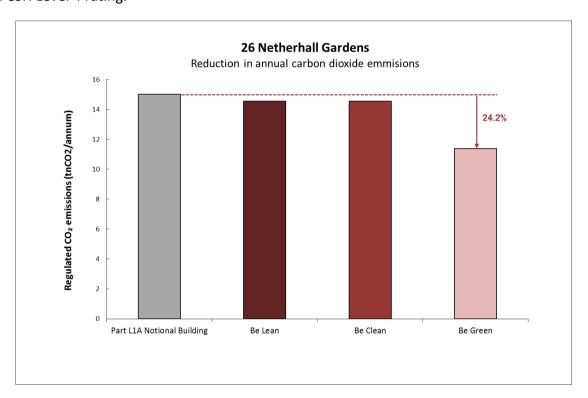


Figure 1 Total carbon savings achieved over Baseline Emissions



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%¹ of the total CO2 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 is located at 26 Netherhall Gardens in London Borough of Camden, within the Fitzjohns / Netherhall conservation area. The development proposed is the demolition of the existing property and redevelopment of the site to provide a four storey (plus basement storey and sub-basement for plant) detached property comprising five self-contained residential units (4 x 2 bedroom and 1 x 3 bedroom); the proposals also include hard and soft landscaping, new boundary treatment and the provision of off-street car parking.

This energy statement reflects the impact recent changes on the design of the 26 Netherhall Gardens scheme, following the appeal decision (Appeal Ref: APP/X5210/W/16/3145922), will have on the energy and sustainability performance of the development.

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

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¹ Department for Environment, Food and Rural Affairs, http://www.defra.gov.uk/, 2008





Figure 2 Bird's eye view of existing Building



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 Economy² 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 Act³ 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.

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² Dti, (2003); Energy White Paper Our Energy Future - Creating a Low Carbon Economy. TSO.

³ 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.

2.2 REGIONAL POLICY

THE LONDON PLAN (INCLUDING FURTHER ALTERATIONS MARCH 2015)

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.



2.3 LOCAL POLICIES

CAMDEN CORE STRATEGY (NOVEMBER 2010)

Camden's Core Strategy sets out the key elements of the Council's planning vision and strategy of the borough. Along with other Local Development Framework documents and Mayor's London Plan for the statutory 'development plan' for Camden.

The following is the review of the London Plan and Camden Planning 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 CO2) 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 various policies, Camden Council encourages developments to meet the highest feasible environmental standards, where feasible and possible, in order to minimise the effects of and adapt to climate change. The climate change risks for the London Borough of Camden are summarised below:

- Hotter, drier summers;
- Milder, wetter winters;
- More frequent extreme high temperatures;
- More frequent heavy downpours of rain;
- Significant decreases in soil moisture content in summer;
- Sea level rise and increases in storm surge height;
- Possible higher wind speeds.



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 CLIMATE CHANGE MITIGATION POLICIES

- Policy 5.1 Climate change mitigation;
- Policy 5.2 Minimising carbon dioxide emissions;
- Policy 5.3 Sustainable design and construction;
- Policy 5.5 Decentralised Energy Networks;
- Policy 5.6 Decentralised energy in development proposals;
- Policy 5.7 Renewable energy;

CAMDEN CORE STRATEGY 2010-2025 CLIMATE CHANGE MITIGATION POLICIES

• Policy CS13 Tackling climate change through promoting higher environmental standards;

CAMDEN DEVELOPMENT POLICIES 2010-2025 CLIMATE CHANGE MITIGATION POLICIES

Policy DP22 Promoting sustainable design and construction.

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

Policy 5.1 Climate Change Mitigation

A. The Mayor seeks to achieve an overall reduction in London's carbon dioxide emissions of 60 per cent (below 1990 levels) by 2025. It is expected that the GLA Group, London boroughs and other organisations will contribute to meeting this strategic reduction target, and the GLA will monitor progress towards its achievement annually.

B. Within LDFs boroughs should develop detailed policies and proposals that promote and are consistent with the achievement of the Mayor's strategic carbon dioxide emissions reduction target for London.

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

The strategy for minimising carbon dioxide emissions is outlined in this Energy Statement, prepared in accordance with GLA Guidance on reporting energy assessments. The Energy sections of the report has taken into consideration both the requirements of London Plan Policy 5.2 and also Camden's Development Policy DP22 and demonstrates that the development exceeds the carbon dioxide target reduction by achieving a reduction of more than 20% over 2013 TER, as required for a CSH Level 4 rating.

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:

Be lean: use less energy;

• Be clean: supply energy efficiently;

Be green: use renewable energy.

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

The proposed scheme, comprising 5 No. new built dwellings, is not classified as a major development according to London Plan. Therefore, Policy 5.2 is not applicable to the proposed development. The energy strategy proposed, however, follows London Plan Energy Hierarchy and this report is written in line with GLA guidance on reporting energy assessments.

In order to design an energy efficient, low carbon development, the design team has followed the London Plan Energy Hierarchy i.e.



- The development is designed to have highly efficient envelope and passive strategies, e.g.
 following Accredited Construction Details to minimise thermal bridging, have been
 incorporated in the design where possible. Efficient building services including MVHR 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.

As a result of the proposed strategy, the scheme achieves an overall reduction of 24.2% over 2013 TER.

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.

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

The strategy for minimising carbon dioxide emissions is outlined in the following sections of the Energy and Sustainability Statement, prepared in accordance with GLA guidance on assessing the energy performance. Due to Sustainable design features integrated in the design of the new 26 Netherhall Gardens units, the development exceeds the carbon dioxide target reduction set by Code for Sustainable Homes Level 4 thus achieving a reduction more than 20% over 2013 TER.

Passive design measures such as enhanced thermal performance of well insulated thermal elements and use of Accredited Construction Details as well as condensing boilers of high efficiency and Mechanical Ventilation with Heat Recovery (MVHR) will help reduce heating demand first and then energy consumption. During summer windows can be fully opened to allow for fresh air to remove excessive heat gains and reduce the risk of overheating. When external air temperature, however, is high, then comfort cooling can be provided by reverse cycle heat pumps. Low water use fittings will be installed to minimise water consumption on site targeting a daily consumption less than 105 litres/person. Materials of low environmental impact, which will be responsibly resourced, will be also specified for the scheme. More information can be found on the Design and Access Statement prepared by Squire & Partners Architects.



Policy 5.5 Decentralised Energy Networks

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.

A. The Mayor expects 25 per cent of the heat and power used in London to be generated through the use of localised decentralised energy systems by 2025. In order to achieve this target, the Mayor prioritises the development of decentralised heating and cooling networks at the development and area wide levels, including larger scale heat transmission networks.

- B. Within LDFs boroughs should develop policies and proposals to identify and establish decentralised energy network opportunities. Boroughs may choose to develop this as a supplementary planning document and work jointly with neighbouring boroughs to realise wider decentralised energy network opportunities. As a minimum, boroughs should:
 - a. identify and safeguard existing heating and cooling networks
 - b. identify opportunities for expanding existing networks and establishing new networks. Boroughs should use the London Heat Map tool and consider any new developments, planned major infrastructure works and energy supply opportunities which may arise
 - c. develop energy master plans for specific decentralised energy opportunities which identify:
 - major heat loads (including anchor heat loads, with particular reference to sites such as universities, hospitals and social housing)
 - major heat supply plant
 - possible opportunities to utilise energy from waste
 - possible heating and cooling network routes
 - implementation options for delivering feasible projects, considering issues of procurement, funding and risk and the role of the public sector
 - d.require developers to prioritise connection to existing or planned decentralised energy networks where feasible.

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

The scheme, comprising of 5 new residential units, will have constant heating demand, mainly due to hot water usage, throughout the year. However, due to high performance building fabric performance proposed and low water use fittings to be specified, this is expected to be low. According to the London Heat Map (Figure 3), the site is not within a district heating opportunity area and there is no existing network in close proximity or one to become available in the future.



Therefore, given the small scale of the scheme and currently no availability in close proximity, it is not feasible or viable to connect to a district heat network.

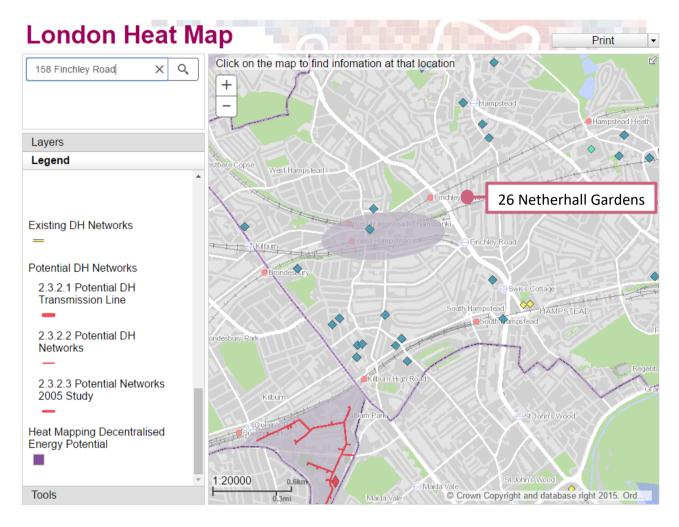


Figure 3 Image of London Heat Map (www.londonheatmap.org.uk)

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:



- Connection to existing heating or cooling networks;
- Site wide CHP network;
- 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, there is no available district heating in close proximity currently or in the future. Given the scale of the proposed scheme, consisting of 5 new flats, installation of Combined Heat and Power (CHP) is not considered to be feasible, as there is not high heating and hot water demand throughout the year to enable the CHP unit to run continuously for long period thus ensuring maximum carbon and cost savings. As per GLA guidance on energy assessments, a higher number of residential units is required to justify installation of a CHP unit.

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

Reverse cycle heat pumps will be installed in each dwelling to provide occupants with both space heating and comfort cooling. Air-source or aerothermal heat-pumps extract heat from the ambient air and transfer it through refrigerants acting as a medium to the hot water storage. Even though



the system consumes electricity, which is a carbon intensive fuel, significant savings can be achieved mainly due to its high seasonal efficiency.. Air source heat pump internal and external units for the site are relatively small and could be well integrated within the design of the building. The system is capable of meeting the total heating and cooling requirement of the main living areas (living/dining room, kitchen and bedrooms) of each flat and therefore it is considered as the optimum option for the scheme.

The scheme achieves a 21.8% reduction in its annual carbon emissions due to the use of renewable energy technologies installed on site. The proposed technologies will have no impact on local biodiversity or air quality. An Air Quality Assessment has been prepared by Aether UK as part of the planning application.

Policy CS13 Tackling climate change through promoting higher environmental standards

Reducing the effects of and adapting to climate change

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

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

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

Local energy generation

The Council will promote local energy generation and networks by:



- e. working with our partners and developers to implement local energy networks in the parts of Camden most likely to support them, i.e. in the vicinity of:
- housing estates with community heating or the potential for community heating and other uses with large heating loads;
- the growth areas of King's Cross; Euston; Tottenham Court Road; West Hampstead Interchange and Holborn;
- schools to be redeveloped as part of Building Schools for the Future programme;
- existing or approved combined heat and power/local energy networks (see Map 4); and other locations where land ownership would facilitate their implementation.
- f. protecting existing local energy networks where possible (e.g. at Gower Street and Bloomsbury) and safeguarding potential network routes (e.g. Euston Road);

Water and surface water flooding

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

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

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

The development makes efficient use of land within the borough by providing additional residential units within the footprint of the existing site. The site is well served by public transportation links thus reducing car usage. More information can be found in the Design and Access Statement prepared by Squire & Partners Architects.

The development is designed to reduce carbon emission by more than 20% overall in line with Code for Sustainable Homes Level 4. Renewable energy will be generated on site using ASHP thus reducing carbon emissions by 20%. The energy section of this report outlines the proposed energy strategy developed for the scheme including enhanced building fabric performance, energy efficiency building services systems and renewable energy technologies.

The scheme has been designed to have mechanical ventilation and the façade has been carefully developed to balance between adequate daylighting, passive solar heat gains and risk of overheating in summer. The development incorporates water-efficient sanitary ware to reduce the use of potable water.



Policy DP22 Promoting Sustainable Design and Construction

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

- a. demonstrate how sustainable development principles, including the relevant measures set out in paragraph 22.5 below, have been incorporated into the design and proposed implementation; and
- b. incorporate green or brown roofs and green walls wherever suitable.

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

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

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

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

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

The scheme is designed to reduce annual carbon emissions by more than 20% over the Target Emission Rate set by Part L 2013 thus complying with CSH Level 4 target in terms of carbon emissions. Code for Sustainable Homes scheme is now scrapped by the government, however, the following sections outline all the sustainable features integrated in the design of the new 26 Netherhall Gardens flats. Low water use will be specified to reduce daily water consumption beyond 105 litres per person. High-performance windows of low-g-value and mechanical ventilation is introduced to tackle overheating and provide occupants with a comfort indoor environment.

In regards to waste reduction, at least 10% of the total value of materials used for the construction of the new development will derive from recycled and reused sources. Appendix 4 provides more information on sustainable use of materials.



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 CLIMATE CHANGE ADAPTATION POLICIES

- Policy 5.9 Overheating and cooling;
- Policy 5.10 Urban greening;
- 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 DEVELOPMENT POLICIES 2010-2025 CLIMATE CHANGE ADAPTATION POLICIES

Policy DP23 Water

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

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:
 - minimise internal heat generation through energy efficient design;
 - reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls;
 - manage the heat within the building through exposed internal thermal mass and high ceilings;
 - passive ventilation;
 - mechanical ventilation;
 - 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:

Even though the scheme is not classified as a major development, measures to eliminate the risk of overheating have been considered and integrated in the design of the new flats. The following will be applied to ensure comfort during summer within the main living areas of the units:



- well insulated fabric elements and high airtightness to prevent heat transfer from the external environment.
- Openable windows to allow for natural cross ventilation. Windows will be of low g-value to avoid heat transmittance during summer but allow for passive heating in the winter.
- When required, additional flow rates can be provided through whole house mechanical ventilation, bypassing heat recovery.
- Comfort cooling via a reverse cycle ASHP will be provided to main living areas to provide comfort cooling when external air temperature is high.
- Tenants will be advised to purchase 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.

Policy 5.10 Urban Greening

A. The Mayor will promote and support urban greening, such as new planting in the public realm (including streets, squares and plazas) and multifunctional green infrastructure, to contribute to the adaptation to, and reduction of, the effects of climate change.

B. The Mayor seeks to increase the amount of surface area greened in the Central Activities Zone by at least five per cent by 2030, and a further five per cent by 2050,

C. Development proposals should integrate green infrastructure from the beginning of the design process to contribute to urban greening, including the public realm. Elements that can contribute to this include tree planting, green roofs and walls, and soft landscaping. Major development proposals within the Central Activities Zone should demonstrate how green infrastructure has been incorporated.

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

The use of appropriate vegetation in the communal and private gardens and balconies aspires to enhance the ecological value of the site thus reducing urban island heat effect.

Further information can be found in the Design and Access Statement prepared by Squire & Partners Architects.

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.

B. Within LDFs boroughs should, in line with the Flood and Water Management Act 2010, utilise Surface Water Management Plans to identify areas where there are particular surface water management issues and develop actions and policy approaches aimed at reducing these risks.

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

As a result of the proposed building works, the impermeable area of the development will not be increased thus reducing surface water run-off.

Policy 5.12 Flood Risk Management

- A. The Mayor will work with all relevant agencies including the Environment Agency to address current and future flood issues and minimise risks in a sustainable and cost effective way.
- 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 [1] 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:
 - the development will remain safe and operational under flood conditions;
 - strategy of either safe evacuation and/or safely remaining in the building is followed under flood conditions;
 - key services including electricity, water etc. will continue to be provided under flood conditions;
 - 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.

E. In line with the NPPF and the Technical Guidance, boroughs should, when preparing LDFs, utilise Strategic Flood Risk Assessments to identify areas where particular flood risk issues exist and develop actions and policy approaches aimed at reducing these risks, particularly through redevelopment of sites at risk of flooding and identifying specific opportunities for flood risk management measures.

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

The site is in a low flood risk zone according to the Environmental Agency Flood Map (Figure 4). Based on Map 5 of the Core Strategy, the site is close to those parts that have experienced significant sewer or surface water flooding and therefore considered to have the potential to be at risk of surface water flooding. As explained previously, however, the proposed development does not increase the impermeable area of the building.





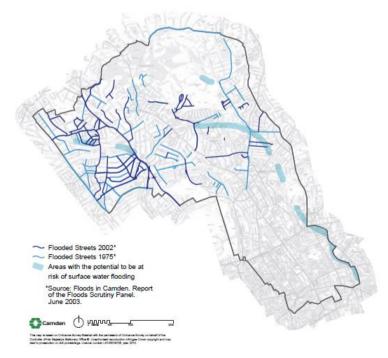


Figure 4 Environment Agency Flood Map & Map 5 of Camden's Core Strategy



Policy 5.15 Water Use Supplies

A. The Mayor will work in partnership with appropriate agencies within London and adjoining regional and local planning authorities to protect and conserve water supplies and resources in order to secure London's needs in a sustainable manner by:

- minimising use of mains water;
- reaching cost-effective minimum leakage levels;
- in conjunction with demand side measures, promoting the provision of additional sustainable water resources in a timely and efficient manner, reducing the water supply deficit and achieving security of supply in London;
- minimising the amount of energy consumed in water supply;
- promoting the use of rainwater harvesting and using dual potable and grey water recycling systems, where they are energy and cost-effective;
- maintaining and upgrading water supply infrastructure;
- ensuring the water supplied will not give rise to likely significant adverse effects to the environment particularly designated sites of European importance for nature conservation.
- B. Development should minimise the use of mains water by:
 - incorporating water saving measures and equipment;
 - designing residential development so that mains water consumption would meet a target of 105 litres or less per head per day.
- C. New development for sustainable water supply infrastructure, which has been selected within water companies' Water Resource Management Plans, will be supported.



Policy DP23. Water

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

- a. incorporating water efficient features and equipment and capturing, retaining and re-using surface water and grey water on-site;
- b. limiting the amount and rate of run-off and waste water entering the combined storm water and sewer network through the methods outlined in part a) and other sustainable urban drainage methods to reduce the risk of flooding;
- c. reducing the pressure placed in the combined storm water and sewer network from foul water and surface water run-off and ensuring developments in the areas identified by the North London Strategic Flood Risk Assessment and shown on Map 2 as being at risk of surface water flooding are designed to cope with the potential flooding;
- d.ensuring that developments are assessed for upstream and downstream groundwater flood risks in areas where historic underground streams are known to have been present; and
- e. encouraging the provision of attractive and efficient water features.

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

As required for CSH Level 4, all new apartments will have low water use fittings to reduce the water consumption and the energy consumption on site. Installation of low flow rate showers, taps and dual flush toilets, together with smaller baths (where applicable) will mean that all apartments will achieve a maximum internal water use of 105 litres per person/day, with an additional 5 litres person/day for external water use.



4. BUILDING REGULATION COMPLIANCE

The Building Regulations Part L (Conservation of Fuel and Power) 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. The development falls under the Building Regulations Part L category of L1A. The criteria of Part L are outlined in the table below.

Table 3: Part L1A 2013 Criteria

Part L Requirements				
Α	 Limiting heat gains and losses i. through thermal elements and other parts of the building fabric; and ii. from pipes, ducts and vessels used for space heating, space cooling and hot water services 			
В	Providing fixed building services which i. are energy efficient; ii. have effective controls; and iii. are commissioned by testing and adjusting as necessary to ensure they use no more fuel and power than is reasonable in the circumstances			
С	Providing to the owner sufficient information about the building, the fixed building services and their maintenance requirements so that the building can be operated in such a way as to use no more fuel than is reasonable in the circumstances.			

The development will comply with all the design limits on building fabric, heating, cooling, hot water and lighting efficiencies where feasible and practicable. Detailed energy calculations have been completed to assess the energy impact of this development.

4.1 BUILDING ENERGY MODEL

STROMA FSAP 2012 software (version 1.0.3.13), approved by BRE for full implementation of the Standard Assessment Procedure (SAP 2012) has been used to assess the energy performance and annual carbon emissions of the scheme after energy efficient measures have been applied. The energy assessment has been completed by Mecserve's energy modelling team who are accredited On Construction Dwelling Energy Assessors.



4.2 BASELINE CARBON EMISSION RATE

The building comprises five new-build flats. According to the GLA Guidance on preparing energy assessments (March 2016), the new build elements will be assessed against Part L1A standards. Therefore, the L1A Target Emission Rate (TER) will be used to determine the baseline CO2 emissions.

The following table (Table 4) presents the baseline CO2 emissions for the proposed scheme.

From 6 April 2014, Approved Document L1A has introduced a fabric energy efficiency standard (FEES). This is the maximum space heating and cooling energy demand for a new home. 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 m² per annum. Table 4 also presents the Target Fabric Energy Efficiency (TFEE) calculated by FSAP 2012 software.

Table 4 Baseline Carbon Dioxide emissions

Regulated Carbon dioxide emissions	26 Netherhall Gardens
Baseline Carbon Emission Rate (Part L1A 2013 TER)	15.01 tnCO₂/annum
Part L1A 2013 Target Fabric Energy Efficiency Rate (TFEE)	58.12 kWh/sqm/annum



5. 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 green: use renewable energy.

The hierarchy provides the mechanism through which the carbon dioxide (CO₂) 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.

Considering that the proposed development is a minor scheme, the following sections indicate the performance of the scheme in relation to the Code for Sustainable Homes Level 4 reduction target. The Code Level 4 equivalent reduction target in carbon dioxide emissions is 20% over Part L1A 2013 TER. New residential dwellings are required to demonstrate how this has been met by following the London Plan Energy Hierarchy described above.



6. 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 demonstrates how the prosed development will achieve energy and CO₂ emissions reduction over the baseline emissions.

6.1 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. The
 main façade is facing West. The internal layout of the dwelling has been set out to maximise
 the number of habitable rooms that can take advantage of solar gain and natural light;
- Passive Solar Design and Daylight: The make-up of the proposed façade has balanced proportion of solid wall to glazing, thus providing optimum amount of daylight and winter solar heating, without excessive solar gains during the summer;
- Thermal performance of the fabric: the proposed building fabric exceeds the requirements set in the Part L regulations;
- High performance windows: Glass of low g-value will be selected to reduce solar gains during summer;
- Thermal bridges: Accredited Construction Details will be used to minimise the impact of thermal bridges thus reducing heat losses;
- Air-tightness: Using enhanced construction skills and rigorous detailing to reduce the air permeability of the building 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.

Table 5 Proposed building fabric specifications

Building Fabric	U-value	Wall	0.18
	[W/m ² K]	Floor	0.15
		Roof	0.15
		Window	1.40 – Double-glazed (G-value: 0.63)
		Door	1.00 – Solid Door
	Air permea	ability	4 m³/m²hr @50Pa
	Thermal B	ridging	All junctions need to conform with Accredited Construction Details



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.

6.2 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: Individual gas-fired condensing boilers of high efficiency are proposed for each flat to provide heating to ancillary areas;
- Ventilation: Fresh air will be provided to the occupants via Mechanical Ventilation with Heat Recovery;
- Domestic Hot Water: A well-insulated hot water cylinder will be provided to every apartment with minimum storage losses fed by individual gas-fired boilers;
- Lighting: All light fittings will be dedicated low energy types i.e. either LED or fluorescent.

Table 6 Proposed building services systems

HVAC Systems	Secondary Main	Individual gas-fired cond	ensing boilers serving anci	llary areas with
Heating System		efficiency of 89%		
	Secondary	Not provided		
	Heating System			
	Heating	Time and temperature zo	one control by suitable arr	angement of plumbing
	Controls	and electrical services inc	cluding a delayed start the	rmostat
	Ventilation	Whole house balanced m	echanical ventilation with	heat recovery of 94%
		and SFP of 0.45 W/l/s		
	Cooling	Comfort cooling provided in each unit		
DHW	Hot Water	Supplied by individual gas-fired boilers		
	System	Dwelling	Tank Volume (I)	Heat loss factor
		Apartment 1-5	150	1.55 kWh/day
	DHW Controls	Cylinder in heated space with thermostat and separate timer for DHW.		rate timer for DHW.
		Primary pipework is fully insulated.		
Lighting	Installed Light	All light fittings are dedicated low energy types i.e. either LED or		
	fittings	fluorescent.		



6.3 SAVINGS FROM BE LEAN MEASURES

After implementing all the passive and active energy efficiency measures listed in sections 6.1-6.2, the carbon dioxide emissions of the proposed scheme are reduced from 14.84 tnCO2 to 14.45 tnCO2 per year. Therefore, the reduction in Carbon Emission of the building at this stage is 3%, as the following table demonstrates.

Table 7 Carbon Dioxide emissions reduction for the development

Regulated Carbon dioxide emissions (Tonnes CO ₂ per annum)		26 Netherhall Gardens	
Baseline Emissions		15.01	
Be Lean After energy demand reduction		14.56	
Carbon Savings over Baseline		0.45	
Carbon Reduction over Baseline		3%	

Subsequently, the reduction in Fabric Energy Efficiency of the building is 6.2%, as the following table demonstrates.

Table 8 Fabric Energy Efficiency Rate reduction for the development

Fabric Energy Efficiency (kWh per m² per annum)	26 Netherhall Gardens
Part L1A Target Fabric Energy Efficiency (TFEE) Rate	58.12
Dwelling Fabric Energy Efficiency (DFEE) Rate	54.50
Reduction over 2013 TFEE	6.2%



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.

7.1 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, there is no district heating network in close proximity available currently or in the future. Therefore, given also the size and scale of the proposed scheme, connection to a district energy network is not considered feasible.

7.2 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. Due to the number of flats been added to the existing block, the annual demand for space heating and domestic hot water for the scheme is expected to be low 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.



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. Photovoltaics were identified as the technology most appropriate to this site.

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

8.1 BIOMASS BOILER

A biomass boiler would work effectively against a consistent heating load. 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. Within this constrained site, it would be difficult to provide sufficient space for biomass storage. For these reasons, we would not recommend a biomass boiler for this development.

8.2 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. Therefore, this technology is not suitable for this site.

8.3 SOLAR HOT WATER HEATING (SHWH)

Solar thermal hot water systems can work well on residential developments. Due to having very limited space inside the apartments for risers and hot water storage and for maintenance issues, it is decided that the limited space available on the roof will be used for installation of PV panels.

8.4 PHOTOVOLTAIC (PV) PANELS

The design team has reviewed the building roof space for the development. Photovoltaic panels work efficiently on flat or south facing roof areas. Given that the SE/SW facing parts of the roof are facing the main road, installation of PV panels would have a negative impact on the surroundings



and the aesthetics of the neighbourhood where the building sits. Therefore, we would not recommend photovoltaic panels for this scheme.

8.5 HEAT PUMPS (GROUND/WATER/AIR)

GROUND SOURCE HEAT PUMP

Ground source heat pumps have been considered for the development. With a closed loop borehole system, it would be possible to drop loops beneath the basement of the buildings.

However, given that the building is an existing one, it is not feasible to install boreholes below ground. 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. A typical coefficient of performance (CoP) for an air source heat pump is around 2.5 to 4.0. This means that for every unit of electricity between 2.5 and 4.0 units of heating or cooling are produced. An air-to-water system: uses the heat to warm water. Air-source or aerothermal heat-pumps extract heat from the ambient air and transfer it through refrigerants acting as a medium to the hot water storage. Even though the system consumes electricity, which is a carbon intensive fuel, significant savings can be achieved mainly due to its high seasonal efficiency.

Table 9 Proposed Renewable Energy Technology (ASHP)

ASHP	СОР	4.74
	EER	3.45

The installation will result in a saving approximately 3.18 tonnes of carbon per year. Table 10 is a summary of the contribution of ASHP installation to the reduction in energy consumption and carbon emissions of the building.

Table 10 Carbon Dioxide emissions reduction for the development

Regu	ulated Carbon dioxide emissions (Tonnes CO2 per annum)	26 Netherhall Gardens					
Baseline Emi	ssions	15.01					
Be Lean	After energy demand reduction	14.56					
Be Clean	After CHP	14.56					
Be Green	After renewable energy	11.38					
Carbon Savin	gs over Clean stage	3.18					
Carbon Redu	ction over Clean Stage	21.8%					



9. CONCLUSIONS

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 London Plan 2015 and London Borough of Camden Climate Change Mitigation and Adaptation Policies.

The strategy for reducing energy use and associated carbon emissions through the design of the scheme follows a three-step approach in line with the London Plan Energy Hierarchy.

- Reducing the energy demand through passive design strategies and provision of high quality building envelope;
- Reducing the energy consumption through best practice design of building services, lighting and control; and,
- Installation of on-site Low and Zero carbon technologies.

Passive and active energy efficiency features include:

- Building fabric of high thermal performance, in terms of U-values and air tightness, and use of Accredited Construction Details;
- Building services systems of high efficiency, including condensing boilers and MVHR units, and light fitting of low energy types;
- An Air-Source-Heat-Pump will provide heating and cooling to the main living areas, as the primary main heating system.

Renewable energy technologies, installed on site, will help reduce carbon emissions by more than 20% as required by Camden Council. Reverse cycle Heat Pumps will provide the main living areas of the dwellings with space heating and comfort cooling. This energy performance statement has demonstrated that the new development has achieved a carbon emission reduction in excess of 20% compared to the Code for Sustainable Home Level 4 Baseline Emission Rate. The following table (Table 11) provides a summary of the carbon savings achieved at each stage of the London Plan Energy Hierarchy as a result of the proposed energy strategy described in the report.

Table 11 Carbon Dioxide emissions reduction for the development

•	ted Carbon dioxide emissions Fonnes CO ₂ per annum)	26 Netherhall Gardens					
Baseline Emi:	ssions	15.01					
Be Lean	After energy demand reduction	14.56					
Be Clean	After CHP	14.56					
Be Green	After renewable energy	11.38					
Carbon Savin	gs over Baseline Emissions	3.63					
Carbon Redu	ction over Baseline Emissions	24.2%					



Table 12 demonstrates the total regulated CO₂ savings from each stage of the Energy Hierarchy. As demonstrated below overall 24.2% reduction in carbon emission can be achieved applying the proposed strategies.

Table 12 Regulated carbon dioxide savings from each stage of the Energy Hierarchy

	Regulated carbo	n dioxide savings
	(Tonnes CO2 per annum)	(%)
Savings from energy demand reduction	0.45	3.0
Savings from CHP	0.0	0.0
Savings from renewable energy	3.18	21.8
Total Cumulative Savings	3.63	24.2
Total Target Savings	3.00	20.0
Annual Surplus	0.63	

Figure 5 below illustrate the total carbon savings and the total reduction achieved at each stage of the proposed Energy Hierarchy respectively.

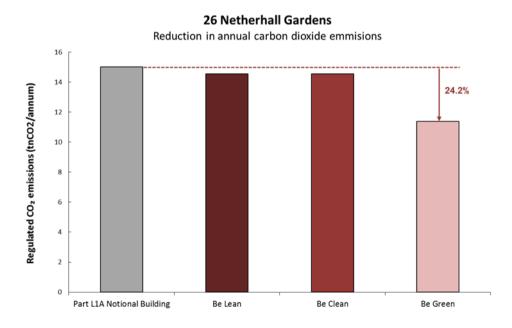


Figure 5 Total carbon savings achieved at each stage over Baseline Emissions



APPENDIX 1. TER WORKSHEET OF TYPICAL APARTMENT

		User Details:				
Assessor Name:	Alexandros Kazantzis	Stroma Nui	mher·	STRO	030219	
Software Name:	Stroma FSAP 2012	Software V			n: 1.0.3.15	
	Pr	operty Address: Apt 1				
Address :	Flat 1, 26 Netherhall Garden	· · · · · · · · · · · · · · · · · · ·				
1. Overall dwelling dime	nsions:					
		Area(m²)	Av. Height(m)	Volume(m³))
Basement		113.7 (1a) x	3.2	(2a) =	363.84	(3a)
Ground floor		77.3 (1b) x	3	(2b) =	231.9	(3b)
Total floor area TFA = (1a	a)+(1b)+(1c)+(1d)+(1e)+(1n)	191 (4)				_
Dwelling volume		(3a)+(3	3b)+(3c)+(3d)+(3e)+.	(3n) =	595.74	(5)
2. Ventilation rate:						
	main secondary heating heating	y other	total		m³ per hour	
Number of chimneys	0 + 0	+ 0 =	0	< 40 =	0	(6a)
Number of open flues	0 + 0	+ 0 =	0	(20 =	0	(6b)
Number of intermittent far	ns		4	< 10 =	40	(7a)
Number of passive vents			0	< 10 =	0	(7b)
Number of flueless gas fin	res		0	< 40 =	0	(7c)
				Air ch	anges per ho	ıır
Infiltration due to chimne	ys, flues and fans = $(6a)+(6b)+(7a)$	a)+(7b)+(7c) =	40	÷ (5) =	0.07	الا (8)
•	een carried out or is intended, proceed		I I	÷ (3) =	0.07	(0)
Number of storeys in the	ne dwelling (ns)			ſ	0	(9)
Additional infiltration			[(9	9)-1]x0.1 =	0	(10)
Structural infiltration: 0.	25 for steel or timber frame or	0.35 for masonry cons	struction		0	(11)
if both types of wall are pr deducting areas of openin	resent, use the value corresponding to	the greater wall area (after				
=	loor, enter 0.2 (unsealed) or 0.2	1 (sealed), else enter ()	Г	0	(12)
If no draught lobby, ent	ter 0.05, else enter 0			Ì	0	(13)
Percentage of windows	s and doors draught stripped			Ì	0	(14)
Window infiltration		0.25 - [0.2 x (14) -	- 100] =	Ī	0	(15)
Infiltration rate		(8) + (10) + (11) +	(12) + (13) + (15) =	Ī	0	(16)
Air permeability value,	q50, expressed in cubic metres	s per hour per square	metre of envelop	e area	5	(17)
If based on air permeabili	ity value, then $(18) = [(17) \div 20] + (8)$), otherwise (18) = (16)		Ì	0.32	(18)
Air permeability value applies	s if a pressurisation test has been done	e or a degree air permeabili	ty is being used	_		
Number of sides sheltere	d				4	(19)
Shelter factor		(20) = 1 - [0.075 x]	(19)] =		0.7	(20)
Infiltration rate incorporat	ing shelter factor	(21) = (18) x (20) :	=		0.22	(21)
Infiltration rate modified for	or monthly wind speed					
Jan Feb	Mar Apr May Jun	Jul Aug Sep	Oct Nov	Dec		
Monthly average wind sp	eed from Table 7					

4.3

3.8

3.8

3.7

4.3

4.5

4.7

Wind Factor (22a)m =	(22)m ÷	4										
(22a)m= 1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18]	
Adjusted infilt	ration rat	e (allowi	ng for sl	nelter an	d wind s	speed) =	(21a) x	(22a)m					
0.28	0.28	0.27	0.24	0.24	0.21	0.21	0.21	0.22	0.24	0.25	0.26		
Calculate effe		•	rate for t	he appli	cable ca	ise	•	•	•	•	•	_	
If exhaust air h			endix N (2	(23a) = (23a	a) x Fmv (e	eguation (I	N5)) othe	rwise (23h	n) = (23a)				0 (2
If balanced wi) = (20a)				0 (2
a) If balanc		•	•	•		,		,	2h)m + (23h) 🗴 [1 – (23c)		0 (
(24a)m = 0	0	0	0	0	0	0	0	0	0	0	0]	(:
b) If balanc	ed mech	anical ve	ntilation	without	heat red	coverv (N	иV) (24b	p)m = (22)	2b)m + (23b)	1	_	
(24b)m = 0	0	0	0	0	0	0	0	0	0	0	0		(2
c) If whole I	house ex	tract ven	tilation o	or positiv	re input v	ventilatio	on from o	outside	!	!		_	
if (22b)	m < 0.5 ×	(23b), t	hen (24	c) = (23b	o); other	wise (24	c) = (22h	o) m + 0	.5 × (23k	o)		_	
(24c)m = 0	0	0	0	0	0	0	0	0	0	0	0		(:
d) If natural					•								
<u> </u>	m = 1, the	<u> </u>	· · ·	ŕ	<u> </u>		- `				1 0.50	1	(1
(24d)m= 0.54	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.52	0.53	0.53	0.53		(:
Effective ai (25)m= 0.54	r cnange 0.54	0.54	nter (24a 0.53	0.53	0.52	c) or (24 0.52	0.52	0.52	0.53	0.53	0.53	1	(2
	1	l			0.52	0.52	0.52	0.52	0.55	0.55	0.55		(,
3. Heat losse	es and he	eat loss p	paramet	er:									
ELEMENT													
	Gros area	_	Openin	_	Net Ar A .r		U-val		A X U		k-value		A X k kJ/K
Windows Typ	area	_	Openin m	_	Net Ar A ,r	m²	U-val W/m2 /[1/(1.4)+	2K	A X U (W/		k-value kJ/m²-		A X k kJ/K
Windows Typ	area e 1	_	•	_	A ,r	m² x1	W/m2	2K · 0.04] =	(W/				kJ/K
Windows Typ Windows Typ	area e 1 e 2	_	•	_	A ,r	m² x1	W/m2 /[1/(1.4)+	2K $0.04 = 0.04 = 0.04 = 0.04$	(W/ 18.83 10.74				kJ/K (:
Windows Typ Windows Typ Windows Typ	area e 1 e 2 e 3	_	•	_	A ,r 14.2 8.1 10.6	m ² x ¹ x ¹ x ¹	W/m2 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+	2K 0.04] = 0.04] = 0.04] =	(W/ 18.83 10.74 14.05				kJ/K (: (:
Windows Typ Windows Typ Windows Typ Windows Typ	area e 1 e 2 e 3 e 4	_	•	_	A ,r 14.2 8.1 10.6 2.5	m ² x1 x1 x1 x1	W/m2 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+	2K 0.04] = 0.04] = 0.04] = 0.04] =	(W/ 18.83 10.74 14.05 3.31				kJ/K (; (; (;
Windows Typ Windows Typ Windows Typ Windows Typ Windows Typ	area e 1 e 2 e 3 e 4	_	•	_	A ,r 14.2 8.1 10.6 2.5 2.5	m ²	W/m2 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+	2K 0.04] = 0.04] = 0.04] = 0.04] = 0.04] =	(W/ 18.83 10.74 14.05 3.31 3.31	K)			kJ/K (;
Windows Typ Windows Typ Windows Typ Windows Typ Windows Typ Floor Type 1	area e 1 e 2 e 3 e 4	_	•	_	A ,r 14.2 8.1 10.6 2.5 2.5 110.3	m ²	W/m2 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+	2K 0.04] = 0.04] = 0.04] = 0.04] = 0.04] =	(W/ 18.83 10.74 14.05 3.31 3.31 14.339	K)			kJ/K (; (; (; (; (; (; (; (; (; (; (; (; (;
Windows Typ Windows Typ Windows Typ Windows Typ Windows Typ Floor Type 1 Floor Type 2	area e 1 e 2 e 3 e 4 e 5	(m²)	· m	<u>,</u>	A ,r 14.2 8.1 10.6 2.5 2.5 110.3	m ²	W/m2 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ 0.13	2K 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = = =	(W/ 18.83 10.74 14.05 3.31 3.31 14.339 0.715	K)			kJ/K (; (; (; (; (; (; (; (; (; (; (; (; (;
Windows Typ Windows Typ Windows Typ Windows Typ Windows Typ Floor Type 1 Floor Type 2 Walls Type1	area e 1 e 2 e 3 e 4 e 5	(m²)	22.3	3	A ,r 14.2 8.1 10.6 2.5 2.5 110.3	m ²	W/m2 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ 0.13 0.13	2K 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = = = =	(W/ 18.83 10.74 14.05 3.31 3.31 14.339 0.715 18.85	K)			kJ/K (; (; (; (; (; (; (; (; (; (; (; (; (;
Windows Typ Windows Typ Windows Typ Windows Typ Windows Typ Floor Type 1 Floor Type 2 Walls Type1 Walls Type2	area e 1 e 2 e 3 e 4 e 5	(m²)	· m	3	A ,r 14.2 8.1 10.6 2.5 2.5 110.3 5.5 104.7	m ²	W/m2 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ 0.13	2K 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = = =	(W/ 18.83 10.74 14.05 3.31 3.31 14.339 0.715	K)			kJ/K (; (; (; (; (; (; (; (; (; (; (; (; (;
Windows Typ Windows Typ Windows Typ Windows Typ Windows Typ Floor Type 1 Floor Type 2 Walls Type1 Walls Type2 Total area of	area e 1 e 2 e 3 e 4 e 5	7 7 7 4, m ²	22.3 15.6	3	A ,r 14.2 8.1 10.6 2.5 2.5 110.3 5.5 104.7 71.1 329.5	m ²	W/m2 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ 0.13 0.13 0.18	2K 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = = = =	(W/ 18.83 10.74 14.05 3.31 3.31 14.339 0.715 18.85	K)	kJ/m²-	K [kJ/K (; (; (; (; (; (; (; (; (; (; (; (; (;
Windows Typ Windows Typ Windows Typ Windows Typ Windows Typ Floor Type 1 Floor Type 2 Walls Type1 Walls Type2	area e 1 e 2 e 3 e 4 e 5 127 86. elements d roof wind	7 7 7 ows, use e	22.3 15.6	indow U-va	A ,r 14.2 8.1 10.6 2.5 2.5 110.3 5.5 104.7 71.1 329.6	m ²	W/m2 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ 0.13 0.13 0.18	2K 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = = = =	(W/ 18.83 10.74 14.05 3.31 3.31 14.339 0.715 18.85	K)	kJ/m²-	K [kJ/K (; (; (; (; (; (; (; (; (; (; (; (; (;
Windows Typ Windows Typ Windows Typ Windows Typ Windows Typ Floor Type 1 Floor Type 2 Walls Type1 Walls Type2 Total area of *for windows an	area e 1 e 2 e 3 e 4 e 5 127 86. elements d roof wind eas on both	(m²) 7 7 ows, use e sides of in	22.3 15.6 Iffective wi	indow U-va	A ,r 14.2 8.1 10.6 2.5 2.5 110.3 5.5 104.7 71.1 329.6	m ²	W/m2 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ 0.13 0.13 0.18	2K 0.04] = 0.04] =	(W/ 18.83 10.74 14.05 3.31 3.31 14.339 0.715 18.85	K)	kJ/m²-	h 3.2	kJ/K (; (; (; (; (; (; (; (; (; (; (; (; (;
Windows Typ Windows Typ Windows Typ Windows Typ Windows Typ Floor Type 1 Floor Type 2 Walls Type1 Walls Type2 Total area of * for windows an ** include the are	area e 1 e 2 e 3 e 4 e 5 127 86. elements d roof winddes on both	(m²) 7 7 7 ows, use e sides of interest of the sides	22.3 15.6 Iffective wi	indow U-va	A ,r 14.2 8.1 10.6 2.5 2.5 110.3 5.5 104.7 71.1 329.6	m ²	W/m2 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ 0.13 0.13 0.18 0.18	PK 0.04] = 0.	(W/ 18.83 10.74 14.05 3.31 3.31 14.339 0.715 18.85	K)	kJ/m²-	h 3.2	kJ/K (; (; (; (; (; (; (; (; (; (; (; (; (;
Windows Typ Windows Typ Windows Typ Windows Typ Windows Typ Floor Type 1 Floor Type 2 Walls Type1 Walls Type2 Total area of * for windows an ** include the are Fabric heat lo	area e 1 e 2 e 3 e 4 e 5 127 86. elements d roof winderas on both ess, W/K:	(m²) 7 7 ows, use e sides of in a sides (A x k)	22.3 15.6 Iffective with ternal wall	ndow U-vals and part	A ,r 14.2 8.1 10.6 2.5 2.5 110.3 5.5 104.7 71.1 329.5 alue calculatitions	x1 x	W/m2 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ 0.13 0.13 0.18 0.18	2K 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 1.004] =	(W/ 18.83 10.74 14.05 3.31 3.31 14.339 0.715 18.85 12.8 ue)+0.04] &	K)	kJ/m²-	h 3.2	kJ/K (; (; (; (; (; (; (; (; (; (; (; (; (;
Windows Typ Windows Typ Windows Typ Windows Typ Windows Typ Windows Typ Floor Type 1 Floor Type 2 Walls Type1 Walls Type1 Walls Type2 Total area of * for windows an ** include the are Fabric heat lo Heat capacity Thermal mass For design asses	area e 1 e 2 e 3 e 4 e 5 127 86. elements d roof winderas on both vss, W/K: r Cm = S(s parame	(m²) 7 7 7 ows, use e sides of ine = S (A x (A x k) eter (TMF)	22.3 15.6 15.6 Iffective winternal wall U) P = Cm - tails of the	indow U-va ls and pan	A ,r 14.2 8.1 10.6 2.5 2.5 110.3 5.5 104.7 71.1 329.5 alue calculatitions	m ²	W/m2 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ 0.13 0.13 0.18 0.18 q formula 1	2K 0.04] = 0.04] = 0.05] =	(W/ 18.83 10.74 14.05 3.31 3.31 14.339 0.715 18.85 12.8 ue)+0.04] & ative Value	K) as given in 2) + (32a) : Medium	kJ/m²-	h 3.2	kJ/K (; (; (; (; (; (; (; (; (; (; (; (; (;
Windows Typ Windows Typ Windows Typ Windows Typ Windows Typ Floor Type 1 Floor Type 2 Walls Type1 Walls Type2 Total area of * for windows an ** include the are Fabric heat lo Heat capacity Thermal mass	area e 1 e 2 e 3 e 4 e 5 127 86. elements d roof winder eas on both ess, W/K: Cm = S(es parame essments wheed of a de	(m²) 7 7 7 ows, use e sides of interpretal interpretation (A x k) eter (TMF) ere the de tailed calculation (TMF)	22.3 15.6 Iffective we atternal wall U) P = Cm - tails of the culation.	andow U-vals and part	A ,r 14.2 8.1 10.6 2.5 2.5 110.3 5.5 104.7 71.1 329.5 alue calculatitions	x1 x	W/m2 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ 0.13 0.13 0.18 0.18 q formula 1	2K 0.04] = 0.04] = 0.05] =	(W/ 18.83 10.74 14.05 3.31 3.31 14.339 0.715 18.85 12.8 ue)+0.04] & ative Value	K) as given in 2) + (32a) : Medium	kJ/m²-	h 3.2 96 389	kJ/K (; (; (; (; (; (; (; (; (; (; (; (; (;

if details of therm	al bridging	are not kn	own (36) =	= 0.15 x (3	1)								
Total fabric he	0 0		, ,	,	,			(33) +	(36) =			109.98	(37)
Ventilation he	at loss ca	alculated	l monthly	y				(38)m	= 0.33 × (25)m x (5)			
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(38)m= 106.17	105.87	105.57	104.16	103.9	102.67	102.67	102.44	103.14	103.9	104.43	104.99		(38)
Heat transfer	coefficie	nt, W/K						(39)m	= (37) + (37)	38)m			
(39)m= 216.15	215.84	215.55	214.14	213.87	212.65	212.65	212.42	213.12	213.87	214.41	214.96		
Heat loss para	ameter (H	HLP), W/	/m²K						Average = = (39)m ÷	Sum(39) _{1.} · (4)	12 /12=	214.14	(39)
(40)m= 1.13	1.13	1.13	1.12	1.12	1.11	1.11	1.11	1.12	1.12	1.12	1.13		
		/							Average =	Sum(40) ₁ .	12 /12=	1.12	(40)
Number of da	1		г . [.]			T							
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	iting ene	rgy requi	irement:								kWh/ye	ear:	
Assumed occ	upancv.	N								2	99		(42)
if TFA > 13	9, N = 1		[1 - exp	(-0.0003	349 x (TF	A -13.9)2)] + 0.0	0013 x (ΓFA -13.				(/
if TFA £ 13.	•	.4	u a : i a : i i i i i i i		الما م		(05 v NI)	. 20					(10)
Annual average Reduce the annual									se target o		5.22		(43)
not more that 125	_				_	_			-				
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage	in litres per	day for ea	ach month	Vd,m = fa	ctor from T	Table 1c x	(43)						
(44)m= 115.74	111.53	107.32	103.11	98.9	94.7	94.7	98.9	103.11	107.32	111.53	115.74		
Energy content o	f hot water	used - cal	culated mo	onthly = 4.	190 x Vd,r	n x nm x D	OTm / 3600			m(44) ₁₁₂ = ables 1b, 1		1262.61	(44)
(45)m= 171.64	150.12	154.91	135.05	129.58	111.82	103.62	118.9	120.32	140.23	153.07	166.22		
	1	!	<u> </u>			<u> </u>	!		Total = Su	m(45) ₁₁₂ =		1655.48	(45)
If instantaneous	water heati	ng at point	of use (no	hot water	storage),	enter 0 in	boxes (46) to (61)					
(46)m= 25.75	22.52	23.24	20.26	19.44	16.77	15.54	17.84	18.05	21.03	22.96	24.93		(46)
Water storage		د نه ماریطنه		olor or M	WHDC	otoro ao	within o	- ma 1/00	امما				(47)
Storage volun	, ,		•			•		ame ves	sei		150		(47)
If community of the of	_			_			, ,	ers) ente	er 'O' in <i>(</i>	47)			
Water storage		not wate	i (uno n	iciuues i	nstantai	ieous cc	ATIOI DOII	cis) cill	51 0 111 (71)			
a) If manufac		eclared l	oss facto	or is kno	wn (kWh	n/day):				1.	39		(48)
Temperature	factor fro	m Table	2b							0.	54		(49)
Energy lost from	om water	storage	, kWh/ye	ear			(48) x (49)) =		0.	75		(50)
b) If manufac			-										
Hot water stor	_			e 2 (kWl	h/litre/da	ıy)					0		(51)
If community Volume factor	_		on 4.3										(52)
Temperature			2b							-	0		(52) (53)
Energy lost from				ear			(47) x (51)) x (52) x (53) =				(54)
Enter (50) or		•	, 12 VII/ y	<i>-</i> 41			(11) X (O1)	, A (02) A (, -	-	0 75		(54) (55)
, , -	. , (•									-		` '

Water storage	loss cal	culated f	for each	month			((56)m = (55) × (41)ı	m				
(56)m= 23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33		(56)
If cylinder contain	s dedicate	d solar sto	rage, (57)ı	m = (56)m	x [(50) – (H11)] ÷ (5	0), else (5	7)m = (56)	m where (H11) is fro	m Append	ix H	
(57)m= 23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33		(57)
Primary circuit	loss (ar	nnual) fro	m Table	3							0		(58)
Primary circuit	loss cal	culated t	for each	month (59)m = ((58) ÷ 36	55 × (41)	m					
(modified by	factor f	rom Tab	le H5 if t	here is s	solar wat	er heatii	ng and a	cylinde	r thermo	stat)			
(59)m= 23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)
Combi loss 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 heat req	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= 218.23	192.2	201.5	180.14	176.18	156.91	150.21	165.5	165.42	186.82	198.16	212.82		(62)
Solar DHW input	calculated	using App	endix G or	Appendix	H (negati	ve quantity	v) (enter '0	' if no sola	r contribut	ion to wate	er heating)		
(add additiona	I lines if	FGHRS	and/or V	VWHRS	applies	, see Ap	pendix (3)	_	_			
(63)m= 0	0	0	0	0	0	0	0	0	0	0	0		(63)
Output from w	ater hea	ter											
(64)m= 218.23	192.2	201.5	180.14	176.18	156.91	150.21	165.5	165.42	186.82	198.16	212.82		
		•					Outp	out from wa	ater heate	r (annual)₁	12	2204.09	(64)
Heat gains fro	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= 94.35	83.58	88.78	80.98	80.36	73.25	71.73	76.81	76.08	83.9	86.97	92.54		(65)
	1		00.00	00.00	1 .0.20	' 1./5	70.01	70.00	03.9	00.97	92.54		(00)
include (57)	m in cal				!	<u> </u>		<u> </u>	<u> </u>	<u> </u>	<u> </u>	eating	(00)
include (57) 5. Internal ga		culation o	of (65)m	only if c	!	<u> </u>		<u> </u>	<u> </u>	<u> </u>	<u> </u>	eating	(00)
5. Internal ga	ains (see	culation of Table 5	of (65)m and 5a	only if c	!	<u> </u>		<u> </u>	<u> </u>	<u> </u>	<u> </u>	eating	(66)
, ,	ains (see	culation of Table 5	of (65)m and 5a	only if c	!	<u> </u>		<u> </u>	<u> </u>	<u> </u>	<u> </u>	eating	(55)
5. Internal ga	ains (see	culation of Table 5	of (65)m and 5a ts	only if c	ylinder i	s in the o	dwelling	or hot w	ater is fr	om com	munity h	eating	(66)
5. Internal games Metabolic gain Jan	rs (Table Feb 149.51	e Table 5 e 5), Wat Mar	of (65)m 5 and 5a ts Apr 149.51	only if c : : : : : : : : : : : : : : : : : : :	ylinder is Jun 149.51	Jul 149.51	Aug 149.51	or hot w Sep 149.51	ater is fr	om com	munity h	eating	
5. Internal games Metabolic gair Jan (66)m= 149.51	rs (Table Feb 149.51	e Table 5 e 5), Wat Mar	of (65)m 5 and 5a ts Apr 149.51	only if c : : : : : : : : : : : : : : : : : : :	ylinder is Jun 149.51	Jul 149.51	Aug 149.51	or hot w Sep 149.51	ater is fr	om com	munity h	eating	
5. Internal games Metabolic gain Jan (66)m= 149.51 Lighting gains (67)m= 33.12	reins (see	E Table 5 E 5), Wat Mar 149.51 ted in Ap	of (65)m 6 and 5a ts Apr 149.51 opendix 18.11	only if c May 149.51 L, equati 13.54	Jun 149.51 ion L9 o	Jul 149.51 r L9a), a	Aug 149.51 Iso see	Sep 149.51 Table 5 21.55	Oct 149.51	Nov	Dec	eating	(66)
5. Internal games Metabolic gain Jan (66)m= 149.51 Lighting gains	reins (see	E Table 5 E 5), Wat Mar 149.51 ted in Ap	of (65)m 6 and 5a ts Apr 149.51 opendix 18.11	only if c May 149.51 L, equati 13.54	Jun 149.51 ion L9 o	Jul 149.51 r L9a), a	Aug 149.51 Iso see	Sep 149.51 Table 5 21.55	Oct 149.51	Nov	Dec	eating	(66)
5. Internal games Metabolic gair Jan (66)m= 149.51 Lighting gains (67)m= 33.12 Appliances games (68)m= 362.41	res (Table Feb 149.51 (calcula 29.42 ins (calcula 366.17	culation of Table 5 (a) Wat Mar 149.51 ted in Ap 23.93 culated in 356.69	of (65)m 5 and 5a ts Apr 149.51 opendix 18.11 Appendix 336.52	only if c May 149.51 L, equati 13.54 dix L, eq 311.05	Jun 149.51 ion L9 o 11.43 uation L 287.12	Jul 149.51 r L9a), a 12.35 13 or L1 271.13	Aug 149.51 Iso see 16.06 3a), also 267.36	Sep 149.51 Table 5 21.55 see Tal 276.84	Oct 149.51 27.36 ble 5 297.02	Nov 149.51 31.94	Dec 149.51	eating	(66) (67)
5. Internal games Metabolic gain Jan (66)m= 149.51 Lighting gains (67)m= 33.12 Appliances games	res (Table Feb 149.51 (calcula 29.42 ins (calcula 366.17	culation of Table 5 (a) Wat Mar 149.51 ted in Ap 23.93 culated in 356.69	of (65)m 5 and 5a ts Apr 149.51 opendix 18.11 Appendix 336.52	only if c May 149.51 L, equati 13.54 dix L, eq 311.05	Jun 149.51 ion L9 o 11.43 uation L 287.12	Jul 149.51 r L9a), a 12.35 13 or L1 271.13	Aug 149.51 Iso see 16.06 3a), also 267.36	Sep 149.51 Table 5 21.55 see Tal 276.84	Oct 149.51 27.36 ble 5 297.02	Nov 149.51 31.94	Dec 149.51	eating	(66) (67)
5. Internal games Metabolic gain Jan (66)m= 149.51 Lighting gains (67)m= 33.12 Appliances games (68)m= 362.41 Cooking gains	res (Table Feb 149.51 (calcula 29.42 ins (calcula 366.17 (calcula 37.95	culation of Table 5 2 5), Wat Mar 149.51 ted in Ap 23.93 culated in 356.69 ated in A 37.95	of (65)m s and 5a ts Apr 149.51 ppendix 18.11 Append 336.52 ppendix 37.95	May 149.51 L, equati 13.54 dix L, eq 311.05 L, equat	Jun 149.51 ion L9 of 11.43 uation L 287.12 ion L15	Jul 149.51 r L9a), a 12.35 13 or L1 271.13 or L15a)	Aug 149.51 Iso see 16.06 3a), also 267.36	Sep 149.51 Table 5 21.55 See Tal 276.84 ee Table	Oct 149.51 27.36 ble 5 297.02 5	Nov 149.51 31.94	Dec 149.51 34.04 346.42	eating	(66) (67) (68)
Metabolic gair Jan (66)m= 149.51 Lighting gains (67)m= 33.12 Appliances ga (68)m= 362.41 Cooking gains (69)m= 37.95	res (Table Feb 149.51 (calcula 29.42 ins (calcula 366.17 (calcula 37.95	culation of Table 5 2 5), Wat Mar 149.51 ted in Ap 23.93 culated in 356.69 ated in A 37.95	of (65)m s and 5a ts Apr 149.51 ppendix 18.11 Append 336.52 ppendix 37.95	May 149.51 L, equati 13.54 dix L, eq 311.05 L, equat	Jun 149.51 ion L9 of 11.43 uation L 287.12 ion L15	Jul 149.51 r L9a), a 12.35 13 or L1 271.13 or L15a)	Aug 149.51 Iso see 16.06 3a), also 267.36	Sep 149.51 Table 5 21.55 See Tal 276.84 ee Table	Oct 149.51 27.36 ble 5 297.02 5	Nov 149.51 31.94	Dec 149.51 34.04 346.42	eating	(66) (67) (68)
5. Internal games Metabolic gair Jan (66)m= 149.51 Lighting gains (67)m= 33.12 Appliances games (68)m= 362.41 Cooking gains (69)m= 37.95 Pumps and fames (70)m= 3	res (Table Feb 149.51 (calcula 29.42 ins (calcula 366.17 (calcula 37.95 ins gains 3	culation of the culation of th	of (65)m ts Apr 149.51 ppendix 18.11 Appendix 336.52 ppendix 37.95 5a) 3	only if controls: May 149.51 L, equati 13.54 dix L, equati 311.05 L, equati 37.95	Jun 149.51 ion L9 of 11.43 uation L 287.12 ion L15 37.95	Jul 149.51 r L9a), a 12.35 13 or L1 271.13 or L15a) 37.95	Aug 149.51 Iso see 16.06 3a), also 267.36 , also se 37.95	Sep 149.51 Table 5 21.55 see Tal 276.84 ee Table 37.95	Oct 149.51 27.36 ble 5 297.02 5 37.95	Nov 149.51 31.94 322.48	Dec 149.51 34.04 346.42 37.95	eating	(66) (67) (68) (69)
5. Internal games Metabolic gair Jan (66)m= 149.51 Lighting gains (67)m= 33.12 Appliances games (68)m= 362.41 Cooking gains (69)m= 37.95 Pumps and fa	reportions (see	culation of the culation of th	of (65)m ts Apr 149.51 ppendix 18.11 Appendix 336.52 ppendix 37.95 5a) 3	only if controls: May 149.51 L, equati 13.54 dix L, equati 311.05 L, equati 37.95	Jun 149.51 ion L9 of 11.43 uation L 287.12 ion L15 37.95	Jul 149.51 r L9a), a 12.35 13 or L1 271.13 or L15a) 37.95	Aug 149.51 Iso see 16.06 3a), also 267.36 , also se 37.95	Sep 149.51 Table 5 21.55 see Tal 276.84 ee Table 37.95	Oct 149.51 27.36 ble 5 297.02 5 37.95	Nov 149.51 31.94 322.48	Dec 149.51 34.04 346.42 37.95	eating	(66) (67) (68) (69)
Metabolic gair Jan (66)m= 149.51 Lighting gains (67)m= 33.12 Appliances ga (68)m= 362.41 Cooking gains (69)m= 37.95 Pumps and fa (70)m= 3 Losses e.g. ev (71)m= -119.61	raporatice residue res	culation of the Europe Solution of the Europe	of (65)m s and 5a ts Apr 149.51 ppendix 18.11 Append 336.52 ppendix 37.95 5a) 3 tive valu	only if construction only if construction only if construction on the construction of the construction on the construction on the construction of the construction on the construction of the construction on the construction of	Jun 149.51 ion L9 o 11.43 uation L 287.12 ion L15 37.95 3	Jul 149.51 r L9a), a 12.35 13 or L1 271.13 or L15a) 37.95	Aug 149.51 Iso see 16.06 3a), also 267.36 , also se 37.95	Sep 149.51 Table 5 21.55 see Tal 276.84 ee Table 37.95	Oct 149.51 27.36 ble 5 297.02 5 37.95	Nov 149.51 31.94 322.48 37.95	Dec 149.51 34.04 346.42 37.95	eating	(66) (67) (68) (69)
Metabolic gair Jan (66)m= 149.51 Lighting gains (67)m= 33.12 Appliances ga (68)m= 362.41 Cooking gains (69)m= 37.95 Pumps and fa (70)m= 3 Losses e.g. ev	raporatice residue res	culation of the Europe Solution of the Europe	of (65)m s and 5a ts Apr 149.51 ppendix 18.11 Append 336.52 ppendix 37.95 5a) 3 tive valu	only if construction only if construction only if construction on the construction of the construction on the construction on the construction of the construction on the construction of the construction on the construction of	Jun 149.51 ion L9 o 11.43 uation L 287.12 ion L15 37.95 3	Jul 149.51 r L9a), a 12.35 13 or L1 271.13 or L15a) 37.95	Aug 149.51 Iso see 16.06 3a), also 267.36 , also se 37.95	Sep 149.51 Table 5 21.55 see Tal 276.84 ee Table 37.95	Oct 149.51 27.36 ble 5 297.02 5 37.95	Nov 149.51 31.94 322.48 37.95	Dec 149.51 34.04 346.42 37.95	eating	(66) (67) (68) (69)
Metabolic gair Jan (66)m= 149.51 Lighting gains (67)m= 33.12 Appliances ga (68)m= 362.41 Cooking gains (69)m= 37.95 Pumps and fa (70)m= 3 Losses e.g. ev (71)m= -119.61 Water heating	res (Table Feb 149.51 (calcula 29.42 ins (calcula 37.95 ins gains 3 raporatio 119.61 gains (Table Feb 149.51 (calcula 149.51 ins gains (Table Feb 149.51 ins gains (Table	culation of the Europe Solution of the Europe	of (65)m ts Apr 149.51 ppendix 18.11 Appendix 336.52 ppendix 37.95 5a) 3 tive valu -119.61	only if construction only if construction only if construction on the construction of	Jun 149.51 ion L9 o 11.43 uation L 287.12 ion L15 37.95 3 le 5) -119.61	Jul 149.51 r L9a), a 12.35 13 or L1 271.13 or L15a) 37.95	Aug 149.51 Iso see 16.06 3a), also 267.36 , also se 37.95	Sep 149.51 Table 5 21.55 See Tal 276.84 ee Table 37.95	Oct 149.51 27.36 ble 5 297.02 5 37.95 3 -119.61	Nov 149.51 31.94 322.48 37.95 3	Dec 149.51 34.04 346.42 37.95 3	eating	(66) (67) (68) (69) (70) (71)
Metabolic gair Jan (66)m= 149.51 Lighting gains (67)m= 33.12 Appliances ga (68)m= 362.41 Cooking gains (69)m= 37.95 Pumps and fa (70)m= 3 Losses e.g. ev (71)m= -119.61 Water heating (72)m= 126.81	res (Table Feb 149.51 (calcula 29.42 ins (calcula 37.95 ins gains 3 raporatio 119.61 gains (Table Feb 149.51 (calcula 149.51 ins gains (Table Feb 149.51 ins gains (Table	culation of the Europe Solution of the Europe	of (65)m ts Apr 149.51 ppendix 18.11 Appendix 336.52 ppendix 37.95 5a) 3 tive valu -119.61	only if construction only if construction only if construction on the construction of	Jun 149.51 ion L9 o 11.43 uation L 287.12 ion L15 37.95 3 le 5) -119.61	Jul 149.51 r L9a), a 12.35 13 or L1 271.13 or L15a) 37.95	Aug 149.51 Iso see 16.06 3a), also 267.36 , also se 37.95	Sep 149.51 Table 5 21.55 See Tal 276.84 See Table 37.95 3 -119.61	Oct 149.51 27.36 ble 5 297.02 5 37.95 3 -119.61	Nov 149.51 31.94 322.48 37.95 3	Dec 149.51 34.04 346.42 37.95 3	eating	(66) (67) (68) (69) (70) (71)

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

Orientat	tion:	Access Facto Table 6d	r	Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	2.5	x	10.63	x	0.63	x	0.7] =	8.12	(74)
North	0.9x	0.77	x	2.5	x	20.32	X	0.63	x	0.7	=	15.53	(74)
North	0.9x	0.77	x	2.5	x	34.53	x	0.63	x	0.7	=	26.38	(74)
North	0.9x	0.77	x	2.5	x	55.46	x	0.63	x	0.7	=	42.38	(74)
North	0.9x	0.77	x	2.5	x	74.72	x	0.63	x	0.7	=	57.09	(74)
North	0.9x	0.77	x	2.5	x	79.99	x	0.63	x	0.7	=	61.11	(74)
North	0.9x	0.77	x	2.5	x	74.68	x	0.63	x	0.7	=	57.06	(74)
North	0.9x	0.77	X	2.5	x	59.25	X	0.63	X	0.7	=	45.27	(74)
North	0.9x	0.77	x	2.5	x	41.52	x	0.63	x	0.7	=	31.72	(74)
North	0.9x	0.77	X	2.5	x	24.19	X	0.63	X	0.7	=	18.48	(74)
North	0.9x	0.77	x	2.5	X	13.12	X	0.63	X	0.7	=	10.02	(74)
North	0.9x	0.77	x	2.5	x	8.86	X	0.63	x	0.7	=	6.77	(74)
East	0.9x	1	X	8.1	x	19.64	X	0.63	X	0.7	=	34.1	(76)
East	0.9x	1	x	8.1	x	38.42	X	0.63	X	0.7	=	66.7	(76)
East	0.9x	1	X	8.1	x	63.27	X	0.63	X	0.7	=	109.84	(76)
East	0.9x	1	X	8.1	x	92.28	X	0.63	X	0.7	=	160.2	(76)
East	0.9x	1	x	8.1	x	113.09	X	0.63	X	0.7	=	196.33	(76)
East	0.9x	1	x	8.1	x	115.77	X	0.63	x	0.7	=	200.98	(76)
East	0.9x	1	X	8.1	x	110.22	X	0.63	X	0.7	=	191.34	(76)
East	0.9x	1	x	8.1	x	94.68	X	0.63	X	0.7	=	164.36	(76)
East	0.9x	1	x	8.1	x	73.59	X	0.63	x	0.7	=	127.75	(76)
East	0.9x	1	X	8.1	X	45.59	X	0.63	X	0.7	=	79.14	(76)
East	0.9x	1	x	8.1	X	24.49	X	0.63	x	0.7	=	42.51	(76)
East	0.9x	1	x	8.1	x	16.15	x	0.63	x	0.7	=	28.04	(76)
South	0.9x	0.77	x	2.5	x	46.75	x	0.63	X	0.7	=	35.72	(78)
South	0.9x	0.77	x	2.5	x	76.57	X	0.63	x	0.7	=	58.5	(78)
South	0.9x	0.77	X	2.5	x	97.53	X	0.63	X	0.7	=	74.52	(78)
South	0.9x	0.77	X	2.5	X	110.23	X	0.63	X	0.7	=	84.22	(78)
South	0.9x	0.77	X	2.5	X	114.87	X	0.63	X	0.7	=	87.77	(78)
South	0.9x	0.77	x	2.5	x	110.55	X	0.63	X	0.7	=	84.46	(78)
South	0.9x	0.77	X	2.5	x	108.01	X	0.63	X	0.7	=	82.52	(78)
South	0.9x	0.77	X	2.5	X	104.89	X	0.63	X	0.7	=	80.14	(78)
South	0.9x	0.77	X	2.5	X	101.89	X	0.63	X	0.7	=	77.84	(78)
South	0.9x	0.77	X	2.5	X	82.59	X	0.63	X	0.7	=	63.1	(78)
South	0.9x	0.77	x	2.5	x	55.42	X	0.63	X	0.7	=	42.34	(78)
South	0.9x	0.77	x	2.5	x	40.4	x	0.63	x	0.7	=	30.87	(78)
West	0.9x	0.54	x	14.2	x	19.64	x	0.63	x	0.7	=	59.77	(80)
West	0.9x	0.77	x	10.6	x	19.64	x	0.63	x	0.7	=	63.62	(80)
West	0.9x	0.54	x	14.2	x	38.42	x	0.63	x	0.7	=	116.93	(80)

	_																_
West	0.9x	0.77	X	10	.6	X	3	8.42	X	0.6	3	X	0.7		=	124.46	(80)
West	0.9x	0.54	X	14	.2	X	6	3.27	X	0.6	3	X	0.7		=	192.57	(80)
West	0.9x	0.77	Х	10	.6	X	6	3.27	X	0.6	3	X	0.7		=	204.97	(80)
West	0.9x	0.54	X	14	.2	X	9	2.28	X	0.6	3	X	0.7		=	280.85	(80)
West	0.9x	0.77	X	10	.6	X	9	2.28	X	0.6	3	X	0.7		=	298.94	(80)
West	0.9x	0.54	X	14	.2	X	11	13.09	X	0.6	3	X	0.7		= [344.19	(80)
West	0.9x	0.77	X	10	.6	X	11	13.09	x	0.6	3	x	0.7		= [366.36	(80)
West	0.9x	0.54	x	14	.2	X	11	15.77	X	0.6	3	X	0.7		=	352.34	(80)
West	0.9x	0.77	x	10	.6	X	11	15.77	X	0.6	3	X	0.7		=	375.04	(80)
West	0.9x	0.54	x	14	.2	X	11	10.22	X	0.6	3	X	0.7		=	335.44	(80)
West	0.9x	0.77	х	10	.6	X	11	10.22	X	0.6	33	X	0.7		= [357.05	(80)
West	0.9x	0.54	х	14	.2	X	9	4.68	X	0.6	3	X	0.7		=	288.14	(80)
West	0.9x	0.77	x	10	.6	x	9	4.68	x	0.6	33	х	0.7		=	306.7	(80)
West	0.9x	0.54	x	14	.2	X	7	3.59	x	0.6	3	x	0.7		=	223.96	(80)
West	0.9x	0.77	x	10	.6	X	7	3.59	x	0.6	3	х	0.7		=	238.39	(80)
West	0.9x	0.54	x	14	.2	X	4	5.59	x	0.6	3	x	0.7		=	138.75	(80)
West	0.9x	0.77	x	10	.6	X	4	5.59	x	0.6	3	x	0.7		=	147.69	(80)
West	0.9x	0.54	x	14	.2	X	2	4.49	x	0.6	3	х	0.7		=	74.53	(80)
West	0.9x	0.77	x	10	.6	X	2	4.49	x	0.6	3	x	0.7		=	79.33	(80)
West	0.9x	0.54	x	14	.2	X	1	6.15	X	0.6	3	X	0.7		=	49.16	(80)
West	0.9x	0.77	x	10	.6	X	1	6.15	x	0.6	3	X	0.7		=	52.32	(80)
	_								•								_
Solar o	ains in	watts, cal	lculated	for eac	h mont	h			(83)m	ı = Sum(7	74)m	(82)m					
(83)m=	201.34		608.29	866.59	1051.74	$\overline{}$	73.93	1023.42	884	.61 69	9.67	447.16	248.74	167	7.15		(83)
Total g	ains – i	nternal ar	nd solar	(84)m =	(73)m	+ (83)m ,	watts					•				
(84)m=	794.53	972.94	1179.09	1404.54	1555.2	15	545.07	1474.16	1342	2.13 117	74.59	955.16	794.8	742	2.86		(84)
7. Me	an inter	nal tempe	erature	(heating	seaso	n)											
		during he					area f	rom Tab	ole 9	, Th1 (°	C)					21	(85)
Utilisa	ation fac	tor for ga	ins for I	iving are	ea, h1,r	n (s	ee Ta	ble 9a)							I		
	Jan	Feb	Mar	Apr	May		Jun	Jul	Α	ug S	Вер	Oct	Nov		Эес		
(86)m=	1	1	1	0.98	0.92	1	0.78	0.61	0.6	8 0.	.92	0.99	1		1		(86)
Mean	interna	l tempera	ture in	living are	ea T1 (follo	w stei	os 3 to 7	in T	able 90	:)		•	•			
(87)m=	19.61	19.76	20.04	20.4	20.72	$\overline{}$	20.92	20.98	20.			20.37	19.92	19	.58		(87)
Tomo	oraturo	during he	ating n	oriode ir	roet o	f dv	بمالام	from Ta	hla (. Th2 /	°C)						
(88)m=	19.98	19.98	19.98	19.98	19.98	_	9.99	19.99	19.	` 	0.99	19.98	19.98	19	.98		(88)
		<u> </u>							<u> </u>				1	1			, ,
	ation fac	tor for ga	0.99	0.97		_	,m (se _{0.69}	0.48	r –	: ₅ 0	96	0.99	1 1	1			(89)
(89)m=		1			0.89				0.5	ļ	.86		1		1		(69)
		l tempera				Ť	<u> </u>		 				1			1	(65)
(90)m=	18.1	18.33	18.72	19.25	19.7	1	9.94	19.98	19.	98 19	0.81	19.21	18.56		.06		(90)
											†L/	4 = LIV	ing area ÷	(4) =		0.33	(91)
							\ (1	A T4		(1 ^)	T 0						

Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	18.6	18.8	19.16	19.63	20.04	20.26	20.31	20.3	20.14	19.59	19.01	18.56		(92)
Apply	/ adjustn	nent to th	he mean	internal	temper	ature fro	m Table	4e, whe	ere appro	priate				
(93)m=	18.6	18.8	19.16	19.63	20.04	20.26	20.31	20.3	20.14	19.59	19.01	18.56		(93)
8. Sp	ace hea	ting requ	uirement											
Set T	i to the r	nean int	ernal ter	nperatur	e obtain	ed at ste	ep 11 of	Table 9	b, so tha	t Ti,m=(76)m an	d re-calc	ulate	
the u	tilisation	factor fo	or gains	using Ta	ble 9a								ı	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
	ation fac	tor for g	ains, hm								1		ı	
(94)m=	1	1	0.99	0.97	0.89	0.72	0.53	0.6	0.87	0.99	1	1		(94)
	ıl gains,			<u> </u>									l	
(95)m=	793.95	970.82		1358.58			774.49	801.57	1025.62	941.77	793.42	742.47		(95)
	hly avera												l	
(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)
	$\overline{}$								– (96)m	Ī			l	
. ,	3090.54			2297.8		1203.72	789.44	829.4				3087.73		(97)
-)m – (95		·		l	
(98)m=	1708.67	1363.79	1159.41	676.24	298.64	0	0	0	0	730.62	1266.77	1744.87		_
								Tota	l per year	(kWh/year	r) = Sum(9	8) _{15,912} =	8949	(98)
Spac	e heatin	g require	ement in	kWh/m²	/year								46.85	(99)
9a. Er	ergy req	uiremer	nts – Indi	vidual h	eating s	vstems i	ncluding	micro-C	CHP)					
	e heatir								<i>'</i>					
•	ion of sp	_	it from se	econdar	y/supple	mentary	system						0	(201)
Fract	ion of sp	ace hea	it from m	ain syst	em(s)			(202) = 1 -	- (201) =				1	(202)
	ion of to			•	• •			(204) = (2	02) x [1 –	(203)] =			1	(204)
	ency of r		_	•									93.5	(206)
	•	•				a ovetom	. 0/							(208)
EIIICI	ency of s					-							0	」 ` ′
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/yea	ar
Spac	e heating								1		1			
	1708.67	1363.79	1159.41	676.24	298.64	0	0	0	0	730.62	1266.77	1744.87		
(211)n	$n = \{[(98)]$			<u> </u>									ı	(211)
	1827.45	1458.6	1240.01	723.25	319.4	0	0	0	0	781.41	1354.83			_
								Tota	ıl (kWh/yea	ar) =Sum(2	211),5,1012	=	9571.12	(211)
•	e heatin	`		, , .	month									
)m x (20	1)] } x 1	00 ÷ (20										ı	
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		_
								Tota	ıl (kWh/yea	ar) =Sum(2	215),,,,5,10,12	=	0	(215)
Water	heating	I												
Outpu	t from wa								l				l	
	218.23	192.2	201.5	180.14	176.18	156.91	150.21	165.5	165.42	186.82	198.16	212.82		٦
Efficie	ncy of w												79.8	(216)
(217)m=	89.15	89.03	88.74	88.02	86.21	79.8	79.8	79.8	79.8	88.09	88.89	89.2		(217)
	or water	•												
(219)n (219)m=	0 = (64) 244.8	m x 100 215.89) ÷ (217) 227.07	m 204.67	204.36	196.63	188.24	207.39	207.29	212.07	222.93	238.58		
(<u>~ 13)</u> =	444.0	210.09	221.01	204.07	204.30	130.03	100.24		I = Sum(2°		222.33	230.30	0500.00	7(040)
								TUId	Juili(2	100_{112}			2569.93	(219)

Americal totals		L-MAIL- A-com	L-18/b /
Annual totals Space heating fuel used, main system 1		kWh/year	kWh/year 9571.12
Water heating fuel used			2569.93
Electricity for pumps, fans and electric keep-hot			
central heating pump:		3	0 (230c)
boiler with a fan-assisted flue		4	5 (230e)
Total electricity for the above, kWh/year	sum of (230a	a)(230g) =	75 (231)
Electricity for lighting			584.97 (232)
12a. CO2 emissions – Individual heating system	s including micro-CHP		
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216 =	2067.36 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	555.1 (264)
Space and water heating	(261) + (262) + (263) + (264) =		2622.47 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	38.93 (267)
Electricity for lighting	(232) x	0.519 =	303.6 (268)
Total CO2, kg/year	sum	of (265)(271) =	2964.99 (272)

TER =

15.52

(273)



APPENDIX 2. DER WORKSHEET OF TYPICAL APARTMENT – BE LEAN

		User Details:				
Assessor Name:	Alexandros Kazantzis	Stroma Nui	nher:	STRO	030219	
Software Name:	Stroma FSAP 2012	Software V			n: 1.0.3.15	
	Pr	operty Address: Apt 1				
Address :	Flat 1, 26 Netherhall Garden	s, LONDON, NW3 5TI	_			
1. Overall dwelling dime	nsions:					
		Area(m²)	Av. Height(m)	Volume(m³))
Basement		113.7 (1a) x	3.2	(2a) =	363.84	(3a)
Ground floor		77.3 (1b) x	3	(2b) =	231.9	(3b)
Total floor area TFA = (1a	a)+(1b)+(1c)+(1d)+(1e)+(1n) 191 (4)				_
Dwelling volume		(3a)+(3	8b)+(3c)+(3d)+(3e)+.	(3n) =	595.74	(5)
2. Ventilation rate:						
	main secondary heating heating	y other	total		m³ per hour	•
Number of chimneys	0 + 0	+ 0 =	0	(40 =	0	(6a)
Number of open flues	0 + 0	+ 0 =	0	(20 =	0	(6b)
Number of intermittent far	ns		0	(10 =	0	(7a)
Number of passive vents			0	(10 =	0	(7b)
Number of flueless gas fin	res		0	(40 =	0	(7c)
			_	Air ch	anges per ho	_ r
Infiltration due to chimne	/s, flues and fans = (6a)+(6b)+(7a	a)+(7h)+(7c) =		-		_
•	een carried out or is intended, proceed		0 from (9) to (16)	÷ (5) =	0	(8)
Number of storeys in th	ne dwelling (ns)			Γ	0	(9)
Additional infiltration			[(9	9)-1]x0.1 =	0	(10)
Structural infiltration: 0.	25 for steel or timber frame or	0.35 for masonry cons	truction	Ī	0	(11)
if both types of wall are pr deducting areas of openin	resent, use the value corresponding to	the greater wall area (after				
•	loor, enter 0.2 (unsealed) or 0.	1 (sealed), else enter ()	Γ	0	(12)
If no draught lobby, ent	ter 0.05, else enter 0			Ī	0	(13)
Percentage of windows	s and doors draught stripped			Ī	0	(14)
Window infiltration		0.25 - [0.2 x (14) -	- 100] =	Ī	0	(15)
Infiltration rate		(8) + (10) + (11) +	(12) + (13) + (15) =	Ī	0	(16)
Air permeability value,	q50, expressed in cubic metres	s per hour per square	metre of envelop	e area	4	(17)
If based on air permeabili	ity value, then $(18) = [(17) \div 20] + (8)$), otherwise $(18) = (16)$		Ī	0.2	(18)
Air permeability value applies	s if a pressurisation test has been don	e or a degree air permeabili	ty is being used	_		
Number of sides sheltere	d			[4	(19)
Shelter factor		(20) = 1 - [0.075 x]	(19)] =	Ĺ	0.7	(20)
Infiltration rate incorporat		(21) = (18) x (20) =	-	[0.14	(21)
Infiltration rate modified for		, ,	, ,	, 		
Jan Feb	Mar Apr May Jun	Jul Aug Ser	Oct Nov	Dec		
Monthly average wind sp	eed from Table 7					

4.3

3.8

3.8

3.7

4.3

4.5

4.7

Wind Factor (22a)m = (1			1	1	
(22a)m= 1.27 1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18		
Adjusted infiltration rate	e (allowi	ng for sh	nelter an	d wind s	speed) =	(21a) x	(22a)m					
0.18 0.18	0.17	0.15	0.15	0.13	0.13	0.13	0.14	0.15	0.16	0.16		
Calculate effective air of the control of the contr	•	rate for t	he appli	cable ca	se						0.5	(23a)
If exhaust air heat pump u		endix N, (2	3b) = (23a	a) × Fmv (e	equation (N	N5)) , othe	rwise (23b) = (23a)			0.5	(23b)
If balanced with heat reco	very: effic	iency in %	allowing f	or in-use f	actor (fron	n Table 4h) =				79.05	(23c)
a) If balanced mecha	anical ve	entilation	with hea	at recove	ery (MVI	HR) (24a	a)m = (2	2b)m + (23b) × [1 – (23c)		`` ′
(24a)m= 0.28 0.28	0.28	0.26	0.26	0.24	0.24	0.23	0.24	0.26	0.26	0.27]	(24a)
b) If balanced mecha	anical ve	entilation	without	heat rec	covery (N	лV) (24b)m = (22	2b)m + (23b)	•	-	
(24b)m= 0 0	0	0	0	0	0	0	0	0	0	0		(24b)
c) If whole house ext	ract ven	tilation o	or positiv	e input v	ventilatio	on from c	outside	-	-		-	
if (22b)m < 0.5 ×	(23b), t	hen (24d	c) = (23b)); other	vise (24	c) = (22k	o) m + 0.	5 × (23b)	,	1	
(24c)m = 0 0	0	0	0	0	0	0	0	0	0	0		(24c)
d) If natural ventilationif (22b)m = 1, the				•				0.51				
(24d)m = 0 0	0	0	0	0	0	0.5 + [(2	0	0.5]	0	0	1	(24d)
Effective air change	rate - er	ter (24a		o) or (24)	c) or (24	d) in box	(25)	<u> </u>			J	, ,
(25)m= 0.28 0.28	0.28	0.26	0.26	0.24	0.24	0.23	0.24	0.26	0.26	0.27	1	(25)
		l .										
0	-4 l ·										•	
3. Heat losses and he	•			Not Ar	.02	اويدا ا	10	Λ Υ Ι Ι		kayalıy		1 Y L
3. Heat losses and he ELEMENT Gros area	s	oaramete Openin m	gs	Net Ar A ,r		U-valı W/m2		A X U (W/		k-value kJ/m²·		A X k kJ/K
ELEMENT Gros	s	Openin	gs		m²		K					
ELEMENT Gros	s	Openin	gs	A ,r	m² x1.	W/m2	K 0.04] =	(W/				kJ/K
ELEMENT Gros area Windows Type 1	s	Openin	gs	A ,r	m ² x ¹	W/m2 /[1/(1.4)+	K $0.04] = \begin{bmatrix} 0.04 \end{bmatrix} = \begin{bmatrix} 0.04 \end{bmatrix}$	(W/				(27)
ELEMENT Gros area Windows Type 1 Windows Type 2	s	Openin	gs	A ,r	m ² x10 x10 x10	W/m2 /[1/(1.4)+ /[1/(1.4)+	$ \begin{array}{c} \text{K} \\ 0.04] = \\ 0.04] = \\ 0.04] = \\ \end{array} $	18.83				(27) (27)
ELEMENT Gros area Windows Type 1 Windows Type 2 Windows Type 3	s	Openin	gs	A ,r 14.2 8.1 10.6	m ² x1. x1. x1. x1. x1.	W/m2 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+	(No.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04]	18.83 10.74 14.05				(27) (27) (27) (27)
ELEMENT Gros area Windows Type 1 Windows Type 2 Windows Type 3 Windows Type 4	s	Openin	gs	A ,r 14.2 8.1 10.6 2.5	x1.	W/m2 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+	(No.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04]	18.83 10.74 14.05 3.31	K)			(27) (27) (27) (27) (27)
ELEMENT Gros area Windows Type 1 Windows Type 2 Windows Type 3 Windows Type 4 Windows Type 5	s	Openin	gs	A ,r 14.2 8.1 10.6 2.5 2.5	x1.	W/m2 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+	(K) 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04]	(W// 18.83 10.74 14.05 3.31 3.31	K)			(27) (27) (27) (27) (27) (27)
ELEMENT Gros area Windows Type 1 Windows Type 2 Windows Type 3 Windows Type 4 Windows Type 5 Floor Type 1	s (m²)	Openin	gs ²	A ,r 14.2 8.1 10.6 2.5 2.5 110.3	x1. x1. x1. x1. x1. x1. x1. x1. x1.	W/m2 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+	(K) 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04]	(W// 18.83 10.74 14.05 3.31 3.31	K)			(27) (27) (27) (27) (27) (27) (28)
Windows Type 1 Windows Type 2 Windows Type 3 Windows Type 4 Windows Type 5 Floor Type 1 Floor Type 2	s (m²)	Openin m	gs ²	A ,r 14.2 8.1 10.6 2.5 2.5 110.3 5.5	x1. x1. x1. x1. x1. x1. x1. x1. x1.	W/m2 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ 0.15	(K 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = = = =	(W// 18.83 10.74 14.05 3.31 3.31 16.545 0.825	K)			(27) (27) (27) (27) (27) (27) (28) (28)
Windows Type 1 Windows Type 2 Windows Type 3 Windows Type 4 Windows Type 5 Floor Type 1 Floor Type 2 Walls Type1	s (m²)	Openin m	gs ²	A ,r 14.2 8.1 10.6 2.5 2.5 110.3 5.5	x1.	W/m2 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ 0.15 0.15	0.04] = 0.04] = 0.04] = 0.04] = 0.04] = = = =	(W// 18.83 10.74 14.05 3.31 3.31 16.545 0.825	K)			(27) (27) (27) (27) (27) (27) (28) (28) (29)
Windows Type 1 Windows Type 2 Windows Type 3 Windows Type 4 Windows Type 5 Floor Type 1 Floor Type 2 Walls Type1 Malls Type2 86.7	s (m²)	22.3 15.6	gs 2	A ,r 14.2 8.1 10.6 2.5 2.5 110.3 5.5 104.7 71.1 329.5	x1.	W/m2 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ 0.15 0.15 0.18	0.04] = 0.04] = 0.04] = 0.04] = 0.04] = = = =	(W// 18.83 10.74 14.05 3.31 3.31 16.545 0.825 18.85	K)	kJ/m²-	K !	(27) (27) (27) (27) (27) (28) (28) (29) (29)
Windows Type 1 Windows Type 2 Windows Type 3 Windows Type 4 Windows Type 5 Floor Type 1 Floor Type 2 Walls Type1 127 Walls Type2 86.7 Total area of elements, * for windows and roof windows include the areas on both in the sarea.	m ² , m ² wws, use e	22.3 15.6 effective winternal wall	gs 2 ndow U-va	A ,r 14.2 8.1 10.6 2.5 2.5 110.3 5.5 104.7 71.1 329.5 alue calculations	x1.	W/m2 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ 0.15 0.15 0.18	0.04] = 0.04] = 0.04] = 0.04] = 0.04] = = = =	(W// 18.83 10.74 14.05 3.31 3.31 16.545 0.825 18.85	K)	kJ/m²-	K !	(27) (27) (27) (27) (27) (28) (28) (29) (29) (31)
Windows Type 1 Windows Type 2 Windows Type 3 Windows Type 4 Windows Type 5 Floor Type 1 Floor Type 2 Walls Type1 Valls Type2 Total area of elements, * for windows and roof windows include the areas on both Fabric heat loss, W/K =	m ² , m ² ows, use e sides of interest of the sides of	22.3 15.6 effective winternal wall	gs 2 ndow U-va	A ,r 14.2 8.1 10.6 2.5 2.5 110.3 5.5 104.7 71.1 329.5 alue calculations	x1.	W/m2 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ 0.15 0.15 0.18	(No.04] =	(W// 18.83 10.74 14.05 3.31 3.31 16.545 0.825 18.85 12.8	K)	kJ/m²-	K !	(27) (27) (27) (27) (27) (28) (28) (29) (29) (31)
Windows Type 1 Windows Type 2 Windows Type 3 Windows Type 3 Windows Type 4 Windows Type 5 Floor Type 1 Floor Type 2 Walls Type1 Total area of elements, * for windows and roof windo ** include the areas on both Fabric heat loss, W/K = Heat capacity Cm = S(m ² , m ² ws, use esides of interest (A x A x k)	22.3 15.6 affective winternal walk	gs 2 ndow U-va ds and pan	A ,r 14.2 8.1 10.6 2.5 2.5 110.3 5.5 104.7 71.1 329.5 alue calculatitions	x1.	W/m2 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ 0.15 0.15 0.18	0.04] = 0.04] = 0.04] = 0.04] = 0.04] = = = = (1/U-value) + (32) = ((28).	(W// 18.83 10.74 14.05 3.31 3.31 16.545 0.825 18.85 12.8 (e)+0.04] &	K)	kJ/m²-	99.26 38915.5	(27) (27) (27) (27) (27) (28) (28) (29) (29) (31)
Windows Type 1 Windows Type 2 Windows Type 3 Windows Type 4 Windows Type 5 Floor Type 1 Floor Type 2 Walls Type1 Total area of elements, * for windows and roof windo ** include the areas on both Fabric heat loss, W/K = Heat capacity Cm = S(Thermal mass parameter	m ² , m ² ws, use e sides of interest (TMF)	22.3 15.6 Iffective winternal walk U) P = Cm ÷	gs 2 ndow U-va ds and pan	A ,r 14.2 8.1 10.6 2.5 2.5 110.3 5.5 104.7 71.1 329.5 alue calculatitions	x1.	W/m2 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ 0.15 0.15 0.18 0.18	0.04] = 0.04] = 0.04] = 0.04] = 0.04] = = = = (1/U-value) + (32) = ((28). Indical	(W// 18.83 10.74 14.05 3.31 3.31 16.545 0.825 18.85 12.8 (a) +0.04] & (a) (a) (b) (b) (c) (c) (c) (c) (c) (c) (c) (c) (c) (c	(K)	kJ/m²-	n 3.2	(27) (27) (27) (27) (27) (28) (28) (29) (29) (31)
Windows Type 1 Windows Type 2 Windows Type 3 Windows Type 3 Windows Type 4 Windows Type 5 Floor Type 1 Floor Type 2 Walls Type1 Total area of elements, * for windows and roof windo ** include the areas on both Fabric heat loss, W/K = Heat capacity Cm = S(m² m² ows, use e sides of in a S (A x A x k) ter (TMF ere the de	22.3 15.6 15.6 Iffective wind ternal walk U) P = Cm : tails of the	gs 2 ndow U-va ds and pan	A ,r 14.2 8.1 10.6 2.5 2.5 110.3 5.5 104.7 71.1 329.5 alue calculatitions	x1.	W/m2 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ 0.15 0.15 0.18 0.18	0.04] = 0.04] = 0.04] = 0.04] = 0.04] = = = = (1/U-value) + (32) = ((28). Indical	(W// 18.83 10.74 14.05 3.31 3.31 16.545 0.825 18.85 12.8 (a) +0.04] & (a) (a) (b) (b) (c) (c) (c) (c) (c) (c) (c) (c) (c) (c	(K)	kJ/m²-	99.26 38915.5	(27) (27) (27) (27) (27) (28) (28) (29) (29) (31)

	ممط مدا	4 laaa aa	ام مغمل بما	الطاهرة مسا						(36) =	OE) ·- (E)		119.93	(37
entilat F			alculated		<u> </u>				· ,	= 0.33 × (· · · ·			
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		(0)
8)m=	55.69	55	54.31	50.87	50.18	46.74	46.74	46.05	48.12	50.18	51.56	52.93		(38
eat tra	ansfer c	oefficier	nt, W/K						(39)m	= (37) + (3	38)m			
9)m=	175.61	174.92	174.24	170.8	170.11	166.67	166.67	165.98	168.04	170.11	171.48	172.86		_
() .		(/1	II D\ \\	21.7						Average =		12 /12=	170.62	(3
г	_		HLP), W/		0.00	0.07	0.07	0.07	` ′	= (39)m ÷	`	0.01		
0)m=	0.92	0.92	0.91	0.89	0.89	0.87	0.87	0.87	0.88	0.89	0.9	0.91	0.00	\ (4
umbe	r of dav	s in mor	nth (Tab	e 1a)					,	Average =	Sum(40) ₁	12 / 12=	0.89	(4
Γ	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
1)m=	31	28	31	30	31	30	31	31	30	31	30	31		(4
' L							1							•
4 207												1.56/1./		
ı. vva	ter neat	ing ener	gy requi	rement:								kWh/ye	ear:	
		pancy, N										.99		(4
			+ 1.76 x	[1 - exp	(-0.0003	849 x (TI	FA -13.9)2)] + 0.0	0013 x (ΓFA -13.	9)	·		
	4 £ 13.9	•	.40			\/ d		(OF 1/ NI)	. 20			1		
	_			•	•	•	erage = designed t	` ,		se target o		5.22		(4
		-	oerson per			-	•			Ü				
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
ot wate	r usage ir	litres per	day for ea			ctor from	Table 1c x	•	•					
4)m=	115.74	111.53	107.32	103.11	98.9	94.7	94.7	98.9	103.11	107.32	111.53	115.74		
L					I	I.					l	-		
									-	Total = Su	m(44) ₁₁₂ =	=	1262.61	(4
nergy c	ontent of	hot water	used - cal	culated mo	onthly $= 4$.	190 x Vd,ı	m x nm x D	0Tm / 3600			(/ /	L	1262.61	(4
	ontent of 171.64	hot water 150.12	used - cal	culated mo	onthly = 4.	190 x Vd,r	n x nm x D	0Tm / 3600 118.9			(/ /	L	1262.61	(4
5)m=	171.64	150.12	154.91	135.05	129.58	111.82	103.62	118.9	120.32	nth (see Ta	ables 1b, 1	c, 1d)	1262.61 1655.48	」 `
5)m=	171.64	150.12	154.91	135.05	129.58	111.82		118.9	120.32	140.23	ables 1b, 1	c, 1d)		」 `
5)m= [instanta 6)m= [171.64 aneous w 25.75	150.12 ater heatir 22.52	154.91	135.05	129.58	111.82	103.62	118.9	120.32	140.23	ables 1b, 1	c, 1d)		(4
5)m= [instanta 6)m= [dater s	171.64 aneous w	150.12 ater heatir 22.52 loss:	154.91 ng at point 23.24	135.05 of use (no	129.58 hot water 19.44	111.82 storage),	103.62 enter 0 in	118.9 boxes (46,	120.32 10 to (61) 18.05	140.23 Total = Su 21.03	153.07 m(45) ₁₁₂ =	c, 1d) 166.22 = 24.93		(4
5)m= [instanta 6)m= [dater setorage	171.64 aneous w 25.75 storage	ater heatin 22.52 loss: e (litres)	154.91 ng at point 23.24 includin	135.05 of use (no 20.26 g any so	129.58 hot water 19.44 plar or W	111.82 r storage), 16.77 /WHRS	103.62 enter 0 in 15.54 storage	118.9 boxes (46) 17.84 within sa	120.32 10 to (61) 18.05	140.23 Total = Su 21.03	153.07 m(45) ₁₁₂ =	(c, 1d)		(2
5)m= [instanta 6)m= [/ater s torage	171.64 aneous w 25.75 storage volumenunity h	ater heating 22.52 loss: e (litres) eating a	154.91 ng at point 23.24 includin nd no ta	135.05 of use (not) 20.26 g any so	129.58 hot water 19.44 clar or W yelling, e	111.82 r storage), 16.77 /WHRS nter 110	enter 0 in 15.54 storage	118.9 boxes (46, 17.84 within sa (47)	120.32 1 to (61) 18.05	140.23 Total = Sur 21.03	153.07 m(45) ₁₁₂ =	c, 1d) 166.22 = 24.93		(4
5)m= [instanta 6)m= [later s torage comm therw	aneous w 25.75 storage volum- nunity h ise if no	ater heating 22.52 loss: e (litres) eating a stored	154.91 ng at point 23.24 includin nd no ta	135.05 of use (not) 20.26 g any so	129.58 hot water 19.44 clar or W yelling, e	111.82 r storage), 16.77 /WHRS nter 110	103.62 enter 0 in 15.54 storage	118.9 boxes (46, 17.84 within sa (47)	120.32 1 to (61) 18.05	140.23 Total = Sur 21.03	153.07 m(45) ₁₁₂ =	c, 1d) 166.22 = 24.93		(4
5)m= [instanta 6)m= [/ater s torage comm therw /ater s	aneous w 25.75 storage e volum- nunity h ise if no	ater heatin 22.52 loss: e (litres) eating a stored loss:	154.91 ng at point 23.24 includin nd no ta hot wate	of use (no 20.26 g any so nk in dw er (this in	129.58 to hot water 19.44 Dlar or Welling, e	111.82 storage), 16.77 /WHRS nter 110 nstantar	enter 0 in 15.54 storage 0 litres in	118.9 boxes (46, 17.84 within sa (47)	120.32 1 to (61) 18.05	140.23 Total = Sur 21.03	153.07 m(45) ₁₁₂ = 22.96	c, 1d) 166.22 = 24.93		(4)
5)m= [instanta 6)m= ['ater s torage comm therw 'ater s) If ma	aneous w 25.75 storage e volum- nunity h ise if no storage anufactor	ater heatin 22.52 loss: e (litres) eating a stored loss: urer's de	154.91 ag at point 23.24 includin nd no ta hot wate	of use (not 20.26) g any sonk in dwer (this in coss factors)	129.58 to hot water 19.44 Dlar or Welling, e	111.82 storage), 16.77 /WHRS nter 110 nstantar	enter 0 in 15.54 storage 0 litres in	118.9 boxes (46, 17.84 within sa (47)	120.32 1 to (61) 18.05	140.23 Total = Sur 21.03	153.07 m(45) ₁₁₂ = 22.96	c, 1d) 166.22 24.93 150		(4)
instanta ins	25.75 storage e voluments if no storage anufactorage rature fa	ater heating 22.52 loss: e (litres) eating a stored loss: urer's deactor from	154.91 ag at point 23.24 includin nd no ta hot wate eclared lo	of use (not 20.26) g any sonk in dwer (this in coss factor 2b	129.58 to hot water 19.44 colar or Water velling, encludes in the column of the colu	111.82 storage), 16.77 /WHRS nter 110 nstantar	enter 0 in 15.54 storage litres in neous co	118.9 boxes (46, 17.84 within sa (47) mbi boil	120.32 10 to (61) 18.05 18.05 18.05 18.05	140.23 Total = Sur 21.03	22.96 27 20.96	c, 1d) 166.22 24.93 150 55 54		
instanta 6)m= [/ater s torage comm therw /ater s) If ma	25.75 storage e volumentity he ise if no storage anufactorature fallost from the control of the	ater heating 22.52 loss: e (litres) eating a stored loss: urer's deactor from water	154.91 ag at point 23.24 includin nd no ta hot wate eclared le m Table storage	of use (not 20.26) g any sonk in dwer (this in coss factor 2b, kWh/ye	129.58 hot water 19.44 clar or W velling, encludes i	111.82 r storage), 16.77 /WHRS nter 110 nstantar	enter 0 in 15.54 storage litres in neous co	118.9 boxes (46, 17.84 within sa (47)	120.32 10 to (61) 18.05 18.05 18.05 18.05	140.23 Total = Sur 21.03	22.96 27 20.96	c, 1d) 166.22 24.93 150		(4)
instanta instanta instanta identalia	25.75 storage e voluments if no storage anufaction rature familiarity for anufaction anu	ater heatin 22.52 loss: e (litres) eating a stored loss: urer's de actor from water urer's de	154.91 ag at point 23.24 includin nd no ta hot wate eclared lo	of use (not) 20.26 g any so nk in dw er (this in) coss facto 2b , kWh/ye	129.58 hot water 19.44 Dlar or W velling, encludes it or is known is kno	111.82 storage), 16.77 /WHRS nter 110 nstantar wn (kWh	enter 0 in 15.54 storage 0 litres in neous con/day):	118.9 boxes (46, 17.84 within sa (47) mbi boil	120.32 10 to (61) 18.05 18.05 18.05 18.05	140.23 Total = Sur 21.03	22.96 27 20 20 20 20 20 20 20 20 20 20 20 20 20	c, 1d) 166.22 24.93 150 55 54		(4)
instanta ins	25.75 storage e volumentation for a volumentat	ater heatin 22.52 loss: e (litres) eating a o stored loss: urer's de actor from m water urer's de	154.91 ag at point 23.24 includin nd no ta hot wate eclared le m Table storage eclared of	of use (not 20.26) g any so nk in dwar (this in 25 factor 25, kWh/ye cylinder loom Table	129.58 hot water 19.44 Dlar or W velling, encludes it or is known is kno	111.82 storage), 16.77 /WHRS nter 110 nstantar wn (kWh	enter 0 in 15.54 storage 0 litres in neous con/day):	118.9 boxes (46, 17.84 within sa (47) mbi boil	120.32 10 to (61) 18.05 18.05 18.05 18.05	140.23 Total = Sur 21.03	22.96 27 20 20 20 20 20 20 20 20 20 20 20 20 20	c, 1d) 166.22 24.93 150 55 54		(4)
instanta ins	25.75 storage e volumentative if no storage anufactive fature fature fature fature fature ter storage anufactive rature fature f	ater heatin 22.52 loss: e (litres) eating a o stored loss: urer's de actor from m water urer's de	including at point 23.24 including at no tale and to tale at a storage eclared of factor free sections.	of use (not 20.26) g any so nk in dwar (this in 25 factor 25, kWh/ye cylinder loom Table	129.58 hot water 19.44 Dlar or W velling, encludes it or is known is kno	111.82 storage), 16.77 /WHRS nter 110 nstantar wn (kWh	enter 0 in 15.54 storage 0 litres in neous con/day):	118.9 boxes (46, 17.84 within sa (47) mbi boil	120.32 10 to (61) 18.05 18.05 18.05 18.05	140.23 Total = Sur 21.03	ables 1b, 1 153.07 m(45)112 = 22.96 47) 0.0	c, 1d) 166.22 24.93 150 55 54		(4)
instanta ins	25.75 storage e voluments if no storage anufaction anufaction anufaction anufaction is to anufaction anufaction anufaction is to anufaction anufaction anufaction anufaction is factor in the factor is to anufaction and anufaction and anufaction and anufaction and anufaction and anufaction anufaction and anufaction an	ater heatin 22.52 loss: e (litres) eating a o stored loss: urer's de actor fro m water urer's de age loss eating s from Tal	including at point 23.24 including at no tale and to tale at a storage eclared of factor free sections.	of use (not 20.26) g any sonk in dwer (this in 25), kWh/ye cylinder loom Table on 4.3	129.58 hot water 19.44 Dlar or W velling, encludes it or is known is kno	111.82 storage), 16.77 /WHRS nter 110 nstantar wn (kWh	enter 0 in 15.54 storage 0 litres in neous con/day):	118.9 boxes (46, 17.84 within sa (47) mbi boil	120.32 10 to (61) 18.05 18.05 18.05 18.05	140.23 Total = Sur 21.03	ables 1b, 1 153.07 m(45)112 = 22.96 47)	c, 1d) 166.22 24.93 150 54 84		(4)
instanta 6)m= [/ater s torage comm therw /ater s) If ma emper of wat comm olume	25.75 storage e volumentative factorage anufactorature factorature	ater heating 22.52 loss: e (litres) eating a stored loss: urer's defactor from water urer's defage loss eating s from Talactor from	including at point 23.24 including at point and no tale and the storage eclared of factor free sections at point 2a.	of use (not 20.26) g any sonk in dwer (this in 2b), kWh/ye cylinder loom Table on 4.3	129.58 hot water 19.44 clar or W yelling, e ncludes i or is kno ear loss fact	111.82 storage), 16.77 /WHRS nter 110 nstantar wn (kWh	enter 0 in 15.54 storage 0 litres in neous con/day): known:	118.9 boxes (46, 17.84 within sa (47) mbi boil	120.32 120.32 1 to (61) 18.05 ame vess	140.23 Total = Su 21.03 sel er '0' in (ables 1b, 1 153.07 m(45)112 = 22.96 47) 0.	c, 1d) 166.22 24.93 150 55 54 84 0		(4 (4 (4 (5) (5) (5)

Water storage	loss cal	culated f	or each	month			((56)m = ((55) × (41)	m				
(56)m= 25.95	23.44	25.95	25.11	25.95	25.11	25.95	25.95	25.11	25.95	25.11	25.95		(56)
If cylinder contains	dedicate	d solar sto	rage, (57)ı	m = (56)m	x [(50) – (H11)] ÷ (5	0), else (5	7)m = (56)	m where (H11) is fro	m Append	ix H	
(57)m= 25.95	23.44	25.95	25.11	25.95	25.11	25.95	25.95	25.11	25.95	25.11	25.95		(57)
Primary circuit	loss (an	nual) fro	m Table	3							0		(58)
Primary circuit	loss cal	culated f	for each	month (59)m = ((58) ÷ 36	65 × (41)	m					
(modified by	factor fi	rom Tabl	le H5 if t	here is s	solar wat	ter heatii	ng and a	cylinde	r thermo	stat)			
(59)m= 23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)
Combi loss cald	culated	for each	month ((61)m =	(60) ÷ 36	65 × (41))m						
(61)m= 0	0	0	0	0	0	0	0	0	0	0	0		(61)
Total heat requ	ired 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= 220.85	194.56	204.11	182.67	178.79	159.44	152.83	168.11	167.95	189.44	200.69	215.43		(62)
Solar DHW input ca	alculated	using App	endix G or	Appendix	H (negati	ve quantity	/) (enter '0	if no sola	r contribut	ion to wate	er heating)		
(add additional	lines if	FGHRS	and/or \	vwhrs	applies	, see Ap	pendix (3)					
(63)m= 0	0	0	0	0	0	0	0	0	0	0	0		(63)
Output from wa	ater hea	ter			•	•							
(64)m= 220.85	194.56	204.11	182.67	178.79	159.44	152.83	168.11	167.95	189.44	200.69	215.43		
<u> </u>							Outp	out from wa	ater heate	r (annual)₁	12	2234.88	(64)
Heat gains fron	n water	heating,	kWh/mo	onth 0.2	5 ′ [0.85	× (45)m	+ (61)m	า] + 0.8 >	([(46)m	+ (57)m	+ (59)m	1	_
(65)m= 96.44	85.47	90.87	83	82.45	75.28	73.82	78.9	78.11	85.99	- 	<u> </u>	<u>-</u>	(65)
			00	02.70	1 75.20	13.02	10.9	70.11	65.99	88.99	94.64		(00)
include (57)n	n in calc				<u> </u>	<u> </u>	<u> </u>					eating	(00)
include (57)n		culation o	of (65)m	only if c	<u> </u>	<u> </u>	<u> </u>					eating	(00)
5. Internal ga	ins (see	culation of Table 5	of (65)m and 5a	only if c	<u> </u>	<u> </u>	<u> </u>					eating	(00)
5. Internal ga	ins (see s (Table	culation of Table 5	of (65)m and 5a	only if c	ı :ylinder i:	s in the o	dwelling	or hot w	ater is fr	rom com	munity h	eating	(00)
5. Internal ga Metabolic gains Jan	ins (see s (Table Feb	culation of Table 5 (5), Wat Mar	of (65)m and 5a ts Apr	only if c	ylinder is	s in the o	dwelling		ater is fr	om com	munity h	eating	(66)
5. Internal ga Metabolic gains Jan (66)m= 149.51	ins (see s (Table Feb 149.51	e Table 5 5), Wat Mar 149.51	of (65)m and 5a ts Apr 149.51	only if constant of the consta	Jun 149.51	Jul 149.51	Aug 149.51	or hot w	ater is fr	rom com	munity h	eating	
5. Internal ga Metabolic gains Jan (66)m= 149.51 Lighting gains (ins (see s (Table Feb 149.51 (calcula	Explanation of Table 5 (a) Table 5 (b) Wat Mar (b) 149.51 (b) ted in Ap	of (65)m and 5a ts Apr 149.51	only if constant of the consta	Jun 149.51	Jul 149.51 r L9a), a	Aug 149.51	or hot w Sep 149.51 Table 5	Oct	Nov	Dec	eating	(66)
5. Internal ga Metabolic gains Jan (66)m= 149.51 Lighting gains (67)m= 33.12	ins (see s (Table Feb 149.51 (calcula 29.42	Table 5 5), Wat Mar 149.51 ted in Ap	of (65)m 5 and 5a ts Apr 149.51 opendix 18.11	May 149.51 L, equat	Jun 149.51 ion L9 o	Jul 149.51 r L9a), a	Aug 149.51 Iso see	Sep 149.51 Table 5 21.55	Oct 149.51	om com	munity h	eating	
5. Internal ga Metabolic gains Jan (66)m= 149.51 Lighting gains (67)m= 33.12 Appliances gain	ins (see s (Table Feb 149.51 (calcula 29.42 ns (calc	Table 5 25), Wat Mar 149.51 ted in Ap 23.93 ulated in	of (65)m and 5a ts Apr 149.51 opendix 18.11	May 149.51 L, equat 13.54 dix L, eq	Jun 149.51 ion L9 o 11.43 uation L	Jul 149.51 r L9a), a 12.35	Aug 149.51 Iso see 16.06 3a), also	Sep 149.51 Table 5 21.55 see Ta	Oct 149.51 27.36 ble 5	Nov 149.51 31.94	Dec 149.51	eating	(66) (67)
5. Internal ga Metabolic gains Jan (66)m= 149.51 Lighting gains (67)m= 33.12 Appliances gain (68)m= 362.41	ins (see Feb 149.51 (calcular 29.42 ns (calc	Table 5 25), Wat Mar 149.51 ted in Ap 23.93 ulated in 356.69	of (65)m 5 and 5a ts Apr 149.51 ppendix 18.11 Appendix 336.52	May 149.51 L, equat 13.54 dix L, eq 311.05	Jun 149.51 ion L9 of 11.43 uation L 287.12	Jul 149.51 r L9a), a 12.35 13 or L1 271.13	Aug 149.51 Iso see 16.06 3a), also	Sep 149.51 Table 5 21.55 See Ta 276.84	Oct 149.51 27.36 ble 5 297.02	Nov	Dec	eating	(66)
5. Internal ga Metabolic gains Jan (66)m= 149.51 Lighting gains (67)m= 33.12 Appliances gain (68)m= 362.41 Cooking gains	ins (see Feb 149.51 (calcular 29.42 ns (calc	Table 5 25), Wat Mar 149.51 ted in Ap 23.93 ulated in 356.69	of (65)m 5 and 5a ts Apr 149.51 ppendix 18.11 Appendix 336.52	May 149.51 L, equat 13.54 dix L, eq 311.05	Jun 149.51 ion L9 of 11.43 uation L 287.12	Jul 149.51 r L9a), a 12.35 13 or L1 271.13	Aug 149.51 Iso see 16.06 3a), also	Sep 149.51 Table 5 21.55 See Ta 276.84	Oct 149.51 27.36 ble 5 297.02	Nov 149.51 31.94	Dec 149.51	eating	(66) (67)
Metabolic gains Jan (66)m= 149.51 Lighting gains (67)m= 33.12 Appliances gain (68)m= 362.41 Cooking gains (69)m= 37.95	ins (see Feb 149.51 (calcula 29.42 ns (calcula 366.17 (calcula 37.95	Table 5 5), Wat Mar 149.51 ted in Ap 23.93 ulated in 356.69 tted in Ap 37.95	of (65)m s and 5a ts Apr 149.51 opendix 18.11 Append 336.52 opendix 37.95	May 149.51 L, equat 13.54 dix L, eq 311.05 L, equat	Jun 149.51 ion L9 of 11.43 uation L 287.12 tion L15	Jul 149.51 r L9a), a 12.35 13 or L1 271.13 or L15a)	Aug 149.51 Iso see 16.06 3a), also 267.36	Sep 149.51 Table 5 21.55 See Ta 276.84 ee Table	Oct 149.51 27.36 ble 5 297.02 5	Nov 149.51 31.94	Dec 149.51 34.04 346.42	eating	(66) (67) (68)
Metabolic gains Jan (66)m= 149.51 Lighting gains (67)m= 33.12 Appliances gain (68)m= 362.41 Cooking gains (69)m= 37.95 Pumps and fan	ins (see Feb 149.51 (calcula 29.42 ns (calc 366.17 (calcula 37.95 ns gains	Table 5	of (65)m 5 and 5a ts Apr 149.51 opendix 18.11 Appendix 336.52 opendix 37.95	May 149.51 L, equat 13.54 dix L, eq 311.05 L, equat 37.95	Jun 149.51 ion L9 o 11.43 uation L 287.12 tion L15 37.95	Jul 149.51 r L9a), a 12.35 13 or L1 271.13 or L15a) 37.95	Aug 149.51 Iso see 16.06 3a), also 267.36), also se 37.95	Sep 149.51 Table 5 21.55 See Ta 276.84 ee Table 37.95	Oct 149.51 27.36 ble 5 297.02 5 37.95	Nov 149.51 31.94 322.48	Dec 149.51 34.04 346.42 37.95	eating	(66) (67) (68) (69)
Metabolic gains Jan (66)m= 149.51 Lighting gains (67)m= 33.12 Appliances gain (68)m= 362.41 Cooking gains (69)m= 37.95 Pumps and fan (70)m= 3	ins (see Feb 149.51 (calcula 29.42 ns (calcula 366.17 (calcula 37.95 ns gains	ted in Ap 37.95 (Table 5	of (65)m and 5a ts Apr 149.51 ppendix 18.11 Append 336.52 ppendix 37.95 5a) 3	only if constructions only if constructions only if constructions on the construction of the construction	Jun 149.51 ion L9 of 11.43 uation L 287.12 tion L15 37.95	Jul 149.51 r L9a), a 12.35 13 or L1 271.13 or L15a)	Aug 149.51 Iso see 16.06 3a), also 267.36	Sep 149.51 Table 5 21.55 See Ta 276.84 ee Table	Oct 149.51 27.36 ble 5 297.02 5	Nov 149.51 31.94	Dec 149.51 34.04 346.42	eating	(66) (67) (68)
Metabolic gains Jan (66)m= 149.51 Lighting gains (67)m= 33.12 Appliances gain (68)m= 362.41 Cooking gains (69)m= 37.95 Pumps and fan (70)m= 3 Losses e.g. eva	ins (see Feb 149.51 (calcular 29.42 ns (calcular 366.17 (calcular 37.95 as gains 3	ted in Ap 37.95 (Table 5	of (65)m s and 5a ts Apr 149.51 ppendix 18.11 Append 336.52 ppendix 37.95 5a) 3 tive valu	only if construction only if c	Jun 149.51 ion L9 o 11.43 uation L 287.12 tion L15 37.95	Jul 149.51 r L9a), a 12.35 13 or L1 271.13 or L15a) 37.95	Aug 149.51 Iso see 16.06 3a), also 267.36), also se 37.95	Sep 149.51 Table 5 21.55 See Ta 276.84 ee Table 37.95	Oct 149.51 27.36 ble 5 297.02 5 37.95	Nov 149.51 31.94 322.48	Dec 149.51 34.04 346.42 37.95	eating	(66) (67) (68) (69)
Metabolic gains Jan (66)m= 149.51 Lighting gains (67)m= 33.12 Appliances gain (68)m= 362.41 Cooking gains (69)m= 37.95 Pumps and fan (70)m= 3 Losses e.g. eva (71)m= -119.61	ins (see Feb 149.51 (calcular 29.42 ns (calcular 366.17 (calcular 37.95 ns gains 3 aporation	ted in Ap 37.95 (Table 5 3 on (negate 19.61)	of (65)m and 5a ts Apr 149.51 ppendix 18.11 Append 336.52 ppendix 37.95 5a) 3	only if constructions only if constructions only if constructions on the construction of the construction	Jun 149.51 ion L9 of 11.43 uation L 287.12 tion L15 37.95	Jul 149.51 r L9a), a 12.35 13 or L1 271.13 or L15a) 37.95	Aug 149.51 Iso see 16.06 3a), also 267.36), also se 37.95	Sep 149.51 Table 5 21.55 See Ta 276.84 ee Table 37.95	Oct 149.51 27.36 ble 5 297.02 5 37.95	Nov 149.51 31.94 322.48	Dec 149.51 34.04 346.42 37.95	eating	(66) (67) (68) (69)
Metabolic gains Jan (66)m= 149.51 Lighting gains (67)m= 33.12 Appliances gain (68)m= 362.41 Cooking gains (69)m= 37.95 Pumps and fan (70)m= 3 Losses e.g. eva (71)m= -119.61 Water heating (9	ins (see S (Table Feb 149.51 (calcula 29.42 ns (calcula 366.17 (calcula 37.95 as gains 3 aporatio -119.61 gains (T	culation of Table 5 5), Wat Mar 149.51 ted in Ap 23.93 ulated in 356.69 tted in Ap 37.95 (Table 5 3 an (negat -119.61	of (65)m and 5a ts Apr 149.51 opendix 18.11 Append 336.52 opendix 37.95 5a) 3 tive valu -119.61	only if constructions only if constructions only if constructions on the construction of the construction	Jun 149.51 ion L9 o 11.43 uation L 287.12 tion L15 37.95 3 ole 5) -119.61	Jul 149.51 r L9a), a 12.35 13 or L1 271.13 or L15a) 37.95	Aug 149.51 Iso see 16.06 3a), also 267.36), also se 37.95	Sep 149.51 Table 5 21.55 See Ta 276.84 ee Table 37.95	Oct 149.51 27.36 ble 5 297.02 5 37.95 3	Nov 149.51 31.94 322.48 37.95	Dec 149.51 34.04 346.42 37.95 3	eating	(66) (67) (68) (69) (70) (71)
Metabolic gains Jan (66)m= 149.51 Lighting gains (67)m= 33.12 Appliances gain (68)m= 362.41 Cooking gains (69)m= 37.95 Pumps and fan (70)m= 3 Losses e.g. eva (71)m= -119.61 Water heating (72)m= 129.62	ins (see Feb 149.51 (calcular 29.42 ns (calcular 366.17 (calcular 37.95 ns gains 3 aporation -119.61 gains (T	culation of Table 5 25), Wat Mar 149.51 ted in Ap 23.93 ulated in 356.69 ted in Ap 37.95 (Table 5 3 on (negation of the second o	of (65)m s and 5a ts Apr 149.51 ppendix 18.11 Append 336.52 ppendix 37.95 5a) 3 tive valu	only if construction only if c	Jun 149.51 ion L9 o 11.43 uation L 287.12 tion L15 37.95 3 ble 5) -119.61	Jul 149.51 r L9a), a 12.35 13 or L1 271.13 or L15a) 37.95	Aug 149.51 Iso see 16.06 3a), also 267.36), also se 37.95	Sep 149.51 Table 5 21.55 See Ta 276.84 ee Table 37.95 3 -119.61	Oct 149.51 27.36 ble 5 297.02 5 37.95 3 -119.61	Nov 149.51 31.94 322.48 37.95	munity h Dec 149.51 34.04 346.42 37.95 3 -119.61	eating	(66) (67) (68) (69)
Metabolic gains Jan (66)m= 149.51 Lighting gains (67)m= 33.12 Appliances gain (68)m= 362.41 Cooking gains (69)m= 37.95 Pumps and fan (70)m= 3 Losses e.g. eva (71)m= -119.61 Water heating (72)m= 129.62 Total internal	ins (see Feb 149.51 (calcular 29.42 ns (calcular 37.95 ns gains 3 aporatio -119.61 gains (T 127.19 gains =	culation of Table 5 25), Wat Mar 149.51 ted in Ap 23.93 ulated in 356.69 tted in Ap 37.95 (Table 5 3 on (negation of 19.61) Table 5) 122.14	of (65)m ts Apr 149.51 ppendix 18.11 Appendix 336.52 ppendix 37.95 5a) 3 tive valu -119.61	only if construction only if c	Jun 149.51 ion L9 of 11.43 uation L 287.12 tion L15 37.95 3 ole 5) -119.61 104.55 (66)	Jul 149.51 r L9a), a 12.35 13 or L1 271.13 or L15a) 37.95 3	Aug 149.51 Iso see 16.06 3a), also 267.36), also se 37.95 3	Sep 149.51 Table 5 21.55 See Ta 276.84 See Table 37.95 3 -119.61 108.48 + (69)m + (69)	Oct 149.51 27.36 ble 5 297.02 5 37.95 3 -119.61 115.58 70)m + (7	Nov 149.51 31.94 322.48 37.95 3 -119.61 123.6 1)m + (72)	munity h Dec 149.51 34.04 346.42 37.95 3 -119.61	eating	(66) (67) (68) (69) (70) (71)
Metabolic gains Jan (66)m= 149.51 Lighting gains ((67)m= 33.12 Appliances gain (68)m= 362.41 Cooking gains (69)m= 37.95 Pumps and fan (70)m= 3 Losses e.g. eva (71)m= -119.61 Water heating ((72)m= 129.62	ins (see Feb 149.51 (calcular 29.42 ns (calcular 366.17 (calcular 37.95 ns gains 3 aporation -119.61 gains (Tar.19 gains = 593.63	culation of Table 5 25), Wat Mar 149.51 ted in Ap 23.93 ulated in 356.69 ted in Ap 37.95 (Table 5 3 on (negation of the second o	of (65)m and 5a ts Apr 149.51 opendix 18.11 Append 336.52 opendix 37.95 5a) 3 tive valu -119.61	only if constructions only if constructions only if constructions on the construction of the construction	Jun 149.51 ion L9 o 11.43 uation L 287.12 tion L15 37.95 3 ble 5) -119.61	Jul 149.51 r L9a), a 12.35 13 or L1 271.13 or L15a) 37.95	Aug 149.51 Iso see 16.06 3a), also 267.36), also se 37.95	Sep 149.51 Table 5 21.55 See Ta 276.84 ee Table 37.95 3 -119.61	Oct 149.51 27.36 ble 5 297.02 5 37.95 3 -119.61	Nov 149.51 31.94 322.48 37.95	munity h Dec 149.51 34.04 346.42 37.95 3 -119.61	eating	(66) (67) (68) (69) (70) (71)

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

Orientat	tion:	Access Facto Table 6d	r	Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	2.5	x	10.63	x	0.63	x	0.7] =	8.12	(74)
North	0.9x	0.77	x	2.5	x	20.32	X	0.63	x	0.7	=	15.53	(74)
North	0.9x	0.77	x	2.5	x	34.53	x	0.63	x	0.7	=	26.38	(74)
North	0.9x	0.77	x	2.5	x	55.46	x	0.63	x	0.7	=	42.38	(74)
North	0.9x	0.77	x	2.5	x	74.72	x	0.63	x	0.7	=	57.09	(74)
North	0.9x	0.77	x	2.5	x	79.99	x	0.63	x	0.7	=	61.11	(74)
North	0.9x	0.77	x	2.5	x	74.68	x	0.63	x	0.7	=	57.06	(74)
North	0.9x	0.77	X	2.5	x	59.25	X	0.63	X	0.7	=	45.27	(74)
North	0.9x	0.77	x	2.5	x	41.52	x	0.63	x	0.7	=	31.72	(74)
North	0.9x	0.77	X	2.5	x	24.19	X	0.63	X	0.7	=	18.48	(74)
North	0.9x	0.77	X	2.5	X	13.12	X	0.63	X	0.7	=	10.02	(74)
North	0.9x	0.77	x	2.5	x	8.86	X	0.63	x	0.7	=	6.77	(74)
East	0.9x	1	X	8.1	x	19.64	X	0.63	X	0.7	=	34.1	(76)
East	0.9x	1	x	8.1	x	38.42	X	0.63	X	0.7	=	66.7	(76)
East	0.9x	1	X	8.1	x	63.27	X	0.63	X	0.7	=	109.84	(76)
East	0.9x	1	X	8.1	x	92.28	X	0.63	X	0.7	=	160.2	(76)
East	0.9x	1	x	8.1	x	113.09	X	0.63	X	0.7	=	196.33	(76)
East	0.9x	1	x	8.1	x	115.77	X	0.63	x	0.7	=	200.98	(76)
East	0.9x	1	X	8.1	x	110.22	X	0.63	X	0.7	=	191.34	(76)
East	0.9x	1	x	8.1	x	94.68	X	0.63	X	0.7	=	164.36	(76)
East	0.9x	1	x	8.1	x	73.59	X	0.63	x	0.7	=	127.75	(76)
East	0.9x	1	X	8.1	X	45.59	X	0.63	X	0.7	=	79.14	(76)
East	0.9x	1	x	8.1	X	24.49	X	0.63	x	0.7	=	42.51	(76)
East	0.9x	1	x	8.1	x	16.15	x	0.63	x	0.7	=	28.04	(76)
South	0.9x	0.77	x	2.5	x	46.75	X	0.63	X	0.7	=	35.72	(78)
South	0.9x	0.77	x	2.5	x	76.57	X	0.63	x	0.7	=	58.5	(78)
South	0.9x	0.77	X	2.5	x	97.53	X	0.63	X	0.7	=	74.52	(78)
South	0.9x	0.77	X	2.5	X	110.23	X	0.63	X	0.7	=	84.22	(78)
South	0.9x	0.77	X	2.5	X	114.87	X	0.63	X	0.7	=	87.77	(78)
South	0.9x	0.77	X	2.5	x	110.55	X	0.63	x	0.7	=	84.46	(78)
South	0.9x	0.77	X	2.5	x	108.01	X	0.63	X	0.7	=	82.52	(78)
South	0.9x	0.77	X	2.5	X	104.89	X	0.63	X	0.7	=	80.14	(78)
South	0.9x	0.77	X	2.5	X	101.89	X	0.63	X	0.7	=	77.84	(78)
South	0.9x	0.77	X	2.5	X	82.59	X	0.63	X	0.7	=	63.1	(78)
South	0.9x	0.77	x	2.5	x	55.42	X	0.63	X	0.7	=	42.34	(78)
South	0.9x	0.77	x	2.5	x	40.4	x	0.63	x	0.7	=	30.87	(78)
West	0.9x	0.54	x	14.2	x	19.64	x	0.63	x	0.7	=	59.77	(80)
West	0.9x	0.77	x	10.6	x	19.64	x	0.63	x	0.7	=	63.62	(80)
West	0.9x	0.54	x	14.2	x	38.42	x	0.63	x	0.7	=	116.93	(80)

	_														_		_
West	0.9x	0.77	X	10.	6	X	38	3.42	X	0	.63	X	0.7		= [124.46	(80)
West	0.9x	0.54	X	14.	2	X	63	3.27	X	0	.63	X	0.7		= [192.57	(80)
West	0.9x	0.77	X	10.	6	X	63	3.27	X	0	.63	x	0.7		= [204.97	(80)
West	0.9x	0.54	X	14.	2	X	92	2.28	X	0	.63	X	0.7		= [280.85	(80)
West	0.9x	0.77	X	10.	6	X	92	2.28	x	0	.63	X	0.7		= [298.94	(80)
West	0.9x	0.54	X	14.	2	X	11:	3.09	X	0	.63	X	0.7		= [344.19	(80)
West	0.9x	0.77	X	10.	6	X	11:	3.09	x	0	.63	x	0.7		= [366.36	(80)
West	0.9x	0.54	X	14.	2	X	11	5.77	x	0	.63	X	0.7		= [352.34	(80)
West	0.9x	0.77	X	10.	6	X	11	5.77	x	0	.63	X	0.7		= [375.04	(80)
West	0.9x	0.54	X	14.	2	X	110	0.22	x	0	.63	X	0.7		= [335.44	(80)
West	0.9x	0.77	X	10.	6	X	110	0.22	x	0	.63	X	0.7		= [357.05	(80)
West	0.9x	0.54	X	14.	2	X	94	1.68	x	0	.63	X	0.7		= [288.14	(80)
West	0.9x	0.77	x	10.	6	X	94	1.68	x	0	.63	x	0.7		= [306.7	(80)
West	0.9x	0.54	x	14.	2	X	73	3.59	x	0	.63	x	0.7	司	= [223.96	(80)
West	0.9x	0.77	x	10.	6	X	73	3.59	x	0	.63	х	0.7		= [238.39	(80)
West	0.9x	0.54	x	14.	2	X	45	5.59	x	0	.63	x	0.7		=	138.75	(80)
West	0.9x	0.77	x	10.	6	X	45	5.59	x	0	.63	x	0.7	司	= [147.69	(80)
West	0.9x	0.54	x	14.	2	X	24	1.49	x	0	.63	х	0.7		= [74.53	(80)
West	0.9x	0.77	x	10.	6	X	24	1.49	x	0	.63	x	0.7		= [79.33	(80)
West	0.9x	0.54	x	14.	2	X	16	6.15	x	0	.63	x	0.7	司	= [49.16	(80)
West	0.9x	0.77	x	10.	6	X	16	6.15	x	0	.63	x	0.7		= [52.32	(80)
	_														•		
Solar o	ains in	watts, cald	culated	for each	n month	1			(83)m	n = Sum	(74)m	(82)m					
(83)m=	201.34	382.12	608.29	866.59	1051.74	10	73.93	1023.42	884	.61 6	99.67	447.16	248.74	167.1	15		(83)
Total g	ains – i	nternal an	d solar	(84)m =	: (73)m	+ (8	83)m ,	watts		•							
(84)m=	797.34	975.75	1181.9	1407.36	1558.01	15	47.89	1476.97	1344	1.94 1	177.4	957.97	797.61	745.6	67		(84)
7. Me	an inter	nal tempe	rature ((heating	seasor	า)											
		during he		•			area fr	om Tab	ole 9,	, Th1 ((°C)				[21	(85)
Utilisa	ation fac	tor for gai	ns for li	iving are	a, h1,n	า (ร	ee Tab	ole 9a)							L		J
	Jan	Feb	Mar	Apr	May	Ĺ	Jun	Jul	A	ug	Sep	Oct	Nov	De	c		
(86)m=	1	1	0.99	0.97	0.87	(0.67	0.49	0.5	56	0.86	0.99	1	1			(86)
Mean	interna	l temperat	ture in I	iving are	ea T1 (f	ollo	w step	s 3 to 7	' in T	able 9)c)			•			
(87)m=	19.9		20.31	20.64	20.88	$\overline{}$	0.98	21	2			20.58	20.18	19.8	9		(87)
Tomo	oratura	during he	ating n	oriode in	roct of	- dv	ollina t	from To	ا مام) Th2	(°C)		Į.	<u> </u>			
(88)m=	20.15		20.16	20.17	20.18	_	20.19	20.19	20.		` 	20.18	20.17	20.1	6		(88)
		<u> </u>								-							` ,
		tor for gain				$\overline{}$	$\overline{}$		9a) 0.4	17	0.70	0.00	1 1	1	_		(89)
(89)m=	1	1	0.99	0.96	0.83		0.59	0.4			0.79	0.98	1	1			(03)
		l temperat				Ť	<u> </u>		·			<u> </u>	1	I	_		(05)
(90)m=	18.66	18.88	19.25	19.74	20.06	2	0.18	20.19	20.	19 2	20.12	19.66		18.6	5		(90)
											†L/	A = LIV	ing area ÷ (4	+) =	l	0.33	(91)
							\ (1										

Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m= 1	9.07 19.	27 19.6	20.03	20.33	20.44	20.46	20.46	20.38	19.96	19.44	19.05		(92)
	<u> </u>	to the mea	n interna	l I temper	ature fro	m Table	4e, whe	ere appro	priate	ļ	<u> </u>		
· · · · · · —	9.07 19.	ı	20.03	20.33	20.44	20.46	20.46	20.38	19.96	19.44	19.05		(93)
8. Space	e heating	requiremer	nt										
		n internal te or for gains			ned at sto	ep 11 of	Table 9l	b, so tha	t Ti,m=(76)m an	d re-calc	ulate	
		eb Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
<u> </u>		or gains, hr		I May	Juli	Jui	Aug	l oeb	Oct	I NOV	Dec		
(94)m=	1 1	<u> </u>	0.95	0.83	0.62	0.43	0.5	0.81	0.98	1	1		(94)
	ains, hm0	! Gm , W = (9	.1 94)m x (8	L 4)m	!	ļ .				!			
	96.9 973	<u>`</u>	- 	1299.61	953.82	640.75	669.04	955.09	941.17	796.39	745.39		(95)
Monthly	average	external ter	nperature	e from Ta	able 8		<u> </u>		<u> </u>				
(96)m=	4.3 4.	9 6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat los	s rate for	mean inter	nal temp	erature,	Lm , W =	=[(39)m :	x [(93)m	– (96)m]		•		
(97)m= 25	93.46 251	3.06 2282	1901.32	1467.87	973.95	642.67	673.28	1055.86	1592.17	2116.52	2567.81		(97)
Space h	eating red	quirement f	or each n	nonth, k	Wh/mon	th = 0.02	24 x [(97)m – (95)m] x (4	1)m			
(98)m= 13	36.64 103	4.38 826.33	402.06	125.19	0	0	0	0	484.35	950.5	1355.88		
							Tota	l per year	(kWh/yeaı	r) = Sum(9	8) _{15,912} =	6515.33	(98)
Space h	eating red	quirement i	n kWh/m²	²/year								34.11	(99)
8c. Spac	ce cooling	requireme	nt										
	Ĭ	ne, July and		See Tal	ble 10b								
	Jan F	eb Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Heat los	s rate Lm	(calculated	dusing 2	5°C inte	nal tem	perature	and ext	ernal ten	nperatur	e from T	able 10)		
(100)m=	0 (0	0	0	1566.67	1233.34	1261.44	0	0	0	0		(100)
Utilisatio	n factor f	or loss hm		1	1	1	r	ı	ı	1			
(101)m=	0 (0	0	0.94	0.98	0.96	0	0	0	0		(101)
		n (Watts) =	` 	`	1		1		1				
(102)m=	0 (0	0		1204.72	l	0	0	0	0		(102)
		calculated	 			-							(402)
(103)m=	0 (0	0	2003.17	Į	1752.62	0	0	0	0	(44)	(103)
•	-	<i>quirement fo</i> o if (104)m			dwelling,	continue	ous (KW	(n) = 0.0	24 X [(10)3)m – (102)m J	x (41)m	
(104)m=	0 (0	0	0	376.85	527.59	401.51	0	0	0	0		
	<u> </u>	!						Total	= Sum((1,0,4)	=	1305.95	(104)
Cooled fra	action							f C =	cooled	area ÷ (4	4) =	0.66	(105)
Intermitte	ncy facto	r (Table 10l	o)										
(106)m=	0 (0	0	0	0.25	0.25	0.25	0	0	0	0		_
•				(404)	(40=)	(400)		Total	l = Sum((104)	=	0	(106)
		uirement for	1	<u> </u>	<u> </u>	``	i			Ι ,			
(107)m=	0 (0	0	0	61.98	86.77	66.03	0 Total	0 - Sum/	0	0	04.4.70	7(407)
0									= Sum(iW/)	=	214.78	(107)
•		irement in	·					` ') ÷ (4) =			1.12	(108)
		ments – Ind	dividual h	eating s	ystems i	ncluding	micro-C	CHP)					
Space h	_	heat from s	2002245	v/oussis	montor	, avatara					ĺ		(201)
FIACHON	or space	neat from 9	secondar	v/Subble	mentarv	system						0	T(ZUT)

Fraction of space heat from main syster	m(s)		(202) = 1	- (201) -			ı	1	(202)
Fraction of total heating from main system	` '		(204) = (2	` '	(203)] =			1	(204)
Efficiency of main space heating system			(, (-	,[.	(/)		[89.9	(206)
Efficiency of secondary/supplementary I		m. %						0] (208)
Cooling System Energy Efficiency Ratio		,						4.32	(209)
Jan Feb Mar Apr	May Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/yea	ar -
Space heating requirement (calculated a	above)							·	
1336.64 1034.38 826.33 402.06 1	125.19 0	0	0	0	484.35	950.5	1355.88		
(211) m = {[(98)m x (204)] } x 100 ÷ (206)	·			.	.	-			(211)
1486.81 1150.59 919.17 447.23 1	139.25 0	0	O Tota	0	538.76	1057.28	1508.21		7(044)
Charachasting fuel (accordant) Islahlam	anth		TOTA	ıı (Kvvn/yea	ar) =Surri(2	2 1 1) _{15,1012}	.	7247.31	(211)
Space heating fuel (secondary), kWh/m= $\{[(98)m \times (201)]\} \times 100 \div (208)$	iontn								
(215)m= 0 0 0 0	0 0	0	0	0	0	0	0		
	•	•	Tota	l (kWh/yea	ar) =Sum(2	215) _{15,1012}	=	0	(215)
Water heating							•		_
Output from water heater (calculated about 220.85 194.56 204.11 182.67 1	ove) 178.79 159.44	152.83	168.11	167.95	189.44	200.69	215.43		
Efficiency of water heater	170.79 133.44	132.03	100.11	107.93	103.44	200.09	210.40	79.8	(216)
	83.67 79.8	79.8	79.8	79.8	86.81	87.96	88.37	70.0	」` ´´´ (217)
Fuel for water heating, kWh/month			1	l	l	l			
$(219)m = (64)m \times 100 \div (217)m$	040.00 400.0	104.54	040.07	040.40	040.00	200.40	243.79		
(219)m= 250.07 220.76 232.74 211.23 2	213.69 199.8	191.51	210.67 Tota	210.46 Il = Sum(2	218.22 19a) =	228.16	243.79	2631.09	(219)
Space cooling fuel, kWh/month.				(7112			2031.03	
(221)m = (107)m÷ (209)									
(221)m= 0 0 0 0	0 14.35	20.09	15.29	0	0	0	0		7
			Tota	ıl = Sum(2	21) ₆₈ =			49.72	(221)
Annual totals Space heating fuel used, main system 1					k'	Wh/year		kWh/year	7
							[7247.31	<u> </u>
Water heating fuel used								2631.09	_
Space cooling fuel used								49.72	_
Electricity for pumps, fans and electric ke	eep-hot								
mechanical ventilation - balanced, extra	act or positive	input fror	n outside	Э			590.53		(230a)
central heating pump:							30		(230c)
boiler with a fan-assisted flue							45		(230e)
Total electricity for the above, kWh/year			sum	of (230a).	(230g) =			665.53	(231)
Electricity for lighting							ļ	584.97	(232)
12a. CO2 emissions – Individual heating	g systems inc	luding mi	cro-CHF				l		

Energy

kWh/year

Emissions

kg CO2/year

Emission factor

kg CO2/kWh

Space heating (main system 1)	(211) x	0.216	=	1565.42	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	568.32	(264)
Space and water heating	(261) + (262) + (263) + (264) =			2133.73	(265)
Space cooling	(221) x	0.519	=	25.8	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	345.41	(267)
Electricity for lighting	(232) x	0.519	=	303.6	(268)
Total CO2, kg/year	sur	m of (265)(271) =		2808.55	(272)
Dwelling CO2 Emission Rate	(27	(2) ÷ (4) =		14.7	(273)
El rating (section 14)				84	(274)



APPENDIX 3. DER WORKSHEET OF TYPICAL APARTMENT – BE GREEN

		User Details:			
Assessor Name: Software Name:	Alexandros Kazantzis Stroma FSAP 2012	Stroma Nu Software V		0030219 on: 1.0.3.15	
Continuity in the second		operty Address: Apt 1			
Address :	Flat 1, 26 Netherhall Gardens	· · · · · ·			
Overall dwelling dime	·	, ,			
		Area(m²)	Av. Height(m)	Volume(m ³	³)
Basement		113.7 (1a) x	3.2 (2a) =	363.84	(3a)
Ground floor		77.3 (1b) x	3 (2b) =	231.9	(3b)
Total floor area TFA = (1a	a)+(1b)+(1c)+(1d)+(1e)+(1n)	191 (4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+(3n) =	595.74	(5)
2. Ventilation rate:					
	main secondary heating heating	other	total	m³ per hou	ır
Number of chimneys	0 + 0	+ 0 =	0 x 40 =	0	(6a)
Number of open flues	0 + 0	+ 0 =	0 x 20 =	0	(6b)
Number of intermittent fa	ns	<u> </u>	0 x 10 =	0	(7a)
Number of passive vents			0 x 10 =	0	(7b)
Number of flueless gas fi	res		0 x 40 =	0	(7c)
				hanges per ho	_
•	ys, flues and fans = $(6a)+(6b)+(7a)$ een carried out or is intended, proceed it		0	0	(8)
Number of storeys in the		to (17), otherwise continue	110111 (9) 10 (10)	0	(9)
Additional infiltration	io arrolling (ilo)		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0	.25 for steel or timber frame or 0).35 for masonry cons		0	(11)
	resent, use the value corresponding to t				` ′
If suspended wooden f	loor, enter 0.2 (unsealed) or 0.1	(sealed), else enter	0	0	(12)
If no draught lobby, en	ter 0.05, else enter 0			0	(13)
Percentage of windows	s and doors draught stripped			0	(14)
Window infiltration		0.25 - [0.2 x (14) -	+ 100] =	0	(15)
Infiltration rate		(8) + (10) + (11) +	(12) + (13) + (15) =	0	(16)
Air permeability value,	q50, expressed in cubic metres	per hour per square	metre of envelope area	4	(17)
If based on air permeabil	ity value, then $(18) = [(17) \div 20] + (8)$, otherwise $(18) = (16)$		0.2	(18)
Air permeability value applie	s if a pressurisation test has been done	or a degree air permeabili	ty is being used		_
Number of sides sheltere	d	(22)		4	(19)
Shelter factor		$(20) = 1 - [0.075 \times 0.000]$		0.7	(20)
Infiltration rate incorporat		$(21) = (18) \times (20)$	=	0.14	(21)
Infiltration rate modified for			, , , , , , , , , , , , , , , , , , , 	7	
Jan Feb	Mar Apr May Jun	Jul Aug Ser	Oct Nov Dec		
Monthly average wind sp	eed from Table 7			_	

4.9

4.4

4.3

3.8

3.8

3.7

4.3

4.5

4.7

5

Wind Factor (22a)m = (1			1	1	
(22a)m= 1.27 1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18		
Adjusted infiltration rate	e (allowi	ng for sh	nelter an	d wind s	speed) =	(21a) x	(22a)m					
0.18 0.18	0.17	0.15	0.15	0.13	0.13	0.13	0.14	0.15	0.16	0.16		
Calculate effective air of the control of the contr	•	rate for t	he appli	cable ca	se						0.5	(23a)
If exhaust air heat pump u		endix N, (2	3b) = (23a	a) × Fmv (e	equation (N	N5)) , othe	rwise (23b) = (23a)			0.5	(23b)
If balanced with heat reco	very: effic	iency in %	allowing f	or in-use f	actor (fron	n Table 4h) =				79.05	(23c)
a) If balanced mecha	anical ve	entilation	with hea	at recove	ery (MVI	HR) (24a	a)m = (2	2b)m + (23b) × [1 – (23c)		`` ′
(24a)m= 0.28 0.28	0.28	0.26	0.26	0.24	0.24	0.23	0.24	0.26	0.26	0.27]	(24a)
b) If balanced mecha	anical ve	entilation	without	heat rec	covery (N	лV) (24b)m = (22	2b)m + (23b)	•	-	
(24b)m= 0 0	0	0	0	0	0	0	0	0	0	0		(24b)
c) If whole house ext	ract ven	tilation o	or positiv	e input v	ventilatio	on from c	outside	-	-		-	
if (22b)m < 0.5 ×	(23b), t	hen (24d	c) = (23b)); other	vise (24	c) = (22k	o) m + 0.	5 × (23b)	,	1	
(24c)m = 0 0	0	0	0	0	0	0	0	0	0	0		(24c)
d) If natural ventilationif (22b)m = 1, the				•				0.51				
(24d)m = 0 0	0	0	0	0	0	0.5 + [(2	0	0.5]	0	0	1	(24d)
Effective air change	rate - er	ter (24a		o) or (24)	c) or (24	d) in box	(25)	<u> </u>			J	, ,
(25)m= 0.28 0.28	0.28	0.26	0.26	0.24	0.24	0.23	0.24	0.26	0.26	0.27	1	(25)
		l .										
0	-4 l ·										•	
3. Heat losses and he	•			Not Ar	.02	اويدا ا	10	Λ Υ Ι Ι		kayalıy		1 Y L
3. Heat losses and he ELEMENT Gros area	s	oaramete Openin m	gs	Net Ar A ,r		U-valı W/m2		A X U (W/		k-value kJ/m²·		A X k kJ/K
ELEMENT Gros	s	Openin	gs		m²		K					
ELEMENT Gros	s	Openin	gs	A ,r	m² x1.	W/m2	K 0.04] =	(W/				kJ/K
ELEMENT Gros area Windows Type 1	s	Openin	gs	A ,r	m ² x ¹	W/m2 /[1/(1.4)+	K $0.04] = \begin{bmatrix} 0.04 \end{bmatrix} = \begin{bmatrix} 0.04 \end{bmatrix}$	(W/				(27)
ELEMENT Gros area Windows Type 1 Windows Type 2	s	Openin	gs	A ,r	m² x10 x10 x10	W/m2 /[1/(1.4)+ /[1/(1.4)+	$ \begin{array}{c} \text{K} \\ 0.04] = \\ 0.04] = \\ 0.04] = \\ \end{array} $	18.83				(27) (27)
ELEMENT Gros area Windows Type 1 Windows Type 2 Windows Type 3	s	Openin	gs	A ,r 14.2 8.1 10.6	m ² x1. x1. x1. x1. x1.	W/m2 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+	(No.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04]	18.83 10.74 14.05				(27) (27) (27) (27)
ELEMENT Gros area Windows Type 1 Windows Type 2 Windows Type 3 Windows Type 4	s	Openin	gs	A ,r 14.2 8.1 10.6 2.5	x1.	W/m2 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+	(No.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04]	18.83 10.74 14.05 3.31	K)			(27) (27) (27) (27) (27)
ELEMENT Gros area Windows Type 1 Windows Type 2 Windows Type 3 Windows Type 4 Windows Type 5	s	Openin	gs	A ,r 14.2 8.1 10.6 2.5 2.5	x1.	W/m2 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+	(K) 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04]	(W// 18.83 10.74 14.05 3.31 3.31	K)			(27) (27) (27) (27) (27) (27)
ELEMENT Gros area Windows Type 1 Windows Type 2 Windows Type 3 Windows Type 4 Windows Type 5 Floor Type 1	s (m²)	Openin	gs ²	A ,r 14.2 8.1 10.6 2.5 2.5 110.3	x1. x1. x1. x1. x1. x1. x1. x1. x1.	W/m2 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+	(K) 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04]	(W// 18.83 10.74 14.05 3.31 3.31	K)			(27) (27) (27) (27) (27) (27) (28)
Windows Type 1 Windows Type 2 Windows Type 3 Windows Type 4 Windows Type 5 Floor Type 1 Floor Type 2	s (m²)	Openin m	gs ²	A ,r 14.2 8.1 10.6 2.5 2.5 110.3 5.5	x1. x1. x1. x1. x1. x1. x1. x1. x1.	W/m2 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ 0.15	(K 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = = = =	(W// 18.83 10.74 14.05 3.31 3.31 16.545 0.825	K)			(27) (27) (27) (27) (27) (27) (28) (28)
Windows Type 1 Windows Type 2 Windows Type 3 Windows Type 4 Windows Type 5 Floor Type 1 Floor Type 2 Walls Type1	s (m²)	Openin m	gs ²	A ,r 14.2 8.1 10.6 2.5 2.5 110.3 5.5	x1.	W/m2 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ 0.15 0.15	0.04] = 0.04] = 0.04] = 0.04] = 0.04] = = = =	(W// 18.83 10.74 14.05 3.31 3.31 16.545 0.825	K)			(27) (27) (27) (27) (27) (27) (28) (28) (29)
Windows Type 1 Windows Type 2 Windows Type 3 Windows Type 4 Windows Type 5 Floor Type 1 Floor Type 2 Walls Type1 Malls Type2 86.7	s (m²)	22.3 15.6	gs 2	A ,r 14.2 8.1 10.6 2.5 2.5 110.3 5.5 104.7 71.1 329.5	x1.	W/m2 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ 0.15 0.15 0.18	0.04] = 0.04] = 0.04] = 0.04] = 0.04] = = = =	(W// 18.83 10.74 14.05 3.31 3.31 16.545 0.825 18.85	K)	kJ/m²-	K !	(27) (27) (27) (27) (27) (28) (28) (29) (29)
Windows Type 1 Windows Type 2 Windows Type 3 Windows Type 4 Windows Type 5 Floor Type 1 Floor Type 2 Walls Type1 127 Walls Type2 86.7 Total area of elements, * for windows and roof windows include the areas on both in the sarea.	m ² , m ² wws, use e	22.3 15.6 effective winternal wall	gs 2 ndow U-va	A ,r 14.2 8.1 10.6 2.5 2.5 110.3 5.5 104.7 71.1 329.5 alue calculations	x1.	W/m2 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ 0.15 0.15 0.18	0.04] = 0.04] = 0.04] = 0.04] = 0.04] = = = =	(W// 18.83 10.74 14.05 3.31 3.31 16.545 0.825 18.85	K)	kJ/m²-	K !	(27) (27) (27) (27) (27) (28) (28) (29) (29) (31)
Windows Type 1 Windows Type 2 Windows Type 3 Windows Type 4 Windows Type 5 Floor Type 1 Floor Type 2 Walls Type1 Valls Type2 Total area of elements, * for windows and roof windows include the areas on both Fabric heat loss, W/K =	m ² , m ² ows, use e sides of interest of the sides of	22.3 15.6 effective winternal wall	gs 2 ndow U-va	A ,r 14.2 8.1 10.6 2.5 2.5 110.3 5.5 104.7 71.1 329.5 alue calculations	x1.	W/m2 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ 0.15 0.15 0.18	(No.04] =	(W// 18.83 10.74 14.05 3.31 3.31 16.545 0.825 18.85 12.8	K)	kJ/m²-	K !	(27) (27) (27) (27) (27) (28) (28) (29) (29) (31)
Windows Type 1 Windows Type 2 Windows Type 3 Windows Type 3 Windows Type 4 Windows Type 5 Floor Type 1 Floor Type 2 Walls Type1 Total area of elements, * for windows and roof windo ** include the areas on both Fabric heat loss, W/K = Heat capacity Cm = S(m ² , m ² ws, use esides of interest (A x A x k)	22.3 15.6 affective winternal walk	gs 2 ndow U-va ds and pan	A ,r 14.2 8.1 10.6 2.5 2.5 110.3 5.5 104.7 71.1 329.5 alue calculatitions	x1.	W/m2 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ 0.15 0.15 0.18	0.04] = 0.04] = 0.04] = 0.04] = 0.04] = = = = (1/U-value) + (32) = ((28).	(W// 18.83 10.74 14.05 3.31 3.31 16.545 0.825 18.85 12.8 (e)+0.04] &	K)	kJ/m²-	99.26 38915.5	(27) (27) (27) (27) (27) (28) (28) (29) (29) (31)
Windows Type 1 Windows Type 2 Windows Type 3 Windows Type 4 Windows Type 5 Floor Type 1 Floor Type 2 Walls Type1 Total area of elements, * for windows and roof windo ** include the areas on both Fabric heat loss, W/K = Heat capacity Cm = S(Thermal mass parameter	m ² , m ² ws, use e sides of interest (TMF)	22.3 15.6 Iffective winternal walk U) P = Cm ÷	gs 2 ndow U-va ds and pan	A ,r 14.2 8.1 10.6 2.5 2.5 110.3 5.5 104.7 71.1 329.5 alue calculatitions	x1.	W/m2 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ 0.15 0.15 0.18 0.18	0.04] = 0.04] = 0.04] = 0.04] = 0.04] = = = = (1/U-value) + (32) = ((28). Indical	(W// 18.83 10.74 14.05 3.31 3.31 16.545 0.825 18.85 12.8 (a) +0.04] & (a) (a) (b) (b) (c) (c) (c) (c) (c) (c) (c) (c) (c) (c	(K)	kJ/m²-	n 3.2	(27) (27) (27) (27) (27) (28) (28) (29) (29) (31)
Windows Type 1 Windows Type 2 Windows Type 3 Windows Type 3 Windows Type 4 Windows Type 5 Floor Type 1 Floor Type 2 Walls Type1 Total area of elements, * for windows and roof windo ** include the areas on both Fabric heat loss, W/K = Heat capacity Cm = S(m² m² ows, use e sides of in a S (A x A x k) ter (TMF ere the de	22.3 15.6 15.6 Iffective wind ternal walk U) P = Cm : tails of the	gs 2 ndow U-va ds and pan	A ,r 14.2 8.1 10.6 2.5 2.5 110.3 5.5 104.7 71.1 329.5 alue calculatitions	x1.	W/m2 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ 0.15 0.15 0.18 0.18	0.04] = 0.04] = 0.04] = 0.04] = 0.04] = = = = (1/U-value) + (32) = ((28). Indical	(W// 18.83 10.74 14.05 3.31 3.31 16.545 0.825 18.85 12.8 (a) +0.04] & (a) (a) (b) (b) (c) (c) (c) (c) (c) (c) (c) (c) (c) (c	(K)	kJ/m²-	99.26 38915.5	(27) (27) (27) (27) (27) (28) (28) (29) (29) (31)

	ممط مدا	4 laaa aa	ام مغمل بما	الطاهرة مسا						(36) =	OE) ·- (E)		119.93	(37
entilat F			alculated		<u> </u>				· ,	= 0.33 × (· · · ·			
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		(0)
8)m=	55.69	55	54.31	50.87	50.18	46.74	46.74	46.05	48.12	50.18	51.56	52.93		(38
eat tra	ansfer c	oefficier	nt, W/K						(39)m	= (37) + (3	38)m			
9)m=	175.61	174.92	174.24	170.8	170.11	166.67	166.67	165.98	168.04	170.11	171.48	172.86		_
() .		(/1	II D\ \\							Average =		12 /12=	170.62	(3
г	_		HLP), W/		0.00	0.07	0.07	0.07	` ′	= (39)m ÷	`	0.01		
0)m=	0.92	0.92	0.91	0.89	0.89	0.87	0.87	0.87	0.88	0.89	0.9	0.91	0.00	\ (4
umbe	r of dav	s in mor	nth (Tab	e 1a)					,	Average =	Sum(40) ₁	12 / 12=	0.89	(4
Γ	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
1)m=	31	28	31	30	31	30	31	31	30	31	30	31		(4
' L							1							•
4 207												1.56/1./		
ı. vva	ter neat	ing ener	gy requi	rement:								kWh/ye	ear:	
		pancy, N										.99		(4
			+ 1.76 x	[1 - exp	(-0.0003	849 x (TI	FA -13.9)2)] + 0.0	0013 x (ΓFA -13.	9)	·		
	4 £ 13.9	•	.40			\/ d		(OF 1/ NI)	. 20			1		
	_			•	•	•	erage = designed t	` ,		se target o		5.22		(4
		-	oerson per			-	•			Ü				
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
ot wate	r usage ir	litres per	day for ea			ctor from	Table 1c x	•	•					
4)m=	115.74	111.53	107.32	103.11	98.9	94.7	94.7	98.9	103.11	107.32	111.53	115.74		
L					I	I.					l	-		
									-	Total = Su	m(44) ₁₁₂ =	=	1262.61	(4
nergy c	ontent of	hot water	used - cal	culated mo	onthly $= 4$.	190 x Vd,ı	m x nm x D	0Tm / 3600			(/ /	L	1262.61	(4
	ontent of 171.64	hot water 150.12	used - cal	culated mo	onthly = 4.	190 x Vd,r	n x nm x D	0Tm / 3600 118.9			(/ /	L	1262.61	(4
5)m=	171.64	150.12	154.91	135.05	129.58	111.82	103.62	118.9	120.32	nth (see Ta	ables 1b, 1	c, 1d)	1262.61 1655.48	」 `
5)m=	171.64	150.12	154.91	135.05	129.58	111.82		118.9	120.32	140.23	ables 1b, 1	c, 1d)		」 `
5)m= [instanta 6)m= [171.64 aneous w 25.75	150.12 ater heatir 22.52	154.91	135.05	129.58	111.82	103.62	118.9	120.32	140.23	ables 1b, 1	c, 1d)		(4
5)m= [instanta 6)m= [dater s	171.64 aneous w	150.12 ater heatir 22.52 loss:	154.91 ng at point 23.24	135.05 of use (no	129.58 hot water 19.44	111.82 storage),	103.62 enter 0 in	118.9 boxes (46,	120.32 10 to (61) 18.05	140.23 Total = Su 21.03	153.07 m(45) ₁₁₂ =	c, 1d) 166.22 = 24.93		(4
5)m= [instanta 6)m= [dater setorage	171.64 aneous w 25.75 storage	ater heatin 22.52 loss: e (litres)	154.91 ng at point 23.24 includin	135.05 of use (no 20.26 g any so	129.58 hot water 19.44 plar or W	111.82 r storage), 16.77 /WHRS	103.62 enter 0 in 15.54 storage	118.9 boxes (46) 17.84 within sa	120.32 10 to (61) 18.05	140.23 Total = Su 21.03	153.07 m(45) ₁₁₂ =	(c, 1d)		(2
5)m= [instanta 6)m= [/ater s torage	171.64 aneous w 25.75 storage volumenunity h	ater heating 22.52 loss: e (litres) eating a	154.91 ng at point 23.24 includin nd no ta	135.05 of use (not) 20.26 g any so	129.58 hot water 19.44 clar or W yelling, e	111.82 r storage), 16.77 /WHRS nter 110	enter 0 in 15.54 storage	118.9 boxes (46, 17.84 within sa (47)	120.32 1 to (61) 18.05	140.23 Total = Sur 21.03	153.07 m(45) ₁₁₂ =	c, 1d) 166.22 = 24.93		(4
5)m= [instanta 6)m= [later s torage comm therw	aneous w 25.75 storage volum- nunity h ise if no	ater heating 22.52 loss: e (litres) eating a stored	154.91 ng at point 23.24 includin nd no ta	135.05 of use (not) 20.26 g any so	129.58 hot water 19.44 clar or W yelling, e	111.82 r storage), 16.77 /WHRS nter 110	103.62 enter 0 in 15.54 storage	118.9 boxes (46, 17.84 within sa (47)	120.32 1 to (61) 18.05	140.23 Total = Sur 21.03	153.07 m(45) ₁₁₂ =	c, 1d) 166.22 = 24.93		(4
5)m= [instanta 6)m= [/ater s torage comm therw /ater s	aneous w 25.75 storage e volum- nunity h ise if no	ater heatin 22.52 loss: e (litres) eating a stored loss:	154.91 ng at point 23.24 includin nd no ta hot wate	of use (no 20.26 g any so nk in dw er (this in	129.58 to hot water 19.44 Dlar or Welling, e	111.82 storage), 16.77 /WHRS nter 110	enter 0 in 15.54 storage 0 litres in	118.9 boxes (46, 17.84 within sa (47)	120.32 1 to (61) 18.05	140.23 Total = Sur 21.03	153.07 m(45) ₁₁₂ = 22.96	c, 1d) 166.22 = 24.93		(4)
5)m= [instanta 6)m= ['ater s torage comm therw 'ater s) If ma	aneous w 25.75 storage e volum- nunity h ise if no storage anufactor	ater heatin 22.52 loss: e (litres) eating a stored loss: urer's de	154.91 ag at point 23.24 includin nd no ta hot wate	of use (not 20.26) g any sonk in dwer (this in coss factors)	129.58 to hot water 19.44 Dlar or Welling, e	111.82 storage), 16.77 /WHRS nter 110	enter 0 in 15.54 storage 0 litres in	118.9 boxes (46, 17.84 within sa (47)	120.32 1 to (61) 18.05	140.23 Total = Sur 21.03	153.07 m(45) ₁₁₂ = 22.96	c, 1d) 166.22 24.93 150		(4)
instanta ins	25.75 storage e voluments if no storage anufactorage rature fa	ater heating 22.52 loss: e (litres) eating a stored loss: urer's deactor from	154.91 ag at point 23.24 includin nd no ta hot wate eclared lo	of use (not 20.26) g any sonk in dwer (this in coss factor 2b	129.58 to hot water 19.44 colar or Water velling, encludes in the column of the colu	111.82 storage), 16.77 /WHRS nter 110	enter 0 in 15.54 storage litres in neous co	118.9 boxes (46, 17.84 within sa (47) mbi boil	120.32 10 to (61) 18.05 18.05 18.05 18.05	140.23 Total = Sur 21.03	22.96 27 20.96	c, 1d) 166.22 24.93 150 55 54		
instanta 6)m= [/ater s torage comm therw /ater s) If ma	25.75 storage e volumentity he ise if no storage anufactorature fallost from the control of the	ater heating 22.52 loss: e (litres) eating a stored loss: urer's deactor from water	154.91 ag at point 23.24 includin nd no ta hot wate eclared le m Table storage	of use (not 20.26) g any sonk in dwer (this in coss factor 2b, kWh/ye	129.58 hot water 19.44 clar or W velling, encludes i	111.82 r storage), 16.77 /WHRS nter 110 nstantar	enter 0 in 15.54 storage litres in neous co	118.9 boxes (46, 17.84 within sa (47)	120.32 10 to (61) 18.05 18.05 18.05 18.05	140.23 Total = Sur 21.03	22.96 27 20.96	c, 1d) 166.22 24.93 150		(4)
instanta instanta instanta identalia	25.75 storage e voluments if no storage anufaction rature familiarity for anufaction anu	ater heatin 22.52 loss: e (litres) eating a stored loss: urer's de actor from water urer's de	154.91 ag at point 23.24 includin nd no ta hot wate eclared lo	of use (not) 20.26 g any so nk in dw er (this in) coss facto 2b , kWh/ye	129.58 hot water 19.44 Dlar or W velling, encludes it or is known is kno	111.82 storage), 16.77 /WHRS nter 110 nstantar wn (kWh	enter 0 in 15.54 storage 0 litres in neous con/day):	118.9 boxes (46, 17.84 within sa (47) mbi boil	120.32 10 to (61) 18.05 18.05 18.05 18.05	140.23 Total = Sur 21.03	22.96 27 20 20 20 20 20 20 20 20 20 20 20 20 20	c, 1d) 166.22 24.93 150 55 54		(4)
instanta ins	25.75 storage e volumentation for a volumentat	ater heatin 22.52 loss: e (litres) eating a o stored loss: urer's de actor from m water urer's de	154.91 ag at point 23.24 includin nd no ta hot wate eclared le m Table storage eclared of	of use (not 20.26) g any so nk in dwar (this in 25 factor 25, kWh/ye cylinder loom Table	129.58 hot water 19.44 Dlar or W velling, encludes it or is known is kno	111.82 storage), 16.77 /WHRS nter 110 nstantar wn (kWh	enter 0 in 15.54 storage 0 litres in neous con/day):	118.9 boxes (46, 17.84 within sa (47) mbi boil	120.32 10 to (61) 18.05 18.05 18.05 18.05	140.23 Total = Sur 21.03	22.96 27 20 20 20 20 20 20 20 20 20 20 20 20 20	c, 1d) 166.22 24.93 150 55 54		(4)
instanta ins	25.75 storage e volumentative if no storage anufactive fature fature fature fature fature ter storage anufactive rature fature f	ater heatin 22.52 loss: e (litres) eating a o stored loss: urer's de actor from m water urer's de	including at point 23.24 including at no tale and to tale at a storage eclared of factor free sections.	of use (not 20.26) g any so nk in dwar (this in 25 factor 25, kWh/ye cylinder loom Table	129.58 hot water 19.44 Dlar or W velling, encludes it or is known is kno	111.82 storage), 16.77 /WHRS nter 110 nstantar wn (kWh	enter 0 in 15.54 storage 0 litres in neous con/day):	118.9 boxes (46, 17.84 within sa (47) mbi boil	120.32 10 to (61) 18.05 18.05 18.05 18.05	140.23 Total = Sur 21.03	ables 1b, 1 153.07 m(45)112 = 22.96 47) 0.0	c, 1d) 166.22 24.93 150 55 54		(4)
instanta ins	25.75 storage e voluments if no storage anufaction anufaction anufaction anufaction is to anufaction anufaction anufaction is to anufaction anufaction anufaction anufaction is factor in the factor is to anufaction and anufaction and anufaction and anufaction and anufaction and anufaction anufaction and anufaction an	ater heatin 22.52 loss: e (litres) eating a o stored loss: urer's de actor fro m water urer's de age loss eating s from Tal	including at point 23.24 including at no tale and to tale at a storage eclared of factor free sections.	of use (not 20.26) g any sonk in dwer (this in 25), kWh/ye cylinder loom Table on 4.3	129.58 hot water 19.44 Dlar or W velling, encludes it or is known is kno	111.82 storage), 16.77 /WHRS nter 110 nstantar wn (kWh	enter 0 in 15.54 storage 0 litres in neous con/day):	118.9 boxes (46, 17.84 within sa (47) mbi boil	120.32 10 to (61) 18.05 18.05 18.05 18.05	140.23 Total = Sur 21.03	ables 1b, 1 153.07 m(45)112 = 22.96 47)	c, 1d) 166.22 24.93 150 54 84		(4)
instanta 6)m= [/ater s torage comm therw /ater s) If ma emper of wat comm olume	25.75 storage e volumentative factorage anufactorature factorature	ater heating 22.52 loss: e (litres) eating a stored loss: urer's defactor from water urer's defage loss eating s from Talactor from	including at point 23.24 including at point and no tale and the storage eclared of factor free sections at point 2a.	of use (not 20.26) g any sonk in dwer (this in 2b), kWh/ye cylinder loom Table on 4.3	129.58 hot water 19.44 clar or W yelling, e ncludes i or is kno ear loss fact	111.82 storage), 16.77 /WHRS nter 110 nstantar wn (kWh	enter 0 in 15.54 storage 0 litres in neous con/day): known:	118.9 boxes (46, 17.84 within sa (47) mbi boil	120.32 120.32 1 to (61) 18.05 ame vess	140.23 Total = Su 21.03 sel er '0' in (ables 1b, 1 153.07 m(45)112 = 22.96 47) 0.	c, 1d) 166.22 24.93 150 55 54 84 0		(4 (4 (4 (5) (5) (5)

Water storage	loss cal	culated f	for each	month			((56)m = (55) × (41)	m				
(56)m= 25.95	23.44	25.95	25.11	25.95	25.11	25.95	25.95	25.11	25.95	25.11	25.95		(56)
If cylinder contain	I ns dedicate	l d solar sto	<u>l</u> rage, (57)։		x [(50) – (<u>I</u> H11)] ÷ (5	1 0), else (5	<u>I</u> 7)m = (56)	n where (H11) is fro	n Append	l ix H	
(57)m= 25.95	23.44	25.95	25.11	25.95	25.11	25.95	25.95	25.11	25.95	25.11	25.95		(57)
Primary circui	t loss (ar	nual) fro	m Table	3	-	-	-	-	-		0		(58)
Primary circui	•	,			59)m = ((58) ÷ 36	65 × (41)	m					
(modified b	y factor f	rom Tab	le H5 if t	here is s	solar wat	ter heatii	ng and a	cylinde	r thermo	stat)			
(59)m= 23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)
Combi loss ca	alculated	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 heat red	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= 220.85	194.56	204.11	182.67	178.79	159.44	152.83	168.11	167.95	189.44	200.69	215.43		(62)
Solar DHW input	calculated	using App	endix G or	Appendix	H (negati	ve quantity	/) (enter '0	' if no sola	r contribut	ion to wate	er heating)	•	
(add additiona	al lines if	FGHRS	and/or V	VWHRS	applies	, see Ap	pendix (3)					
(63)m= 0	0	0	0	0	0	0	0	0	0	0	0		(63)
Output from v	ater hea	ter			-	-	-	-	-	-	-		
(64)m= 220.85	194.56	204.11	182.67	178.79	159.44	152.83	168.11	167.95	189.44	200.69	215.43		
	•	•					Outp	out from w	ater heate	r (annual) ₁	12	2234.88	(64)
Heat gains fro	m water	heating,	kWh/mo	onth 0.2	5 ´ [0.85	× (45)m	+ (61)m	n] + 0.8 x	κ [(46)m	+ (57)m	+ (59)m]	
(65)m= 96.44	85.47	90.87	83	82.45	75.28	73.82	70.0		05.00	I			(CE)
		00.07	03	02.43	75.20	13.62	78.9	78.11	85.99	88.99	94.64		(65)
include (57	m in cal		ļ.		<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	ļ		eating	(65)
,		culation o	of (65)m	only if c	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	ļ		eating	(65)
5. Internal g	ains (see	culation of Table 5	of (65)m and 5a	only if c	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	ļ		eating	(65)
,	ains (see	culation of Table 5	of (65)m and 5a ts	only if c	<u> </u>	<u> </u>	dwelling	or hot w	<u> </u>	ļ	munity h	eating	(65)
5. Internal g	ains (see	culation of Table 5	of (65)m and 5a	only if c	ylinder i	s in the o	<u> </u>	<u> </u>	ater is fr	rom com		eating	(66)
5. Internal g Metabolic gai Jan (66)m= 149.51	ains (see ns (Table Feb 149.51	e Table 5 e 5), Wat Mar	of (65)m 5 and 5a ts Apr 149.51	only if constant of the consta	Jun 149.51	Jul 149.51	Aug 149.51	or hot w Sep 149.51	ater is fr	om com	munity h	eating	
5. Internal g Metabolic gai	ains (see ns (Table Feb 149.51	e Table 5 e 5), Wat Mar	of (65)m 5 and 5a ts Apr 149.51	only if constant of the consta	Jun 149.51	Jul 149.51	Aug 149.51	or hot w Sep 149.51	ater is fr	om com	munity h	eating	
5. Internal g Metabolic gai Jan (66)m= 149.51 Lighting gains (67)m= 33.12	ains (see ns (Table Feb 149.51 c (calcula 29.42	Example 5 to the collection of	of (65)m 6 and 5a ts Apr 149.51 opendix 18.11	May 149.51 L, equat	Jun 149.51 ion L9 o	Jul 149.51 r L9a), a	Aug 149.51 Iso see	Sep 149.51 Table 5 21.55	Oct 149.51	Nov	Dec	eating	(66)
5. Internal g Metabolic gai Jan (66)m= 149.51 Lighting gains (67)m= 33.12 Appliances ga	ains (see ns (Table Feb 149.51 (calcula 29.42	culation of Table 5 (a) Wat Mar 149.51 ted in Ap 23.93	ts Apr 149.51 ppendix 18.11 Append	May 149.51 L, equat 13.54 dix L, eq	Jun 149.51 ion L9 o 11.43 uation L	Jul 149.51 r L9a), a 12.35 13 or L1	Aug 149.51 Iso see 16.06 3a), also	Sep 149.51 Table 5 21.55 see Ta	Oct 149.51 27.36 ble 5	Nov	Dec 149.51	eating	(66)
5. Internal g Metabolic gai Jan (66)m= 149.51 Lighting gains (67)m= 33.12 Appliances ga (68)m= 362.41	res (Table Feb 149.51 (calcula 29.42 ains (calcula 366.17	culation of Table 5 (a) Wat Mar 149.51 ted in Ap 23.93 culated in 356.69	of (65)m 5 and 5a ts Apr 149.51 opendix 18.11 Appendix 336.52	May 149.51 L, equat 13.54 dix L, eq 311.05	Jun 149.51 ion L9 of 11.43 uation L 287.12	Jul 149.51 r L9a), a 12.35 13 or L1 271.13	Aug 149.51 Iso see 16.06 3a), also	Sep 149.51 Table 5 21.55 see Ta	Oct 149.51 27.36 ble 5 297.02	Nov 149.51 31.94	Dec	eating	(66) (67)
5. Internal g Metabolic gai Jan (66)m= 149.51 Lighting gains (67)m= 33.12 Appliances ga	res (Table Feb 149.51 (calcula 29.42 ains (calcula 366.17	culation of Table 5 (a) Wat Mar 149.51 ted in Ap 23.93 culated in 356.69	of (65)m 5 and 5a ts Apr 149.51 opendix 18.11 Appendix 336.52	May 149.51 L, equat 13.54 dix L, eq 311.05	Jun 149.51 ion L9 of 11.43 uation L 287.12	Jul 149.51 r L9a), a 12.35 13 or L1 271.13	Aug 149.51 Iso see 16.06 3a), also	Sep 149.51 Table 5 21.55 see Ta	Oct 149.51 27.36 ble 5 297.02	Nov 149.51 31.94	Dec 149.51	eating	(66) (67)
Metabolic gai Jan (66)m= 149.51 Lighting gains (67)m= 33.12 Appliances ga (68)m= 362.41 Cooking gains (69)m= 37.95	res (Table Feb 149.51 (calcula 29.42 sins (calcula 366.17 s (calcula 37.95	culation of Table 5 2 5), Wat Mar 149.51 ted in Ap 23.93 culated in 356.69 ated in A 37.95	of (65)m s and 5a ts Apr 149.51 ppendix 18.11 Append 336.52 ppendix 37.95	May 149.51 L, equat 13.54 dix L, eq 311.05 L, equat	Jun 149.51 ion L9 of 11.43 uation L 287.12 tion L15	Jul 149.51 r L9a), a 12.35 13 or L1 271.13 or L15a)	Aug 149.51 Iso see 16.06 3a), also 267.36	Sep 149.51 Table 5 21.55 See Ta 276.84 ee Table	Oct 149.51 27.36 ble 5 297.02	Nov 149.51 31.94	Dec 149.51 34.04 346.42	eating	(66) (67) (68)
5. Internal g Metabolic gai Jan (66)m= 149.51 Lighting gains (67)m= 33.12 Appliances ga (68)m= 362.41 Cooking gains	res (Table Feb 149.51 (calcula 29.42 sins (calcula 366.17 s (calcula 37.95	culation of Table 5 2 5), Wat Mar 149.51 ted in Ap 23.93 culated in 356.69 ated in A 37.95	of (65)m s and 5a ts Apr 149.51 ppendix 18.11 Append 336.52 ppendix 37.95	May 149.51 L, equat 13.54 dix L, eq 311.05 L, equat	Jun 149.51 ion L9 of 11.43 uation L 287.12 tion L15	Jul 149.51 r L9a), a 12.35 13 or L1 271.13 or L15a)	Aug 149.51 Iso see 16.06 3a), also 267.36	Sep 149.51 Table 5 21.55 See Ta 276.84 ee Table	Oct 149.51 27.36 ble 5 297.02	Nov 149.51 31.94	Dec 149.51 34.04 346.42	eating	(66) (67) (68)
Metabolic gains (66)m= 149.51 Lighting gains (67)m= 33.12 Appliances gains (68)m= 362.41 Cooking gains (69)m= 37.95 Pumps and fains (70)m= 10	res (Table Feb 149.51 (calcula 29.42 ains (calcula 366.17 s (calcula 37.95 ans gains 10	culation of Table 5 2 5), Wat Mar 149.51 ted in Ap 23.93 culated in 356.69 ated in Ap 37.95 (Table 5	of (65)m ts Apr 149.51 ppendix 18.11 Appendix 336.52 ppendix 37.95 5a) 10	only if constructions only if constructions only if constructions on the construction of the construction	Jun 149.51 ion L9 of 11.43 uation L 287.12 tion L15 37.95	Jul 149.51 r L9a), a 12.35 13 or L1 271.13 or L15a) 37.95	Aug 149.51 Iso see 16.06 3a), also 267.36), also se 37.95	Sep 149.51 Table 5 21.55 See Ta 276.84 ee Table 37.95	Oct 149.51 27.36 ble 5 297.02 5 37.95	Nov 149.51 31.94 322.48	Dec 149.51 34.04 346.42 37.95	eating	(66) (67) (68)
Metabolic gai Jan (66)m= 149.51 Lighting gains (67)m= 33.12 Appliances ga (68)m= 362.41 Cooking gains (69)m= 37.95 Pumps and fa	res (Table Feb 149.51 (Calcula 29.42 ains (Calcula 37.95 as gains 10 vaporatio	culation of Table 5 2 5), Wat Mar 149.51 ted in Ap 23.93 culated in 356.69 ated in Ap 37.95 (Table 5	of (65)m ts Apr 149.51 ppendix 18.11 Appendix 336.52 ppendix 37.95 5a) 10	only if constructions only if constructions only if constructions on the construction of the construction	Jun 149.51 ion L9 of 11.43 uation L 287.12 tion L15 37.95	Jul 149.51 r L9a), a 12.35 13 or L1 271.13 or L15a) 37.95	Aug 149.51 Iso see 16.06 3a), also 267.36), also se 37.95	Sep 149.51 Table 5 21.55 See Ta 276.84 ee Table 37.95	Oct 149.51 27.36 ble 5 297.02 5 37.95	Nov 149.51 31.94 322.48	Dec 149.51 34.04 346.42 37.95	eating	(66) (67) (68)
Metabolic gai Jan (66)m= 149.51 Lighting gains (67)m= 33.12 Appliances ga (68)m= 362.41 Cooking gains (69)m= 37.95 Pumps and fa (70)m= 10 Losses e.g. e (71)m= -119.61	res (Table Feb 149.51 (Calcula 29.42 ains (Calcula 37.95 as (Calcula 10 yaporatic -119.61	culation of the Europe Solution of the Europe Solution of the Europe Solution of the Europe Solution (Table Solution (negative solution) and the Europe Solution of the Europe Solution	of (65)m s and 5a ts Apr 149.51 ppendix 18.11 Append 336.52 ppendix 37.95 5a) 10 tive valu	only if construction only if c	Jun 149.51 ion L9 o 11.43 uation L 287.12 tion L15 37.95	Jul 149.51 r L9a), a 12.35 13 or L1 271.13 or L15a) 37.95	Aug 149.51 Iso see 16.06 3a), also 267.36), also se 37.95	Sep 149.51 Table 5 21.55 See Ta 276.84 ee Table 37.95	Oct 149.51 27.36 ble 5 297.02 5 37.95	Nov 149.51 31.94 322.48	Dec 149.51 34.04 346.42 37.95	eating	(66) (67) (68) (69)
Metabolic gai Jan (66)m= 149.51 Lighting gains (67)m= 33.12 Appliances ga (68)m= 362.41 Cooking gains (69)m= 37.95 Pumps and fa (70)m= 10 Losses e.g. e	res (Table Feb 149.51 (calcula 29.42 sins (calcula 366.17 s (calcula 37.95 s) (calcula 19.61 s) (calcu	culation of the Europe Solution of the Europe	of (65)m s and 5a ts Apr 149.51 ppendix 18.11 Append 336.52 ppendix 37.95 5a) 10 tive valu	only if construction only if c	Jun 149.51 ion L9 o 11.43 uation L 287.12 tion L15 37.95	Jul 149.51 r L9a), a 12.35 13 or L1 271.13 or L15a) 37.95	Aug 149.51 Iso see 16.06 3a), also 267.36), also se 37.95	Sep 149.51 Table 5 21.55 See Ta 276.84 ee Table 37.95	Oct 149.51 27.36 ble 5 297.02 5 37.95	Nov 149.51 31.94 322.48	Dec 149.51 34.04 346.42 37.95	eating	(66) (67) (68) (69)
Metabolic gai Jan (66)m= 149.51 Lighting gains (67)m= 33.12 Appliances ga (68)m= 362.41 Cooking gains (69)m= 37.95 Pumps and fa (70)m= 10 Losses e.g. e (71)m= -119.61 Water heating	res (Table Feb 149.51 (calcula 29.42 ains (calcula 37.95 ars gains 10 vaporatio 127.19	culation of Table 5 2 5), Wat Mar 149.51 ted in Ap 23.93 culated in 356.69 ated in Ap 37.95 (Table 5 10 on (negation of the first section of the first secti	of (65)m ts Apr 149.51 ppendix 18.11 Appendix 336.52 ppendix 37.95 5a) 10 tive valu -119.61	only if construction only if c	Jun 149.51 ion L9 o 11.43 uation L 287.12 tion L15 37.95 10 ole 5) -119.61	Jul 149.51 r L9a), a 12.35 13 or L1 271.13 or L15a) 37.95	Aug 149.51 Iso see 16.06 3a), also 267.36), also se 37.95	Sep 149.51 Table 5 21.55 See Ta 276.84 ee Table 37.95 10 -119.61	Oct 149.51 27.36 ble 5 297.02 5 37.95 10 -119.61	Nov 149.51 31.94 322.48 37.95	Dec 149.51 34.04 346.42 37.95 10 -119.61	eating	(66) (67) (68) (69) (70) (71)
5. Internal g Metabolic gai Jan (66)m= 149.51 Lighting gains (67)m= 33.12 Appliances ga (68)m= 362.41 Cooking gains (69)m= 37.95 Pumps and fa (70)m= 10 Losses e.g. e (71)m= -119.61 Water heating (72)m= 129.62	res (Table Feb 149.51 (calcula 29.42 ains (calcula 37.95 ars gains 10 vaporatio 127.19	culation of Table 5 2 5), Wat Mar 149.51 ted in Ap 23.93 culated in 356.69 ated in Ap 37.95 (Table 5 10 on (negation of the first section of the first secti	of (65)m ts Apr 149.51 ppendix 18.11 Appendix 336.52 ppendix 37.95 5a) 10 tive valu -119.61	only if construction only if c	Jun 149.51 ion L9 o 11.43 uation L 287.12 tion L15 37.95 10 ole 5) -119.61	Jul 149.51 r L9a), a 12.35 13 or L1 271.13 or L15a) 37.95	Aug 149.51 Iso see 16.06 3a), also 267.36), also se 37.95	Sep 149.51 Table 5 21.55 See Ta 276.84 ee Table 37.95 10 -119.61	Oct 149.51 27.36 ble 5 297.02 5 37.95 10 -119.61	Nov 149.51 31.94 322.48 37.95	Dec 149.51 34.04 346.42 37.95 10 -119.61	eating	(66) (67) (68) (69) (70) (71)

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

Orientat	tion:	Access Facto Table 6d	r	Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	2.5	x	10.63	x	0.63	x	0.7] =	8.12	(74)
North	0.9x	0.77	x	2.5	x	20.32	x	0.63	x	0.7	=	15.53	(74)
North	0.9x	0.77	х	2.5	x	34.53	x	0.63	x	0.7	=	26.38	(74)
North	0.9x	0.77	x	2.5	x	55.46	x	0.63	x	0.7] =	42.38	(74)
North	0.9x	0.77	x	2.5	x	74.72	x	0.63	x	0.7	=	57.09	(74)
North	0.9x	0.77	x	2.5	x	79.99	x	0.63	x	0.7	=	61.11	(74)
North	0.9x	0.77	x	2.5	x	74.68	x	0.63	x	0.7	=	57.06	(74)
North	0.9x	0.77	x	2.5	x	59.25	x	0.63	x	0.7	=	45.27	(74)
North	0.9x	0.77	x	2.5	x	41.52	x	0.63	x	0.7	=	31.72	(74)
North	0.9x	0.77	x	2.5	x	24.19	x	0.63	x	0.7	=	18.48	(74)
North	0.9x	0.77	x	2.5	x	13.12	x	0.63	x	0.7	=	10.02	(74)
North	0.9x	0.77	x	2.5	x	8.86	x	0.63	x	0.7	=	6.77	(74)
East	0.9x	1	x	8.1	x	19.64	x	0.63	x	0.7	=	34.1	(76)
East	0.9x	1	x	8.1	x	38.42	X	0.63	x	0.7	=	66.7	(76)
East	0.9x	1	x	8.1	x	63.27	x	0.63	x	0.7	=	109.84	(76)
East	0.9x	1	X	8.1	x	92.28	X	0.63	X	0.7	=	160.2	(76)
East	0.9x	1	x	8.1	x	113.09	X	0.63	x	0.7	=	196.33	(76)
East	0.9x	1	x	8.1	x	115.77	X	0.63	x	0.7	=	200.98	(76)
East	0.9x	1	X	8.1	x	110.22	X	0.63	X	0.7	=	191.34	(76)
East	0.9x	1	x	8.1	x	94.68	X	0.63	x	0.7	=	164.36	(76)
East	0.9x	1	x	8.1	x	73.59	X	0.63	x	0.7	=	127.75	(76)
East	0.9x	1	X	8.1	X	45.59	X	0.63	X	0.7	=	79.14	(76)
East	0.9x	1	x	8.1	x	24.49	x	0.63	x	0.7	=	42.51	(76)
East	0.9x	1	x	8.1	x	16.15	x	0.63	x	0.7	=	28.04	(76)
South	0.9x	0.77	x	2.5	x	46.75	X	0.63	X	0.7	=	35.72	(78)
South	0.9x	0.77	x	2.5	x	76.57	X	0.63	x	0.7	=	58.5	(78)
South	0.9x	0.77	X	2.5	x	97.53	X	0.63	X	0.7	=	74.52	(78)
South	0.9x	0.77	X	2.5	X	110.23	X	0.63	X	0.7	=	84.22	(78)
South	0.9x	0.77	X	2.5	X	114.87	X	0.63	X	0.7	=	87.77	(78)
South	0.9x	0.77	X	2.5	X	110.55	X	0.63	X	0.7	=	84.46	(78)
South	0.9x	0.77	X	2.5	x	108.01	X	0.63	X	0.7	=	82.52	(78)
South	0.9x	0.77	X	2.5	x	104.89	X	0.63	X	0.7	=	80.14	(78)
South	0.9x	0.77	X	2.5	X	101.89	X	0.63	X	0.7	=	77.84	(78)
South	0.9x	0.77	X	2.5	X	82.59	X	0.63	X	0.7	=	63.1	(78)
South	0.9x	0.77	x	2.5	x	55.42	X	0.63	X	0.7	=	42.34	(78)
South	0.9x	0.77	x	2.5	x	40.4	x	0.63	x	0.7	=	30.87	(78)
West	0.9x	0.54	x	14.2	x	19.64	x	0.63	x	0.7	=	59.77	(80)
West	0.9x	0.77	x	10.6	x	19.64	x	0.63	x	0.7	=	63.62	(80)
West	0.9x	0.54	x	14.2	x	38.42	x	0.63	x	0.7	=	116.93	(80)

	_											_					_
West	0.9x	0.77	X	10.	.6	X	3	8.42	X		0.63	X	0.7		=	124.46	(80)
West	0.9x	0.54	X	14.	.2	X	6	3.27	X		0.63	X	0.7		=	192.57	(80)
West	0.9x	0.77	X	10.	.6	X	6	3.27	X		0.63	X	0.7		=	204.97	(80)
West	0.9x	0.54	X	14.	.2	X	9	2.28	X		0.63	X	0.7		=	280.85	(80)
West	0.9x	0.77	X	10.	.6	X	9	2.28	X		0.63	X	0.7		=	298.94	(80)
West	0.9x	0.54	X	14.	.2	X	11	13.09	X		0.63	X	0.7		=	344.19	(80)
West	0.9x	0.77	X	10.	.6	X	11	13.09	x		0.63	x	0.7		=	366.36	(80)
West	0.9x	0.54	X	14.	.2	X	11	15.77	x		0.63	X	0.7		=	352.34	(80)
West	0.9x	0.77	X	10.	.6	X	11	15.77	X		0.63	х	0.7		=	375.04	(80)
West	0.9x	0.54	X	14.	.2	X	11	10.22	x		0.63	x	0.7		=	335.44	(80)
West	0.9x	0.77	x	10.	.6	X	11	10.22	x		0.63	x	0.7		=	357.05	(80)
West	0.9x	0.54	x	14.	.2	X	9	4.68	x		0.63	x	0.7		=	288.14	(80)
West	0.9x	0.77	X	10.	.6	X	9	4.68	x		0.63	X	0.7		=	306.7	(80)
West	0.9x	0.54	X	14.	.2	X	7	3.59	x		0.63	, x	0.7		=	223.96	(80)
West	0.9x	0.77	x	10.	.6	X	7	3.59	x		0.63	×	0.7		=	238.39	(80)
West	0.9x	0.54	x	14.	.2	X	4	5.59	x		0.63	X	0.7		=	138.75	(80)
West	0.9x	0.77	x	10.	.6	X	4	5.59	x		0.63	X	0.7		=	147.69	(80)
West	0.9x	0.54	x	14.	.2	X	2	4.49	X		0.63	x	0.7		=	74.53	(80)
West	0.9x	0.77	x	10.	.6	X	2	4.49	X		0.63	X	0.7		=	79.33	(80)
West	0.9x	0.54	x	14.	.2	X	1	6.15	X		0.63	X	0.7		=	49.16	(80)
West	0.9x	0.77	x	10.		X		6.15	X		0.63	X	0.7		=	52.32	(80)
	L	-							ı			_	_				」 ` '
Solar o	ains in	watts, cal	culated	for each	h montl	า			(83)m	n = Sur	n(74)m	(82)m					
(83)m=	201.34	T	608.29	866.59		$\overline{}$	073.93	1023.42	`		699.67	447.16	248.74	167.	15		(83)
Total g	ains – i	nternal ar	nd solar	(84)m =	(73)m	+ (83)m ,	, watts	<u> </u>		<u> </u>			!			
(84)m=	804.34	982.75	1188.9	1414.36	1565.01	15	554.89	1483.97	1351	1.94	1184.4	964.9	7 804.61	752.6	67		(84)
7. Mea	an inter	nal tempe	erature	(heating	seaso	n)							-				
		during he		`			area f	from Tab	ole 9.	, Th1	(°C)					21	(85)
•		ctor for ga	• .			_					` ,						_
	Jan	Feb	Mar	Apr	May	T	Jun	Jul	Α	ug	Sep	Oct	Nov	De	С		
(86)m=	1	1	0.99	0.97	0.87		0.66	0.49	0.5	56	0.85	0.99	1	1			(86)
Mean	interna	l tempera	ture in l	iving are	ea T1 (1	follo	w stei	ns 3 to 7	in T	able	9c)						
(87)m=	21	21	21	21	21	T	21	21	2		21	21	21	21			(87)
L	oroturo	during he		oriodo in	root o	 	و مناله،	from To	hla (L	. (°C)						
(88)m=	20.15	20.15	20.16	20.17	20.18	_	20.19	20.19	20.		20.18	20.18	20.17	20.1	6		(88)
			!								20.10	20.10	20.17	20.1			(00)
г		tor for ga				$\overline{}$	`		_	<u> T</u>	0.70	0.00	1 .				(00)
(89)m=	1	1	0.99	0.96	0.82		0.59	0.4	0.4		0.79	0.98	1	1			(89)
Г		l tempera				Ť			i 				_				
(90)m=	20.15	20.15	20.16	20.17	20.18	2	20.18	20.19	20.	19	20.18	20.18		20.1	6		(90)
											fL	.A = Liv	ring area ÷ (4	4) =		0.33	(91)

Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m= 20.43	20.43	20.43	20.44	20.45	20.45	20.46	20.46	20.45	20.45	20.44	20.44		(92)
Apply adjust	ment to t	he mean	internal	temper	ature fro	m Table	4e, whe	ere appro	priate	Į.			
(93)m= 20.43	20.43	20.43	20.44	20.45	20.45	20.46	20.46	20.45	20.45	20.44	20.44		(93)
8. Space hea	ating requ	uirement											
Set Ti to the the utilisation			•		ned at ste	ep 11 of	Table 9	o, so tha	t Ti,m=(76)m an	d re-calc	ulate	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation fa	ctor for g	ains, hm	1:		_	_							
(94)m= 1	1	0.99	0.96	0.84	0.61	0.43	0.5	0.81	0.99	1	1		(94)
Useful gains	, hmGm	, W = (94	4)m x (84	4)m				•	•	•			
(95)m= 804.06	981.42	1180.92	1357.81	1312.13	955.5	641.03	669.63	963.83	951.31	803.77	752.49		(95)
Monthly ave	rage exte	ernal tem	perature	from Ta	able 8						, , , , , , , , , , , , , , , , , , , 		
(96)m= 4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat loss rat						· · · · · ·				1	1		
(97)m= 2832.74	2717.05	2427.94	1971.84	1487.94	975.36	642.9	673.78	1067.62	1675.06	2288.1	2807.05		(97)
Space heatir					Wh/mon	th = 0.02	4 x [(97)m – (95)m] x (4	r –			
(98)m= 1509.3 ²	1166.34	927.78	442.1	130.81	0	0	0	0	538.47	1068.72	1528.59		_
							Tota	l per year	(kWh/year) = Sum(9	8) _{15,912} =	7312.15	(98)
Space heatir	ng require	ement in	kWh/m²	/year								38.28	(99)
8c. Space co	ooling red	quiremen	nt								·		
Calculated for	or June, .	July and	August.	See Tal	ole 10b								
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Heat loss rat	te Lm (ca	lculated	using 25	5°C inter	nal temi	perature	and ext	arnal tan	nnaratur	e from T	able 10)		
(100)m = 0		1				-		tillal lell	iperatui	<u> </u>	<u>ubio 10)</u>		
(100)111= 0	0	0	0	0		1233.34		0	0	0	0		(100)
Utilisation fa								i	r e	i	· i		, ,
Utilisation fa	ctor for lo	oss hm	0	0	0.94			i	r e	i	· i		(100) (101)
Utilisation fa (101)m= 0 Useful loss,	ctor for lo	oss hm 0 Vatts) = (0 (100)m x	0 0 (101)m	1566.67	0.98	0.96	0	0	0	0		(101)
Utilisation fa (101)m= 0 Useful loss, (102)m= 0	ctor for lo	oss hm 0 Vatts) = (0 0 (100)m x	0 0 (101)m 0	1566.67 0.94 1479.77	1233.34 0.98 1204.72	0.96	0 0	0	0	0		, ,
Utilisation fa (101)m= 0 Useful loss, (102)m= 0 Gains (solar	ctor for lo	oss hm 0 Vatts) = (0 lculated	0 (100)m x 0 for appli	0 0 (101)m 0 cable we	1566.67 0.94 1479.77 eather re	1233.34 0.98 1204.72 egion, se	0.96 1212.96 e Table	0 0 10)	0 0	0 0	0 0		(101)
Utilisation fa $(101)m = 0$ Useful loss, $(102)m = 0$ Gains (solar $(103)m = 0$	ctor for lo	oss hm 0 Vatts) = (0 Iculated 0	0 (100)m x 0 for appli	0 0 (101)m 0 cable we	1566.67 0.94 1479.77 eather re 2003.17	1233.34 0.98 1204.72 egion, se 1913.85	0.96 1212.96 e Table 1752.62	0 0 10) 0	0 0	0 0	0 0		(101)
Utilisation fa (101)m= 0 Useful loss, (102)m= 0 Gains (solar (103)m= 0 Space coolin	ctor for lo	oss hm 0 Vatts) = (0 Iculated 0 ement fo	0 (100)m x 0 for appli 0 r month,	0 (101)m 0 cable we 0	1566.67 0.94 1479.77 eather re 2003.17	1233.34 0.98 1204.72 egion, se 1913.85	0.96 1212.96 e Table 1752.62	0 0 10) 0	0 0	0 0	0 0	к (41)т	(101)
Utilisation fa (101)m= 0 Useful loss, (102)m= 0 Gains (solar (103)m= 0 Space coolin set (104)m to	ctor for lo	oss hm 0 Vatts) = (0 Iculated 0 ement fo	0 (100)m x 0 for appli 0 r month,	0 (101)m 0 cable we 0	1566.67 0.94 1479.77 eather re 2003.17	1233.34 0.98 1204.72 egion, se 1913.85 continuo	0.96 1212.96 e Table 1752.62	0 0 10) 0	0 0	0 0	0 0	k (41)m	(101)
Utilisation fa (101)m= 0 Useful loss, (102)m= 0 Gains (solar (103)m= 0 Space coolin set (104)m to	ctor for lo	oss hm 0 Vatts) = (0 lculated 0 ement fo (104)m <	0 (100)m x 0 for appli 0 r month,	0 (101)m 0 cable we 0 whole co	1566.67 0.94 1479.77 eather re 2003.17	1233.34 0.98 1204.72 egion, se 1913.85	0.96 1212.96 e Table 1752.62 bus (kW	0 0 10) 0 /h) = 0.0	0 0 0 24 x [(10	0 0 0 0 03)m - (0 0 0 102)m]	. ,	(101) (102) (103)
Utilisation fa (101)m= 0 Useful loss, (102)m= 0 Gains (solar (103)m= 0 Space coolin set (104)m to	ctor for lo	oss hm 0 Vatts) = (0 lculated 0 ement fo (104)m <	0 (100)m x 0 for appli 0 r month,	0 (101)m 0 cable we 0 whole co	1566.67 0.94 1479.77 eather re 2003.17	1233.34 0.98 1204.72 egion, se 1913.85 continuo	0.96 1212.96 e Table 1752.62 bus (kW	0 0 10) 0 /h) = 0.0 Total	0 0 0 0 24 x [(10	0 0 0 03)m - (0 1,04)	0 0 0 102)m]	x (41)m 1305.95 0.66	(101)
Utilisation fa (101)m= 0 Useful loss, (102)m= 0 Gains (solar (103)m= 0 Space coolin set (104)m to (104)m= 0	ctor for lo	oss hm 0 Vatts) = (0 Iculated 0 ement fo (104)m <	0 (100)m x 0 for appli 0 r month,	0 (101)m 0 cable we 0 whole co	1566.67 0.94 1479.77 eather re 2003.17	1233.34 0.98 1204.72 egion, se 1913.85 continuo	0.96 1212.96 e Table 1752.62 bus (kW	0 0 10) 0 /h) = 0.0 Total	0 0 0 24 x [(10	0 0 0 03)m - (0 1,04)	0 0 0 102)m]	1305.95	(101) (102) (103)
Utilisation fa (101)m= 0 Useful loss, (102)m= 0 Gains (solar (103)m= 0 Space coolin set (104)m to (104)m= 0 Cooled fraction	ctor for lo	oss hm 0 Vatts) = (0 Iculated 0 ement fo (104)m <	0 (100)m x 0 for appli 0 r month,	0 (101)m 0 cable we 0 whole co	1566.67 0.94 1479.77 eather re 2003.17	1233.34 0.98 1204.72 egion, se 1913.85 continuo	0.96 1212.96 e Table 1752.62 bus (kW	0 0 10) 0 /h) = 0.0 Total	0 0 0 24 x [(10	0 0 0 03)m - (0 1,04)	0 0 0 102)m]	1305.95	(101) (102) (103)
Utilisation fa (101)m= 0 Useful loss, (102)m= 0 Gains (solar (103)m= 0 Space coolin set (104)m to (104)m= 0 Cooled fractic Intermittency (106)m= 0	ctor for lo	oss hm 0 Vatts) = (0 lculated 0 ement fo (104)m < 0 able 10b	0 (100)m x 0 for appli 0 r month, 3 x (98 0	0 0 (101)m 0 cable we 0 whole o)m 0	1566.67 0.94 1479.77 eather re 2003.17 dwelling, 376.85	1233.34 0.98 1204.72 egion, se 1913.85 continuo 527.59	0.96 1212.96 e Table 1752.62 DUS (kW 401.51	0 0 10) 0 7h) = 0.0 Total f C =	0 0 0 24 x [(10 0 = Sum(0 0 0 03)m - (0 1,04) area ÷ (4	0 0 0 102)m];	1305.95	(101) (102) (103)
Utilisation fa (101)m= 0 Useful loss, (102)m= 0 Gains (solar (103)m= 0 Space cooling set (104)m to (104)m= 0 Cooled fraction Intermittency (106)m= 0 Space cooling	ctor for lo	oss hm 0 Vatts) = (0 Iculated 0 ement for able 10b 0 ment for	0 (100)m x 0 for appli 0 r month, 3 x (98 0	0 (101)m 0 cable we 0 whole o)m 0	1566.67 0.94 1479.77 eather re 2003.17 dwelling, 376.85 0.25 × (105)	1233.34 0.98 1204.72 egion, se 1913.85 continue 527.59 0.25 × (106)r	0.96 1212.96 e Table 1752.62 ous (kW 401.51	0 0 10) 0 Total f C =	0 0 0 24 x [(10 0 = Sum(cooled :	0 0 0 0 03)m - (0 1,04) area ÷ (4	0 0 0 102)m] 2 0 = 4) =	1305.95 0.66	(101) (102) (103) (104) (105)
Utilisation fa (101)m= 0 Useful loss, (102)m= 0 Gains (solar (103)m= 0 Space coolin set (104)m to (104)m= 0 Cooled fractic Intermittency (106)m= 0	ctor for lo	oss hm 0 Vatts) = (0 lculated 0 ement fo (104)m < 0 able 10b	0 (100)m x 0 for appli 0 r month, 3 x (98 0	0 0 (101)m 0 cable we 0 whole o)m 0	1566.67 0.94 1479.77 eather re 2003.17 dwelling, 376.85	1233.34 0.98 1204.72 egion, se 1913.85 continuo 527.59	0.96 1212.96 e Table 1752.62 DUS (kW 401.51	0 0 10) 0 Total f C = 0 Total	0 0 0 24 x [(10 0 = Sum(cooled:	0 0 0 0 0 0 0 1,0,4) area ÷ (4 0	0 0 0 102)m] x	1305.95 0.66	(101) (102) (103) (104) (105) (106)
Utilisation fa (101)m= 0 Useful loss, (102)m= 0 Gains (solar (103)m= 0 Space cooling (104)m= 0 Cooled fraction Intermittency (106)m= 0 Space cooling (107)m= 0	ctor for lo	oss hm 0 Vatts) = (0 lculated 0 ement for 0 able 10b 0 ment for	0 (100)m x 0 for appli 0 r month, 3 x (98 0	0 (101)m 0 cable we 0 whole o)m 0	1566.67 0.94 1479.77 eather re 2003.17 dwelling, 376.85 0.25 × (105)	1233.34 0.98 1204.72 egion, se 1913.85 continue 527.59 0.25 × (106)r	0.96 1212.96 e Table 1752.62 ous (kW 401.51	0 0 10) 0 Total f C = 0 Total	0 0 0 24 x [(10 0 = Sum(cooled a	0 0 0 0 0 0 0 1,0,4) area ÷ (4 0	0 0 0 102)m] 2 0 = 4) =	1305.95 0.66	(101) (102) (103) (104) (105)
Utilisation fa (101)m= 0 Useful loss, (102)m= 0 Gains (solar (103)m= 0 Space cooling set (104)m to (104)m= 0 Cooled fraction Intermittency (106)m= 0 Space cooling	ctor for lo	oss hm 0 Vatts) = (0 lculated 0 ement for 0 able 10b 0 ment for	0 (100)m x 0 for appli 0 r month, 3 x (98 0	0 (101)m 0 cable we 0 whole o)m 0	1566.67 0.94 1479.77 eather re 2003.17 dwelling, 376.85 0.25 × (105)	1233.34 0.98 1204.72 egion, se 1913.85 continue 527.59 0.25 × (106)r	0.96 1212.96 e Table 1752.62 ous (kW 401.51	0 0 10) 0 Total f C = 0 Total	0 0 0 24 x [(10 0 = Sum(cooled:	0 0 0 0 0 0 0 1,0,4) area ÷ (4 0	0 0 0 0 102)m]; 0 = 1) = 0	1305.95 0.66	(101) (102) (103) (104) (105) (106)
Utilisation fa (101)m= 0 Useful loss, (102)m= 0 Gains (solar (103)m= 0 Space cooling set (104)m to (104)m= 0 Cooled fraction Intermittency (106)m= 0 Space cooling (107)m= 0 Space cooling 9a. Energy residue)	ctor for lo	oss hm 0 Vatts) = (0 Iculated 0 ement for 0 ment for 0 ment in k	0 (100)m x 0 for appli 0 r month, 3 x (98 0) 0 month =	0 (101)m 0 cable we 0 whole c)m 0 (104)m 0 /ear	1566.67 0.94 1479.77 eather re 2003.17 dwelling, 376.85 0.25 × (105) 61.98	1233.34 0.98 1204.72 egion, se 1913.85 continue 527.59 0.25 × (106)r 86.77	0.96 1212.96 e Table 1752.62 ous (kW 401.51 0.25 n 66.03	0 0 10) 0 10) 0 Total f C = 0 Total (107)	0 0 0 24 x [(10 0 = Sum(cooled a	0 0 0 0 0 0 0 1,0,4) area ÷ (4 0	0 0 0 0 102)m]; 0 = 1) = 0	1305.95 0.66 0	(101) (102) (103) (104) (105) (106)
Utilisation fa (101)m= 0 Useful loss, (102)m= 0 Gains (solar (103)m= 0 Space cooling set (104)m to (104)m= 0 Cooled fraction Intermittency (106)m= 0 Space cooling (107)m= 0 Space cooling	ctor for lo	oss hm 0 Vatts) = (0 lculated 0 ement for 0 ment for 0 ment in kents – Indi	0 (100)m x 0 for appli 0 r month, 3 x (98 0) 0 month = 0 kWh/m²/y	0 0 (101)m 0 cable we 0 whole o)m 0 (104)m 0 /ear eating s	1566.67 0.94 1479.77 eather re 2003.17 dwelling, 376.85 0.25 × (105) 61.98	1233.34 0.98 1204.72 egion, se 1913.85 continue 527.59 0.25 x (106)r 86.77	0.96 1212.96 e Table 1752.62 ous (kW 401.51 0.25 n 66.03	0 0 10) 0 10) 0 Total f C = 0 Total (107)	0 0 0 24 x [(10 0 = Sum(cooled a	0 0 0 0 0 0 0 1,0,4) area ÷ (4 0	0 0 0 0 102)m]; 0 = 1) = 0	1305.95 0.66 0	(101) (102) (103) (104) (105) (106)

Fraction of sp													
	ace hea	at from m	ain syst	em(s)			(202) = 1	- (201) =				1	(202)
Fraction of ma	ain heat	ing from	main sy	stem 2								0.34	(203)
Fraction of to	tal heati	ng from i	main sys	stem 1			(204) = (2	02) x [1 –	(203)] =			0.66	(204)
Fraction of to	tal heati	ng from i	main sys	stem 2			(205) = (2	02) × (203) =		Ī	0.34	(205)
Efficiency of r	main spa	ace heati	ng syste	em 1							Ī	404	(206)
Efficiency of r	main spa	ace heati	ng syste	em 2							Ī	89.9	(207)
Efficiency of s	seconda	ry/supple	ementar	y heating	g systen	າ, %						0	(208)
Cooling Syste	em Ener	gy Efficie	ency Rat	tio								4.32	(209)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/ye	ear
Space heatin				d above)		1	1						
1509.34	1166.34	927.78	442.1	130.81	0	0	0	0	538.47	1068.72	1528.59		
$(211)m = \{[(98)]$						ı	ī	1					(211)
246.57	190.54	151.57	72.22	21.37	0	0	O Tota	0 II (kWh/yea	87.97	174.59	249.72	1101.55	(244)
(242)m (00)m	· v (202)	v 100 ·	(207)				1018	ii (KVVII/yea	ar) =3um(2	2 1 1) _{15,1012}		1194.55	(211)
(213)m = (98) m (213) m= 570.83	441.11	350.88	167.2	49.47	0	0	0	0	203.65	404.19	578.11		
(2.0)								l (kWh/yea				2765.44	(213)
Space heating $= \{[(98)m \times (200)] $ $(215)m = 0$	-	-		0	0	0	0	0	0	0	0		
(2.0)			Ū	ŭ				l (kWh/yea	_	_	_	0	(215)
Output from wa		ter (caici		\									
Efficiency of w	1	204.11 iter	182.67	178.79	159.44	152.83	168.11	167.95	189.44	200.69	215.43	79.8	(216)
Efficiency of w (217)m= 232.55	ater hea	204.11 iter 200.43	182.67 157.56		159.44 79.8	152.83 79.8	79.8	167.95 79.8	189.44	200.69	215.43	79.8	
Efficiency of w (217)m= 232.55 Fuel for water	ater hea 222.02 heating,	204.11 Iter 200.43 kWh/mc	182.67 157.56 onth	178.79			<u> </u>					79.8	
Efficiency of w (217)m= 232.55	ater hea 222.02 heating,	204.11 Iter 200.43 kWh/mc	182.67 157.56 onth	178.79			<u> </u>					79.8	
Efficiency of w (217)m= 232.55 Fuel for water (219)m = (64)	ater hea 222.02 heating, m x 100	204.11 iter 200.43 kWh/mc) ÷ (217)	182.67 157.56 onth m	178.79	79.8	79.8	79.8	79.8	167.46	212.64	235.59	79.8 1677.28	(217)
Efficiency of w (217)m= 232.55 Fuel for water (219)m = (64) (219)m= 94.97 Space cooling	ater hea 222.02 heating, m x 100 87.63	204.11 tter 200.43 kWh/mc ÷ (217) 101.84 Wh/mor	182.67 157.56 onth m 115.94	178.79	79.8	79.8	79.8	79.8	167.46	212.64	235.59		(217)
Efficiency of w (217)m= 232.55 Fuel for water (219)m = (64) (219)m= 94.97 Space cooling (221)m = (107)	ater hea 222.02 heating, m x 100 87.63	204.11 tter 200.43 kWh/mc ÷ (217) 101.84 Wh/mor	182.67 157.56 onth m 115.94	178.79	79.8	79.8	79.8	79.8	167.46	212.64	235.59		(217)
Efficiency of w (217)m= 232.55 Fuel for water (219)m = (64) (219)m= 94.97 Space cooling (221)m = (107)	ater hea 222.02 heating, m x 100 87.63 g fuel, k)m÷ (209	204.11 Inter 200.43 kWh/mo 5 ÷ (217) 101.84 Wh/mor 9)	182.67 157.56 onth m 115.94	178.79 108.03 165.51	79.8	79.8	79.8 210.67 Tota	79.8 210.46 I = Sum(2	167.46 113.13 19a) ₁₁₂ =	212.64 94.38	91.44		(217)
Efficiency of w (217)m= 232.55 Fuel for water (219)m = (64) (219)m= 94.97 Space cooling (221)m = (107)	ater hea 222.02 heating, m x 100 87.63 g fuel, k)m÷ (209	204.11 Inter 200.43 kWh/mo 5 ÷ (217) 101.84 Wh/mor 9)	182.67 157.56 onth m 115.94	178.79 108.03 165.51	79.8	79.8	79.8 210.67 Tota	79.8 210.46 Il = Sum(2	113.13 19a) ₁₁₂ = 0 21) ₆₈ =	94.38	91.44	1677.28 49.72	(217)
Efficiency of w (217)m= 232.55 Fuel for water (219)m= (64) (219)m= 94.97 Space cooling (221)m = (107) (221)m= 0	ater hea 222.02 heating, m x 100 87.63 g fuel, k)m÷ (209 0	204.11 tter 200.43 kWh/mc 217) 101.84 Wh/mor 9) 0	182.67 157.56 onth m 115.94 onth.	178.79 108.03 165.51	79.8	79.8	79.8 210.67 Tota	79.8 210.46 Il = Sum(2	113.13 19a) ₁₁₂ = 0 21) ₆₈ =	212.64 94.38	91.44	1677.28	(217)
Efficiency of w (217)m= 232.55 Fuel for water (219)m= (64) (219)m= 94.97 Space cooling (221)m = (107) (221)m= 0	ater hear 222.02 heating, m x 100 87.63 g fuel, k)m÷ (200 0	204.11 Inter 200.43 kWh/mo 101.84 Wh/mor 9) 0	182.67 157.56 onth m 115.94 oth. 0	178.79 108.03 165.51	79.8	79.8	79.8 210.67 Tota	79.8 210.46 Il = Sum(2	113.13 19a) ₁₁₂ = 0 21) ₆₈ =	94.38	91.44	1677.28 49.72 kWh/yea	(217)
Efficiency of w (217)m= 232.55 Fuel for water (219)m = (64) (219)m= 94.97 Space cooling (221)m = (107) (221)m= 0 Annual totals Space heating	ater hear 222.02 heating, m x 100 87.63 g fuel, k m÷ (209 0) fuel use fuel use	204.11 Inter 200.43 kWh/mo 101.84 Wh/mor 9) 0	182.67 157.56 onth m 115.94 oth. 0	178.79 108.03 165.51	79.8	79.8	79.8 210.67 Tota	79.8 210.46 Il = Sum(2	113.13 19a) ₁₁₂ = 0 21) ₆₈ =	94.38	91.44	49.72 kWh/yea 1194.55	(217)
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Efficiency of w (217)m= 232.55 Fuel for water (219)m = (64) (219)m= 94.97 Space cooling (221)m = (107) (221)m= 0 Annual totals Space heating Space heating Water heating Space cooling	ater hear ater hear 222.02 heating, m x 100 87.63 g fuel, k m; (209 0) fuel use fuel use fuel use fuel use fuel use	204.11 Inter 200.43 kWh/mo 0 ÷ (217) 101.84 Wh/mor 9) 0 ed, main ed, main ed ed	182.67 157.56 onth m 115.94 oth. 0 system system	178.79 108.03 165.51 0	79.8 199.8	79.8	79.8 210.67 Tota	79.8 210.46 Il = Sum(2	113.13 19a) ₁₁₂ = 0 21) ₆₈ =	94.38	91.44	49.72 kWh/yea 1194.55 2765.44 1677.28	(217)
Efficiency of w (217)m= 232.55 Fuel for water (219)m = (64) (219)m= 94.97 Space cooling (221)m = (107) (221)m= 0 Annual totals Space heating Space heating Water heating Space cooling Electricity for p	ater hear ater hear 222.02 heating, m x 100 87.63 g fuel, k m; (209 0) fuel use fuel use fuel use fuel use pumps, fa	204.11 Inter 200.43 kWh/mod (217) 101.84 Wh/mod (2) ÷ (217) 0 ed, main (2) ed, main (2) ed, main (2) ed ans and	182.67 157.56 onth m 115.94 hth. 0 system system electric	178.79 108.03 165.51 0	79.8 199.8 14.35	79.8	79.8 210.67 Tota 15.29 Tota	79.8 210.46 I = Sum(2)	113.13 19a) ₁₁₂ = 0 21) ₆₈ =	94.38	91.44	49.72 kWh/yea 1194.55 2765.44 1677.28	(217) (219) (221) r
Efficiency of w (217)m= 232.55 Fuel for water (219)m = (64) (219)m= 94.97 Space cooling (221)m = (107) (221)m= 0 Annual totals Space heating Space heating Water heating Space cooling	ater hear ater hear 222.02 heating, m x 100 87.63 g fuel, k m; (209 0) fuel use fuel	204.11 Inter 200.43 kWh/mor (217) 101.84 Wh/mor (9) 0 ed, main ed, main ed ans and n - balan	182.67 157.56 onth m 115.94 hth. 0 system system electric	178.79 108.03 165.51 0	79.8 199.8 14.35	79.8	79.8 210.67 Tota 15.29 Tota	79.8 210.46 I = Sum(2)	113.13 19a) ₁₁₂ = 0 21) ₆₈ =	94.38	91.44	49.72 kWh/yea 1194.55 2765.44 1677.28	(217)

sum of (230a)...(230g) = (231)Total electricity for the above, kWh/year 620.53 Electricity for lighting (232)584.97 12a. CO2 emissions - Individual heating systems including micro-CHP **Energy Emission factor Emissions** kg CO2/year kWh/year kg CO2/kWh (211) x Space heating (main system 1) (261)0.519 619.97 Space heating (main system 2) (213) x (262)0.216 597.34 Space heating (secondary) (215) x (263)0.519 Water heating (219) x (264)0.216 362.29 (261) + (262) + (263) + (264) =Space and water heating (265)1579.6 (221) x Space cooling (266)0.519 25.8 (231) x Electricity for pumps, fans and electric keep-hot (267)0.519 322.05 (232) x Electricity for lighting 0.519 303.6 (268)sum of (265)...(271) = Total CO2, kg/year 2231.06 (272)

 $(272) \div (4) =$

Dwelling CO2 Emission Rate

El rating (section 14)

(273)

(274)

11.68

87



APPENDIX 4. SUSTAINABLE USE OF MATERIALS

More than 10% of the total value of materials used on site will be derived from recycled and reused sources. Following strategies will ensure that this target will be achieved:

 High recycled content will be used in the main building elements including blockwork, plasterboard, chipboard and slabs. The project target for recycled content in each of these items is as below:

a. Blockwork: 40%b. Plasterboard: 80%c. Chipboard: 50%d. Slabs: 10%

This strategy will ensure that the target set by the council is achieved.

- 2. Take Back Schemes: the contractor will be required to use take back schemes to ensure the best use of the left over materials
- 3. During the design, the architects will implement modular design to ensure less off cut will be created on site from various materials
- 4. The materials will be stored in secure place on site to avoid any weather damage to the materials. The materials will also be handled properly to avoid any breakage and damage and to reduce the waste.