QODA

Perry Road, Harlow, Essex, CM18 7LT

Energy Statement

LN1040-QODA-XX-XX-RP-YS-0002-01

Revision Summary

Issue	Document prepared			Document checked		
	Name	Signature	Date	Name	Signature	Date
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QODA

Contents

QODA

1 Executive Summary

This Energy Statement has been prepared by QODA Consulting as part of the of the planning application for the proposed residential development at Perry Road, Harlow, Essex, CM18 7LT. This is a development by Harlow District Council, to provide residential units in the form of construction of 24 flats with a total GIA of 1763.00 m^2.

The Harlow Local Development Plan Adopted December 2020 set out sustainability requirements for residential developments. The key policy is Policy PL03 Sustainable Design, Construction and Energy Usage which encourages new-build residential developments to follow the energy hierarchy and to achieve a minimum of 19% carbon reduction over building regulations baseline.

This report shows how the reduction of energy consumption has been considered by reducing CO_2 emissions following be lean, be clean, be green energy hierarchy. In this case overall 64% reduction is achieved on site. A Standard Assessment Procedure (SAP) calculation and a BRUKL calculation has been performed to calculate the development's expected carbon emissions against the Approved Document L baseline, following the Part L 2021 methodology and GLA Guidance 2022.

The excellent energy performance of the proposed residential development is mainly driven by the following key factors based on the fabric first approach methodology:

- High levels of insulation.
- Airtight construction.
- Energy efficient building services and controls.
- Mechanical ventilation with heat recovery
- The inclusion of low or zero carbon technology (LZCT) in the form of external air source hot water tanks for domestic hot water generation in flats. Localised VRF system to provide heating and cooling in the commercial space. PV panels to generate electricity for commercial space.

Results show that 64% carbon reduction for the domestic development compared to the baseline case, which for domestic areas exceeds the requirements set by the Adopted Local Plan and represents a high-performance and low-carbon development.

Table 1-1 Domestic carbon reduction from proposed measures

	Carbon Emissions (tonnes CO_2/yr)	
	Baseline	Proposed
Domestic Carbon Emissions	24.2	8.7
% Saving over baseline		64 %

2 Introduction

The report demonstrates how the proposed design is in accordance with relevant national, regional and local planning policies in terms of energy and carbon reductions. It has been produced to document the steps taken to reduce the energy consumption and associated carbon emissions relating to the development. Improvement measures identified in this report relate to the architectural design and construction of the development as well as the proposed building services.

In addition to low carbon design, all proposals for the scheme have been considered with respect to their in-use operation and the effect they may have to users operating and maintaining the building.

2.1 Aims and Objectives

The purpose of this energy statement is to demonstrate that the Proposed Development incorporates climate change mitigation measures in order to comply with applicable energy policies set out below.

This report aims to:

- Address the planning requirements associated with energy in Policy PL 03 Sustainable Design. Construction, and Energy Usage.
- Provide information relating to the detailed energy assessment for residential areas.
- Demonstrate that the "Be Lean, Be Clean, Be Green" energy hierarchy has been followed.
- The report also shows compliance with Part O Overheating.

2.2 Site Context

The site is situated in Harlow at the intersection of Southern Way and Perry Road, adjacent to the Staple Tye shopping centre. On the other side of the Perry Road development, there is the planned Staple Tye residential project, while to the east (across the cycle lane) lies the Risden's residential area. Further east is the A1169 Southern Way, a key route in Harlow that links to the A41 and M11 to the east. South of the site is the Staple Tye Mews.

The development consists of a 5-storey apartment block with a commercial unit on the ground floor.

Table 2-1 Type and number of properties in the Proposed Development

Property Type	Units
Flats	24
Development Total	24

Figure 2-1 Proposed Site plan

3 Planning Policy Requirements

The Proposed Development will be designed in line with current national, regional, and local policy. The policies that have been considered for this energy assessment include National Planning Policy Framework 2021; The Harlow Local Development Plan Adopted December 2020; Harlow Design Guide (SPD) Adopted October 2011 and the Energy Assessment Guidance by GLA – 2022.

3.1 National Planning Policy Framework (2021)

The National Planning Policy Framework sets out the Government's planning policies for England and how these should be applied. It provides a framework within which locally prepared plans for housing and other development can be produced. At the heart of the NPPF is a presumption in favour of sustainable development. Achieving sustainable development means that the planning system has three overarching objectives, which are interdependent and need to be pursued in mutually supportive ways (so that opportunities can be taken to secure net gains across each of the different objectives).

An economic objective – to help build a strong, responsive, and competitive economy, by ensuring that sufficient land of the right type is available in the right places and at the right time to support growth, innovation and improved productivity; by identifying and coordinating the provision of infrastructure.

A social objective – to support strong, vibrant, and healthy communities, by ensuring that a sufficient number and range of homes can be provided to meet the needs of present and future generations: To foster a well-designed and safe built environment, with accessible services and open spaces that reflect current and future needs and support communities' health, social and cultural well-being.

An environmental objective – to contribute to protecting and enhancing our natural, built and historic environment; including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimising waste and pollution and mitigating and adapting to climate change, including moving to a low carbon economy.

3.2 Harlow Local Development Plan Adopted December 2020

Policy PL3 Sustainable Design, Construction and Energy Usage

New development will be expected to deliver high standards of sustainable design and construction and efficient energy usage, taking account of predicted changes to heating and cooling requirements as a result of climate change.

13.18 The Building Regulations set out the minimum requirements for the conservation of fuel and power. Development will be encouraged to exceed the minimum standards required by Building Regulations. Where exceeded, the amount by which the minimum standards should be exceeded is preferably at least 19%. The Council supports development that follows the principles of sustainable construction and encourages developers to deliver schemes which adopt a fabric-first approach to development and meet the performance and quality set by appropriate standards, such as Passivhaus, Home Quality Mark (HQM) and BREEAM UK New Construction 2018.

13.19 Development proposals must demonstrate how the reduction of energy consumption and carbon dioxide emissions is being considered. The wellbeing of building occupants must also be addressed within the design and layout, by minimising risks of overheating and providing adequate daylight and ventilation.

13.20 Where a low-carbon district heating scheme is proposed, the Council will expect the scheme to demonstrate that any proposed heating and cooling systems have been selected in line with the following order of preference:

(a) if possible, connection with heat distribution networks which exist at the time.

(b) site-wide heat network fuelled by renewable energy sources.

(c) communal network fuelled by renewable energy sources.

(d) individual Air Source Heat Pump.

Details of the base case and performance against this criterion mentioned in 13.8 are detailed within later sections of the report.

3.3 Energy Assessment Guidance June 2022 by GLA

The guidance document explains how to prepare an energy assessment to accompany strategic planning applications referred to the Mayor, as set out in London Plan. It is for anyone involved in, or with an interest in developing energy assessments including developers, energy consultants and local government officials. Although primarily aimed at strategic planning applications, Local boroughs in England are encouraged to apply the same structure for energy assessments related to non-referable applications and adapt it for relevant scales of development.

The guidance explains how the energy assessment should be carried out to achieve compliance with policies using energy hierarchy. It provides detailed guidance on the following:

- Requirements for different types of planning application.
- Integration with other supporting documents for planning applications.
- Structure and contents of the energy assessment.
- Usage of carbon emission factors for reporting CO_2 emissions.
- The methodology for establishing CO_2 emissions for the development.
- Application of Be Lean, Be Clean and Be Green measures and associated calculations.
- Evaluation and mitigation of overheating and reducing active cooling requirements.
- Managing peak demand and incorporate energy flexibility into developments.

3.4 Climate Crisis

The Proposed Development comes at a time when there is international consensus on the effects of human-made carbon emissions on the global climate. The International Panel for Climate Change (IPCC) in their 2018 and 2022 reports have identified the effects on the planet of various climate change scenarios.

It is now widely accepted that a 1.5degC rise in global average temperatures is a 'least bad' limit to global warming, although this will still result in significant impacts to humans and the natural environment. To avoid exceeding the 1.5degC temperature rise, global climate emissions must stop increasing by around 2030, and become zero by 2050.

Currently, around 40% of the UK's carbon emissions come from the built environment, and there is a responsibility on designers to develop buildings with drastically lower carbon emissions.

4 Energy and Carbon Strategy

4.1 General Approach

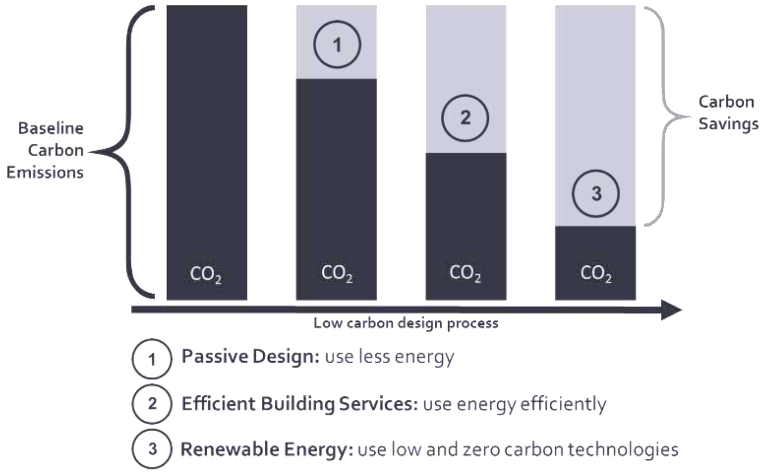
The energy strategy for the site can be summarised as:

- Efficient passive design utilising high levels of insulation to minimise heat losses.
- Airtight construction to minimise heat losses via air infiltration.
- Mechanical ventilation with heat recovery
- Direct electric panel radiators to provide space heating in flats.
- Energy efficient building services and controls.
- Instantaneous electric hot water for the commercial space.
- The inclusion of low or zero carbon technology (LZCT) in the form of external air source hot water tanks for domestic hot water generation in flats. Localised VRF system to provide heating and cooling in the commercial space. PV panels to generate electricity for commercial space.

Passive Design

A 'fabric first' approach has been taken, with the aim of reducing the buildings energy demands through a high performing building envelope. The key point is that such measures are extremely difficult to implement later.

Figure 4-1 Energy Hierarchy



Efficient Building Services

Heat, ventilation, and light will be provided efficiently through appropriate selection of products, good design practices and controls. Minimising distribution and storage losses from space heat and hot water systems is a significant element of this, particularly for a multi-residential scheme. Technologies such as LED lighting, and mechanical ventilation with heat recovery will be adopted as part of the design.

Renewable Energy

The final stage of carbon reduction is to utilise renewable energy (or low carbon) technology which supplies heat or power from a low (or zero) carbon source. It is far easier to retrofit such technologies compared to building envelope measures. In the context of Perry Road this takes the form of an external air hot water tank for domestic hot water generation in flats and an VRF system for heating and cooling for the commercial space. Additionally, PV panels will be installed to generate electricity on site to cater to the commercial space.

5 Proposed Design Specification

5.1 Building Fabric

The table below outlines target U-values and air permeability compared to the minimum standards required by Part L1 2021.

Table 5-1 : Proposed fabric standards compared to minimum Part L 2021 standards

Building Fabric	Minimum Standard Domestic (Building Regs 2021)	Targeted Standard Flats	Targeted Standard Commercial Space
External Walls	0.26 W/m².K L1/L2	0.18 W/m².K	0.14 W/m².K
Roofs	0.16 W/m².K L1 0.18 W/m².K L2	0.10 W/m².K	0.14 W/m².K
Ground Floors	0.18 W/m².K L1/L2	0.12 W/m².K	0.13 W/m².K
External Glazing	1.60 W/m².K L1/L2	1.20 W/m².K	1.40 W/m².K
Air Permeability	Minimum Standard	Targeted Standard (Domestic)	Targeted Standard (Commercial Space)
Airtightness Standard	8 m³/h.m² @50Pa L1/L2	3 m³/h.m² @50Pa	5 m³/h.m² @50Pa

5.2 Building Services

The building services strategy has been based on the following key elements:

Flats:

- Direct electric panel radiators for space heating.
- Domestic hot water is to be provided via external air source hot water tank.
- Mechanical ventilation with heat recovery.
- LED Lighting throughout.

Commercial space:

- Space heating and cooling via a VRF system.
- Mechanical ventilation with heat recovery.
- LED Lighting throughout.
- Instantaneous direct electric hot water.
- PV panels to generate electricity on site.

5.3 Building Energy Systems Summary

The table below provides a summary of the proposed building specification for all the units which have been modelled in SAP and IESVE for energy and carbon calculations.

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Table 5-2 Proposed building fabric and services specification for residential units and the commercial space

Perry Road	Flats	Commercial Space
Fabric Specification		
External wall U-value	0.18 W/m²K	0.14 W/m²K
Roof U-value	0.10 W/m²K	0.14 W/m²K
Ground Floor U-value	0.12 W/m²K	0.13 W/m²K
Glazing	U-Value = 1.20 W/m²K (Double glazing, argon filled, low-e coating)	U-Value = 1.40 W/m²K (Double glazing, argon filled, low-e coating)
	g-value 0.42	g-value 0.40
Door U-value	1.0 W/m²K	1.0 W/m²K
Thermal Mass Parameter	Medium Thermal Mass Construction	Medium Thermal Mass Construction
Thermal Bridging Y-value target	FHH recognised construction details	Y = 0.08
Building Air Permeability		
Air-tightness standard	3 m³/h.m² @50Pa	5 m³/h.m² @50Pa
Space Heating and Hot water		
Heating System	Direct Electric Panel Heaters	VRF (COP 5.5)
Heating Controls	7 Day Programmer	7 Day Programmer
DHW System	External Air Hot Water Tank	Instantaneous direct electric point of use
	Cylinder in heated space	
	Heat Loss 1.61 kWh/24hr	
	COP 3.19	
	Cylinder with stat	
Cylinder Volume	200l	-
Cylinder Insulation	80mm, factory insulated	-
Pipework Insulation	Fully insulated primary network	Fully insulated primary network
Cooling	N/A	VRF (COP 9.2)
Ventilation		
System Type	MVHR	MVHR
Heat Recovery %	85%	80%
Specific Fan Power	0.97 W/l/s	1.8 W/l/s
Lighting		
% energy efficient LED lighting	100%	100%
PV		
Number of Panels	-	3 (390W)

6 Energy and Carbon Analysis

A SAP and BRUKL assessment has been conducted to calculate the development's performance in terms of energy demand and carbon emissions. The Elmhurst SAP software and IESVE 2022 has been used for this assessment, following the SAP 10.2 and NCM 2022 assessment procedure together with the proposed building specifications from Table 5-2.

6.1 Calculation Methodology

6.1.1 Carbon Factors

SAP 10.2 was published by BRE in December 2021. The SAP 10.2 carbon factors were produced by the government to be a closer representation of the carbon intensity of the grid today. The factors are also published in the GLA Energy Assessment Guidance 2022.

Table 6-1 SAP 10.2 carbon factor

	SAP 10.2 ($kgCO_2/kWh$)
Natural Gas	0.210
Grid Electricity	0.136

6.1.2 Base Case - Domestic

The Adopted Local Plan urges that a new residential development should reduce at least 19% of carbon emissions against a building regulations compliant base case. In the Part L methodology, the carbon emissions reduction is calculated against the "notional building", which consists of a standard specification for fabric, lighting etc, but more crucially, matches the proposed building in terms of heating and ventilation systems. While this may be appropriate for standardising compliance with building regulations, it is problematic for assessing real building performance as the 'goal posts' are effectively moved when the designer seeks to implement low energy systems in the building. One consequence of this is that it can often be easier to achieve a % carbon reduction using inferior systems (in carbon terms), because these may offer a greater margin for improvement than low carbon systems. The actual building's carbon emissions, in absolute terms, would be much higher.

The GLA's London Plan recognises this fact, and, for example, requires that a separate "baseline" model should be created which incorporates gas boilers and no renewable energy systems. This means that alternative heating systems such as heat pumps are then rightly compared against a true 'minimum' standard. Following this approach, the baseline specification has been based on the Approved Document L1 Notional standard (2021), of a building that has the following:

The exact specification details of the baseline model, measured against the proposed specification, can be found in Appendix B.

6.1.3 Base Case – Non-Domestic

Since the new Part L baseline now includes low carbon heating for non-domestic developments and as the proposed building services strategy includes Air source heat pump, the baseline model assumes an ASHP with notional building performance values.

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7 Baseline Emissions

Regulated CO_2 emissions for a Part L 2021 of the Building Regulations compliant development was calculated to establish the baseline CO_2 emissions for the Proposed Development. In establishing TER for the development, a Gas Boiler system for heating and hot water generation was modelled for the domestic areas in line with the Limiting Coefficient of Performance of Part L 2021 for domestic assessment and an air source heat pump with the Limiting Coefficient of Performance of Part L 2021 for non-domestic assessment.

Table 7-1 Regulated baseline CO2 emissions Domestic (Part L 2021 carbon factors)

Perry Road	Baseline
Carbon Emissions ($KgCO_2$/ m^2·yr)	17.20
Carbon Emissions (Tonnes CO_2 /year)	24.20

8 Be Lean

This section outlines the demand reduction measures incorporated in order to exceed the requirements of Building regulation Part L 2021 requirements.

8.1.1 Fabric First Approach

In the construction industry, there is significant evidence to suggest that buildings do not perform as well when they are completed as was anticipated when they were being designed. The difference between anticipated and actual performance is known as the performance gap. Recent studies have suggested that in-use energy consumption can be 5 to 10 times higher than compliance calculations carried out during design stage.

8.1.2 Proposed Fabric First Measures

- High levels of thermal insulation to reduce heating demand, and continuity of insulation to avoid cold bridges which create heat loss and cold surfaces.
- Air-tight construction to avoid cold draughts, reduce heat losses and protect the fabric against moisture egress.
- High performance double glazing to reduce heating demand and provide warm internal surfaces to improve occupant comfort.
- Mechanical ventilation with heat recovery system to provide improved indoor air quality while minimizing energy use.
- Detailed calculations at design stage to ensure that all energy demands are understood and incorporated in the design.
- High levels of quality control during construction to ensure that the required air tightness can be achieved, insulation is installed properly, and services commissioned correctly.

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8.1.3 Passive Be Lean Design Measures

Consideration has been given to the building fabric in order to reduce the energy demand and associated CO_2 emissions of the development. Passive design measures considered include the following:

- Optimising building form, orientation, and site layout.
- Use of natural ventilation.
- Maximising day lighting.
- Use of high-performance glazing.
- Optimising glazing ratio and use of solar shading.
- Use of enhanced thermal insulation and improvements to U-Values.
- Improvements to fabric air permeability.
- Minimising thermal bridging.

Proposed building fabric performance and services set for the development are shown in Table 5-1.

8.1.4 Active Be Lean Design Measures

Following the application of passive design measures, active design measures have been applied to further reduce the energy demand and CO_2 emissions. Active design measures considered include the following:

- Installation of low energy LED lighting.
- Mechanical ventilation with heat recovery.
- Use of smart meters for heat and electricity networks.
- Use of programmable heating controls with individual zone control for heating and hot water.

9 Be Clean

Following the reduction of energy demand in the Be Lean stage, the Local Plan requires the development to demonstrate how the energy systems will supply energy efficiently and cleanly to reduce CO_2 emissions in the Be Clean stage of the energy hierarchy. This section is concluded to have no change from the "Be Lean" results.

9.1 Heating Hierarchy

Connecting to a local or planned heat network

Potential to connect to an existing heat network was investigated, however there is currently no existing heat network within the surrounding area which is close enough to connect to.

Zero emission and/or local secondary heat sources

Availability of secondary heat sources locally was investigated in order to minimise primary energy demand and CO_2 emissions. No waste heat sources were identified on or adjacent to the site. Analysis showing the feasibility of the renewable technologies considered feasible on site can be found in Be Green section of the report.

Low emission Combined Heat and Power (CHP)

Due to the rapid decarbonisation of the electricity grid resulting in reduced CO_2 savings and air quality concerns associated with combustion-based systems, gas-fired CHP was not considered a viable option compared to the possibility of using renewable technologies identified above.

Ultra-low NOx boilers

Gas boilers are not proposed for the development. The energy strategy proposal is 100% electric with direct electric heating coupled with external air source heat pump hot water tank for domestic hot water for the flats and VRF heating and cooling system for the commercial space.

9.2 The Cooling Hierarchy

Measures to reduce the cooling demand have been considered under the following categories:

1. Reduce the amount of heat entering the building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure.
2. Minimise internal heat generation through energy efficient design.
3. Manage the heat within the building through exposed internal thermal mass and high ceilings.
4. Passive ventilation.
5. Mechanical ventilation.
6. Active cooling systems.

Reduce the amount of heat entering the building

High efficiency building fabric with low U-values incorporated in design will reduce the heat transfer from outside during summer months. The g-value and glazing ratio of windows has been selected to optimise the amount of solar heat gains and natural daylight levels throughout the year.

Minimise internal heat generation

The heat distribution infrastructure and building services within the building have been designed to minimise heat losses to spaces and improve system efficiencies. All electric heating system and localised EAHP for domestic hot water generation is proposed in flats, which has minimal heat loss (and therefore minimal unwanted heat gains in summer) when compared to a standard communal heat network. All necessary pipework and ductwork are insulated to exceed the requirements of Building Regulations to further reduce heat losses into spaces. High efficiency LED lighting is used to reduce the heat gains from lighting with optimised lighting control in communal areas.

Manage the heat within the building through exposed internal thermal mass and high ceilings

Ceiling heights are in line with the Housing Design Guide. Exposed thermal mass in not incorporated in this scheme.

Passive ventilation

High levels of passive ventilation have been considered to reduce the likelihood of the dwellings overheating. The dwelling and window designs are provided to maximise the operable area available to each occupied space. Most of the dwellings are dual aspect allowing higher levels of natural ventilation through opening windows compared to single sided ventilation. The dwelling floor plates are relatively shallow and so occupied spaces are provided close to the façade openings.

Mechanical Ventilation

Mechanical ventilation with heat recovery is provided in all dwellings and in the commercial space.

10 Be Green

Following the reduction of energy demand in the Be Lean stage, opportunities to use renewable energy on-site were considered as required by the Be Green stage of energy hierarchy.

10.1 LZCT Feasibility Analysis

The following renewable technologies were considered feasible for the site:

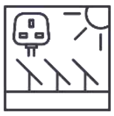
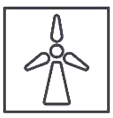
- External air hot water tanks for domestic hot water (Flats)
- VRF systems for heating and cooling (Commercial Space)
- PV panels to generate electricity on site (Commercial space)

Site specific analysis carried out to investigate which technologies are best suited to the developments is shown in Table 10-2.

Table 10-2 LZCT Feasibility Analysis

Technology	How it works	Key Considerations	Viability for ONE YMCA
External Air Heat Pump (EAHP)	The heat pump comprises of a stainless-steel inner vessel with a hot water heat pump mounted on top. The heat pump produces hot water by extracting heat from external air supplied via insulated ductwork. The heat pump is provided with an integral backup heater (immersion) and all necessary controls including domestic hot water temperature control and time clock.	Building fabric should very thermally efficient to reduce space heating demand, which will reduce occupants' heating costs. Larger ductworks required to be accommodated within apartment ceiling void and greater extent of louvres to be incorporated as part of the external façade design. Decentralised heating equipment placed within apartment. Decentralised domestic hot water production plant located within apartments. Decentralised whole house ventilation equipment located within apartment. Domestic hot water recovery time varies between 7 to 10 hours depending on the unit selected. This is not in line with CIBSE's guidance which recommends a minimum of 2-hour recovery period. No centralised plant on roof making space available for PV panels. Low capital cost Low embodied carbon Low distribution losses Low impact on overheating Requires only 1 no. water meter and 1 no. electricity meter	
Air-source Heat Pump (air to water ASHP) 	Heat pumps and exchangers extract heat from outside air to provide space heating and/or hot water. ASHPs are less efficient than GSHP due to the lower average temperature of outside air and greater variance across the year.	Requires a suitable location for the external unit to the building – planning permission may be required. The noise generated by the external unit must be considered. Like GSHPs, air to water ASHPs are most effective when providing space heating via under-floor heating systems designed to operate at temperatures of around 30°C-40°C. ASHPs are easier and cheaper to install than GSHPs however GHSPs are more efficient. The increasingly decarbonizing electrical grid combined with high efficiency heat pumps results in a low carbon source of heat.	

Technology	How it works	Key Considerations	Viability for ONE YMCA
Ground-source Heat Pump (GSHP) 	GSHPs transfer heat from the ground into a building to provide space heating and/or hot water. The ground tends to be at a constant temperature of around 12°C throughout the year and, through the use of a refrigerant cycle this constant low-grade heat can be harnessed to provide a useful level of heat for a building.	Feasibility depends on space for the piping circuit and whether the geology is suitable for either boreholes or trenches. Heat pumps are most suitable for low temperature heating systems such as underfloor heating. The capital cost of GSHPs are significantly higher that fossil-fuel boiler. Greatest carbon savings when combined with renewable electricity-generating technologies. The increasingly decarbonizing electrical grid combined with high efficiency heat pumps results in a low carbon source of heat.	✗
Biomass 	Energy by burning solid organic matter in the form of wood chips or sawdust pellets. Biomass boilers can provide energy for heating and hot water systems. A carbon neutral energy source.	Best suited for relatively continuous operation. Require store facilities to accommodate the fuel. Ideally, biomass fuel should be sourced locally to reduce transport costs and associated carbon emissions. Use may be limited in Smoke Control Zones.	✗
Cobined Heat and Power (CHP) 	CHP is the simultaneous generation of both usable heat and electrical power from the same source. Fuel (usually mains gas or oil) is combusted in an engine where the mechanical power produced is used to generate electricity while the heat emitted provides space heating or hot water.	CHP requires predictable and fairly constant electricity and heating loads for best performance. CHP units are best suited for hotels, residential homes, student accommodations, hospitals and schools. The unit should be sized on heat demands, rather than electrical requirements – units are usually sized on the building's hot water load as this is continuous throughout the year.	✗

Technology	How it works	Key Considerations	Viability for ONE YMCA
Solar Thermal 	Solar thermal panels generate hot water from the sun's energy through the use of solar collectors. A mixture of water and anti-freeze is circulated through the solar collectors and a heat exchanger within the water storage cylinder to heat the water in the tank.	Most effective in a south-facing position on an incline of 30-40 degrees. Panel locations should be clear of obstructions and over shading. Requires space for a hot water cylinder close to the collectors. Most economically viable in buildings with a high hot water demand or where a building is not on the national gas grid.	✘
Photovolatics (PV) 	PV arrays are made up of semi-conductor solar cells which convert sunlight into electricity. Energy from sunlight causes an electrical current to flow between difference atomic energy levels within the solar cells. PV panels are made of solar cells, and several panels create a PV array.	The position of the PV array will affect the energy generation and, consequently the carbon and financial savings. PV panels may require regular cleaning to avoid a reduction in efficiency PV panels should be free from shading from adjacent buildings/trees. Permission is required from the DNO (Distribution Network Operator) to connect the array to the grid (the cost of this grid connection is dependent on the size of the array and its location on the grid).	
Wind 	Wind turbines produce energy by using wind power to drive a generator. Turbines can either be free-standing or roof mounted. Roof-mounted wind turbines require an average wind speed of 3 m/s to be viable whereas larger, stand-alone turbines require greater speeds of approximately 6 m/s to be viable.	Rural areas are better suited than urban areas as the wind speeds are higher and less turbulent. Pay-back periods are strongly dependent on wind conditions plus the length of cabling required to connect the turbine to the building. Planning permission is required and is often a contentious issue	✘

The Adopted Local Plan expects all residential development proposals to maximise on-site renewable energy generation. In line with this, external air source hot water tanks were considered for the flats and a VRF system for heating and cooling for the commercial space along with PV panels to generate electricity on site for the commercial space, in order to maximise CO_2 reductions achieved on site.

11 Conserving Water and Maximising Water Efficiency

As a design team we have made initial selections of sanitaryware and appliances to demonstrate that the target of 110 litres/person/day will be achieved. The table below shows the performance of each appliance and fitting.

Table 11-1: Proposed standards for water fittings and appliances

Appliance/Fitting	Targeted Standard
WCs	6/4 litres dual flush
Wash basins	3 litres/min
Showers	8 litres/min
Baths	157 litres
Kitchen sink taps	9 litres/min
Washing machines	7.5 litres/kg
Dishwasher	0.79 litres/place setting

12 Using Recycled and Recyclable Material and Sourcing them Responsibly

The project will follow the "reduce, reuse, recycle" principle, which will limit virgin material use, reducing extraction, waste, and pollution.

The structural specification will consider the use of recycled materials, and recyclability at end of life. Simple measures such as low or no cement content mortars facilitate the easy re-use of masonry and there is a myriad of masonry products available with high recycled content.

On a physical level, the use of non-toxic and non-volatile finishes reduces the build-up of airborne compounds which can be harmful in elevated concentrations. Durable self- finished materials also require less maintenance and remove the need for re-application of applied finishes. Where possible the design will consider the use of self- finished materials and limited use of paint systems in interior environments.

13 Minimising Waste and Maximising Recycling During Construction and Operation

During construction, the site will operate an avoid, prevent, and minimise strategy to waste and will aim to achieve a 90% diversion from landfill approach. During operation, properties will be provided with suitable space for recycling and food waste in line with the Council's waste guidance.

The buildings will be designed to be low maintenance, avoiding additional finishes and use of harmful products. The team will look to reuse the building materials where possible, such as excavated material being reused for landscaping, and the reuse of tiles or bricks to form the architecture/structure.

Certifications will be required for all structural materials supplied on the project to guarantee it is of legal origin.

Structures will be designed in accordance with Eurocodes and have a design life of at least 60 years.

14 Minimising Flood Risk Including Floor Resilient Construction

The site is located in Flood risk zone 1 and has low probability of flooding from rivers and the sea.

15 Part O Overheating Assessment

15.1 Thermal Comfort Assessment

An Overheating Assessment has been conducted to investigate whether the development is likely to overheat during summertime periods. CIBSE TM59 Design Methodology for the Assessment of Overheating Risk in Homes (2017) has been used as a guide for what is regarded as acceptable thermal conditions. TM59 is used to assess the dwellings and has specific modelling instructions for bedrooms, kitchens and living areas.

TM59 uses an "adaptive thermal comfort" approach and provides time and temperature limits for the operative temperature to define the risk of overheating; a temperature limit is set in bedrooms during the night. The methodology also calculates the hourly operative temperature (T_{op}) within each room accounting for both air temperature and other room factors. CIBSE TM59 provides time and temperature limits for the operative temperature to define the risk of overheating.

For homes that are predominantly naturally or mechanically ventilated, compliance with TM59 is based on passing both of the following criteria:

Criterion 1: for living rooms, kitchens and bedrooms.

T_{op} should not exceed T_{max} by more than 1 degree for more than 3% of occupied hours during the months of May to September.

Criterion 1 will show which rooms frequently overheat. This is likely to happen in rooms where heat gains are not dissipated sufficiently, and heat accumulates over several days. This is often the case for rooms which don't have a night cooling/ventilation strategy.

Criterion 2: For bedrooms only.

T_{op} should not exceed 26°C for more than 1% of occupied hours from 10pm to 7am. 1% of annual hours between 10pm and 7am is 32 hours, so 33 or more hours above 26°C will be recorded as a fail.

The TM59 methodology is prescriptive so that it is consistently applied. It uses defined internal gain and window opening profiles, and specific weather files with clearly defined thresholds to provide a clear pass/fail result. It provides a set of profiles that represent reasonable usage patterns for a home; the profiles have been developed to test the building design against overheating risk, not to cover all usage modes.

As stated in CIBSE TM59 this methodology will; Allow different designs to be compared with a common approach, based on reasonable assumptions, support design decisions that improve comfort without cooling, and Provide consistency across the industry as all consultants will be using the same methodology for overheating risk prediction.

15.2 Part O - Overheating Assessment

In 2021 the government introduced a new approved document Part O which aims to protect the health and welfare of occupants of a building by reducing the occurrences of high indoor temperatures. The regulations in Part O are intended to mitigate the future risks of global temperature increase and the increased frequency of extreme events such as heat waves. It is a response to buildings where occupants have experienced high temperatures that impact their quality of life. It also addresses the changing methods of construction with lightweight structures or modern methods of construction becoming more popular.

There are two routes to compliance contained within the approved Part O document:

- Simplified Method
- Dynamic Thermal Modelling

For this report, dynamic thermal modelling has been used to achieve Part O compliance. Part O guidance requires adopting the CIBSE TM59 methodology for the assessment with the following limits. Usually, the CIBSE's TM59 method requires the modeller to make choices however Part O limits these choices, which are detailed below –

a. When a room is occupied during the day (8am to 11pm), openings should be modelled to do all of the following.

i. Start to open when the internal temperature exceeds 22°C.

ii. Be fully open when the internal temperature exceeds 26°C.

iii. Start to close when the internal temperature falls below 26°C.

iv. Be fully closed when the internal temperature falls below 22°C.

b. At night (11pm to 8am), openings should be modelled as fully open if both of the following apply.

i. The opening is on the first floor or above and not easily accessible.

ii. The internal temperature exceeds 23°C at 11pm.

c. When a ground floor or easily accessible room is unoccupied, both of the following apply.

i. In the day, windows, patio doors and balcony doors should be modelled as open, if this can be done securely.

ii. At night, windows, patio doors and balcony doors should be modelled as closed.

d. An entrance door should be included, which should be shut all the time.

15.3 Site context

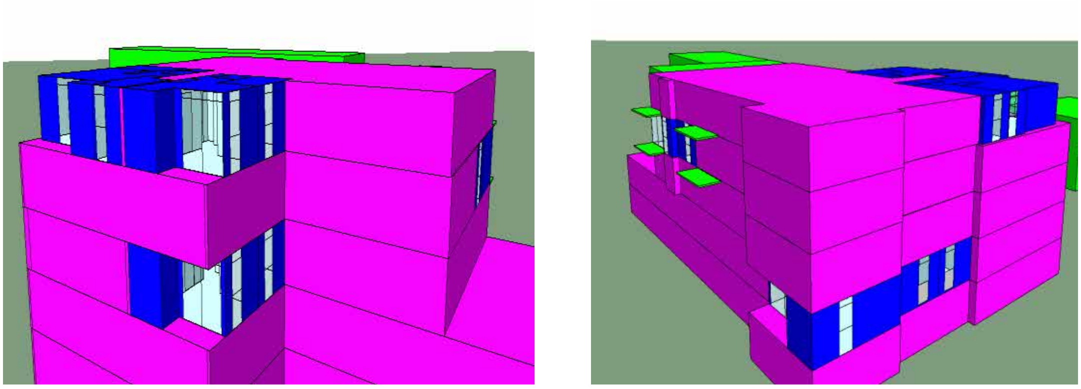
This Overheating Risk Assessment has been prepared in support of the residential project at Perry Road, hereafter referred to as the Proposed Development. The proposed development includes the construction of a 5-storey block of flats with a commercial space on the ground floor located at Perry Road, Harlow, Essex, CM18 7LT.

Figure 15-1 First Floor – Perry Road development

16 Overheating Assessment Methodology

A dynamic thermal modelling method has been used to assess overheating risk. The modelling has been conducted using the dynamic simulation modelling software IES Virtual Environment (VE). IES VE is a CIBSE AM 11 Building Energy and Performance Modelling accredited software. Buildings have been zoned into separate rooms including kitchens, living rooms, bedrooms, bathrooms and circulation areas.

Figure 16-1 Sample Dwellings chosen



In accordance with TM59 methodology, a sample of units within the development has been selected for the overheating assessment. The sample units and respective IES model geometries are indicated by Error! Reference source not found.below. Refer to the Architect's drawings for internal layouts.

Figure 16-2 Sample units selected for overheating assessment

The sample dwellings were selected due to exhibiting the following features:

- Larger, sun-facing windows, which increase solar heat gains.
- Lower external shading than others, and therefore, reduced protection from unwanted solar heat gains in summer.
- South-facing kitchens and living rooms, which are more prone to daytime overheating (TM 59 Criterion a)).
- west-facing bedrooms, which are more prone to night-time overheating (TM 59 Criterion b)).
- bedrooms with windows in non-secure locations (ground floors and above porch roofs).

The sample dwellings chosen are:

- First Floor Unit 06
- Second Floor Unit 02
- Third Floor Unit 04
- Fouth Floor Unit 01
- Fouth Floor Unit 02

This sample is deemed to represent a worst-case overheating scenario for the proposed development. Other dwellings within the development have a lower proportion of large, sun-facing windows, benefit more from shading, and benefit from a similar amount of natural ventilation openings and opportunities for cross-ventilation as the sample dwellings. Therefore, if the sample dwellings comply with the overheating requirements, all other dwellings can be reasonably expected to also comply.

16.1 Weather files

The weather file selected for the assessment has a substantial impact on the overheating results, therefore the latest DSY weather files are used for Perry Road to assess the overheating risk.

However, as there is no dedicated weather file for the location of Harlow, the weather data that has been used for the assessment is based on the CIBSE DSY1 2020 High 50 file, for the location of Norwich. This is not the closest location to the site but is a representative weather file based on the topography and geographical conditions applicable to Harlow.

16.2 Building Fabric

The thermal model replicates the geometry based on the architectural drawings. Modelling parameters including U-value fabric standards, window openings and usage profiles (TM59 Guidelines) were applied to the model.

Table 16-1 Fabric Specification

Building Fabric	
External Walls	0.18 W/m².K
Roof	0.10 W/m².K
Ground Floor	0.12 W/m².K
External Glazing	1.2 W/m².K
Glazing G-value	0.45
Doors	1.0 W/m².K
Airtightness	
Airtightness	3 m³/m².h

16.2.1 Internal Heat Gains

The internal heat gains have been based on the TM59 recommendations for each property type and are detailed in the table below.

Table 16-2: Internal heat gains per house type

	Lighting Gain (W/m²)	Nr People	Sensible Gain (W/person)	Equipment Gain (W)	Lights, Occupancy and Equipment Profiles (W)
Double Bedroom	2	2	75	80	Based on CIBSE TM59 Guide Profiles
2 Bedroom Property Living/Kitchen	2	2	75	450	
3 Bedroom Property Living/Kitchen	2	4	75	450	

16.2.2 Ventilation

The dwellings are proposed to have a hybrid ventilation strategy, with natural ventilation via openable windows and background ventilation via MVHR unit. Building Regulation Part F parameters have been applied.

Table 16-3: Ventilation specification

	Specification	
Opening window types	side-hung	
Mechanical ventilation system	MVHR	
	Kitchen Living Dining – 1 Bedroom	12/ls
	Kitchen Living Dining – 2 Bedroom	14/ls
	Double Bedroom	10l/s

16.3 Dynamic thermal modelling method (Part O input)

Table 16-4: Modelling specification

2b.1 Modelling details	
Dynamic software name and version	IES-VE 2023
Weather file location used	Norwich _DSY1_2020 High 50
2b.2 Modelled occupancy	
Has the project passed the assessment described in CIBSE's TM59, taking into account the limits detailed in paragraphs 2.5 and 2.6?(1)	Yes
Details of the occupancy profiles used	Based on TM59 Occupancy profiles
Details of the equipment profiles used	Based on TM59 Occupancy profiles
Details of the opening profiles used	Based on Part O limits detailed in paragraphs 2.5 and 2.6
Window g-value	0.45
Shading strategy	75mm reveal
Mechanical cooling	-

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16.4 Window Openings

The acoustic constraints at Perry Road have meant that the natural ventilation strategy has been tested with bedroom windows open during the day only to satisfy this risk. Additional spandrel panels have been incorporated on the first-floor windows on the West Elevation to reduce overheating risk. These will need to be incorporated on the floors above to ensure the whole building meets compliance.

The results below demonstrate that Part O constraints are met, and the sample dwellings assessed pass with acoustic and security constraints taken into account.

16.5 Overheating Assessment Results

The assessment results showed that with the proposed dwelling specification, there is a low risk of overheating under current climatic conditions.

Table 16-5: Overheating Assessment Results

Room Name			TM59 Criterion 1	TM59 Criterion 2	TM59 Result
Unit 06	First Floor	Kitchen Living Dining	0.5	NA	Pass
	First Floor	Bedroom 1	0.1	32	Pass
	First Floor	Bedroom 2	0.2	14	Pass
Unit 02	Second Floor	Kitchen Living Dining	0.5	NA	Pass
	Second Floor	Bedroom 1	0.2	2	Pass
Unit 04	Third Floor	Kitchen Living Dining	0.3	NA	Pass
	Third Floor	Bedroom 1	0.3	0	Pass
	Third Floor	Bedroom 2	0.4	22	Pass
Unit 01	Fourth Floor	Kitchen Living Dining	0.6	NA	Pass
	Fourth Floor	Bedroom 1	0.5	19	Pass
	Fourth Floor	Bedroom 2	0.4	12	Pass
Unit 02	Fourth Floor	Kitchen Living Dining	0.6	NA	Pass
	Fourth Floor	Bedroom 1	0.3	12	Pass

17 Overheating Assessment Conclusions

The main conclusions from the overheating risk assessment are:

- The suggested strategy performs well overall and the risk of overheating under current climate conditions is low.
- All areas comply with the CIBSE TM59 criteria and Part O guidance under the 2020 weather data.

Mechanical ventilation is vital in maintaining the night-time temperature in bedrooms below 26°C, especially for south/west facing rooms.
The design achieves very good performance in terms of thermal comfort, ensuring that it will meet the occupiers' needs.

The overheating risk assessment demonstrates that, under current climate conditions as represented by the Norwich CIBSE DSY1 2020 High 50 weather data, there is a low risk of overheating in all occupied spaces in the sample dwellings, as defined in TM59. The proposed building design allows internal temperatures in all occupied spaces to be maintained in line with the TM59/Part O recommended levels.

18 Conclusions

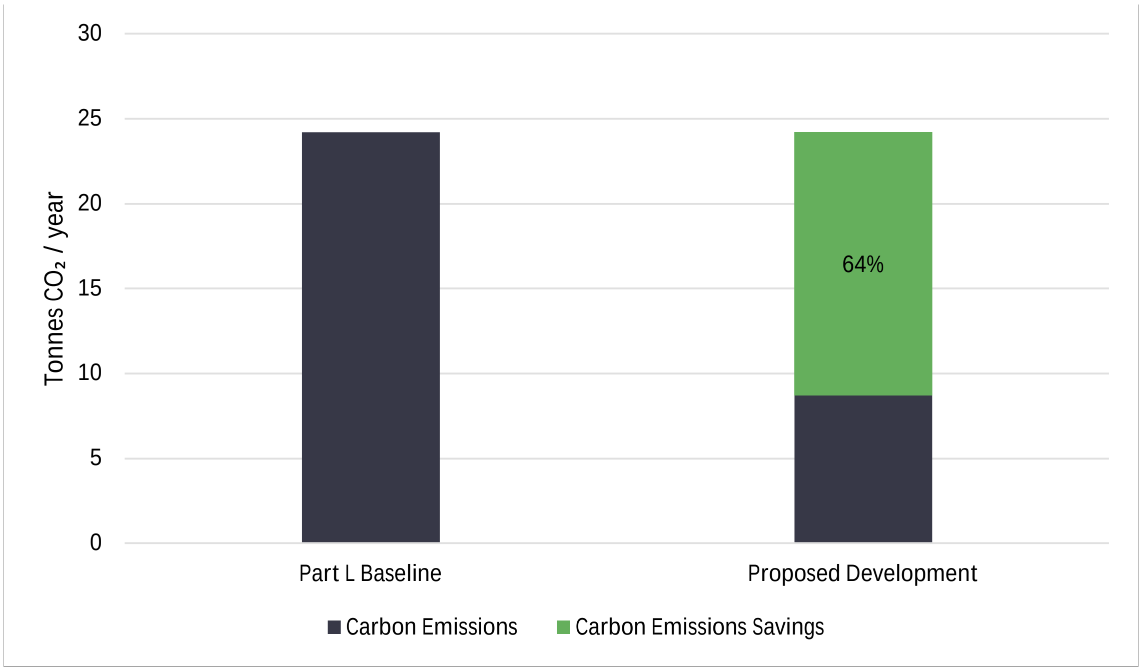
This Energy Assessment Report demonstrates that the Proposed Development at Perry Road, Harlow, Essex, CM18 7LT incorporates passive and active measures to comply with applicable energy policies. The assessment involved establishing applicable policies and applying CO_2 reduction measures to the development in accordance with the Harlow Local Development Plan.

During the Be Lean phase of the hierarchy, passive and active demand reduction measures were prioritised. Following the reduction of energy demand in the Be Lean stage, methods of supplying energy efficiently and cleanly to reduce CO_2 emissions further were investigated at the Be Clean stage of the energy hierarchy. No opportunities to connect to existing or planned district heating networks were identified.

Opportunities to use renewable energy on-site were considered in the Be Green stage of the energy hierarchy. An external air source heat pump hot water tank domestic hot water tanks for flats and VRF system for space heating to commercial areas and with addition of PV panels to generate on site electricity for the commercial space was incorporated to achieve the necessary carbon targets to meet the client's ambitious energy criteria and provide flexibility for the future.

The results of modelling done using the SAP 10.2 software and IESVE demonstrates approx. 64% site wide reduction of CO_2 emissions over Building Regulations Part L 2021 for the development.

Figure 18-1 Carbon emissions reduction over Part L 2021



The results show that the Proposed Developments complies with the energy policies of Harlow District Council and National Planning Policy Framework as a result of passive and active measures incorporated into the development. The energy assessment demonstrates energy remains an integral part of the development's design and evolution in order to address the climate change emergency declared by the UK.

Appendix A: Fabric Efficiency and Primary energy

Table 18-2 Fabric Energy Efficiency

	Target Fabric Energy Efficiency (kWh/m^2)	Dwelling Fabric Energy Efficiency (kWh/m^2)	Improvement (%)
Development total	34.20	33.21	3%

Table 18-3 Primary Energy

	Target Primary Energy Efficiency (kWh/m^2)	Dwelling Primary Energy Efficiency (kWh/m^2)	Improvement (%)
Development total	70.08	49.16	29.8%

Appendix B: Baseline Building Specification

Table 188-4 Baseline Building Specification

	Baseline (Part L 2021) Residential	Baseline (Part L 2021) Commercial
	Fabric Specification	Fabric Specification
External wall U-value	0.18 W/m2K	0.18 W/m^{2}K
Roof U-value	0.13 W/m2K	0.15 W/m^{2}K
Ground Floor U-value	0.13 W/m2K	0.15 W/m^{2}K
Glazing	U-Value = 1.4 W/m2K (Double glazing)	U-Value = 1.0 W/m^{2}K (Double glazing, argon filled, low-e coating)
	g-value 0.63	g-value 0.40
Door U-value	1.0 W/m2K	1.4 W/m^{2}K
	Building Air Permeability	Building Air Permeability
Air-tightness standard	3 m^3/h.m^2 @50Pa	3 m^3/h.m^2 @50Pa
	Space Heating	Space Heating
System	Mains Gas 89.5% efficient	ASHP 264%
Heating Controls	Time and Temperature zone control	Time and Temperature zone control
	Hot Water System	Hot Water System
System	Natural Gas Combi Boiler	Direct electric (100%)
	Cylinder in heated space	
	Cylinder with stat	
Cylinder Volume	150l	
Cylinder Insulation	Better than 0.85x(0.2+0.051)kWh/day	
Pipework Insulation	Fully insulated primary network	Fully insulated primary network
	Ventilation	Ventilation
System Type	Natural Ventilation via openable windows. Local extract fans in wet rooms.	Natural Ventilation via openable windows. Local extract fans in wet rooms.
Ductwork Insulated?	-	-
Ducting Type	-	-
Specific Fan Power	-	-
Heat Exchanger Efficiency	-	-
Cooling Efficiency	N/A	N/A
	Lighting	Lighting
% Energy efficient LED lighting	100%	100%
	PV Panels	PV Panels
PV	For flats: kWp = 40% of dwelling floor area / (6.5 ´ number of storeys in block)	No PV

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Appendix C Part O Window Openings

Description	Openable Area %	Height (mm)	Width (mm)	Restrictor	Degree of Opening
Window 1	71%	1.060	0.930	No	ADO.Section_26ab, a and c
Window 2	79%	2.220	1.700	No	ADO.Section_26ab, a and c
Window 3	79%	2.220	1.468	No	ADO.Section_26ab, a and c

Appendix D SAP /BRUKL Calculations (Sample)

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Perry Road - office PL2021_V2_VRF+PV As designed

Date: Tue Apr 18 16:27:22 2023

Administrative information

Building Details

Address: Address 1, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.18

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.18

BRUKL compliance module version: v6.1.d.0

Foundation area [m²]: 235.44

The CO_2 emission and primary energy rates of the building must not exceed the targets

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	4.03	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	3.18	
Target primary energy rate (TPER), $kWh/m^2.annum$	42.96	
Building primary energy rate (BPER), $kWh/m^2.annum$	34.07	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

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

Fabric element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	First surface with maximum value
Walls*	0.26	0.14	0.14	GF000000:Surf[2]
Floors	0.18	0.13	0.13	GF000000:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	0.14	0.14	GF000000:Surf[1]
Windows** and roof windows	1.6	1.4	1.4	1F000006:Surf[3]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	0.93	1.91	1F000006:Surf[4]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

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

* 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.

*** Values for rooflights refer to the horizontal position.

^ For fire doors, limiting U-value is 1.8 W/m²K

NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
$m^3/(h.m^2)$ at 50 Pa	8	5

Page 1 of 4

QODA

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	>0.95

1- Shell & Core: Office - capped

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	5.5	9.2	0	1.8	0.8
Standard value	2.5*	N/A	N/A	2^	N/A
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.

^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

1- Shell & core: office - DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	-
Standard value	1	N/A

"No zones in project where local mechanical ventilation, exhaust, or terminal unit is applicable"

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
GF WC	100	-	-
GF WC	100	-	-
1F office void	100	-	-
GF office_tea	100	-	-
GF office	100	-	-

The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
GF WC	N/A	N/A
GF WC	N/A	N/A
1F office void	NO (-74.6%)	NO
GF office_tea	N/A	N/A
GF office	NO (-38.5%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	YES
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
Floor area [m²]	433.5	433.5
External area [m²]	1050.3	1050.3
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	5	3
Average conductance [W/K]	305.65	417.38
Average U-value [W/m²K]	0.29	0.4
Alpha value* [%]	25.15	10

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

Building Use

% Area	Building Type
	Retail/Financial and Professional Services
	Restaurants and Cafes/Drinking Establishments/Takeaways
100	**Offices and Workshop Businesses**
	General Industrial and Special Industrial Groups
	Storage or Distribution
	Hotels
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential Schools
	Residential Institutions: Universities and Colleges
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
	Non-residential Institutions: Libraries, Museums, and Galleries
	Non-residential Institutions: Education
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
	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	4.71	9.86
Cooling	2.29	2.48
Auxiliary	7.16	6.79
Lighting	7.7	7.06
Hot water	2.88	2.6
Equipment*	40.76	40.76
TOTAL**	**24.74**	**28.78**

* 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	1.81	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*1.81*	*0*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	135.31	139.95
Primary energy [kWh/m²]	34.07	42.96
Total emissions [kg/m²]	3.18	4.03

Page 3 of 4

QODA

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] Variable refrigerant flow, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	87.5	47.8	4.7	2.3	7.2	5.16	5.79	5.5	9.2
	Notional	98.6	41.3	9.9	2.5	6.8	2.78	4.63	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

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

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