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

RAMBOLL

KINGS CROSS METHODIST CHURCH
ENERGY STATEMENT

Revision	**02**
Date	**08/11/18**
Made by	**ZW/VO**
Checked by	**AS**
Approved by	**AS**
Description	**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 period[1].

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-an-application/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

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 stage of the Energy Hierarchy						
	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 Energy 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 CO_2 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 out-lined 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

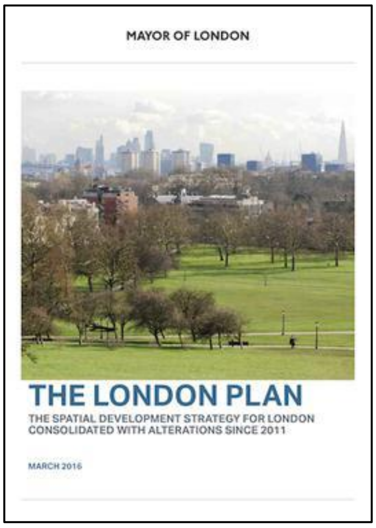


Figure 1 The London Plan March 2016

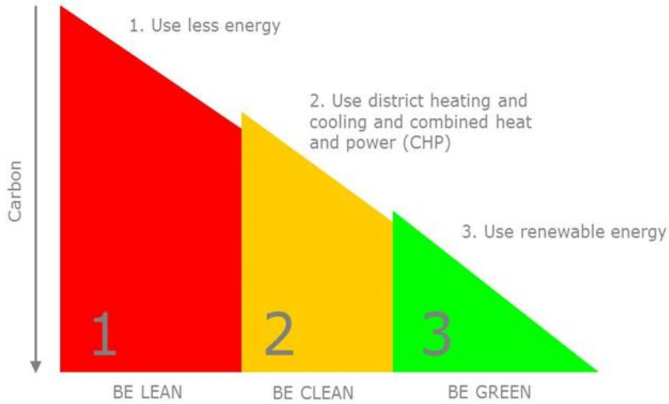


Figure 2: The London Plan Energy Hierarchy

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 Improvements	Non-domestic Building Improvements on 2010 Buildings Regulations
After 1st 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 CO_2 emissions for new residential and new non-domestic buildings, with the targets for individual buildings being differentiated according to building type. This reduction in CO_2 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 CO_2 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 m^2 of accommodation for the church and associated hostel and 825 m^2 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.

5. BASELINE EMISSIONS

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 CO_2/year

For the Commercial elements of the scheme, the 2013 Target Emissions Rate is the CO_2 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 CO_2/year.
The baseline emissions for the development as a whole are:

Baseline carbon emissions (Part L 2013) = 70.4 tCO_2/year

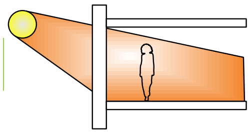
6. BE LEAN

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.

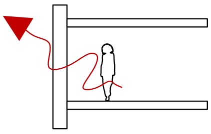
6.1 Minimising Demand

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:

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

WLMC - Domestic AND COMMERCIAL part of the development		
	Be lean	**Be Clean**
Opaque Elements		
Ground/Exposed/Basement Floor U-Value (W/m²K) Residential	0.13	
Ground/Exposed/Basement Floor U-Value (W/m²K) Commercial	0.10	
Roof U-Value (W/m²K)	0.13	
External Wall (W/m²K)	0.18	
Sheltered Wall (W/m²K)	0.18 (cavity Wall)	
Party Wall U-Value (W/m²K)	0 (fully fitted cavity with sealed edges)	
Thermal Mass Parameter	Medium	
Openings		
Window U-Value (W/m²K)	1.40	
Glazing g-Value	0.63 residential 0.4 Commercial	
Frame factor	0.8	
Other parameters	Metal frame windows, thermal break	
Flat entrance doors in corridors U-Value (W/m²K)	1	
External entrance doors U-Value (W/m²K)	-	
Overshading	Average/Unknown	
Thermal Bridging		
y-Value (W/m.K)	0.15 default	
Air Permeability		
Design Air Permeability (m³/m²h @ 50 Pa)	4.00 residential 3.00 commercial	

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.

Table 4 Systems Performance and control criteria

Space Type	Residential	Commercial
HVAC + Ventilation System	Combi boiler with radiators	Central gas boiler with underfloor heating -VRF cooling – natural ventilation where possible and mechanical ventilation heat recover for internal areas 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 windows 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 occupancy areas HR 76%
Local supply or extract SFP (W/l/s)	0.56	0.8
VRF Terminal Unit SFP (W/l/s)		0.3
Domestic Hot Water		
Generator Type	LTHW Boiler	Generator Type
DHW Delivery efficiency	n/a	90
Is this a storage system?	No	500l
Lighting	**Residential**	**Commercial**
Installed Power density(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

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 CO_2 emissions over the baseline case.

Be Lean carbon emissions (Part L 2013) = 59.1 tCO_2/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.

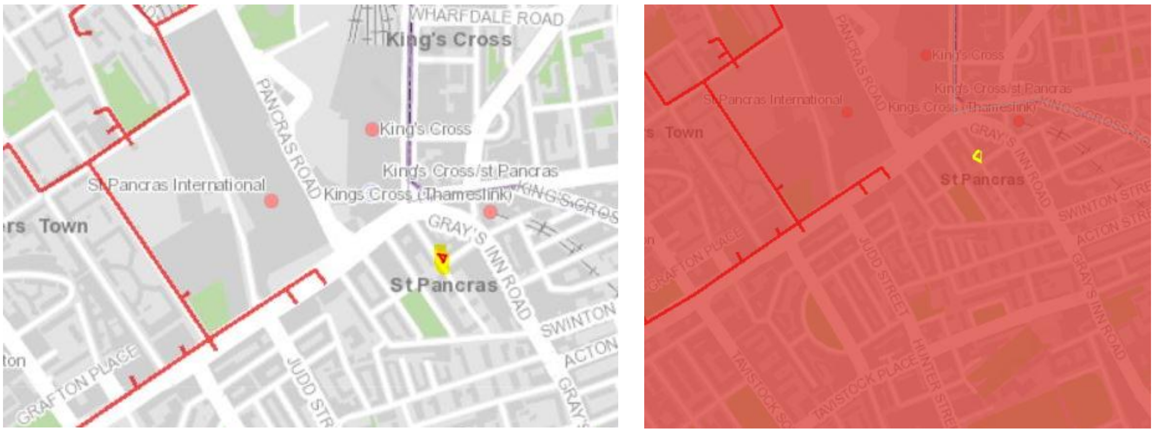


Figure 5: London Heat Map

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 tCO_2/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

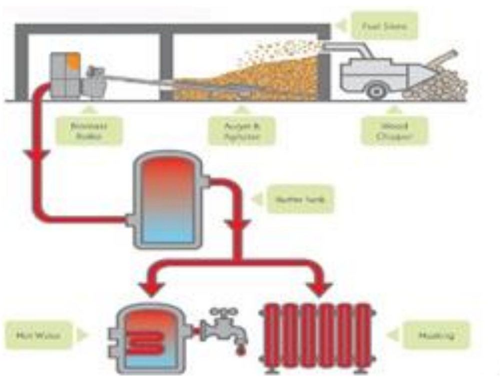


Figure 1: Biomass boiler system

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.

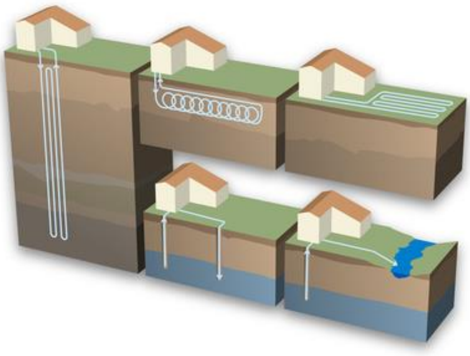


Figure 7: Example GSHP systems

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.

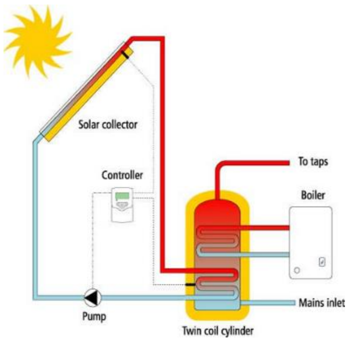


Figure 2: Typical Solar Collector System

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 tCO_2/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.

Table 5 – Assessed Unregulated Energy Use for the development.

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

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

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

Regulated Carbon Dioxide (tCO2/year)		
	CO_2 emissions (tCO_2/year)	**Accumulated CO_2 savings from Part L 2013 (%)**
Baseline (Part L 2013)	70.4	-
Be Lean	59.1	16.0
Be Clean	44.9	36.2
Be Green	44	37.5

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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

KXMC

As built

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 CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.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	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	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

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

* 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
m³/(h.m²) at 50 Pa	10	3

Building services

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

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

1- 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 boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

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

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

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
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

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
L0 - Refuse&Recycling	-	-	-	0.8	-	-	-	-	-	-	N/A
L0 - Storage 1	-	-	-	0.8	-	-	-	-	-	-	N/A
L0 - Storage 2	-	-	-	0.8	-	-	-	-	-	-	N/A
L0 - Vestry/Storage	-	-	-	0.8	-	-	-	-	-	-	N/A
L1 - Cleaners Store	-	-	-	0.8	-	-	-	-	-	-	N/A
L1 - F WC	-	-	-	0.8	-	-	-	-	-	-	N/A
L1 - M WC	-	-	-	0.8	-	-	-	-	-	-	N/A
L1 - Toilet SE	-	-	-	0.8	-	-	-	-	-	-	N/A
L2 - 01-Toilet	-	-	-	0.8	-	-	-	-	-	-	N/A
L2 - 02 Toilet	-	-	-	0.8	-	-	-	-	-	-	N/A
L2 - 03 Toilet	-	-	-	0.8	-	-	-	-	-	-	N/A
L2 - 04 Toilet	-	-	-	0.8	-	-	-	-	-	-	N/A
L2 - 05 Toilet	-	-	-	0.8	-	-	-	-	-	-	N/A
L2 - 06 Toilet	-	-	-	0.8	-	-	-	-	-	-	N/A
L2 - 07 Toilet	-	-	-	0.8	-	-	-	-	-	-	N/A
L2 - 08 Toilet	-	-	-	0.8	-	-	-	-	-	-	N/A
L2 - 09 Toilet	-	-	-	0.8	-	-	-	-	-	-	N/A
L2 - 10 Toilet	-	-	-	0.8	-	-	-	-	-	-	N/A
L2 - 11 Toilet	-	-	-	0.8	-	-	-	-	-	-	N/A
L2 - Cleaners cupboard	-	-	-	0.8	-	-	-	-	-	-	N/A
L2 - Storage	-	-	-	0.8	-	-	-	-	-	-	N/A
L3 - 12-Toilet	-	-	-	0.8	-	-	-	-	-	-	N/A
L3 - 13 Toilet	-	-	-	0.8	-	-	-	-	-	-	N/A
L3 - 14 Toilet	-	-	-	0.8	-	-	-	-	-	-	N/A
L3 - 15 Toilet	-	-	-	0.8	-	-	-	-	-	-	N/A
L3 - 16 Toilet	-	-	-	0.8	-	-	-	-	-	-	N/A
L3 - 17 Toilet	-	-	-	0.8	-	-	-	-	-	-	N/A
L3 - 18 Toilet	-	-	-	0.8	-	-	-	-	-	-	N/A
L3 - 19 Toilet	-	-	-	0.8	-	-	-	-	-	-	N/A
L3 - 20 Toilet	-	-	-	0.8	-	-	-	-	-	-	N/A
L4 - 21 - Toilet	-	-	-	0.8	-	-	-	-	-	-	N/A
L4 - 22 Bedroom	-	-	-	0.8	-	-	-	-	-	-	N/A
L4 - 22 - Toilet	-	-	-	0.8	-	-	-	-	-	-	N/A
L4 - 24 - Toilet	-	-	-	0.8	-	-	-	-	-	-	N/A
L4 - 25 - Toilet	-	-	-	0.8	-	-	-	-	-	-	N/A
L4 - 25 Toilet	-	-	-	0.8	-	-	-	-	-	-	N/A
L4 - Accessable WC	-	-	-	0.8	-	-	-	-	-	-	N/A
L4 - MCH Kitchen	-	-	-	0.8	-	-	-	-	-	-	N/A
L4 - Storage	-	-	-	0.8	-	-	-	-	-	-	N/A
L4 - Storage	-	-	-	0.8	-	-	-	-	-	-	N/A
LB - Charity use/Store	-	-	-	0.8	-	-	-	-	-	-	N/A
LB - Cleaners Cupboard	-	-	-	0.8	-	-	-	-	-	-	N/A
LB - Cycle storage	-	-	-	0.8	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
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	Luminous efficacy [lm/W]			
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	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
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

General lighting and display lighting	Luminous efficacy [lm/W]			
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	100	-	-	242
LB - Cleaners Cupboard	100	-	-	6
LB - Corridor 1	-	100	-	59
LB - Corridor 2	-	100	-	44
LB - Corridor 3	-	100	-	32
LB - Corridor 4	-	100	-	106
LB - Cycle storage	-	100	-	274
LB - Kitchen	-	100	-	293
LB - Kitchen Storage	100	-	-	8

General lighting and display lighting	Luminous efficacy [lm/W]			
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?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	2166.2	2166.2
External area [m²]	2878.2	2878.2
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	999.41	1321.7
Average U-value [W/m²K]	0.35	0.46
Alpha value* [%]	10.23	10

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

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
43	**C2 Residential Institutions: Universities and colleges**
	C2A Secure Residential Institutions
	Residential spaces
57	**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: 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 & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	124.42	142.65
Primary energy* [kWh/m²]	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.

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] 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 multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [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] 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

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Key Features

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

Building fabric

Element	U_{i-Typ}	U_{i-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

U_{i-Typ} = Typical individual element U-values [W/(m²K)]

U_{i-Min} = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

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

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

		Lean				Clean (Lean + Community heating and				Green (Lean + ASHP)			
	Area	TER	BER	TER	BER	TER	BER	TER	BER	TER	BER	TER	BER
	m2	kgCO2/m2/annum		Tonnes		kgCO2/m2/annum		Tonnes		kgCO2/m2/annum		Tonnes	
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
% Improvement BER/TER					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

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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 number	3635
Client		Last modified	20/08/2015
Address	Wardens King's Cross Methodist Church, London		

Check	Evidence	Produced by	OK?
Criterion 1: predicted carbon dioxide emission from proposed dwelling does not exceed the target			
TER (kg CO_2/m².a)	Fuel = N/A Fuel factor = 1.55 TER = 20.15	Authorised SAP Assessor	
DER for dwelling as designed (kg CO_2/m².a)	DER = 12.04	Authorised SAP Assessor	
Are emissions from dwelling as designed less than or equal to the target?	DER 12.04 < TER 20.15	Authorised SAP Assessor	Passed
Is the fabric energy efficiency of the dwellling as designed less than or equal to the target?	DFEE 26.63 < TFEE 32.05	Authorised SAP Assessor	Passed
Criterion 2: the performance of the building fabric and the heating, hot water and fixed lighting systems should be no worse than the design limits			
Fabric U-values			
Are all U-values better than the design limits in Table 2?	**Element / Weighted average / Highest** Wall 0.18 (max 0.30) 0.18 (max 0.70) Party wall 0.00 (max 0.20) N/A Floor (no floor) Roof (no roof) Openings 1.20 (max 2.00) 1.40 (max 3.30)	Authorised SAP Assessor	Passed
Thermal bridging			
How has the loss from thermal bridges been calculated?	Thermal bridging calculated from linear thermal transmittances for each junction	Authorised SAP Assessor	
Heating and hot water systems			
Does the efficiency of the heating systems meet the minimum value set out in the Domestic Heating Compliance Guide?	Main heating system: Heat pump - wet system from database, Electricity NIBE F370 Secondary heating system: None	Authorised SAP Assessor	
Does the insulation of the hot water cylinder meet the standards set out in the Domestic Heating Compliance Guide?	No hot water cylinder	Authorised SAP Assessor	
Do controls meet the minimum controls provision set out in the Domestic Heating Compliance Guide?	Space heating control: Time and temperature zone control - plumbing circuit Hot water control: No hot water cylinder Boiler interlock (main system 1)	Authorised SAP Assessor	Passed

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% Minimum = 75 %	Authorised SAP Assessor	Passed
Criterion 3: the dwelling has appropriate 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 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 = 0.62 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 $0.2W/m^2K$: • Wall access (0.00) • Wall party (0.00) The following openings have a U-value less than $1.2W/m^2K$: • Solid door reference 7 (0.00)	Authorised SAP Assessor	

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Peter Mitchell	Assessor number	3635
Client		Last modified	20/08/2015
Address	Wardens King's Cross Methodist Church, London		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		89.10	(1a)	x	2.50	(2a)	=	222.75	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	89.10	(4)						
Dwelling volume							(3a) + (3b) + (3c) + (3d)...(3n) =	222.75	(5)

2. Ventilation rate

				m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.20	(18)
Number of sides on which the dwelling is sheltered		3	(19)
Shelter factor	1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.16	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table 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 (allowing for shelter and wind factor) (21) x (22a)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	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
c) whole house extract ventilation or positive input ventilation from outside	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(24c)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			11.05	x	1.33	=	14.65			(27)
Door			1.89	x	0.00	=	0.00			(26)
Party wall			106.91	x	0.00	=	0.00			(32)
External wall			28.25	x	0.18	=	5.09			(29a)
Total area of external elements ∑A, m²			41.19							(31)
Fabric heat loss, W/K = ∑(A × U)								(26)...(30) + (32) =	19.73	(33)
Heat capacity Cm = ∑(A x κ)								(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K									250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K									6.93	(36)
Total fabric heat loss								(33) + (36) =	26.67	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 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 coefficient, W/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	
Average = ∑(39)1...12/12 =												63.42	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	
Average = ∑(40)1...12/12 =												0.71	(40)
Number of days in month (Table 1a)	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 heating energy requirement

Assumed occupancy, N	2.61 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	96.26 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	105.89	102.04	98.19	94.34	90.49	86.64	86.64	90.49	94.34	98.19	102.04	105.89	
∑(44)1...12 =												1155.16	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	157.03	137.34	141.72	123.56	118.56	102.31	94.80	108.79	110.08	128.29	140.04	152.08	
∑(45)1...12 =												1514.60	(45)
Distribution loss 0.15 x (45)m	23.55	20.60	21.26	18.53	17.78	15.35	14.22	16.32	16.51	19.24	21.01	22.81	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	170.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	1.56 (48)
Temperature factor from Table 2b	0.54 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.84 (50)
Enter (50) or (54) in (55)	0.84 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	26.11	23.59	26.11	25.27	26.11	25.27	26.11	26.11	25.27	26.11	25.27	26.11	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	26.11	23.59	26.11	25.27	26.11	25.27	26.11	26.11	25.27	26.11	25.27	26.11	(57)

Primary circuit loss for each month from Table 3

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 3c

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 required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

183.15	160.93	167.84	148.83	144.67	127.58	120.92	134.90	135.36	154.41	165.31	178.19	(62)

Solar DHW input calculated using Appendix G or Appendix H

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 water heater for each month (kWh/month) (62)m + (63)m

183.15	160.93	167.84	148.83	144.67	127.58	120.92	134.90	135.36	154.41	165.31	178.19	
									∑(64)1...12 =		1822.08	(64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

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 gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	156.79	156.79	156.79	156.79	156.79	156.79	156.79	156.79	156.79	156.79	156.79	156.79	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	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 gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	354.35	358.02	348.76	329.03	304.13	280.73	265.09	261.42	270.68	290.41	315.31	338.71	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	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 gains (Table 5a)	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. evaporation (Table 5)	-104.53	-104.53	-104.53	-104.53	-104.53	-104.53	-104.53	-104.53	-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 gains (66)m + (67)m + (68)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)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	3.40	x	36.79	x 0.9 x	0.63	x	0.80	=	43.69	(79)
NorthEast	0.54	x	7.65	x	11.28	x 0.9 x	0.63	x	0.80	=	21.14	(75)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains in watts ∑(74)m...(82)m	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)
Total gains - internal and solar (73)m + (83)m	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)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see 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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	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 heating periods in the rest of dwelling from Table 9, Th2(°C)	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 for rest of dwelling η2,m	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 temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	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 — Living area ÷ (4) = 0.38 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	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 mean internal temperature from Table 4e where appropriate	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)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	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, ηmGm, 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 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 internal temperature, Lm, W [(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, kWh/month 0.024 x [(97)m - (95)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	

∑(98)1...5, 10...12 = 1246.28 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 13.99 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)		0.00	(201)
Fraction of space heat from main system(s)	1 - (201) =	1.00	(202)
Fraction of space heat from main system 2		0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)		298.74	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month	96.42	69.61	47.92	17.44	3.16	0.00	0.00	0.00	0.00	18.18	60.43	104.03

∑(211)1...5, 10...12 = 417.19 (211)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Efficiency of water heater	220.69	220.69	220.69	220.69	220.69	220.69	220.69	220.69	220.69	220.69	220.69	220.69	(217)
Water heating fuel, kWh/month	82.99	72.92	76.05	67.44	65.56	57.81	54.79	61.13	61.33	69.97	74.91	80.74	

∑(219a)1...12 = 825.65 (219)

Annual totals

Space heating fuel - main system 1 — 417.19

Water heating fuel				825.65	
Electricity for pumps, fans and electric keep-hot (Table 4f)					
mechanical ventilation fans - balanced, extract or positive input from outside		144.73			(230a)
Total electricity for the above, kWh/year				144.73	(231)
Electricity for lighting (Appendix L)				412.76	(232)
Total delivered energy for all uses			(211)...(221) + (231) + (232)...(237b) =	1800.32	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	417.19	x	13.19	x 0.01 =	55.03	(240)
Water heating	825.65	x	13.19	x 0.01 =	108.90	(247)
Pumps and fans	144.73	x	13.19	x 0.01 =	19.09	(249)
Electricity for lighting	412.76	x	13.19	x 0.01 =	54.44	(250)
Additional standing charges					0.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		237.46	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	0.74	(257)
SAP value	89.62	
SAP rating (section 13)	90	(258)
SAP band	B	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	417.19	x	0.52	=	216.52	(261)
Water heating	825.65	x	0.52	=	428.51	(264)
Space and water heating			(261) + (262) + (263) + (264) =		645.03	(265)
Pumps and fans	144.73	x	0.52	=	75.11	(267)
Electricity for lighting	412.76	x	0.52	=	214.22	(268)
Total CO_2, kg/year				(265)...(271) =	934.37	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	10.49	(273)
EI value					90.66	
EI rating (section 14)					91	(274)
EI band					B	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	417.19	x	3.07	=	1280.76	(261)
Water heating	825.65	x	3.07	=	2534.73	(264)
Space and water heating			(261) + (262) + (263) + (264) =		3815.49	(265)
Pumps and fans	144.73	x	3.07	=	444.31	(267)
Electricity for lighting	412.76	x	3.07	=	1267.18	(268)
Primary energy kWh/year					5526.98	(272)
Dwelling primary energy rate kWh/m2/year					62.03	(273)

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 number	3635
Client		Last modified	20/08/2015
Address	R3.2 King's Cross Methodist Church, London		

Check	Evidence	Produced by	OK?
Criterion 1: predicted carbon dioxide emission from proposed dwelling does not exceed the target			
TER (kg CO_2/m^2.a)	Fuel = N/A Fuel factor = 1.55 TER = 29.88	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 than or equal to the target?	DFEE 43.85 < TFEE 50.54	Authorised SAP Assessor	Passed
Criterion 2: the performance of the building fabric and the heating, hot water and fixed lighting systems should be no worse than the design limits			
Fabric U-values			
Are all U-values better than the design limits in Table 2?	**Element** / **Weighted average** / **Highest** Wall: 0.18 (max 0.30) / 0.18 (max 0.70) Party wall: 0.00 (max 0.20) / N/A Floor: (no floor) Roof: 0.13 (max 0.20) / 0.13 (max 0.35) Openings: 1.31 (max 2.00) / 1.40 (max 3.30)	Authorised SAP Assessor	Passed
Thermal bridging			
How has the loss from thermal bridges been calculated?	Thermal bridging calculated from linear thermal transmittances for each junction	Authorised SAP Assessor	
Heating and hot water systems			
Does the efficiency of the heating systems meet the minimum value set out in the Domestic Heating Compliance Guide?	Main heating system: Heat pump - wet system from database, Electricity NIBE F370 Secondary heating system: None	Authorised SAP Assessor	
Does the insulation of the hot water cylinder meet the standards set out in the Domestic Heating Compliance Guide?	No hot water cylinder	Authorised SAP Assessor	
Do controls meet the minimum controls provision set out in the Domestic Heating Compliance Guide?	Space heating control: Time and temperature zone control - plumbing circuit Hot water control: No hot water cylinder Boiler interlock (main system 1)	Authorised SAP Assessor	Passed

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% Minimum = 75 %	Authorised SAP Assessor	Passed
Criterion 3: the dwelling has appropriate 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 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 $0.2W/m^2K$: • Wall party (0.00) The following openings have a U-value less than $1.2W/m^2K$: • Solid door reference 6 (1.00)	Authorised SAP Assessor	

SAP Worksheet
Design - Draft

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01202 280062

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Peter Mitchell	Assessor number	3635
Client		Last modified	20/08/2015
Address	R3.2 King's Cross Methodist Church, London		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		50.40	(1a)	x	2.90	(2a)	=	146.16	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.40	(4)						
Dwelling volume							(3a) + (3b) + (3c) + (3d)...(3n) =	146.16	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	0	x 10 =	0	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.20	(18)
Number of sides on which the dwelling is sheltered		3	(19)
Shelter factor	1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.16	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table 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 (allowing for shelter and wind factor) (21) x (22a)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	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
c) whole house extract ventilation or positive input ventilation from outside	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	(24c)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			6.74	x	1.33	=	8.94			(27)
Door			1.89	x	1.00	=	1.89			(26)
External wall			21.17	x	0.18	=	3.81			(29a)
Party wall			51.40	x	0.00	=	0.00			(32)
Roof			52.40	x	0.13	=	6.81			(30)
Total area of external elements ∑A, m²			82.20							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	21.45	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		6.63	(36)
Total fabric heat loss	(33) + (36) =	28.08	(37)

	Jan	Feb	Mar	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	27.59	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	55.67	55.67	55.67	55.67	55.67	55.67	55.67	55.67	55.67	55.67	
Heat loss parameter (HLP), W/m²K (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	
Number of days in month (Table 1a)	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)

Heat transfer coefficient: Average = ∑(39)1...12/12 = 55.67 (39)

Heat loss parameter: Average = ∑(40)1...12/12 = 1.10 (40)

4. Water heating energy requirement

Assumed occupancy, N	1.70	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	74.62	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	82.08	79.10	76.11	73.13	70.14	67.16	67.16	70.14	73.13	76.11	79.10	82.08	
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	121.72	106.46	109.86	95.78	91.90	79.30	73.49	84.33	85.33	99.45	108.56	117.88	
Distribution loss 0.15 x (45)m	18.26	15.97	16.48	14.37	13.79	11.90	11.02	12.65	12.80	14.92	16.28	17.68	(46)

Hot water usage: ∑(44)1...12 = 895.44 (44)

Energy content: ∑(45)1...12 = 1174.06 (45)

Storage volume (litres) including any solar or WWHRS storage within same vessel	170.00	(47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)	1.56	(48)
Temperature factor from Table 2b	0.54	(49)
Energy lost from water storage (kWh/day) (48) x (49)	0.84	(50)
Enter (50) or (54) in (55)	0.84	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	26.11	23.59	26.11	25.27	26.11	25.27	26.11	26.11	25.27	26.11	25.27	26.11	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	26.11	23.59	26.11	25.27	26.11	25.27	26.11	26.11	25.27	26.11	25.27	26.11	(57)

Primary circuit loss for each month from Table 3

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 3c

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 required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

147.84	130.05	135.97	121.05	118.01	104.58	99.60	110.44	110.61	125.56	133.83	144.00	(62)

Solar DHW input calculated using Appendix G or Appendix H

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 water heater for each month (kWh/month) (62)m + (63)m

147.84	130.05	135.97	121.05	118.01	104.58	99.60	110.44	110.61	125.56	133.83	144.00	

∑(64)1...12 = 1481.53 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

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)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	102.11	102.11	102.11	102.11	102.11	102.11	102.11	102.11	102.11	102.11	102.11	102.11	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	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 (calculated in Appendix L, equation L13 or L13a), also see Table 5	221.30	223.60	217.81	205.49	189.94	175.32	165.56	163.26	169.05	181.37	196.92	211.54	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	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)
Pump and fan gains (Table 5a)	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. evaporation (Table 5)	-68.08	-68.08	-68.08	-68.08	-68.08	-68.08	-68.08	-68.08	-68.08	-68.08	-68.08	-68.08	(71)
Water heating gains (Table 5)	54.40	52.68	49.10	44.23	41.07	36.62	32.84	37.69	39.41	44.44	50.13	52.68	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	392.18	388.78	373.52	350.10	326.48	305.16	292.60	299.12	312.52	336.11	362.25	381.68	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
NorthEast	0.77	x	3.51	x	11.28	x 0.9 x	0.63	x	0.80	=	13.83	(75)
NorthEast	0.54	x	1.43	x	11.28	x 0.9 x	0.63	x	0.80	=	3.95	(75)
SouthWest	0.54	x	1.80	x	36.79	x 0.9 x	0.63	x	0.80	=	16.22	(79)

Solar gains in watts ∑(74)m...(82)m

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)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Utilisation factor for gains for living area n1,m (see Table 9a)

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 living 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 heating periods in the rest of dwelling from Table 9, Th2(°C)

20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	(88)

Utilisation factor for gains 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 temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 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 — Living area ÷ (4) = 0.45 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

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 internal temperature from Table 4e where appropriate

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)

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Utilisation factor for gains, ηm

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, ηmGm, W (94)m x (84)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)

Monthly average external temperature from Table 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 internal temperature, 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 requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

355.08	282.46	234.42	128.31	48.19	0.00	0.00	0.00	0.00	122.65	249.70	370.47

∑(98)1...5, 10...12 = 1791.29 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 35.54 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)		0.00	(201)
Fraction of space heat from main system(s)	1 - (201) =	1.00	(202)
Fraction of space heat from main system 2		0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)		287.12	(206)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Space heating fuel (main system 1), kWh/month

123.67	98.38	81.64	44.69	16.78	0.00	0.00	0.00	0.00	42.72	86.97	129.03

∑(211)1...5, 10...12 = 623.87 (211)

Water heating

Efficiency of water heater

220.69	220.69	220.69	220.69	220.69	220.69	220.69	220.69	220.69	220.69	220.69	220.69	(217)

Water heating fuel, kWh/month

66.99	58.93	61.61	54.85	53.48	47.39	45.13	50.04	50.12	56.90	60.64	65.25

∑(219a)1...12 = 671.33 (219)

Annual totals

Space heating fuel - main system 1			623.87	
Water heating fuel			671.33	
Electricity for pumps, fans and electric keep-hot (Table 4f)				
mechanical ventilation fans - balanced, extract or positive input from outside	127.18			(230a)
Total electricity for the above, kWh/year			127.18	(231)
Electricity for lighting (Appendix L)			250.95	(232)
Total delivered energy for all uses		(211)...(221) + (231) + (232)...(237b) =	1673.33	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	623.87	x	13.19	x 0.01 =	82.29	(240)
Water heating	671.33	x	13.19	x 0.01 =	88.55	(247)
Pumps and fans	127.18	x	13.19	x 0.01 =	16.77	(249)
Electricity for lighting	250.95	x	13.19	x 0.01 =	33.10	(250)
Additional standing charges					0.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		220.71	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	0.97	(257)
SAP value	86.44	
SAP rating (section 13)	86	(258)
SAP band	B	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	623.87	x	0.52	=	323.79	(261)
Water heating	671.33	x	0.52	=	348.42	(264)
Space and water heating			(261) + (262) + (263) + (264) =		672.21	(265)
Pumps and fans	127.18	x	0.52	=	66.00	(267)
Electricity for lighting	250.95	x	0.52	=	130.24	(268)
Total CO_2, kg/year				(265)...(271) =	868.46	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	17.23	(273)
EI value					87.80	
EI rating (section 14)					88	(274)
EI band					B	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	623.87	x	3.07	=	1915.29	(261)
Water heating	671.33	x	3.07	=	2061.00	(264)
Space and water heating			(261) + (262) + (263) + (264) =		3976.28	(265)
Pumps and fans	127.18	x	3.07	=	390.43	(267)
Electricity for lighting	250.95	x	3.07	=	770.41	(268)
Primary energy kWh/year					5137.12	(272)
Dwelling primary energy rate kWh/m2/year					101.93	(273)