Intended for Dexter Moren Associates

On behalf of West London Mission

Date November 2018

METHODIST CHURCH AND RESIDENTIAL ACCOMMODATION, 58A BIRKENHEAD STREET, KINGS CROSS, LONDON ENERGY STATEMENT



KINGS CROSS METHODIST CHURCH ENERGY STATEMENT

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EXECUTIVE SUMMARY

This report has been prepared to set down the results of the energy analysis and the resulting energy strategy in support of the planning application for the new King Cross Methodist Church and residential development at 58A Birkenhead Street, Kings Cross, London.

Following the application submitted in 2015 (ref: 2015/7013/P), the proposed scheme has been revised to address design and heritage comments from Camden London Borough Council planning officers. This Energy Statement has been updated to reflect the design and layouts variations to the proposals

An Energy Assessment and a Statement of the intended Energy Strategy is a requirement of the planning authority and one of the considerations in the approval process. The assessment has to follow the principles set out by the Energy hierarchy of:

- Be Lean minimise energy demand
- Be Clean use energy efficiently
- Be Green use renewable energy where feasible

The Energy Strategy will be judged by the planning authority against target reductions in CO_2 emissions set by the Greater London Authority and the London Borough of Camden. The targets are expressed in terms of the improvement on 2013 Building Regulations TER for Domestic and Non Domestic buildings and are:

- Greater London Authority 35% for Domestic and Non domestic buildings
- Greater London Authority and the London Borough of Camden achieve a reduction in carbon dioxide emissions of 20% from on-site renewable energy generation unless it can be demonstrated that such provision is not feasible

The assessment has been carried out in accordance with the principles of the Energy Hierarchy and it has been concluded that the energy strategy for the site to achieve the optimum reduction in carbon emissions is:

Be Lean – Thermal improvements to the building envelope, optimise system performance and incorporate 100% LED lighting.

Be Clean – Incorporate Combined Heat and Power for heating and hot water generation in the Church and associated accommodation.

Be Green – Incorporate exhaust air heat pumps in the domestic flats for heating and domestic hot water generation.

The assessment has predicted that the development will meet the targets for CO_2 reduction set by the planning authorities. The energy strategy that has been adopted shows a carbon reduction as shown on Table 1. Carbon off set contribution to achieve the residential target of zero carbon has been calculated and is estimated to be £25,231. This takes into consideration Camden's Council cost of £90 per tonne of CO_2 over a 30-year period¹.

Table 1 below sets out the predicted carbon emissions and reductions resulting from the energy strategy set out above. The table is formatted to comply with the requirements of the GLA in their guidance on preparing energy assessments and carbon off set reporting.

¹ https://www.camden.gov.uk/ccm/content/environment/planning-and-built-environment/two/planning-applications/making-anapplication/supporting-documentation/sustainability-statements-design-and-construction/ (Accessed 07/11/2018)

Table 1 - Carbon dioxide savings resulting from the conclusions of the energy assessment

Energy Hierarchy Tables West London Methodist Church - Development

	pinene					
Total Building area [m ²]	2,070	Non Domestic	825	Residential	2,895	Total Development
Camden's Council cost of carbon tonne (for 30 yr)	£90					
CO ₂ emissions after each stag	ge of the Energy Hierarc					
	CO ₂ Emissions		CO ₂ Emissions		CO ₂ Emissions	
	[Tonnes CO ₂ /annum]		[Tonnes CO ₂ /annum]		[Tonnes CO ₂ /annum]	
	Regulated		Regulated		Regulated	
Building Regulations Part L 2013 Compliant Development	53.30		17.1		70.4	
After energy demand reduction (Be Lean)	42.90		16.2		59.1	
After CHP (Be clean)	33.57		11.4		44.9	
After renewable energy (Be Green)	33.57		10.4		44.0	
Regulated CO ₂ emissions savings from	each stage of the Energ	y Hierarchy				
	Regulated CO ₂ Emissions Savings		Regulated CO ₂ Emissions Savings		Regulated CO ₂ Emissions Savings	
	[Tonnes CO ₂ /annum] %		[Tonnes CO ₂ /annum]	%	[Tonnes CO ₂ /annum]	%
Savings from energy demand reduction (Be Lean)	10.4	19.5	0.9	5.1	11.3	16.0
Savings from CHP (Be Clean)	9.3	17.5	4.8	28.3	14.2	20.1
Savings from renewable energy (Be Green)	0.0	0.0	0.9	5.5	0.9	1.3
Cumulative on-site savings	19.7	37.0	6.6	38.9	26.4	37.5
Annual savings from off-set payment -1.08		10.4		44.0		
Cumulative savings for off-set payment	-32		313		280	
Estimated payment [£]	-£2,902.50		£28,134.00		£25,231.50	

1. INTRODUCTION

1.1 Development Description

The Proposed Development comprises a new build Methodist Church and associated accommodation together with 11 leasehold flats on the site of the existing Methodist Church and accommodation which is to be demolished. The scheme is arranged over basement, ground plus four floors and comprises $2,070m^2$ of accommodation for the church and associated charity and $825 m^2$ of leasehold flats.

An overview of the accommodation and the mechanical and electrical services is given in Section 3 of this report.

1.2 Energy Assessment Procedure

The assessment process which has been followed is commonly known as Being Lean, Being Clean and Being Green where:

- Being Lean minimises the energy consumption of the building through fabric and plant optimisation;
- Being Clean is introducing building services that produces on-site energy rather than importing from the grid and
- Being Green is introducing technologies that require no or a small quantity of grid energy to reduce the overall CO₂ emissions from on-site activities.

The predicted Energy consumption and associated CO_2 emissions have been calculated using SAP 2012 software for the Domestic accommodation comprising the leasehold and Warden's flats. The remaining Non-Domestic accommodation has been analysed using IESVE 2018 software.

This report sets out the results of the assessment and the intended energy strategy that responds to these targets and employs mechanical and electrical solutions that are both economical and practically feasible.

2. PLANNING POLICY BACKGROUND

2.1 National Policy

The Energy White Paper, published in 2003, sets out the UK target of producing 10% of UK electricity from renewable energy by 2010 and the aspiration of doubling this by 2020. This is within the context of the UK carbon dioxide target and the goal of putting the UK on a path to cut carbon dioxide emissions by some 60% by 2050. The Energy White Paper indicated that the Government would be looking to work with regional and local bodies to deliver its objectives, including establishing regional targets for renewable energy generation.

The Government Planning Guidance allows and encourages local planning authorities to set out clear policy requirements for on-site renewable energy generation in major development proposals.

2.2 Regional Policy – GLA London Plan 2016

The London Plan prepared by the Greater London Authority sets out in Chapter 5 London's Response to Climate Change and sets down a number of policies to be followed by major developments in the capital to achieve the Mayors goals of reducing carbon dioxide emissions and conserving resources.

Policy 5.1. Climate Change Mitigation, requires London Boroughs to put in place policies that are consistent with the mayor's goal of working towards a 60 % reduction relative to the 1990 level by 2025.

Policy 5.3 of the London Plan issued by the Major of London provides guidance on Sustainable Design and Construction. Major development proposals should meet the minimum standards outlined in the Mayor's Supplementary Planning Guidance (March 2016) and this should be clearly demonstrated within the Design and Access Statement submitted for Planning Approval.

These standards include the following design principles:

- a. minimising carbon dioxide emission across the site, including the building and its services
- b. avoiding internal overheating and contributing to the urban heat island effect

c. efficient use of natural resources (including water), including making the most of natural systems both within and around buildings

- d. minimising pollution (including noise, air and urban run-off)
- e. minimising the generation of waste and maximising reuse or recycling
- f. avoiding impacts from natural hazards (including flooding)

g. ensuring developments are comfortable and secure for users, including avoiding the creation of adverse local climatic conditions

h. securing sustainable procurement of materials, using local supplies where feasible promoting and protecting biodiversity and green infrastructure



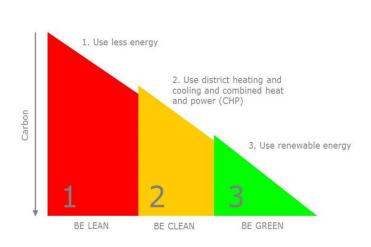


Figure 1 The London Plan March 2016



Policy 5.2 contains an energy hierarchy for minimising carbon dioxide emission: Be Lean, Be Clean, Be Green. This hierarchy outlines a framework under which the GLA requires sustainable building design to be approached. Firstly looking to reduce the energy consumption of a building through passive design and energy efficiency measures (*Be Lean*), secondly considering the application of district heating and combined heat and power (*Be Clean*), and finally the use of renewable energy technologies (*Be Green*).

Policy 5.2 also outlines specific targets for carbon dioxide reduction in buildings. These targets are expressed as a minimum improvement over the Target Emission Rate (TER) calculated under the Building Regulations Part L. The targets are furtherly explain in the GLA guidance on preparing energy assessments published on March 2016 and are as follows:

Table 2: London Plan Required Carbon emissions reduction

Year	Residential Building Improve- ments	Non-domestic Building Im- provements on 2010 Build- ings Regulations	
After 1 st of October 2016	Zero Carbon (35% + Cash in lieu)	35%	

Policy 5.2 of the London Plan states that from 2013 to 2016 energy assessment should be produced to meet a target of 40% cent carbon reduction beyond Part L 2010 of the Building Regulations.

On the 6th of April 2014 the 2013 changes to Part L of the Building Regulations came into effect; Part L 2013 delivers an overall reduction in CO₂ emissions for new residential and new non-domestic buildings, with the targets for individual buildings being differentiated according to building type. This reduction in CO₂ emissions affects the percentage reduction necessary above the new Part L 2013 regulations to meet the Mayor's targets in the London Plan.

As outlined in the Sustainable, Design and Construction SPG and the GLA guidance on preparing energy assessments the Major will apply 35% carbon reduction target beyond Part L 2013 Building Regulations for all non-residential developments and zero carbon targets for residential developments. The 'Zero Carbon' policy was adopted as an approach to ensure that the development industry in London will be prepared for the 'Nearly Zero Energy Buildings' in 2020. For the proposed new King Cross Methodist Church and residential development, the residential element must achieve at least a 35% reduction in regulated carbon dioxide emissions (beyond Part L 2013) on

site. The remaining carbon dioxide emissions to 100% are to be off-set through a cash in lieu contribution to the relevant council. Non-domestic developments will continue to require a 35% reduction against part L 2013.

Clause 5.23 of the London Plan states that where the targets for carbon dioxide reduction cannot be fully achieved on-site the shortfall may be provided by off-site applications, but only in cases where there is an alternative proposal identified and delivery is certain.

Policy 5.6 encourages developments to evaluate the feasibility of Combined Heat and Power (CHP) systems, and examine opportunities to extend systems beyond the site boundary to adjacent sites.

Following on from this goal, it is required that energy systems for all major developments are evaluated and designed with the following hierarchy in mind:

- 1. Connection to an existing heating or cooling network
- 2. Site wide community heating network
- 3. Communal Heating and Cooling

Policy 5.9 Cooling Hierarchy - Measures that are proposed to reduce the demand for cooling should be set out under the following categories:

Minimising internal heat generation through energy efficient design: For example, heat distribution infrastructure within buildings should be designed to minimise pipe lengths, particularly lateral pipework in corridors of apartment blocks, and adopting pipe configurations which minimise heat loss e.g. twin pipes. All heating and hot water pipework will be adequately insulated to mitigate the heat gains. The design will also include energy efficient lighting fittings to reduce heat gains in the communal areas, retail units and apartments.

Reducing the amount of heat entering the building in summer: For example, through use of carefully designed shading measures, including balconies, louvres, internal or external blinds, shutters, trees and vegetation. The design of the proposed development includes recessed windows with low g-value. The design of balconies also provides shading to the apartments below.

Use of thermal mass and high ceilings to manage the heat within the building: Increasing the amount of exposed thermal mass can help to absorb excess heat within the building.

Passive ventilation: For example, through the use of openable windows, shallow floorplates, dual aspect units, designing in the 'stack effect'. Purge ventilation will be provided in all flats of the scheme via openable windows.

Mechanical ventilation: Mechanical ventilation can be used to make use of 'free cooling' where the outside air temperature is below that in the building during summer months. This will require a by-pass on the heat recovery system for summer mode operation.

Clause 5.42 of the London Plan states:

"Individual development proposals will also help to achieve these targets by applying the energy hierarchy in Policy 5.2. There is a presumption that all major development proposals will seek to reduce carbon dioxide emissions by at least 20 % through the use of on-site renewable energy generation wherever feasible.

Development proposals should seek to utilise renewable energy technologies such as: biomass heating; cooling and electricity; renewable energy from waste; photovoltaics; solar water heating; wind and heat pumps.

The Mayor encourages the use of a full range of renewable energy technologies, which should be incorporated wherever site conditions make them feasible and where they contribute to the highest overall and most cost effective carbon dioxide emissions savings for a development proposal."

The GLA has published the "GLA Guidance on preparing energy assessments". This clarifies what energy consumptions should be included in the calculations, and how they are calculated.

The guidance states that the Energy Hierarchy must demonstrate savings in regulated CO_2 emissions compared to a development that complies with the 2010 Building Regulations.

The Guidance defines regulated emissions as the energy consumed in the operation of the space heating / cooling and hot water systems, ventilation and internal lighting. It also defines unregulated emissions as relating to cooking and electrical appliances and other small power.

Non-regulated small power may typically include lifts, infrastructure plant such as cold water and sewage pumps, unregulated ventilation such as that for underground car-parks, and unregulated lighting such as external lighting and underground car-parks.

For the regulated emissions, the GLA Guidance states that a Building CO₂ Emissions Rate (BER) calculated through the Building Regulations 2010 methodology based on the National Calculation Methodology (NCM), implemented through approved software, should be established. For non-regulated emissions, benchmarks from CIBSE Guide F, or others from previous development work should be followed.

2.3 Local Policy – London Borough of Camden

The central part of the Local Development Framework for the Borough of Camden is the "Core Strategy 2010-2025" which sets out the vision and strategy for the borough. Core Strategy 13 sets out the requirements to minimise the effects of climate change and reduce carbon emissions. This outlines a similar approach to minimising energy consumption as the London plan and requires developments to be designed to minimise energy consumption, assess the availability of local energy networks or the potential to generate from low carbon technology. The Council expects that developments "achieve a reduction in carbon dioxide emissions of 20% from on-site renewable energy generation unless it can be demonstrated that such provision is not feasible"

"Camden Development Policies 2010-2025" is one of the documents making up the Local Development Framework and sets out the detailed planning policies to be used in determining planning applications in the borough. The policy relating to sustainable design and energy in particular is Policy DP22 "Promoting sustainable design and construction".

2.4 Energy Hierarchy

2.4.1 Summary of Being Lean

In order to reduce the demand of energy on a specific development, there is the potential to enhance the building passive design, these strategies include:

- Improved u-values.
- Improved air tightness.
- Optimised glazing areas.
- Optimising orientation and site layout.
- Natural ventilation and lighting.
- Thermal mass and solar shading.
- Energy efficient lighting.
- Efficient mechanical ventilation with heat recovery.

2.4.2 Summary of Being Clean

Once the demand for energy has been minimised, energy systems can then be selected to generate on-site energy in efficiently. Technologies that can be considered for this are:

- District Heating Networks.
- Combined Heat and Power Systems.
- Combined Cooling Heat and Power Systems.

2.4.3 Summary of Being Green

On site renewable energy technologies should be considered in order to reduce the CO_2 emissions of the site. The renewable technologies often provide energy without the requirement for input energy and therefore provide complete CO_2 savings.

The technologies highlighted by the 'Renewables Toolkit' as suitable for London, and therefore qualifying as 'Renewables' for London Boroughs are:

- Solar hot water systems
- Biomass Combined Heat and Power
- Biomass heating
- Ground source heating
- Ground source cooling
- Wind turbines
- Photovoltaics

The GLA document 'Energy Planning – GLA Guidance on preparing energy assessments' (March 2016) also includes air-source heat pumps as feasible renewable energy source

3. DEVELOPMENT DESCRIPTION

3.1 Development Location

The Proposed Development is located and is on the site of the existing Methodist Church at 58A Birkenhead Street, Kings Cross, London on the south side of the Euston/Pentonville Road and fronts both Birkenhead and Crestfield Street.



Figure 3: Location Map

The site is bounded on both sides by residential buildings of 3 and 4 stories above ground. The site is constrained and does not provide opportunities for exploring alternative orientations and building form to minimise energy consumption.

3.2 Development Overview

The existing church and accommodation are to be demolished to make way for the new development which provides

- a new church and associated accommodation including seminar and meeting rooms and a kitchen,
- subsidised ancillary accommodation on the second, third and fourth floors,
- a wardens flat and
- 11 leasehold flats.

The scheme is arranged over basement, ground plus four floors and comprises 2,070 m² of accommodation for the church and associated hostel and 825 m² of leasehold flats. The building rises to ground plus four floors on the Crestfield Street frontage and ground plus 3 floors on Birkenhead Street. An external light well is arranged in the centre of the development which reaches down to the basement to assist with natural light and fresh air ventilation.

There are 3 lifts serving the church and associated accommodation, the hostel and wardens flat and the leasehold flats.

3.3 Overview of Mechanical Building Services

The Domestic flats will be naturally ventilated with trickle vents in the windows and continuously running extract ventilation in bathrooms, WC's and kitchens. Purge ventilation will be via openable windows.

Wherever possible the Non-Domestic accommodation will be naturally ventilated, although due to high occupancies in a number of the spaces mechanical ventilation with heat recovery (MVHR) will be necessary to meet fresh air requirements for the occupants. MVHR will be necessary for internal occupied spaces to supply and exhaust fresh air.

Heating will be provided to by low temperature hot water underfloor heating

Due to high occupancies in the church, seminar and meeting rooms cooling will be necessary to maintain acceptable temperatures; the cooling will be provided by air source VRF units.

LED lighting will be provided throughout. The flats will be manually switched; the remainder will be a mix of PIR and daylight dimming as appropriate.

4. ASSESSMENT OF ANNUAL ENERGY CONSUMPTION

4.1 Estimating Annual Energy Demand

This report draws on the methodology and approach set out by the Camden Council, the London Plan and the GLA Guidance on Energy Assessments. Predicted levels of carbon dioxide emissions will be assessed against the Approved Part L 2013 Document of the Building Regulations.

4.2 Residential Scheme Assessment

The residential element has been modelled using the National Homes Energy Rating (NHER) software version 6.2.3 to calculate the carbon emissions at each stage of the Energy Hierarchy. SAP worksheets for each representative unit are provided in the appendix C of this report.

The SAP calculations have been undertaken in line with the Part L1A 2013, the SAP 2012 methodology and the latest SAP 2012 conventions published on 31 August 2017 (v7.0). Emissions associated with non-building regulations elements (for example, cooking and home appliances) have been calculated based on the SAP 2012 Section 16 methodology.

The SAP calculations have been carried out for 2 representative apartments in the proposed development and the results have been area weighted averaged to provide a robust representation of the overall energy performance and carbon emissions savings of the residential element. This is in accordance with paragraph 2.7 "Building containing multiple dwellings" of the Building Regulations 2013 Part L1A.

This software assesses the regulated energy use and forms the basis for assessing the carbon reductions and compliance with the planning targets. The SAP assessments are for 2 of the flats which are considered representative of the remaining 10. The Wardens flat on the first floor and the leasehold flat R3.32 on the top floor have been selected.

The results of the SAP and Part L2a compliance assessment have been summarised in Tables 7 and 8 respectively which together with the SAP and VE Compliance Part L2a output documentation for the selected energy strategy are included Appendices 1 and 2 at the end of the report.

4.3 Commercial Scheme Assessment

The non-domestic elements have been modelled following the National Calculation Methodology (NCM) 2013. The IES virtual environment 2018 software version 2018.0.1.0 was used for the simulation using the Part L2A 2013 module VE compliance 7.0.10.0. The BRUKL reports for all stages of the energy hierarchy are provided in the Appendix 1 of the report.

Both residential and commercial part of the scheme have been modelled following the freeze drawings issued by Dexter Moren Architects on September 2018. The series of drawings used are:

- 0948 A 100 001 P0 GA Plans
- 0948 A 110 001 P0 GA Elevations
- 0948 A 120 001 P0 GA Sections

4.4 Geometry

The geometry used to create the model is based on architect drawings

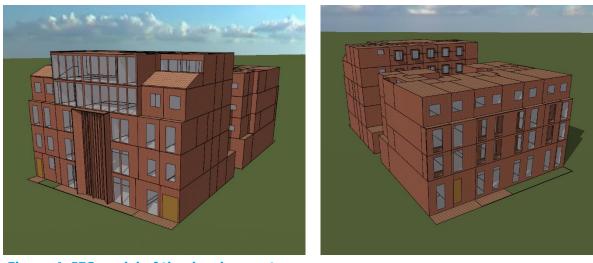


Figure 4: IES model of the development

4.5 Weather

Weather data for simulation-based Part L2 assessments are provided by CIBSE. The weather file used for the Part L analysis in this study is Birmingham Typical Reference Year (TRY) 05.

BASELINE EMISSIONS 5.

To assess the residential element of the scheme the Target Emission Rate (TER) has been calculated for each representative unit and has been area weighted across the residential scheme. The TER is the emission rate of a notional unit of the same size and shape based on elemental standards stated in the appendix R of SAP 2012 and minimum fabric values stated Building Regulations 2013. The baseline Carbon dioxide emissions for the domestic part of the West London Methodist Church development are 17.10 t CO₂/year

For the Commercial elements of the scheme, the 2013 Target Emissions Rate is the CO₂ emission rate from a notional building of the same size and shape as the actual building, but with specified properties as set out in the NCM Modelling guide. The baseline regulated Carbon dioxide emissions for the non-domestic part of the development are 53.30 t CO₂/year.

The baseline emissions for the development as a whole are:

Baseline carbon emissions (Part L 2013) = 70.4 tCO₂/year

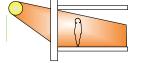
6. BE LEAN

The proposed development will feature best practice energy saving measures so that compliance with Part L of the Building regulations will be achieved without reliance on the contribution of renewables and low carbon technologies.

This section analyses the energy efficiency measures that have been considered at the feasibility stage of the design in order to minimise the energy demand and achieve excellent building performance.

6.1 Minimising Demand

6.1.1 Envelope Optimisation: Solar Gain



Solar gain can have a significant effect on the amount of energy required to cool the building. The design will minimise the amount of solar gain whilst maintaining high levels of usable daylight. This will be achieved through the careful design of the façade and the orientation of the building. The balconies will provide shading to the apartments below will Block C will shade the Eastern side of Blocks A-B. Glazing elements with low g-values will be used in all windows facing, South, East or West.

6.1.2 Envelope Optimisation: Thermal Performance



Heat loss through the building envelope will have a significant effect on the amount of energy required to heat the buildings. The design will optimise the thermal performance of the envelope with respect to heat loss (annual energy consumption) and build cost. U-Values and an air permeability exceeding the current Part L 2013 Building Regulations will be applied throughout the development.

6.1.3 Envelope Optimisation: Balancing Daylight, Solar Gain and Heat Loss



The available daylight, solar gain and envelope thermal performance are all linked. The design of the building façade and fabric has been carefully balanced to minimise solar gains on the south facing element of the scheme whilst minimising the heating load throughout the building.

The tables below summarises the building fabric requirements:

WLMC - Domestic AN	D COMMERCIAL part of the d	levelopment	
	Be lean	Be Clean	
Opaque Elements			
Ground/Exposed/Basement Floor U- Value (W/m ² K) Residential Ground/Exposed/Basement Floor U- Value (W/m ² K) Commercial	0.1	-	
Roof U-Value (W/m ² K)	0.1	3	
External Wall (W/m ² K)	0.1	8	
Sheltered Wall (W/m ² K)	0.18 (cavi	ty Wall)	
Party Wall U-Value (W/m ² K)	0 (fully fitted cavity with sealed edges)		
Thermal Mass Parameter	Medium		
Openings			
Window U-Value (W/m ² K) Glazing g-Value	1.4 0.63 resi 0.4 Com	dential	
Frame factor	0.8	3	
Other parameters Flat entrance doors in corridors U- Value (W/m ² K) External entrance doors U-Value (W/m ² K)	Metal frame windov 1 -	vs, thermal break	
Overshading	Average/U	Inknown	
Thermal Bridging			
y-Value (W/m.K)	0.15 de	efault	
Air Permeability Design Air Permeability (m³/m²h @ 50 Pa)	4.00 resi 3.00 com		

Table 3: Building fabric properties for the Domestic and commercial part of the WLMC development

6.2 Efficient Servicing

The next step is to service this demand for work as efficiently as possible to reduce energy use: Options that service the demand for doing work in the building as efficiently as possible. This often relates to work done in artificially creating the internal environment.

6.2.1 Lighting Technology



The design of the lighting and the technology employed will have a significant effect on the amount of energy needed to achieve the required light levels. The design has considered all the available technology and lighting will be selected to provide the highest level of energy efficiency whilst maintaining the operational requirements.

- Energy efficient lighting (above 45lm/W) will be provided throughout the residential elements.
- LED lighting will be used in the commercial areas with an average efficacy of 100lm/W

6.2.2 Occupancy Linked Lighting Controls



Spaces frequently do not require lighting when they are unoccupied. Smart controls can be used to sense whether a space is occupied and to switch off the lighting if it is not required.

- Occupancy sensing will be provided where possible
- In the residential areas, sophisticated controls will allow occupants to control lighting on a room by room basis

6.2.3 Fan and Pump Energy



Moving air, heat, coolth and water around a building requires work to be done. How much energy is required to do this work will depend on the design of the systems, the technology used and the controls. The design will minimise these energy uses:

- All fans and pumps will operate with variable speed control
- SFP shall not exceed 1.1 W/l/s for ventilation system.
- High electric power factor will be specified at least 0.95 efficiency

6.2.4 Chiller Performance



The technology used to generate the cooling used in the building significantly effects the amount of energy required to cool the building. The design will carefully select the most energy efficient equipment whilst balancing capital costs. A high efficiency chiller has been suggested with a seasonal efficiency of 5.0.

6.2.5 Heat Recovery



Where possible, heat recovery shall be used on all ventilation in order to minimise the heat lost in order to provide fresh air throughout the building.

- Heat recovery with an efficiency of 76% will be used in the retail element
- MVHR with an efficiency of approximately 90%% will be used in the residential element

6.2.6 Metering



The metering strategy will be in alignment with CIBSE TM39. All meters will be provided with pulsed output to the Building Energy Management system (BEMS) for automated centralised monitoring of all energy and water use. The BMS system will also ensure that heating and cooling systems are highly responsive and operate at their optimal efficiency in order to maintain internal conditions to comfort standards.

6.2.7 System Performance Be Lean

The criteria used in the analysis for the heating, cooling, ventilation and hot water service and lighting are set out in Table 2. Further design development will be required during the detailed design process.

Space Туре	Residential	Commercial
HVAC + Ventilation System	Combi boiler with radiators	Central gas boiler with underfloor heating -VRF cooling – natural ventila- tion where possible and mechanical ventilation heat recover for internal ar- eas and high occupancy areas, extract ventilation for toilet and store
Heating		
Heating system type (i.e FCU, VRF)	Radiators	Radiator and Underfloor heating
Heat source	LTHW Boiler	LTHW Boiler
Fuel	Natural gas	Natural gas
Seasonal Efficiency	89.5% (SEDBUK 2009)	92%
Cooling		
Cooling system type (i.e FCU, VRF)	n/a	VRF
Fuel Type	n/a	Electricity
Generator SEER	n/a	5.0
Ventilation		
Natural Ventilation	All perimeter rooms provided with trickle ventilators and openable win- dows compliant with Part F	All perimeter rooms provided with openable windows compliant with Part F
Mechanical Extract Ventilation	Continuous ventilation in Bathrooms and kitchens	Toilet, cycle and store room
Mechanical Supply and Extract Ventilation with Heat Recover	MVHR HR 90%	MVHR for internal areas and high occu- pancy areas HR 76%
Local supply or extract SFP (W/l/s)	0.56	0.8
VRF Terminal Unit SFP (W/I/s)		0.3
Domestic Hot Water		
Generator Type	LTHW Boiler	Generator Type
DHW Delivery effi- ciency	n/a	90
Is this a storage sys- tem?	No	5001
Lighting	Residential	Commercial
Installed Power den- sity(W/m2/100lux)	Inference method	Inference method
Lamp efficacy	100% low energy >45Lumen	100Lumen/W
Light Control	Manual Switching	PIR (manual on automatic off) with daylight dimming where appropriate

Table 4 Systems Performance and control criteria

In addition the following will be implemented in the Non Domestic Accommodation:

- Lighting will include Separate Metering.
- Lighting will include out of range value monitoring.
- Lighting will include constant illuminance control.
- All perimeter zones will have proportional daylight dimming. Once the lux level of each space is achieved by natural daylight, the lighting will switch off. As the illuminance of the space reduces, the lights will proportionally increase in order to maintain the desired lux level.
- The daylight sensors will be on a time switch and have a parasitic value of 0.1W/m2.
- The automatic controls will be on a time switch and have a parasitic value of 0.1W/m2.

6.3 Be Lean Results

Through the energy saving measures outlined above, the overall development is anticipated to save 16% on CO₂ emissions over the baseline case.

Be Lean carbon emissions (Part L 2013) = 59.1 tCO₂/year

7. BE CLEAN

The London Plan expects all major developments to demonstrate that the proposed heating and cooling systems have been selected in accordance with the following order of preference:

- 1. Existing and planned networks
- 2. Site wide CHP network
- 3. Communal Heating and Cooling

Decentralised energy production and, heating and cooling networks are identified as the most cost effective mechanism for delivering carbon dioxide reductions in London.

7.1 Existing and Planned Networks

District Heating (DH) is a method of delivering heat from a variation of heat producing sources to a variation of heat customers. Heat produced from a fossil fuel sources such as natural gas, oil or renewables burned directly in boilers or through combined heat and power (CHP), or a combination of both, can be delivered to residual dwellings, commercial and public offices, schools, warehouse and factory, hospitals plus industrial process heating. Conventionally the heat demand in a DH system is met by a waste heat from power stations and energy from waste plants, utilising a heat generation which would otherwise be wasted and subsequently it comes at a very low cost. In smaller schemes it is common to look at installing heat production facilities, which often unfortunately adds costs to the scheme. The advantage of district heating is the flexibility and the ability utilise a variety of heat sources an including what can be called low grade heat.

7.1.1 Off site CHP heat generation

There are a number of district heating networks existing and planned in the area that employ CHP to deliver heating energy currently more efficiently than a conventional gas fired installation on site.

Contact has been made with Brookfield Metropolitan who own and operate the local district heating network to determine the viability of connecting the development. There are currently no plans to extend the network south of Euston Road and the development heating load is too small to make a connection financially feasible.

The London Heat Map shows existing DH networks as red lines as possible future connections.



Figure 5: London Heat Map

7.1.2 On site CHP heat generation

An onsite community heating installation with CHP could potentially achieve significant CO_2 reductions.

A combined heat and power (CHP) system generates electricity as well as heat (in the form of hot water) from a single piece of plant. A CHP plant consists of an 'engine' which runs on fuels such as natural gas, driving an alternator to generate electricity. Heat produced by the engine and exhaust system is typically utilised for buildings' heating systems. The efficiency of the system and the economic viability of the scheme rely on achieving long periods of full load operation and as far as possible coincident demand for heat and electricity.

The CHP installation could be employed to meet the heating and hot water load of the development or just the non-domestic church and associated accommodation. Both scenarios have been considered.

Non-Domestic Church and Associated Accommodation

Ramboll has been appointed to prepare a detailed CHP performance study in support of the planning application. In the CHP study, an ultra-low oxides of nitrogen (NO_x) CHP unit is implemented in the proposed Methodist Church and accommodation development. Based on the simulated heating and electrical demand profile of the proposed development, the CHP engine could achieve 6,906 running hours and 72% of the annual heat share. (ref: 1620005695-RAM-XX-XX-RY-YS-002).

A separate Air Quality Assessment has been carried out by Ramboll (ref: RUK18-24230_3_AQA). It confirms that the CHP would be fitted with a catalyst to significantly reduce emissions of NOx to levels that would comfortably meet the emission limits included within the Mayor of London's Sustainable Design and Construction SPG. The assessment, the scope of which was agreed by Camden Council Officers, has demonstrated that the emissions from the CHP will have a negligible impact on air quality.

Residential Element of Development

In order to use the CHP to supply heat to the flats there would need to be a common heating network which would require heat interface units, heat metering and a billing system together with the ongoing management of the revenue costs, billing of the residents and dealing with payment defaults. For the 11 leasehold flats on the development the infrastructure costs and the ongoing revenue costs will impose a burden on the Church which they will have neither the expertise nor the resources to manage.

There are also the issues of the standing losses for the heating distribution network which has to run 24/7 and the resulting overheating of corridors and service cupboards. Neither are insurmountable but do require additional costs in the design specification and operation of the system.

7.1.3 Be Clean Results

The implementation of a common heating network for the site and the inclusion of CHP are predicted to result in a 17.5% carbon reduction over and above the Lean measures equivalent to 9.3 Tonnes of carbon dioxide annually.

It is estimated the proposed development will save **20.1%** carbon emissions over the 'be lean' scenario. More specifically it is estimated that the overall development will save **14.2** $tCO_2/year$ over the 'be lean' scenario.

Be Clean carbon emissions (Part L 2013) = 44.9 tCO₂/year

8. BE GREEN

8.1.1 Introduction

Once all suitable energy reduction and efficiency techniques have been considered, renewable energy technologies are assessed in order to further reduce the CO_2 emissions of the development where practical. The following are the technologies that are accepted as renewable and are to be considered in the assessment:

- Solar thermal hot water systems.
- Biomass heating.
- Photovoltaics (PVs).
- Wind turbines.
- Ground source heat pump.
- Air source heat pump.

The constraints of the site limit the size and capacity of each of the technologies and hence the potential to reduce carbon emissions on this development varies with each technology. Biomass boilers or air source heat pumps for heating and hot water could deliver all or the majority of the demand and achieve a high carbon reduction whereas solar thermal hot water, photovoltaics, wind turbines and ground source heat pumps are physically limited by the site and could not deliver equivalent reductions.

The following qualitative assessment considers each of the technologies and their suitability for the development.

8.1.2 Air Source Heat Pumps



Air Source Heat Pump (ASHP) systems use a refrigeration cycle in reverse, to extract low-grade heat from the outside air, and transfer it into useful heat at a higher temperature, for use with space heating systems, and to generate domestic hot water.

ASHP system is technically suited to the Proposed Development, for the following reasons:

- This system is practical for heating systems that are of a low temperature nature .i.e. underfloor heating.
- This technology is relatively robust and low maintenance.
- The technology can be screened or incorporated on the roof ensuring that there is limited visual impact.
- As the technology is electrically driven, there is no on-site pollution impact.
- ASHP system can also work in reverse cycle to provide cooling, which will be a benefit to the Non-domestic element of the scheme.
- The heat pump can be arranged to provide heating and cooling to different zones simultaneously, transferring heat from cooling zones to heating zones thereby improving efficiency

The results of a quantitative assessment predict that exhaust air heat pumps in the flats and VRF heat pumps in the residential units will reduce carbon emissions by 33.84%.

The target reductions in the carbon emissions for the flats are therefore met by this technology; further reductions are required to the remainder of the development.

8.1.3 Bio-mass Heating Boilers

Biomass is the term used to describe a range of solid fuels from wood (chips, pellets or logs), straw and other waste materials. While carbon may be produced when biomass is burnt, it is considered to be almost carbon neutral as the carbon dioxide produced is offset by the carbon dioxide absorbed by the trees or crops when they were grown.

A biomass boiler may be technically suited to the Proposed Development, due to the year-round base heat load from domestic hot water but a number of factors make this an inappropriate solution for this development:

- Space and access to site for fuel storage and delivery.
- Biomass wood chip or pellet installations contribute to air quality problems in urban environments, in particular NOx and particulate emissions.
- Taller flues will be required than for equivalent gas boilers, which will be an issue where plant is located at basement level.
- On-going maintenance is generally high when compared to other heat generating equipment.
- Natural gas boilers will be required to act as standby for the periods when the biomass boiler is being serviced.
- Biomass boilers have difficulty responding to varying load particularly the lows and highs created by hot water demand. As a consequence, thermal storage will be required to even out the load

For these reasons a biomass boiler has been discounted in favour of the air source heat pump

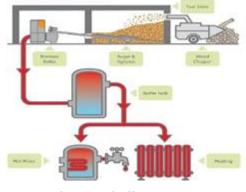


Figure 1: Biomass boiler system

8.1.4 Ground Source Heat Pumps

Ground Source Heat Pump (GSHP) technologies involve the use of underground water sources (aquifers) which retain a near constant temperature all year round, hence in winter the underground water is warmer than the surface air temperatures, and in summer it is cooler. This temperature difference can be used in combination with a heat pump to provide heating and cooling energy.

In order for the technology to work effectively, the ground conditions are required to provide adequate thermal transfer. The constrained plan area of the site does not allow either an open loop or horizontal mat to be used to extract and reject heat. This leaves closed loop vertical piles as the only option.

Extensive site investigations will be necessary to determine whether the local geological conditions are suitable and if there are any obstructions to the pile locations bearing in mind the piles are likely to be in the order of 100m deep.

A ground source heat pump installation is very expensive and installations on small sites such as this do not achieve high carbon reductions when compared to other technologies such as air source heat pumps and biomass boilers.

For these reasons a ground source heat pump has been rejected in favour of the air source solution.

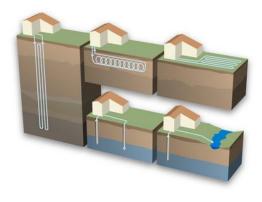


Figure 7: Example GSHP systems

8.1.5 Solar Thermal Hot Water

Solar Thermal Hot Water systems are a well-established renewable energy source to provide hot water for domestic use.

Solar thermal systems in the UK normally operate with a backup source of heat, such as gas or electricity. Due to the variable and unpredictable demand for hot water there would need to be significant thermal storage to collect heat when it is available in readiness for its use when the demand arises.

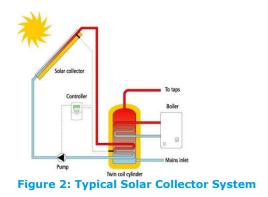




Figure 9: Solar thermal evacuated tubes arranged as brise soleil

8.1.6 Photovoltaics

Photovoltaic (PVs) systems convert energy from the sun into electricity through semi-conductor cells. PVs can supply electricity to the building they are installed on, or to any other load connected to the electricity grid. Energy can still be produced in overcast or cloudy conditions, so PVs can be used successfully in all parts of the UK, especially in South England.

If installed by a registered installer in accordance with the regulations the installation can benefit from the feed in tariff for electrical generation. The installation is relatively simple and does not take up large areas of space within the building in comparison with other technologies

Photovoltaic electricity generation is complementary to the heat generating solutions and does not replace or reduce the capacity of the other technologies. The only competing technology is solar thermal due to the conflict for space on the roof of the development.

The area of photovoltaic panel is constrained by the roof area available but has to accommodate the requisite area for air cooled condensers for the VRF cooling of the church and other high occupancy areas.



Figure 10: Typical PV roof tile array

8.1.7 Wind Turbines

Recorded data identifies the UK is the windiest country in Europe, and as such wind power is one of the UK's most promising renewable energy technologies, and already provides electricity for nearly a quarter of million homes. Wind turbines are a technically proven technology using aerodynamic forces ('lift' and 'drag') to produce mechanical power that can then be converted to electricity.



Figure 3: Wind Turbine and UK Wind Map

In urban areas, wind is characterised by increased turbulence which reduces the efficiency of wind turbines which are to these variations. Wind turbines are known to produce very low and unreliable outputs when mounted in urban environments and have been discounted from this assessment.

8.1.8 Summary of Be Green Results

The annual energy demand and carbon emissions have been assessed for air source heat pumps, solar thermal and photovoltaics in a number of combinations. The results have been tabled in Appendices 1 and 2

The quantitative assessment predicts that exhaust air heat pumps (EAHP) in the flats will achieve the target reduction of 35%. The carbon emission result of the proposed development after the incorporation of EAHP to provide heating and hot water shows below.

Be Green carbon emissions (Part L 2013) = 44 tCO2/year

8.1.9 Non-regulated Energy Uses

The target criteria set by the planning authorities is referenced to the carbon emissions from regulated energy use. The assessment is not required and does not include unregulated energy use such as electrical appliances, process equipment, and external infrastructure.

For the purposes of giving a full account of the energy use on the site an assessment has been made of the non-regulated use on the site.

Energy consumption arising from unregulated use is assessed using guidance such as CIBSE Guides, BREDEM and manufacturers data.

The following uses are unregulated:

- Small power
- Cooking.
- Passenger Lifts (3No). CIBSE Guide D Transportation Systems in Buildings (2005)
- Cold water booster pumps.
- External Lighting to the Light Well and Cycle Stores.

In order to minimise the unregulated energy use, high efficiency catering equipment will be specified, high efficiency lighting will be employed externally, and lifts will be specified with LED lighting, standby mode in off peak periods and variable speed drives.

Development	Electricity kWh/annum	Natural Gas kWh/annum
Small Power		
Flats	30,000	
Hostel	18,200	
Church	4,000	
Office, Meeting rooms etc.	16,000	
Total	68,200	
Catering		
Flats	2,182	
Hostel	600	780
Church	9,824	8,496
Total	12,606	9,276
External Lighting	3,500	
Lifts	4,500	
Cold Water Boosting Equipment	750	
Development Total kWhr/annum	89,556	18,552
Total Tonnes CO ₂ /annum	46	4

Table 5 – Assessed Unregulated Energy Use for the development.

9. CONCLUSIONS

The driving factor of the assessment and the conclusions of this report is the need to comply with the carbon reduction targets policies set by the Greater London Authority and the London Borough of Camden in their respective planning policies. The targets are:

- Reduce carbon emissions by 35% below the target emission rate set by Building Regulations 2013;
- Connect to a local CHP network or include CHP on site;
- The regulated development CO2 emissions to be offset by local Renewable or low emission sources.

All the above criteria are caveated by "where feasible".

The results of the assessment have concluded that the optimum strategy is to implement the following:

Be Lean – thermal improvements to the building envelope, optimise system performance and incorporate 100% LED lighting

Be Clean – incorporate Combined Heat and Power for heating and hot water generation in the Church and associated accommodation

Be Green – incorporate exhaust air heat pumps (EAHP) in the Domestic flats for heating and domestic hot water generation.

The assessment has predicted that the development will meet the targets for CO_2 reduction set by the planning authorities but the energy strategy that has been adopted is shown to be the optimum for maximising carbon reduction on the site the total Improvement is 37.5%. Carbon off set contribution has been calculated and is estimated to be £25,231

Reculated Carbon Dioxide (tCO2/year)CO2 emissions (tCO2/year)Accumulated CO2 savings
from Part L 2013 (%)Baseline (Part L 2013)70.4-Be Lean59.116.0Be Clean44.936.2Be Green4437.5

Table 6 - Carbon dioxide savings resulting from the conclusions of the energy assessment

APPENDIX 1: RESULTS OF THE IES ANALYSIS FOR THE CHURCH AND ASSOCIATED ACCOMMODATION

BRUKL Output Document Compliance with England Building Regulations Part L 2013

Project name

KXMC

Date: Thu Nov 08 12:07:22 2018

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.10

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.10

BRUKL compliance check version: v5.4.b.0

Owner Details

Name: Name Telephone number: Phone Address: Street Address, City, Postcode

Certifier details

Name: Name Telephone number: Phone Address: Street Address, City, Postcode

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

CO ₂ emission rate from the notional building, kgCO ₃ /m ² .annum	24.6
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	24.6
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	15.5
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

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

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

Element	Ua-Limit	Ua-Calo	Ul-Calo	Surface where the maximum value occurs*	
Wall**	0.35	0.18	0.18	GF000003:Surf[1]	
Floor	0.25	0.1	0.1	GF000015:Surf[0]	
Roof	0.25	0.13	0.13	GF000005:Surf[6]	
Windows***, roof windows, and rooflights	2.2	1.39	1.4	GF000003:Surf[0]	
Personnel doors	2.2	1.01	1.01	GF000018:Surf[0]	
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building	
High usage entrance doors	3.5	-	-	No High usage entrance doors in building	
Uscale = Limiting area-weighted average U-values [W/(m*K)] Uscale = Calculated area-weighted average U-values [W/(m*K)] Uscale = Calculated maximum individual element U-values [W/(m*K)]					
* There might be more than one surface where the maximum U-value occurs. ** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.					

*** Display windows and similar glazing are excluded from the U-value check. N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

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

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As built

HM Government

Building services

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

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

1- Gas Boiler

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency	
This system	0.92	-	0	0	0.76	
Standard value	0.91*	N/A	N/A	N/A	0.5	
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system NO						
* Standard shown is for gas single boller systems <= 2 MW output. For single boller systems > 2 MW or multi-boller systems, (overall) limiting efficiency is 0.86. For any individual boller in a multi-boller system, limiting efficiency is 0.82.						

2- AC-cooling

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency	
This system	5	5	0	0	0.76	
Standard value	2.5*	3.2	N/A	N/A	0.65	
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system NO						
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.						

"No HWS in project, or hot water is provided by HVAC system"

1- CHECK2-CHP

	CHPQA quality index	CHP electrical efficiency				
This building	147	0.27				
Standard value	105	0.2				

Local mechanical ventilation, exhaust, and terminal units

t recovery
/ery
_

Zone name		SFP [W/(I/s)]										
ID of system type	Α	в	С	D	Е	F	G	н	I.	HR efficiency		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard	
L0 - Cafe	-	-	-	0.8	-	-	-	-	-	-	N/A	
L0 - Events Regen Kitchen	-	-	-	0.8	-	-	-	-	-	-	N/A	
L0 - F Toilets	-	-	-	0.8	-	-	-	-	-	-	N/A	
L0 - M Toilets	-	-	-	0.8	-	-	-	-	-	-	N/A	
L0 - Pram Shelter Store	-	-	-	0.8	-	-	-	-	-	-	N/A	
L0 - Refuse Recycling	-	-	-	0.8	-	-	-	-	-	-	N/A	

				SFP [W/(l/s)]								
A	В	С	D	E	F	G	н	1	ппе	efficiency		
0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard		
-	-	-	0.8	-	-	-		-	-	N/A		
	-	-	0.8			-			-	N/A		
	-	-	0.8			-		-	-	N/A		
-	-	-	0.8	-	-	-	-	-	-	N/A		
		-	0.8			-			-	N/A		
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Zone name		SFP [W/(I/s)]									HR efficiency	
ID of system type	Α	В	С	D	E	F	G	н	1	nin eniciency		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard	
LB - Kitchen	-	-	-	0.8	-	-	-	-	-	-	N/A	
LB - Kitchen Storage	-	-	-	0.8	-	-	-	-	-	-	N/A	
LB - MCH Cycle storage	-	-	-	0.8	-	-	-	-	-	-	N/A	
LB - MCH Laundry	-	-	-	0.8	-	-	-	-	-	-	N/A	
LB - Meters Room	-	-	-	0.8	-	-	-	-	-	-	N/A	
LB - Plant/Storage	-	-	-	0.8	-	-	-	-	-	-	N/A	
LB - Residential Plant	-	-	-	0.8	-	-	-	-		-	N/A	
LB - Storage	-	-	-	0.8	-	-	-	-	-	-	N/A	
LB - Storage		-	-	0.8		-	-	-		-	N/A	
LB - Toilet	-	-	-	0.8	-	-	-		-	-	N/A	
LB - WC/Showers/Lockers	-	-	-	0.8	-	-	-		-	-	N/A	

General lighting and display lighting	Lumine	ous effic		
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
L0 - Accessible WC	-	100	-	31
L0 - Cafe	-	100	-	15
L0 - Chapel	-	100	-	417
L0 - Corridor 2	-	100	-	24
L0 - Corridor Stairs	-	100	-	61
L0 - Events Regen Kitchen	-	100	-	308
L0 - F Toilets	-	100	-	70
L0 - Lobby Break-out(ciruclation)	-	100	-	141
L0 - M Toilets	-	100	-	85
L0 - Main Chapel	-	100	-	1002
L0 - MCH Lobby	-	100	-	70
L0 - Pram Shelter Store	100	-	-	4
L0 - Refuse Recycling	-	100	-	203
L0 - Refuse&Recycling	-	100	-	205
L0 - Storage 1	100	-	-	13
L0 - Storage 2	100	-	-	12
L0 - Vestry/Storage	100	-	-	10
L1 - Bedroom 1	-	100	-	28
L1 - Bedroom 2	-	100	-	19
L1 - Bedroom 3		100	-	22
L1 - Circulation	-	100	-	18
L1 - Cleaners Store	100	-	-	11
L1 - F WC	-	100	-	47
L1 - Living/Dining		100	-	96
L1 - M WC	-	100	-	56
L1 - Stairs NW	-	100	-	35
L1 - Stairs SE 2	-	100	-	40
L1 - Subdivisible Meeting room/Office	100	-	-	413

General lighting and display lighting		ous effic				
Zone name	Luminaire	Lamp	Display lamp	General lighting [V		
Standard value	60	60	22			
L1 - Toilet SE	-	100	-	33		
L1 - Warden's flat(corridor)	-	100	-	43		
L1 - Warden's Office	100	-	-	109		
L2 - 01 Bedroom	-	100	-	20		
L2 - 01-Toilet	-	100	-	24		
L2 - 02 Bedroom	-	100	-	20		
L2 - 02 Toilet	-	100	-	24		
L2 - 03 Bedroom	-	100	-	25		
L2 - 03 Toilet	-	100	-	25		
L2 - 04 Bedroom	-	100	-	25		
L2 - 04 Toilet	-	100	-	25		
L2 - 05 Bedroom	-	100	-	20		
L2 - 05 Toilet	-	100	-	25		
L2 - 06 Bedroom	-	100	-	20		
L2 - 06 Toilet	-	100	-	24		
L2 - 07 Bedroom	-	100	-	20		
L2 - 07 Toilet	-	100	-	24		
L2 - 08 Bedroom	-	100	-	20		
L2 - 08 Toilet	-	100	-	23		
L2 - 09 Bedroom	-	100	-	20		
L2 - 09 Toilet	-	100	-	23		
L2 - 10 Bedroom	-	100	-	20		
L2 - 10 Toilet	-	100	-	24		
L2 - 11 Bedroom	-	100	-	20		
L2 - 11 Toilet	-	100	-	23		
L2 - Cleaners cupboard	100	-	-	4		
L2 - Corridor	-	100	-	15		
L2 - Corridor 2	-	100	-	66		
L2 - Stairs 1	-	100	-	26		
L2 - Stairs 2	-	100	-	30		
L2 - Storage	100	-	-	8		
L2 - TV Room	-	100	-	58		
L3 - 12 Bedroom	-	100	-	17		
L3 - 12-Toilet	-	100	-	22		
L3 - 13 Bedroom	-	100	-	17		
L3 - 13 Toilet		100	-	22		
L3 - 14 Bedroom		100	-	24		
L3 - 14 Toilet		100	-	24		
L3 - 15 Bedroom		100	-	18		
L3 - 15 Toilet		100	-	23		
L3 - 16 Bedroom	-	100	-	19		
L3 - 16 Toilet		100	-	22		
L3 - 17 Bedroom	-	100	-	19		
20 1. 200100m	1	100				

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General lighting and display lighting	Lumino	ous effic		
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
L3 - 17 Toilet	-	100	-	22
L3 - 18 Bedroom	-	100	-	19
L3 - 18 Toilet	-	100	-	22
L3 - 19 Bedroom	-	100	-	19
L3 - 19 Toilet	-	100	-	22
L3 - 20 Bedroom	-	100	-	19
L3 - 20 Toilet	-	100	-	22
L3 - Corridor	-	100	-	15
L3 - Corridor 2	-	100	-	60
L3 - Library&Study Room	100	-	-	287
L3 - Quiet Room	100	-	-	114
L3 - Stairs 1	-	100	-	25
L3 - Stairs 2	-	100	-	29
L4 - 21 Bedroom	-	100	-	19
L4 - 21 - Toilet	-	100	-	22
L4 - 22 Bedroom	-	100	-	15
L4 - 22 - Toilet	-	100	-	24
L4 - 23 Bedroom	-	100	-	19
L4 - 24 Bedroom	-	100	-	19
L4 - 24 - Toilet	-	100	-	22
L4 - 25 Bedroom	-	100		19
L4 - 25 - Toilet	-	100	-	22
L4 - 25 Toilet		100		22
L4 - Accessable WC		100	-	23
L4 - Corridor		100	-	15
L4 - Corridor 2		100	-	29
L4 - MCH Dining	-	100	-	154
L4 - MCH Kitchen		100		232
L4 - Stairs 1	-	100	-	25
L4 - Stairs 2	-	100	-	25
L4 - Storage	100	-	-	3
L4 - Storage	100	-	-	6
LB - Charity use/Store	100	-		26
LB - Charity/Workshop	100	-	-	148
LB - Childern's Playroom		-		242
LB - Cleaners Cupboard	100	-	-	6
	100	<u> </u>	-	59
LB - Corridor 1		100	-	44
LB - Corridor 2	-	100		
LB - Corridor 3		100		32
LB - Corridor 4	-	100	-	106
LB - Cycle storage	-	100	-	274
LB - Kitchen	-	100	-	293
LB - Kitchen Storage	100	-	-	8

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General lighting and display lighting	Lumino	us effic		
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
LB - MCH Cycle storage	-	100	-	309
LB - MCH Laundry	-	100	-	76
LB - Meeting room 9/10	100	-	-	314
LB - Meeting Room/Office 1	100	-	-	130
LB - Meeting Room/Office 2&3	100	-	-	260
LB - Meeting Room/Office 4	100	-	-	125
LB - Meeting Room/Office 5	100	-	-	161
LB - Meeting Room/Office 8	100	-	-	220
LB - Meters Room	100	-	-	21
LB - Music Room 1	100	-	-	88
LB - Music Room 2	100	-	-	106
LB - Plant/Storage	100	-	-	80
LB - Residential Plant	100	-	-	90
LB - Stairs NW	-	100	-	31
LB - Stairs SE	-	100	-	25
LB - Stairs SE2	-	100	-	26
LB - Storage	100	-	-	9
LB - Storage	100	-	-	9
LB - Toilet		100	-	53
LB - WC/Showers/Lockers	-	100		102

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
L0 - Chapel	NO (-12.7%)	NO
L0 - Main Chapel	NO (-42%)	NO
L0 - Refuse Recycling	N/A	N/A
L0 - Refuse&Recycling	N/A	N/A
L1 - Bedroom 1	NO (-90.3%)	NO
L1 - Bedroom 2	NO (-60.4%)	NO
L1 - Bedroom 3	NO (-86.4%)	NO
L1 - Living/Dining	NO (-81.4%)	NO
L1 - Subdivisible Meeting room/Office	NO (-33.7%)	NO
L1 - Warden's Office	NO (-68.1%)	NO
L2 - 01 Bedroom	NO (-74.4%)	NO
L2 - 02 Bedroom	NO (-41.9%)	NO
L2 - 03 Bedroom	NO (-25.7%)	NO
L2 - 04 Bedroom	NO (-27.5%)	NO
L2 - 05 Bedroom	NO (-44.2%)	NO
L2 - 06 Bedroom	NO (-73.9%)	NO
L2 - 07 Bedroom	NO (-81.4%)	NO
L2 - 08 Bedroom	NO (-82%)	NO
L2 - 09 Bedroom	NO (-83.3%)	NO
L2 - 10 Bedroom	NO (-83.7%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
L2 - 11 Bedroom	NO (-82.6%)	NO
L2 - TV Room	NO (-61.9%)	NO
L3 - 12 Bedroom	NO (-84.9%)	NO
L3 - 13 Bedroom	NO (-70.3%)	NO
L3 - 14 Bedroom	YES (+5.4%)	NO
L3 - 15 Bedroom	NO (-71.3%)	NO
L3 - 16 Bedroom	NO (-77.4%)	NO
L3 - 17 Bedroom	NO (-76.2%)	NO
L3 - 18 Bedroom	NO (-76.4%)	NO
L3 - 19 Bedroom	NO (-77.8%)	NO
L3 - 20 Bedroom	NO (-77.3%)	NO
L3 - Library&Study Room	YES (+13.6%)	NO
L3 - Quiet Room	NO (-91.3%)	NO
L4 - 21 Bedroom	NO (-46.3%)	NO
L4 - 22 Bedroom	NO (-75%)	NO
L4 - 23 Bedroom	NO (-73.4%)	NO
L4 - 24 Bedroom	NO (-73.9%)	NO
L4 - 25 Bedroom	NO (-73.1%)	NO
L4 - MCH Dining	NO (-12.7%)	NO
LB - Charity/Workshop	NO (-81.1%)	NO
LB - Childern's Playroom	NO (-85.3%)	NO
LB - Cycle storage	N/A	N/A
LB - MCH Cycle storage	N/A	N/A
LB - Meeting room 9/10	N/A	N/A
LB - Meeting Room/Office 1	NO (-81%)	NO
LB - Meeting Room/Office 2&3	NO (-85.1%)	NO
LB - Meeting Room/Office 4	YES (+8.2%)	NO
LB - Meeting Room/Office 5	NO (-56.5%)	NO
LB - Meeting Room/Office 8	NO (-30.3%)	NO
LB - Music Room 1	N/A	N/A
LB - Music Room 2	N/A	N/A

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters			Building Use		
	Actual	Notional	% Area	Building Type	
Area [m²]	2166.2	2166.2		A1/A2 Retail/Financial and Professional services	
External area [m ²]	2878.2	2878.2		A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways	
Weather	LON	LON		B1 Offices and Workshop businesses B2 to B7 General Industrial and Special Industrial Groups	
Infiltration [m³/hm²@ 50Pa]	3	3		B8 Storage or Distribution	
Average conductance [W/K]	999.41	1321.7		C1 Hotels	
Average U-value [W/m ² K]	0.35	0.46		C2 Residential Institutions: Hospitals and Care Homes	
Alpha value* [%]	10.23	10	43	C2 Residential Institutions: Residential schools C2 Residential Institutions: Universities and colleges	
* Percentage of the building's average heat transfer coefficient which is due to thermal bridging		40	C2A Secure Residential Institutions		
				Residential spaces	
			57	D1 Non-residential Institutions: Community/Day Centre	

	G2 Residential Institutions, Respitals and Gare Homes
	C2 Residential Institutions: Residential schools
3	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
7	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs

Others: Car Parks 24 hrs

Others: Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	38.59	31.78
Cooling	1.14	2
Auxiliary	3.04	2.17
Lighting	7.24	15.54
Hot water	49.77	32.42
Equipment*	23.64	23.64
TOTAL**	81.06	83.91

* Energy used by equipment does not count towards the total for consumption or calculating emissions. ** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	18.72	0
Solar thermal systems	0	0

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	124.42	142.65
Primary energy* [kWh/m ²]	90.99	150.38
Total emissions [kg/m²]	15.5	24.6

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

Н	HVAC Systems Performance									
Sys	tem Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST	[ST] Central heating using water: floor heating, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
	Actual	107.3	0	11.9	0	2.8	0.82	0	0.92	0
	Notional	0	0	0	0	0	0	0		
[ST] Split or m	ulti-split sy	stem, [HS]	Heat pump	(electric): a	air source, (HFT] Electr	icity, [CFT]	Electricity	
	Actual	96.3	83.5	5.7	4.8	3.9	4.66	4.8	5	7
	Notional	118	0	38	0	2	0.86	0		
[ST	[ST] No Heating or Cooling									
	Actual	0	0	0	0	0	0	0	0	0
	Notional	106.7	115.4	11.6	8.5	2.6	2.56	3.79		

Key to terms

 Key to terms

 Heat dem [MJ/m2]
 - Heating energy demand

 Cool dem [MJ/m2]
 = Cooling energy demand

 Heat con [kWh/m2]
 = Heating energy consumption

 Cool con [kWh/m2]
 = Cooling energy consumption

 Aux con [kWh/m2]
 = Auxiliary energy consumption

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

 Cool SSEER
 = Cooling generator seasonal efficiency

 Cool gen SSEFF
 = Heating generator seasonal efficiency ratio

 ST
 = System type

 HS
 = Heat source

 HFT
 = Heating fuel type

 CFT
 = Cooling fuel type

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Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	U⊦тур	Ui-Min	Surface where the minimum value occurs*		
Wall	0.23	0.18	GF000003:Surf[1]		
Floor	0.2	0.1	GF000015:Surf[0]		
Roof	0.15	0.13	GF000005:Surf[6]		
Windows, roof windows, and rooflights	1.5	1.21	GF000005:Surf[0]		
Personnel doors	1.5	1.01	GF000018:Surf[0]		
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building		
High usage entrance doors	1.5	-	No High usage entrance doors in building		
Ui-Typ = Typical individual element U-values [W/(m ² K)]		U-Mn = Minimum individual element U-values [W/(m ² K)]		
* There might be more than one surface where the minimum U-value occurs.					

	Air Permeability	Typical value	This building
[m³/(h.m²) at 50 Pa	5	3

APPENDIX 2: RESULTS OF THE SAP ASSESSMENT FOR THE LEASEHOLD AND WARDENS FLATS

			Lea	n		Clean (Le	an + Comn	nunity heat	ing and		Green (Lea	n + ASHP)	
	Area	TER	BER	TER	BER	TER	BER	TER	BER	TER	BER	TER	BER
	m2	kgCO2/m2	/annum	Tonr	nes	kgCO2/m2	/annum	Toni	nes	kgCO2/m	2/annum	Tonr	ies
Wardens													
Flat	87.5	14.4	13.52	1.26	1.18	14.18	9.5	1.24	0.83	20.15	12.04	1.76	1.05
R1.1	77	14.4	13.52	1.11	1.04	14.18	9.5	1.09	0.73	20.15	12.04	1.55	0.93
R1.2	74	14.4	13.52	1.07	1.00	14.18	9.5	1.05	0.70	20.15	12.04	1.49	0.89
R1.3	73	14.4	13.52	1.05	0.99	14.18	9.5	1.04	0.69	20.15	12.04	1.47	0.88
R2.1	77	14.4	13.52	1.11	1.04	14.18	9.5	1.09	0.73	20.15	12.04	1.55	0.93
R2.2	51	14.4	13.52	0.73	0.69	14.18	9.5	0.72	0.48	20.15	12.04	1.03	0.61
R2.3	50	14.4	13.52	0.72	0.68	14.18	9.5	0.71	0.48	20.15	12.04	1.01	0.60
R2.4	57	14.4	13.52	0.82	0.77	14.18	9.5	0.81	0.54	20.15	12.04	1.15	0.69
R3.1	72	14.4	13.52	1.04	0.97	14.18	9.5	1.02	0.68	20.15	12.04	1.45	0.87
R3.2	51	20.59	20.11	1.05	1.03	20.43	13.37	1.04	0.68	29.88	19.32	1.52	0.99
R3.3	50	20.59	20.11	1.03	1.01	20.43	13.37	1.02	0.67	29.88	19.32	1.49	0.97
R3.4	53	20.59	20.11	1.09	1.07	20.43	13.37	1.08	0.71	29.88	19.32	1.58	1.02
Residential	772.5			12.08	11.46			11.92	7.93			17.06	10.42
% Improv BER/1					5.1%				33.4%				38.9%

 Table 2 – Summary of the results of the SAP analysis for the leasehold and Wardens flats

L1A 2013 - Regulations Compliance Report Design - Draft

This design draft submission provides evidence towards compliance with Part L of the Building Regulations, in accordance with Appendix C of AD L1A. It has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the 'as built' property. This report covers only items included within the SAP and is not a complete report of regulations compliance.

Assessor name	Mr Peter	Mitchell			Assessor numb	er	3635	
lient					Last modified	2	20/08/2015	
ddress	Wardens	King's Cross 1	Methodist Church, Lo	ndon				
Check		Evidence				Produced by	and the	OK?
Criterion 1: predicted	carbon dioxic	le emission fro	om proposed dwellin	g does not exceed the t	arget			
TER (kg CO ₃ /m ² .a)		Fuel = N/A Fuel factor = 1 TER = 20.15	1.55			Authorised S		
DER for dwelling as de CO ₂ /m ² .a)	esigned (kg	DER = 12.04				Authorised S	AP Assessor	
Are emissions from dv designed less than or target?	Den Base	DER 12.04 < T	ER 20.15			Authorised S	AP Assessor	Passed
Is the fabric energy ef the dwellling as design or equal to the target	ned less than	DFEE 26.63 <	TFEE 32.05			Authorised S	AP Assessor	Passed
Criterion 2: the perfor	mance of the	building fabri	ic and the heating, he	ot water and fixed lighti	ng systems should b	e no worse th	an the design	limits
Fabric U-values								
Are all U-values bette design limits in Table	27	Element Wall Party wall Floor Roof Openings	Weighted average 0.18 (max 0.30) 0.00 (max 0.20) (no floor) (no roof) 1.20 (max 2.00)	e Highest 0.18 (max 0.70) N/A 1.40 (max 3.30)		Authorised S	AP Assessor	Passed
Thermal bridging								
How has the loss from bridges been calculate		Thermal bridg junction	ging calculated from	linear thermal transmitt	tances for each	Authorised 5	AP Assessor	
Heating and hot wate	er systems							
Does the efficiency of systems meet the min set out in the Domest Compliance Guide?	nimum value	Heat pump - Electricity NIBE F370	wet system from dat	abase,		Authorised S	AP Assessor	
			ating system: None			Authorised S	AP Assessor	
Does the insulation of water cylinder meet t set out in the Domest Compliance Guide?	the standards	No hot water	cylinder			Automators		
Do controls meet the controls provision set Domestic Heating Con Guide?	out in the	Space heating Time and ten Hot water co No hot water	nperature zone contr ntrol:	ol - plumbing circuit		Authorised 5	5AP Assessor	Passed
			ck (main system 1)					



Check	Evidence	Produced by	OK?
Fixed internal lighting			
Does fixed internal lighting comply with paragraphs 42 to 44?	Schedule of installed fixed internal lighting Standard lights = 0 Low energy lights = 1 Percentage of low energy lights = 100%	Authorised SAP Assessor	Passed
	Minimum = 75 %		
Criterion 3: the dwelling has appro	priate passive control measures to limit solar gains		
Does the dwelling have a strong tendency to high summertime temperatures?	Overheating risk (June) = Not significant Overheating risk (July) = Slight Overheating risk (August) = Slight Region = Thames Thermal mass parameter = 250.00 Ventilation rate in hot weather = 3.00 ach Blinds/curtains = Light-coloured curtain or roller blind	Authorised SAP Assessor	Passed
Criterion 4: the performance of the	e dwelling, as designed, is consistent with the DER		
Design air permeability (m³/(h.m²) at 50Pa)	Design air permeability = 4.00 Max air permeability = 10.00	Authorised SAP Assessor	Passed
Specific fan power (SFP)	Mechanical extract ventilation: SFP = 0.62 W/(litre/sec) Max SFP = 0.7 W/(litre/sec)	Authorised SAP Assessor	Passed
Have the key features of the design been included (or bettered) in practice?	The following party walls have a U-value less than 0.2W/m ² K: • Wall access (0.00) • Wall party (0.00) The following openings have a U-value less than 1.2W/m ² K: • Solid door reference 7 (0.00)	Authorised SAP Assessor	



URN: KXMC Wardens GREEN version NHER Plan Assessor version 6.1. SAP version 9.9.

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Assessor name Mr Peter Mitchell Client	c) + (1d)() ntended, pro	(6a)	Area (m²) 89.10 89.10 + (6b) + (7 17), otherw		(3a	0 0 0 0 0	đ	3n) = = = Air	8/2015 olume (m ³) 222.75 222.75 3 ³ per hour 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Address Wardens King's Cross 1. Overall dwelling dimensions Lowest occupied Total floor area (1a) + (1b) + (1) Dwelling volume 2. Ventilation rate Number of chimneys Number of open flues Number of flueless gas fires Infiltration due to chimneys, flues, fans, PSVs If a pressurisation test has been carried out or is life Air permeability value, q50, expressed in cubic medits If based on air permeability value, then (18) = [(12)] Number of sides on which the dwelling is sheltered Shelter factor Infiltration rate incorporating shelter factor Infiltration rate modified for monthly wind speed: Jan Feb Mar Monthly average wind speed from Table U2 5.10 5.00 4 1.28 1.28 1.23	c) + (1d)() ntended, pro	(6a)	Area (m²) 89.10 89.10 + (6b) + (7 17), otherw	a) + (7b) + (ise continu	Ave h (3a	rage storey eight (m) 2.50) + (3b) + (3)) + (3b) + (3 0 0 0 0 0 0 0 0 0 0 0 0 0	((20) = (20) = (x + (3d)(x) (x + (3d))(x) (x + (3d))	3n) = = = Air	olume (m ³) 222.75 222.75 3 ³ per hour 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1. Overall dwelling dimensions Lowest occupied Total floor area (1a) + (1b) + (1) Dwelling volume 2. Ventilation rate Number of chimneys Number of open flues Number of intermittent fans Number of flueless gas fires Infiltration due to chimneys, flues, fans, PSVs If a pressurisation test has been carried out or is lie Air permeability value, q50, expressed in cubic meetif based on air permeability value, then (18) = [(17) Number of sides on which the dwelling is sheltered Shelter factor Infiltration rate incorporating shelter factor Infiltration rate modified for monthly wind speed: Jan Feb Mar Monthly average wind speed from Table U2 5.10 5.00 4.90 Wind factor (22)m ÷ 4	c) + (1d)() ntended, pro	(6a)	Area (m²) 89.10 89.10 + (6b) + (7 17), otherw	a) + (7b) + (ise continu	Ave h (3a	rage storey eight (m) 2.50) + (3b) + (3)) + (3b) + (3 0 0 0 0 0 0 0 0 0 0 0 0 0	((20) = (20) = (x + (3d)(x) (x + (3d))(x) (x + (3d))	3n) = = = Air	olume (m ³) 222.75 222.75 3 ³ per hour 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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Air permeability value, q50, expressed in cubic me if based on air permeability value, then (18) = [(17 Number of sides on which the dwelling is sheltere Shelter factor Infiltration rate incorporating shelter factor Infiltration rate modified for monthly wind speed: Jan Feb Mar Monthly average wind speed from Table U2 5.10 5.00 4.90 Wind factor (22)m ÷ 4 1.28 1.25 1.23	etres per ho				, , , , , , , , , , , , , , , , , , , ,				
f based on air permeability value, then (18) = [(17) Number of sides on which the dwelling is shelter Shelter factor Infiltration rate incorporating shelter factor Infiltration rate modified for monthly wind speed Jan Feb Mar Monthly average wind speed from Table U2 5.10 5.00 4.90 Nind factor (22)m ÷ 4 1.28 1.25 1.23				of envelope	e area				4.00
Shelter factor Infiltration rate incorporating shelter factor Infiltration rate modified for monthly wind speed Jan Feb Mar Monthly average wind speed from Table U2 5.10 5.00 4.90 Wind factor (22)m ÷ 4 1.28 1.25 1.23	1720 1(8), otherwis	se (18) = (1						0.20
Infiltration rate incorporating shelter factor Infiltration rate modified for monthly wind speed Jan Feb Mar Monthly average wind speed from Table U2 5.10 5.00 4.90 Wind factor (22)m ÷ 4 1.28 1.25 1.23									3
Jan Feb Mar Jan Feb Mar Monthly average wind speed from Table U2 5.10 5.00 4.90 Wind factor (22)m ÷ 4 1.28 1.25 1.23						1 -	[0.075 x (1	9)] =	0.78
Jan Feb Mar Monthly average wind speed from Table U2 5.10 5.00 4.90 S.10 5.00 4.90 4.90 Wind factor (22)m ÷ 4 1.28 1.25 1.23							(18) × (2		0.16
S.10 S.00 4.90 Wind factor (22)m ÷ 4 1.28 1.25 1.23								,	
5.10 5.00 4.90 Vind factor (22)m ÷ 4 1.28 1.25 1.23	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Vind factor (22)m ÷ 4 1.28 1.25 1.23									
1.28 1.25 1.23	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70
	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18
Adjusted infiltration rate (allowing for shelter and	wind factor	r) (21) × (2	2a)m						
0.20 0.19 0.19	0.17	0.17	0.15	0.15	0.14	0.16	0.17	0.17	0.18
alculate effective air change rate for the applicat								_	
If mechanical ventilation: air change rate throu									0.50
If balanced with heat recovery: efficiency in %	-			able 4h					N/A
c) whole house extract ventilation or positive in	nput ventila		outside						
0.50 0.50 0.50		0.50					0.50	0.50	0.50
Effective air change rate - enter (24a) or (24b) or (0.50	0.50	0.50	0.50	0.50	0.50	0.50		0.50



Page 1

	and heat ic	oss parame	eter		and the	IN SHITTER	Section 1	Secolar .	A Start	ALLAND LA	- Statistics	and the sea	6 11.
Element				Gross	Opening		area	U-value	AxUV		-value,	А х к,	
				area, m²	m²		, m²	W/m ² K			u/m².K	kJ/K	
Window						11	1.05 x	1.33	= 14.6	15			(27
Door						1	.89 ×	0.00	= 0.00	0			(26
Party wall						10	6.91 ×	0.00	= 0.00	D			(32
External wall						28	3.25 ×	0.18	= 5.05	9			(29
Total area of ex	dernal elem	ients ∑A, n	n ²			41	1.19						(31
Fabric heat loss	s, W/K ≈ ∑(A	× U)							G	26)(30) +	(32) =	19.73] (33
Heat capacity C	im = Σ{A x κ)						(28)	.(30) + (32)	+ {32a}(32e) = 🗌	N/A	(34
Thermal mass p	parameter (*	TMP) in kJ,	/m²K									250.00	(35
Thermal bridge	s: ∑(L x Ψ) c	alculated	using Appe	ndix K								6.93	(36
Total fabric hea	it loss									(33) +	(36) =	26.67	137
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation hea	t loss calcul	ated mont	hly 0.33 x	(25)m x (5))								
	36.75	36.75	36.75	36.75	36.75	36.75	36.75	36.75	36.75	36.75	36.75	36.75	(38)
Heat transfer co	oefficient, W	V/K (37)m	+ (38)m										
	63.42	63.42	63.42	63.42	63.42	63,42	63.42	63.42	63.42	63.42	63.42	63.42	1
	300 M. C.	1C	2.152 (C.26)	an an san ar					Average =	Σ(39)11	2/12 =	63.42	(39)
Heat loss param	neter (HLP),	W/m²K (3	19)m ÷ (4)							- to the second			- 0.00
	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	1
				-					Average =		-	0.71	٦ (40
Number of days	s in month (Table 1a)							Bo	2110,1			-
and a second second		rance and											
	1 21.00	28.00	21.00	20.00	21.00	20.00	21.00	21.00	30.00	21.00	20.00	21.00	Tun
	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)
4. Water heati		-		30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00] (40
	ing energy r	-		30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	2.61	1403
Assumed occup	ing energy r ancy, N	equireme	nt	i anti			31.00	31.00	30.00	31.00	30.00		42)
Assumed occup	ing energy r ancy, N	equireme	nt	i anti			31.00			31.00	30.00	2.61] (40)] (42)] (43)
Assumed occup Annual average	ing energy r ancy, N hot water t Jan	equireme usage in lit Feb	nt res per day Mar	r Vd,averag Apr	ge = (25 x N) + May	- 36 Jun	Jul	31.00	30.00 Sep	aganai		2.61 96.26	42)
Assumed occup Annual average	ing energy r ancy, N hot water t Jan e in litres pe	equireme usage in lit Feb er day for e	nt res per day Mar each month	r Vd,averag Apr 1 Vd,m = fa	ge = (25 x N) + May ctor from Tal	- 36 Jun Dle 1c x (43	Iut ((Aug	Sep	Oct	Nov	2.61 96.26 Dec	42)
Assumed occup Annual average	ing energy r ancy, N hot water t Jan	equireme usage in lit Feb	nt res per day Mar	r Vd,averag Apr	ge = (25 x N) + May	- 36 Jun	Jul			Oct 98.19	Nov	2.61 96.26 Dec] (42)] (43)
Assumed occup Annual average Hot water usage	ing energy r ancy, N hot water u Jan e in litres pe 105.89	equirente usage in lit Feb er day for e 102.04	nt res per day Mar each month 98.19	v Vd,averag Apr n Vd,m = fa 94.34	ge = (25 x N) + May ctor from Tal 90.49	- 36 Jun ble 1c x (43 86,64	Jul 1) 86.64	Aug	Sep	Oct	Nov	2.61 96.26 Dec] (42)] (43)
 Water heat Assumed occup Annual average Hot water usage Energy content 	ing energy r ancy, N hot water s Jan e in litres pe 105.89 of hot wate	equireme usage in lit Feb er day for e 102.04	nt res per day Mar each month 98.19 18 x Vd,m	r Vd,averag Apr h Vd,m = fa 94.34 x nm x Tm	ge = (25 x N) + May ctor from Tal 90.49 /3600 kWh/n	- 36 Jun ble 1c x (43 86.64 nonth (see	Jul)) [86.64 Tables 1b,	Aug 90.49 , 1c 1d)	Sep 94.34	Οct 98.19 Σ(44)1.	Nov 102.04	2.61 96.26 Dec 105.89 1155.16] (42)] (43)
Assumed occup Annual average Hot water usage	ing energy r ancy, N hot water u Jan e in litres pe 105.89	equirente usage in lit Feb er day for e 102.04	nt res per day Mar each month 98.19	v Vd,averag Apr n Vd,m = fa 94.34	ge = (25 x N) + May ctor from Tal 90.49 /3600 kWh/n	- 36 Jun ble 1c x (43 86,64	Jul 1) 86.64	Aug	Sep	Oct 98.19 Σ(44)1 128.29	Nov	2.61 96.26 Dec 105.89 1155.16 152.08] (42)] (43)] (44)] (44)
Assumed occup Annual average Hot water usage Energy content	ing energy r ancy, N hot water u Jan e in litres pe 105.89 of hot wate 157.03	requireme usage in lit Feb er day for e 102.04 or used = 4. 137.34	nt res per day Mar each month 98.19 18 x Vd,m	r Vd,averag Apr h Vd,m = fa 94.34 x nm x Tm	ge = (25 x N) + May ctor from Tal 90.49 /3600 kWh/n	- 36 Jun ble 1c x (43 86.64 nonth (see	Jul)) [86.64 Tables 1b,	Aug 90.49 , 1c 1d)	Sep 94.34	Οct 98.19 Σ(44)1.	Nov	2.61 96.26 Dec 105.89 1155.16	(42)
Assumed occup Annual average Hot water usage Energy content	ing energy r ancy, N hot water u Jan e in litres pe 105.89 of hot wate 157.03	requireme usage in lit Feb er day for e 102.04 or used = 4. 137.34	nt res per day Mar each month 98.19 18 x Vd,m	r Vd,averag Apr h Vd,m = fa 94.34 x nm x Tm	ge = (25 x N) + May ctor from Tal 90.49 /3600 kWh/n	- 36 Jun ble 1c x (43 86.64 nonth (see	Jul)) [86.64 Tables 1b,	Aug 90.49 , 1c 1d)	Sep 94.34	Oct 98.19 Σ(44)1 128.29	Nov	2.61 96.26 Dec 105.89 1155.16 152.08] (42)] (43)] (44)] (44)
Assumed occup Annual average Hot water usage	ing energy r ancy, N hot water u Jan e in litres pe 105.89 of hot wate 157.03	requireme usage in lit Feb er day for e 102.04 or used = 4. 137.34	nt res per day Mar each month 98.19 18 x Vd,m	r Vd,averag Apr h Vd,m = fa 94.34 x nm x Tm	ge = (25 x N) + May ctor from Tal 90.49 /3600 kWh/n	- 36 Jun ble 1c x (43 86.64 nonth (see	Jul)) [86.64 Tables 1b,	Aug 90.49 , 1c 1d)	Sep 94.34	Oct 98.19 Σ(44)1 128.29	Nov	2.61 96.26 Dec 105.89 1155.16 152.08	(42) (43) (43) (44) (44)
Assumed occup Annual average Hot water usage Energy content	ing energy r ancy, N hot water u Jan e in litres pe 105.89 of hot wate 157.03 s 0.15 x (45 23.55	equireme usage in lit Feb er day for e 102.04 er used ~ 4. 137.34)m 20.60	nt res per day Mar each month 98.19 18 x Vd,m 141.72 21.26	r Vd,averag Apr n Vd,m = fa 94.34 x nm x Tm 123.56 18.53	ge = (25 x N) + May ctor from Tal 90.49 /3600 kWh/n 118.56 17.78	- 36 Jun ole 1c x (43 86,64 nonth (see 102.31 15.35	Jul) 86.64 Tables 1b, 94.80	Aug 90.49 , 1c 1d) 108.79	Sep 94.34 110.08	Oct 98.19 Σ(44)1 128.29 Σ(45)1	102.04 12 = 140.04 12 =	2.61 96.26 Dec 105.89 1155.16 152.08 1514.60] (42)] (43)] (44)] (44)] (45)] (46)
Assumed occup Annual average Hot water usage Energy content Distribution loss	ing energy r ancy, N hot water c Jan e in litres pe 105.89 of hot wate 157.03 s 0.15 x (45 23.55 c (litres) inclu	equireme usage in lit Feb er day for e 102.04 er used ~ 4. 137.34)m 20.60	nt res per day Mar each month 98.19 18 x Vd,m 141.72 21.26	r Vd,averag Apr n Vd,m = fa 94.34 x nm x Tm 123.56 18.53	ge = (25 x N) + May ctor from Tal 90.49 /3600 kWh/n 118.56 17.78	- 36 Jun ole 1c x (43 86,64 nonth (see 102.31 15.35	Jul) 86.64 Tables 1b, 94.80	Aug 90.49 , 1c 1d) 108.79	Sep 94.34 110.08	Oct 98.19 Σ(44)1 128.29 Σ(45)1	102.04 12 = 140.04 12 =	2.61 96.26 Dec 1105.89 1155.16 1514.60 22.81] (42)] (43)] (44)] (44)] (45)] (46)
Assumed occup Annual average Hot water usage Energy content Distribution loss Storage volume Water storage li	ing energy r ancy, N hot water t Jan e in litres pe 105.89 of hot wate 157.03 s 0.15 x (45 23.55 (litres) inclu oss:	equireme usage in lit Feb er day for e 102.04 er used = 4. 137.34)m 20.60 uding any s	it res per day Mar each month 98.19 18 x Vd,m 141.72 21.26 solar or WV	v Vd,averag Apr a Vd,m = fa 94.34 x nm x Tm 123.56 18.53 WHRS stora	te = (25 x N) + May ctor from Tal 90,49 /3600 kWh/n 118.56 17.78 age within sal	- 36 Jun ole 1c x (43 86,64 nonth (see 102.31 15.35	Jul) 86.64 Tables 1b, 94.80	Aug 90.49 , 1c 1d) 108.79	Sep 94.34 110.08	Oct 98.19 Σ(44)1 128.29 Σ(45)1	102.04 12 = 140.04 12 =	2.61 96.26 Dec 1105.89 1155.16 1514.60 22.81	(42) (43) (44) (44) (45) (45) (45) (47)
Assumed occup Annual average Hot water usage Energy content Distribution loss Storage volume Water storage li	Ing energy r ancy, N hot water s Jan e in litres pe 105.89 of hot wate 157.03 s 0.15 x (45 23.55 c (litres) incluoss: rer's declare	equireme usage in lit Feb er day for e 102.04 r used ~ 4. 137.34)m 20.60 uding any s ed loss fact	it res per day Mar sach month 98.19 18 x Vd,m 141.72 21.26 solar or WV or is know	v Vd,averag Apr a Vd,m = fa 94.34 x nm x Tm 123.56 18.53 WHRS stora	te = (25 x N) + May ctor from Tal 90,49 /3600 kWh/n 118.56 17.78 age within sal	- 36 Jun ole 1c x (43 86,64 nonth (see 102.31 15.35	Jul) 86.64 Tables 1b, 94.80	Aug 90.49 , 1c 1d) 108.79	Sep 94.34 110.08	Oct 98.19 Σ(44)1 128.29 Σ(45)1	102.04 12 = 140.04 12 =	2.61 96.26 Dec 105.89 1155.16 152.08 1514.60 22.81 170.00	(42) (42) (43) (44) (44) (44) (45) (45) (45) (45) (45
Assumed occup Annual average Hot water usage Energy content Distribution loss Storage volume Water storage k a) If manufactur	Ing energy r ancy, N hot water s Jan e in litres pe 105.89 of hot wate 157.03 s 0.15 x (45 23.55 (litres) inclu oss: rer's declare e factor fron	equireme usage in lit Feb er day for e 102.04 er used = 4. 137.34)m 20.60 uding any s ed loss fact m Table 2b	it res per day Mar sach month 98.19 .18 x Vd,m 141.72 21.26 solar or WV or is known	r Vd,averag Apr n Vd,m = fa 94.34 x nm x Tm 123.56 18.53 WHRS stora n (kWh/da	te = (25 x N) + May ctor from Tal 90,49 /3600 kWh/n 118.56 17.78 age within sal	- 36 Jun ole 1c x (43 86,64 nonth (see 102.31 15.35	Jul) 86.64 Tables 1b, 94.80	Aug 90.49 , 1c 1d) 108.79	Sep 94.34 110.08	Oct 98.19 Σ(44)1 128.29 Σ(45)1	102.04 12 = 140.04 12 =	2.61 96.26 Dec 105.89 1155.16 1514.60 22.81 170.00 1.56	(42) (42) (43) (44) (44) (44) (44) (44) (44) (47) (48) (49)
Assumed occup Annual average Hot water usage Energy content Distribution loss Storage volume Water storage k a) If manufactur Temperature Energy lost f	Ing energy r ancy, N hot water u Jan e in litres pe 105.89 of hot wate 157.03 s 0.15 x (45 23.55 (litres) inclu oss: rer's declare e factor from rom water s	equireme usage in lit Feb er day for e 102.04 er used = 4. 137.34)m 20.60 uding any s ed loss fact m Table 2b	it res per day Mar sach month 98.19 .18 x Vd,m 141.72 21.26 solar or WV or is known	r Vd,averag Apr n Vd,m = fa 94.34 x nm x Tm 123.56 18.53 WHRS stora n (kWh/da	te = (25 x N) + May ctor from Tal 90,49 /3600 kWh/n 118.56 17.78 age within sal	- 36 Jun ole 1c x (43 86,64 nonth (see 102.31 15.35	Jul) 86.64 Tables 1b, 94.80	Aug 90.49 , 1c 1d) 108.79	Sep 94.34 110.08	Oct 98.19 Σ(44)1 128.29 Σ(45)1	102.04 12 = 140.04 12 =	2.61 96.26 Dec 105.89 1155.16 1514.60 22.81 170.00 1.56 0.54	(42) (43) (43) (44) (45) (45) (45) (45) (47) (48) (49) (48) (49) (50)
Assumed occup Annual average Hot water usage Energy content Distribution loss Storage volume Water storage li a) If manufactur Temperature	Ing energy r ancy, N hot water u Jan e in litres pe 105.89 of hot wate 157.03 s 0.15 x (45 23.55 c (litres) inclu oss: rer's declare e factor from yater s 4) in (55)	equireme usage in lit Feb er day for e 102.04 er used = 4. 137.34)m 20.60 uding any s ed loss fact n Table 2b storage (kV	it res per day Mar each month 98.19 18 x Vd,m 18 x Vd,m 141.72 21.26 solar or WV or is known Vh/day) (4	r Vd,averag Apr n Vd,m = fa 94.34 x nm x Tm 123.56 18.53 WHRS stora n (kWh/da 18) x (49)	ge = (25 x N) + May ctor from Tal 90.49 /3600 kWh/r 118.56 17.78 age within sai	- 36 Jun ole 1c x (43 86,64 nonth (see 102.31 15.35	Jul) 86.64 Tables 1b, 94.80	Aug 90.49 , 1c 1d) 108.79	Sep 94.34 110.08	Oct 98.19 Σ(44)1 128.29 Σ(45)1	102.04 12 = 140.04 12 =	2.61 96.26 Dec 1155.16 1514.60 22.81 170.00 1.56 0.54 0.84	(42) (43) (43) (44) (45) (45) (45) (45) (47) (48) (49) (48) (49) (50)
Assumed occup Annual average Hot water usage Energy content Distribution loss Storage volume Water storage li a) If manufactur Temperature Energy lost fi Enter (50) or (54	ing energy r ancy, N hot water t Jan e in litres pe 105.89 of hot wate 157.03 s 0.15 x (45 23.55 (litres) inclu oss: rer's declare e factor from rom water s 4) in (55)	equireme usage in lit Feb er day for e 102.04 ar used ~ 4. 137.34)m 20.60 uding any s ad loss fact n Table 2b storage (kv ed for each	it: res per day Mar sach month 98.19 18 x Vd,m 141.72 21.26 solar or WV or is known Vh/day) (4 in month (5	v Vd,averag Apr N Vd,m = fa 94.34 x nm x Tm 123.56 18.53 WHRS stora n (kWh/da 18) x (49) 15) x (41)m	te = (25 x N) + May ctor from Tal 90,49 /3600 kWh/n 118.56 17.78 age within sal	- 36 Jun ole 1c x (43 86,64 nonth (see 102.31 15.35 me vessel	Jul) 86.64 Tables 1b, 94.80 14.22	Aug 90.49 , 1c 1d) 108.79 16.32	Sep 94.34 110.08 16.51	Oct 98.19 Σ(44)1 128.29 Σ(45)1 19.24	Nov	2.61 96.26 Dec 105.89 1155.16 1514.60 22.81 170.00 1.56 0.54 0.84 0.84	(42) (43) (43) (44) (45) (45) (45) (45) (45) (45) (45
Assumed occup Annual average Hot water usage Energy content Distribution loss Storage volume Water storage k a) If manufactur Temperature Energy lost fi Enter (50) or (54 Water storage k	Ing energy r ancy, N hot water s Jan e in litres pe 105.89 of hot wate 157.03 s 0.15 x (45 23.55 (litres) inclu oss: rer's declare e factor from rom water s 4) in (55) oss calculate 26.11	equireme usage in lit Feb er day for e 102.04 r used = 4 137.34)m 20.60 uding any s ed loss fact n Table 2b storage (ku ed for eact 23.59	it: res per day Mar sach month 98.19 18 x Vd,m 141.72 21.26 solar or WV or is known vh/day) (4 1 month (5 26.11	v Vd, averag Apr v Vd, m = fa 94.34 x nm x Tm 123.56 18.53 WHRS stora n (kWh/da 18) x (49) 18) x (49) 18) x (41)m 25.27	ge = (25 x N) + May ctor from Tal 90.49 /3600 kWh/n 118.56 17.78 age within sal y) 26.11	- 36 Jun ole 1c x (43 86.64 nonth (see 102.31 15.35 ne vessel	Jul) 86.64 Tables 1b, 94.80 14.22 26.11	Aug 90.49 , 1c 1d) 108.79 16.32	Sep 94.34 110.08	Oct 98.19 Σ(44)1 128.29 Σ(45)1	102.04 12 = 140.04 12 =	2.61 96.26 Dec 1155.16 1514.60 22.81 170.00 1.56 0.54 0.84	(42) (43) (43) (44) (45) (45) (45) (45) (45) (45) (45
Assumed occup Annual average Hot water usage Energy content Distribution loss Storage volume Water storage li a) If manufactur Temperature Energy lost fi Enter (50) or (54	Ing energy r ancy, N hot water s Jan e in litres pe 105.89 of hot wate 157.03 s 0.15 x (45 23.55 (litres) inclu oss: rer's declare e factor from rom water s 4) in (55) oss calculate 26.11	equireme usage in lit Feb er day for e 102.04 r used = 4 137.34)m 20.60 uding any s ed loss fact n Table 2b storage (ku ed for eact 23.59	it: res per day Mar sach month 98.19 18 x Vd,m 141.72 21.26 solar or WV or is known vh/day) (4 1 month (5 26.11	v Vd, averag Apr v Vd, m = fa 94.34 x nm x Tm 123.56 18.53 WHRS stora n (kWh/da 18) x (49) 18) x (49) 18) x (41)m 25.27	ge = (25 x N) + May ctor from Tal 90.49 /3600 kWh/n 118.56 17.78 age within sal y) 26.11	- 36 Jun ole 1c x (43 86.64 nonth (see 102.31 15.35 ne vessel	Jul) 86.64 Tables 1b, 94.80 14.22 26.11	Aug 90.49 , 1c 1d) 108.79 16.32	Sep 94.34 110.08 16.51	Oct 98.19 Σ(44)1 128.29 Σ(45)1 19.24	Nov	2.61 96.26 Dec 105.89 1155.16 1514.60 22.81 170.00 1.56 0.54 0.84 0.84] (42)] (43)] (44)] (44)

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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59
Combi loss for	each month	from Table	3a, 3b or 3	3c		50.0-0					19		-11
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61
Total heat req	uired for wat	er heating	calculated	for each m	onth 0.85	x (45)m + (4	46)m + (57)	m + (59):	n + (61)m		1	1	-0.000
	183.15	160.93	167.84	148.83	144.67	127.58	120.92	134.9	-	154.41	165.31	178.19	162
Solar DHW inp		1					1	1		1 40 11 14	100/01		1100
2222300000000000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	63
Output from w	-			-		-	0.00	0.00	0.00	0.00	0.00	0.00	103
Superiori	183.15	160.93	167.84	148.83	144.67	127.58	120.02	124.0	126.26	154.41	107.31	170.10	12
	103.13	100.93	107.04	140.03	144.07	127-38	120.92	134.9	0 135.36	154.41	165.31	178.19	1
Uset color from		Constitution for		r. 10.0r	1451 10		1140			Σ(64)1.	12 =	1822.08	(64
Heat gains from			1	-		-		1		1			-
	52.21	45.67	47.12	41.08	39.42	34.02	31.52	36.17	36.60	42.66	46.56	50.57	(65
5. Internal ga	ins		-21-21-22	IN FALLER	(Internet)	CIPE	Part and	110/010		and and and	12 02/12	and a superior	1
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gain	s (Table 5)			10000				2001	0.000				
	156.79	156.79	156.79	156.79	156.79	156.79	156.79	156.75	9 156.79	156.79	156.79	156.79	1 (66
Lighting gains (15000	1 1000	150.15	1 130.113	130.15	1 130.13	1.00
	58.43	51.90	42.21	31.95	23.89	20.16	21.79	28.32	38.01	48.27	56.33	60.05	(67
Appliance gain					100 C	-	64.03	20.52	36.01	40.27	0.33	00.05	1993
Obbuintee Paris	354.35	358.02	348.76	329.03	1		265.09	0.00	220.00	200.42	345.34	220.71	1
Cooking going (304.13	280.73	265.09	261.42	2 270.68	290.41	315.31	338.71	(68
Cooking gains i					-		1	1			1	1	1000
200000000000	53.29	53.29	53.29	53.29	53.29	53.29	53.29	53.29	53.29	53.29	53.29	53.29	(69
Pump and fan									_				
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. eva	poration (Tal	ble 5)											
	-104.53	-104.53	-104.53	-104.53	-104.53	-104.53	-104.53	+104.5	3 -104.53	-104.53	-104.53	-104.53	[71
Water heating	gains (Table	5)											
	70.18	67.96	63.34	57.06	52.98	47.25	42.37	48.62	50.84	57.34	64.67	67.96	(72)
Total internal g	ains (66)m +	(67)m + (6	8)m + (69)	m + (70)m	+ (71)m + (72)m							
	588.51	583.43	559.86	523.60	486.56	453.69	434.81	443.91	465.09	501.57	541.87	572.29	(73
	-			TATE OF THE OWNER		-	and the second se		In the second				
6. Solar gains		1.1	AUL - V			THE REAL	C. Comment			() (state	NY CAL	AND ALL	
			Access f Table		Area m ²		lar flux V/m²		g ecific data	FF specific (data	Gains W	
			Table	00	in.	. *	v/m		Table 6b	or Table		44	
SouthWest			0.7	7 x	3.40	x 3	6.79 x	0.9 x	0.63 x	0.80	=	43.69	1(79)
NorthEast			0.54		7.65			0.9 x	0.63 x				175
		(02)	0.54	4 × [7.05	X	1.28 X	0.9 X	0.63 X	0.80	= [21.14	1 (vol
Solar gains in w		1.2.2.2.2.1.1.1											1000
	64.84	117.46	179.37	253.51	312.49	322.79	305.98	260.06	204.74	134.85	78.94	54.66	(83)
	ernal and so	lar (73)m +	(83lm)										
Total gains - int	653.35	700.89	739.23	777.11	799.05	776.48	740.78	703.97	669.83	636.42	620.81	626.95	(84)

Temperature (during heating	g periods in	the living	area from T	able 9, Thi	(°C)						21.00	(85
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation fact	or for gains f	or living are	ea n1,m (se	e Table 9a)									
	0.99	0.98	0.95	0.88	0.72	0.52	0.38	0.41	0.64	0.90	0.98	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

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21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00	(87)
Temperature during heat					1	11.00	22.00	e ano	21.00	21.00	21.00	fort
20.33	20.33	20.33	20.33	20.33	20.33	20.33	20.33	20.33	20.33	20.33	20.33	(88)
Utilisation factor for gains				10.00	20.00	20.00	20.00	20.55	20.55	20.55	20.33	1 (00)
0.99	0.98	0.94	0.85	0.67	0.47	0.32	0.35	0.59	0.87	0.97	0.99	(89)
Mean internal temperatu	_				1		0.00	0.33	0.87	0.37	0.33	[(63)
20.33	20.33	20.33	20.33	20.33	20.33	20.33	20.33	20.33	20.33	20.33	20.33	(90)
Living area fraction	20.55	20.55	20.35	20.35	20.55	20.55	20.33		iving area +		0.38	-
Mean internal temperatu	re for the wh	ole dwellin	e fl A x T1 -	+(1 - f(A) y	T2				iving area v	(4) =	0.38	(91)
20.58	20.58	20.58	20.58	20.58	20.58	20.58	20.58	20.58	20.58	20.58	20.58	(92)
Apply adjustment to the r							20.50	20.56	20.36	20.38	20.58	1927
20.58	20.58	20.58	20.58	20.58	20.58	20.58	20.58	20.58	20.58	20.58	20.58	(93)
		20.00	20.00	20.00	20.50	20.30	20.56	20.30	20.55	20.36	20.36] (55)
8. Space heating require	ment											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains	, ղու											
0.99	0.98	0.95	0.86	0.69	0.49	0.34	0.38	0.61	0.88	0.97	0.99	(94)
Useful gains, nmGm, W {	94)m x (84)m											
645.45	685.11	700.69	668.55	550.60	378.49	252.50	265.13	406.96	560.09	604.33	621.25	(95)
Monthly average external	temperature	from Table	e U1									
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean in	ternal tempe	rature, Lm,	(39)m	x [(93)m -	(96)m]							
1032.62	994.57	893.10	740.89	563.31	379.39	252.55	265.24	411.10	633.07	855.04	1038.96	(97)
Space heating requirement	it, kWh/mont	th 0.024 x	(97)m - (9	5)m] x (41)	m							
288.05	207.95	143.15	52.09	9.45	0.00	0.00	0.00	0.00	54.30	180.51	310.78]
								Σ(98	8)15, 10	.12 =	1246.28	(98)
Space heating requirement	+ WATE I m? from									_		
	ic kvvii/m/ye	ar							(98)	÷ (4)	13.99	(99)
									(98)	÷ (4)	13.99	(99)
9a. Energy requirements			tems inclu	ding micro	-СНР	and the second sec			(98)	÷ (4)	13.99	(99)
Space heating	- individual l	heating sys				-			(98)	÷ (4)	13.99	
Space heating Fraction of space heat from	- individual I n secondary/	heating sys /supplemen							(98)	÷ (4)	0.00	(99) (201)
Space heating Fraction of space heat from Fraction of space heat from	- individual m secondary/ m main system	heating sys /supplemen m(s)				-		nda.	(98) 1 - (2)			
Space heating Fraction of space heat from Fraction of space heat from Fraction of space heat from	n individual n secondary/ n main system n main system	heating sys /supplemen m(s) m 2				and the second se					0.00	(201)
Space heating Fraction of space heat from Fraction of space heat from Fraction of space heat from Fraction of total space heat	n secondary/ n main system n main system n main system	heating sys /supplemen m(s) m 2 system 1						(20		01} =	0.00	(201) (202)
Space heating Fraction of space heat from Fraction of space heat from Fraction of space heat from Fraction of total space heat Fraction of total space heat	n secondary/ n main system n main system t from main si	heating sys /supplemen m(s) m 2 system 1				- Alexandria		(20	1 - (2)	01} =	0.00 1.00 0.00] (201)] (202)] (202)
Space heating Fraction of space heat from Fraction of space heat from Fraction of space heat from Fraction of total space heat Fraction of total space heat Efficiency of main system	- individual m secondary/ m main system main system t from main s t from main s t from main s	heating sys /supplemen m(s) m 2 system 1 system 2	itary system	m (table 11				(20	1 - (24 12) × [1- (20	01} =	0.00 1.00 0.00 1.00	(201) (202) (202) (202) (204)
Space heating Fraction of space heat from Fraction of space heat from Fraction of space heat from Fraction of total space heat Fraction of total space heat Efficiency of main system Jan	- individual n secondary/ n main system n main system it from main s it from main s t from main s t from main s	heating sys /supplemen m(s) m 2 system 1 system 2 Mar				Jul	Aug	(20 Sep	1 - (24 12) × [1- (20	01} =	0.00 1.00 0.00 1.00 0.00	(201) (202) (202) (202) (204) (205)
Space heating Fraction of space heat from Fraction of space heat from Fraction of space heat from Fraction of total space heat Fraction of total space heat Efficiency of main system Jan Space heating fuel (main s	n secondary/ n main system n main system it from main it from main 1 (%) Feb ystem 1), kW	heating sys /supplemen m(s) m 2 system 1 system 2 Mar h/month	itary system Apr	m (table 11 May) Jun			Sep	1 - (2) 2) × (1- (20 (202) × (2) Oct	01} = 33] = 03] = Nov	0.00 1.00 0.00 1.00 0.00 298.74 Dec	(201) (202) (202) (202) (204) (205)
Space heating Fraction of space heat from Fraction of space heat from Fraction of space heat from Fraction of total space heat Fraction of total space heat Efficiency of main system Jan	- individual n secondary/ n main system n main system it from main s it from main s t from main s t from main s	heating sys /supplemen m(s) m 2 system 1 system 2 Mar	itary system	m (table 11)	Jul	Aug 0.00		1 - (20 12) × [1- (20 (202) × (20	01} = [0.00 1.00 0.00 1.00 0.00 298.74	(201) (202) (202) (202) (204) (205)
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Space heating Fraction of space heat from Fraction of space heat from Fraction of space heat from Fraction of total space heat Fraction of total space heat Efficiency of main system Jan Space heating fuel (main s 95.42	n secondary/ n main system n main system t from main s t f	heating sys /supplemen m(s) m 2 system 1 system 2 Mar h/month	itary system Apr	m (table 11 May) Jun			Sep 0.00	1 - (2))2) × (1- (20 (202) × (2) Oct 18.18	01} = 3)] = 03) = Nov 60.43	0.00 1.00 0.00 1.00 0.00 298.74 Dec 104.03	(201) (202) (202) (204) (205) (206)
Space heating Fraction of space heat from Fraction of space heat from Fraction of space heat from Fraction of total space heat Fraction of total space heat Efficiency of main system Jan Space heating fuel (main s 96.42 Water heating Efficiency of water heater 220.69	n secondary/ n main system n main system it from main it from main it from main it (%) Feb ystem 1), kW 69.61	heating sys /supplemen m(s) m 2 system 1 system 2 Mar h/month	itary system Apr	m (table 11 May) Jun			Sep 0.00	1 - (2))2) × (1- (20 (202) × (2) Oct 18.18	01} = 3)] = 03) = Nov 60.43	0.00 1.00 0.00 1.00 0.00 298.74 Dec 104.03	(201) (202) (202) (204) (205) (206)
Space heating Fraction of space heat from Fraction of space heat from Fraction of space heat from Fraction of total space heat Fraction of total space heat Efficiency of main system Jan Space heating fuel (main s 96.42 Water heating Efficiency of water heater	n secondary/ n main system n main system it from main s it f it f it f it f it f	heating sys /supplemen m(s) m 2 system 1 system 2 Mar /h/month 47.92	Apr 17.44	m (table 11 May 3.16) Jun 0.00	0.00	0.00	Sep 0.00 Σ{211	1 - (2) 2) × (1- (20 (202) × (2) Oct 18.18 .)15, 10	01} = 3)] = 03] = Nov 60.43 12 =	0.00 1.00 0.00 1.00 0.00 298.74 Dec 104.03 417.19	(201) (202) (202) (204) (205) (206) (211)
Space heating Fraction of space heat from Fraction of space heat from Fraction of space heat from Fraction of total space heat Fraction of total space heat Efficiency of main system Jan Space heating fuel (main s 96.42 Water heating Efficiency of water heater 220.69	n secondary/ n main system n main system it from main it from main it from main it (%) Feb ystem 1), kW 69.61	heating sys /supplemen m(s) m 2 system 1 system 2 Mar /h/month 47.92	Apr 17.44	m (table 11 May 3.16) Jun 0.00	0.00	0.00	Sep 0.00 Σ{211	1 - (2) 2) × (1- (20 (202) × (2) Oct 18.18 .)15, 10	01} = 3)] = 03] = Nov 60.43 12 =	0.00 1.00 0.00 1.00 0.00 298.74 Dec 104.03 417.19	(201) (202) (202) (204) (205) (206) (211)
Space heating Fraction of space heat from Fraction of space heat from Fraction of space heat from Fraction of total space heat Fraction of total space heat Efficiency of main system Jan Space heating fuel (main s 96.42 Water heating Efficiency of water heater 220.69 Water heating fuel, kWh/r	n secondary/ n main system n main system it from main s it f it f it f it f it f	heating sys /supplemen m(s) m 2 system 1 system 2 Mar /h/month 47.92	Apr 17.44 220.69	m (table 11 May 3,16	Jun 0.00 220.69	0.00	0.00	Sep 0.00 Σ(211 220.69 61.33	1 - (2) (2) × (1- (20) (202) × (2) Oct 18.18 (15, 10 220.69	01} = 3)] = Nov 60.43 12 = 220.69 74.91	0.00 1.00 0.00 298.74 Dec 104.03 417.19 220.69	(201) (202) (202) (204) (205) (206) (211)
Space heating Fraction of space heat from Fraction of space heat from Fraction of space heat from Fraction of total space heat Fraction of total space heat Efficiency of main system Jan Space heating fuel (main s 96.42 Water heating Efficiency of water heater 220.69 Water heating fuel, kWh/r	n secondary/ n main system n main system it from main s it f it f it f it f it f	heating sys /supplemen m(s) m 2 system 1 system 2 Mar /h/month 47.92	Apr 17.44 220.69	m (table 11 May 3,16	Jun 0.00 220.69	0.00	0.00	Sep 0.00 Σ(211 220.69 61.33	1 - (2) (2) × (1- (20) (202) × (2) Oct 18.18 115, 10 220.69 69.97	01} = 3)] = Nov 60.43 12 = 220.69 74.91	0.00 1.00 0.00 298.74 Dec 104.03 417.19 220.69 80.74	(201) (202) (202) (204) (205) (206) (211) (211)
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Space heating Fraction of space heat from Fraction of space heat from Fraction of space heat from Fraction of total space heat Fraction of total space heat Efficiency of main system Jan Space heating fuel (main s 96.42 Water heating Efficiency of water heater 220.69 Water heating fuel, kWh/r 82.99 Annual totals	- individual m secondary/ m main system m main system it from main si it from main si from main si it from main si from main s	heating sys /supplemen m(s) m 2 system 1 system 2 Mar /h/month 47.92	Apr 17.44 220.69	m (table 11 May 3,16	Jun 0.00 220.69	0.00	0.00	Sep 0.00 Σ(211 220.69 61.33	1 - (2) (2) × (1- (20) (202) × (2) Oct 18.18 1)15, 10 220.69 69.97 Σ(219a)1	01} = 3]] = Nov 60.43 12 = 220.69 74.91 12 =	0.00 1.00 0.00 1.00 0.00 298.74 Dec 104.03 417.19 220.69 80.74 825.65 417.19	(201) (202) (202) (204) (205) (206) (211) (217) (219)
Space heating Fraction of space heat from Fraction of space heat from Fraction of space heat from Fraction of total space heat Fraction of total space heat Efficiency of main system Jan Space heating fuel (main s 96.42 Water heating Efficiency of water heater 220.69 Water heating fuel, kWh/r 82.99 Annual totals	- individual m secondary/ m main system n main system it from main si it from main si si from main si it from main si it from	heating sys /supplemen m(s) m 2 system 1 system 2 Mar /h/month 47.92	Apr 17.44 220.69	m (table 11 May 3,16	Jun 0.00 220.69	0.00	0.00	Sep 0.00 Σ(211 220.69 61.33	1 - (2) 2) × (1- (20 (202) × (2) Oct 18.18 1)15, 10 220.69 69.97 Σ(219a)1	01} = 3]] = 03] = Nov 60.43 12 = 220.69 74.91 12 = MC Warde	0.00 1.00 0.00 298.74 Dec 104.03 417.19 220.69 80.74	(201) (202) (202) (204) (205) (206) (211) (217) (217) (219)

Water heating fuel					825.65	
Electricity for pumps, fans and electric keep-hot (Table 4	af)					
mechanical ventilation fans - balanced, extract or pos	sitive input from outside		144.73			(230
Total electricity for the above, kWh/year					144.73	(23)
Electricity for lighting (Appendix L)				1	412.76	(23)
Total delivered energy for all uses		(21	11)(221) + (231) + (2	32)(237b) = [1800.32	(238
10a. Fuel costs - individual heating systems including n	micro-CHP			A starting of		
	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	417.19	×	13.19	x 0.01 = [55.03	(24)
Water heating	825.65	x	13.19	x 0.01 = [108.90	(24
Pumps and fans	144.73	x	13.19	x 0.01 = [19.09	(24
Electricity for lighting	412.76	×	13.19	× 0.01 = [54.44	(25)
Additional standing charges				[0.00	(25)
Total energy cost			(240)(242) + ((245)(254) = [237.46	(255
11a. SAP rating - individual heating systems including r	micro-CHP					
Energy cost deflator (Table 12)				[0.42	(256
Energy cost factor (ECF)				[0.74	25
SAP value				(89.62	
SAP rating (section 13)				[90	[25
				2.4	16	-
SAP band					В	_
SAP band 12a. CO2 emissions - individual heating systems includi	ing micro-CHP	11			в	
SAP band 12a. CO ₂ emissions - individual heating systems includi	Energy		Emission factor		Emissions	
12a. CO2 emissions - individual heating systems includi	Energy kWh/year	x	kg CO₂/kWh	- 1	Emissions kg CO2/year	
12a. CO ₂ emissions - individual heating systems includi Space heating - main system 1	Energy kWh/year 417.19	x	kg CO _z /kWh	 - [- [Emissions] [26] [264
12a. CO2 emissions - individual heating systems includi Space heating - main system 1 Water heating	Energy kWh/year	x x	kg COz/kWh 0.52 0.52	= [Emissions kg CO ₂ /year 216.52	(26
12a. CO2 emissions - individual heating systems includi space heating - main system 1 Water heating space and water heating	Energy kWh/year 417.19	x	kg CO _z /kWh	= [Emissions kg CO2/year 216.52 428.51	-
12a. CO ₂ emissions - individual heating systems includi space heating - main system 1 Water heating space and water heating Pumps and fans	Energy kWh/year 417.19 825.65		kg CO ₂ /kWh 0.52 0.52 (261) + (262) + (2	= [Emissions kg CO ₂ /year 216.52 428.51 645.03] (264] (265
12a. CO ₂ emissions - individual heating systems includi space heating - main system 1 Water heating space and water heating Pumps and fans Electricity for lighting	Energy kWh/year 417.19 825.65 144.73	x x	kg CO ₂ /kWh 0.52 0.52 (261) + (262) + (2 0.52 0.52	= [263) + (264) = [= [= [Emissions kg CO ₂ /year 216.52 428.51 645.03 75.11] (26)] (26)] (26)] (26)
12a. CO ₂ emissions - individual heating systems includi Space heating - main system 1 Water heating Space and water heating Pumps and fans Electricity for lighting Fotal CO ₂ , kg/year	Energy kWh/year 417.19 825.65 144.73	x x	kg CO ₂ /kWh 0.52 0.52 (261) + (262) + (2 0.52 0.52	= [263) + (264) = [= [265)(271) = [Emissions kg CO ₂ /year 216.52 428.51 645.03 75.11 214.22] (26)] (26)] (26)] (26)] (26)] (27)
12a. CO ₂ emissions - individual heating systems includi space heating - main system 1 Water heating Space and water heating Pumps and fans Electricity for lighting Fotal CO ₂ , kg/year Dwelling CO ₂ emission rate	Energy kWh/year 417.19 825.65 144.73	x x	kg CO ₂ /kWh 0.52 0.52 (261) + (262) + (2 0.52 0.52	= [263) + (264) = [= [= [Emissions kg CO ₂ /year 216.52 428.51 645.03 75.11 214.22 934.37] (26)] (26)] (26)] (26)] (27)
12a. CO ₂ emissions - individual heating systems includi Space heating - main system 1 Water heating Space and water heating Pumps and fans Electricity for lighting Fotal CO ₂ , kg/year Dwelling CO ₂ emission rate El value	Energy kWh/year 417.19 825.65 144.73	x x	kg CO ₂ /kWh 0.52 0.52 (261) + (262) + (2 0.52 0.52	= [263) + (264) = [= [265)(271) = [Emissions kg CO ₂ /year 216.52 428.51 645.03 75.11 214.22 934.37 10.49 90.66] (26)] (26)] (26)] (26)] (27)] (27)] (27)
12a. CO ₂ emissions - individual heating systems includi space heating - main system 1 Water heating space and water heating Pumps and fans clectricity for lighting fotal CO ₂ , kg/year Dwelling CO ₂ emission rate cl value cl rating (section 14)	Energy kWh/year 417.19 825.65 144.73	x x	kg CO ₂ /kWh 0.52 0.52 (261) + (262) + (2 0.52 0.52	= [263) + (264) = [= [265)(271) = [Emissions kg CO ₂ /year 216.52 428.51 645.03 75.11 214.22 934.37 10.49] (26)] (26)] (26)] (26)] (27)] (27)] (27)
12a. CO ₂ emissions - individual heating systems includi space heating - main system 1 Water heating Space and water heating Pumps and fans Electricity for lighting Fotal CO ₂ , kg/year Dwelling CO ₂ emission rate El value El rating (section 14) El band	Energy kWh/year 417.19 825.65 144.73 412.76	x x	kg CO ₂ /kWh 0.52 0.52 (261) + (262) + (2 0.52 0.52	= [263) + (264) = [= [265)(271) = [Emissions kg CO ₂ /year 216.52 428.51 645.03 75.11 214.22 934.37 10.49 90.66 91] (26)] (26)] (26)] (26)] (27)] (27)] (27)
12a. CO ₂ emissions - individual heating systems includi Space heating - main system 1 Water heating Space and water heating Pumps and fans Electricity for lighting Fotal CO ₂ , kg/year Owelling CO ₂ emission rate	Energy kWh/year 417.19 825.65 144.73 412.76	x x	kg CO ₂ /kWh 0.52 0.52 (261) + (262) + (2 0.52 0.52	= [263) + (264) = [= [265)(271) = [(272) + (4) = [[[Emissions kg CO ₂ /year 216.52 428.51 645.03 75.11 214.22 934.37 10.49 90.66 91] (26)] (26)] (26)] (26)] (27)] (27)] (27)] (27)
12a. CO ₂ emissions - individual heating systems includi space heating - main system 1 Water heating space and water heating Pumps and fans Sectricity for lighting Social CO ₂ , kg/year Owelling CO ₂ emission rate St value St rating (section 14) St band 13a. Primary energy - individual heating systems includ	Energy kWh/year 417.19 825.65 144.73 412.76 ding micro-CHP Energy	x x	kg CO ₂ /kWh 0.52 (251) + (262) + (7 0.52 0.52	= [263) + (264) = [= [265)(271) = [(272) + (4) = [[[Emissions kg CO ₂ /year 216.52 428.51 645.03 75.11 214.22 934.37 10.49 90.66 91 8 Primary Energy] (26)] (26)] (26)] (26)] (27)] (27)] (27)] (27)
12a. CO ₂ emissions - individual heating systems includi space heating - main system 1 Water heating space and water heating Pumps and fans flectricity for lighting fotal CO ₂ , kg/year Dwelling CO ₂ emission rate fl value fl rating (section 14) fl band 13a. Primary energy - individual heating systems includ space heating - main system 1	Energy kWh/year 417.19 825.65 144.73 412.76 ding micro-CHP Energy kWh/year	x x x	kg CO ₂ /kWh 0.52 (251) + (262) + (7 0.52 0.52 (251) + (262) + (7 0.52 0.52 (251) + (262) + (7) 0.52 (251) + (262) + (7) (251) + (262) + (7) (252) + (7) (251) + (262) + (7) (252) + (7) (252	= [263) + (264) = [= [265)(271) = [(272) + (4) = [[Emissions kg CO ₂ /year 216.52 428.51 645.03 75.11 214.22 934.37 10.49 90.66 91 8 8 Primary Energy kWh/year	(26) (26) (26) (26) (27) (27) (27) (27) (27)
12a. CO ₂ emissions - individual heating systems includi space heating - main system 1 Water heating space and water heating Pumps and fans Electricity for lighting fotal CO ₂ , kg/year Dwelling CO ₂ emission rate El value El rating (section 14) El band 13a. Primary energy - individual heating systems includ space heating - main system 1 Water heating	Energy kWh/year 417.19 825.65 144.73 412.76 ding micro-CHP Energy kWh/year 417.19	x x x	kg CO ₂ /kWh 0.52 (261) + (262) + (2 0.52 0.52 0.52 Primary factor 3.07	= [[263) + (264) = [= [265)(271) = [(272) + (4) = [[[265] = [[Emissions kg CO ₂ /year 216.52 428.51 645.03 75.11 214.22 934.37 10.49 90.66 91 8 Primary Energy kWh/year 1280.76	(26) (26) (26) (27) (27) (27) (27) (27) (27) (27) (27
12a. CO ₂ emissions - individual heating systems includi Space heating - main system 1 Water heating Space and water heating Pumps and fans Electricity for lighting Fotal CO ₂ , kg/year Dwelling CO ₂ emission rate El value El rating (section 14) El band	Energy kWh/year 417.19 825.65 144.73 412.76 ding micro-CHP Energy kWh/year 417.19	x x x	kg CO ₂ /kWh 0.52 0.52 (261) + (262) + (2 0.52 0.52 0.52 (261) + (262) + (2 0.52	= [[263) + (264) = [= [265)(271) = [(272) + (4) = [[[265] = [[Emissions kg CO ₂ /year 216.52 428.51 645.03 75.11 214.22 934.37 10.49 90.66 91 8 91 8 Primary Energy kWh/year 1280.76 2534.73	(28) (26) (26) (27) (27) (27) (27) (27) (27) (27) (27
12a. CO ₂ emissions - individual heating systems includi Space heating - main system 1 Water heating Space and water heating Pumps and fans Electricity for lighting Fotal CO ₂ , kg/year Dwelling CO ₂ emission rate El value El rating (section 14) El band 13a. Primary energy - individual heating systems includ Space heating - main system 1 Water heating Space and water heating Pumps and fans	Energy kWh/year 417.19 825.65 144.73 412.76 ding micro-CHP Energy kWh/year 417.19 825.65	x x x x	kg CO ₂ /kWh 0.52 0.52 (261) + (262) + (2 0.52 0.52 0.52 Primary factor 3.07 (261) + (262) + (2 (261) + (262) + (262) + (262) + (262) + (262) + (262) + (262) + (262) + (262) + (262) + (262) + (262) + (262) + (262) + (262) + (262) + (262	= [= [= [265)(271) = [(272) + (4) = [[[- [- [- [- [- [- [Emissions kg CO ₂ /year 216.52 428.51 645.03 75.11 214.22 934.37 10.49 90.66 91 8 Primary Energy kWh/year 1280.76 2534.73 3815.49	(26) (26) (26) (27) (27) (27) (27) (27) (27) (27) (27
12a. CO2 emissions - individual heating systems includi Space heating - main system 1 Water heating Space and water heating Pumps and fans Electricity for lighting Fotal CO22 kg/year Dwelling CO2 emission rate El value El rating (section 14) El band 13a. Primary energy - individual heating systems includ Space heating - main system 1 Nater heating Space and water heating	Energy kWh/year 417.19 825.65 144.73 412.76 ding micro-CHP Energy kWh/year 417.19 825.65 144.73	x x x x x x	kg CO ₂ /kWh 0.52 0.52 (251) + (262) + (2 0.52 0.52 0.52 Primary factor 3.07 (261) + (262) + (2 3.07	= [= [= [265)(271) = [(272) + (4) = [[[= [263] + (264) = [= [= [Emissions kg CO ₂ /year 216.52 428.51 645.03 75.11 214.22 934.37 10.49 90.66 91 8 Primary Energy kWh/year 1280.76 2534.73 3815.49 444.31	(26) (26) (26) (26) (27) (27) (27) (27) (27) (27)

Page 5



URN: KXMC Wardens GREEN version NHER Plan Assessor version 6.1.

SAP version 9.9

L1A 2013 - Regulations Compliance Report Design - Draft



PAZEST A MICH.

This design draft submission provides evidence towards compliance with Part L of the Building Regulations, in accordance with Appendix C of AD L1A. It has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the 'as built' property. This report covers only items included within the SAP and is not a complete report of regulations compliance.

A	ssessor name Mr Pet	er Mitchell			Assessor numb	er 36.	35	
c	lient				Last modified	20,	/08/2015	
-	ddress R3.2 K	ing's Cross Meth	hodist Church, Londo	'n				
1	Check	Evidence	AND THE REAL			Produced by	And the	OK?
1	Criterion 1: predicted carbon dic	ixide emission fi	rom proposed dwelli	ng does not exceed the ta	arget	1.531.531	0.2.11	New York
	TER (kg CO ₂ /m ² .a)	Fuel = N/A Fuel factor = TER = 29.88	1.55			Authorised SAP	Assessor	
	DER for dwelling as designed (kg $CO_2/m^2.a$)	DER = 19.32				Authorised SAP	Assessor	
	Are emissions from dwelling as designed less than or equal to the target?	DER 19.32 <	TER 29.88			Authorised SAP	Assessor	Passed
	Is the fabric energy efficiency of the dwellling as designed less th or equal to the target?		: TFEE 50.54			Authorised SAP	Assessor	Passed
	Criterion 2: the performance of	the building fab	ric and the heating, h	not water and fixed lightin	g systems should be	e no worse than	the design	limits
	Fabric U-values							
	Are all U-values better than the design limits in Table 2?	Element Wall Party wall Floor Roof Openings	Weighted averag 0.18 (max 0.30) 0.00 (max 0.20) (no floor) 0.13 (max 0.20) 1.31 (max 2.00)	ge Highest 0.18 (max 0.70) N/A 0.13 (max 0.35) 1.40 (max 3.30)		Authorised SAP	Assessor	Passed
	Thermal bridging							
	How has the loss from thermal bridges been calculated?	Thermal brid junction	ging calculated from	linear thermal transmitta	inces for each	Authorised SAP	Assessor	
	Heating and hot water systems							
	Does the efficiency of the heatin systems meet the minimum valu set out in the Domestic Heating Compliance Guide?	e Heat pump -		tabase,		Authorised SAP	Assessor	
		Secondary he	eating system: None					
	Does the insulation of the hot water cylinder meet the standar set out in the Domestic Heating Compliance Guide?	No hot water ds	r cylinder			Authorised SAP	Assessor	
	Do controls meet the minimum controls provision set out in the Domestic Heating Compliance Guide?	Hot water co No hot water	nperature zone cont	rol - plumbing circuit		Authorised SAP	Assessor	Passed



Page 1 of 2

Check	Evidence	Produced by	OK?
Fixed internal lighting			
	Schedule of installed fixed internal lighting Standard lights = 0 Low energy lights = 1 Percentage of low energy lights = 100%	Authorised SAP Assessor	Passed
	Minimum = 75 %		
Criterion 3: the dwelling has appro	priate passive control measures to limit solar gains		
Does the dwelling have a strong tendency to high summertime temperatures?	Overheating risk (June) = Not significant Overheating risk (July) = Slight Overheating risk (August) = Slight Region = Thames Thermal mass parameter = 250.00 Ventilation rate in hot weather = 3.00 ach Blinds/curtains = Light-coloured curtain or roller blind	Authorised SAP Assessor	Passed
Criterion 4: the performance of the	e dwelling, as designed, is consistent with the DER		
Design air permeability (m ³ /(h.m ²) at 50Pa)	Design air permeability = 4.00 Max air permeability = 10.00	Authorised SAP Assessor	Passed
Mechanical ventilation system Specific fan power (SFP)	Mechanical extract ventilation: SFP = 0.66 W/(litre/sec) Max SFP = 0.7 W/(litre/sec)	Authorised SAP Assessor	Passed
Have the key features of the design been included (or bettered in practice?	The following party walls have a U-value less than 0.2W/m ² K: • Wall party (0.00) The following openings have a U-value less than 1.2W/m ² K: • Solid door reference 6 (1.00)	Authorised SAP Assessor	



URN: KXMC R3-2 GREEN version NHER Plan Assessor version 6.1.: SAP version 9.9:

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SAP Worksheet Design - Draft	t								be		buildening 2.280062	y co.irk
This design submission has property as constructed.	been carriec	d out using	Approved :	SAP softw	vare. It has t	oeen prepa	ared from	plans and spe	cifications a	nd may n	ot reflect t	the
Assessor name	Mr Peter	Mitchell						Assessor num	ber	3635		
Client								Last modified		20/08,	/2015	
Address	R3.2 King	s Cross Me	thodist Chu	urch, Lond	don							
									and an and the	A COLORADO AND		
1. Overall dwelling dimen	sions	1.1.1	And the				2	1				
				A	krea (m²)		A	verage storey height (m)		Vo	lume (m³)	
Lowest occupied					50.40	(1a) x	Г	2.90	(2a) =		146.16	(3a)
Total floor area	(1a) ·	+ (1b) + (1c) + (1d)(1	n) =	50.40	(4)						
Dwelling volume							(3a) + (3b) + (3d	c) + (3d)(3r	n) = 🗌	146.16	(5)
2. Ventilation rate		the sector we wanted	1051.700	1.1				and the second second			1 2 1 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1	
2. Ventilation rate			and the second	Survey and the	all comments of	4.1110.111				m'	per hour	
Number of chimneys								0	x 40 =		0	(6a)
Number of open flues								0	x 20 =		0	(6b)
Number of intermittent far	15							0	x 10 =		0	(7a)
Number of passive vents								0	x 10 =		0	(7b)
Number of flueless gas fire	5							0	x 40 =		0	(7c)
										Air c	hanges pe hour	r
to filmention due to allow any	. Duran kana	DEVe		16-) + (6b) + (7a	al + (7bl +	(7c) =	0	÷ (5) =		0.00	(8)
Infiltration due to chimney. If a pressurisation test has			tended pr						- 151 -		0.00	1 (0)
Air permeability value, q50								,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			4.00	(17)
If based on air permeability											0.20	(18)
Number of sides on which						-,					3	(19)
Shelter factor	the strends	is shere i	-					1 -	[0.075 x (19)] =	0.78	(20)
Infiltration rate incorporati	ng shelter fa	ictor							(18) × (2	0) =	0.16	(21)
Infiltration rate modified for												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind spec	ed from Tabl	le U2										_
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4												-
1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (a	Illowing for s	shelter and					_				0.10	-
0.20	0.19	0.19	0.17	0.17	0.15	0.15	0.1.4	0.16	0.17	0.17	0.18	(22b)
Calculate effective air chan											0.50	-
If mechanical ventilatio										-	0.50	(23a)
If balanced with heat re						able 4h					N/A	(23c)
c) whole house extract					-	0.57	0.57	0.57	0.57	0.57	0.57	(24c)
0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.37	0.37	0.57	(240)
Effective air change rate - 0	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	(25)
0.57	0.57	0.37	0.21	0.07	5.9.2							



Page 1

	a state of the second	- marker						
Element	Gross	Openings	Net area	U-value	A x U W/M		Ахк, kJ/K	
	area, m²	m²	A, m²	W/m²K		kJ/m².K	KJ/K	
Window			6.74 ×	1.33	= 8.94	1		(27)
Door			1.89 ×		= 1.89	1		(26)
External wall			21.17 ×		= 3.81]		(29a)
Party wall			51.40 ×		= 0.00			(32)
Roof			52.40 ×	0.13	= 6.81	J		(30)
Total area of external elements ∑A, m ²			82.20					(31)
Fabric heat loss, $W/K = \Sigma(A \times U)$						(30) + (32) =	21.45	(33)
Heat capacity Cm = Σ(A x κ)				(28)	.(30) + (32) + (32a)(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m ² K						Ļ	250.00	(35)
Thermal bridges: $\Sigma(L \ x \ \Psi)$ calculated using /	Appendix K					L	6.63	(36)
Total fabric heat loss						(33) + (36) =	28.08	(37)
Jan Feb M	Aar Apr	May	Jun Jul	Aug	Sep	Oct Nov	Dec	
Ventilation heat loss calculated monthly 0.	33 x (25)m x (5)							
27.59 27.59 2	7.59 27.59	27.59	27.59 27.59	27.59	27.59	27.59 27.59	27.59	(38)
Heat transfer coefficient, W/K (37)m + (38)m							
55.67 55.67 55	5.67 55.67	55.67	55.67 55.67	55.67	55.67	55.67 55.67	55.67	
					Average = ∑(39)112/12 =	55.67	(39)
Heat loss parameter (HLP), W/m ² K (39)m -	- (4)							
1.10 1.10 1	.10 1.10	1.10	1.10 1.10	1.10	1.10	1.10 1.10	1.10	
					Average = ∑{	40)112/12 =	1.10	(40)
Number of days in month (Table 1a)								
31.00 28.00 3	1.00 30.00	31.00	30.00 31.00	31.00	30.00	31.00 30.00	31.00	(40)
				Contraction of the local division of the	Al and the local distance			
4. Water heating energy requirement	and the second second		and a state of the		and the stand		4.70	(42)
Assumed occupancy, N							1.70	
Annual average hot water usage in litres pe	ar day Vid average						74.63	
	a nak kolakeinBe						74.62	(43)
	Mar Apr	May	Jun Jul	Aug	Sep	Oct Nov		
Jan Feb T Hot water usage in litres per day for each r	Mar Apr	May	Jun Jul le 1c x (43)				Dec	
Hot water usage in litres per day for each r	Mar Apr	May	Jun Jul		Sep 73.13	76.11 79.10	Dec 0 82.08	(43)
Hot water usage in litres per day for each r 82.08 79.10 7	Mar Apr nonth Vd,m = fact 6.11 73.13	May tor from Tab 70.14	Jun Jul le 1c x (43) 67.16 67.18	5 70.14			Dec	
Hot water usage in litres per day for each r	Mar Apr nonth Vd,m = fact 6.11 73.13	May tor from Tab 70.14	Jun Jul le 1c x (43) 67.16 67.18	5 70.14		76.11 79.10 ∑(44)112 =	Dec 0 82.08 895.44	(43)
Hot water usage in litres per day for each r 82.08 79.10 7 Energy content of hot water used = 4.18 x	Mar Apr nonth Vd,m = fact 6.11 73.13	May tor from Tab 70.14	Jun Jul le 1c x (43) 67.16 67.18	5 70.14 1b, 1c 1d)		76.11 79.10 Σ(44)112 = 99.45	Dec 0 82.08 895.44 6 117.88	(43)
Hot water usage in litres per day for each r 82.08 79.10 7 Energy content of hot water used = 4.18 x	Mar Apr month Vd,m = fact 6.11 6.11 73.13 Vd,m x nm x Tm/3	May tor from Tab 70.14 3600 kWh/m	Jun Jul le 1c x (43) 67.16 67.16 nonth (see Tables :	5 70.14 1b, 1c 1d)	73.13	76.11 79.10 ∑(44)112 =	Dec 0 82.08 895.44	(43)
Hot water usage in litres per day for each r 82.08 79.10 7 Energy content of hot water used = 4.18 x	Mar Apr month Vd,m = fact 6.11 6.11 73.13 Vd,m x nm x Tm/3	May tor from Tab 70.14 3600 kWh/m	Jun Jul le 1c x (43) 67.16 67.16 nonth (see Tables :	5 70.14 1b, 1c 1d)	73.13	76.11 79.10 Σ(44)112 = 99.45	Dec 0 82.08 895.44 6 117.88	(43) (44) (45)
Hot water usage in litres per day for each r 82.08 79.10 7 Energy content of hot water used = 4.18 x 121.72 106.46 10 Distribution loss 0.15 x (45)m	Mar Apr month Vd,m = fact 6.11 6.11 73.13 Vd,m x nm x Tm/3	May tor from Tab 70.14 3600 kWh/m	Jun Jul le 1c x (43) 67.16 67.16 nonth (see Tables :	5 70.14 1b, 1c 1d) 9 84.33	73.13	76.11 79.10 Σ(44)112 = 99.45	Dec 0 82.08 895.44 6 117.88 1174.06	(43)
Hot water usage in litres per day for each r 82.08 79.10 7 Energy content of hot water used = 4.18 x 121.72 106.46 10 Distribution loss 0.15 x (45)m	Mar Apr month Vd,m = fact 6.11 73.13 Vd,m x nm x Tm/3 99.86 95.78 6.48 14.37	May tor from Tab 70.14 3600 kWh/m 91.90 13.79	Jun Jul le 1c x (43) 67.16 67.16 67.16 wonth (see Tables 1 79.30 73.49 11.90 11.00	5 70.14 1b, 1c 1d) 9 84.33	85.33	76.11 79.10 Σ{44}112 = 99.45 108.5 Σ(45)112 =	Dec 0 82.08 895.44 6 117.88 1174.06	(43) (44) (45)
Hot water usage in litres per day for each r 82.08 79.10 7 Energy content of hot water used = 4.18 x 121.72 106.46 10 Distribution loss 0.15 x (45)m 18.26 15.97 1	Mar Apr month Vd,m = fact 6.11 73.13 Vd,m x nm x Tm/3 99.86 95.78 6.48 14.37	May tor from Tab 70.14 3600 kWh/m 91.90 13.79	Jun Jul le 1c x (43) 67.16 67.16 67.16 wonth (see Tables 1 79.30 73.49 11.90 11.00	5 70.14 1b, 1c 1d) 9 84.33	85.33	76.11 79.10 Σ{44}112 = 99.45 108.5 Σ(45)112 =	Dec 0 82.08 895.44 6 117.88 1174.06 8 17.68	(43) (44) (45) (45)
Hot water usage in litres per day for each r 82.08 79.10 7 Energy content of hot water used = 4.18 x 121.72 106.46 10 Distribution loss 0.15 x (45)m 18.26 15.97 1 Storage volume (litres) including any solar	Mar Apr month Vd,m = fact 6.11 73.13 Vd,m x nm x Tm/3 99.86 95.78 6.48 14.37 or WWHRS storage	May tor from Tab 70.14 3600 kWh/m 91.90 13.79 ge within san	Jun Jul le 1c x (43) 67.16 67.16 67.16 wonth (see Tables 1 79.30 73.49 11.90 11.00	5 70.14 1b, 1c 1d) 9 84.33	85.33	76.11 79.10 Σ{44}112 = 99.45 108.5 Σ(45)112 =	Dec 0 82.08 895.44 6 117.88 1174.06 8 17.68	(43) (44) (45) (45)
Hot water usage in litres per day for each r 82.08 79.10 7 Energy content of hot water used = 4.18 x 121.72 106.46 10 Distribution loss 0.15 x (45)m 18.26 15.97 1 Storage volume (litres) including any solar Water storage loss:	Mar Apr month Vd,m = fact 6.11 73.13 Vd,m x nm x Tm/3 99.86 95.78 6.48 14.37 or WWHRS storage	May tor from Tab 70.14 3600 kWh/m 91.90 13.79 ge within san	Jun Jul le 1c x (43) 67.16 67.16 67.16 wonth (see Tables 1 79.30 73.49 11.90 11.00	5 70.14 1b, 1c 1d) 9 84.33	85.33	76.11 79.10 Σ{44}112 = 99.45 108.5 Σ(45)112 =	Dec 82.08 895.44 6 117.88 1174.06 8 17.68 170.00	(43) (44) (45) (45) (47)
Hot water usage in litres per day for each r 82.08 79.10 7 Energy content of hot water used = 4.18 x 121.72 106.46 10 Distribution loss 0.15 x (45)m 18.26 15.97 1 Storage volume (litres) including any solar Water storage loss: a) If manufacturer's declared loss factor is Temperature factor from Table 2b	Mar Apr month Vd,m = fact 6.11 73.13 Vd,m x nm x Tm/3 99.86 95.78 6.48 14.37 0 or WWHRS storage known (kWh/day)	May tor from Tab 70.14 3600 kWh/m 91.90 13.79 ge within san	Jun Jul le 1c x (43) 67.16 67.16 67.16 wonth (see Tables 1 79.30 73.49 11.90 11.00	5 70.14 1b, 1c 1d) 9 84.33	85.33	76.11 79.10 Σ{44}112 = 99.45 108.5 Σ(45)112 =	Dec 0 82.08 895.44 6 117.88 1174.06 8 17.68 170.00 1.56	(43) (44) (45) (45) (45) (47) (48)
Hot water usage in litres per day for each r 82.08 79.10 7 Energy content of hot water used = 4.18 x 121.72 106.46 10 Distribution loss 0.15 x (45)m 18.26 15.97 1 Storage volume (litres) including any solar Water storage loss: a) If manufacturer's declared loss factor is	Mar Apr month Vd,m = fact 6.11 73.13 Vd,m x nm x Tm/3 99.86 95.78 6.48 14.37 0 or WWHRS storage known (kWh/day)	May tor from Tab 70.14 3600 kWh/m 91.90 13.79 ge within san	Jun Jul le 1c x (43) 67.16 67.16 67.16 wonth (see Tables 1 79.30 73.49 11.90 11.00	5 70.14 1b, 1c 1d) 9 84.33	85.33	76.11 79.10 Σ{44}112 = 99.45 108.5 Σ(45)112 =	Dec 0 82.08 895.44 6 117.88 1174.06 8 17.68 170.00 1.56 0.54	(43) (44) (45) (45) (45) (47) (48) (48)
Hot water usage in litres per day for each r 82.08 79.10 7 Energy content of hot water used = 4.18 x 121.72 106.46 10 Distribution loss 0.15 x (45)m 18.26 15.97 1 Storage volume (litres) including any solar Water storage loss: a) if manufacturer's declared loss factor is Temperature factor from Table 2b Energy lost from water storage (kWh/d) Enter (50) or (54) in (55)	Mar Apr nonth Vd,m = fact 6.11 73.13 Vd,m x nm x Tm/3 99.86 95.78 6.48 14.37 or WWHRS storag known (kWh/day) ay) (48) x (49)	May tor from Tab 70.14 3600 kWh/m 91.90 13.79 ge within san	Jun Jul le 1c x (43) 67.16 67.16 67.16 wonth (see Tables 1 79.30 73.49 11.90 11.00	5 70.14 1b, 1c 1d) 9 84.33	85.33	76.11 79.10 Σ{44}112 = 99.45 108.5 Σ(45)112 =	Dec 2 82.08 895.44 36 117.88 1174.06 8 17.68 170.00 1.56 0.54 0.84	(43) (44) (45) (45) (45) (47) (48) (49) (50)
Hot water usage in litres per day for each r 82.08 79.10 7 Energy content of hot water used = 4.18 x 121.72 106.46 10 Distribution loss 0.15 x (45)m 18.26 15.97 1 Storage volume (litres) including any solar Water storage loss: a) If manufacturer's declared loss factor is Temperature factor from Table 2b Energy lost from water storage (kWh/d Enter (50) or (54) in (55) Water storage loss calculated for each mo	Mar Apr month Vd,m = fact 6.11 73.13 Vd,m x nm x Tm/3 19.86 95.78 6.48 14.37 or WWHRS storag known (kWh/day) ay) (48) x (49) nth (55) x (41)m	May tor from Tab 70.14 3600 kWh/m 91.90 13.79 ge within san	Jun Jul le 1c x (43) 67.16 67.16 67.16 wonth (see Tables 1 79.30 73.49 11.90 11.00	5 70.14 1b, 1c 1d) 9 84.33 2 12.65	85.33	76.11 79.10 Σ{44}112 = 99.45 108.5 Σ(45)112 =	Dec 82.08 895.44 6 117.88 1174.06 8 17.68 170.00 1.56 0.54 0.84 0.84	(43) (44) (45) (45) (45) (47) (48) (49) (50)
Hot water usage in litres per day for each r 82.08 79.10 7 Energy content of hot water used = 4.18 x 121.72 106.46 10 Distribution loss 0.15 x (45)m 18.26 15.97 1 Storage volume (litres) including any solar Water storage loss: a) If manufacturer's declared loss factor is Temperature factor from Table 2b Energy lost from water storage (kWh/d Enter (50) or (54) in (55) Water storage loss calculated for each mo 26.11 23.59 2	Mar Apr month Vd,m = fact 6.11 73.13 Vd,m x nm x Tm/3 19.86 95.78 6.48 14.37 or WWHRS storag known (kWh/day) ay) (48) x (49) nth (55) x (41)m (5.11 25.27	May tor from Tab 70.14 3600 kWh/m 91.90 13.79 ge within san) 26.11	Jun Jul le 1c x (43) 67.16 67.16 67.16 wonth (see Tables 79.30 79.30 73.49 11.90 11.00 ne vessel 25.27	5 70.14 1b, 1c 1d) 9 84.33 2 12.65 1 26.11	73.13	76.11 79.10 Σ (44)112 =	Dec 82.08 895.44 6 117.88 1174.06 8 17.68 170.00 1.56 0.54 0.84 0.84	(43) (44) (45) (45) (47) (48) (47) (48) (49) (50) (55)
Hot water usage in litres per day for each r 82.08 79.10 7 Energy content of hot water used = 4.18 x 121.72 106.46 10 Distribution loss 0.15 x (45)m 18.26 15.97 1 Storage volume (litres) including any solar Water storage loss: a) If manufacturer's declared loss factor is Temperature factor from Table 2b Energy lost from water storage (kWh/d Enter (50) or (54) in (55) Water storage loss calculated for each mo 26.11 23.59 2 If the vessel contains dedicated solar storage	Mar Apr month Vd,m = fact 6.11 73.13 Vd,m x nm x Tm/3 99.86 95.78 99.86 95.78 95.78 6.48 14.37 0 or WWHRS storage 99.86 95.78 known (kWh/day) 48) x (49) 440 ay) (48) x (49) 441 443 inth (55) x (41)m 10.11 25.27 ge or dedicated V 10.12 10.12	May tor from Tab 70.14 3600 kWh/m 91.90 13.79 ge within san) 26.11 WWHRS (56)	Jun Jul le 1c x (43) 67.16 67.16 67.16 wonth (see Tables 79.30 79.30 73.49 11.90 11.00 ne vessel 25.27	5 70.14 1b, 1c 1d) 9 84.33 2 12.65 1 26.11 7), else (56)	73.13	76.11 79.10 Σ (44)112 =	Dec 82.08 895.44 6 117.88 1174.06 8 17.68 170.00 1.56 0.54 0.84 0.84 7 26.11	(43) (44) (45) (45) (47) (48) (47) (48) (49) (50) (55)
Hot water usage in litres per day for each r 82.08 79.10 7 Energy content of hot water used = 4.18 x 121.72 106.46 10 Distribution loss 0.15 x (45)m 18.26 15.97 1 Storage volume (litres) including any solar Water storage loss: a) If manufacturer's declared loss factor is Temperature factor from Table 2b Energy lost from water storage (kWh/d) Enter (50) or (54) in (55) Water storage loss calculated for each mo 26.11 23.59 2 If the vessel contains dedicated solar storage	Mar Apr month Vd,m = fact 6.11 73.13 Vd,m x nm x Tm/3 19.86 95.78 6.48 14.37 or WWHRS storag known (kWh/day) ay) (48) x (49) nth (55) x (41)m (5.11 25.27	May tor from Tab 70.14 3600 kWh/m 91.90 13.79 ge within san) 26.11	Jun Jul le 1c x (43) 67.16 67.16 67.16 wonth (see Tables 1 79.30 79.30 73.49 11.90 11.00 ne vessel 11.00 25.27 26.1 m x [(47) - Vs] + (4	5 70.14 1b, 1c 1d) 9 84.33 2 12.65 1 26.11 7), else (56)	73.13	76.11 79.11 Σ (44)112 = 99.45 99.45 108.5 Σ (45)112 = 16.2 14.92 16.2 26.11 25.2	Dec 2 82.08 895.44 36 117.88 1174.06 8 17.68 170.00 1.56 0.54 0.84 0.84 7 26.11	(43) (44) (45) (45) (45) (47) (48) (49) (50) (55) (55) (56)



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Primary circuit los	s for each	month from	n Table 3				V				-		-
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	159
Combi loss for ead	h month	from Table	3a, 3b or 3	c									
	0.00	0.00	0.00	0.00	0.00	D.00	0.00	0.00	0.00	0.00	0.00	0.00	[61
Total heat require	d for wate	er heating c	alculated f	or each mo	onth 0.85 x	(45)m + (4	6)m + (57)r	n + (59)m	+ (61)m				
[147.84	130.05	135.97	121.05	118.01	104.58	99.60	110.44	110.61	125.56	3 133.83	144.00	[62
Solar DHW input o	alculated	using Appe	ndix G or A	Appendix H									
Ε	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63
Dutput from wate	r heater f	or each mo	nth (kWh/r	month) (62	2)m + (63)m	n							
Γ	147.84	130.05	135.97	121.05	118.01	104.58	99.60	110.44	110.61	125.56	3 133.83	144.00]
		0								Σ(64)	112 =	1481.53	(64
Heat gains from w	ater heat	ing (kWh/m	onth) 0.25	5 × [0.85 ×	(45)m + (61	l)m] + 0.8 ×	: [(46]m + (57)m + (5	9)m]				
Γ	40.47	35.40	36.53	31.85	30.56	26.37	24.43	28.04	28.37	33.07	36.09	39.20	(65
L													
5. Internal gains		1	1	(1) (1)					and the set		1000		a second
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains ('	Table 5)												2
	102.11	102.11	102.11	102.11	102.11	102.11	102.11	102.11	102.11	102.11	1 102.11	102.11	(66
Lighting gains (cal	culated in	Appendix I	, equation	L9 or L9a),	also see Ta	able S							
Γ	35.52	31.55	25.66	19.43	14.52	12.26	13.25	17.22	23.11	29.34	34.25	36.51	(67
 Appliance gains (o	alculated	in Appendi	x L, equatio	on L13 or L	13a), also s	ee Table 5							
Г. Г	221.30	223.60	217.81	205.49	189.94	175.32	165.56	163.26	169.05	181.3	7 196.92	211.54	(68
Cooking gains (ca	culated in	Appendix I	, equation	L15 or L15	ia), also see	Table 5							
Γ	46.91	46.91	46.91	46.91	46.91	46.91	46.91	46.91	46.91	46.91	46.91	46.91	(69
L Pump and fan gal					1								
r unip unu runger	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70
Losses e.g. evapo			0.00	0.00	0.00								
Cosses e.g. evapo		-68.08	-68.08	-68.08	-68.08	-68.08	-68.08	-68.08	-68.08	-68.08	-68.08	-68.08	(71
L	-68.08		-06.06	-00.00	-00.00	-06.04	-00.00	-00.00	00.00	1 00100		1	- 100
Water heating ga			10.10		1 44 67	1 26.62	22.04	27.60	39.41	44.44	50.13	52.68	7 (72
L	54.40	52.68	49.10	44.23	41.07	36.62	32.84	37.69	39.41	94,44	30.15	32.00	11/2
Total internal gain			1.		1			1	1			1 202 20	1
L.	392.18	388.78	373.52	350.10	326.48	305.16	292.60	299.12	312.52	336.1	1 362.25	381.68	(73
6. Solar gains	(1)() () () () () () () () () () () () ()	Contraction of the	191 191	Con later	WIN P		THAT WAS	C BY AN		and the second			ALC: N
o. aciai gania	1 Colorador	A STREET	Access	factor	Area	50	lar flux	and the first state	в	F	F	Gains	
			Table		m²		V/m²		ecific data Table 6b		ic data ble 6c	w	
NorthEast			0.7	7 x	3.51		1.28 ×	0.9 x	0.63	x 0.	80 =	13.83	175
NorthEast			0.5		1.43			0.9 x	0.63		80 =	3.95	(75
NUTTINGSE			0.5	- I ^ L	1.75								-
SouthWest			0.5	4 x	1.80	X	36.79 ×	0.9 x	0.63	x 0.	80 =	16.22	. 179

2(74) a Ran 34.01 63.83 103.03 153.96 196.45 205.59 193.82 160.50 120.41 74.78 41.81 28.41 (83) Total gains - internal and solar (73)m + (83)m 426.18 452.61 476.55 504.06 522.94 510.75 486.42 459.62 432.93 410.89 404.06 410.09 (84) 7. Mean internal temperature (heating season)

21.00 (85) Temperature during heating periods in the living area from Table 9, Th1(°C) Oct Nov Dec Jul Aug Sep Jan Feb Mar Apr May Jun Utilisation factor for gains for living area n1,m (see Table 9a)



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0.99	0.99	0.97	0.93	0.83	0.66	0.50	0.54	0.78	0.94	0.98	0.99	(86)
Mean internal temp of liv	ing area T1	(steps 3 to 7	in Table 9c	:)								
21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00	(87)
Temperature during heat	ing periods i	in the rest of	dwelling fr	rom Table	9. Th2("C)							
						20.00	20.00	20.00	20.00	20.00	20.00	(88)
20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	foot
Utilisation factor for gain	s for rest of	dwelling n2,	m									
0.99	0.98	0.96	0.91	0.78	0.57	0.39	0.43	0.71	0.92	0.98	0.99	(89)
Mean internal temperatu	re in the res	t of dwelling	g T2 (follow	steps 3 to	7 in Table 9	9c)						
20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	(90)
Living area fraction								Lis	ving area ÷	(4) =	0.45	(91)
Mean internal temperatu	re for the w	hole dwellin	ofl∆ v T1 +	(1 - f) A) x	T2				0			
		-				20.44	70.44	20.44	20.44	20.44	20.44	(0.2)
20.44	20.44	20.44	20.44	20.44	20.44	20.44	20.44	20.44	20.44	20.44	20.44	(92)
Apply adjustment to the	mean intern	al temperati	ure from Ta	ble 4e whe	ere appropr	iate						
20.44	20.44	20.44	20.44	20.44	20.44	20.44	20.44	20.44	20.44	20.44	20.44	(93)
	Contraction in the local division in the	Constant of the second							15. 15 Mar			
8. Space heating require	ement		1					- and the same	A REAL PROPERTY.	and the second		
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gain	s, nm											
0.99	0.98	0.97	0.92	0.81	0.61	0.44	0.48	0.74	0.93	0.98	0.99	(94)
Useful gains, nmGm, W	94)m x (84)r	m										
421.48	445.01	461.19	464.46	422.03	313.26	212.33	222.30	321.64	383.18	396.07	406.37	(95)
				122.00	220.00							
Monthly average externa		-				10.00	10.00	11.10	10.00	7.10	4.20	10.51
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean i	nternal temp	perature, Lm	, W [(39)m	x [(93)m -	(96)m]							
898.74	865.34	776.27	642.67	486.80	325.37	214.03	225.17	353.20	548.04	742.87	904.31	(97)
Space heating requireme	nt, kWh/mo	nth 0.024 x	[(97)m - (9	5)m] x (41)	im							
355.04	282.46	234.42	128.31	48.19	0.00	0.00	0.00	0.00	122.65	249.70	370.47	
								Σ(98	8)15, 10	.12 = 1	791.29	(98)
Space heating requireme	at kWh/m²/	vear							(98)	÷ (4)	35.54	(99)
share nearing redomente	in contrary in y	year							,,			
9a. Energy requirement	s - individua	I heating sy	stems inclu	iding micro	D-CHP	TANK						
			100 - 10 Mar 100 - 100									
Space heating				. In the second							0.00	(201)
Fraction of space heat fre	m secondar	y/suppleme	ntary syste	m (table 1)	1}							
Fraction of space heat fre	om main syst	tem(s)							1 - (2	01) =	1.00	(202)
Fraction of space heat fre	m main syst	tem 2									0.00	(202)
Fraction of total space he	at from mai	n system 1						(20)2) × [1- (20	3)] =	1.00	(204)
Fraction of total space he	at from mai	in system 2							(202) × (2	03) =	0.00	(205)
Efficiency of main system											287.12	(206)
				May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Jan	Feb	Mar	Apr	тар	2011	201	COMP.	ach				
Space heating fuel (main	system 1), k	Wh/month			,					1		
123.6	98.38	81.64	44.69	16.78	0.00	0.00	0.00	0.00	42.72	86.97	129.03	
								Σ(21)	1)15, 10	.12 =	623.87	(211)
Water heating												
Efficiency of water heate	r											
220.6		220.69	220.69	220.69	220.69	220.69	220.69	220.69	220.69	220.69	220.69	(217)
						220.00	220100	220100				
Water heating fuel, kWh		220.69	220.09									
22.00	/month							50.10	00.00	10.14	er or	1
66.99	/month	61.61	54.85	53.48	47.39	45.13	50.04	50.12	56.90	60.64	65.25	124.00
66.95	/month				47.39	45.13	50.04	50.12	56.90 Σ(219a)1		65.25 671.33	(219)
66.95	/month				47.39	45.13	50.04	50.12	-			(219)

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SAP version 9.9

pace heating fuel 621.33 Water heating fuel 671.33 Sector() for pump, fans and electric keep hot (Table 4/) 272.18 273.1 mechanical ventilation fans - balanced, extract or positive input from outside 272.18 273.1 fotal electricity for the above, KWN/year 273.1 273.1 fotal electricity for the above, KWN/year 270.3 273.2 fotal electricity for the above, KWN/year 270.3 273.2 fotal electricity for the above, KWN/year 100.2 100.2 fotal electricity for the above, KWN/year Fuel price Fuel price fotal electricity for the above, KWN/year 13.19 0.01 = 22.29 fotal electricity for lighting 250.95 x 13.19 x 0.00 = 5.27 fotal electricity for lighting 250.95 x 13.19 x 0.00 = 5.20 fotal electricity for lighting 250.95 x 13.19 x 0.00 = 5.21 fotal electricity for lighting 250.95 x 13.29 x 0.00 = 5.21 fotal electricity for lighting 250.95 x 0.52	Annual totals						
pack and provides 671.33 Betricity for pumps, fairs and electric keep hot (Table 40) (272.18) (270.13) mechanical ventilation fairs - balanced, extract or positive input from outside (272.18) (270.13) State lectricity for lighting (Appendix L) (200.65) (233.1) State lectricity for lighting (Appendix L) (200.65) (233.1) State lectricity for lighting (Appendix L) (200.65) (233.1) State lectricity for lighting (Appendix L) (200.76) (201.723.1) (233.7) State lectricity for lighting (200.75) (201.71.23) (201.71.23) (201.71.23) State lectricity for lighting (200.55) x (213.1) (213.1) (201.1) (217.12) (201.71.23) (201.1) State lectricity for lighting (200.55) x (213.1) (201.1)					ſ	623.87	1
Bactricity for punps, fans and electric keep-hot [Table 47] (200) mechanical vestitation fans - balanced, extra or positive input from outside (27.18) (201) Cital electricity for lighting (Appendix L) (200) (201) Cital electricity for lighting (Appendix L) (201) (201) (201) Cital eleverity for all uoes (211)-(221) + (231) + (232)-(237) + (201) (202) Cital eleverity for all uoes (211) (211)-(221) + (231) + (232)-(237) + (201) (201) Cital eleverity for all uoes (211) (211) (211) (211) (212) (201) Cital eleverity for all uoes (211) (21					ľ		í
mechanical ventilation (ans - balanced, extract or positive input from outside 127.18 (7.00) food electricity for the above, WUN/year 20.05 (7.3) iscentricity for the above, WUN/year (2.11, (2.21) + (2.31) + (2.32), (2.37) + (2.32) (2.33) cold elevered every for all uses (2.11, (2.21) + (2.31) + (2.32), (2.37) + (2.32) (2.33) cold elevered every for all uses (2.11, (2.21) + (2.32), (2.37) + (2.32) (2.33) cold elevered every for all uses (2.11, (2.21) + (2.32), (2.37) + (2.32) (2.40) Mater heating 62.3 & 7 x 13.19 x 0.01 = 82.22 (2.40) Mater heating 67.133 x 13.19 x 0.01 = 82.22 (2.40) Mater heating 23.095 x 13.19 x 0.01 = 82.22 (2.40) Mater heating e systems including micro- CHP 0.00 (2.51) 0.00 (2.51) Is-SAP rating - includiual heating systems including micro- CHP 0.02 (2.51) Marker heating (2.51) 0.52 2.23.79 (2.51) Space heating - main system 1 62.347 x							,
Interdation into Automatical Matrix Spectra in positive matrix in the Matrix Spectra in Sp		it from outside		127.18			(230a)
Database	the second at a second second	it from outside		167.10	ſ	127.18	1
becomes under programmer of and uses (211)(221) + (231) + (232)(237) + (272.33) (23) total believed not systems including micro-CHP Fuel Fuel Fuel (211)(221) + (231) + (232)(237) + (222)(242)					ſ		1
Space heating - main system 1 networking micro-CHP Fuel Fuel <t< td=""><td></td><td></td><td>(211)</td><td>(221) + (221) + (</td><td>232) (2375) = [</td><td></td><td>1</td></t<>			(211)	(221) + (221) + (232) (2375) = [1
Fuel kWN/year Fuel price Fuel cot £/year Space heating - main system 1 671.33 x 13.19 x.0.01 88.25 (24) Water heating 671.33 x 13.19 x.0.01 88.25 (24) Vamps and fans 127.18 x 13.19 x.0.01 68.77 (24) Electricity for lighting 250.95 x 13.19 x.0.01 20.00 (21) Galdenergy cost (240)(242) + (245)(254) = 20.07 (25) Instact of Elefort 0.42 (25) 0.37 (25) AP rating (section 13) 85 85 (25) (25) SAP and and water heating 671.33 x 0.52 = 232.37 (26) Space heating - main system 1 623.87 x 0.52 = 232.79 (26) Space heating - main system 1 623.87 x 0.52 = 232.79 (26) Space heating - main system 1 623.87 x 0.52 = <	Total delivered energy for all uses		(211)		232](2370) - [1075.55] (230)
kvh/year Kuh/year cot f/year ippace heating - main system 1 623.87 x 13.19 x 0.01 = 82.29 (24) Vater heating 127.18 x 13.19 x 0.01 = 85.2 (24) Vater heating 127.18 x 13.19 x 0.01 = 16.77 (24) Vater heating charges 0.00 (25) 0.00 (25) fotal energy cost (240)(242) + (245)(254) = 220.71 (25) fotal energy cost (240)(242) + (245)(254) = 220.77 (25) fotal energy cost (240)(242) + (245)(254) = 220.77 (25) fotal energy cost (240)(242) + (245)(254) = 220.77 (25) fotal energy cost (240)(242) + (245)(254) = 0.07 (25) fotal energy cost (240)(242) + (245)(254) = 0.07 (25) fotal energy cost (26) 0.57 257 264 space hasting - main system 1 623.87 0.52 = 322.77 (26)	10a. Fuel costs - individual heating systems including micro-CHI	Þ					
page tending - main system 1 200 Additional standing charges 13.19 x fortal energy cost (240)(242) + (245)(254) = 220.95 x 13.19 x 0.01 = 65.77 Additional standing charges (240)(242) + (245)(254) = 220.91 (253) 11s. SAP rating - individual heating systems including micro-CHP 0.02 (246)(242) + (245)(254) = (255) Energy cost factor (ECF) 0.957 (257) 0.957 (257) SAP value 86.44 (258) 8 (258) SAP atoling (section 13) 86 (258) 8 (261)				Fuel price			_
values reading 13.19 x 10.00 (251) Total energy cost (240)(242) + (245)(254) = 220.71 (255) 0.67 (256) Total energy cost deflator (Table 12) 0.42 (256) 0.97 (257) Energy cost factor (ECF) 0.62 0.97 (257) SAP hald 85 258 85 258 85 258 85 258 85 258 85 258 85 258 85 258 86.44 264 264 264 264 264 264 264 264 264 264 262 266 262 266 266 266 266 266 <	Space heating - main system 1	623.87	x	13.19	x 0.01 = [82.29	(240)
comparison 250.95 x 13.19 x0.01 = 33.10 (230) Additional standing charges 0.00 (251) 0.00 (251) Goal energy cost (240)(242) + (245)(254) = 220.71 (255) 11.5 SAP rating - individual heating systems including micro-CHP 0.42 (256) Energy cost factor (ECF) 0.97 (257) AP rating (section 13) 86 (258) SAP rating (section 13) 86 (258) SAP and ing (section 13) 86 (258) Sapace heating - main system 1 671.33 0.52 = 222.72 (261) Space heating - main system 1 671.33 0.52 = 222.72 (261) Water heating (261) + (262) + (263) + (264) = 672.22 (265) (267) (267) Space and water heating (271.18 0.52 = 66.00 (267) Divelling CO, envision rate (272) + (41) = 130.20 (274) 88 (272) Ei value (272) + (41) = 130.20 (274) 88 (272) (274) 88 (272	Water heating	671.33	х	13.19	× 0.01 = [88.55	(247)
Lick Core, Michigang 0.00 [251] fortal energy cost (240)(242] + (245)(254] + 220.71 (255) 115: SAP rating - Individual heating systems including micro-CHP 0.42 (256) Energy cost deflator (Table 12) 0.42 (256) Energy cost deflator (Table 12) 0.42 (256) SAP value 86.44 88 SAP value 86.44 88 SAP and 8 8 122. CO; emissions - individual heating systems including micro-CHP Emission factor Emission factor Space heating - main system 1 623.87 x 0.52 = 323.79 (251) Space and water heating 671.33 x 0.52 = 323.79 (251) Pumps and fans 127.18 x 0.52 = 323.79 (251) Space and water heating (261) + (262) + (263) + (264) = 672.21 (255) Pumps and fans 127.18 x 0.52 = 130.24 (268) I vaide Energy Energy <td>Pumps and fans</td> <td>127.18</td> <td>x</td> <td>13.19</td> <td>x 0.01 = [</td> <td>16.77</td> <td>(249)</td>	Pumps and fans	127.18	x	13.19	x 0.01 = [16.77	(249)
Nature reating (240)(242] + (245)(254] + 220.71 (255) 11s. SAP rating-individual heating systems including micro-CHP 0.42 (256) Coreray cost deflator (Table 12) 0.42 (257) Coreray cost deflator (Table 12) 0.42 (258) Coreray cost factor (ECF) 0.97 (257) SAP value 86.44 (258) SAP band 8 (258) 12.2. CO; emissions - individual heating systems including micro-CHP Emission factor Emission factor Space heating - main system 1 623.87 x 0.52 = 323.79 (261) Space and water heating (261) + (262) + (263) + (264) = 672.21 (265) (267) Pumps and fans 127.18 x 0.52 = 130.24 (268) Space heating - main system 1 623.87 x 0.52 = 130.24 (268) Upweling CO, kg/year 0.52 = 130.24 (268) (272) (272) (41) (172.32 (273) Upweling CO, emission rate (272) (272) (41) (172.32 (273) <	Electricity for lighting	250.95	x	13.19	x 0.01 =	33.10	(250)
113: SAP rating - Individual heating systems including micro-CHP 0.42 (256) Energy cost deflator (Table 12) 0.42 (257) BAP value 86.44 88 SAP rating (section 13) 86 (258) SAP band 8 (258) 125: CO ₂ emissions - individual heating systems including micro-CHP Emission factor kg CO ₂ /kWh Emission factor kg CO ₂ /kWh Space heating - main system 1 623.87 0.52 323.79 (261) Water heating (261) + (262) + (263) + (264) = (262) (265) (267) Space heating - main system 1 623.87 0.52 323.79 (261) Space and water heating (261) + (262) + (263) + (264) = (262) (264) (267) Space and water heating (261) + (262) + (263) + (264) = (272) (265) Pumps and fans 127.18 x 0.52 30.24 (268) Electricity for lighting 250.95 x 0.52 (265) (272) Dowelling (Soction 14) 88 (274) 888.4 (274) El value Energy Primary Energy RWh/year	Additional standing charges				[0.00	(251)
Energy cost deflator (Table 12) 0.42 (256) Energy cost factor (ECF) 0.97 (257) SAP value 86.44 85 SAP rating (section 13) 86 (258) SAP and 86 (258) 120. C0, emissions - individual heating systems including micro-CHP Emission factor kg C0,//vear Emission factor kg C0,//vear Space heating - main system 1 623.87 × 0.52 = 323.79 (251) Water heating 671.33 × 0.52 = 323.79 (256) Space and water heating (251)+(262)+(263)+(264) = 672.21 (256) Pumps and fans 127.18 × 0.52 = 130.24 (268) C12 C0, kg/year (265)(271) = 868.46 (272) (272) (271) = 868.46 (272) Dwelling C10, kg/year (262)(271) = 868.46 (272) (265) (272) (272) (4) = (272) (272) (4) = (272) (272) (4) = (272) (272) (271) = 868.46 (272) (272) (272) (271) =	Total energy cost			(240)(242) +	(245)(254) = [220.71	(255)
Energy cost deflator (Table 12) 0.42 (256) Energy cost factor (ECF) 0.97 (257) SAP value 86.44 86.44 SAP rating (section 13) 86 (258) SAP and 86 8 120. CO, emissions - individual heating systems including micro-CHP Emission factor kg CO,/kwh Emission factor kg CO,/kwh Space heating - main system 1 623.87 × 0.52 323.79 (261) Water heating 671.33 × 0.52 323.79 (261) Space and water heating (261) + (262) + (263) + (264) = 672.21 (265) Pumps and fans 127.18 × 0.52 = 130.24 (268) Cotal CO _x , kg/year (265)(271) = 868.46 (272) (265)(271) = 868.46 (272) Dwelling CO _x emission rate (272) + (4) = 17.22 (273) 88 (274) 88 (274) 88 (274) 88 (274) 88 (274) 88 (274) 88 (274) 88 (274) 88 (274) 88 (274) 88 (274)	11a. SAP rating - individual heating systems including micro-CH	P					
Energy cost factor (ECF) 0.97 (257) SAP value 86.44 SAP rating (section 13) 86 (258) SAP band 8 (258) 120. CO ₂ emissions-individual heating systems including micro-CHP Emission factor Emissions Space heating - main system 1 623.87 × 0.52 = 323.79 (251) Space heating - main system 1 623.87 × 0.52 = 323.79 (261) Water heating (251)+(262)+(263)+(264) = 672.21 (265) (267) (265) (267) Pumps and fans 127.18 × 0.52 = 130.24 (268) Total CO ₂ , kg/year (265)(271) = 868.46 (272) (272) (4) = 17.23 (273) El value 88 (274) 88 (274) 88 (274) 13					[0.42	(256)
SAP value 86.44 SAP rating (section 13) 86 SAP band 85 120. CO, emissions - individual heating systems including micro-CMP Emergy kWh/year Emission factor kg CO_/kWh Emissions kg CO_/kear Space heating - main system 1 623.87 × 0.52 = 323.79 (261) Water heating 671.33 × 0.52 = 348.42 (264) Space and water heating (261) + (262) + (263) + (264) = 672.21 (265) Pumps and fans 127.18 × 0.52 = 130.24 (267) Electricity for lighting 250.95 × 0.52 = 130.24 (263) Doweling CO ₂ emission rate (272) + (4) = 172.23 (273) El value 88 (274) 88 (274) El band 88 (274) 88 (274) Space heating - main system 1 623.87 x 3.07 = 1915.29 (261) El value El rating (section 14) 88 (274) 88 (274) 88 (274) 88 <td></td> <td></td> <td></td> <td></td> <td>[</td> <td>0.97</td> <td>(257)</td>					[0.97	(257)
SAP rating (section 13) 86 (258) SAP band 123. CO2 emissions - individual heating systems including micro-CHP Emergy kWh/year Emission factor kg CO2/kWh Emissions kg CO2/kWh Space heating - main system 1 623.87 × 0.52 = 323.79 (261) Water heating 671.33 × 0.52 = 344.42 (264) Space and water heating (261) + (262) + (263) + (264) = 672.21 (265) Pumps and fans 127.18 × 0.52 = 302.42 (266) Pumps and fans 127.18 × 0.52 = 130.24 (268) Total CO2, kg/year (265)(271) = 868.46 (272) (268) Dwelling CO2 emission rate (272) + (4) = 172.3 (274) 88 (274) El value 88 (274) 88 (274) 88 (274) 88 (274) El band 623.87 x 3.07 = 1915.29 (261) 88 (274) Space heating - main system 1 623.87 x 3.07 = <					[86.44]
SAP band B 120. CO2 emissions - individual heating systems including micro-CHP Emission factor Emission factor Emissions Space heating - main system 1 623.87 × 0.52 = 323.79 (261) Water heating 671.33 × 0.52 = 348.42 (264) Space and water heating (261) + (262) + (263) + (264) = 672.21 (265) (267) Pumps and fans 127.18 × 0.52 = 130.24 (268) Pumps and fans 127.18 × 0.52 = 130.24 (268) Total CO2, kg/year (265)(271) = 868.46 (272) (265)(271) = 868.46 (272) Dwelling CO2 emission rate (265)(271) = 868.46 (272) (265)(271) = 868.46 (272) El value 88 (274) 88 (274) 88 (274) 88 (274) El band 88 (274) 88 (274) 88 (274) 88 (274) 88 (274) 88 (274) 88 (274) 88 <td></td> <td></td> <td></td> <td></td> <td>ĺ</td> <td>86</td> <td>(258)</td>					ĺ	86	(258)
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