

# Sustainability & Energy Statement Hunters Lodge, Friars Lane, Richmond

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#### **Executive Summary**

This Sustainability and Energy Statement has been prepared in support of a planning application for the demolition of the existing garage building at Hunters Lodge, Friars Lane, Richmond and the construction of a 2½-storey building, comprising four, 1 and 2-bedroom apartments.

The Statement sets out the commitments of the applicant to the site and the targets that will be applied to the development.

The methodology used has been based upon the 'Energy Assessment Guidance' published by the Mayor of London in June 2022 and uses the carbon factors for gas and electricity proposed for SAP 10.2.

In order to demonstrate the energy efficiency of the building a set of SAP calculations have been prepared for representative apartments for the 'Be Lean' scenario based on the notional systems specification set out in the Part L 2021 baseline. This is not the proposed strategy but purely demonstrates the reduction from the 'Be Lean' condition.

The TER & DER Worksheets for the modelled units and the Be Lean case are attached as Appendix 1.

The fabric standards of the apartments will exceed the requirements of the Building Regulations.

It is proposed to install heat pump hot water cylinders into each apartment. In addition, the Roof Plan & Elevation attached as Appendix 3 demonstrates a total of 22 photovoltaic panels could be installed without detrimentally impacting on the aesthetics of the development (the output of the panels is assumed to be 400W).

A further set of SAP calculations have been prepared based on the proposed specification and the DER Worksheets for the Be Green scenario are attached as Appendix 2.

The completed GLA Carbon Emissions Reporting Spreadsheet accompanies the planning application but the reductions in emissions can be summarised as follows:

	Total Emissions	% Reduction
	kg CO <sub>2</sub> per year	
Be Lean		
Baseline (Building Regulations TER)	3,135	
Be Lean - after energy efficiency (DER)	2,725	13.08%
Be Clean	2,725	13.08%
Be Green (ASHP & Photovoltaic Panels)		
Be Green Emissions	923	70.56%

The residual emissions are 0.923 tonnes and therefore the carbon offset payment would be £2,631  $(0.923 \times £2,850)$ .

The LBRuT Sustainable Construction Checklist is attached as Appendix 4.



#### 1.0 Introduction

This report has been commissioned by Mr C Deehan and provides a Sustainability and Energy Statement in support of a planning application for the demolition of the existing garage building at Hunters Lodge, Friars Lane, Richmond and the construction of a  $2\frac{1}{2}$ -storey building, comprising four, 1 and 2-bedroom apartments.

The report describes the methodology used in assessing the development and the initiatives proposed.

The building has been designed and will be constructed to reduce energy demand and carbon dioxide emissions.

The objective is to reduce the energy demand to an economic minimum by making investments in the parts of the building that has the greatest impact on energy demand and are the most difficult and costly to change in the future, namely the building fabric.

Once a cost-effective structure has been designed, low-carbon and renewable technologies have been considered to provide heat and/or electricity.

The following hierarchy has been followed:

Lean reduce demand and consumption

• Clean increase energy efficiency

• Green provide low carbon renewable energy sources

The report has been prepared by Ivan Ball of Bluesky Unlimited who are sustainability consultants.



# 2.0 Planning Policy Context

### **National Policy**

The UK Government published its sustainable development strategy in 1999 entitled "A better quality of life: A strategy for sustainable development in the UK". This sets out four main objectives for sustainable development in the UK:

- Social progress that recognises the needs of everyone.
- Effective protection of the environment.
- Prudent use of natural resources.
- Maintenance of high stable levels of economic growth and employment.

Sustainable Communities: Building for the Future, known colloquially as the Communities Plan was published in 2003. The Plan sets out a long-term programme of action for delivering sustainable communities in both urban and rural areas. It aims to tackle housing supply issues in parts of the country, low demand in other parts and the quality of our public spaces. The Communities Plan describes sustainable communities as: Active, inclusive and safe, well run, environmentally sensitive, well designed and built, well connected, thriving, well served and fair for everyone.

The most relevant national planning policy guidance on sustainability is set out in:

National Planning Policy Framework - 2023

Paragraph 157 states;

"The planning system should support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change. It should help to: shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure."



# **Regional and Local Policies**

The Development Plan comprises the London Plan (2021) and the London Borough of Richmond Local Plan (2018).

London Plan, published March 2021 - the following policies are relevant to the application:

# Policy SI 1 Improving air quality

- A Development Plans, through relevant strategic, site-specific and area-based policies, should seek opportunities to identify and deliver further improvements to air quality and should not reduce air quality benefits that result from the Mayor's or boroughs' activities to improve air quality.
- B To tackle poor air quality, protect health and meet legal obligations the following criteria should be addressed:
  - 1) Development proposals should not:
    - a) lead to further deterioration of existing poor air quality
    - b) create any new areas that exceed air quality limits, or delay the date at which compliance will be achieved in areas that are currently in exceedance of legal limits
    - c) create unacceptable risk of high levels of exposure to poor air quality.
  - 2) In order to meet the requirements in Part 1, as a minimum:
    - a) development proposals must be at least Air Quality Neutral
    - b) development proposals should use design solutions to prevent or minimise increased exposure to existing air pollution and make provision to address local problems of air quality in preference to post-design or retro-fitted mitigation measures
    - c) major development proposals must be submitted with an Air Quality Assessment. Air quality assessments should show how the development will meet the requirements of B1
    - d) development proposals in Air Quality Focus Areas or that are likely to be used by large numbers of people particularly vulnerable to poor air quality, such as children or older people should demonstrate that design measures have been used to minimise exposure.
- C Masterplans and development briefs for large-scale development proposals subject to an Environmental Impact Assessment should consider how local air quality can be improved across the area of the proposal as part of an air quality positive approach. To achieve this a statement should be submitted demonstrating:
  - 1) how proposals have considered ways to maximise benefits to local air quality, and
  - 2) what measures or design features will be put in place to reduce exposure to pollution, and how they will achieve this.
- D In order to reduce the impact on air quality during the construction and demolition phase development proposals must demonstrate how they plan to comply with the Non-Road Mobile Machinery Low Emission Zone and reduce emissions from the demolition and construction of buildings following best practice guidance.



Development proposals should ensure that where emissions need to be reduced to meet the requirements of Air Quality Neutral or to make the impact of development on local air quality acceptable, this is done on-site. Where it can be demonstrated that emissions cannot be further reduced by on-site measures, off-site measures to improve local air quality may be acceptable, provided that equivalent air quality benefits can be demonstrated within the area affected by the development.

# Policy SI 2 Minimising greenhouse gas emissions

- A Major development should be net zero-carbon. This means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the following energy hierarchy:
  - 1) be lean: use less energy and manage demand during operation
  - 2) be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly
  - 3) be green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site
  - 4) be seen: monitor, verify and report on energy performance.
- B Major development proposals should include a detailed energy strategy to demonstrate how the zero-carbon target will be met within the framework of the energy hierarchy.
- C A minimum on-site reduction of at least 35 per cent beyond Building Regulations is required for major development. Residential development should achieve 10 per cent, and non-residential development should achieve 15 per cent through energy efficiency measures. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, in agreement with the borough, either:
  - 1) through a cash in lieu contribution to the borough's carbon offset fund, or
  - 2) off-site provided that an alternative proposal is identified and delivery is certain.
- D Boroughs must establish and administer a carbon offset fund. Offset fund payments must be ringfenced to implement projects that deliver carbon reductions. The operation of offset funds should be monitored and reported on annually.
- E Major development proposals should calculate and minimise carbon emissions from any other part of the development, including plant or equipment, that are not covered by Building Regulations, i.e. unregulated emissions.
- F Development proposals referable to the Mayor should calculate whole life-cycle carbon emissions through a nationally recognised Whole Life-Cycle Carbon Assessment and demonstrate actions taken to reduce life-cycle carbon emissions.

#### Policy SI 4 Managing heat risk

A Development proposals should minimise adverse impacts on the urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure.



- B Major development proposals should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the following cooling hierarchy:
  - 1) reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure
  - 2) minimise internal heat generation through energy efficient design
  - 3) manage the heat within the building through exposed internal thermal mass and high ceilings
  - 4) provide passive ventilation
  - 5) provide mechanical ventilation
  - 6) provide active cooling systems.

#### Policy SI 5 Water infrastructure

- A In order to minimise the use of mains water, water supplies and resources should be protected and conserved in a sustainable manner.
- B Development Plans should promote improvements to water supply infrastructure to contribute to security of supply. This should be done in a timely, efficient and sustainable manner taking energy consumption into account.
- C Development proposals should:
  - through the use of Planning Conditions minimise the use of mains water in line with the Optional Requirement of the Building Regulations (residential development), achieving mains water consumption of 105 litres or less per head per day (excluding allowance of up to five litres for external water consumption)
  - 2) achieve at least the BREEAM excellent standard for the 'Wat 01' water category or equivalent (commercial development)
  - incorporate measures such as smart metering, water saving and recycling measures, including retrofitting, to help to achieve lower water consumption rates and to maximise future-proofing.
- D In terms of water quality, Development Plans should:
  - 1) promote the protection and improvement of the water environment in line with the Thames River Basin Management Plan, and should take account of Catchment Plans
  - 2) support wastewater treatment infrastructure investment to accommodate London's growth and climate change impacts. Such infrastructure should be constructed in a timely and sustainable manner taking account of new, smart technologies, intensification opportunities on existing sites, and energy implications. Boroughs should work with Thames Water in relation to local wastewater infrastructure requirements.
- E Development proposals should:
  - 1) seek to improve the water environment and ensure that adequate wastewater infrastructure capacity is provided



2) take action to minimise the potential for misconnections between foul and surface water networks. F Development Plans and proposals for strategically or locally defined growth locations with particular flood risk constraints or where there is insufficient water infrastructure capacity should be informed by Integrated Water Management Strategies at an early stage.

#### **London Borough of Richmond**

The London Borough of Richmond adopted its Local Plan on the 3<sup>rd</sup> July 2018.

The following policy is of particular relevance to the topic area of this Statement and has been edited for clarity and relevance to the application in question.

#### Local Plan (2018)

#### Policy LP 22 - Sustainable Design and Construction

A. Developments will be required to achieve the highest standards of sustainable design and construction to mitigate the likely effects of climate change. Applicants will be required to complete the following:

- Development of 1 dwelling unit or more, or 100sqm or more of non-residential floor space (including extensions) will be required to complete the Sustainable Construction Checklist SPD. A completed Checklist has to be submitted as part of the planning application.
- 2. Development that results in a new residential dwelling, including conversions, change of use, and extensions that result in a new dwelling unit, will be required to incorporate water conservation measures to achieve maximum water consumption of 110 litres per person per day for homes (including an allowance of 5 litres or less per person per day for external water consumption).
- New non-residential buildings over 100sqm will be required to meet BREEAM 'Excellent' standard.

# Reducing Carbon Dioxide Emissions

- B. Developers are required to incorporate measures to improve energy conservation and efficiency as well as contributions to renewable and low carbon energy generation. Proposed developments are required to meet the following minimum reductions in carbon dioxide emissions:
- All new major residential developments (10 units or more) should achieve zero carbon standards in line with London Plan policy.
- 2. All other new residential buildings should achieve a 35% reduction.
- 3. All non-residential buildings over 100sqm should achieve a 35% reduction. From 2019 all major non-residential buildings should achieve zero carbon standards in line with London Plan policy.



Targets are expressed as a percentage improvement over the target emission rate (TER) based on Part L of the 2013 Building Regulations.\*

C. This should be achieved by following the Energy Hierarchy:

1. Be lean: use less energy

Be clean: supply energy efficiently
 Be green: use renewable energy

#### **Decentralised Energy Networks**

D. The Council requires developments to contribute towards the Mayor of London target of 25% of heat and power to be generated through localised decentralised energy (DE) systems by 2025. The following will be required:

 All new development will be required to connect to existing DE networks where feasible. This also applies where a DE network is planned and expected to be operational within 5 years of the development being completed.

Applicants are required to consider the installation of low, or preferably ultra-low, NOx boilers to reduce the amount of NOx emitted in the borough.

Local opportunities to contribute towards decentralised energy supply from renewable and low-carbon technologies will be encouraged where appropriate.

As a result of revisions to the Building Regulations the LBRuT have published an update to the policy. This sets out a requirement for smaller residential schemes (below 10 units) to achieve a 35% reduction in emissions against a Building Regulations Part L (2021) baseline.

The update also sets out a requirement to follow the GLA Energy Assessment Guidance (2022) and to complete the 2022 Carbon Emissions Reporting Spreadsheet.



# 3.0 Assessment Methodology

The methodology used has followed that set out in the Energy Assessment Guidance published by the GLA in June 2022.

SAP calculations have been prepared using Part L 2021 to 'test' the Be Lean emissions. This uses the specification for building systems set out in the notional dwelling specification for new dwellings (Part L 2021 - Table 1.1).

Further SAP calculations have been prepared for the Be Green scenario, which uses the fabric specification established at the Be Lean stage but includes the actual building systems proposed.

#### **Emission Factors**

The CO<sub>2</sub> emission factors, where applicable, used throughout this report have been taken from SAP 10.2 as required by the GLA Energy Assessment Guidance.

	kg CO₂/kWh
Mains gas	0.210
Grid supplied and displaced electricity	0.136

# 4.0 Proposal

The accommodation schedule in detail is (note these figures differ from the areas quoted on the floor plans because of the different measuring requirements);

Unit Type	Number	Area	Total Area
		m²	m²
1-Bedroom Ground-floor apartments	2	55.4	110.8
2-Bedroom duplex apartments (1st & 2nd-floor)	2	73.8	147.6
Total	4		258.4



# 5.0 Energy Efficiency

# 5.1 Demand Reduction (Be Lean)

#### Design

The energy performance of a building is affected by its design, construction and use and whilst occupant behaviour is beyond the remit of this statement, better design and construction methods can significantly reduce the life cycle emissions of a building and assist the occupant to reduce consumption.

Sustainable design is not just about incorporating renewable technologies; buildings should be designed at the outset to provide suitable environmental conditions for the occupants whilst also consuming as little energy as practical.

#### **Passive Design Measures**

The passive design measures proposed include;

#### **Passive Solar Gain**

Passive measures include allowing for natural ventilation and exposed thermal mass coupled with high levels of insulation, air tightness and the control of solar gain.

The location and design of the building is in context with surrounding development and the shape of the site. The apartments are designed with dual aspects with the front of each being orientated towards the northeast and the rear towards the southwest.

All apartments benefit from access to direct sunlight at some point throughout the day and from cross ventilation to limit summer overheating.

# **Natural Daylighting**

The orientation and the size of the windows have been optimised to maximise the amount of natural daylight whilst avoiding summer overheating and therefore reduce the demand for artificial lighting.

#### **Efficient Building Fabric**

# **Building Envelope**

U-values of the building envelope must meet Building Regulations Part L standards and further improvements to U-values will reduce the building's heating requirements.

The ground-floor will be insulated with 200mm 'Kingspan' PIR insulation or similar.



The external walls will be built in traditional cavity wall construction with an overall width of 350mm. This will be comprised of 100mm facing brick, 150mm fully-filled cavity and 100mm medium density block internally.

The flat roof over the rear portion of Units 1 & 2 will be insulated with 200mm PIR insulation. Cold roofs will be insulated with 450mm of mineral wool, sloping ceilings and low-level walls within the second floor will be insulated with at least 150mm of PIR insulation.

Windows are proposed as double glazed with Low 'e' soft coat and argon filled.

It is proposed to set maximum limits for the elemental U-values as follows:

Element	Part L Limiting U-values		
	W/m <sup>2</sup> K	W/m <sup>2</sup> K	
Ground-Floors	0.18	0.11	39%
External Walls	0.26	0.18	31%
Flat Roof	0.16	0.13	19%
Roofs (cold)	0.16	0.10	38%
Sloping Ceilings & Low-level walls to 2 <sup>nd</sup> Floor	0.16	0.15	6%
Windows, Glazed Doors & Rooflights	1.60	1.20	25%
Entrance Doors	1.60	1.20	38%

'g' Value for Windows and Glazed Doors	0.54
'g' Value for Rooflights	0.45

#### Air Leakage

Large amounts of heat are lost in winter through air leakage from a building (also referred to as infiltration or air permeability) often through poor sealing of joints and openings in the building.

The Building Regulations set a minimum standard for air permeability of 8 m³ of air per hour per m² of envelope area, at 50Pa. It is proposed to achieve a 50% improvement over Building Regulations and the apartments will target a permeability of 4.0 m³/hr/m².

# **Thermal Bridging**

The significance of Thermal Bridging, as a potentially major source of fabric heat losses, is increasingly understood. Improving the U-values for the main building fabric without accurately addressing the Thermal Bridging is no longer an option and will not achieve the fabric energy efficiency and energy and  $CO_2$  reduction targets set out in this strategy.



The thermal details for the building will be modelled at the detailed working drawing stage but for the purposes of this assessment the thermal details formulated by the Recognised Construction Details have been used. Any details not available on the RCD website will be modelled. These will enable the building to achieve the higher energy efficiency requirements of the Building Regulations.

The following table provides the values currently used within the modelled SAP calculations.

Reference	Location	PSI Values
		W/mK
E2	Other Lintels (including other steel lintels)	0.028
E3	Sill	0.024
E4	Jamb	0.019
E5	Ground Floor	0.046
E7	Party Floor	0.036
E10	Eaves (Ceiling)	0.051
E14	Flat Roof	0.041
E16	Corner (normal)	0.037
E17	Corner (inverted)	-0.079
E18	Party Wall	0.041

#### Ventilation

As a result of increasing thermal efficiency and air tightness, Building Regulations Approved Document F was also revised in 2021 to address the possibility of overheating and poor air quality. The ventilation to the En-Suites and Bathrooms will be comprised of continuous extract ventilation as per System 3 criteria. This reduces the number of external penetrations required to the building envelope.

# Active Design Measures will include;

# **Efficient Lighting and Controls**

Throughout the scheme natural lighting will be optimised.

Part L of the Building Regulations requires all light fitting to have lamps with a minimum luminous efficacy of 85 light source lumens per circuit-watt.

#### **Space Heating and Hot Water**

The baseline SAP modelling has been based upon the use of a combination boiler installed to each apartment (as required by the GLA Guidance in order to test the efficiency of the building structure) but the proposed specification is based on the installation of heat pump hot water cylinders.



# 5.2 Establishing Carbon Dioxide Emissions (Be Lean)

The GLA Energy Assessment Guidance requires the energy efficiency of a building (Be Lean) to be tested using the building systems set out in Table 1.1 of Part L 2021.

SAP calculations have been prepared for one of the ground-floor 1-bedroom apartments and for one of the 1<sup>st</sup> and 2<sup>nd</sup>-floor duplex apartments. These are proposed as representative of all four units.

The baseline calculations are based on the fabric specification set out above but using the notional systems as required by the GLA Energy Assessment Guidance. These are not the proposed final option but are used to test the 'Be Lean' reductions only.

The TER & DER Worksheets for the 'Be Lean' scenario are attached as Appendix 1 but the emissions from the modelled apartments can be summarised as follows;

Unit Type	TER	DER
	kg CO₂/yr	kg CO₂/yr
1-Bed Ground-floor apartment	13.95	14.13
2-Bed Duplex apartment	10.78	11.60

#### **Summary**

The SAP calculations have allowed the GLA Carbon Reporting Spreadsheet to be populated.

This accompanies the planning application but from the spreadsheet the total TER emissions for the site are calculated as 3,135 kg CO<sub>2</sub> per year with DER emissions of 2,725 kg CO<sub>2</sub> per year.

The reduction in emissions is therefore 410 kg CO<sub>2</sub> per year, which equates to a reduction of 13.08% for the 'Be Lean' case.

The energy efficiency measures incorporated into the development therefore meet the requirements of the Guidance.



# 5.3 Low-Carbon and Renewable Technologies (Be Clean and Be Green)

The carbon dioxide emissions established above have been used to test the viability of various renewable and low carbon technologies as follows.

The Government's Renewable Obligation defines renewable energy in the UK. The identified technologies are;

- Small hydro-electric
- Landfill and sewage gas
- Onshore and offshore wind
- Biomass
- Tidal and wave power
- Geothermal power
- Solar

The use of landfill or sewage gas, offshore wind or any form of hydroelectric power is not suitable for the site due to its location. The remaining technologies are considered below;

#### Wind

Wind turbines are available in various sizes from large rotors able to supply whole communities to small roof or wall-mounted units for individual dwellings.

The Government wind speed database predicts local wind speeds at Friars Lane to be 4.8 m/s at 10m above ground level and 5.5 m/s at 25m above ground level. This is below the level generally required for commercial investment in large wind turbines. In addition the land take, potential for noise and signal interference make a large wind turbine unsuitable for this development.

Roof mounted turbines could be used at the development to generate small but valuable amounts of renewable electricity but the small output and contribution to total emissions means any investment would be small and purely tokenism. In addition the use of wind turbines will have a detrimental aesthetic impact on the appearance of the development.

#### **Combined Heat and Power and Community Heating**

Combined heat and power (CHP) also called co-generation is a de-centralised method of producing electricity from a fuel and 'capturing' the heat generated for use in buildings. The plant is essentially a small-scale electrical power station. The production and transportation of electricity via the National Grid is very inefficient with over 65% of the energy produced at the power station being lost to the atmosphere and through transportation.



CHP units are generally gas fuelled and generate electricity with heat being a by-product. The heat is usually used to meet the hot water load, which is fairly consistent throughout the year.

Historically CO<sub>2</sub> savings have been achieved because gas has been used to generate electricity and gas has had a lower emissions factor than electricity, However, with the de-carbonisation of the electricity grid the benefit of CHP is negated and consequently the use of a CHP would increase emissions rather than reduce them.

CHP is not proposed.

#### **Ground Source Heat Pumps**

Sub soil temperatures are reasonably constant and predictable in the UK, providing a store of the sun's energy throughout the year. Below London the groundwater in the lower London aquifer is at a fairly constant temperature of 12° C. Ground source heat pumps (GSHP) extract this low-grade heat and convert it to usable heat for space heating.

GSHP operates on a similar principle to refrigerators, transferring heat from a cool place to a warmer place. They operate most efficiently when providing space heating at a low temperature, typically via under floor heating or with low temperature radiators.

The installation of ground source heat pumps to this scheme is not appropriate.

#### Solar

### (i) Solar Water Heating

Solar hot water panels use the suns energy to directly heat water circulating through panels or pipes. The technology is simple and easily understood by purchasers.

Solar hot water heating panels are based generally around two types, which are available being 'flat plate collectors' and 'evacuated tubes'. Flat plate collectors can achieve an output of up to 1,124 kWh/annum (Schuco) and evacuated tubes can achieve outputs up to 1,365 kWh/annum (Riomay).

Panels are traditionally roof mounted and for highest efficiencies should be mounted plus or minus 30 degrees of due south. Evacuated tubes can be laid horizontally on flat roofs but flat plate collectors are recommended for installation at an incline of 30 degrees

The installation of heat pumps reduces the emissions from the hot water demand significantly and the installation of solar hot water heating panels only reduces further emissions marginally and does not represent good value when compared with only technologies.

In addition, solar hot water panels are only applicable to the duplex apartments.

They are therefore are not proposed.



# (ii) Photovoltaics

Photovoltaic panels (PV) provide clean silent electricity. They generate electricity during most daylight conditions although they are most efficient when exposed to direct sunlight or are orientated to face plus or minus 30 degrees of due south.

PV panels can be integrated into many different aspects of a development including roofs, walls, shading devices or architectural panels. The panels typically have an electrical warranty of 20-25 years and an expected system lifespan of 25-40 years.

The Roof Plan & Elevation attached as Appendix 3 demonstrate a total of 22 panels could be installed. These will be very gently inclined at around 10 degrees to allow for self-cleaning on racks and orientated towards the southeast. Assuming the installation of 400W panels the total reduction in emissions from the array will be **731 kg CO<sub>2</sub> per year**. This reduction has been incorporated into the Be Green SAP calculations.

#### Air Source Heat Pumps (ASHP)

Air sourced heat pumps operate using the same reverse refrigeration cycle as ground source heat pumps; however, the initial heat energy is extracted from the external air rather than the ground.

The installation of heat pump hot water cylinders is appropriate and the analysis set out in 5.4 below considers the use of this technology.



# 5.4 Establishing Carbon Dioxide Emissions (Be Green)

SAP calculations have been prepared for the modelled apartments based on the fabric specification set out above but with the actual systems proposed for installation.

These include the installation of a heat pump hot water cylinder to each unit and the installation of 22 x 400W photovoltaic panels on the southwest orientated rear roof of the building.

The DER Worksheets for the 'Be Green' scenario are attached as Appendix 2 but the emissions from the apartments can be summarised as follows;

Unit Type	DER
	kg CO₂/yr
1-Bed Ground-floor apartment	4.38
2-Bed Duplex apartment	2.97

#### **Summary**

These emissions have been inputted into the GLA Carbon Emissions Reporting Spreadsheet and from these the total DER emissions for the Be Green scenario are calculated as 923 kg CO<sub>2</sub> per year.

The reduction in emissions is therefore 2,212 kg CO<sub>2</sub> per year, which equates to a reduction of 70.56% for the 'Be Green' case.



# 5.5 Summary of Calculations

#### Be Lean

SAP calculations have been prepared using Part L 2021 of the Building Regulations.

Based on the Be Lean scenario the total  $CO_2$  emissions are calculated as 3,135 kg  $CO_2$  per year (TER) and 2,725 kg  $CO_2$  per year (DER).

This equates to a reduction of **410 kg CO<sub>2</sub> per year** or **13.08%** of the total TER emissions and is therefore compliant with the GLA energy guidance.

The TER & DER Worksheets for the modelled apartments for the Be Lean scenario are attached as Appendix 1.

#### Be Green

A further set of calculations has been prepared for the proposed energy strategy.

These propose the installation of a heat pump hot water cylinder into each apartment as well as a total of 22 x 400W photovoltaic panels installed on the southwest orientated rear roof of the building.

A Roof Plan & Elevation showing the indicative layout of the panels is attached as Appendix 3.

Based on the Be Green scenario the total CO<sub>2</sub> emissions are calculated as 923 kg CO<sub>2</sub> per year (DER).

This equates to a reduction of 2,212 kg CO<sub>2</sub> per year or 70.56% of the total TER emissions.

The DER Worksheets for the modelled apartments for the Be Green scenario are attached as Appendix 2.

#### **Summary**

The GLA Carbon Emissions Reporting Spreadsheet has been completed and (separately) accompanies this Statement

The residual emissions are **0.923 tonnes**, which requires a carbon offset payment of £2,631 (based on the carbon offset payment of £2,850 per tonne).



# 6.0 Climate change adaption and Water resources

# Sustainable Drainage Systems (SUDS)

The site lies within Flood Zone 1 and is classified as being of low risk.

#### **Surface Water Management**

Consideration has been given to the use of grey water recycling. However, customer's resistance to the appearance of the recycled water and the cost of the systems does not currently make them a viable option. They have therefore not been included in the proposals.

#### Water efficiency measures

In excess of 20% of the UK's water is used domestically with over 50% of this used for flushing WCs and washing (source: Environment Agency). The majority of this comes from drinking quality standard or potable water.

The water efficiency measures included will ensure that the water use target of 110 litres per person per day is achieved.

Water efficient devices will be fully evaluated, and installed, wherever possible. The specification of such devices will be considered at detailed design stage and each will be subject to an evaluation based on technical performance, cost and market appeal, together with compliance with the water use regulations.

The following devices will be incorporated within the apartments:

- water efficient taps
- water efficient toilets
- low output showers
- flow restrictors to manage water pressures to achieve optimum levels and
- water meters

Water consumption calculations have been carried out using the Water Efficiency Calculator provided by the BRE. Although not perfect this calculator gives a good indication of the probable water use in a dwelling, although this is largely dependent on the way on which occupants use their homes.



Below is a typical specification, which would achieve the 110 Litres per person per day target (including five litres per person per day allowance for external water use).

Schedule of Appliance Water Consumption									
Appliance	Total Litres								
wc	6/3 litres dual flush	17.64							
Basin	2.0 litres/min.	4.74							
Shower	9.0 litres/min	39.33							
Bath	175 litres	19.25							
Sink	5.0 litres/min	12.56							
Washing Machine	6.75 litres/kg	14.18							
Dishwasher	1.25 litres/places	4.50							
		112.20							
	Normalisation Factor	0.91							
Total Int	ernal Water Consumption	102.10							
	External Water Use	5.00							
	107.10								



#### 7.0 Materials and Waste

The BRE Green Guide to Specification is a simple guide for design professionals. The guide provides environmental impact, cost and replacement interval information for a wide range of commonly used building specifications over a notional 60-year building life. The construction specification will prioritise materials within ratings A+, A or B.

Preference will be given to the use of local materials & suppliers where viable to reduce the transport distances and to support the local economy. A full evaluation of these suppliers will be undertaken at the next stage of design.

In addition, timber would be sourced, where practical, certified by PEFC or an equivalent approved certification body and all site timber used within the construction process would be recycled.

All insulation materials to will have a zero ozone depleting potential

#### **Construction waste**

Targets will be set to promote resource efficiency in accordance with guidance from WRAP, Envirowise, BRE and DEFRA.

The overarching principle of waste management is that waste should be treated or disposed of within the region where it is produced.

Construction operations generate waste materials as a result of general handling losses and surpluses. These wastes can be reduced through appropriate selection of the construction method, good site management practices and spotting opportunities to avoid creating unnecessary waste.

The Construction Strategy will explore these issues, some of which are set out below:

- Proper handling and storage of all materials to avoid damage.
- Efficient purchasing arrangements to minimise over ordering.
- Segregation of construction waste to maximise potential for reuse/recycling.
- Suppliers who collect and reuse/recycle packaging materials.



Appendix 1 – TER & DER Worksheets for the Modelled Apartments for the Be Lean scenario	



Property Reference	се		riars Lane 1BF	GND 55 - Lean	l					Issued	on Date	01/03/2024	
Assessment Refe	rence	I	riars Lane 1BF	GND 55 Lean				Prop Type F	Ref	Friars La	ne 1BF GND 55 -	Lean	
Property		I	Hunters Lodge,	Friars Lane, Ric	hmond, London,	TW9 1NX							
SAP Rating					85 B		DER	14	1.13		TER	13.95	
Environmental					90 B		% DER < TE	R				-1.29	
CO <sub>2</sub> Emissions (t/	year)				0.69		DFEE	29	9.10		TFEE	34.02	
Compliance Chec	k				See BREL		% DFEE < T	FEE				14.47	
% DPER < TPER					-7.32		DPER	79	9.05		TPER	73.66	
Assessor Details		Mr. Iva	ın Ball								Assessor ID	X001-72	283
Client													
SAP 10 WORKSHEET CALCULATION OF I						, 2022)							
1. Overall dwell	ing charac	cteristic						Area (m2)		torey hei	ght (m)	Volume (m3)	
Ground floor Total floor area Dwelling volume	a TFA = (1a	a)+(1b)+(	lc)+(1d)+(1e	e)(1n)	5	55.4000		55.4000	(1b) x	2.4	(3e)(3n) =	= 135.7300	(1b) - (3b) (4)
2. Ventilation r									-				
Number of open of Number of open f Number of chimme Number of flues Number of flues Number of blocke Number of interm Number of passiv Number of fluele	flues  eys / flues  attached fattached fed chimneys  mittent extremely extre	to solid : to other h s tract fans	fuel boiler neater	fire							0 * 80 = 0 * 20 = 0 * 10 = 0 * 20 = 0 * 10 = 0 * 35 = 0 * 20 = 1 * 10 = 0 * 40 = 0 *	= 0.0000 = 0.0000 = 0.0000 = 0.0000 = 10.0000 = 0.0000	(6a) (6b) (6c) (6d) (6d) (6e) (6f) (7a)
Infiltration due Pressure test Pressure Test Me Measured/design Infiltration rat Number of sides	ethod AP50		s and fans	= (6a)+(6b)	+ (6c) + (6d) + (	(6e) + (6f) + (	(6g)+(7a)+	(7b)+(7c) =	=	10.	Air char 0000 / (5) =	Yes Blower Door 4.0000 0.2737	7 (8) 3 5 0 (17)
Shelter factor Infiltration rat			ıde shelter	factor					(20) = 1		75 x (19)] = 18) x (20) =	= 0.7750	(20)
Wind speed Wind factor	Jan 5.1000 1.2750	Feb 5.0000 1.2500		Apr 4.4000 1.1000	May 4.3000 1.0750	Jun 3.8000 0.9500	Jul 3.8000 0.9500				Nov 000 4.500 750 1.125	00 4.7000	) (22) ) (22a)
Adj infilt rate Effective ac	0.2704 0.5366	0.2651 0.5351			0.2280 0.5260	0.2015 0.5203	0.2015 0.5203				280 0.238 260 0.528		2 (22b) L (25)
3. Heat losses a	and heat lo	oss parame	eter										
Element  Glazed Door/ Wir  Heatloss Floor 1  External Wall 1	ndow (Uw =			Gross m2 53.7800	Openings m2 15.2900	Net 15. 55.	m2 .2900 .4000 .4900	U-value W/m2K 1.1450 0.1100 0.1500	17. 6.	x U W/K 5076 0940 7735	K-value kJ/m2K	A x F kJ/F	
Flat Roof Total net area of Fabric heat loss Party Wall Party Ceiling	of external			6.8500		6. 116. 29.	.8500 .0300	0.1300 (30) + (32) 0.0000	0. = 30.	8905 2656 0000			(30) (31) (33) (32) (32b)
E3 Sill E4 Jamb E16 Corr E18 Part E5 Grour E14 Flat	Bridges ent r lintels her (normal ty wall beind floor (normal	(including	g other stee	el lintels)	external are	ea)		2	Length 9.4000 6.7000 22.4000 7.3500 4.9000 1.9500 5.5400 2.4500	Psi-val 0.02 0.02 0.01 0.03 0.04 0.04 -0.07	80 0. 40 0. 90 0. 70 0. 10 0. 60 1.	250.0000 Total .2632 .1608 .4256 .2719 .2009 .0097 .2271 .1936	) (35)

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Company   Comp	Point Thermal b Total fabric he	bridges eat loss		lated using						(:	33) + (36) -	(36a) = + (36a) =	2.3657 0.0000 32.6314	
Martin   M	Ventilation hea	Jan	Feb	Mar	Apr			Jul	Aug	Sep	Oct	Nov	Dec	
Second   Control   Contr				23.9073	23.6145	23.5597	23.3047	23.3047	23.2575	23.4029	23.5597	23.6705	23.7864	(38)
March   1.028	Average = Sum(			56.5387	56.2459	56.1911	55.9361	55.9361	55.8888	56.0343	56.1911	56.3019		(39)
March   1,028   1,029   1,02	-			Mar	Apr	Mav	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Series la senit   22   28   27   29   29   29   29   29   29   29		1.0228	1.0217	1.0206			1.0097	1.0097			1.0143	1.0163		(40)
Marie Mari		31	28	31	30	31	30	31	31	30	31	30		
Marie   Mari														
March   Marc														
Martin   M	4. Water heating	ng energy r	equirement	s (kWh/year	)									
Description   Company	Assumed occupan	ncy											1.8491	(42)
State   Stat	-	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Marce   Sile   Marce   Sile		63.6272	62.6822	61.3515	58.8980	57.0608	55.0236	53.9232	55.2446	56.6834	58.8632	61.3673	63.4121	(42b)
The part	-	33.5663	32.3457		29.9045	28.6840	27.4634	27.4634	28.6840	29.9045	31.1251	32.3457		
Delly not water use	Average daily i						_		_	_				(43)
Ready   Content   13.385   143.385   143.385   143.385   143.385   143.285	Daily hot wate:	r use				-			-	-				
Section   1968		153.9307									122.1133	133.5114	151.8447	
Marca   1,000		oss (46) m												
Company   Comp	Water storage		20.2978	21.3200	18.2349	17.3143	15.2141	14.7645	15.5882	16.0157	18.3170	20.0267	22.7767	(46)
Principle   0.000	Total storage		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
Combi Cose 49,5287 43,7389 47,1291 43,739 43,6946 00.6785 41,4777 42,7709 45,8571 46,2146 49,4121 6170 talheat required for water heating accordance for acc	If cylinder con				0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Total heat required for water heating calculated for each month.  WHEN BIRS 0.1459: 179.15791 291.2581 165.3932 195.1381 142.1039 146.5902 149.4721 157.7702 179.7702 201.2581 (69) milks with the property of													0.0000	(59)
WRIES   0.0000   0.		uired for w	ater heati	ng calculate	ed for each	n month								
Solar input 0.00000 0.0000 0.00000 0.0000 0.00000 0.0000 0.0000 0.0000 0.0000 0		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
Output from w/h  203.4595   179.0574   189.2583   165.3592   189.1234   142.1059   139.9038   144.6902   149.4724   167.9704   179.7260   201.2581   67.2582	Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
State   Park   CMB/year   Calculated   Cal		h												
Electric shower(s) 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (64a)  Heat gains from water heating, kMt/month 63.5641 55.3281 59.0406 51.3690 49.3037 43.8942 43.0964 45.2460 46.1768 52.0669 55.9462 62.8431 (65)  S. Internal gains (see Table 5 and 5a)  What a see Table 5 and 5	100 . 1			189.2383	103.3392	159.1234	142.1059	139.9038					2023.3902	(64)
Face   Second   Face		r(s)												
S. Internal gains (see Table 5 and 5a)   S. 1860   S.		0 0000			0 0000	0 0000								(642)
Matabolic gains   Cable   5   Watts   Succession   Success														
Matabolic gains   Cable   5   Watts   Succession   Success	Heat gains from	m water hea	ting, kWh/	month	Tot	al Energy us	sed by insta	intaneous e	lectric show	wer(s) (kWh	/year) = Sur	m(64a)m =	0.0000	(64a)
Metabolic gains (Table 5), Watte	Heat gains from	m water hea	ting, kWh/	month	Tot	al Energy us	sed by insta	intaneous e	lectric show	wer(s) (kWh	/year) = Sur	m(64a)m =	0.0000	(64a)
Company   Comp		m water hea 63.5641	ting, kWh/: 55.9281	month 59.0406	Tot 51.3690	49.3037	sed by insta 43.8942	43.0964	lectric show	wer(s) (kWh	/year) = Sur	m(64a)m =	0.0000	(64a)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	5. Internal ga	m water hea 63.5641 ins (see Ta	ting, kWh/: 55.9281	month 59.0406	Tot	49.3037	43.8942	43.0964	45.2460	wer(s) (kWh	/year) = Sur	m(64a)m =	0.0000	(64a)
Sample   S	5. Internal ga	m water hea 63.5641  ins (see Ta	ting, kWh/: 55.9281 ble 5 and, Watts	month 59.0406	Tot	49.3037	43.8942	43.0964	45.2460	wer(s) (kWh.	/year) = Sur 52.0669	m(64a)m = 55.9462	0.0000 62.8431	(64a)
161,2159   162,8888   158,6731   149,6984   138,3694   127,7218   120,6088   118,9356   123,1513   132,1260   143,4550   154,1026   (68)	5. Internal ga: Metabolic gain:	m water hea 63.5641 ins (see Ta 	ting, kWh/: 55.9281 ble 5 and, Watts Feb 92.4535	month 59.0406 5a) 	Tot 51.3690 Apr 92.4535	49.3037 May 92.4535	43.8942  Jun 92.4535	43.0964	45.2460	wer(s) (kWh, 46.1768 Sep	/year) = Sur 52.0669 Oct	m(64a)m = 55.9462	0.0000 62.8431 Dec	(64a) (65)
Pumps, fans   3.2453   32.2453   3	5. Internal ga: Metabolic gain: (66) m Lighting gains	m water hea 63.5641  ins (see Ta (Table 5) Jan 92.4535 (calculate 81.3149	ting, kWh/s 55.9281 ble 5 and , Watts Feb 92.4535 d in Appen 90.0272	month 59.0406 5a) Mar 92.4535 dix L, equa 81.3149	Tot 51.3690 	49.3037 49.3037 May 92.4535 L9a), also s 81.3149	43.8942  43.8942  Jun 92.4535 see Table 5 84.0254	Jul 92.4535 81.3149	45.2460 45.2460  Aug 92.4535	wer(s) (kWh, 46.1768 Sep 92.4535	/year) = Sur 52.0669 Oct 92.4535	M(64a)m = 55.9462 Nov 92.4535	0.0000 62.8431 Dec 92.4535	(64a) (65)
Losses e.g. evaporation (negative values) (Table 5)	5. Internal ga: Metabolic gain: (66) m Lighting gains Appliances gain	m water hea 63.5641  ins (see Ta s (Table 5) Jan 92.4535 (calculate 81.3149 ns 161.2159	ting, kWh/s 55.9281 ble 5 and , Watts Feb 92.4535 d in Appen 90.0272 ted in App 162.8888	month 59.0406 5a) Mar 92.4535 dix L, equa: 81.3149 endix L, equ 158.6731	Tot 51.3690 Apr 92.4535 tion L9 or 84.0254 uation L13 149.6984	May 92. 4535 L9a), also s 81.3149 or L13a), also 138.3694	3.8942 43.8942 Jun 92.4535 see Table 5 84.0254 lso see Tabl	Jul 92.4535 81.3149 e 5 120.6085	45.2460 45.2460 	sep 92.4535 84.0254	/year) = Sur 52.0669 Oct 92.4535 81.3149	Nov 92.4535 84.0254	0.0000 62.8431 Dec 92.4535 81.3149	(64a) (65)
Water heating gains (Table 5) 85.4377 83.264 79.3556 71.3458 66.2685 60.9642 57.9253 60.8146 64.1344 69.9825 77.7030 84.4666 (72) Total internal gains 381.7025 389.8784 373.0796 358.8057 339.6888 323.4474 310.5847 311.8011 322.0471 337.1594 358.9194 373.6201 (73)  6. Solar gains    Jan   Area   Solar flux   Table 6a   Specific data   Specific data   Factor   W	5. Internal ga: Metabolic gain: (66)m Lighting gains Appliances gain Cooking gains	m water hea 63.5641	ting, kWh/: 55.9281  ble 5 and	month 59.0406 	Tot 51.3690  Apr 92.4535 tion L9 or 84.0254 uation L13 149.6984 ion L15 or 32.2453	May 92.4535 L9a), also: 81.3149 a 138.3694 L15a), also: 32.2453	43.8942 43.8942 Jun 92.4535 see Table 5 84.0254 127.7218 see Table 5 32.2453	Jul 92.4535 81.3149 e 5 120.6085	45.2460 45.2460 	Sep 92.4535 84.0254 123.1513 32.2453	/year) = Sur 52.0669 Oct 92.4535 81.3149 132.1260 32.2453	Nov 92.4535 84.0254 143.4550 32.2453	0.0000 62.8431 Dec 92.4535 81.3149 154.1026 32.2453	(64a) (65) (66) (67) (68) (69)
Total internal gains  381.7025 389.8784 373.0796 358.8057 339.6888 323.4474 310.5847 311.8011 322.0471 337.1594 358.9194 373.6201 (73)  6. Solar gains  [Jan]  Area  Solar flux  m2  Table 6a  Wm2  Table 6a  Specific data  Or Table 6b  Or Table 6c	5. Internal ga: Metabolic gain: (66)m Lighting gains Appliances gain Cooking gains Pumps, fans Losses e.g. ev.	m water hea 63.5641  ins (see Ta  s (Table 5) Jan 92.4535 (calculate 81.3149 ns (calculated 32.2453 3.0000 aporation (	ting, kWh/: 55.9281 ble 5 and 	Mar 92.4535 dix L, equat. 158.6731 ix L, equat. 32.2453 32.0000 alues) (Tab.	Tot 51.3690 Apr 92.4535 tion L9 or 84.0254 uation L13 149.6984 uot L15 or 32.2453 3.0000 le 5)	May 92.4535 L9a), also s1,3149 or L13a), also 32,2453 3.0000	Jun 92.4535 84.0254 lso see Table 5 32.2453 0.0000	Jul 92.4535 81.3149 e 5 120.6085 5 32.2453 0.0000	45.2460 45.2460 	sep 92.4535 84.0254 123.1513 32.2453 0.0000	/year) = Sur 52.0669 Oct 92.4535 81.3149 132.1260 32.2453 3.0000	Nov 92.4535 84.0254 143.4550 32.2453 3.0000	Dec 92.4535 81.3149 154.1026 32.2453 3.0000	(64a) (65) (66) (67) (68) (69) (70)
6. Solar gains  [Jan] Area m2 Table 6a Specific data or Table 6b Table 6c Table 6d  Northeast 5.5700 11.2829 0.5400 0.7000 0.7700 16.4628 (75) Southwest 3.7800 36.7938 0.5400 0.7000 0.7700 57.2515 (77) Southwest 3.7800 36.7938 0.5400 0.7000 0.7700 0.7700 36.4327 (79)  Solar gains 110.1470 193.0893 278.7178 369.6905 436.3057 442.9251 422.9593 371.7671 309.9870 217.3210 132.9265 93.6185 (83) Total gains 491.8494 582.9677 651.7974 728.4962 775.9945 766.3725 733.5441 683.5682 632.0341 554.4804 491.8459 467.2386 (84)  7. Mean internal temperature (heating season)  Temperature during heating periods in the living area from Table 9, Th1 (C)  Table 6c Table 6c Table 6d  0.7000 0.7700 0.7700 16.4628 (75) 0.7000 0.7700 0.7700 36.4327 (79) 0.7000 0.7700 36.4327 (79) 0.7000 0.7700 36.4327 (79) 0.7000 0.7000 0.7700 36.4327 (79) 0.7000 0.7000 0.7700 36.4327 (79) 0.7000 0.7000 0.7700 36.4327 (79) 0.7000 0.7000 0.7000 0.7000 0.7000 0.7000 0.7000 0.7000 0.7000 36.4327 (79) 0.7000 0.70	5. Internal ga: Metabolic gain: (66)m Lighting gains Appliances gain Cooking gains Pumps, fans Losses e.g. eve	m water hea 63.5641  ins (see Ta 5) Jan 92.4535 (calculate 81.3149 ns (calculate 32.2453 3.0000 aporation (-73.9628 gains (Tabl	ting, kWh/: 55.9281 	month 59.0406 ———————————————————————————————————	Apr 92.4535 tion L9 or 84.0254 uation L13 or 32.2453 3.0000 le 5) -73.9628	May 92.4535 19a), also s 81.3149 or L13a), al 138.364	Jun 92.4535 see Table 5 84.0254 lso see Table 5 32.2453 0.0000 -73.9628	Jul 92.4535 81.3149 e 5 120.6085 5 32.2453 0.0000 -73.9628	Aug 92.4535 81.3149 118.9356 32.2453 0.0000 -73.9628	Sep 92.4535 84.0254 123.1513 32.2453 0.0000 -73.9628	Oct 92.4535 81.3149 132.1260 32.2453 3.0000 -73.9628	Nov 92.4535 84.0254 143.4550 32.2453 3.0000 -73.9628	Dec 92.4535 81.3149 154.1026 32.2453 3.0000 -73.9628	(64a) (65) (66) (67) (68) (69) (70) (71)
6. Solar gains    Jan   Area   Solar flux   g   FF   Access   Gains   m2   Table 6a   Specific data   or Table 6c   Table 6d   M/m2   Or Table 6c   Table 6d   Or Table 6c   Table 6d   Or Table 6c   Table 6d   Or Table 6c   Or Table 6c   Table 6d   Or Table 6c   Or Table 6c   Table 6d   Or Table 6c   Or Table 6c   Or Table 6c   Table 6d   Or Table 6c   Or Table 9c   Or Table 6c   Or Table 6c   Or Table 6c   Or Table 6c   Or Table 9c   Or T	5. Internal gas Metabolic gain: (66)m Lighting gains Appliances gain Cooking gains Pumps, fans Losses e.g. eva	m water hea 63.5641  ins (see Ta 5.75 (alculate 81.3149) ns (alculate 32.2453 (alculated 32.2453 3.0000 aporation (73.9628 gains (Tabl 85.4357 gains	ble 5 and	month 59.0406 5a) Mar 92.4535 dix L, equa- 81.3149 endix L, equa- 158.6731 ix L, equat- 32.2453 3.0000 alues) (Tab. -73.9628 79.3556	Apr 92.4535 tion L9 or 84.0254 uation L13 3.0000 le 5) -73.9628 71.3458	May 92.4535 L9a), also s 81.3149 or L13a), also 32.2453 3.0000 -73.9628	Jun  92.4535 see Table 5 84.0254 lso see Table 5 32.2453 0.0000 -73.9628 60.9642	Jul 92.4535 81.3149 e 5 120.6085 32.2453 0.0000 -73.9628 57.9253	Aug 92.4535 81.3149 118.9356 32.2453 0.0000 -73.9628 60.8146	Sep 92.4535 84.0254 123.1513 32.2453 0.0000 -73.9628 64.1344	Oct 92.4535 81.3149 132.1260 32.2453 3.0000 -73.9628 69.9825	Nov 92.4535 84.0254 143.4550 32.2453 3.0000 -73.9628 77.7030	Dec 92.4535 81.3149 154.1026 32.2453 3.0000 -73.9628 84.4666	(64a) (65) (66) (67) (68) (69) (70) (71) (72)
6. Solar gains    Jan   Area   Solar flux   g   FF   Access   Gains   m2   Table 6a   Specific data   or Table 6c   Table 6d   M/m2   Or Table 6c   Table 6d   Or Table 6c   Table 6d   Or Table 6c   Table 6d   Or Table 6c   Or Table 6c   Table 6d   Or Table 6c   Or Table 6c   Table 6d   Or Table 6c   Or Table 6c   Or Table 6c   Table 6d   Or Table 6c   Or Table 9c   Or Table 6c   Or Table 6c   Or Table 6c   Or Table 6c   Or Table 9c   Or T	5. Internal gas Metabolic gain: (66)m Lighting gains Appliances gain Cooking gains Pumps, fans Losses e.g. eva	m water hea 63.5641  ins (see Ta 5.75 (alculate 81.3149) ns (alculate 32.2453 (alculated 32.2453 3.0000 aporation (73.9628 gains (Tabl 85.4357 gains	ble 5 and	month 59.0406 5a) Mar 92.4535 dix L, equa- 81.3149 endix L, equa- 158.6731 ix L, equat- 32.2453 3.0000 alues) (Tab. -73.9628 79.3556	Apr 92.4535 tion L9 or 84.0254 uation L13 3.0000 le 5) -73.9628 71.3458	May 92.4535 L9a), also s 81.3149 or L13a), also 32.2453 3.0000 -73.9628	Jun  92.4535 see Table 5 84.0254 lso see Table 5 32.2453 0.0000 -73.9628 60.9642	Jul 92.4535 81.3149 e 5 120.6085 32.2453 0.0000 -73.9628 57.9253	Aug 92.4535 81.3149 118.9356 32.2453 0.0000 -73.9628 60.8146	Sep 92.4535 84.0254 123.1513 32.2453 0.0000 -73.9628 64.1344	Oct 92.4535 81.3149 132.1260 32.2453 3.0000 -73.9628 69.9825	Nov 92.4535 84.0254 143.4550 32.2453 3.0000 -73.9628 77.7030	Dec 92.4535 81.3149 154.1026 32.2453 3.0000 -73.9628 84.4666	(64a) (65) (66) (67) (68) (69) (70) (71) (72)
Area mu/mu/mu/mu/mu/mu/mu/mu/mu/mu/mu/mu/mu/m	5. Internal gas Metabolic gain: (66)m Lighting gains Appliances gain Cooking gains Pumps, fans Losses e.g. eva Water heating of	m water hea 63.5641	ting, kWh/: 55.9281	Mar 92.4535 dix L, equa 81.3149 endix L, equa 158.6731 ix L, equat. 32.2453 3.0000 alues) (Tab. -73.9628 79.3556	Apr 92.4535 tion L9 or 84.0254 dation L13 149.6984 dion L15 or 32.2453 3.0000 le 5) -73.9628 71.3458 358.8057	May 92.4535 L9a), also 81.3149 a138.3694 L15a), also 32.2453 3.0000 -73.9628 66.2685 339.6888	Jun 92.4535 see Table 5 84.0254 lso see Tabl 127.7218 see Table 5 32.2453 0.0000 -73.9628 60.9642 323.4474	Jul 92.4535 81.3149 e 5 120.6085 32.2453 0.0000 -73.9628 57.9253 310.5847	Aug 92.4535 81.3149 118.9356 32.2453 0.0000 -73.9628 60.8146 311.8011	Sep 92.4535 84.0254 123.1513 32.2453 0.0000 -73.9628 64.1344	Oct 92.4535 81.3149 132.1260 32.2453 3.0000 -73.9628 69.9825	Nov 92.4535 84.0254 143.4550 32.2453 3.0000 -73.9628 77.7030	Dec 92.4535 81.3149 154.1026 32.2453 3.0000 -73.9628 84.4666	(64a) (65) (66) (67) (68) (69) (70) (71) (72)
Table 6a Specific data or Table 6c Table 6d Tabl	5. Internal ga:  Metabolic gains  (66) m Lighting gains  Appliances gain  Cooking gains  Pumps, fans Losses e.g. ev.  Water heating of  Total internal	m water hea 63.5641  ins (see Ta s (Table 5) Jan 92.4535 (calculate 81.3149 ns (calculate 32.2453 3.0000 aporation (-73.9628 gains (Tabl 85.4357 gains 381.7025	ting, kWh/: 55.9281	Mar 92.4535 dix L, equa- 81.3149 endix L, equa- 158.6731 ix L, equat- 32.2453 3.0000 alues) (Tab- -73.9628 79.3556 373.0796	Apr 92.4535 tion L9 or 84.0254 uation L13 149.694 ion L15 or 32.2453 3.0000 le 5) -73.9628 358.8057	May 92, 4535 L9a), also s 81,3149 or L13a), also 32,2453 3,0000 -73,9628 66,2685 339,6888	Jun 92.4535 see Table 5 84.0254 Iso see Table 5 32.2453 0.0000 -73.9628 60.9642 323.4474	Jul 92.4535 81.3149 e 5 120.6085 57.9253 310.5847	Aug 92.4535 81.3149 118.9356 32.2453 0.0000 -73.9628 60.8146 311.8011	Sep 92.4535 84.0254 123.1513 32.2453 0.0000 -73.9628 64.1344	Oct 92.4535 81.3149 132.1260 32.2453 3.0000 -73.9628 69.9825	Nov 92.4535 84.0254 143.4550 32.2453 3.0000 -73.9628 77.7030	Dec 92.4535 81.3149 154.1026 32.2453 3.0000 -73.9628 84.4666	(64a) (65) (66) (67) (68) (69) (70) (71) (72)
Northeast 5.5700 11.2829 0.5400 0.7000 0.7700 16.4628 (75) Southeast 5.9400 36.7938 0.5400 0.7000 0.7700 57.2515 (77) Southwest 5.9400 36.7938 0.5400 0.7000 0.7700 57.2515 (77) Southwest 0.5400 0.7000 0.7700 36.4327 (79)  Solar gains 110.1470 193.0893 278.7178 369.6905 436.3057 442.9251 422.9593 371.7671 309.9870 217.3210 132.9265 93.6185 (83) Total gains 491.8494 582.9677 651.7974 728.4962 775.9945 766.3725 733.5441 683.5682 632.0341 554.4804 491.8459 467.2386 (84)  7. Mean internal temperature (heating season)  Temperature during heating periods in the living area from Table 9, Th1 (C) Utilisation factor for gains for living area, nil,m (see Table 9a)  Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec tau 67.8946 67.9709 68.0459 68.0459 68.0450 68.4668 68.7789 68.7789 68.8730 68.6583 68.4668 68.3320 68.1917 alpha 5.5263 5.5314 5.5364 5.5500 5.5645 5.5645 5.5853 5.5891 5.5772 5.5645 5.5555 5.5461	5. Internal ga:  Metabolic gains  (66) m Lighting gains  Appliances gain  Cooking gains  Pumps, fans Losses e.g. ev.  Water heating of  Total internal	m water hea 63.5641  ins (see Ta s (Table 5) Jan 92.4535 (calculate 81.3149 ns (calculate 32.2453 3.0000 aporation (-73.9628 gains (Tabl 85.4357 gains 381.7025	ting, kWh/: 55.9281	Mar 92.4535 dix L, equa- 81.3149 endix L, equa- 158.6731 ix L, equat- 32.2453 3.0000 alues) (Tab- -73.9628 79.3556 373.0796	Apr 92.4535 tion L9 or 84.0254 uation L13 149.694 ion L15 or 32.2453 3.0000 le 5) -73.9628 71.3458 358.8057	May 92. 4535 L9a), also s 81.3149 or L13a), also 32.2453 3.0000 -73.9628 66.2685 339.6888	Jun 92.4535 see Table 5 84.0254 lso see Table 5 32.2453 0.0000 -73.9628 60.9642 323.4474	Jul 92.4535 81.3149 e 5 120.6085 57.9253 310.5847	Aug 92.4535 81.3149 118.9356 32.2453 0.0000 -73.9628 60.8146 311.8011	Sep 92.4535 84.0254 123.1513 32.2453 0.0000 -73.9628 64.1344	Oct 92.4535 81.3149 132.1260 32.2453 3.0000 -73.9628 69.9825	Nov 92.4535 84.0254 143.4550 32.2453 3.0000 -73.9628 77.7030	Dec 92.4535 81.3149 154.1026 32.2453 3.0000 -73.9628 84.4666	(64a) (65) (66) (67) (68) (69) (70) (71) (72)
Solar gains 110.1470 193.0893 278.7178 369.6905 436.3057 442.9251 422.9593 371.7671 309.9870 217.3210 132.9265 93.6185 (83) Total gains 491.8494 582.9677 651.7974 728.4962 775.9945 766.3725 733.5441 683.5682 632.0341 554.4804 491.8459 467.2386 (84)  7. Mean internal temperature (heating season)  Temperature during heating periods in the living area from Table 9, Th1 (C) Utilisation factor for gains for living area, nil,m (see Table 9a)  Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec tau 67.8946 67.9709 68.0459 68.4001 68.4668 68.7789 68.7789 68.870 68.6583 68.668 68.3320 68.1917 alpha 5.5263 5.5314 5.5364 5.5600 5.5645 5.5655 5.5863 5.5853 5.5891 5.5772 5.5645 5.5555 5.5461	5. Internal ga: Metabolic gain: (66)m Lighting gains Appliances gain Cooking gains Pumps, fans Losses e.g. eve Water heating of Total internal	m water hea 63.5641  ins (see Ta s (Table 5) Jan 92.4535 (calculate 81.3149 ns (calculate 32.2453 3.0000 aporation (-73.9628 gains (Tabl 85.4357 gains 381.7025	ting, kWh/: 55.9281	Mar 92.4535 dix L, equa- 81.3149 endix L, equa- 158.6731 ix L, equat- 32.2453 3.0000 alues) (Tab- -73.9628 79.3556 373.0796	Apr 92.4535 tion L9 or 84.0254 dion L15 or 32.2453 3.0000 le 5) -73.9628 358.8057	May 92.4535 L9a), also: 81.3149 cr L13a), also: 32.2453 3.0000 -73.9628 66.2685 339.6888	Jun 92.4535 see Table 5 84.0254 lso see Table 5 32.2453 0.0000 -73.9628 60.9642 323.4474	Jul 92.4535 81.3149 e 5 120.6085 3 0.0000 -73.9628 57.9253 310.5847	Aug 92.4535 81.3149 118.9356 32.2453 0.0000 -73.9628 60.8146 311.8011	Sep 92.4535 84.0254 123.1513 32.2453 0.0000 -73.9628 64.1344 322.0471	Oct 92.4535 81.3149 132.1260 32.2453 3.0000 -73.9628 69.9825 337.1594	Nov 92.4535 84.0254 143.4550 32.2453 3.0000 -73.9628 77.7030 358.9194	Dec 92.4535 81.3149 154.1026 32.2453 3.0000 -73.9628 84.4666 373.6201	(64a) (65) (66) (67) (68) (69) (70) (71) (72) (73)
Solar gains 110.1470 193.0893 278.7178 369.6905 436.3057 442.9251 422.9593 371.7671 309.9870 217.3210 132.9265 93.6185 (83) Total gains 491.8494 582.9677 651.7974 728.4962 775.9945 766.3725 733.5441 683.5682 632.0341 554.4804 491.8459 467.2386 (84)  7. Mean internal temperature (heating season)  Temperature during heating periods in the living area from Table 9, Th1 (C) Utilisation factor for gains for living area, nil,m (see Table 9a)  Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec tau 67.8946 67.9709 68.0459 68.4001 68.4668 68.7789 68.7789 68.8770 68.6583 68.4668 68.3320 68.1917 alpha 5.5263 5.5314 5.5364 5.5600 5.5645 5.5645 5.5853 5.5853 5.5891 5.5772 5.5645 5.5555	5. Internal ga: Metabolic gain: (66)m Lighting gains Appliances gain Cooking gains Pumps, fans Losses e.g. evo Water heating of Total internal	m water hea 63.5641  ins (see Ta 5) Jan 92.4535 (calculate 81.3149 ns (calculate 32.2453 3.0000 aporation (-73.9628 gains (Tabl 85.4357 gains 381.7025	ting, kWh/: 55.9281  ble 5 and  Watts Feb 92.4535 din Appen 90.0272 ted in App 162.8888 in Append 32.2453 3.0000 negative v -73.9628 e 5) 83.2264 389.8784	month 59.0406 5a) Mar 92.4535 dix L, equa: 81.3149 endix L, equ 158.6731 ix L, equat: 32.2453 3.0000 alues) (Tab. -73.9628 79.3556 373.0796	Apr 92.4535 tion L9 or 84.0254 vation L13 at 149.6984 ion L15 or 32.2453 3.0000 le 5) -73.9628 71.3458 358.8057	May 92, 4535 L9a), also 881,3149 or L13a), also 32,2453 3.0000 -73.9628 66.2685 339.6888	Jun 92.4535 see Table 5 84.0254 1127.7218 see Table 5 32.2453 0.0000 -73.9628 60.9642 323.4474	Jul 92.4535 81.3149 e 5 120.6085 3 0.0000 -73.9628 57.9253 310.5847	Aug 92.4535 81.3149 118.9356 32.2453 0.0000 -73.9628 60.8146 311.8011	Sep 92.4535 84.0254 123.1513 32.2453 0.0000 -73.9628 64.1344 322.0471	Oct 92.4535 81.3149 132.1260 32.2453 3.0000 -73.9628 69.9825 337.1594	Nov 92.4535 84.0254 143.4550 32.2453 3.0000 -73.9628 77.7030 358.9194	Dec 92.4535 81.3149 154.1026 32.2453 3.0000 -73.9628 84.4666 373.6201	(64a) (65) (66) (67) (68) (69) (70) (71) (72) (73)
Total gains 491.8494 582.9677 651.7974 728.4962 775.9945 766.3725 733.5441 683.5682 632.0341 554.4804 491.8459 467.2386 (84)  Temperature during heating periods in the living area from Table 9, Th1 (C)  Utilisation factor for gains for living area, nil,m (see Table 9a)  Tan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec tau 67.8946 67.9709 68.0459 68.0459 68.4601 68.4668 68.7789 68.7789 68.8780 68.6583 68.4668 68.3320 68.1917 alpha 5.5263 5.5314 5.5364 5.5600 5.5645 5.5853 5.5853 5.5891 5.5772 5.5645 5.5555 5.5461	5. Internal ga: Metabolic gain: (66)m Lighting gains Appliances gain Cooking gains Pumps, fans Losses e.g. evo Water heating ( Total internal	m water hea 63.5641  ins (see Ta 5) Jan 92.4535 (calculate 81.3149 ns (calculate 32.2453 3.0000 aporation (-73.9628 gains (Tabl 85.4357 gains 381.7025	ting, kWh/: 55.9281  ble 5 and  Watts Feb 92.4535 din Appen 90.0272 ted in App 162.8888 in Append 32.2453 3.0000 negative v -73.9628 e 5) 83.2264 389.8784	month 59.0406 5a) Mar 92.4535 dix L, equa: 81.3149 endix L, equ 158.6731 ix L, equat: 32.2453 3.0000 alues) (Tab. -73.9628 79.3556 373.0796	Apr 92.4535 tion L9 or 84.0254 vation L13 at 149.6984 ion L15 or 32.2453 3.0000 le 5) -73.9628 71.3458 358.8057	May 92, 4535 L9a), also 881,3149 or L13a), also 32,2453 3.0000 -73.9628 66.2685 339.6888	Jun 92.4535 see Table 5 84.0254 1127.7218 see Table 5 32.2453 0.0000 -73.9628 60.9642 323.4474	Jul 92.4535 81.3149 e 5 120.6085 3 0.0000 -73.9628 57.9253 310.5847	Aug 92.4535 81.3149 118.9356 32.2453 0.0000 -73.9628 60.8146 311.8011	Sep 92.4535 84.0254 123.1513 32.2453 0.0000 -73.9628 64.1344 322.0471	Oct 92.4535 81.3149 132.1260 32.2453 3.0000 -73.9628 69.9825 337.1594	Nov 92.4535 84.0254 143.4550 32.2453 3.0000 -73.9628 77.7030 358.9194	Dec 92.4535 81.3149 154.1026 32.2453 3.0000 -73.9628 84.4666 373.6201  Gains W	(64a) (65) (66) (67) (68) (69) (70) (71) (72) (73)
Total gains 491.8494 582.9677 651.7974 728.4962 775.9945 766.3725 733.5441 683.5682 632.0341 554.4804 491.8459 467.2386 (84)  7. Mean internal temperature (heating season)  Temperature during heating periods in the living area from Table 9, Th1 (C)  Utilisation factor for gains for living area, nil,m (see Table 9a)  tau 67.8946 67.9709 68.0459 68.0459 68.401 68.4668 68.7789 68.7789 68.8780 68.6583 68.4668 68.3320 68.1917 alpha 5.5263 5.5314 5.5364 5.5560 5.5645 5.5853 5.5891 5.5772 5.5645 5.5555 5.5461	5. Internal ga: Metabolic gain: (66)m Lighting gains Appliances gain Cooking gains Pumps, fans Losses e.g. ev. Water heating of Total internal  6. Solar gains [Jan]  Northeast Southeast Southeast	m water hea 63.5641  ins (see Ta 5.75 (Table 5.75)  Jan 92.4535 (calculate 81.3149 ns (calculate 81.3149 ns (calculate 32.2453 3.0000 aporation (-73.9628 gains (Tabl 85.4357 gains 381.7025	ting, kWh/: 55.9281	month 59.0406  Mar 92.4535 dix L, equa: 81.3149 endix L, eq 158.6731 ix L, equat: 32.2453 3.0000 alues) (Tab73.9628 79.3556 373.0796	Apr 92.4535 tion L9 or 84.0254 vation L13 or 32.2453 3.0000 le 5) -73.9628 71.3458 358.8057	May 92, 4535 L9a), also 32, 2453 3, 0000 -73, 9628 66, 2685 339, 6888 Solar flux Table 6a W/m2 11, 2829 36, 7938 36, 7938	Jun 92.4535 see Table 5 84.0254 127.7218 see Table 5 32.2453 0.0000 -73.9628 60.9642 323.4474	Jul 92.4535 81.3149 e 5 120.6085 3 0.0000 -73.9628 57.9253 310.5847	Aug 92.4535 81.3149 118.9356 32.2453 0.0000 -73.9628 60.8146 311.8011	Sep 92.4535 84.0254 123.1513 32.2453 0.0000 -73.9628 64.1344 322.0471	Oct 92.4535 81.3149 132.1260 32.2453 3.0000 -73.9628 69.9825 337.1594 Accentable 0.771 0.771 0.771	Nov 92.4535 84.0254 143.4550 32.2453 3.0000 -73.9628 77.7030 358.9194	Dec 92.4535 81.3149 154.1026 32.2453 3.0000 -73.9628 84.4666 373.6201  Gains W	(64a) (65) (66) (67) (68) (69) (70) (71) (72) (73)
7. Mean internal temperature (heating season)  Temperature during heating periods in the living area from Table 9, Th1 (C)  Utilisation factor for gains for living area, nil,m (see Table 9a)  Tan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  tau 67.8946 67.9709 68.0459 68.0459 68.4061 68.4668 68.7789 68.7789 68.8370 68.6583 68.4668 68.3320 68.1917  alpha 5.5263 5.5314 5.5364 5.5600 5.5645 5.5853 5.5853 5.5891 5.5772 5.5645 5.5555 5.5461	5. Internal gas Metabolic gains (66)m Lighting gains Appliances gain Cooking gains Pumps, fans Losses e.g. ev. Water heating of Total internal  6. Solar gains [Jan]  Northeast Southeast Southeast	m water hea 63.5641  ins (see Ta 5.75	ting, kWh/: 55.9281  ble 5 and	month 59.0406  Mar 92.4535 dix L, equa- 81.3149 endix L, eq 158.6731 ix L, equat- 32.2453 3.0000 alues) (Tab73.9628  79.3556 373.0796	Apr 92.4535 tion L9 or 84.0254 uation L13 149.6984 ion L15 or 32.2453 3.0000 le 5) -73.9628 71.3458 358.8057	May 92.4535 L9a), also: 81.3149 or L13a), also: 32.2453 3.0000 -73.9628 66.2685 339.6888  Solar flux Table 6a W/m2 11.2829 36.7938 36.7938	Jun 92.4535 see Table 5 84.0254 127.7218 see Table 5 32.2453 0.0000 -73.9628 60.9642 323.4474  Specif	Jul 92.4535 81.3149 e 5 120.6085 57.9253 310.5847	Aug 92.4535 81.3149 118.9356 32.2453 0.0000 -73.9628 60.8146 311.8011	Sep 92.4535 84.0254 123.1513 32.2453 0.0000 -73.9628 64.1344 322.0471	/year) = Sur 52.0669 Oct 92.4535 81.3149 132.1260 32.2453 3.0000 -73.9628 69.9825 337.1594 Acce: fact: Table (	Nov 92.4535 84.0254 143.4550 32.2453 3.0000 -73.9628 77.7030 358.9194	Dec 92.4535 81.3149 154.1026 32.2453 3.0000 -73.9628 84.4666 373.6201  Gains W 16.4628 57.2515 36.4327	(64a) (65) (66) (67) (68) (69) (70) (71) (72) (73)
7. Mean internal temperature (heating season)  Temperature during heating periods in the living area from Table 9, Th1 (C)  Utilisation factor for gains for living area, nil,m (see Table 9a)  Tan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  tau 67.8946 67.9709 68.0459 68.0459 68.4061 68.4668 68.7789 68.7789 68.8370 68.6583 68.4668 68.3320 68.1917  alpha 5.5263 5.5314 5.5364 5.5600 5.5645 5.5853 5.5853 5.5891 5.5772 5.5645 5.5555 5.5461	5. Internal ga: Metabolic gain: (66)m Lighting gains Appliances gain Cooking gains Pumps, fans Losses e.g. eva Water heating of Total internal  6. Solar gains [Jan]  Northeast Southeast Southeast Southeast Solar gains	m water hea 63.5641  ins (see Ta s (Table 5) Jan 92.4535 (calculate 81.3149 as (calculate 32.2453 3.0000 aporation (-73.9628 gains (Tabl 85.4357 gains 381.7025	ting, kWh/: 55.9281  ble 5 and	month 59.0406  Mar 92.4535 dix L, equa: 81.3149 endix L, equat: 32.2453 3.0000 alues) (Tab73.9628 79.3556 373.0796	Apr 92. 4535 tion L9 or 84.0254 hation L13 3.0000 le 5) -73.9628 71.3458 358.8057	May 92, 4555 L9a), also s 81, 3149 or L13a), also 32, 2453 3,0000 -73, 9628 66, 2685 339, 6888  Solar flux Table 6a W/m2 11, 2829 36, 7938 36, 7938	Jun 92.4535 see Table 5 84.0254 lso see Tabl 127.7218 see Table 5 32.2453 0.0000 -73.9628 60.9642 323.4474	Jul 92.4535 81.3149 5 120.6085 32.2453 0.0000 -73.9628 57.9253 310.5847	Aug 92.4535 81.3149 118.9356 32.2453 0.0000 -73.9628 60.8146 311.8011 Specific or Tab:	Sep 92.4535 84.0254 123.1513 32.2453 0.0000 -73.9628 64.1344 322.0471 FF data le 6c .7000 .7000 .7000 309.9870	Oct 92.4535 81.3149 132.1260 32.2453 3.0000 -73.9628 69.9825 337.1594 Accee fact. Table 0 0.770 0.770 0.770 0.770	Nov 92.4535 84.0254 143.4550 32.2453 3.0000 -73.9628 77.7030 358.9194	0.0000 62.8431  Dec 92.4535 81.3149 154.1026 32.2453 3.0000 -73.9628 84.4666 373.6201  Gains W 16.4628 57.2515 36.4327	(64a) (65) (66) (67) (68) (69) (70) (71) (72) (73)
Temperature during heating periods in the living area from Table 9, Th1 (C)  Utilisation factor for gains for living area, nil,m (see Table 9a)  Tan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  tau 67.8946 67.9709 68.0459 68.0459 68.4001 68.4668 68.7789 68.7789 68.8370 68.6583 68.4668 68.3320 68.1917  alpha 5.5263 5.5314 5.5364 5.5600 5.5645 5.5853 5.5853 5.5891 5.5772 5.5645 5.5555 5.5461	5. Internal ga: Metabolic gain: (66)m Lighting gains Appliances gain Cooking gains Pumps, fans Losses e.g. eva Water heating of Total internal  6. Solar gains [Jan]  Northeast Southeast Southeast Southeast Solar gains	m water hea 63.5641  ins (see Ta s (Table 5) Jan 92.4535 (calculate 81.3149 as (calculate 32.2453 3.0000 aporation (-73.9628 gains (Tabl 85.4357 gains 381.7025	ting, kWh/: 55.9281  ble 5 and	month 59.0406  Mar 92.4535 dix L, equa: 81.3149 endix L, equat: 32.2453 3.0000 alues) (Tab73.9628 79.3556 373.0796	Apr 92. 4535 tion L9 or 84.0254 hation L13 3.0000 le 5) -73.9628 71.3458 358.8057	May 92, 4555 L9a), also s 81, 3149 or L13a), also 32, 2453 3,0000 -73, 9628 66, 2685 339, 6888  Solar flux Table 6a W/m2 11, 2829 36, 7938 36, 7938	Jun 92.4535 see Table 5 84.0254 lso see Tabl 127.7218 see Table 5 32.2453 0.0000 -73.9628 60.9642 323.4474	Jul 92.4535 81.3149 5 120.6085 32.2453 0.0000 -73.9628 57.9253 310.5847	Aug 92.4535 81.3149 118.9356 32.2453 0.0000 -73.9628 60.8146 311.8011 Specific or Tab:	Sep 92.4535 84.0254 123.1513 32.2453 0.0000 -73.9628 64.1344 322.0471 FF data le 6c .7000 .7000 .7000 309.9870	Oct 92.4535 81.3149 132.1260 32.2453 3.0000 -73.9628 69.9825 337.1594 Accee fact. Table 0 0.770 0.770 0.770 0.770	Nov 92.4535 84.0254 143.4550 32.2453 3.0000 -73.9628 77.7030 358.9194	0.0000 62.8431  Dec 92.4535 81.3149 154.1026 32.2453 3.0000 -73.9628 84.4666 373.6201  Gains W 16.4628 57.2515 36.4327	(64a) (65) (66) (67) (68) (69) (70) (71) (72) (73)
Utilisation factor for gains for living area, nil,m (see Table 9a)  Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  tau 67.8946 67.9709 68.0459 68.4001 68.4668 68.7789 68.7789 68.8370 68.6583 68.4668 68.3320 68.1917  alpha 5.5263 5.5314 5.5364 5.5600 5.5645 5.5853 5.5853 5.5851 5.5772 5.5645 5.5555 5.5461	5. Internal ga: Metabolic gain: (66)m Lighting gains Appliances gain Cooking gains Pumps, fans Losses e.g. evo Water heating of Total internal  6. Solar gains [Jan]  Northeast Southeast Southeast Southeast Southeast Total gains	m water hea 63.5641  ins (see Ta 63.5641  s (Table 5)     Jan 92.4535     (calculate 81.3149     ns (calculate 81.3149     ns (calculate 32.2453	ting, kWh/: 55.9281	month 59.0406  Mar 92.4535 dix L, equa: 81.3149 endix L, eq 158.6731 ix L, equat: 32.2453 3.0000 alues) (Tab73.9628 79.3556 373.0796  A: 5.5' 5.9' 3.7' 278.7178 651.7974	Apr 92.4535 tion L9 or 84.0254 uation L15 149.6984 ion L15 or 32.2453 3.0000 le 5) -73.9628 71.3458 358.8057	May 92.4535 L9a), also: 81.3149 or L13a), also: 38.3694 L15a), also: 32.2453 3.0000 -73.9628 66.2685 339.6888  Solar flux Table 6a W/m2 11.2829 36.7938 36.7938 436.3057 775.9945	Jun 92.4535 see Table 5 84.0254 127.7218 see Table 5 32.2453 0.0000 -73.9628 60.9642 323.4474  Specif or T	Jul 92.4535 81.3149 e 5 120.6085 3 0.0000 -73.9628 57.9253 310.5847 Gic data able 6b 0.5400 0.5400 0.5400 0.5400 0.5400 0.5401 422.9593 733.5441	Aug 92.4535 81.3149 118.9356 32.2453 0.0000 -73.9628 60.8146 311.8011 Specific or Tab:	Sep 92.4535 84.0254 123.1513 32.2453 0.0000 -73.9628 64.1344 322.0471 FF data le 6c .7000 .7000 .7000 309.9870	Oct 92.4535 81.3149 132.1260 32.2453 3.0000 -73.9628 69.9825 337.1594 Accee fact. Table 0 0.770 0.770 0.770 0.770	Nov 92.4535 84.0254 143.4550 32.2453 3.0000 -73.9628 77.7030 358.9194	0.0000 62.8431  Dec 92.4535 81.3149 154.1026 32.2453 3.0000 -73.9628 84.4666 373.6201  Gains W 16.4628 57.2515 36.4327	(64a) (65) (66) (67) (68) (69) (70) (71) (72) (73)
tau 67.8946 67.9709 68.0459 68.4001 68.4668 68.7789 68.7789 68.8370 68.6583 68.4668 68.3320 68.1917 alpha 5.5263 5.5314 5.5364 5.5600 5.5645 5.5853 5.5853 5.5851 5.5772 5.5645 5.5555 5.5461	5. Internal gas Metabolic gains (66)m Lighting gains Appliances gain Cooking gains Pumps, fans Losses e.g. evo Water heating of Total internal  6. Solar gains [Jan]  Northeast Southeast Southwest  Solar gains Total gains Total gains	m water hea 63.5641  ins (see Ta 8 (Table 5) Jan 92.4535 (calculate 81.3149 ns (calculate 32.2453 3.000 aporation (73.9628 gains (Tabl 85.4357 gains 381.7025	ting, kWh/: 55.9281	month 59.0406  Mar 92.4535 dix L, equa- 81.3149 endix L, eq 158.6731 ix L, equat. 32.2453 3.0000 alues) (Tab73.9628 79.3556 373.0796  A: 5.55 5.9 3.7	Apr 92.4535 tion L9 or 84.0254 uation L13 149.6984 ion L15 or 32.2453 3.0000 le 5) -73.9628 71.3458 358.8057	May 92.4535 L9a), also 81.3149 or L13a), al 138.3694 L15a), also 32.2453 3.0000 -73.9628 66.2685 339.6888 Solar flux Table 6a W/m2 11.2829 36.7938 36.7938 436.3057 775.9945	Jun 92.4535 see Table 5 84.0254 127.7218 see Table 5 32.2453 0.0000 -73.9628 60.9642 323.4474  Specifier or T	Jul 92.4535 81.3149 e 5 120.6085 32.2453 0.0000 -73.9628 57.9253 310.5847	Aug 92.4535 81.3149 118.9356 32.2453 0.0000 -73.9628 60.8146 311.8011 Specific or Tab:	Sep 92.4535 84.0254 123.1513 32.2453 0.0000 -73.9628 64.1344 322.0471 FF data le 6c .7000 .7000 .7000 309.9870	Oct 92.4535 81.3149 132.1260 32.2453 3.0000 -73.9628 69.9825 337.1594 Accee fact. Table 0 0.770 0.770 0.770 0.770	Nov 92.4535 84.0254 143.4550 32.2453 3.0000 -73.9628 77.7030 358.9194	O.0000 62.8431  Dec 92.4535 81.3149 154.1026 32.2453 3.0000 -73.9628 84.4666 373.6201  Gains W 16.4628 57.2515 36.4327 93.6185 467.2386	(64a) (65) (66) (67) (68) (69) (70) (71) (72) (73) (75) (77) (79) (83) (84)
	Metabolic gains  (66) m Lighting gains  Appliances gain  Cooking gains  Pumps, fans Losses e.g. ev.  Water heating of  Total internal  Northeast Southeast Southwest  Solar gains  Total gains  7. Mean internal	m water hea 63.5641  ins (see Ta 53.5641  ins (see Ta 54.55)  ins	ting, kWh/: 55.9281  ble 5 and	month 59.0406  Mar 92.4535 dix L, equa- 81.3149 endix L, equa- 158.6731 ix L, equa- 32.2453 3.0000 alues) (Tab- 73.9628 79.3556 373.0796  A.  278.7178 651.7974  ng season) in the livin; ving area, ying area, y	Apr 92.4535 tion L9 or 84.0254 uation L13 149.6984 ion L15 or 32.2453 3.0000 le 5) -73.9628 71.3458 358.8057	May 92.4535 L9a), also 81.3149 or L13a), al 138.3694 L15a), also 32.2453 3.0000 -73.9628 66.2685 339.6888 Solar flux Table 6a W/m2 11.2829 36.7938 36.7938 436.3057 775.9945	Jun 92.4535 see Table 5 84.0254 see Table 5 32.2453 0.0000 -73.9628 60.9642 323.4474 Specifor 1	Jul 92.4535 81.3149 e 5 120.6085 3 0.0000 -73.9628 57.9253 310.5847 gic data arable 6b 0.5400 0.5400 0.5400 422.9593 733.5441	Aug 92.4535 81.3149 118.9356 32.2453 0.0000 -73.9628 60.8146 311.8011  Specific or Tab:	Sep 92.4535 84.0254 123.1513 32.2453 0.0000 -73.9628 64.1344 322.0471 FF data le 6c -7000 .7000	/year) = Sur 52.0669 Oct 92.4535 81.3149 132.1260 32.2453 3.0000 -73.9628 69.9825 337.1594 Acces factor Table ( 0.77( 0.77( 0.77( 0.77( 0.77(	Nov 92.4535 84.0254 143.4550 32.2453 3.0000 -73.9628 77.7030 358.9194	O.0000 62.8431  Dec 92.4535 81.3149 154.1026 32.2453 3.0000 -73.9628 84.4666 373.6201  Gains W 16.4628 57.2515 36.4327 93.6185 467.2386	(64a) (65) (66) (67) (68) (69) (70) (71) (72) (73) (75) (77) (79) (83) (84)
	Metabolic gains  (66) m Lighting gains  Appliances gain  Cooking gains  Pumps, fans Losses e.g. ev.  Water heating of  Total internal  6. Solar gains  [Jan]  Northeast Southeast Southwest  7. Mean internal  Temperature du  Utilisation factau	m water hea 63.5641  ins (see Ta 63.5641  ins (see Ta 74.61	ting, kWh/: 55.9281	Mar 92.4535 dix L, equa- 81.3149 endix L, equa- 158.6731 ix L, equa- 32.2453 3.0000 alues) (Tab- -73.9628 79.3556 373.0796 A- 	Apr 92.4535 tion L9 or 84.0254 dation L15 or 32.2453 3.0000 le 5) -73.9628 71.3458 358.8057	May 92.4535 L9a), also s 81.3149 or L13a), also s 32.2453 3.0000 -73.9628 66.2685 339.6888  Solar flux Table 6a W/m2 11.2829 36.7938 36.7938 436.3057 775.9945	Jun 92.4535 see Table 5 84.0254 lso see Table 5 32.2453 0.0000 -73.9628 60.9642 323.4474  Specif or T 442.9251 766.3725  Th1 (C) Jun 68.7789	Jul 92.4535 81.3149 e 5 120.6085 32.2453 0.0000 -73.9628 57.9253 310.5847 Gic data cable 6b 0.5400 0.5400 0.5400 422.9593 733.5441	Aug 92.4535 81.3149 118.9356 32.2453 0.0000 -73.9628 60.8146 311.8011 Specific or Tab:	Sep 92.4535 84.0254 123.1513 32.2453 0.0000 -73.9628 64.1344 322.0471 FF data le 6c .7000 .7000 309.9870 632.0341	/year) = Sur 52.0669 Oct 92.4535 81.3149 132.1260 32.2453 3.0000 -73.9628 69.9825 337.1594 Access factor Table 0 0.770 0.770 0.770 217.3210 554.4804	Nov 92.4535 84.0254 143.4550 32.2453 3.0000 -73.9628 77.7030 358.9194	O.0000 62.8431  Dec 92.4535 81.3149 154.1026 32.2453 3.0000 -73.9628 84.4666 373.6201  Gains W 16.4628 57.2515 36.4327 93.6185 467.2386	(64a) (65) (66) (67) (68) (69) (70) (71) (72) (73) (75) (77) (79) (83) (84)

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	0.9869	0.9678	0.9259	0.8173	0.6471	0.4636	0.3350	0.3751	0.5958	0.8690	0.9704	0.9899	(86)
MIT Th 2	20.0870	20.3124	20.5713	20.8310	20.9595	20.9946	20.9993	20.9987	20.9800	20.7966	20.3945	20.0379	(87)
util rest of h		0.9590	0.9069	0.7786	0.5909	0.3982	0.2649	0.3003	0.5223	0.8298	0.9607	0.9868	
MIT 2 Living area fra	19.0228	19.3043	19.6189	19.9151	20.0412	20.0725	20.0751	20.0755	20.0620	19.8878 Living area	19.4140	18.9636 0.5235	(90)
MIT Temperature ad	19.5799	19.8320	20.1174	20.3946	20.5219	20.5552	20.5589	20.5588	20.5426	20.3635	19.9273	19.5259 -0.1500	
	19.4299	19.6820	19.9674	20.2446	20.3719	20.4052	20.4089	20.4088	20.3926	20.2135	19.7773	19.3759	(93)
0 Cnac booti													
8. Space heatin													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(0.4)
Utilisation Useful gains	0.9797 481.8568	0.9546 556.5097	0.9046 589.5987	0.7863 572.8141	0.6095 472.9967	0.4217 323.1664	0.2902 212.9006	0.3273 223.7494	0.5482 346.4518	0.8364 463.7593	0.9570 470.6824	0.9839 459.7159	(95)
Ext temp. Heat loss rate		4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Space heating !		836.6762	761.4310	638.0846	487.2827	324.7179	213.0522	224.0449	352.5990	540.1944	713.7542	856.1930	
Space heating	requirement	188.2719 - total p		46.9947 h/year)	10.6288	0.0000	0.0000	0.0000	0.0000	56.8678	175.0117	294.9790 1179.9488	(98a)
Solar heating   Solar heating	0.0000	0.0000 on - total	0.0000 per vear (k	0.0000 Wh/vear)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Space heating l	kWh	188.2719		46.9947	10.6288	0.0000	0.0000	0.0000	0.0000	56.8678	175.0117	294.9790	(98c)
Space heating : Space heating :	requirement			tion - total	per year	(kWh/year)				(98c)	) / (4) =	1179.9488 21.2987	
9a. Energy requ	uirements -	- Individua	l heating s	ystems, inc	luding micr	ro-CHP							
Fraction of spa	ace heat fr	om seconda	ry/suppleme									0.0000	
Fraction of spa Efficiency of m	main space	heating sy	stem 1 (in									1.0000	(206)
Efficiency of a												0.0000	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating :	279.3517	188.2719		46.9947	10.6288	0.0000	0.0000	0.0000	0.0000	56.8678	175.0117	294.9790	(98)
Space heating	89.5000	89.5000	89.5000	89.5000	89.5000	0.0000	0.0000	0.0000	0.0000	89.5000	89.5000	89.5000	(210)
Space heating :	312.1248	210.3596	142.8416	52.5081	11.8757	0.0000	0.0000	0.0000	0.0000	63.5394	195.5438	329.5855	(211)
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating : Space heating :	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
opace nearing .	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating Water heating :	rogui romont												
Efficiency of v	203.4595	179.0574	189.2583	165.3592	159.1234	142.1059	139.9038	146.6902	149.4724	167.9704	179.7260	201.2638 89.5000	
(217)m Fuel for water	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	
Space cooling :	227.3290	200.0641	211.4617	184.7589	177.7915	158.7775	156.3170	163.8996	167.0083	187.6764	200.8112	224.8758	(219)
(221)m Pumps and Fa	0.0000 7.3041	0.0000 6.5973	0.0000 7.3041	0.0000 7.0685	0.0000 7.3041	0.0000 7.0685	0.0000 7.3041	0.0000 7.3041	0.0000 7.0685	0.0000 7.3041	0.0000 7.0685	0.0000 7.3041	
Lighting Electricity gen	16.5503	13.2773	11.9547	8.7585	6.7653	5.5273	6.1716	8.0220	10.4198	13.6714	15.4418	17.0103	
(233a)m Electricity ger	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
(234a)m Electricity gen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
(235a)m Electricity use	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 eneration)	0.0000	0.0000	0.0000	0.0000	(235a)
(235c)m Electricity gen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
(233b)m Electricity gen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
(234b)m Electricity gen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 ity)	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
(235b)m Electricity use	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 eneration)	0.0000	0.0000	0.0000	0.0000	(235b)
(235d)m Annual totals	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Space heating : Space heating :	fuel - main											1318.3785	
Space heating : Efficiency of v	fuel - seco	ndary										0.0000	
Water heating : Space cooling :	fuel used											2260.7712	
Electricity for		fans.										0.0000	()
central heat	ting pump	. 10115.										41.0000 45.0000	
main heating	ity for the			iv T)								86.0000	(231)
Electricity for												133.5703	(232)
Energy saving/o		cecnnologi	es (Appendi	ces M ,N and	ı Q)							0.0000	
Wind generation Hydro-electric	generation											0.0000	(235a)
Electricity gen Appendix Q - sp	pecial feat	ures	Appendix N)									0.0000	
Energy saved of Energy used	-											-0.0000 0.0000	(237)
Total delivered	a energy IC	ı aıı uses										3798.7200	(230)

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12a. Carbon diox	 kide emissi	ons - Indiv	vidual hea	ting systems	includina m								
Space heating - Total CO2 associ Water heating ( Space and water Pumps, fans and Energy for light Total CO2, kg/ye EPC Dwelling Car	main syste ated with other fuel) heating electric k ing ar	m 1 community s	systems					Energy kWh/year 1318.3785 2260.7712 86.0000 133.5703	Emissio kg	n factor CO2/kWh 0.2100 0.2100 0.1387 0.1443	k	Emissions g CO2/year 276.8595 0.0000 474.7619 751.6214 11.9293 19.2783 782.8290 14.1300	(373) (264) (265) (267) (268) (272)
13a. Primary ene													
Space heating - Total CO2 assoc: Water heating ( Space and water Pumps, fans and Energy for light Total Primary en Dwelling Primary	main syste Lated with other fuel) heating electric k ling hergy kWh/y	m 1 community s eep-hot								y factor CO2/kWh 1.1300 1.1300 1.5128 1.5338		ary energy kWh/year 1489.7677 0.0000 2554.6714 4044.4391 130.1008 204.8746 4379.4145 79.0500	(473) (278) (279) (281) (282) (286)
SAP 10 WORKSHEE	FOR New B	uild (As De											
1. Overall dwel:	ing charac	teristics						Area		y height (m) 2.4500		Volume (m3) 135.7300	(1b) - (3b
Total floor area Dwelling volume		) + (1b) + (1c)	+(1d)+(1e	e)(1n)		55.4000			3a)+(3b)+(3c)+	(3d)+(3e)	)(3n) =	135.7300	(4) (5)
											m	3 per hour	
Number of open of Number of open in Number of chimne Number of flues Number of flues Number of blocke Number of interr Number of passiv Number of flues	flues eys / flues attached t attached t ed chimneys mittent ext ve vents	o solid fue o other hea ract fans	el boiler	fire							0 * 80 = 0 * 20 = 0 * 10 = 0 * 20 = 0 * 35 = 0 * 20 = 2 * 10 = 0 * 10 = 0 * 40 =	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 20.0000 0.0000	(6b) (6c) (6d) (6e) (6f) (7a) (7b)
Infiltration due Pressure test Pressure Test Me Measured/design Infiltration rat Number of sides	ethod AP50	ys, flues a	and fans	= (6a)+(6b)	+(6c)+(6d)+(	(6e) + (6f) + (	6g)+(7a)+(	7b)+(7c) =		20.0000	Air change D / (5) = B	0.1474 Yes lower Door 5.0000 0.3974	(17)
Shelter factor Infiltration rat	e adjusted	to include	e shelter	factor					(20) = 1 - (21		x (19)] = x (20) =	0.7750 0.3079	(20)
Wind speed Wind factor Adj infilt rate	Jan 5.1000 1.2750	Feb 5.0000 1.2500	Mar 4.9000 1.2250	Apr 4.4000 1.1000	May 4.3000 1.0750	Jun 3.8000 0.9500	Jul 3.8000 0.9500	Aug 3.7000 0.9250	1.0000	Oct 4.3000 1.0750		Dec 4.7000 1.1750	
Effective ac	0.3926 0.5771	0.3849 0.5741	0.3772 0.5712		0.3310 0.5548	0.2925 0.5428	0.2925 0.5428	0.2849 0.5406		0.3310 0.5548		0.3618 0.5655	
3. Heat losses a				Gross	Openings			U-value	ΑxU		K-value	АхК	
TER Opening Type Heatloss Floor : External Wall 1 Flat Roof Total net area of Fabric heat loss Party Wall	of external	elements A	Aum(A, m2)	m2 53.7800 6.8500	m2 13.8400	13. 55. 39. 6. 116.	m2 8400 4000 9400 8500 0300	W/m2K 1.1450 0.1300 0.1800 0.1100 30) + (32) 0.0000	W/K 15.8473 7.2020 7.1892 0.7535		kJ/m2K	kJ/K	(27) (28b) (29a) (30) (31) (33) (32)
Thermal mass par List of Thermal K1 Eleme E2 Other E3 Sill	Bridges ent	P = Cm / TF							Length Ps 9.4000 6.7000	i-value 0.0500 0.0500	Tot. 0.47 0.33	00	(35)

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E18 Pa: E5 Grou E14 Fla E17 Co: Thermal bridge: Point Thermal B	rner (norma rty wall be und floor ( at roof rner (inver s (Sum(L x bridges	tween dwell normal) ted - inter	rnal area g		n external an	rea)		7 4 21 5	.4000 .3500 .9000 .9500 .5400	0.0500 0.0900 0.0600 0.1600 0.0800 -0.0900	1.12 0.66 0.29 3.51 0.44 -0.22 (36a) =	115 140 20 32 05 6.6152 0.0000	)
Total fabric he									(	33) + (36)	+ (36a) =	37.6072	. (37)
Ventilation hea	at loss cal Jan 25.8479	culated mor Feb 25.7139	nthly (38)m Mar 25.5825	= 0.33 x Apr 24.9652	25)m x (5) May 24.8498	Jun 24.3122	Jul 24.3122	Aug 24.2126	Sep 24.5192	Oct 24.8498	Nov 25.0834	Dec 25.3276	: /201
Heat transfer ( Average = Sum()	coeff 63.4552	63.3211	63.1897	62.5725	62.4570	61.9194	61.9194	61.8199	62.1265	62.4570	62.6906	62.9348	(39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	62.5719 Dec	
HLP HLP (average) Days in mont	1.1454	1.1430	1.1406	1.1295	1.1274	1.1177	1.1177	1.1159	1.1214	1.1274	1.1316	1.1360 1.1295 31	,
4. Water heating													
Assumed occupan	 ncy											1.8491	(42)
Hot water usage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage	63.6272	62.6822	61.3515	58.8980	57.0608	55.0236	53.9232	55.2446	56.6834	58.8632	61.3673	63.4121	(42b)
Hot water usage Average daily h	33.5663	32.3457	31.1251 /day)	29.9045	28.6840	27.4634	27.4634	28.6840	29.9045	31.1251	32.3457	33.5663 89.5072	
Daily hot wate:	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte Energy content	97.1935 153.9307	95.0279 135.3185	92.4767 142.1332	88.8025 121.5662	85.7447 115.4289	82.4870 101.4273	81.3866 98.4300	83.9286 103.9211	86.5879 106.7716	89.9883 122.1133 Total = S	93.7130 133.5114 um(45)m =	96.9784 151.8447 1486.3969	(45)
Distribution 10	oss (46)m 23.0896	= 0.15 x (4	45) m 21.3200	18.2349	17.3143	15.2141	14.7645	15.5882	16.0157	18.3170	20.0267	22.7767	
Total storage	loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder com	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Combi loss Total heat requ	49.5287 uired for w	43.7389 ater heatir	47.1251 ng calculate	43.7930 ed for each	43.6946 month	40.6785	41.4737	42.7691	42.7009	45.8571	46.2146	49.4191	(61)
WWHRS	0.0000	179.0574 0.0000	0.0000	165.3592 0.0000	159.1234 0.0000	142.1059 0.0000	139.9038	146.6902 0.0000	149.4724	167.9704	179.7260 0.0000	201.2638	(63a)
PV diverter Solar input FGHRS	-0.0000 0.0000 0.0000	-0.0000 0.0000 0.0000	-0.0000 0.0000 0.0000	-0.0000 0.0000 0.0000	-0.0000 0.0000 0.0000	-0.0000 0.0000 0.0000	-0.0000 0.0000 0.0000	-0.0000 0.0000 0.0000	-0.0000 0.0000 0.0000	-0.0000 0.0000 0.0000	-0.0000 0.0000 0.0000	-0.0000 0.0000 0.0000	(63c)
Output from w/l		179.0574	189.2583	165.3592	159.1234	142.1059	139.9038	146.6902 Total pe	149.4724 er year (kW	167.9704 h/year) = S	179.7260 um(64)m =	201.2638 2023.3902	
12Total per year Electric showe:	r(s)												(64)
T	0.0000	0.0000	0.0000	0.0000 Tot	0.0000 al Energy us	0.0000 sed by inst	0.0000 antaneous e	0.0000 lectric sho	0.0000 wer(s) (kWh	0.0000 /year) = Su	0.0000 m(64a)m =	0.0000	
Heat gains from	63.5641	55.9281	59.0406	51.3690	49.3037	43.8942	43.0964	45.2460	46.1768	52.0669	55.9462	62.8431	(65)
5. Internal gas	ins (see Ta	ble 5 and 5	5a)										
Metabolic gain: (66) m	Jan 92.4535	Feb 92.4535	Mar 92.4535	Apr 92.4535	92.4535	Jun 92.4535	92.4535	Aug 92.4535	Sep 92.4535	Oct 92.4535	Nov 92.4535	Dec 92.4535	(66)
Lighting gains	81.3149	90.0272	81.3149	84.0254	81.3149	84.0254	81.3149	81.3149			84.0254	81.3149	(67)
Appliances gain Cooking gains	161.2159	162.8888	158.6731	149.6984	138.3694	127.7218	120.6085	118.9356	123.1513	132.1260	143.4550	154.1026	(68)
Pumps, fans	32.2453	32.2453	32.2453	32.2453	32.2453 3.0000	32.2453	32.2453			32.2453 3.0000		32.2453 3.0000	
Losses e.g. eva	aporation (	negative va	alues) (Tab	le 5)	-73.9628					-73.9628		-73.9628	
Water heating	gains (Tabl	e 5)			66.2685				64.1344	69.9825	77.7030	84.4666	(72)
Total internal		389.8784	373.0796	358.8057	339.6888	323.4474	310.5847	311.8011	322.0471	337.1594	358.9194	373.6201	(73)
6. Solar gains													
[Jan]				rea m2	Solar flux Table 6a W/m2	Speci or	g fic data Table 6b	Specific or Tab	FF data le 6c	Acce: fact: Table	ss or 6d	Gains W	
Northeast Southeast Southwest			5.0 5.3 3.4	400 800 200	11.2829 36.7938 36.7938		0.6300 0.6300 0.6300	0 0 0				17.3790 60.4963 38.4568	(77)
									327 3780	229.5194	140 3903	98.8758	1021

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Temperature during heating					Th1 (C)						21.0000	(85)
Utilisation factor for ga	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau 60.6290 alpha 5.0419	60.7573 5.0505	60.8837 5.0589	61.4843 5.0990	61.5979 5.1065	62.1327 5.1422	62.1327 5.1422	62.2328 5.1489	61.9256 5.1284	61.5979 5.1065	61.3684 5.0912	61.1302 5.0753	
util living area 0.9881	0.9717	0.9359	0.8404	0.6806	0.4936	0.3586	0.4014	0.6312	0.8876	0.9741	0.9907	(86)
MIT 19.9008 Th 2 19.9639	20.1427 19.9659	20.4349 19.9678	20.7524 19.9768	20.9299 19.9785	20.9888 19.9864	20.9982 19.9864	20.9969 19.9879	20.9635 19.9834	20.7152 19.9785	20.2525 19.9751	19.8570 19.9715	
util rest of house 0.9845	0.9635	0.9181	0.8018	0.6196	0.4187	0.2766	0.3143	0.5495	0.8498	0.9651	0.9878	
MIT 2 18.7123 Living area fraction	19.0165	19.3753	19.7467	19.9259	19.9807	19.9859	19.9869		19.7187 Living area		18.6625 0.5235	(91)
MIT 19.3345 Temperature adjustment	19.6061	19.9299	20.2732	20.4515	20.5084	20.5158	20.5156	20.4861	20.2404	19.7341	19.2878	
adjusted MIT 19.3345	19.6061	19.9299	20.2732	20.4515	20.5084	20.5158	20.5156	20.4861	20.2404	19.7341	19.2878	(93)
8. Space heating requirer	ment											
Jan	Feb	Mar	Apr		Jun	Jul	Aug	Son	Oct	Nov	Dec	
Utilisation 0.9816 Useful gains 488.8729	0.9600 570.0717	0.9174 612.2873	0.8138 609.7187	May 0.6486 519.2132	0.4576 362.0884	0.3196 241.9931	0.3600 253.5653	Sep 0.5910 383.7848	0.8605 487.6321	0.9625 480.5650	0.9852 465.5246	
Ext temp. 4.3000 Heat loss rate W	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
954.0137 Space heating kWh	931.2039	848.6327	711.6466	546.5897	365.8469	242.4654	254.4255	396.7488	602.1080	792.0404	949.5458	(97)
346.0648 Space heating requirement	242.6808 - total pe	175.8409 er year (kW	73.3881 h/year)	20.3681	0.0000	0.0000	0.0000	0.0000	85.1701	224.2623	360.1118 1527.8870	(98a)
Solar heating kWh 0.0000 Solar heating contribution	0.0000	0.0000 per year (ki	0.0000 Wh/vear)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Space heating kWh 346.0648		175.8409	73.3881	20.3681	0.0000	0.0000	0.0000	0.0000	85.1701	224.2623	360.1118	(98c)
Space heating requirement Space heating per m2			tion - total	l per year	(kWh/year)				(98c)	/ (4) =	1527.8870 27.5792	(99)
9a. Energy requirements											0.0000	(201)
Fraction of space heat fraction of space heat fr	com main sys	stem(s)		m (labie ii	- )						0.0000 1.0000 92.4000	(202)
Efficiency of main space Efficiency of main space Efficiency of secondary/s	heating sys	stem 2 (in	%)								0.0000	(207)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(200)
Space heating requirement 346.0648		175.8409	73.3881	20.3681	0.0000	0.0000	0.0000	0.0000	85.1701	224.2623	360.1118	(98)
Space heating efficiency 92.4000			1) 92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000	
Space heating fuel (main 374.5290		stem) 190.3040	79.4244	22.0434	0.0000	0.0000	0.0000	0.0000	92.1754	242.7082	389.7314	(211)
Space heating efficiency 0.0000	(main heat:	ing system : 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (second 0.0000	ndary) 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating	_											
Water heating requirement 203.4595 Efficiency of water heate	179.0574	189.2583	165.3592	159.1234	142.1059	139.9038	146.6902	149.4724	167.9704	179.7260	201.2638	
(217)m 85.5093 Fuel for water heating, 1	85.0335	84.2241	82.7610	81.1913	80.3000	80.3000	80.3000	80.3000	83.0015	84.8569	85.6127	
237.9383 Space cooling fuel requir	210.5729	224.7079	199.8033	195.9859	176.9687	174.2263	182.6777	186.1425	202.3703	211.7989	235.0863	(219)
(221)m 0.0000 Pumps and Fa 7.3041	0.0000	0.0000 7.3041	0.0000 7.0685	0.0000 7.3041	0.0000 7.0685	0.0000 7.3041	0.0000 7.3041	0.0000 7.0685	0.0000 7.3041	0.0000 7.0685	0.0000 7.3041	
Lighting 16.8956 Electricity generated by	13.5543	12.2041	8.9413	6.9065	5.6427	6.3003	8.1894	10.6372	13.9566	15.7640	17.3652	
(233a)m -19.0075 Electricity generated by	-27.7491	-41.2986	-48.1504	-53.4357		-49.8619	-46.3336	-40.3472	-32.5112	-21.2404	-16.3256	(233a)
(234a)m 0.0000 Electricity generated by	0.0000 hydro-elect	0.0000 tric genera	0.0000 tors (Append	0.0000 dix M) (neg	0.0000 gative quant		0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
(235a)m 0.0000 Electricity used or net								0.0000	0.0000	0.0000		(235a)
(235c)m 0.0000 Electricity generated by	0.0000 PVs (Append		0.0000 ative quanti	0.0000 ity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by						-69.7815	-58.7746	-42.6898	-24.7111	-10.7874	-6.3308	
(234b)m 0.0000 Electricity generated by							0.0000	0.0000	0.0000	0.0000	0.0000	
(235b)m 0.0000 Electricity used or net								0.0000	0.0000	0.0000	0.0000	
(235d)m 0.0000 Annual totals kWh/year	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Space heating fuel - main Space heating fuel - main	n system 2										1653.5573	(213)
Space heating fuel - sec Efficiency of water heate Water heating fuel used											0.0000 80.3000 2438.2790	
Space cooling fuel											0.0000	
Electricity for pumps and Total electricity for the		h/vear									86.0000	(231)
Electricity for lighting			ix L)								136.3574	
Energy saving/generation PV generation	technologie	es (Appendi	ces M ,N and	(Q f							-912.7613	(233)
Wind generation Hydro-electric generation	n (Appendix	N)									0.0000	(234)
Electricity generated - N Appendix Q - special feat	Micro CHP (A										0.0000	
Energy saved or generated											-0.0000	(236)

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Energy used 0.0000 (237)
Total delivered energy for all uses 3401.4324 (238)

12a. Carbon dioxide emissions - Individual heating systems including			
	Energy	Emission factor	Emissions
	kWh/year	kg CO2/kWh	kg CO2/year
Space heating - main system 1	1653.5573	0.2100	347.2470 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2438.2790	0.2100	512.0386 (264)
Space and water heating			859.2856 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	136.3574	0.1443	19.6806 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-446.7171	0.1338	-59.7868
PV Unit electricity exported	-466.0441	0.1255	-58.5037
Total			-118.2905 (269)
Total CO2, kg/year			772.6050 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			13.9500 (273)
13a. Primary energy - Individual heating systems including micro-CHP			
		imary energy factor	Primary energy
		kg CO2/kWh	kWh/year
Space heating - main system 1	1653.5573	1.1300	1868.5198 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2438.2790	1.1300	2755.2552 (278)
Space and water heating			4623.7750 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	136.3574	1.5338	209.1495 (282)
3- 3			
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-446.7171	1.4946	-667.6599
The state of the s	466 0441	0.4608	
PV Unit electricity exported	-466.0441	0.4608	-214.7411
PV Unit electricity exported Total	-466.0441	0.4608	
	-466.0441	0.4608	-214.7411
Total	-400.0441	0.4608	-214.7411 -882.4010 (283)

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Property Reference	ce	Fi	riars Lane 2BF	DUP 74 - Lean						Issued on Da	ite	01/03/2024	
Assessment Refe	rence	Fi	riars Lane 2BF	DUP 74 Lean				Prop Type F	Ref F	riars Lane 2BI	F DUP 74 - Le	an	
Property		Н	unters Lodge,	Friars Lane, Ric	hmond, London,	TW9 1NX							
SAP Rating					87 B		DER	11	.60	TER		10.78	
Environmental					91 B		% DER < TER	₹				-7.61	
CO <sub>2</sub> Emissions (t/					0.75		DFEE		3.14	TFEE		26.28	
Compliance Chec	k				See BREL		% DFEE < TF					11.92	
% DPER < TPER					-15.26		DPER	65	5.05	TPER		56.44	
Assessor Details Client		Mr. Ivan	n Ball							Asses	ssor ID	X001-728	33
	DWELLING EM	MISSIONS FO	OR REGULATI	(Version 10	ICE	2022)				ey height (m)		Volume (m3)	
Ground floor First floor Total floor area Dwelling volume		a) + (1b) + (1d	c)+(1d)+(1e	e)(1n)		3.7700		40.8900 32.8800	(1b) x	2.4500 1.8000			(1b) - (3 (1c) - (3 (4)
. ventilation r	rate 										n	3 per hour	
Number of open of Number of open f Number of chimme Number of flues Number of flues Number of blocke Number of intern Number of passiv Number of fluele	flues  eys / flues  attached t  attached t  ed chimneys  mittent ext  ve vents	to solid for to other he tract fans	uel boiler eater	fire							0 * 80 = 0 * 20 = 0 * 10 = 0 * 20 = 0 * 35 = 0 * 20 = 2 * 10 = 0 * 10 = 0 * 40 =	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 20.0000 0.0000	(6b) (6c) (6d) (6e) (6f) (7a) (7b)
Infiltration due Pressure test Pressure Test Me Measured/design Infiltration rat Number of sides	ethod AP50 Le	eys, flues	and fans	= (6a)+(6b)	+(6c)+(6d)+(	6e)+(6f)+(	6g)+(7a)+(	7b)+(7c) =			Air change / (5) = E	0.1255 Yes Blower Door 4.0000 0.3255	(8)
Shelter factor Infiltration rat		ł to inclu	de shelter	factor					(20) = 1 -	[0.075 x 1) = (18)		0.7750 0.2523	(20)
Wind speed	Jan 5.1000	Feb 5.0000	Mar 4.9000	Apr 4.4000	May 4.3000	Jun 3.8000	Jul 3.8000	Aug 3.7000	Sep 4.0000	Oct 4.3000	Nov 4.5000	Dec 4.7000	(22)
Wind factor Adj infilt rate	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	
Effective ac	0.3216 0.5517	0.3153 0.5497	0.3090 0.5477	0.2775 0.5385	0.2712 0.5368	0.2396 0.5287	0.2396 0.5287	0.2333 0.5272		0.2712 0.5368	0.2838 0.5403	0.2964 0.5439	
3. Heat losses a	and heat lo	ss paramet	ter								1.		
Element  Glazed Door/ Wir  Sedroom 1  Landing  Sedroom 1 & Land  External Wall 1  External Wall 2  Cold Roof  Sloping Ceiling  Cotal net area of  Fabric heat loss  Party Wall  Party Floor 1	ding	elements	Aum(A, m2)	Gross m2  47.0400 16.4700 18.1100 30.6600	Openings m2 13.0600 3.3600	13. 0. 0. 1. 33. 16. 18. 27. 112.	Area m2 0600 9600 9600 9600 4400 9800 4770 1100 3000 2800 (26)(2500 8900	U-value W/m2K 1.1450 1.1450 1.1450 0.1500 0.1500 0.1500 0.1500 30) + (32) 0.0000	W/ 14.954 1.099 1.099 1.648 5.097 2.470 1.811 4.095	K 1 2 2 2 2 9 0 5 0 0 0	-value kJ/m2K	A x K kJ/K	
Thermal mass par List of Thermal K1 Eleme E2 Other E3 Sill E4 Jamb	Bridges ent		TFA) in kJ/						Length P 8.4000 8.4000 4.4000	si-value 0.0280 0.0240 0.0190	Tot 0.23 0.20 0.27	152 116	(35)

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E18 Pa E17 Co E7 Par R1 Hea R2 Sil	ty floor be d of roof w l of roof w b of roof w s (Sum(L x bridges	tween dwel ted - inte tween dwel indow indow indow	rnal area gr lings (in bl	ocks of fl		rea)		6 2 19 4 4	.3500 .7000 .4500 .2000 .2000 .2000	0.0370 0.0410 -0.0790 0.0360 0.0280 0.0240 0.0190	0.27 0.27 -0.19 0.69 0.11 0.10 0.21 (36a) = + (36a) =	47 36 12 76	
Ventilation he	at loss cal	culated mo	nthly (38)m Mar	= 0.33 x (	(25)m x (5) May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m Heat transfer	29.0153 coeff	28.9097	28.8062	28.3198	28.2289	27.8053	27.8053	27.7269	27.9685	28.2289	28.4129	28.6054	
Average = Sum(	63.4762 39) m / 12 =		63.2671	62.7808	62.6898	62.2662	62.2662	62.1878	62.4294	62.6898	62.8739	63.0663 62.7803	(39)
HLP HLP (average)	Jan 0.8605	Feb 0.8590	Mar 0.8576	Apr 0.8510	May 0.8498	Jun 0.8441	Jul 0.8441	Aug 0.8430	Sep 0.8463	Oct 0.8498	Nov 0.8523	Dec 0.8549 0.8510	(40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	
4. Water heati	ng energy r	equirement	s (kWh/year)										
Assumed occupa Hot water usag	e for mixer											2.3341	. ,
Hot water usag	0.0000 e for baths 73.0422	0.0000 71.9574	0.0000 70.4298	0.0000 67.6132	0.0000 65.5041	0.0000 63.1655	0.0000	0.0000 63.4192	0.0000	0.0000 67.5733	0.0000 70.4479	0.0000 72.7952	
Hot water usag	e for other 38.5332	uses 37.1320	35.7308	34.3296	32.9284	31.5271	31.5271	32.9284	34.3296	35.7308	37.1320	38.5332	(42c)
Average daily	Jan	Feb	Mar Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	102.7518 Dec	(43)
Daily hot wate Energy conte Energy content	111.5753 176.7081 (annual)	155.3418	106.1606 163.1648	101.9427 139.5545	98.4325 132.5090	94.6927 116.4357	93.4295 112.9949	96.3476 119.2985	99.4004 122.5707	103.3040 140.1826 Total = S	107.5799 153.2672 um(45)m =	111.3284 174.3134 1706.3412	
Distribution 1 Water storage	26.5062	= 0.15 x ( 23.3013		20.9332	19.8764	17.4654	16.9492	17.8948	18.3856	21.0274	22.9901	26.1470	(46)
Total storage  If cylinder co	0.0000	0.0000	0.0000 r storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
Primary loss Combi loss	0.0000 0.0000 50.9589	0.0000 0.0000 46.0274	0.0000 0.0000 50.9589	0.0000 0.0000 49.3151	0.0000 0.0000 50.1601	0.0000 0.0000 46.6978	0.0000 0.0000 47.6106	0.0000 0.0000 49.0977	0.0000 0.0000 49.0194	0.0000 0.0000 50.9589	0.0000 0.0000 49.3151	0.0000 0.0000 50.9589	(59)
Total heat req	uired for w 227.6670	ater heati 201.3692	ng calculate 214.1237	ed for each 188.8696	month 182.6692	163.1335	160.6055	168.3961	171.5901	191.1415	202.5823	225.2723	(62)
WWHRS PV diverter Solar input FGHRS	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	(63b) (63c)
Output from w/	227.6670	201.3692	214.1237	188.8696	182.6692	163.1335	160.6055	168.3961 Total pe	171.5901 er year (kW	191.1415 h/year) = S	202.5823 um(64)m =	225.2723 2297.4199	(64)
12Total per ye Electric showe		r) 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Heat gains fro	m water hea	ting, kWh/:	month 66.9920	Tot 58.7306	al Energy us 56.5993	sed by insta 50.3893	antaneous e 49.4735	lectric show	wer(s) (kWh 53.0096	/year) = Sun 59.3504	m(64a)m = 63.2901	0.0000 70.6989	
	71.4332	03.1300	00.3320	30.7300	30.3333	30.3033	43.4733	31.3412	33.0030	33.3304	03.2301	70.0303	(03)
5. Internal ga	ins (see Ta	 ble 5 and	5a)										
Metabolic gain		, Watts		700	Marr	Tun	Tu 1	Aug	Con	Oct	Nov	Dog	
(66)m Lighting gains	116.7034	116.7034	116.7034		May 116.7034 L9a), also s		116.7034			116.7034	116.7034	Dec 116.7034	(66)
Appliances gai	ns (calcula	ted in App	endix L, equ	ation L13		so see Tab	le 5			103.8688	107.3310	103.8688	
Cooking gains	(calculated	in Append	ix L, equati	on L15 or	176.7482 L15a), also 34.6703	see Table	5		157.3091 34.6703	168.7731 34.6703	183.2443 34.6703	196.8452 34.6703	
Pumps, fans Losses e.g. ev	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000		3.0000	3.0000	3.0000	
Water heating	-93.3627	-93.3627	-93.3627	-93.3627	-93.3627	-93.3627	-93.3627	-93.3627	-93.3627	-93.3627	-93.3627	-93.3627	(71)
Total internal	gains					69.9852	66.4966	69.8134	73.6245	79.7721	87.9029	95.0254	(72)
	466.9068	478.0620	457.6062	441.1318	417.7022	398.4745	382.4374	383.6173	396.2756	413.4249	439.4893	456.7504	(73)
6. Solar gains													
[Jan]				rea m2	Solar flux Table 6a W/m2	Speci:	g fic data Table 6b	Specific or Tab	FF data le 6c	Acce: fact: Table	ss or 6d	Gains W	
Northeast			4.73	300	11.2829		0.5400		7000			13.9800	
Southwest Northwest Northeast Southwest Northwest			1.82 0.96 1.44 0.96	.00 200 500 100	36.7938 11.2829 26.0000 26.0000 26.0000		0.5400 0.4500 0.4500 0.4500	0 0 0	.7000 .7000 .7000 .7000 .7000	0.77 0.77 0.77 1.00 1.00	00 00 00 00	62.7453 5.3792 7.0762 10.6142 7.0762	(81) (82) (82)
Solar gains Total gains	106.8711	197.7230	308.6791	440.6757	542.5743	559.0880	530.5970	452.1843	354.3985	229.1500	130.9478		

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7. Mean internal temperature (heating season)  Temperature during heating periods in the living area from Table 9, Th1 (C)  Utilisation factor for gains for living area, nli,m (see Table 9a)  Tamperature during heating periods in the living area from Table 9, Th1 (C)  Tamperature during heating periods in the living area nli,m (see Table 9a)  Tamperature during heating periods in the living area from Table 9, Th1 (C)  Tamperature during heating periods in the living area nli,m (see Table 9a)  Tamperature during heating periods in the living area nli,m (see Table 9a)  Tamperature during heating periods in the living area nli,m (see Table 9a)  Tamperature during heating periods in the living area from Table 9, Th1 (C)  Tamperature during heating periods in the living area from Table 9, Th1 (C)  Tamperature during heating periods in the living area from Table 9, Th1 (C)  Tamperature during heating periods in the living area from Table 9, Th1 (C)  Tamperature during heating periods in the living area from Table 9, Th1 (C)  Tamperature during heating periods in the living area from Table 9, Th1 (C)  Tamperature during heating periods in the living area from Table 9, Th1 (C)  Tamperature adjustment  Tamperature adjus
Table 1
Util living area  0.9908
MIT 20.2459 20.4450 20.6849 20.9076 20.9855 20.9988 20.9999 20.9997 20.9921 20.8591 20.5132 20.2067
### Properties of house ### Pr
HIT 2 19.3304 19.5806 19.8725 20.1249 20.1997 20.2147 20.2153 20.2161 20.2087 20.0820 19.6733 19.2836
-0.1500 adjusted MIT 19.5217 19.7528 20.0253 20.2667 20.3426 20.3570 20.3578 20.3582 20.3508 20.2217 19.8364 19.4774  3. Space heating requirement  Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  Itilisation 0.9851 0.9628 0.9076 0.7594 0.5580 0.3740 0.2562 0.2944 0.5162 0.8368 0.9647 0.9885  Useful gains 565.2126 650.6659 695.4683 669.6798 535.8258 358.0815 233.9560 246.0920 387.4926 537.7325 550.3003 539.9602  Ext temp. 4.3000 4.9000 6.5000 8.9000 11.7000 14.6000 16.6000 16.4000 14.1000 10.6000 7.1000 4.2000  Heat loss rate W  966.2140 941.2312 855.7077 713.6104 541.8048 358.4651 233.9815 246.1541 390.2310 603.1793 800.7866 963.4906  Space heating kWh  298.3450 195.2598 119.2181 31.6300 4.4483 0.0000 0.0000 0.0000 0.0000 48.6924 180.3501 315.1066  Space heating requirement - total per year (kWh/year)  0.0000
8. Space heating requirement  Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Utilisation 0.9851 0.9628 0.9076 0.7594 0.5580 0.3740 0.2562 0.2944 0.5162 0.8368 0.9647 0.9885 Useful gains 565.2126 650.6659 695.4683 669.6798 535.8258 358.0815 233.9560 246.0920 387.4926 537.7325 550.3003 539.9602 Ext temp. 4.3000 4.9000 6.5000 8.9000 11.7000 14.6000 16.6000 16.4000 14.1000 10.6000 7.1000 4.2000 Heat loss rate W  966.2140 941.2312 855.7077 713.6104 541.8048 358.4651 233.9815 246.1541 390.2310 603.1793 800.7866 963.4906 Space heating kWh  298.3450 195.2598 119.2181 31.6300 4.4483 0.0000 0.0000 0.0000 0.0000 48.6924 180.3501 315.1066 Space heating requirement - total per year (kWh/year)  50lar heating kWh  0.0000
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Julisation 0.9851 0.9628 0.9076 0.7594 0.5580 0.3740 0.2562 0.2944 0.5162 0.8368 0.9647 0.9885 0.9461 gains 565.2126 650.6659 695.4683 669.6798 535.8258 358.0815 233.9560 246.0920 387.4926 537.7325 550.3003 539.9602 25xt temp. 4.3000 4.9000 6.5000 8.9000 11.7000 14.6000 16.6000 16.4000 14.1000 10.6000 7.1000 4.2000 4.9100 966.2140 941.2312 855.7077 713.6104 541.8048 358.4651 233.9815 246.1541 390.2310 603.1793 800.7866 963.4906 963.4906 983.4906 1298.3450 195.2598 119.2181 31.6300 4.4483 0.0000 0.0000 0.0000 0.0000 48.6924 180.3501 315.1066 963.4906 96
Utilisation 0.9851 0.9628 0.9076 0.7594 0.5580 0.3740 0.2562 0.2944 0.5162 0.8368 0.9647 0.9885   Useful gains 565.2126 650.6659 695.4683 669.6798 535.8258 358.0815 233.9560 246.0920 387.4926 537.7325 550.3003 539.9602   Uset temp. 4.3000 4.9000 6.5000 8.9000 11.7000 14.6000 16.6000 16.4000 14.1000 10.6000 7.1000 4.2000   Uset loss rate W 966.2140 941.2312 855.7077 713.6104 541.8048 358.4651 233.9815 246.1541 390.2310 603.1793 800.7866 963.4906   Uset loss rate W 968.2140 941.2312 855.7077 713.6104 541.8048 358.4651 233.9815 246.1541 390.2310 603.1793 800.7866 963.4906   Uset loss rate W 968.2140 941.2312 855.7077 713.6104 541.8048 358.4651 233.9815 246.1541 390.2310 603.1793 800.7866 963.4906   Uset loss rate W 968.2140 941.2312 855.7077 713.6104 541.8048 358.4651 233.9815 246.1541 390.2310 603.1793 800.7866 963.4906   Uset loss rate W 968.2140 941.2312 855.7077 713.6104 541.8048 358.4651 233.9815 246.1541 390.2310 603.1793 800.7866 963.4906   Uset loss rate W 968.2140 941.2312 855.7077 713.6104 541.8048 358.4651 233.9815 246.1541 390.2310 603.1793 800.7866 963.4906   Uset loss rate W 968.2140 941.2312 855.7077 713.6104 541.8048 358.4651 233.9815 246.1541 390.2310 603.1793 800.7866 963.4906   Uset loss rate W 968.2140 941.2312 855.7077 713.6104 541.8048 358.4651 233.9815 246.1541 390.2310 603.1793 800.7866 963.4906   Uset loss rate W 968.2140 941.2312 855.7077 713.6104 541.8048 358.4651 233.9815 246.1541 390.2310 603.1793 800.7866 963.4906   Uset loss rate W 968.2140 941.2312 855.7077 713.6104 541.8048 358.4651 233.9815 246.1541 390.2310 603.1793 800.7866 963.4906   Uset loss rate W 968.2140 941.2312 855.7077 713.6104 541.8048 358.4651 233.9815 246.1541 390.2310 603.1793 800.7866 963.4906   Uset loss rate W 968.2140 941.2312 855.7077 713.6104 941.8048 358.4651 233.9815 246.1541 390.2310 603.1793 800.7866 963.4906   Uset loss rate W 968.2140 941.2312 855.7077 713.6104 941.8048 358.4651 233.9815 246.1541 390.2310 603.1793 800.7866 963.4906   Uset loss rate W 968.2140 941.2312 855.7077 713.6104 941.8048   Uset lo
966.2140 941.2312 855.7077 713.6104 541.8048 358.4651 233.9815 246.1541 390.2310 603.1793 800.7866 963.4906 Space heating kWh 298.3450 195.2598 119.2181 31.6300 4.4483 0.0000 0.0000 0.0000 48.6924 180.3501 315.1066 Space heating requirement - total per year (kWh/year) 1193.0505 Solar heating kWh 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
298.3450 195.2598 119.2181 31.6300 4.4483 0.0000 0.0000 0.0000 0.0000 48.6924 180.3501 315.1066 Space heating requirement - total per year (kWh/year) 0.0000
0.0000 $0.0000$ $0.0000$ $0.0000$ $0.0000$ $0.0000$ $0.0000$ $0.0000$ $0.0000$ $0.0000$ $0.0000$
Space heating kWh 298.3450 195.2598 119.2181 31.6300 4.4483 0.0000 0.0000 0.0000 0.0000 48.6924 180.3501 315.1066  Space heating requirement after solar contribution - total per year (kWh/year)  Space heating per m2  (98c) / (4) = 16.1726
Fraction of space heat from main system(s)  Efficiency of main space heating system 1 (in %)  Efficiency of main space heating system 2 (in %)  Efficiency of secondary/supplementary heating system, %  O.0000
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Space heating requirement
298.3450 195.2598 119.2181 31.6300 4.4483 0.0000 0.0000 0.0000 0.0000 48.6924 180.3501 315.1066 Space heating efficiency (main heating system 1) 89.5000 89.5000 89.5000 89.5000 89.5000 0.0000 0.0000 0.0000 89.5000 89.5000 89.5000
Space heating fuel (main heating system)  333.3464 218.1674 133.2046 35.3408 4.9702 0.0000 0.0000 0.0000 54.4050 201.5085 352.0744
Space heating efficiency (main heating system 2) 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
Space heating fuel (main heating system 2) 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
space heating fuel (secondary) 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
Nater heating Nater heating requirement 227.6670 201.3692 214.1237 188.8696 182.6692 163.1335 160.6055 168.3961 171.5901 191.1415 202.5823 225.2723
%9.5000 (217)m 89.5000 89.5000 89.5000 89.5000 89.5000 89.5000 89.5000 89.5000 89.5000 89.5000 89.5000 89.5000 Nuel for water heating, kWh/month
254.3765 224.9935 239.2444 211.0275 204.0996 182.2720 179.4475 188.1521 191.7208 213.5659 226.3489 251.7009 Space cooling fuel requirement
(221)m 0.0000 0.
Electricity generated by PVs (Appendix M) (negative quantity) 233a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
llectricity generated by wind turbines (Appendix M) (negative quantity)  234a]m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000  lectricity generated by hydro-electric generators (Appendix M) (negative quantity)
(Appendix M) (negative quantity) (235a)m 0.0000 0.0
235c)m 0.00000 0.0000 0.0000 0.0000 0.0000 0.0000 0.00000 0.00000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
233b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
234b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
235b)m 0.00000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.00000 0.0000 0.0000 0.0000 0.0000 0.0000 0.00000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
235d)m 0.00000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.00000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.00000
pace heating fuel - main system 2 pace heating fuel - main system 2 pace heating fuel - secondary 0.0000 pace heating fuel - secondary
### ### ### ### ### ### ### ### ### ##
Electricity for pumps and fans: central heating pump 41.0000
main heating flue fan 45.0000 Total electricity for the above, kWh/year 86.0000 Electricity for lighting (calculated in Appendix L) 170.6180
Energy saving/generation technologies (Appendices M , $\mathbb N$ and $\mathbb Q$ )

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PV generation Wind generation Hydro-electric gelectricity gene Appendix Q - spe Energy saved or Energy used Total delivered	erated - Midecial featur generated	cro CHP (Ap										0.0000 0.0000 0.0000 0.0000 -0.0000 0.0000 4156.5849	(234) (235a) (235) (236) (237)	
12a. Carbon diox	kide emissi	ons - Indiv	idual heati	ng systems	including m	icro-CHP								
								Energy				Emissions		
Space heating -			vat om o					kWh/year 1333.0173		CO2/kWh 0.2100		kg CO2/year 279.9336 0.0000	(261)	
Total CO2 associ Water heating (c Space and water	other fuel)	community s	ystems					2566.9496		0.2100		539.0594 818.9931	(264)	
Pumps, fans and Energy for light	electric k	eep-hot						86.0000 170.6180		0.1387 0.1443		11.9293 24.6254	(267)	
Total CO2, kg/ye EPC Dwelling Car		e Emission	Rate (DER)									855.5478 11.6000		
13a. Primary ene	ergy - Indi	vidual heat	ing systems	including	micro-CHP									
								Energy	Primary energy			imary energy kWh/year		
Space heating - Total CO2 associ	iated with		ystems					1333.0173		1.1300		1506.3096 0.0000	(473)	
Water heating (c Space and water Pumps, fans and	heating	oon-hot						2566.9496 86.0000				2900.6531 4406.9627 130.1008	(279)	
Energy for light Total Primary er	ing	-						170.6180		1.5128 1.5338		261.6996 4798.7630	(282)	
Dwelling Primary												65.0500		
SAP 10 WORKSHEET														
CALCULATION OF T	FARGET EMIS	SIONS												
1. Overall dwell								Area		y height		Volume		
Ground floor								(m2) 40.8900		(m)		(m3) 100.1805	(1b) -	(3b)
First floor Total floor area	a TFA = (1a	)+(1b)+(1c)	+(1d)+(1e).	(1n)	7	3.7700		32.8800				59.1840	(4)	(3c)
Dwelling volume								(	3a)+(3b)+(3c)+	(3d) + (3e)	)(3n) =	159.3645	(5)	
2. Ventilation r														
												m3 per hour		
Number of open of Number of open f	flues										0 * 80 = 0 * 20 =	0.0000	(6b)	
Number of chimne Number of flues	attached to	o solid fue	l boiler	re							0 * 10 = 0 * 20 = 0 * 35 =	0.0000	(6d)	
Number of flues Number of blocke Number of interm	ed chimneys		ter								0 * 20 = 3 * 10 =	0.0000	(6f)	
Number of passiv Number of fluele	e vents										0 * 10 = 0 * 40 =	0.0000	(7b)	
			nd 6	. 160) 1 (0)	1.60.1.16.22.1	(60) 1 (60)	(6~)   (7. ) : :	76)   /7 '		20 000		ges per hour	(0)	
Infiltration due Pressure test Pressure Test Me		ys, flues a	nd fans =	(6a)+(6b)	+ (6c) + (6d) + (	6e)+(6i)+(	(6g) + (7a) + (	/b)+(/c) =		30.0000	0 / (5) =	0.1882 Yes Blower Door		
Measured/design Infiltration rat	AP50											5.0000 0.4382	(17)	
Number of sides	sheltered												(19)	
Shelter factor Infiltration rat	te adjusted	to include	shelter fa	ctor					(20) = 1 - (21)		x (19)] = x (20) =			
rate at the	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(22)	
Wind speed Wind factor Adj infilt rate	5.1000 1.2750	5.0000 1.2500	4.9000 1.2250	4.4000 1.1000	4.3000 1.0750	3.8000 0.9500	3.8000 0.9500	3.7000 0.9250		4.3000 1.0750				
Effective ac	0.4330		0.4161 0.5866			0.3227 0.5521	0.3227 0.5521	0.3142 0.5494		0.3651 0.5667				
3. Heat losses a 				Gross	Openings		 :Area	U-value	A x U	,	K-value	Α×Κ		
TER Opening Type	e (Uw = 1.2)	0)		m2	m2		m2 .0600	W/m2K 1.1450			kJ/m2K	kJ/K		
Bedroom 1							9600	1.5918	1.5281				(27a)	

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Landing Bedroom 1 & Landing External Wall 1 External Wall 2 Cold Roof Sloping Ceiling Total net area of e Fabric heat loss, W Party Wall	external			47.0400 16.4700 18.1100 30.6600	13.060 3.360	1 0 33 16 18 0 27 112	.9600 .4400 .9800 .4700 .1100 .3000 .2800 (26)(	1.5918 1.5918 0.1800 0.1800 0.1100 0.1100 30) + (32)	1.52 2.29 6.11 2.96 1.99 3.00 = 34.37 0.00	21 64 46 21 30			(27a) (27a) (29a) (29a) (30) (30) (31) (33) (32)
E3 Sill E4 Jamb E16 Corner E18 Party v E17 Corner E7 Party f R1 Head of R2 Sill of R3 Jamb of Thermal bridges (Sv Point Thermal bridge)	intels  (normal wall bet (invert loor bet roof wi roof wi roof wi um(L x I ges	(including tween dwel ted - inte tween dwel indow indow indow	other steel lings rnal area gi lings (in b)	eater than cocks of fl	ats)	rea)		8 8 14 7 6 2 19 4 4	.4000 .4000 .4000 .3500 .7000 .4500 .2000 .2000	Psi-value 0.0500 0.0500 0.05500 0.0900 0.0600 -0.0900 0.0700 0.0800 0.0600 0.0800	Tot 0.42 0.42 0.42 0.72 0.66 0.40 0.00 0.22 1.34 0.33 0.25 0.89 (36a) =	00 00 00 15 20 05 40 60 20 60 5.2310 0.0000	(36)
Total fabric heat									(	33) + (36)	+ (36a) =	39.6096	(37)
	oss calc an .2262	Feb 31.0347	Mar 30.8470	= 0.33 x ( Apr 29.9655	25)m x (5) May 29.8005	Jun 29.0327	Jul 29.0327	Aug 28.8905	Sep 29.3285	Oct 29.8005	Nov 30.1342	Dec 30.4830	(20)
Heat transfer coefs		70.6443	70.4566	69.5751	69.4101	68.6423	68.6423	68.5001	68.9381	69.4101	69.7438	70.0926	
Average = Sum(39)m		, 0.0110	70.1000	03.0701	03.1101	00.0120	00.0120	00.0001	00.3001	03.1101	03.7130	69.5743	(33)
	an .9602 31	Feb 0.9576 28	Mar 0.9551 31	Apr 0.9431 30	May 0.9409 31	Jun 0.9305 30	Jul 0.9305 31	Aug 0.9286 31	Sep 0.9345 30	Oct 0.9409 31	Nov 0.9454 30	Dec 0.9502 0.9431 31	(40)
4. Water heating er													
Assumed occupancy Hot water usage for												2.3341	
Hot water usage for		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Hot water usage for			70.4298	67.6132	65.5041	63.1655	61.9023	63.4192	65.0709	67.5733 35.7308	70.4479	72.7952	
Average daily hot w	.5332 water us	37.1320 se (litres	35.7308 /day)	34.3296	32.9284	31.5271	31.5271	32.9284	34.3296	33.7306	37.1320	38.5332 102.7518	
Ja Daily hot water use	an e	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte 176. Energy content (ann	.5753 .7081 nual)	109.0894 155.3418	106.1606 163.1648	101.9427 139.5545	98.4325 132.5090	94.6927 116.4357	93.4295 112.9949	96.3476 119.2985	99.4004 122.5707	103.3040 140.1826 Total = S	107.5799 153.2672 um(45)m =	111.3284 174.3134 1706.3412	
Distribution loss 26. Water storage loss:	.5062	= 0.15 x (- 23.3013	45)m 24.4747	20.9332	19.8764	17.4654	16.9492	17.8948	18.3856	21.0274	22.9901	26.1470	(46)
Total storage loss		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contain				0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Combi loss 50.	.0000 .9589	0.0000 46.0274	0.0000 50.9589	0.0000 49.3151	0.0000 50.1601	0.0000 46.6978	0.0000 47.6106	0.0000 49.0977	0.0000 49.0194	0.0000 50.9589	0.0000 49.3151	0.0000 50.9589	
	.6670	201.3692	214.1237	188.8696	182.6692	163.1335	160.6055	168.3961	171.5901	191.1415	202.5823	225.2723	
PV diverter -0.	.0000	0.0000	0.0000 -0.0000 0.0000	0.0000	0.0000 -0.0000 0.0000	0.0000 -0.0000 0.0000	0.0000	0.0000 -0.0000 0.0000	0.0000	0.0000		0.0000 -0.0000 0.0000	(63b)
FGHRS 0.	.0000	0.0000	0.0000		0.0000		0.0000	0.0000		0.0000		0.0000	
			214.1237	188.8696	182.6692	163.1335	160.6055				202.5823 um(64)m =		(64)
Electric shower(s)		0.0000	0.0000	0.0000 Tot		0.0000 sed by insta	0.0000 antaneous e					0.0000	(64a)
Heat gains from wat	ter heat .4952	63.1580	month 66.9920					51.9412		59.3504		70.6989	
5. Internal gains													
Metabolic gains (Ta													
Ja (66) m 116.	an .7034	Feb 116.7034	Mar 116.7034					Aug 116.7034	Sep 116.7034	Oct 116.7034	Nov 116.7034	Dec 116.7034	(66)
	.8688	114.9976	103.8688	107.3310	103.8688	107.3310	103.8688	103.8688	107.3310	103.8688	107.3310	103.8688	(67)
	.9314	208.0684	202.6834	191.2194	176.7482	163.1473	154.0610	151.9241	157.3091	168.7731	183.2443	196.8452	(68)
	.6703	34.6703	34.6703	34.6703	34.6703	34.6703	34.6703	34.6703	34.6703	34.6703	34.6703	34.6703	
Losses e.g. evapora	ation (r				3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	
Water heating gains	s (Table	∍ 5)	-93.3627				-93.3627	-93.3627		-93.3627	-93.3627	-93.3627	
Total internal gair	ns		90.0430	81.5703		69.9852	66.4966	69.8134	73.6245	79.7721	87.9029	95.0254	
466.	.9068	478.0620	457.6062	441.1318	417.7022	398.4745	382.4374	383.6173	396.2756	413.4249	439.4893	456.7504	(73)
6. Solar gains													

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[Jan]				m2	W/m2	Speci or	g fic data Table 6b	Specific or Tab	FF data le 6c	Acces facto Table (	or	Gains W	
Northeast Southwest Northwest Northeast Southwest Northwest			4.73 6.51 1.82 0.96 1.44 0.96	800 100 200 600 100	11.2829 36.7938 11.2829 26.0000 26.0000		0.6300 0.6300 0.6300 0.6300 0.6300 0.6300	0 0 0 0 0	.7000 .7000 .7000	0.770 0.770 0.770 1.000 1.000	00 00 00	16.3100 73.2028 6.2757 9.9066 14.8599 9.9066	(79) (81) (82) (82)
Solar gains Total gains													
7. Mean inter	nal tempera	ture (heatin	ng season)										
Temperature d	actor for g	ains for liv	/ing area, r	nil,m (see	Table 9a)							21.0000	(85)
tau alpha util living a:	Jan 72.3210 5.8214 rea	Feb 72.5170 5.8345	Mar 72.7102 5.8473	Apr 73.6315 5.9088	May 73.8065 5.9204	Jun 74.6320 5.9755	Jul 74.6320 5.9755	Aug 74.7870 5.9858	Sep 74.3119 5.9541	Oct 73.8065 5.9204	Nov 73.4534 5.8969	Dec 73.0878 5.8725	
	0.9906	0.9732	0.9236	0.7786	0.5794	0.4001	0.2893	0.3328	0.5607	0.8710	0.9767	0.9929	
MIT Th 2 util rest of 1	20.1102 20.1166	20.3435 20.1188	20.6284 20.1209	20.8911 20.1310	20.9819 20.1329	20.9983 20.1417	20.9998 20.1417	20.9996 20.1433	20.9889 20.1383	20.8245 20.1329	20.4207 20.1291	20.0715 20.1251	
MIT 2 Living area f	0.9878 19.0924 raction	0.9658 19.3864	0.9047 19.7332	0.7390 20.0325	0.5291 20.1197	0.3469 20.1408	0.2329 20.1416	0.2710 20.1431		0.8334 19.9737 Living area		0.9908 19.0500 0.3728	(90) (91)
MIT Temperature adjusted MIT	djustment	19.7432	20.0669	20.3526	20.4411	20.4605	20.4615	20.4624	20.4513	20.2909	19.8397	19.4308 0.0000 19.4308	
adjusted MII									20.4313	20.2909	19.0397	19.4300	(93)
8. Space heat	ing require	ment											
	4.3000	693.3443	Mar 0.9034 758.0161 6.5000	Apr 0.7496 741.0146 8.9000	May 0.5472 598.3147 11.7000	Jun 0.3667 401.6340 14.6000	Jul 0.2540 265.0089 16.6000	Aug 0.2940 278.1453 16.4000	Sep 0.5188 433.3466 14.1000	Oct 0.8409 584.7679 10.6000	Nov 0.9657 579.0575 7.1000	Dec 0.9886 559.3707 4.2000	(95)
Heat loss rate Space heating	1074.7085	1048.5879	955.8787	796.8151	606.7196	402.2752	265.0638	278.2748	437.8487	672.6438	888.5118	1067.5650	(97)
Space heating	361.7264 requiremen	238.7237 t - total pe		40.1763 n/year)	6.2532	0.0000	0.0000	0.0000	0.0000	65.3797	222.8071	378.0966 1460.3728	
Solar heating	0.0000	0.0000 on - total p	0.0000 per year (kW	0.0000 Wh/year)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Space heating Space heating Space heating	361.7264 requiremen	238.7237 t after sola			6.2532 1 per year	0.0000 (kWh/year)	0.0000	0.0000	0.0000	65.3797 (98c)		378.0966 1460.3728 19.7963	
9a. Energy re	quirements	- Individual	L heating sy	stems, inc	luding micr	o-CHP							
Fraction of sy Fraction of sy Efficiency of Efficiency of Efficiency of	pace heat f main space main space	rom main sys heating sys heating sys	stem(s) stem 1 (in 9 stem 2 (in 9	\$) \$)	m (Table 11	)						0.0000 1.0000 92.4000 0.0000 0.0000	(202) (206) (207)
Space heating	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating	361.7264	238.7237		40.1763 L)	6.2532	0.0000	0.0000	0.0000	0.0000	65.3797	222.8071	378.0966	(98)
Space heating	92.4000 fuel (main	92.4000 heating sys	92.4000 stem)	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000	
Space heating		258.3590 (main heat: 0.0000		43.4809	6.7676 0.0000	0.0000	0.0000	0.0000	0.0000	70.7572	0.0000	409.1954 0.0000	
Space heating				0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Space heating		ndary) 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Water heating Water heating		t											
Efficiency of	227.6670 water heat	201.3692 er		188.8696	182.6692	163.1335	160.6055	168.3961	171.5901	191.1415	202.5823	225.2723 80.3000	(216)
(217)m Fuel for wate		84.7471 kWh/month 237.6120	83.5946	81.6861 231.2139	80.5579 226.7550	80.3000 203.1550	80.3000 200.0069	80.3000 209.7088	80.3000 213.6863	82.3299 232.1654	84.5858 239.4990	85.4819 263.5321	
Space cooling (221)m			0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Pumps and Fa Lighting	7.3041 21.5819	6.5973 17.3138	7.3041 15.5891	7.0685 11.4213	7.3041 8.8221	7.0685 7.2077	7.3041 8.0478	7.3041 10.4609	7.0685 13.5876	7.3041 17.8277	7.0685 20.1364	7.3041 22.1817	(231)
Electricity go (233a)m Electricity go	-25.0301	-36.3934	-53.9358	-62.5919	-69.1820		-64.3882	-59.9500	-52.4057	-42.4783	-27.9071	-21.5127	(233a)
(234a)m Electricity ge	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 ity)	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
(235a)m Electricity u	0.0000 sed or net	0.0000 electricity	0.0000 generated h	0.0000 by micro-CH	0.0000 P (Appendix	0.0000 N) (negati	0.0000 ve if net g		0.0000	0.0000	0.0000		(235a)
(235c)m Electricity ge	0.0000 enerated by	0.0000 PVs (Append	0.0000 dix M) (nega	0.0000 ative quant	0.0000 ity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		(235c)
(233b) m Electricity ge (234b) m						ty)	-94.9277 0.0000	-80.0109	-58.1653 0.0000	-33.7181	-14.7407 0.0000	-8.6563 0.0000	
Electricity ge (235b)m	enerated by 0.0000	hydro-elect 0.0000	ric generat 0.0000	ors (Appen 0.0000	dix M) (neg 0.0000	ative quant 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		(235b)
Electricity u													•

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(235d)m 0.0000 0.0000 Annual totals kWh/year Space heating fuel - main system 1 Space heating fuel - main system 2 Space heating fuel - secondary Efficiency of water heater Water heating fuel used Space cooling fuel	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 1580.4900 0.0000 0.0000 80.3000 2780.1674 0.0000	(211) (213) (215) (219)
Electricity for pumps and fans: Total electricity for the above, kV Electricity for lighting (calculate		: L)								86.0000 174.1781	
Energy saving/generation technologi PV generation Wind generation Hydro-electric generation (Appendix Electricity generated - Micro CHP)	( N)	s M ,N and	Q)							-1215.4224 0.0000 0.0000 0.0000	(234) (235a)
Appendix Q - special features Energy saved or generated Energy used Total delivered energy for all uses	:									-0.0000 0.0000 3405.4132	(237)
12a. Carbon dioxide emissions - Inc	lividual heati	ng systems	including n	micro-CHP							
						Energy	Emissi	on factor		Emissions	
						kWh/year	k	g CO2/kWh	k	g CO2/year	(0.61)
Space heating - main system 1 Total CO2 associated with community	, systems					1580.4900		0.2100		331.9029 0.0000	
Water heating (other fuel)	-1					2780.1674		0.2100		583.8352	
Space and water heating										915.7381	
Pumps, fans and electric keep-hot Energy for lighting						86.0000 174.1781		0.1387		11.9293 25.1393	
Energy saving/generation technolog PV Unit electricity used in dwellir						-580.9644		0.1339		-77.8130	
PV Unit electricity exported	.9					-634.4580		0.1256		-79.6607	
Total										-157.4737	
Total CO2, kg/year EPC Target Carbon Dioxide Emission	Data (TED)									795.3329 10.7800	
Erc larget Carbon broxide Emission	Rate (IER)									10.7800	(273)
13a. Primary energy - Individual he											
							imary energ		Prim	ary energy	
Space heating - main system 1						kWh/year 1580.4900	K	1.1300		kWh/year 1785.9537	
Total CO2 associated with community	systems									0.0000	
Water heating (other fuel) Space and water heating						2780.1674		1.1300		3141.5891 4927.5429	
Pumps, fans and electric keep-hot						86.0000		1.5128		130.1008	
Energy for lighting						174.1781		1.5338		267.1602	(282)
Energy saving/generation technolog	ries										
PV Unit electricity used in dwelling						-580.9644		1.4950		-868.5266	
PV Unit electricity exported						-634.4580		0.4609		-292.3995	(202)
Total Total Primary energy kWh/year										-1160.9261 4163.8778	
Target Primary Energy Rate (TPER)										56.4400	

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ppendix 2 – DER Worksheets for the Modelled Apartments for the Be Green scenario	
ppendix 2 BER Workshieds for the Modelled Apartificities for the Be Green sections	



Property Reference	се	F	riars Lane 1BF	GND 55 - Gree	n					Issued	on Date	01/03/2024	
Assessment Refe	rence	F	riars Lane 1BF	GND 55 Green				Prop Type F	Ref	Friars Lar	ne 1BF GND 55 -	Green	
Property		H	Hunters Lodge,	Friars Lane, Ric	hmond, London,	TW9 1NX							
SAP Rating					84 B		DER	4.3	38		TER	13.81	
Environmental					97 A		% DER < TE	R				68.28	
CO <sub>2</sub> Emissions (t/	year)				0.17		DFEE	29	9.10		TFEE	34.02	
Compliance Chec	k				See BREL		% DFEE < T	FEE				14.47	
% DPER < TPER					27.24		DPER	53	3.04		TPER	72.90	
Assessor Details		Mr. Iva	n Ball								Assessor ID	X001-72	183
Client													
SAP 10 WORKSHEET CALCULATION OF I						7 2022)							
1. Overall dwell	ing charac	cteristics						Area	- - 1 S	torey hei	ght	Volume	<u>.</u>
Ground floor Total floor area Dwelling volume	a TFA = (1a	a)+(1b)+(1	lc)+(1d)+(1e	e)(1n)	5	55.4000			(1b) x	2.4	(m) 500 (2b) = (3e)(3n) =		(1b) - (3b) (4)
2. Ventilation r												m3 per hour	
Number of open of Number of open of Number of chimne Number of flues Number of flues Number of blocke Number of intern Number of passiv Number of fluele	flues  eys / flues  attached fattached fed chimneys  mittent extre vents	to solid to to other has tract fans	fuel boiler neater	fire							0 * 80 = 0 * 20 = 0 * 10 = 0 * 20 = 0 * 35 = 0 * 20 = 1 * 10 = 0 * 10 = 0 * 40 =	= 0.0000 = 0.0000 = 0.0000 = 0.0000 = 0.0000 = 10.0000 = 0.0000	(6a) (6b) (6c) (6d) (6e) (6e) (6f) (7a)
Infiltration due Pressure test Pressure Test Me Measured/design Infiltration rat	ethod AP50		s and fans	= (6a)+(6b)	)+(6c)+(6d)+(	(6e) + (6f) + (	(6g)+(7a)+	(7b)+(7c) =		10.	Air char 0000 / (5) =	Yes Blower Door 4.0000 0.273	7 (8) 3 5 (17) 7 (18)
Number of sides Shelter factor Infiltration rat			ıde shelter	factor					(20) = 1		75 x (19)] = 18) x (20) =	= 0.7750	
Wind speed Wind factor	Jan 5.1000 1.2750	Feb 5.0000 1.2500		Apr 4.4000 1.1000	May 4.3000 1.0750	Jun 3.8000 0.9500	Jul 3.8000 0.9500				Nov 000 4.500 750 1.125	00 4.7000	) (22) ) (22a)
Adj infilt rate		0.2651 0.5351	0.2598	0.2333	0.2280	0.2015 0.5203	0.2015 0.5203	0.1962	0.212	1 0.2	280 0.238 260 0.528	36 0.2492	(22b)
3. Heat losses a													
Element				Gross	Openings		:Area	U-value		x U	K-value	АхІ	ζ.
Glazed Door/ Wir Heatloss Floor 1 External Wall 1 Flat Roof Total net area of Fabric heat loss Party Wall Party Ceiling	of external	l elements		m2 53.7800 6.8500	15.2900	15. 55. 38. 6. 116.	m2 2900 4000 4900 8500 0300	W/m2K 1.1450 0.1100 0.1500 0.1300 (30) + (32) 0.0000	17. 6. 5. 0.	x 0 W/K 5076 0940 7735 8905	k-value kJ/m2K	A X r	
E3 Sill E4 Jamb E16 Corr E18 Part E5 Grour E14 Flat	Bridges ent r lintels her (normal ty wall beind floor (normal	(including 1) tween dwel normal)	g other stee	el lintels)	external are	ea)		2	Length 9.4000 6.7000 22.4000 7.3500 4.9000 11.9500 5.5400 2.4500	Psi-val 0.02 0.02 0.01 0.03 0.04 0.04 -0.07	80 0. 40 0. 90 0. 70 0. 10 0. 60 1.	250.0000 Cotal 2632 1608 4256 2719 2009 00097 2271 1936	) (35)

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Ventilation hea	Jan	culated mo	nthly (38)m Mar	= 0.33 x (	(25)m x (5) May	Jun	Jul	Aug	Sep	33) + (36) ·	Nov	32.6314 Dec	
(38)m Heat transfer o		23.9696	23.9073	23.6145	23.5597	23.3047	23.3047	23.2575	23.4029	23.5597	23.6705	23.7864	
Average = Sum(	56.6646 39)m / 12 =	56.6010	56.5387	56.2459	56.1911	55.9361	55.9361	55.8888	56.0343	56.1911	56.3019	56.4178 56.2456	
ILP	Jan 1.0228	Feb 1.0217	Mar 1.0206	Apr 1.0153	May 1.0143	Jun 1.0097	Jul 1.0097	Aug 1.0088	Sep 1.0114	Oct 1.0143	Nov 1.0163	Dec 1.0184	
LP (average) ays in mont	31	28	31	30	31	30	31	31	30	31	30	1.0153	
. Water heatin	ng energy r	equirement	s (kWh/year	)									
Assumed occupar Not water usage	e for mixer											1.8491	
ot water usage	0.0000 for baths 63.6272	0.0000	0.0000	0.0000	0.0000 57.0608	0.0000 55.0236	0.0000	0.0000 55.2446	0.0000	0.0000	0.0000	0.0000	
ot water usage			61.3515	58.8980 29.9045	28.6840	27.4634	53.9232 27.4634	28.6840	56.6834 29.9045	58.8632 31.1251	32.3457	63.4121 33.5663	
verage daily l						_		_				89.5072	
aily hot wate:	Jan r use 97.1935	Feb 95.0279	Mar 92.4767	Apr 88.8025	May 85.7447	Jun 82.4870	Jul 81.3866	Aug 83.9286	Sep 86.5879	Oct 89.9883	Nov 93.7130	Dec 96.9784	(44
nergy conte nergy content istribution lo	153.9307 (annual)	135.3185	142.1332	121.5662	115.4289	101.4273	98.4300	103.9211	106.7716	122.1133	133.5114 um(45)m =		(45)
ater storage :	23.0896	20.2978	21.3200	18.2349	17.3143	15.2141	14.7645	15.5882	16.0157	18.3170	20.0267	22.7767	(46)
Store volume a) If manufact Temperature : Enter (49) or	factor from (54) in (55	Table 2b	actor is kn	own (kWh/c	day):							200.0000 1.2000 0.6000 0.7200	(48)
otal storage : f cylinder co	22.3200	20.1600 cated sola	22.3200 r storage	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200	(56)
Primary loss	22.3200 54.8576 0.0000	20.1600 49.5488 0.0000	22.3200 54.8576 0.0000	21.6000 53.0880 0.0000	22.3200 54.8576 0.0000	21.6000 22.5120 0.0000	22.3200 23.2624 0.0000	22.3200 23.2624 0.0000	21.6000 22.5120 0.0000	22.3200 54.8576 0.0000	21.6000 53.0880 0.0000	22.3200 54.8576 0.0000	(59)
otal heat requ	231.1083	205.0273	219.3108	196.2542	192.6065	145.5393	144.0124	149.5035	150.8836	199.2909	208.1994	229.0223	
WHRS V diverter olar input	0.0000 -0.0000 0.0000	0.0000 -0.0000 0.0000	0.0000 -0.0000 0.0000	0.0000 -0.0000 0.0000	0.0000 -0.0000 0.0000	0.0000 -0.0000 0.0000	0.0000 -0.0000 0.0000	0.0000 -0.0000 0.0000	0.0000 -0.0000 0.0000	0.0000 -0.0000 0.0000	0.0000 -0.0000 0.0000	0.0000 -0.0000 0.0000	(63)
GHRS utput from w/l	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63
2Total per yea		205.0273 r)	219.3108	196.2542	192.6065	145.5393	144.0124	149.5035 Total p	150.8836 er year (kW	199.2909 h/year) = S	208.1994 um(64)m =	229.0223 2270.7585 2271	
lectric showe:	0.0000	0.0000	0.0000	0.0000	0.0000 al Energy us	0.0000	0.0000	0.0000	0.0000 wer(s) (kWh	0.0000 /vear) = Su	0.0000 m(64a)m =	0.0000	
eat gains from	n water hea 95.0680	ting, kWh/ 84.6324	month 91.1454	82.8912	82.2662	51.7342	51.3379	53.1637	53.5111	84.4888	86.8629	94.3744	
. Internal ga	ins (see Ta												
etabolic gains													
66) m	92.4535				92.4535				Sep 92.4535	Oct 92.4535	Nov 92.4535	Dec 92.4535	(66)
ighting gains ppliances gain	81.3149	90.0272	81.3149	84.0254	81.3149	84.0254	81.3149	81.3149	84.0254	81.3149	84.0254	81.3149	(67)
ooking gains	161.2159 (calculated	162.8888 in Append	158.6731 ix L, equat	149.6984 ion L15 or	138.3694 L15a), also	127.7218 see Table 5	120.6085					154.1026	(68)
umps, fans	32.2453	32.2453	32.2453 0.0000	32.2453	32.2453 0.0000	32.2453 0.0000	32.2453 0.0000	32.2453 0.0000	32.2453 0.0000	32.2453 0.0000	32.2453 0.0000		
osses e.g. eva Water heating o	-73.9628	-73.9628	-73.9628	-73.9628	-73.9628	-73.9628	-73.9628	-73.9628	-73.9628	-73.9628	-73.9628	-73.9628	(71
otal internal	127.7796 gains	125.9411			110.5728					113.5602			
	421.0464	429.5932	413.2312	399.5864	380.9932	334.3363	321.6620	322.4431	332.2337	377.7371	398.8594	413.0009	(73)
5. Solar gains													
[Jan]			A	rea m2	Solar flux Table 6a W/m2	Specif or 1	g fic data Table 6b	Specific or Tab	FF data le 6c	Acce fact Table	ss or 6d	Gains W	
 Northeast			5.5 5.9 3.7	700 400 800	11.2829 36.7938 36.7938		0.5400 0.5400 0.5400	0 0 0	.7000 .7000 .7000	0.77 0.77 0.77	00 00 00	16.4628 57.2515 36.4327	(75) (77) (79)
Southeast Southwest									309.9870	217.3210	132.9265	93.6185	(83)
outhwest	110.1470 531.1934	622.6824	691.9491	769.2769	817.2989	777.2613	744.6213	694.2102	642.2208	595.0581	531.7858	300.6194	(84)

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Jan tau 67.8946	Feb 67.9709	Mar 68.0459	Apr 68.4001	May 68.4668	Jun 68.7789	Jul 68.7789	Aug 68.8370	Sep 68.6583	Oct 68.4668	Nov 68.3320	Dec 68.1917	
alpha 5.5263 util living area	5.5314	5.5364	5.5600	5.5645	5.5853	5.5853	5.5891	5.5772	5.5645	5.5555	5.5461	
0.9815	0.9580	0.9089	0.7912	0.6192	0.4573	0.3301	0.3694	0.5874	0.8399	0.9593	0.9853	(86)
MIT 20.4052 Th 2 20.0644	20.5361 20.0653	20.6834 20.0662	20.8252 20.0706	20.8911 20.0715	20.9081 20.0753	20.9107 20.0753	20.9105	20.8998 20.0738	20.8101 20.0715	20.5865	20.3769 20.0681	
util rest of house 0.9763	0.9470	0.8871	0.7507	0.5640	0.3927	0.2610	0.2957	0.5145	0.7967	0.9467	0.9811	(89)
MIT 2 19.3777 Living area fraction	19.5403	19.7175	19.8785	19.9425	19.9597	19.9611	19.9618		19.8682 Living area		19.3454 0.5235	(91)
MIT 19.9156 Temperature adjustment	20.0616	20.2231	20.3740	20.4391	20.4561	20.4582	20.4584	20.4486	20.3612	20.1206	19.8854 0.4000	
adjusted MIT 20.3156	20.4616	20.6231	20.7740	20.8391	20.8561	20.8582	20.8584	20.8486	20.7612	20.5206	20.2854	(93)
8. Space heating require	ment											
								_			_	
Jan Utilisation 0.9778	Feb 0.9520	Mar 0.9007	Apr 0.7819	May 0.6099	Jun 0.4473	Jul 0.3195	Aug 0.3582	Sep 0.5758	Oct 0.8296	Nov 0.9532	Dec 0.9822	
Useful gains 519.4197 Ext temp. 4.3000 Heat loss rate W	592.7787 4.9000	623.2144 6.5000	601.4880 8.9000	498.4409 11.7000	347.7015 14.6000	237.9094 16.6000	248.6531 16.4000	369.7920 14.1000	493.6696 10.6000	506.9227 7.1000	497.5946 4.2000	
907.5151 Space heating kWh	880.8006	798.5015	667.8653	513.5355	349.9443	238.1880	249.1741	378.1557	570.9713	755.6051	907.5002	(97)
	193.5508		47.7916 h/year)	11.2304	0.0000	0.0000	0.0000	0.0000	57.5124	179.0513	304.9698 1213.2629	(98a)
Solar heating kWh 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution					******						0.0000	(,
	193.5508 t after sola		47.7916 tion - total	11.2304 L per vear	0.0000 (kWh/vear)	0.0000	0.0000	0.0000	57.5124	179.0513	304.9698 1213.2629	(98c)
Space heating per m2				1 - 1	, , ,				(98c)	/ (4) =	21.9001	(99)
9a. Energy requirements												
Fraction of space heat f											0.0000	(201)
Fraction of space heat f: Efficiency of main space	heating sys	stem 1 (in s									1.0000	
Efficiency of main space Efficiency of secondary/s											0.0000	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	193.5508		47.7916	11.2304	0.0000	0.0000	0.0000	0.0000	57.5124	179.0513	304.9698	(98)
	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000	(210)
	193.5508	130.4136	47.7916	11.2304	0.0000	0.0000	0.0000	0.0000	57.5124	179.0513	304.9698	(211)
Space heating efficiency 0.0000 Space heating fuel (main	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
0.0000 Space heating fuel (second	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating Water heating requirement	t											
Efficiency of water heat	er	219.3108	196.2542	192.6065	145.5393	144.0124	149.5035	150.8836	199.2909	208.1994	229.0223 170.0000	
(217)m 170.0000 Fuel for water heating,	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	
	120.6043	129.0063	115.4436	113.2979	85.6114	84.7132	87.9432	88.7550	117.2300	122.4702	134.7190	(219)
(221)m 0.0000 Pumps and Fa 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Lighting 16.5503 Electricity generated by	13.2773 PVs (Append	11.9547 dix M) (nega	8.7585 ative quant:	6.7653 ity)	5.5273	6.1716	8.0220	10.4198	13.6714	15.4418	17.0103	(232)
(233a)m -28.3568 Electricity generated by		nes (Append:					-64.5204	-55.8732	-47.5175	-31.6574	-24.2826	(233a)
(234a)m 0.0000 Electricity generated by							0.0000	0.0000	0.0000	0.0000	0.0000	
(235a)m 0.0000 Electricity used or net								0.0000	0.0000	0.0000	0.0000	
(235c)m 0.0000 Electricity generated by				0.0000 ity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Electricity generated by		nes (Append:	ix M) (negat	tive quanti			-75.1139	-54.4398	-28.5012	-10.8910	-5.8159	
(234b)m 0.0000 Electricity generated by (235b)m 0.0000				0.0000 dix M) (neg 0.0000			0.0000	0.0000	0.0000	0.0000	0.0000	
Electricity used or net				(Appendix				0.0000	0.0000	0.0000	0.0000	
(235d)m 0.0000 Annual totals kWh/year Space heating fuel - main	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Space heating fuel - main Space heating fuel - second	n system 2										0.0000	(213)
Efficiency of water heate Water heating fuel used											170.0000 1335.7403	
Space cooling fuel											0.0000	
Electricity for pumps and Total electricity for the		n/vear									0.0000	(231)
Electricity for lighting			ix L)								133.5703	
Energy saving/generation PV generation	technologie	es (Appendio	ces M ,N and	(Q f							-1212.5863	(233)
Wind generation Hydro-electric generation	n (Appendiy	N)									0.0000	(234)
Electricity generated - I Appendix Q - special feat	Micro CHP (A										0.0000	
Energy saved or generated Energy used											-0.0000 0.0000	
Total delivered energy for	or all uses										1469.9872	

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	-CHP		
	Energy	Emission factor	Emissions
	kWh/year	kg CO2/kWh	kg CO2/year
Space heating - main system 1 Total CO2 associated with community systems	1213.2629	0.1573	190.8716 (261 0.0000 (373
Water heating (other fuel) Space and water heating	1335.7403	0.1418	189.4074 (264 380.2790 (265
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267
Energy for lighting	133.5703	0.1443	19.2783 (268
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-645.2913	0.1344	-86.7444
PV Unit electricity exported	-567.2951	0.1233	-69.9329
Total			-156.6773 (269
Total CO2, kg/year			242.8801 (272
EPC Dwelling Carbon Dioxide Emission Rate (DER)			4.3800 (273
		imary energy factor	Primary energy
	Energy Pr	imary energy factor kg CO2/kWh	
Space heating - main system 1	Energy Pr kWh/year		
	Energy Pr kWh/year	kg CO2/kWh	kWh/year 1919.8341 (275
Space heating - main system 1 Total CO2 associated with community systems	Energy Pr kWh/year 1213.2629	kg CO2/kWh 1.5824	kWh/year 1919.8341 (275 0.0000 (473
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel)	Energy Pr kWh/year 1213.2629	kg CO2/kWh 1.5824	kWh/year 1919.8341 (275 0.0000 (473 2036.1861 (278
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Space and water heating	Energy Pr kWh/year 1213.2629 1335.7403	kg CO2/kWh 1.5824 1.5244	kWh/year 1919.8341 (275 0.0000 (473 2036.1861 (278 3956.0203 (279
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Space and water heating Pumps, fans and electric keep-hot Energy for lighting  Energy saving/generation technologies	Energy Pr kWh/year 1213.2629 1335.7403 0.0000 133.5703	kg CO2/kWh 1.5824 1.5244 0.0000 1.5338	kWh/year 1919.8341 (275 0.0000 (473 2036.1861 (278 3956.0203 (279 0.0000 (281 204.8746 (282
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Space and water heating Pumps, fans and electric keep-hot Energy for lighting Energy saving/generation technologies PV Unit electricity used in dwelling	Energy Pr kWh/year 1213.2629 1335.7403 0.0000 133.5703	kg CO2/kWh 1.5824 1.5244 0.0000 1.5338	kWh/year 1919.8341 (275 0.0000 (473 2036.1861 (278 3956.0203 (279 0.0000 (281 204.8746 (282
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Space and water heating Pumps, fans and electric keep-hot Energy for lighting  Energy saving/generation technologies PV Unit electricity used in dwelling PV Unit electricity exported	Energy Pr kWh/year 1213.2629 1335.7403 0.0000 133.5703	kg CO2/kWh 1.5824 1.5244 0.0000 1.5338	kWh/year 1919.8341 (275 0.0000 (473 2036.1861 (278 3956.0203 (279 0.0000 (281 204.8746 (282
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Space and water heating Pumps, fans and electric keep-hot Energy for lighting  Energy saving/generation technologies PV Unit electricity used in dwelling PV Unit electricity exported Total	Energy Pr kWh/year 1213.2629 1335.7403 0.0000 133.5703	kg CO2/kWh 1.5824 1.5244 0.0000 1.5338	kWh/year 1919.8341 (275 0.0000 (473 2036.1861 (278 3956.0203 (279 0.0000 (281 204.8746 (282 -965.8866 -256.6324 -1222.5190 (283
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Space and water heating Pumps, fans and electric keep-hot Energy for lighting Energy saving/generation technologies PV Unit electricity used in dwelling PV Unit electricity exported	Energy Pr kWh/year 1213.2629 1335.7403 0.0000 133.5703	kg CO2/kWh 1.5824 1.5244 0.0000 1.5338	kWh/year 1919.8341 (275 0.0000 (473 2036.1861 (278 3956.0203 (279 0.0000 (281 204.8746 (282

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			DUP 74 - Greer	n					ssued on Da		01/03/2024	
Assessment Reference			DUP 74 Green				Prop Type R	Ref	ars Lane 2Bl	DUP 74 - Gre	een	
Property	Hu	inters Lodge, I	Friars Lane, Ric	hmond, London,	TW9 1NX							
SAP Rating				87 B		DER	2.9	97	TER		10.52	
Environmental				98 A		% DER < TER					71.77	
CO <sub>2</sub> Emissions (t/year)				0.14		OFEE	23	.14	TFEE		26.28	
% DPER < TPER				See BREL		% DFEE < TFI DPER		70	TPER		11.92	
1% DPER > IPER				29.59		DPEK	38	.76	IPER		55.05	
Assessor Details  Client	Mr. Ivan	Ball							Asses	sor ID	X001-728	33
SAP 10 WORKSHEET FOR New CALCULATION OF DWELLING E  Overall dwelling chara  Ground floor First floor Total floor area TFA = (1) Welling volume	emissions fo	R REGULATI	(Version 10	NCE	2022)		Area (m2) 40.8900 32.8800	(1b) x	1.8000	(2b) = (2c) =	Volume (m3) 100.1805 59.1840 159.3645	(1b) - (3 (1c) - (3 (4)
Number of open chimneys Number of open flues Number of chimneys / flue Number of flues attached Number of flues attached Number of blocked chimney Number of intermittent ex Number of passive vents Number of flueless gas fi	to solid fu to other he ys ctract fans ires	el boiler eater								0 * 80 = 0 * 20 = 0 * 10 = 0 * 20 = 0 * 35 = 0 * 20 = 2 * 10 = 0 * 10 = 0 * 40 = Air change	0.0000 0.0000 s per hour	(6a) (6b) (6c) (6d) (6e) (6f) (7a) (7b) (7c)
Infiltration due to chimr Pressure test Pressure Test Method Measured/design AP50 Infiltration rate Number of sides sheltered		and fans	= (6a)+(6b)	+(6c)+(6d)+(	6e)+(6I)+(	6g)+(/a)+(	/b)+(/c) =				0.1255 Yes lower Door 4.0000 0.3255	(17)
Shelter factor Infiltration rate adjuste	ed to includ	e shelter	factor					(20) = 1 - (21)	[0.075 x ) = (18)		0.7750 0.2523	
Jan Wind speed 5.1000	Feb 5.0000	Mar 4.9000	Apr 4.4000	May 4.3000	Jun 3.8000	Jul 3.8000	Aug 3.7000		Oct 4.3000	Nov 4.5000	Dec 4.7000	
Wind factor 1.2750 Adj infilt rate	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250		1.0750	1.1250	1.1750	
0.3216 Effective ac 0.5517	0.3153 0.5497	0.3090 0.5477	0.2775 0.5385	0.2712 0.5368	0.2396 0.5287	0.2396 0.5287	0.2333 0.5272		0.2712 0.5368	0.2838 0.5403	0.2964 0.5439	
3. Heat losses and heat l	loss paramet	er							ı K-	-value	АхК	
Selazed Door/ Window (Uw = Sedroom 1	al elements	Aum(A, m2)	m2 47.0400 16.4700 18.1100 30.6600	13.0600 3.3600	13. 0. 0. 1. 33. 16. 18. 27. 112.	m2 0600 9600 9600 4400 9800 4700 1100 3000 2800	W/m2K 1.1450 1.1450 1.1450 0.1500 0.1500 0.1500 0.1500 0.1500 0.1500	W/F 14.9542 1.0992 1.0992 1.6488 5.0970 2.4705 1.8110 4.0950		J√m2K	kJ/K	

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E18 Party E17 Corne E7 Party R1 Head ( R2 Sill (	er (inverter floor betof roof with of roof with floor betof with the floor flo	tween dwell ted - inter tween dwell indow indow indow	rnal area g lings (in b	locks of fl		6 2 19 4 4	.3500 .7000 .4500 .2000 .2000 .2000	0.0370 0.0410 -0.0790 0.0360 0.0280 0.0240 0.0190	0.27 0.27 -0.19 0.69 0.11 0.10 0.21 (36a) = + (36a) =	47 36 12 76 08			
Ventilation heat									_			_	
(38)m :	Jan 29.0153	Feb 28.9097	Mar 28.8062	Apr 28.3198	May 28.2289	Jun 27.8053	Jul 27.8053	Aug 27.7269	Sep 27.9685	Oct 28.2289	Nov 28.4129	Dec 28.6054	(38)
	63.4762	63.3706	63.2671	62.7808	62.6898	62.2662	62.2662	62.1878	62.4294	62.6898	62.8739	63.0663 62.7803	(39)
HLP HLP (average)	Jan 0.8605	Feb 0.8590	Mar 0.8576	Apr 0.8510	May 0.8498	Jun 0.8441	Jul 0.8441	Aug 0.8430	Sep 0.8463	Oct 0.8498	Nov 0.8523	Dec 0.8549 0.8510	(40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	
4. Water heating	energy re	equirements	s (kWh/year	)									
Assumed occupancy Hot water usage	for mixer											2.3341	
Hot water usage :		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Hot water usage :	73.0422 for other 38.5332	71.9574 uses 37.1320	70.4298	67.6132 34.3296	65.5041 32.9284	63.1655 31.5271	61.9023	63.4192	65.0709 34.3296	67.5733 35.7308	70.4479 37.1320	72.7952 38.5332	
Average daily ho				34.3290	32.9204	31.3271	31.3271	32.3204	34.3290	33.7300	37.1320	102.7518	
Daily hot water	Jan use	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte 1 Energy content (a Distribution loss	76.7081 annual)	109.0894 155.3418	106.1606 163.1648	101.9427 139.5545	98.4325 132.5090	94.6927 116.4357	93.4295 112.9949	96.3476 119.2985	99.4004 122.5707	103.3040 140.1826 Total = S	107.5799 153.2672 um(45)m =	111.3284 174.3134 1706.3412	
	26.5062	23.3013	24.4747	20.9332	19.8764	17.4654	16.9492	17.8948	18.3856	21.0274	22.9901	26.1470	(46)
Store volume a) If manufactu: Temperature fac Enter (49) or (5	rer declas	Table 2b	actor is kno	own (kWh/c	day):							200.0000 1.2000 0.6000 0.7200	(48) (49)
Total storage lo		20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200	
Primary loss	22.3200 54.8576	20.1600 49.5488	22.3200 54.8576	21.6000 53.0880	22.3200 54.8576	21.6000 22.5120	22.3200 23.2624	22.3200 23.2624	21.6000 22.5120	22.3200 54.8576	21.6000 53.0880	22.3200 54.8576	(59)
Combi loss Total heat requi: 2: WWHRS	0.0000 red for wa 53.8857 0.0000	0.0000 ater heatin 225.0506 0.0000	0.0000 ng calculate 240.3424 0.0000	0.0000 ed for each 214.2425 0.0000	0.0000 n month 209.6866 0.0000	0.0000 160.5477 0.0000	0.0000 158.5773 0.0000	0.0000 164.8809 0.0000	166.6827	0.0000 217.3602 0.0000	0.0000 227.9552 0.0000	0.0000 251.4910	(62)
	-0.0000 0.0000 0.0000	-0.0000 0.0000 0.0000	-0.0000 0.0000 0.0000	-0.0000 0.0000 0.0000	-0.0000 0.0000 0.0000	-0.0000 0.0000 0.0000	-0.0000 0.0000 0.0000	-0.0000 0.0000 0.0000	0.0000 -0.0000 0.0000 0.0000	-0.0000 0.0000 0.0000	-0.0000 0.0000 0.0000	0.0000 -0.0000 0.0000 0.0000	(63b) (63c)
Output from w/h		225.0506	240.3424	214.2425	209.6866	160.5477	158.5773	164.8809	166.6827	217.3602	227.9552	251.4910	(64)
12Total per year Electric shower(		r)						TOTAL P	er year (kW	n/year) = S	um(64)m =	2490.7028 2491	
	0.0000	0.0000	0.0000	0.0000 Tot	0.0000 al Energy u	0.0000 sed by insta	0.0000 antaneous e	0.0000 lectric sho	0.0000 wer(s) (kWh	0.0000 /year) = Su	0.0000 m(64a)m =	0.0000	
Heat gains from 1			98.1384	88.8723	87.9453	56.7245	56.1807	58.2767	58.7644	90.4968	93.4318	101.8453	(65)
5. Internal gains	s (see Tak	ole 5 and 5	5a)										
Metabolic gains		, Watts							Sep	Oct	Nov	Dog	
	16.7034	116.7034	Mar 116.7034 dix L. equa	Apr 116.7034 tion L9 or	May 116.7034	Jun 116.7034 see Table 5	Jul 116.7034	Aug 116.7034	116.7034	116.7034		Dec 116.7034	(66)
Appliances gains	03.8688	114.9976	103.8688	107.3310	103.8688	107.3310	103.8688	103.8688	107.3310	103.8688	107.3310	103.8688	(67)
Cooking gains (ca	05.9314 alculated	208.0684 in Append	202.6834 ix L, equat:	191.2194 ion L15 or	176.7482 L15a), also	163.1473 see Table 5	154.0610		157.3091			196.8452	
Pumps, fans	0.0000	0.0000	0.0000	0.0000	34.6703 0.0000	34.6703 0.0000	34.6703 0.0000		34.6703 0.0000	34.6703 0.0000		34.6703 0.0000	
Losses e.g. evapo -! Water heating gas	93.3627	-93.3627			-93.3627	-93.3627	-93.3627	-93.3627	-93.3627	-93.3627	-93.3627	-93.3627	(71)
	37.9590		131.9064	123.4337	118.2061	78.7840	75.5117	78.3288	81.6172	121.6355	129.7663	136.8888	(72)
		516.9254	496.4696	479.9952	456.8340	407.2733	391.4525	392.1327	404.2683	452.2883	478.3527	495.6138	(73)
6. Solar gains													
[Jan]				m2	Solar flux Table 6a W/m2	Specif or 1	g fic data Table 6b	Specific or Tab	FF data le 6c	Acce fact Table	ss or 6d	Gains W	
Northeast			4.7									13.9800	
Southwest Northwest Northeast			1.8	100 200 600	11.2829 36.7938 11.2829 26.0000 26.0000		0.5400	0	.7000	0.77 0.77 0.77 1.00	00	62.7453 5.3792 7.0762	(81)
Northeast Southwest Northwest			1.4	400 600	26.0000 26.0000		0.4500	0	.7000	1.00	00	10.6142 7.0762	(82)
									· · ·	1.00	-		/

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Solar gains Total gains	106.8711 612.6413	197.7230 714.6484	308.6791 805.1487	440.6757 920.6709	542.5743 999.4083	559.0880 966.3613	530.5970 922.0495	452.1843 844.3171	354.3985 758.6668	229.1500 681.4383	130.9478 609.3005	89.5104 585.1242	
7. Mean inter		ture (heati	ng season)										
Temperature d	uring heatin	ng periods	in the livi	ng area from	n Table 9,							21.0000	(85)
tau alpha util living a	Jan 80.7060 6.3804	Feb 80.8406 6.3894	Mar 80.9729 6.3982	Apr 81.6001 6.4400	May 81.7185 6.4479	Jun 82.2744 6.4850	Jul 82.2744 6.4850	Aug 82.3782 6.4919	Sep 82.0594 6.4706	Oct 81.7185 6.4479	Nov 81.4793 6.4320	Dec 81.2307 6.4154	
,	0.9870	0.9668	0.9143	0.7701	0.5757	0.4116	0.2971	0.3386	0.5614	0.8459	0.9681	0.9900	(86)
MIT Th 2 util rest of	20.5030 20.2012 house	20.6190 20.2025	20.7554 20.2037	20.8761 20.2093	20.9158 20.2104	20.9227 20.2153	20.9233 20.2153	20.9233 20.2162	20.9187 20.2134	20.8532 20.2104	20.6608 20.2082	20.4800 20.2060	
MIT 2 Living area f	0.9833 19.6207	0.9582 19.7660	0.8946 19.9306	0.7325 20.0681	0.5294 20.1063	0.3615 20.1166	0.2441 20.1169	0.2810 20.1179	0.5001 20.1122 ft.A =	0.8070 20.0493 Living area	0.9582 19.8248	0.9871 19.5960 0.3728	(90)
MIT Temperature a adjusted MIT	19.9496	20.0840	20.2381	20.3693	20.4081	20.4171	20.4175	20.4181	20.4128	20.3490	20.1364	19.9255 0.4000 20.3255	(92)
8. Space heat		nent											
Utilisation Useful gains Ext temp. Heat loss rat	Jan 0.9841 602.8945 4.3000	Feb 0.9615 687.1220 4.9000	Mar 0.9058 729.3141 6.5000	Apr 0.7595 699.2655 8.9000	May 0.5646 564.2540 11.7000	Jun 0.4000 386.4976 14.6000	Jul 0.2848 262.5544 16.6000	Aug 0.3253 274.6272 16.4000	Sep 0.5470 414.9993 14.1000	Oct 0.8343 568.4950 10.6000	Nov 0.9626 586.5335 7.1000	Dec 0.9875 577.8389 4.2000	(95)
Space heating	1018.7670	987.5668	894.4760	745.1652	570.9824	387.1135	262.6089	274.7539	419.0781	636.2357	844.8007	1016.9758	(97)
Space heating Solar heating		201.8989 - total p	122.8804 er year (kW	33.0478 h/year)	5.0059	0.0000	0.0000	0.0000	0.0000	50.3991	185.9524	326.7179 1235.3115	(98a)
Solar heating Space heating	0.0000 contribution	0.0000 on - total	0.0000 per year (k	0.0000 Wh/year)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Space heating Space heating	309.4091 requirement		122.8804 ar contribu	33.0478 tion - total	5.0059 l per year	0.0000 (kWh/year)	0.0000	0.0000	0.0000	50.3991 (98c)	185.9524	326.7179 1235.3115 16.7454	
Fraction of s Fraction of s Efficiency of Efficiency of Efficiency of	pace heat fi main space main space	rom main sy heating sy heating sy	stem(s) stem 1 (in stem 2 (in	%) %)	m (Table 11	Jun	Jul	Aug	Sep	Oct	Nov	0.0000 1.0000 100.0000 0.0000 0.0000	(202) (206) (207)
Space heating		5	122.8804	33.0478	5.0059	0.0000	0.0000	0.0000	0.0000	50.3991	185.9524	326.7179	(98)
Space heating	efficiency 100.0000	(main heat 100.0000	ing system 100.0000		100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000	
Space heating Space heating	309.4091	201.8989	122.8804	33.0478	5.0059	0.0000	0.0000	0.0000	0.0000	50.3991	185.9524	326.7179	(211)
Space heating	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Water heating	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating	requirement 253.8857	225.0506	240.3424	214.2425	209.6866	160.5477	158.5773	164.8809	166.6827	217.3602	227.9552	251.4910	
Efficiency of (217)m Fuel for wate	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000 170.0000	
Space cooling	149.3445 fuel requir	132.3827 rement		126.0250	123.3451	94.4398	93.2807	96.9887	98.0486	127.8589	134.0913	147.9359	
(221)m Pumps and Fa Lighting	0.0000 0.0000 21.1408	0.0000 0.0000 16.9599	0.0000 0.0000 15.2705	0.0000 0.0000 11.1878	0.0000 0.0000 8.6418	0.0000 0.0000 7.0604	0.0000 0.0000 7.8833	0.0000 0.0000 10.2471	0.0000 0.0000 13.3099	0.0000 0.0000 17.4633	0.0000 0.0000 19.7248	0.0000 0.0000 21.7283	(231)
Electricity g (233a)m	enerated by	PVs (Appen	dix M) (neg						-71.7388	-60.8637	-41.1196	-31.7564	
Electricity g (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity g (235a)m Electricity u	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
(235c)m Electricity g	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	(235c)
(233b)m Electricity g	-10.7999 enerated by	-24.7436 wind turbi	-53.8373 nes (Append	-88.4110 ix M) (negat	-121.0015 tive quanti				-75.1528	-40.3619	-15.5373	-8.3225	
(234b)m Electricity g								0.0000	0.0000	0.0000	0.0000		(234b)
(235b)m Electricity u (235d)m	0.0000 sed or net 6 0.0000	0.0000 electricity 0.0000	0.0000 generated 0.0000	0.0000 by micro-CHI 0.0000	0.0000 P (Appendix 0.0000	0.0000 N) (negati 0.0000	0.0000 ve if net g 0.0000		0.0000	0.0000	0.0000		(235b) (235d)
Annual totals Space heating	kWh/year		0.0000	3.0000	3.0000	3.3000	0.0000	0.0000	3.0000	3.0000	3.0000	1235.3115	
Space heating Space heating Efficiency of Water heating	fuel - main fuel - seco water heate fuel used	n system 2 ondary										0.0000 0.0000 170.0000 1465.1193	(213) (215) (219)
Space cooling Electricity f Total electri	or pumps and	e above, kW	h/year d in Append	ix L)								0.0000 0.0000 170.6180	(231)

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Energy saving/generation technologies (Appendices M ,N and Q) PV generation Wind generation Hydro-electric generation (Appendix N) Electricity generated - Micro CHP (Appendix N) Appendix Q - special features			-1614.6664 0.0000 0.0000 0.0000	(234) (235a)
Energy saved or generated Energy used Total delivered energy for all uses			-0.0000 0.0000 1256.3823	(237)
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP				
Space heating - main system 1	Energy kWh/year 1235.3115	Emission factor kg CO2/kWh 0.1579	Emissions kg CO2/year 195.1129	
Total CO2 associated with community systems Water heating (other fuel) Space and water heating	1465.1193	0.1418	0.0000 207.7201 402.8330	(264) (265)
Pumps, fans and electric keep-hot Energy for lighting	0.0000 170.6180	0.0000 0.1443	0.0000 24.6254	
Energy saving/generation technologies PV Unit electricity used in dwelling PV Unit electricity exported Total Total CO2, kg/year EPC Dwelling Carbon Dioxide Emission Rate (DER)	-824.6513 -790.0151	0.1345 0.1237	-110.9253 -97.6994 -208.6246 218.8339 2.9700	(272)
13a. Primary energy - Individual heating systems including micro-CHP				
		imary energy factor	Primary energy	
	kWh/year	kg CO2/kWh	kWh/year	
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel)	1235.3115 1465.1193	1.5847 1.5243	1957.5513 0.0000 2233.2829	(473)
Space and water heating			4190.8342	
Pumps, fans and electric keep-hot Energy for lighting	0.0000 170.6180	0.0000 1.5338	0.0000 261.6996	
Energy saving/generation technologies PV Unit electricity used in dwelling PV Unit electricity exported Total Total Primary energy kWh/year Dwelling Primary energy Rate (DPER)	-824.6513 -790.0151	1.4971 0.4539	-1234.6167 -358.5567 -1593.1734 2859.3604 38.7600	(286)

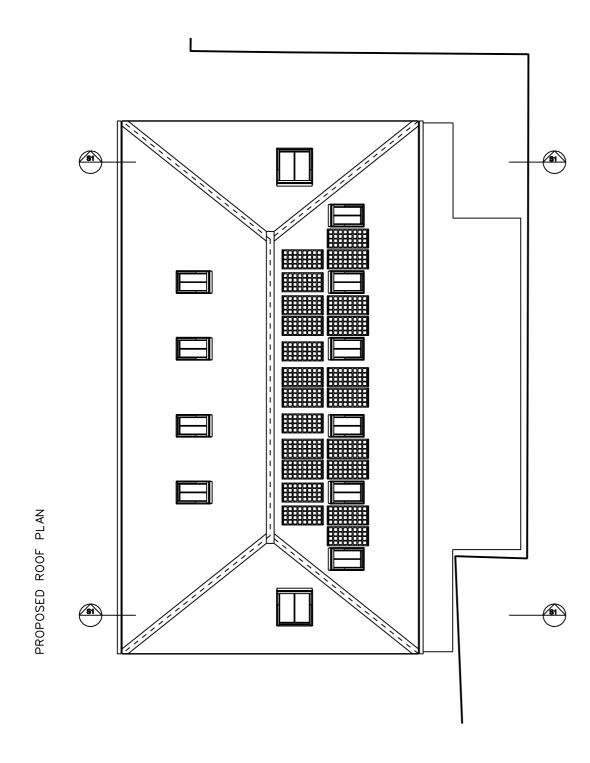
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Appendix 3 -	- Roof Plan & E	Elevation showi	ing the Indicat	ive Location of	f Photovoltaic P	'anels

#### **HUNTERS LODGE / FRIARS LANE / RICHMOND**

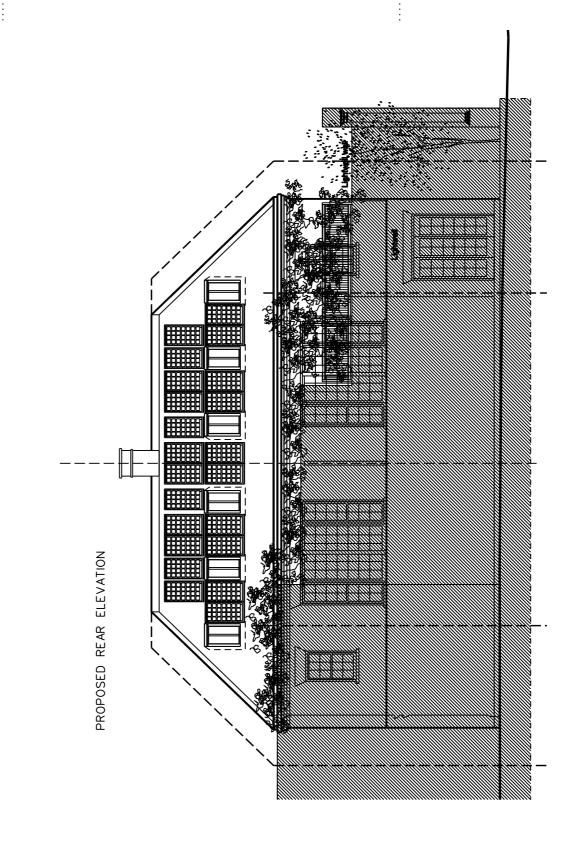
REVISED PROPOSALS APP 3

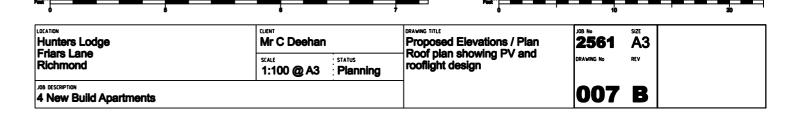


Notes: The General contractor is responsible for the verification of all dimensions on site &Notes: The General contractor is responsible for the verification or all dimensions on site & shall inform the contract administrator of any descrepencies. Do not scale from this drawing. Use figured dimension only. Existing foundations, lintels and wall to be exposed if req'd by Building Control for assessment & upgrading if found inadequate. Unless stated otherwise these drawings represent design intent only & approved assembly drawings will be required from the Trade Contractor prior to any work and/or procurement being undertaken. If in doubt, ask.

Any images shown are for illustrative purposes only.

- / 240215 Issued to client via email A 240216 Issued to client/FJ via email B 240223 Issued to LBRUT via email







Appendix 4 – LBRuT	Sustainable	Construction	Checklist

#### LBRUT Sustainable Construction Checklist - June 2020

This document forms part of the Sustainable Construction Checklist SPD. This document must be filled out as part of the planning application for the following developments: all residential development providing one or more new residential units (including conversions leading to one or more new units), and all other forms of development providing 100sqm or more of non-residential floor space. Developments including new non-residential development of less than 100sqm floor space, extensions less than 100sqm, and other conversions are strongly encouraged to comply with this checklist. Where further information is requested, please either fill in the relevant section, or refer to the document where this information may be found in detail, e.g. Flood Risk Assessment or similar. Further guidance on completing the Checklist may be found in the Justification and Guidance section of this SPD.

Piopei	rty Name (ir relevant):	Hunters Lodge, Friars Lane	e, Richmona		Application No	o. (If known):			
	ss (include. postcode)	Hunters Lodge, Friars Lane	e, Richmond						
Comple	eted by:	Ivan Ball							
		IVan Dan						_	
	n-Residential f development (m2)				For Residential Number of dwellings	4			
3126 01					Number of dwellings				
1	MINIMUM COMPLIANC	E (RESIDENTIAL AND NON-F	RESIDENTIAL)						
Energ	y Assessment								
			nonstrates the expected energy and car HP and community heating systems? If			ncy and renewable	TRUE		
	energy measures, inclu	uling the leasibility of CHP/CC	ne and community heating systems? II	ryes, please selec	I IRUE.				
Carbo	n Dioxide emissions red		an against a Duilding Degulations Dest I	(2012) bassins			70.56	2 0/	
			on against a Building Regulations Part L require a 35% onsite reduction in CO <sub>2</sub> (		Building Regulations 2013.		70.50	70	
				,	• •				
		reduction from efficiency mea	asures alone require a 10% onsite reduction in CO2 o				13.08	8 %	
			neasures for residential and 15% for non						
							57.48	20/	
	Percentage of total site	CO2 emissions saved throug	gh renewable energy installation?				57.48	5 %	
		ning carbon to be offset					0.923	Tonne	
	Policy LP 22 B. and Dr.	aft London Plan Policy 9.2.4 r	require Major developments to achieve 2	Zero Carbon after	offsetting.				
	Are remaining emission	s going to be offset through o	offset fund payment in accordance with	current guidelines	issued for the cost per tonne of	of CO2?	TRUE		
	What is the total predic	ted cost of offset?					2631	1 f	
			er 30 years, this should be updated bas	sed on As Build ca	alculations.		200		
1A	MINIMUM POLICY COM	MPLIANCE (NON-RESIDENTIA	AL AND DOMESTIC REFURBISHMENT)	1					
- 10	MINIMON TOLIGITOR		ease check the Guidance Section of the		licy requirements				
Emilia	onmental Rating of develo		ase theth the Guidante Section of the	nis 3FD for the po	nicy requirements				
	esidential new-build (100s								
	BREEAM Level		Please Select		Have you attached a pre-as	sessment to support this?			FALSE
	ent required under Policy L sions and conversions for i								
	BREEAM Domestic Ref	urbishment	Please Select		Have you attached a pre-as	sessment to support this?			FALSE
	ent required under Policy L sions and conversions for I								
	BREEAM Level		Please Select		Have you attached a pre-as	sessment to support this?			FALSE
Excelle	ent required under Policy	LP 22							
	Score awarded for Envi BREEAM:		Excellent = 8, Outstanding = 16				Subtota	0	
	DILLEAW.								
1B	MINIMUM POLICY COM	MPLIANCE (RESIDENTIAL)					Saara		
	MINIMUM POLICY COM						Score		
	Usage Internal water usage af	MPLIANCE (RESIDENTIAL) regray/rainwater systems limi	ited to 105 litres person per day. (Exclu	iding an allowance	5 litres per person per day for	external water consumption).	Score		TOUS
	Usage Internal water usage af Calculations using the	MPLIANCE (RESIDENTIAL)  ter gray/rainwater systems limiwater efficiency calculator for r	ited to 105 litres person per day. (Exclur new dwellings have been submitted.	-		external water consumption).	Score	1	TRUE
	Usage Internal water usage af Calculations using the	MPLIANCE (RESIDENTIAL)  ter gray/rainwater systems limiwater efficiency calculator for r	ited to 105 litres person per day. (Exclu	-		external water consumption).	Score Subtota	1 1	TRUE
	Usage Internal water usage af Calculations using the	MPLIANCE (RESIDENTIAL)  ter gray/rainwater systems limiwater efficiency calculator for r	ited to 105 litres person per day. (Exclur new dwellings have been submitted.	-		external water consumption).	1	1	TRUE
Water	Usage Internal water usage af Calculations using the v 1101/p/d Required for n	MPLIANCE (RESIDENTIAL)  ter gray/rainwater systems limi water efficiency calculator for r ew dwellings under Policy LP2	ited to 105 litres person per day. (Exclur new dwellings have been submitted.	-		external water consumption).	Subtota	ı I 1	TRUE
2. ENE	Usage Internal water usage af Calculations using the v 110Vp/d Required for n	IPLIANCE (RESIDENTIAL)  ter gray/rainwater systems limi water efficiency calculator for r ew dwellings under Policy LP2  ON	ited to 105 litres person per day. (Exclunew dwellings have been submitted. 22 A 2 105/p/d required under Draft Lo.	-		external water consumption).	1	1 1	TRUE
Water	Usage Internal water usage af Calculations using the v 110Vp/d Required for n	MPLIANCE (RESIDENTIAL)  ter gray/rainwater systems limi water efficiency calculator for re ew dwellings under Policy LP2  ON  ment incorporate cooling meas	ited to 105 litres person per day. (Exclunew dwellings have been submitted. 22 A 2 105/p/d required under Draft Lo.	ondon Plan Policy	S15	external water consumption).	Subtota		TRUE
2. ENE	Usage Internal water usage af Calculations using the v 110Vp/d Required for n	IPLIANCE (RESIDENTIAL)  ter gray/rainwater systems limi water efficiency calculator for re w dwellings under Policy LP2  ON  ment incorporate cooling meas Energy efficient design inco Reduce her	ited to 105 litres person per day. (Exclu- new dwellings have been submitted. 22 A 2 105/p/d required under Draft Lo 22 A 2 105/p/d required under Draft Lo sures? Tick all that apply: ryporating specific heat demand to less: at entering a building through providing.	ondon Plan Policy on the property of the prope	5 kWh/sqm	external water consumption).	Subtota  Score	62	TRUE FALSE
2. ENE	Usage Internal water usage af Calculations using the v 110Vp/d Required for n	IPLIANCE (RESIDENTIAL)  ter gray/rainwater systems limi water efficiency calculator for re w dwellings under Policy LP2  ON  ment incorporate cooling meas Energy efficient design inco Reduce her Reduce her	iled to 105 litres person per day. (Exclur new dwellings have been submitted. 22 A 2 105l/p/d required under Draft Lo sures? Tick all that apply: proporating specific heat demand to less:	ondon Plan Policy on the property of the prope	5 kWh/sqm	external water consumption).	Subtota Score	5 2 3	TRUE FALSE FALSE
2. ENE	Usage Internal water usage af Calculations using the v 110Vp/d Required for n	IPLIANCE (RESIDENTIAL)  ter gray/rainwater systems limi water efficiency calculator for re w dwellings under Policy LP2  ON  ment incorporate cooling meas Energy efficient design inco Reduce hei Reduce hei Exposed th Passiev ery Passiev ery	ited to 105 litres person per day. (Exclunew dwellings have been submitted. 22 A 2 105/p/d required under Draft Lo. sures? Tick all that apply: sures? Tick all that apply: at entering a building through providing at entering a building through shading ermal mass and high ceilings nitiation.	ondon Plan Policy on the property of the prope	5 kWh/sqm	external water consumption).	Subtota Score	5 2 3 4	TRUE FALSE FALSE FALSE TRUE
2. ENE	Usage Internal water usage af Calculations using the v 110Vp/d Required for n	IPLIANCE (RESIDENTIAL)  ter gray/rainwater systems limi water efficiency calculator for r ew dwellings under Policy LP2  ON  ment incorporate cooling meas Energy efficient design inco Reduce her Reduce her Exposed th Passive ver Mechanical ventilation with	ited to 105 litres person per day. (Exclurew dwellings have been submitted. 22 A 2 105/p/d required under Draft Losures? Tick all that apply: opporating specific heat demand to less at entering a building through providing at entering a building through shading lemal mass and high ceilings nitlation.	ondon Plan Policy on the property of the prope	5 kWh/sqm	external water consumption).	Subtota  Score	5 2 3 4 4 3	TRUE FALSE FALSE TRUE FALSE
2. ENE 2.1 No	Usage Internal water usage af Calculations using the v 110Vp/d Required for n	ter gray/rainwater systems limi water efficiency calculator for r ew dwellings under Policy LP2  ON ment incorporate cooling meas Energy efficient design inco Reduce hes Reduce hes Exposed th Passive ver Mechanical verit	ited to 105 litres person per day. (Exclurew dwellings have been submitted. 22 A 2 105/p/d required under Draft Losures? Tick all that apply: opporating specific heat demand to less at entering a building through providing at entering a building through shading lemal mass and high ceilings nitlation.	ondon Plan Policy on the property of the prope	5 kWh/sqm	external water consumption).	Subtota Score	5 2 3 4 4 3	TRUE FALSE FALSE FALSE TRUE
2. ENE 2.1 No a.	Usage Internal water usage af Calculations using the 1101/p/d Required for n  ERGY USE AND POLLUTI eed for Cooling How does the develops	ter gray/rainwater systems limi water efficiency calculator for r ew dwellings under Policy LP2  ON ment incorporate cooling meas Energy efficient design inco Reduce hes Reduce hes Exposed th Passive ver Mechanical verit	ited to 105 litres person per day. (Exclurew dwellings have been submitted. 22 A 2 105/p/d required under Draft Losures? Tick all that apply: opporating specific heat demand to less at entering a building through providing at entering a building through shading lemal mass and high ceilings nitlation.	ondon Plan Policy on the property of the prope	5 kWh/sqm	external water consumption).	Subtota Score	5 2 3 4 4 3	TRUE FALSE FALSE TRUE FALSE
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f.	see <i>Policy LP 10</i> Have you attached a Lighting Pollution Report?	-	
Please	give any additional relevant comments to the Energy Use and Pollution Section below	Subtotal 19	
	oposals include all electric systems on site. Therefore will be no on-site emissions.		
3. TRA	INSPORT		
3.1 Pro a.	ovision for the safe efficient and sustainable movement of people and goods  Does your development provide opportunities for occupants to use innovative travel technologies?		FALSE
Please	e explain:		
b.	Does your development provide for 100% active provision for electric vehicle charging point(s) and have you successfully demonstrated that it would be able to operate satisfactorily in the future expectation of all vehicles being electrically powered?	Score 2	TRUE
C.	For major developments ONLY: Has a Transport Assessment been produced for your development based on TfL's Best Practice Guidance?  If you have provided a Transport Assessment as part of your planning application, please tick here and move to Section 3 of this Checklist.	5	FALSE
d.	See policy LP44 For smaller developments ONLY: Have you provided a Transport Statement?	5	FALSE
e.	Does your development provide cycle storage? (Standard space requirements are set out in the Council's Parking Standards - Local Plan Appendix 3)	2	TRUE
	If so, for how many bicycles? Is this shown on the site plans?	7	TRUE
f.	See Local Plan Appendix 3 Will the development create or improve links with local and wider transport networks? If yes, please provide details.	2	FALSE
		Subtotal 4	
	e give any additional relevant comments to the Transport Section below storage is provided.		
Cycle s	surage is provided.		
4 4.1 Mir	BIODIVERSITY nimising the threat to biodiversity from new buildings, lighting, hard surfacing and people		
a.	Does your development involve the loss of an ecological feature or habitat, including a loss of garden or other green space? (Indicate if yes)  If so, please state how much in sqm?	-2 sqm	FALSE
b.	Does your development involve the removal of any tree(s)? (Indicate if yes)  If so, has a tree report been provided in support of your application? (Indicate if yes)		FALSE FALSE
c. d.	Does your development plan to add (and not remove) any tree(s) on site? (Indicate if yes)  Please indicate which features and/or habitats that your development will incorporate to improve on site biodiversity:		FALSE
	Pond, reedbed or extensive native planting An extensive green roof An intensive green roof 4 Area provided: Garden space Additional native and/or wildlife friendly planting to peripheral areas Additional planting to peripheral areas A living wall Bat boxes Bird boxes Swift boxes Other  A rea provided:	sqm sqm 7.5 sqm sqm sqm sqm	FALSE FALSE TRUE TRUE FALSE FALSE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE
e.	Does your development use at least 70% of available roof plate as green/brown roof Policy LP 17 requires 70%	1 Subtotal 9.5	FALSE
	e give any additional relevant comments to the Biodiversity Section below in roof is provided to the bin and cycle store. Bat boxes, Bird boxes and Swift boxes could be installed.	0.00	
5	FLOODING AND DRAINAGE		
	ting the risks of flooding and other impacts of climate change in the borough Is your site located in a high flood risk zone (Zone 3)? (Indicate if yes)	-2	FALSE
	Have you submitted a Flood Risk Assessment? (Indicate if yes)	•	FALSE
b.	Which of the following measures of the drainage hierarchy are incorporated onto your site? (tick all that apply)  Store rainwater for later use Use of infiltration techniques such as porous surfacing materials to allow drainage on-site Attenuate rainwater in ponds or open water features Store rainwater in tanks for gradual release to a watercourse Discharge rainwater directly to watercourse	5 3 4 3 2	FALSE TRUE FALSE FALSE FALSE
	Discharge rainwater to surface water drain Discharge rainwater to combined sewer	1 0	FALSE TRUE
	Have you submitted a Drainage Statement (Indicate if yes) See Policy LP 21 and Draft London Plan SL 13		FALSE
c.	Please give the change in area of permeable surfacing which will result from your development proposal:  Please give the change in area of permeable surfacing which will result from your development proposal:    0	sqm	
		Subtotal 3	
Please	give any additional relevant comments to the Flooding and Drainage Section below		
6	IMPROVING RESOURCE EFFICIENCY		
6.1 Re a.	rduce waste generated and amount disposed of by landfill though increasing level of re-use and recycling  Will demolition be required on your site prior to construction? [Points will only be awarded if 10% or greater of demolition waste is reused/recycled]	1	TRUE
	If so, what percentage of demolition waste will be reused in the new development?	%	
	What percentage of demolition waste will be recycled?	%	
b.	Does your site have any contaminated land?	1	FALSE
	Have you submitted an assessment of the site contamination?	2	FALSE

C.	,		nitted a remediation plan? ace to include composting on site?		1	FAI FAI
	Will a waste management	plan and facil	ities be in place in line with Policy LP24	Yes		
6.2 Red	ducing levels of water was	te				
a.	Will the following measure:	s of water con	servation be incorporated into the development? (Please tick all that apply):			
			efficient taps, shower heads etc		1	TR
			fficient A or B rated appliances		1	TR
		Rainwater han Greywater syst	resting for internal use		4 4	FAI FAI
		∍reywater sys Fit a water me			1	TR
	'	it a water me	51			
				Sub	total 3	
Please	give any additional relevant	comments to	the Improving Resource Efficiency Section below	042		
7	ACCESSIBILITY					
7.1	Ensure flexible adaptable					
a.			meet the requirements of the nationally described space standard for internal space and layout?		1	TR
	ı	i ine siandaro	s are not met, in the space below, please provide details of the functionality of the internal space and layout			
AND						
b.	If the development is res	idential, will it	meet Building Regulation Requirement M4 (2) 'accessible and adaptable dwellings'?		2	TR
	I	f this is not me	et, in the space below, please provide details of any accessibility measures included in the development.			
		For major resid	ential developments, are 10% or more of the units in the development to Building Regulation Requirement M4		1	FAI
			user dwellings'?		•	IA
OR	,	-,				
C.	If the development is nor	n-residential,	does it comply with requirements included in Richmond's Local Plan LP1, LP28.B, LP30 & LP45		2	FAI
						_
	,	riease piovide	details of the accessibility measures specified in the Local Plan that will be included in the development			
				0.1	total 3	
Please	e give any additional relevant	comments to	he Design Standards and Accessibility Section below	Sub		
Please	e give any additional relevant	comments to	the Design Standards and Accessibility Section below	Sun		
		cklist- Scorin	g Matrix for New Construction (Non-Residential and domestic refurb)		DTAL 42.5	
	istainable Construction Che Score		g Matrix for New Construction (Non-Residential and domestic refurb) Significance			
	stainable Construction Che Score 84 or more	cklist- Scorin Rating <i>A</i> +	g Matrix for New Construction (Non-Residential and domestic refurb)  Significance Project strives to achieve highest standard in energy efficient sustainable development			
	istainable Construction Che Score	cklist- Scorin Rating	g Matrix for New Construction (Non-Residential and domestic refurb) Significance			
	Score   Score   Score   Score   Stainable Construction Che   Stain Price   Stain Pri	cklist- Scorin Rating A+ A B C	g Matrix for New Construction (Non-Residential and domestic refurb)  Significance Project strives to achieve highest standard in energy efficient sustainable development Makes a major contribution towards achieving sustainable development in Richmond Helps to significantly improve the Borough's stock of sustainable developments Minimal effort to increase sustainability beyond general compliance			
	sstainable Construction Che Score 84 or more 75-83 56-74	cklist- Scorin Rating A+ A B	g Matrix for New Construction (Non-Residential and domestic refurb)  Significance Project strives to achieve highest standard in energy efficient sustainable development Makes a major contribution towards achieving sustainable development in Richmond Helps to significantly improve the Borough's stock of sustainable developments			
RUT Sus	Score   84 or more   75-83   56-74   40-55   39 or less	cklist- Scorin Rating A+ A B C FAIL	g Matrix for New Construction (Non-Residential and domestic refurb)  Significance Project strives to achieve highest standard in energy efficient sustainable development Makes a major contribution towards achieving sustainable development in Richmond Helps to significantly improve the Borough's stock of sustainable developments Minimal effort to increase sustainability beyond general compliance Does not comply with SPD Policy			
RUT Sus	Score   Scor	cklist- Scorin Rating A+ A B C FAIL	g Matrix for New Construction (Non-Residential and domestic refurb)  Significance Project strives to achieve highest standard in energy efficient sustainable development Makes a major contribution towards achieving sustainable development in Richmond Helps to significantly improve the Borough's stock of sustainable developments Minimal effort to increase sustainability beyond general compliance Does not comply with SPD Policy  g Matrix for New Construction Residential new-build			
RUT Sus	stainable Construction Che Score 84 or more 75-83 56-74 40-55 39 or less stainable Construction Che Score	cklist- Scorin Rating A+ A B C FAIL cklist- Scorin Rating	g Matrix for New Construction (Non-Residential and domestic refurb)  Significance Project strives to achieve highest standard in energy efficient sustainable development Makes a major contribution towards achieving sustainable development in Richmond Helps to significantly improve the Borough's stock of sustainable developments Minimal effort to increase sustainability beyond general compliance Does not comply with SPD Policy  g Matrix for New Construction Residential new-build  Significance			
RUT Sus	sstainable Construction Che Score 84 or more 75-83 56-74 40-55 39 or less sstainable Construction Che Score 85 or more	cklist- Scorin Rating A+ A B C FAIL cklist- Scorin Rating A++	g Matrix for New Construction (Non-Residential and domestic refurb)  Significance Project strives to achieve highest standard in energy efficient sustainable development Makes a major contribution towards achieving sustainable development in Richmond Helps to significantly improve the Borough's stock of sustainable developments Minimal effort to increase sustainability beyond general compliance Does not comply with SPD Policy  g Matrix for New Construction Residential new-build Significance Project strives to achieve highest standard in energy efficient sustainable development			
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RUT Sus	Stainable Construction Che   Score	cklist-Scorin Rating A+ A B C FA/L cklist-Scorin Rating A++ A+ A	g Matrix for New Construction (Non-Residential and domestic refurb)  Significance  Project strives to achieve highest standard in energy efficient sustainable development  Makes a major contribution towards achieving sustainable development in Richmond Helps to significantly improve the Borough's stock of sustainable developments  Minimal effort to increase sustainability beyond general compliance  Does not comply with SPD Policy  g Matrix for New Construction  Residential new-build  Significance  Project strives to achieve highest standard in energy efficient sustainable development  Project strives to achieve higher standard in energy efficient sustainable development  Makes a major contribution towards achieving sustainable development in Richmond			
RUT Sus	Stainable Construction Che   Score   84 or more   75-83   56-74   40-55   39 or less   Stainable Construction Che   Score   85 or more   68-84   59-67   39-58	cklist-Scoriir Rating A+ A B C FAIL cklist-Scoriir Rating A++ A+ A B	g Matrix for New Construction (Non-Residential and domestic refurb)  Significance Project strives to achieve highest standard in energy efficient sustainable development Makes a major contribution towards achieving sustainable development in Richmond Helps to significantly improve the Borough's stock of sustainable developments Minimal effort to increase sustainability beyond general compliance Does not comply with SPD Policy  g Matrix for New Construction  Residential new-build  Significance Project strives to achieve higherst andard in energy efficient sustainable development Project strives to achieve higher standard in energy efficient sustainable development Makes a major contribution towards achieving sustainable development in Richmond Helps to significantly improve the Borough's stock of sustainable developments			
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