ENERGY STATEMENT

2-8 Danson Road

Produced by XCO2 for Carebase Ltd

November 2020

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CONTENTS

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Date	24/11/2020					
Project reference	9.611					

EXECUTIVE SUMMARY

The energy strategy for the 2-8 Danson Road development has been developed in line with the energy policies of the London Plan and of the London Borough of Bexley Local Plan. The three-step Energy Hierarchy has been implemented and the estimated regulated CO_2 savings on site are 35.1% with SAP10 carbon factors.

This report assesses the predicted energy performance and carbon dioxide emissions of the proposed development at 2-8 Danson Road, located in the London Borough of Bexley.

The proposed development at 2-8 Danson Road is a four-storey care home located within the London Borough of Bexley.

In line with London Plan policy 5.2B and London Borough of Bexley London Plan the development would need to achieve a 35% reduction in regulated CO2 emissions against a Building Regulations (Part L 2013) compliant scheme.

The energy strategy outlined in this report has been developed using the SAP10 emissions factors to ensure the development meets the upcoming version of the Building Regulations.

The methodology used to determine the expected operational CO_2 emissions for the development is in accordance with the London Plan's three-step Energy Hierarchy (Policy 5.2A) and the CO_2 savings achieved for each step are outlined below:

BE LEAN – USE LESS ENERGY

The first step addresses reduction in energy demand, through the adoption of passive and active design measures.

The proposed energy efficiency measures include levels of insulation beyond Building Regulation requirements, low air tightness levels, efficient lighting as well as energy saving controls for space conditioning and lighting.

By means of energy efficiency measures alone, regulated CO_2 emissions are shown to reduce by 16.9% (5.1 tonnes per annum) across the whole site.

At the 'Be Lean' stage, the proposed development meets the GLA target of 15% regulated CO_2 emission reductions for non-domestic buildings.

BE CLEAN – SUPPLY ENERGY EFFICIENTLY

The application site is located in an area where district heating is not expected to be implemented in the future. The proposed design will employ a site-wide heat network to future-proof the connection with the district heat network once it is established.

BE GREEN – USE RENEWABLE ENERGY

The renewable technologies feasibility study carried out for the development identified air source heat pumps (which would work in conjunction with back-up boilers) and photovoltaics as suitable technologies for the development.

The incorporation of renewable technologies will reduce CO_2 emissions by a further 18.2% (5.5 tonnes per annum) across the whole site.

CUMULATIVE ON SITE SAVINGS

The overall regulated CO_2 savings on site against a Part L 2013 compliant scheme are therefore 35.1% (10.5 tonnes per annum) across the whole site.

CARBON OFF-SETTING

The proposed development complies with the London Plan CO_2 savings target of 35% overall.

To achieve 'zero carbon' for the scheme, 19.5 tonnes per annum of regulated CO2, equivalent to 583.9 tonnes over 30 years should be offset offsite.

Any carbon offset contributions will be subject to viability discussions and detailed design stage calculations.

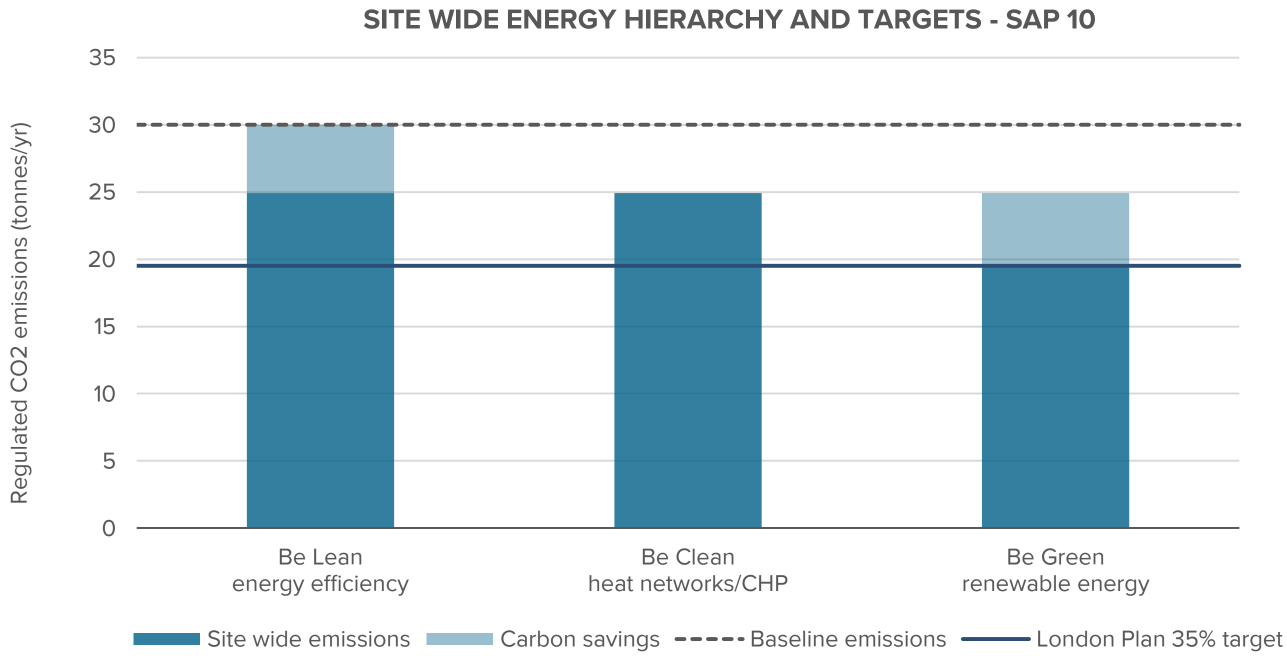


Figure 1: The Site Wide Energy Hierarchy (SAP10 carbon factors)

INTRODUCTION

This Chapter presents the description of the site and of the development proposal, the energy policy framework and the methodology employed for the energy assessment.

SITE & PROPOSAL

The site is located to the south of approximately 840 m to the south-west of Bexleyheath station, at the junction between Danson Road and Park view Road.

The scheme will comprise of 70 en-suite bedrooms located across the lower ground, ground, first and second floors. The proposed development also includes a cinema, salon, an orangery as well as dining areas on the ground floor.

The site approximate location can be seen in the figure below.

Figure 2: Location of the application site.

POLICY FRAMEWORK

The proposal will seek to respond to the energy policies of the London Plan and of the policies within the London Borough of Bexley's London Plan.

The most relevant applicable energy policies in the context of the proposed development are presented below.

THE LONDON PLAN

The London Plan (2016) is the overall strategic plan for London, setting out an integrated economic, environmental, transport and social framework for the development of London over the next 20–25 years.

The overarching energy policies of the London Plan are included in Chapter Five *London's Response to Climate Change* and include Policies 5.2 to 5.9:

- Policy 5.2: Minimising carbon dioxide emissions;
- Policy 5.3: Sustainable Design and Construction;
- Policy 5.4: Retrofitting;
- Policy 5.4A: Electricity and gas supply;
- Policy 5.5: Decentralised energy networks;
- Policy 5.6: Decentralised energy in development proposals;
- Policy 5.7: Renewable energy;
- Policy 5.8: Innovative energy technologies, and,
- Policy 5.9: Overheating and cooling.

Extracts of Policies 5.2, 5.6, 5.7 and 5.9 are presented below as these are considered most relevant to the proposed scheme.

The London Plan also consists of a suite of guidance documents, most relevant of which are the Sustainable Design and Construction SPG (April 2014) & Energy Planning – GLA Guidance on preparing energy assessments (October 2018).

POLICY 5.2 MINIMISING CARBON DIOXIDE EMISSIONS

A. Development proposals should make the fullest contribution to minimising carbon dioxide emissions in accordance with the following energy hierarchy:

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

B. The Mayor will work with boroughs and developers to ensure major developments meet the following targets for carbon dioxide emissions reduction in buildings. These targets are expressed as minimum improvements over the Target Emission Rate (TER) outlined in the national Building Regulations leading to zero carbon residential buildings from 2016 and zero carbon non-domestic buildings from 2019.

Table 1: CO_2 emissions improvement targets against the current Building Regulations

Residential Buildings	
Year	Minimum improvement over Building Regulations 2013
2016 - 2031	Zero Carbon
Non-domestic Buildings	
Year	Minimum improvement over Building Regulations 2013
2016 - 2019	35%
2019 - 2031	Zero Carbon

POLICY 5.6 DECENTRALISED ENERGY IN DEVELOPMENT PROPOSALS

A. Development proposals should evaluate the feasibility of Combined Heat and Power (CHP) systems, and where a new CHP system is appropriate also examine opportunities to extend the system beyond the site boundary to adjacent sites.

B. Major development proposals should select energy systems in accordance with the following hierarchy:

Connection to existing heating or cooling networks;
Site wide CHP network;
Communal heating and cooling.

C. Potential opportunities to meet the first priority in this hierarchy are outlined in the London Heat Map tool. Where future network opportunities are identified, proposals should be designed to connect to these networks.

POLICY 5.7 RENEWABLE ENERGY

B. Within the framework of the energy hierarchy (see Policy 5.2), major proposals should provide a reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation, where feasible.

D. All renewable energy systems should be located and designed to minimise any potential adverse impacts on biodiversity, the natural environment and historical assets, and to avoid any adverse impacts on air quality.

POLICY 5.9 OVERHEATING AND COOLING

B. Major development proposals should reduce potential overheating and reliance on air conditioning systems and demonstrate this in accordance with the following cooling hierarchy:

1. *Minimise internal heat generation through energy efficient design*
2. *Reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls*
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 (ensuring they are the lowest carbon options).*

DRAFT LONDON PLAN

The current 2016 consolidation Plan is still the adopted Development Plan. However, the Draft London Plan, last updated in July 2019, is a material consideration in planning decisions. The New London Plan is scheduled to be published in early 2020.

The following paragraphs highlight the key changes and additional requirements stemming from emerging policies.

GREENHOUSE GAS EMISSIONS

Policy GG6 (Increasing efficiency and resilience) sets a positive direction for the new draft Plan in terms of ambitious new greenhouse gas emission targets. This policy references London's target to become zero carbon by 2050 and the need to design buildings and infrastructure for a changing climate. To drive this change both residential and non-residential schemes will need to be net zero-carbon (via offset payments). At least 35% of this reduction must be made on site for major developments, with residential developments expected to achieve at least a 10% (and non-residential at least a 15%) reduction in emissions through energy efficiency measures alone (Policy SI2).

In a major departure from the previous London Plan, calculations will be required to include both regulated and unregulated emissions at each stage of the energy hierarchy. Furthermore, major developments will have to submit details of the method with energy performance and carbon dioxide emissions monitored post-construction for at least the first five years of building operation.

ENERGY INFRASTRUCTURE

In addition to upgrades to the lean and green stages of the energy hierarchy the clean stage has also been enhanced. A "be seen" stage has also been introduced so the development energy performance is monitored and reported. Most notably, all major developments within Heat Network Priority Areas will need to utilise a communal low-temperature heating system.

Policy SI3 (Energy infrastructure) recommends zero-emission or local secondary heat sources technology as step on the heating hierarchy but prioritises a connection to local existing or planned heat networks where feasible, for selecting communal heating systems. Where developments are utilising low-emission CHP this policy requires them to demonstrate that the CHP will *enable the delivery of an area-wide heat network, meet the development's electricity demand and provide demand response to the local electricity network*.

MATERIALS, WASTE & LIFE-CYCLE CARBON

Policy SI2 (Minimising greenhouse gas emissions) mentions the requirement for Energy Strategies to include a *whole life-cycle carbon emissions assessment and actions to reduce life-cycle carbon emissions*. This is to fully capture the development's carbon impact: unregulated and embodied emissions, and emissions associated with maintenance, repair and demolition will be considered. This may result in more sustainable material choices at design stage and could lead to straw, bamboo, clay and recycled materials alongside the more widely recognised cross-laminated timber becoming more commonplace in the capital. This section also links with Policy SI7 (Reducing waste and supporting the circular economy), whereby materials are retained in use at their highest value for as long as possible to minimise waste. All referable applications will be required to submit a Circular Economy Statement, intended to cover the whole life cycle of development.

AIR QUALITY

The new draft Plan addresses this crucial area by requiring large-scale development proposals to demonstrate how they maximise benefits to air quality and the measures or design solutions they will implement to minimise exposure to air pollution.

In practice this will mean that a preliminary Air Quality Assessment (AQA) will need to be carried out for all major developments prior to any design work taking place, with a full AQA submitted in support of the planning application. In addition, the new draft London Plan supports electric vehicle charging points and other transport alternatives to achieve carbon-free travel by 2050.

It should be noted that, as the policies in the draft London Plan are not yet adopted, the following sections demonstrate compliance with the current plan.

GLA GUIDANCE ON PREPARING ENERGY ASSESSMENTS

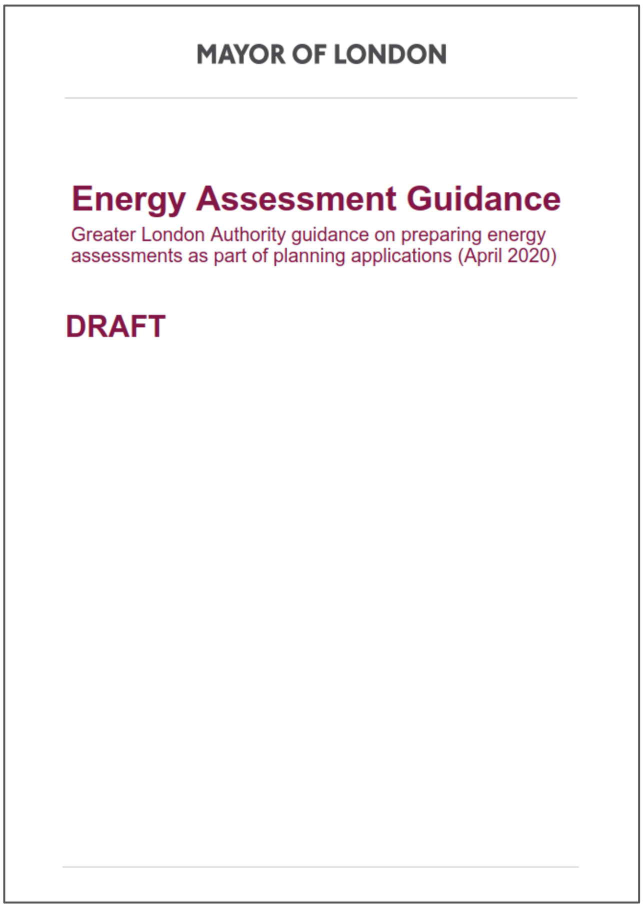
This document (last updated in April 2020) provides guidance on preparing energy assessments to accompany strategic planning applications; it contains clarifications on Policy SI 2, of the new London Plan, carbon reduction targets in the context of zero carbon policy, as well as detailed guidelines on the content of the Energy Assessments undertaken for planning.

The guidance document specifies the emission reduction targets the GLA will apply to applications as follows:

The regulated carbon dioxide emissions reduction target for major domestic and non-domestic development is net zero carbon, with at least a 35% on-site reduction beyond Part L 2013 of the Building Regulations.

The new guidance also includes changes to technical requirements relating to the use of updated carbon factors, cost estimates, overheating risk analysis, the structure of the heating hierarchy and scrutiny over the performance of heat pumps. The guidance also provides information on how the new stage of the energy hierarchy 'be seen' is expected to be carried out in energy assessments.

The structure of this report and the presentation of the carbon emission information for the development follows the guidance in this document.


MAYOR OF LONDON

Energy Assessment Guidance

Greater London Authority guidance on preparing energy assessments as part of planning applications (April 2020)

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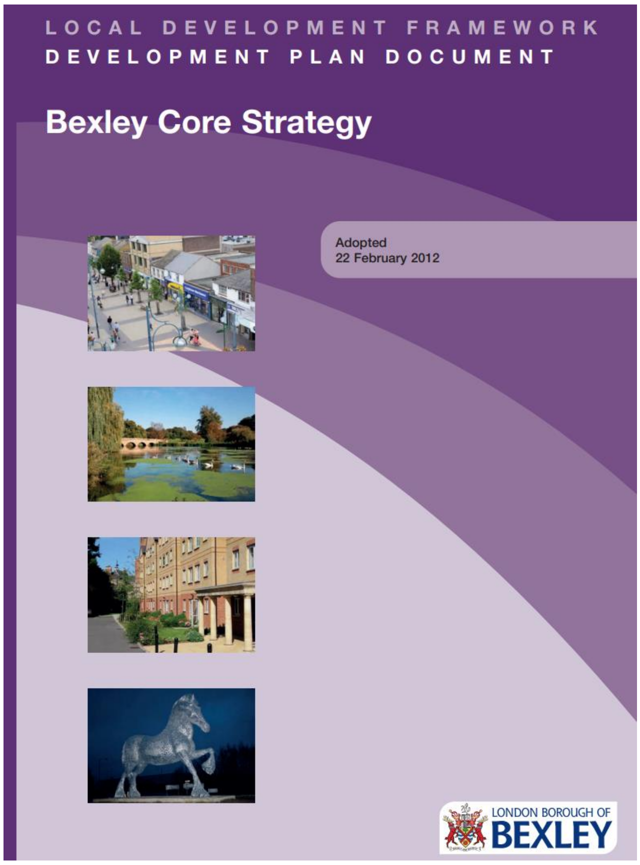
BEXLEY'S LOCAL PLAN: CORE STRATEGY

Barnet's Core Strategy sets out the vision, objectives and related strategic policies within the Borough.



POLICY CS08 – ADAPTING TO AND MITIGATING THE EFFECTS OF CLIMATE CHANGE, INCLUDING FLOOD RISK MANAGEMENT

All development should contribute to the delivery of sustainable development by planning for, adapting to, and mitigating the impacts of climate change, by reducing the carbon emissions related to the construction and operation of all development.

The Council will achieve this by applying the requirements and targets outlined in national and regional planning policy and guidance to new development. In particular, this will encompass the requirements of the Mayor's London Plan with regard to environment policies such as: reducing CO_2 emissions; the Mayor's energy hierarchy; integrating energy efficiency; decentralised energy (in particular district heating where appropriate); site-wide communal heat networks supported by CHP; adopting on-site renewable energy technologies; sustainable transport (in particular public transport, cycling and walking); green infrastructure; flood risk management; and sustainable urban drainage systems (SUDS), including supporting the Mayor's drainage hierarchy.

POLICY CS09 – USING BEXLEY'S RESOURCES SUSTAINABLY

Development that seeks to maximise the effective and efficient use of natural and physical resources, while contributing to the health and well-being of the community and the environment, will be encouraged. The Council will do this by applying the requirements outlined in national and regional planning policy and guidance to new development, in particular the requirements of the Mayor's London Plan with regard to open space and the Blue Ribbon Network, energy and water supplies and resources, air and water quality, water and sewerage infrastructure, noise reduction, contaminated land, hazardous substances and sites and minerals.

METHODOLOGY

The sections below present the methodology followed in determining the on-site and off-site carbon savings for the proposed scheme.

ON-SITE CARBON SAVINGS – THE ENERGY HIERARCHY

The methodology employed to develop the energy strategy for the scheme and achieve on-site carbon savings is in line with the GLA's *Guidance on preparing energy assessments* and is as follows:

The **baseline** CO_2 emissions are first established, i.e. the emissions of a scheme that is compliant with Part L 2013 of the Building Regulations.

The software used to model and calculate the energy performance and carbon emissions for the non-domestic scheme is SBEM. The emissions of the scheme are established by modelling representative spaces and multiplying the Target Emission Rate (TER) of each type with the cumulative floor area for that type to establish the total emissions for the proposal.

The same approach is followed to determine the energy performance and CO_2 emissions of the proposed scheme for each of the steps of the **Energy Hierarchy**. The CO_2 emissions are estimated based on SBEM Building Emission Rate (BER) figures for the non-domestic elements. The Energy Hierarchy aims at delivering significant carbon savings on-site.

The three consecutive steps of the Energy Hierarchy are:

- **Be Lean** whereby the demand for energy is reduced through a range of passive and active energy efficiency measures; as part of this step the Cooling Hierarchy (see Policy 5.9) is implemented and measures are proposed to reduce the demand for active cooling;
- **Be Clean** whereby as much of the remaining energy demand is supplied as efficiently as possible (e.g. by connecting to a district energy network or developing a site-wide CHP network), and,
- **Be Green** whereby renewable technologies are incorporated to offset part of the carbon emissions of the development. The uptake of renewable technologies is based on feasibility and viability considerations, including their compatibility with the energy system determined in the previous step.

The implementation of the Energy Hierarchy determines the total regulated carbon savings that can be feasibly and viably achieved on site.

The % improvement against the baseline emissions is compared to the relevant targets for each element and in case of a shortfall, savings through off-site measures should be achieved.

OFF-SITE CARBON SAVINGS – CARBON OFFSETTING

The GLA and the London Borough of Bexley has an established provision to ensure that the shortfall in carbon savings is met off-site; this comprises a carbon offset payment with a figure of £60/tonne for a period of 30 years.

The cash in lieu contribution for the proposal is calculated and summed to provide the total carbon offset payment to be made to the Council.

The structure of the main body of the assessment follows the Methodology presented above and comprises the sections:

- Be Lean;
- Be Clean;
- Be Green.

The Conclusions section summarises the energy strategy and associated carbon savings for the proposed development.

BE LEAN – USE LESS ENERGY

The proposals incorporate a range of passive and active design measures that will reduce the energy demand for space conditioning, hot water and lighting. Measures will also be put in place to reduce the risk of overheating. The regulated carbon saving achieved in this step of the Energy Hierarchy is 16.9% over the site wide baseline level with SAP10 emission factors.

PASSIVE DESIGN MEASURES

ENHANCED U-VALUES

The heat loss of different building fabric elements is dependent upon their U-value. A building with low U-values provides better levels of insulation and reduced heating demand during the cooler months.

The proposed development will incorporate high levels of insulation and high-performance glazing beyond Part L 2013 targets and notional building specifications, in order to reduce the demand for space heating.

The tables to the right demonstrate the improved performance of the proposed building fabric beyond the Building Regulations requirements.

AIR TIGHTNESS IMPROVEMENT

Heat loss may also occur due to air infiltration. Although this cannot be eliminated altogether, good construction detailing and the use of best practice construction techniques can minimise the amount of air infiltration.

The proposed development will aim to improve upon the Part L 2013 minimum standards for air tightness by targeting air permeability rates of $3m^3/m^2.h$ at 50Pa for all areas.

Table 2: Thermal Envelope U-values

Non-domestic (U-values in $W/m^2.K$)			
Element	**Building Regulations**	**Proposed**	**Improvement**
Walls	0.35	0.15	57%
Floor	0.25	0.1	60%
Roof	0.25	0.1	60%
Windows	2.20	1.3	41%

REDUCING THE NEED FOR ARTIFICIAL LIGHTING

The development has been designed to maximise daylight in all habitable spaces as a way of improving the health and wellbeing of its occupants.

All of the habitable areas will benefit from large areas of glazing to increase the amount of daylight within the internal spaces where possible. This is expected to reduce the need for artificial lighting whilst delivering pleasant, healthy spaces for occupants.

ACTIVE DESIGN MEASURES

HIGH EFFICACY LIGHTING

The development intends to incorporate low energy lighting fittings throughout the spaces. All light fittings will be specified as low energy lighting, and will accommodate LED, compact fluorescent (CFLs) or fluorescent luminaires only.

HEAT RECOVERY VENTILATION

Mechanical ventilation heat recovery (MVHR) is proposed for the development. The mechanical ventilation system will include heat recovery in order to achieve ventilation in the most energy-efficient way. MVHR does not recirculate air.

CONTROLS

Advanced lighting and space conditioning controls will be incorporated, specifically the eating controls in the will comprise time and temperature zone controls.

MONITORING

In addition to the above design measures, the development will incorporate monitoring equipment and systems to enable occupiers to monitor and reduce their energy use.

Smart meters may be installed to monitor the heat and electricity consumption of each care home room; the display board would demonstrate real-time and historical energy use data and would be installed at an accessible location within the commercial spaces.

MINIMISING OVERHEATING

The potential risk of overheating will be mitigated by incorporating passive and active design measures, in line with the London Plan Policy 5.9 and the Cooling Hierarchy, as follows.

THE COOLING HIERARCHY

MINIMISING INTERNAL HEAT GENERATION THROUGH ENERGY EFFICIENT DESIGN

The distribution of heat infrastructure within the residential parts of the development will be designed to reduce the lateral pipework lengths within the internal spaces to reduce heat loss.

Heat sources and pipework will be sufficiently insulated (following CIBSE CoP1 guidelines).

REDUCING THE AMOUNT OF HEAT ENTERING THE BUILDING IN SUMMER

Internal blinds will be considered to reduce the amount of heat entering the building.

USE OF THERMAL MASS AND HIGH CEILINGS TO MANAGE THE HEAT WITHIN THE BUILDING

During peak summer periods the thermal mass of the building will absorb and store excess heat. The building will release its heat in the cooler evenings to allow for cooler internal spaces dampening the peak diurnal weather conditions.

PASSIVE VENTILATION

Passive ventilation will be employed as the main strategy for providing fresh air and dissipating heat across the development, with the exception of areas deemed most likely to be exposed to discomfort of noise and excessive solar gain.

OVERHEATING RISK ASSESSMENT

An overheating assessment was undertaken for representative 'worst case' rooms in line with CIBSE TM52. Dynamic thermal modelling was conducted using three design weather years, also accounting for climate change scenarios.

The analysis for DSY1 showed that the inclusion of openings with Free Areas of 30% and solar control glazing with g-value of 0.4 would enable all bedrooms to achieve compliance with the overheating benchmarks.

The results for DSY2 and DSY3 indicated that some form of cooling would be required for the spaces to achieve the desirable internal environment during more onerous heat waves.

The Overheating Assessment can be seen in full in Appendix A.

ENERGY USE

CARE HOME ROOM EMISSION RATES AND ENERGY DEMAND

The table below shows a breakdown of carbon dioxide emissions associated with the proposed development's fossil fuel and electricity consumption along with total energy demand for the different uses. The site-wide data are presented in the table. The figures provide a comparison between the baseline condition and the proposed development once energy efficiency measures (Lean) have been applied.

This table demonstrates the energy savings achieved through energy efficiency measures (Lean stage of the Energy Hierarchy).

Table 3: Breakdown of energy consumption and CO_2 emissions for the baseline and the proposed schemes after 'Lean' measures are implemented with SAP10 factors

	Baseline			Lean		
	Energy (kWh/yr.)	$kgCO_2$ /yr.	$kgCO_2/m^2$	Energy (kWh/yr.)	$kgCO_2$ /yr.	$kgCO_2/m^2$
Hot Water	52,600	11,046	6.9	50,920	10,693	6.7
Space Heating	39,210	8,233	5.1	11,760	2,470	1.5
Cooling	0	0	0.0	0	0	0.0
Auxiliary	18,300	4,157	2.6	21,970	4,990	3.1
Lighting	28,900	6,566	4.1	29,800	6,770	4.2
Equipment	108,150	25,199	15.7	108,150	25,199	15.7
Total Part L	**139,010**	**30,002**	**18.7**	**114,450**	**24,923**	**15.6**
Total (incl. equipment)	**247,160**	**55,201**	**34.5**	**222,600**	**50,122**	**31.3**

BE LEAN CO_2 EMISSIONS

By means of energy efficiency measures alone, regulated CO_2 emissions are shown to reduce by 16.9% (5.1 tonnes per annum) across the whole site. At the 'Be Lean' stage, the proposed development meets the GLA target of 15% regulated CO_2 emission reductions.

BE CLEAN – SUPPLY ENERGY EFFICIENTLY

No existing or proposed district energy network is located within close proximity to the proposed development.

ENERGY SYSTEM HIERARCHY

The energy system for the development has been selected in accordance with the London Plan decentralised energy hierarchy. The hierarchy listed in Policy 5.6 states that energy systems should consider:

1. Connection to existing heating and cooling networks;
2. Site wide CHP network; and,
3. Communal heating and cooling.

Local heat and power sources minimise distribution losses and achieve greater efficiencies when compared to separate energy systems, thus reducing CO_2 emissions.

In a communal energy system, energy in the form of heat, cooling, and/or electricity is generated from a central source and distributed via a network of insulated pipes to surrounding residences.

CONNECTION TO AN EXISTING NETWORK

The London Heat Map identifies existing and potential opportunities for decentralised energy projects in London. It builds on the 2005 London Community Heating Development Study.

An excerpt from the London Heat Map can be seen on the following page which shows the energy demand for different areas. Darker shades of red signify areas where energy demand is high. The map also highlights any existing and proposed district heating networks within the vicinity of the development.

A review of the map shows that there are no existing or proposed district energy network located within close proximity to the site location.

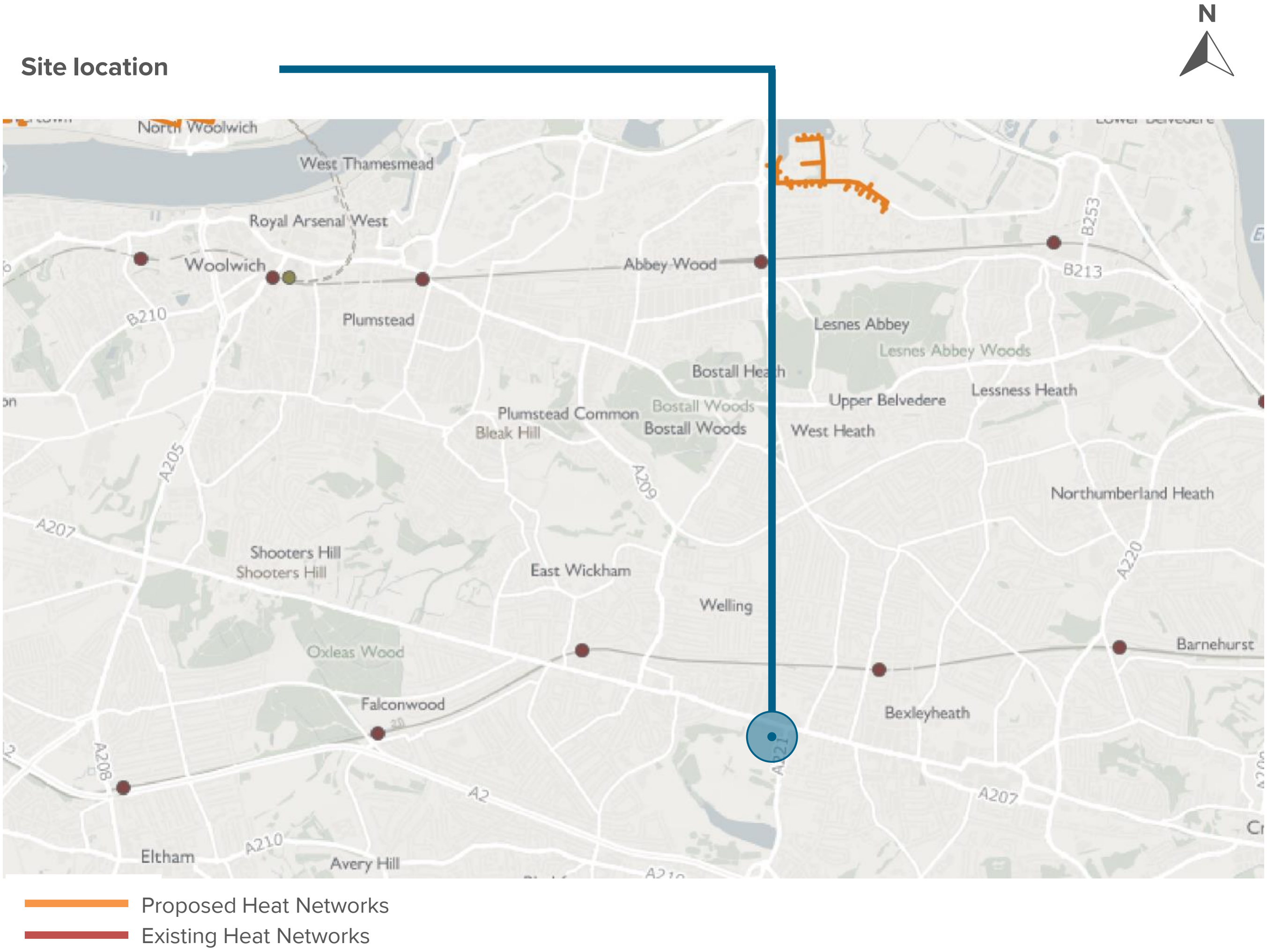


Figure 3: Excerpt from the London Heat Map. Existing district networks outlined in red, proposed networks in orange.

BE CLEAN CO_2 EMISSIONS

Given that it has not been found feasible or viable for the proposed development to incorporate the supply of low carbon heating or cooling, no carbon savings are achieved for this step of the Energy Hierarchy.

BE GREEN – USE RENEWABLE ENERGY

The renewable technologies feasibility study carried out for the development identified photovoltaics and air source heat pumps with back-up boilers as suitable technologies for the development. The regulated carbon saving achieved in this step of the Energy Hierarchy is 18.2% over the site wide baseline level with SAP10 emission factors.

RENEWABLE TECHNOLOGIES FEASIBILITY STUDY

Methods of generating on-site renewable energy (Green) were assessed, once Lean and Clean measures were taken into account.

The development of 2-8 Danson Road will benefit from an energy efficient building fabric which will reduce the energy consumption of the proposed development in the first instance. A range of renewable technologies were subsequently considered including:

- Biomass;
- Ground/water source heat pumps;
- Air source heat pump;
- Wind energy;
- Photovoltaic panels, and,
- Solar thermal panels.

In determining the appropriate renewable technology for the site, the following factors were considered:

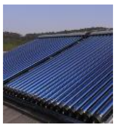
- CO_2 savings achieved;
- Site constraints, and,
- Any potential visual impacts

RENEWABLE ENERGY APPRAISAL SUMMARY

The table below summarises the factors taken into account in determining the appropriate renewable technologies for this project. This includes estimated capital cost, lifetime, level of maintenance and level of impact on external appearance. The final column indicates the feasibility of the technology in relation to the site conditions (10 being the most feasible and 0 being infeasible). It is important to note that the information provided is indicative and based upon early project stage estimates.

The feasibility study demonstrates that photovoltaics and ASHP would be the most feasible renewable technologies for the proposed 2-8 Danson Road development. Detailed assessments for the proposed technologies can be found in the following sections.

Table 4. Summary of renewable technologies feasibility study

		Comments	Lifetime	Maintenance	Impact on external appearance	Site feasibility
Biomass		Not adopted – burning of wood pellets releases high NOx emissions and there are limitations for their storage and delivery within an urban location.	20 yrs.	High	High	1
PV		Adopted - there will be sufficient roof space for PV installation to generate a notable CO_2 reduction.	25 yrs.	Low	Med	9
Solar thermal		Not adopted – Solar thermal array mounted on the pitched roof would significantly alter the appearance and character of the Listed Building.	25 yrs.	Low	Med	2
GSHP		Not adopted -the installation of ground loops requires significant space, additional time at the beginning of the construction process and very high capital costs.	20 yrs.	Med	Low	4
ASHP		Adopted - ASHPs provide significant carbon savings.	20 yrs.	Med	Med	9
Wind		Not adopted - Wind turbines located at the site will have a significant visual impact on the site and surroundings.	25 yrs.	Med	High	1

DETAILED ASSESSMENT OF PHOTOVOLTAIC PANELS

Four types of solar cells are available on the market at present and these are mono-crystalline, poly-crystalline, thin film and hybrid panels. Although mono-crystalline and hybrid cells are the most expensive, they are also the most efficient with an efficiency rate of 12-20%. Poly-crystalline cells are cheaper but they are less efficient (9-15%). Thin film cells are only 5-8% efficient but can be produced as thin and flexible sheets.

Photovoltaics are considered a suitable technology for this development for the following reasons:

- The development provides an extent of roof space for the installation of PV panels;
- PV arrays are relatively easy to install when compared to other renewable systems; and
- PV panels provide a significant amount of CO_2 savings.

The PV shall comprise 6.5 kWp (34m^2) of horizontal roof mounted arrays.

The table below summarises the technical data for the proposed PV array and estimated CO_2 savings from the application of this technology. In total the PV installation would produce regulated CO_2 savings of 3.7% for the development.

An indicative area for the installation of the PV panels on the roof can be found in the following page.

Table 5: Summary of technical/operational data and estimated CO_2 savings for PVs

Photovoltaics		
Module efficiency	19	%
Orientation	Horizontal	
Predicted site solar energy	914	kWh/m^2.yr
System losses	20	%
System peak power	6.5	kWp
Array area	34	m^2
Primary energy offset by PV	4,723	kWh/yr.
Total CO_2 savings	1.1	t/yr.
Regulated baseline CO_2 emissions	30.0	t/yr.
Total baseline CO_2 emissions	55.2	t/yr.
% Regulated CO_2 reduction*	3.7	%
% Total CO_2 reduction*	2.0	%

* % reduction from site baseline

Figure 4: Monocrystalline PV arrays

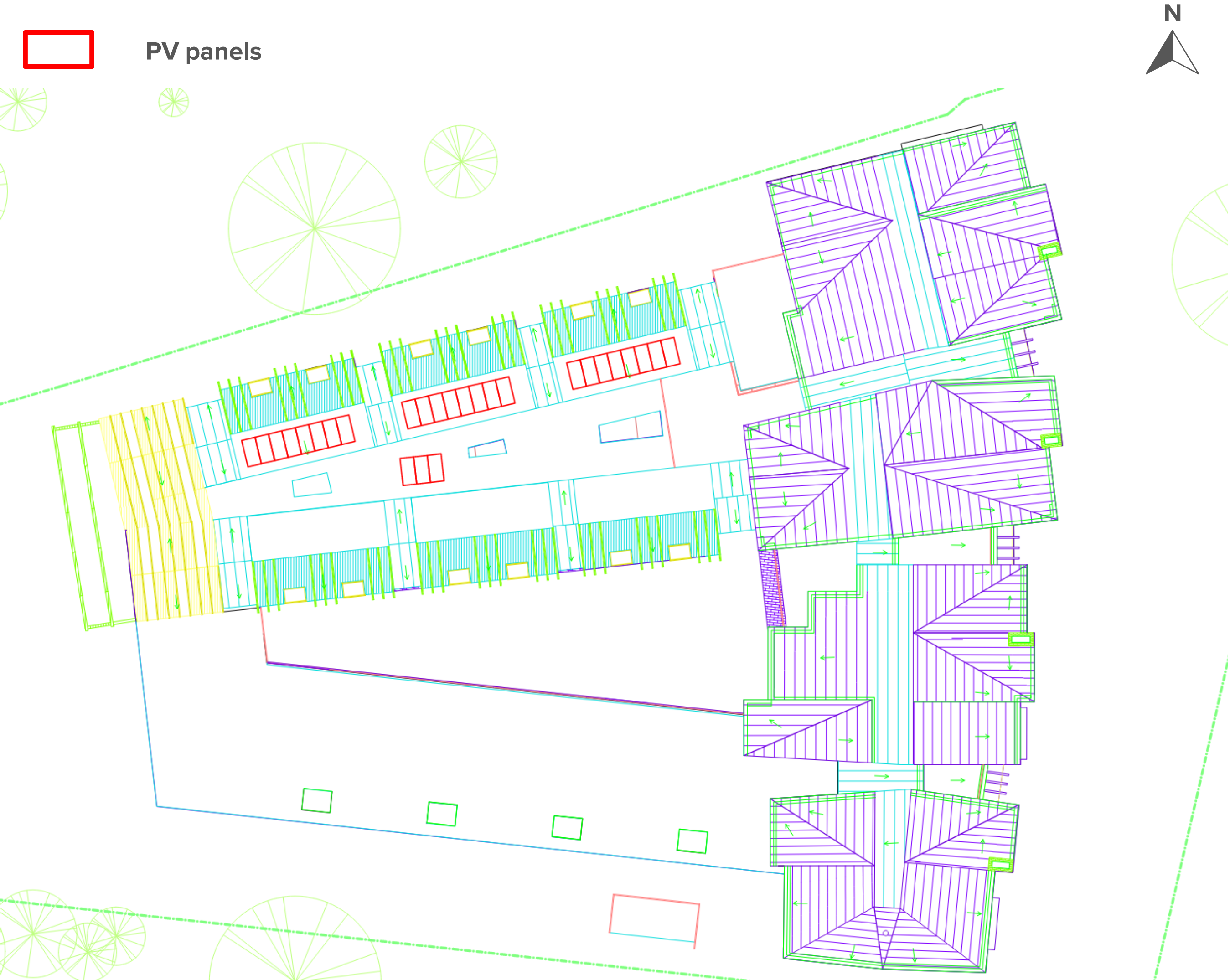


Figure 5. Proposed PV layout for 2-8 Danson Road.

DETAILED ASSESSMENT OF AIR SOURCE HEAT PUMPS

Air source heat pumps (ASHPs) employ the same technology as ground source heat pump (GSHPs). However, instead of using heat exchangers buried in the ground, heat is extracted from the external ambient air.

The efficiency of heat pumps is very much dependent on the temperature difference between the heat source and the space required to be heated. As a result, ASHPs tend to have a lower COP than GSHPs. This is due to the varying levels of air temperature throughout the year when compared to the relatively stable ground temperature. The lower the difference between internal and external air temperature, the more efficient the system.

ASHP is considered a suitable technology for the development for the following reasons:

- It is a high efficiency system that can cater for the space heating and cooling of the most energy-intensive areas of the proposed development;
- Requires less capital cost than GSHP and other renewable technologies;
- It can be integrated with the proposed ventilation strategy; and,
- It is simple to install when compared to other renewable technologies and will work well alongside PV.

The table below summarises the technical data for the proposed ASHP and estimated CO_2 savings from the application of this technology. In total the ASHP technology would produce regulated CO_2 savings of 14.5% for the development.

Table 6: Summary of technical/operational data and estimated CO_2 savings for ASHP

ASHP for domestic spaces		
COP heating	3	
COP cooling	-	
Carbon intensity of electricity	0.233	$kgCO_2/kWh$
Proportion of DHW heating from ASHP	50	%
Proportion of space heating from ASHP	50	%
Energy met by ASHP	28,176	kWh/yr.
Energy used by ASHP	9,392	kWh/yr.
Total CO_2 savings	4.4	t/yr.
Regulated baseline CO_2 emissions	30.0	t/yr.
Total baseline CO_2 emissions	55.2	t/yr.
% Regulated CO_2 reduction*	14.5	%
% Total CO_2 reduction*	7.9	%

* % reduction from site baseline

BE GREEN CO_2 EMISSIONS

Following the measures adopted at Lean stage, further savings can be obtained through the incorporation of the proposed PV panels and ASHP. Through the integrated performance of the proposed measures at each step in the Energy Hierarchy, the development meets the relevant London Plan and London Borough of Bexley policies.

CONCLUSIONS

Following the implementation of the three-step Energy Hierarchy, the regulated CO_2 savings for the site as a whole are 35.1% with SAP20 emission factors.

ON SITE CO_2 SAVINGS

By implementing the three step Energy Hierarchy as detailed in the previous sections, the Regulated CO_2 emissions for the development have been reduced against a Part L 2013 compliant scheme through on site measures alone by 35.1% (10.5 tonnes per annum).

OFF SITE CO_2 SAVINGS: CARBON OFFSET PAYMENT

The proposed development complies with the London Plan CO_2 savings target of 35% overall.

With the SAP10 carbon factors, to achieve 'zero carbon' for the residential portion of the scheme, 19.5 tonnes per annum of regulated CO_2, equivalent to 583.9 over 30 years should be offset offsite.

Any carbon offset contributions will be subject to viability discussions and detailed design stage calculations when the SAP10 methodology and emission factors are finalised.

The tables in the following pages summarise the implementation of the Energy Hierarchy for the proposed scheme and detail the CO_2 emissions and savings against the baseline scheme for each step of the hierarchy; as well as the savings achieved through carbon offset.

Overall, the proposed development has been designed to meet energy policies set out by the GLA and the London Borough of Bexley, which demonstrates the client and the design team's commitment to enhancing sustainability of the scheme.

SITE-WIDE CUMULATIVE SAVINGS

Table 7: Site wide regulated CO_2 emissions and savings

	Total regulated emissions (tonnes CO_2/year)	Regulated CO_2 savings (tonnes CO_2/year)	Percentage saving (%)
Baseline	30.0		
Be Lean	24.9	5.1	16.9%
Be Clean	24.9	0.0	0.0%
Be Green	19.5	5.5	18.2%
Total		10.5	35.1%
Shortfall from zero carbon		583.9 tonnes over 30 years	

APPENDIX A – OVERHEATING RISK ASSESSMENT

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OVERHEATING ASSESSMENT

9.611 – 2-8 DANSON ROAD

17/10/2020 *by AC, reviewed by KM*

EXECUTIVE SUMMARY

An overheating analysis has been conducted for the bedrooms of the proposed development at 2-8 Danson Road, located in the London Borough of Bexley. The purpose of this analysis is to test the existing design and ensure the mitigation of any overheating risk within the occupied rooms. This will ensure the comfort of the occupants as well as future-proof the scheme by taking into account projected increased ambient air temperatures from climate change.

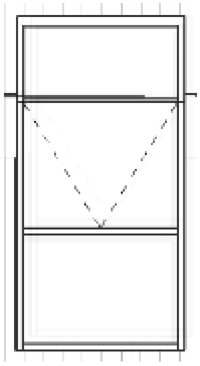
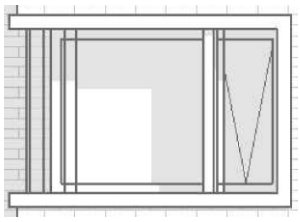
In order to assess the thermal performance of the development, models were constructed within a thermal simulation software. The internal temperature, lighting and ventilation conditions were estimated for all the internal spaces.

With the aim of giving the most robust consideration, performance of the various occupied rooms was compared with CIBSE Technical Memorandum 52 performance recommendations. These are rigorous targets that determine the acceptability of overheating based on the temperature differential between the internal and the external environment (ΔT), considering the frequency of high temperature difference, the severity, and an absolute peak difference beyond which the level of overheating is considered unacceptable.

A sample of bedrooms, considered to be the worst-case scenario, were considered for the dynamic thermal model. The thermal simulations indicated that the use of natural ventilation with opening Free Areas of 30% as well as solar control glazing with g-value of 0.5 and internal blinds enabled the bedrooms to pass overheating risk criteria under DSY1 2020 high emissions 50 percentile weather file. It is recommended that internal blinds are attached to the window frame so that they don't interfere with the air flow required for natural ventilation.

This indicates that natural ventilation would be possible for the bedrooms based on the method of assessment adopted but if strict control of internal environment is required, then some form of cooling would need to be provided.

On the following page, the table provides summary of the main window sizes and types identified for bedrooms within the scheme. Based on the architect's elevations (received on 09/11/2020 from Ryder), each window type identified throughout the scheme is able to comply with the minimum unobstructed free areas recommended (30%).

	g-value	Minimum Unobstructed Free Area Recommended	Reducing Overheating Further
	0.50	30%	Do not include bottom unopenable pane.
	0.50	30%	Both panes openable.

METHODOLOGY

3D thermal models of the proposed scheme at 2-8 Danson Road have been developed based on the planning architectural drawings received (November, 2020). To give a fair representation of the development, 8 habitable rooms were analysed to provide a representative sample of the space within the development. The rooms were selected based on type, size, location in the building, solar exposure, glazing areas and shading elements.

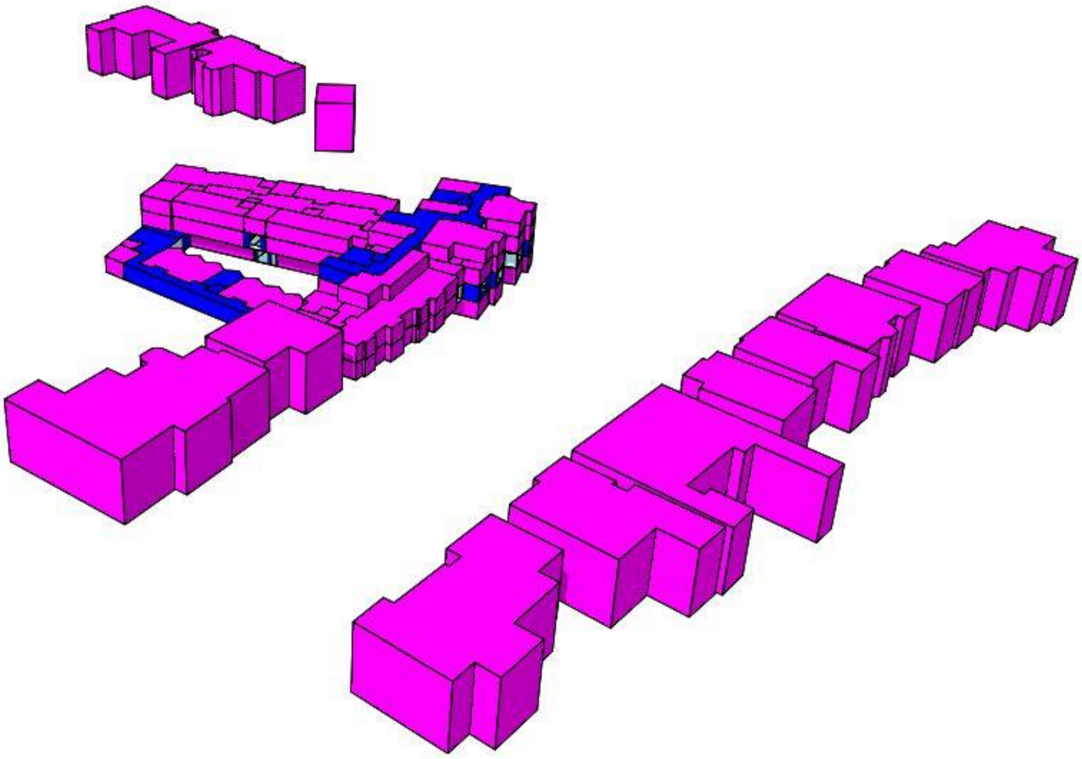


Figure 1: South-east axonometric view of 2-8 Danson Road

The overheating risks of the spaces were assessed for current and future climate scenarios as a worst-case approach. Following the methodology set out in CIBSE TM49 Design Summer Years for London, which was published after CIBSE TM52 guidance, the following three years were selected to form the set of probabilistic design summer years for the future weather scenarios:

- 2020 (DSY1-High 50 Percentile)
- 2020 (DSY2-High 50 Percentile)
- 2020 (DSY3-High 50 Percentile)

The first of these years, 2020 (DSY1-High 50 Percentile) represents a moderately warm summer, as is interpreted in current CIBSE guidance. The years 2020 (DSY2-High 50 Percentile) and 2020 (DSY3-High 50 Percentile) were chosen as more extreme years with different types of summer: the former has a more intense single warm spell, whereas the latter represents a year with a long period of persistent warmth.

The buildings have been modelled using dynamic thermal simulation software which is fully compliant with CIBSE Applications Manual AM11. The software can compute operative temperatures using CIBSE weather data sets, building fabric specification, window areas and opening, all aspects of solar and internal gains as well as natural ventilation flows within buildings. Compliance of the design with the CIBSE TM52 criteria has been sought and recommendations are formulated to future-proof the design for further interventions in the future.

ASSESSMENT CRITERIA

The performance standards set out within CIBSE TM52 have been used to assess the overheating risk within the proposed development.

At least two of the following criteria must be met:

1) **Hours of exceedance (H_e): H_e<3% of occupied hours**
The first criterion sets a limit for the number of hours that the operative temperature can exceed the threshold comfort temperature by 1°C or more during the occupied hours of a typical non-heating season (1 May to 30 September).
2) **Daily weighted exceedance (W_e): W_e<6**
The second criterion deals with the severity of overheating within any one day, which can be as important as its frequency, the level of which is a function of both temperature rise and duration. This criterion sets a daily limit for acceptability.
3) **Upper limit temperature (T_{upp}): T_{op}[1] - T_{max}[2] <4°C**
The third criterion sets an absolute maximum daily temperature for a room, beyond which the level of overheating is unacceptable.

All the criteria are evaluated in terms of the ΔT, which is the difference between the operative temperature T_{op} and the limiting maximum temperature T_{max}. $\Delta T = T_{op} - T_{max}$.

In order to estimate T_{op}, dynamic thermal modelling is carried out to compute the predicted temperature distribution in the different thermal zones of the building. The maximum acceptable temperature is a function of the outdoor temperature and the design limits which are shown below. The table details the suggested acceptability in terms of the temperature range of naturally ventilated buildings. For the purpose of the assessment, we have used Category II limits.

Table 2: CIBSE TM52 – Suggested applicability of the category and the associated acceptable temperature range for a free running building

Category	Explanation	Acceptable Range (ºC)
II	Normal expectation (for new buildings and renovations)	±3

[1] Operative temperature models the combined effect of convective and radiant heat transfer. It accounts for the combined of the temperature of the air, the temperature of the surfaces and air speed.
[2] T_{max} is the maximum acceptable temperature and is dependent on the outdoor running mean temperature and the building category with each associated acceptability range.

MODELLING ASSUMPTIONS

FABRIC PERFORMANCE

The specification of the fabric is summarised in the table below:

Element	Specification	
	U-value [W/m².K]	
External Walls	0.15	
Ground Floor	0.10	
Roof	0.10	
	U-value [W/m².K]	**g-value**
Window	1.3	0.63
	Air permeability (@50Pa)	
	3.0 m³/m².h	

OCCUPANCY

CIBSE does not specify the exact hours that the spaces are occupied, and as a result the BRE estimates that are inherited for the National Calculation Methodology (NCM) are often used as a basis for the prediction of the occupied hours of different areas of occupation in overheating assessment calculations.

Table 3 set out the predicted occupancy patterns for the assessed rooms; these are then programmed into the dynamic software model to calculate the relative occupancy gains for the designated space.

Table 3: Occupancy assumptions for bedrooms

Area	NCM Predicted occupation pattern
Bedroom	As per National Calculation Methodology

INTERNAL GAINS

Similarly to occupancy hours, the BRE estimates that are inherited for the National Calculation Methodology (NCM) are often used as a basis for the prediction of internal gains (lighting, equipment, people), however, when information is available that is specific to the project with regards to internal gains, this is incorporated into the model to give a more accurate representation of the conditions expected in the assessed rooms. In this case, people and equipment gains have been assumed as per the NCM predictions and lighting gains have been based on current assumptions for the lighting specification for the development.

Table 4 sets out the assumed internal gains for the assessed bedrooms; these are then programmed into the dynamic software model to calculate the relative internal gains for the designated space.

Table 4: Internal Gains assumptions for bedrooms

Area	Predicted Internal Gains		
	Lighting	**People**	**Equipment**
Bedroom	6.5 W/m²	9.55 m²/person at 100 W/person sensible gain and 40 W/person latent gain	3 W/m²

RESULTS

This section presents the results summary for each of the tests carried out for the bedrooms.

The results are presented in this subsection in line with CIBSE TM52 methodology, using DSY1, DSY2 and DSY3 2020 high emissions 50 percentile weather files.

The table below shows the number of the modelling iterations undertaken and the sequential improvement measures that are proposed to be incorporated for each iteration. The number of rooms that were found to meet at least 2 of the CIBSE TM52 criteria for each of the modelling iterations are also shown in the last column. The following observations can be made from the results:

- The use of natural ventilation alone (iterations 1-2) is not sufficient to mitigate the overheating risk in the bedrooms.
- The use of natural ventilation with free areas up to 30% combined with solar control glazing (g-value of 0.5) was found to have significant effect, resulting in 7 of 8 rooms meeting TM52 criteria (iteration 3).
- The use of natural ventilation (F.A 30%) together with solar control glazing (g-value of 0.5 and internal blinds fixed to the window frame) enabled compliance with TM52 criteria for the south-west facing bedroom located on the top floor (iteration 4).

Table 5: Overheating assessment results for the bedrooms with DSY1

Design Summer Year DSY1 2020 high emissions 50pct				
Iteration	**Window F.A. (occupied hours)**	**Glazing g-value**	**Solar shading**	**No. of spaces meeting 2/3 of TM52 criteria**
1	20%	0.63	-	3 of 8
2	30%	0.63	-	4 of 8
3	30%	0.5	-	7 of 8
4	30%	0.5	Venetian blinds fixed to window panes	8 of 8

The following table shows the results for the DSY2 and DSY3 weather files (2020 High Emissions 50 percentile).

Table 6: Overheating assessment results for the London Weather Centre with DSY2 and DSY3

Design Summer Years DSY2 and DSY3 high emissions 50pct						
Iteration	**Aperture F.A.**	**Glazing g-value**	**Thermal mass**	**Solar shading**	**No. of rooms meeting 2/3 of criteria**	
					DSY2	**DSY3**
5	30%	0.5	-	-	3 of 8	4 of 8
6	30%	0.5	Exposed ceiling	-	3 of 8	4 of 8

The results for Design Summer Year 2 and 3 show that none of the spaces meet TM52 criteria using standard mitigation techniques that suffice for moderately warm summer weather year in the 2020's (2011-2040 period) as presented in iteration 4. The combination of free areas for natural ventilation (30%), reduced g-value (0.5) for glazing, and exposed thermal mass would still not be sufficient to mitigate overheating risks as shown in iterations 5 and 6. This is primarily because these DSY2 and DSY3 weather files are particularly onerous to enable the rooms to achieve compliance with overheating benchmarks. Non-domestic spaces have stricter environmental control requirements, so some form of cooling would be recommended to achieve the desirable temperatures under more extreme summer periods and intense heat waves.

CONCLUSIONS AND RECOMMENDATIONS

High external temperature combined with solar gain and internal occupant/equipment gains in the spaces are the main contributors to the rise of internal air temperatures.

The analysis for DSY1 showed that the inclusion of openings with Free Areas of 30% and solar control glazing with g-value of 0.5 would enable all bedrooms to achieve compliance with the overheating benchmarks.

The results for DSY2 and DSY3 indicated that some form of cooling would be required for the spaces to achieve the desirable internal environment during more onerous heat waves.

Table 7: Summary of recommendations

Measure	Implementation
Minimise internal heat generation through energy efficient design	
High efficiency lighting installations (e.g. LED)	Energy efficient lighting installation recommended for all spaces.
LTHW pipework design and installations (location, configuration and insulation) to minimise heat losses.	LTHW pipework running in corridors and circulation areas to be highly insulated across the whole length; including jackets for valves and junctions. Primary distribution within the four residential blocks will be vertical rather than horizontal to reduce pipe lengths.
Reduce the amount of heat entering the building	
Solar control glazing	Application of double-glazing with a maximum g-value of 0.4 for all windows exposed to solar radiation.
Use of thermal mass to manage heat within the building	
Concrete slab providing thermal mass	Exposed thermal mass in the ceiling could help reduce some peak summer temperatures.
Passive ventilation	
Natural ventilation opening	Openable windows with 30% free area for natural ventilation.

APPENDIX B – SBEM RESULTS

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Danson Road_LEAN

As designed

Date: Thu Nov 26 14:05:50 2020

Administrative information

Building Details

Address: London,

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.6.b.0

Interface to calculation engine: Virtual Environment

Interface to calculation engine version: v7.0.13

BRUKL compliance check version: v5.6.b.0

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	27.3
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	27.3
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	24.8
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	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	Surface where the maximum value occurs*
Wall**	0.35	0.15	0.15	"LG000001_W1"
Floor	0.25	0.1	0.1	"LG000001_F"
Roof	0.25	0.1	0.1	"LG000001_C"
Windows***, roof windows, and rooflights	2.2	1.3	1.3	"LG00000F_W4_O0"
Personnel doors	2.2	1.5	1.5	"GF000019_W4_O1"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

$U_{a-Limit}$ = 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)]

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

** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

*** Display windows and similar glazing are excluded from the U-value check.

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

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ 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- LEAN

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.94	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* 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- DHW

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.94	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* 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.

1- SYST0000-DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	Hot water provided by HVAC system	-
Standard value	N/A	N/A

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
LGF_Bathroom	-	-	-	1	-	-	-	-	-	0.75	0.5
LGF_Sluice	-	-	-	1	-	-	-	-	-	0.75	0.5
LGF_Shower	-	-	-	1	-	-	-	-	-	0.75	0.5
LGF_Changing room	-	-	-	1	-	-	-	-	-	0.75	0.5
LGF_Kitchen	-	-	-	1	-	-	-	-	-	0.75	0.5
LGF_Storage	-	-	-	1	-	-	-	-	-	0.75	0.5
LGF_Plant room	-	-	-	1	-	-	-	-	-	0.75	0.5
LGF_Laundry	-	-	-	1	-	-	-	-	-	0.75	0.5

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**
LGF_WC	-	-	-	1	-	-	-	-	-	0.75	0.5
LGF_Bathroom	-	-	-	1	-	-	-	-	-	0.75	0.5
LGF_Bedroom	-	-	-	1	-	-	-	-	-	0.75	0.5
LGF_Bathroom	-	-	-	1	-	-	-	-	-	0.75	0.5
LGF_Bedroom	-	-	-	1	-	-	-	-	-	0.75	0.5
LGF_Treatement room	-	-	-	1	-	-	-	-	-	0.75	0.5
LGF_Nurse	-	-	-	1	-	-	-	-	-	0.75	0.5
LGF_Store	-	-	-	1	-	-	-	-	-	0.75	0.5
LGF_Dining area	-	-	-	1	-	-	-	-	-	0.75	0.5
LGF_Store	-	-	-	1	-	-	-	-	-	0.75	0.5
LGF_Corridors	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Orangery	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Bedroom	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Store	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Bathroom	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Nurse	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Treatment room	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Bedroom	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Bathroom	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Dining area	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Cinema	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Salon	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_WC	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Bistro Dining area	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Office	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Bathroom	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Office	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Store	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Store	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_WC	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Bathroom	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Bedroom	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Bathroom	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Bedroom	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Corridor	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Corridor	-	-	-	1	-	-	-	-	-	0.75	0.5
2F_Bedroom	-	-	-	1	-	-	-	-	-	0.75	0.5
2F_Bathroom	-	-	-	1	-	-	-	-	-	0.75	0.5
2F_Treatment room	-	-	-	1	-	-	-	-	-	0.75	0.5
2F_Bedroom	-	-	-	1	-	-	-	-	-	0.75	0.5
2F_Bathroom	-	-	-	1	-	-	-	-	-	0.75	0.5
2F_Corridor	-	-	-	1	-	-	-	-	-	0.75	0.5

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
LGF_Bathroom	-	85	-	46
LGF_Sluice	77	-	-	27
LGF_Shower	-	85	-	19
LGF_Changing room	77	-	-	138
LGF_Kitchen	-	85	-	283
LGF_Storage	77	-	-	50
LGF_Plant room	77	-	-	101
LGF_Laundry	-	85	-	287
LGF_WC	-	85	-	55
LGF_Bathroom	-	85	-	19
LGF_Bedroom	-	85	-	50
LGF_Bathroom	-	85	-	19
LGF_Bedroom	-	85	-	51
LGF_Treatement room	77	-	-	102
LGF_Nurse	77	-	-	51
LGF_Store	77	-	-	83
LGF_Dining area	-	85	-	48
LGF_Store	77	-	-	24
LGF_Corridors	-	85	-	981
GF_Orangery	77	-	-	221
GF_Bedroom	-	85	-	48
GF_Store	77	-	-	19
GF_Bathroom	-	85	-	19
GF_Nurse	77	-	-	59
GF_Treatment room	77	-	-	76
GF_Bedroom	-	85	-	48
GF_Bathroom	-	85	-	21
GF_Dining area	-	85	-	37
GF_Cinema	77	-	-	127
GF_Salon	77	-	-	116
GF_WC	-	85	-	33
GF_Bistro Dining area	-	85	-	254
GF_Office	77	-	-	120
GF_Bathroom	-	85	-	45
GF_Office	77	-	-	60
GF_Store	77	-	-	21
GF_Store	77	-	-	19
GF_WC	-	85	-	39
GF_Bathroom	-	85	-	18
GF_Bedroom	-	85	-	49
GF_Bathroom	-	85	-	20
GF_Bedroom	-	85	-	43

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
GF_Corridor	-	85	-	13
GF_Corridor	-	85	-	721
2F_Bedroom	-	85	-	48
2F_Bathroom	-	85	-	17
2F_Treatment room	77	-	-	52
2F_Bedroom	-	85	-	48
2F_Bathroom	-	85	-	16
2F_Corridor	-	85	-	275

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?
LGF_Changing room	N/A	N/A
LGF_Bedroom	NO (-13.2%)	YES
LGF_Bedroom	NO (-30.8%)	YES
LGF_Treatement room	N/A	N/A
LGF_Nurse	N/A	N/A
LGF_Dining area	YES (+2.4%)	YES
GF_Orangery	YES (+31.9%)	YES
GF_Bedroom	NO (-24.6%)	YES
GF_Nurse	N/A	N/A
GF_Treatment room	N/A	N/A
GF_Bedroom	NO (-50.1%)	YES
GF_Dining area	YES (+22.5%)	YES
GF_Cinema	YES (+16.1%)	YES
GF_Salon	NO (-56.6%)	YES
GF_Bistro Dining area	NO (-18.8%)	YES
GF_Office	NO (-74.9%)	YES
GF_Office	N/A	N/A
GF_Bedroom	NO (-67.8%)	YES
GF_Bedroom	NO (-66.6%)	YES
2F_Bedroom	NO (-63.8%)	YES
2F_Treatment room	N/A	N/A
2F_Bedroom	NO (-76.1%)	YES

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]	1602.2	1602.2
External area [m²]	2196.2	2196.2
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	491.7	1014.81
Average U-value [W/m²K]	0.22	0.46
Alpha value* [%]	33.69	20.45

* 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
100	**C2 Residential Institutions: Hospitals and Care Homes**
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	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	7.34	24.47
Cooling	0	0
Auxiliary	13.71	11.42
Lighting	18.6	18.04
Hot water	31.78	32.83
Equipment*	67.5	67.5
TOTAL**	**71.43**	**86.76**

* 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	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	341.42	343.34
Primary energy* [kWh/m²]	144.43	158.09
Total emissions [kg/m²]	24.8	27.3

* 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: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	23.3	318.1	7.3	0	13.7	0.88	0	0.94	0
	Notional	72.2	271.2	24.5	0	11.4	0.82	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

Key Features

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

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.15	"LG000001_W1"
Floor	0.2	0.1	"LG000001_F"
Roof	0.15	0.1	"LG000001_C"
Windows, roof windows, and rooflights	1.5	1.3	"LG00000F_W4_O0"
Personnel doors	1.5	1.5	"GF000019_W4_O1"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = 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
$m^3/(h.m^2)$ at 50 Pa	5	3

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Danson Road_GREEN

As designed

Date: Thu Nov 26 14:08:57 2020

Administrative information

Building Details

Address: London,

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.6.b.0

Interface to calculation engine: Virtual Environment

Interface to calculation engine version: v7.0.13

BRUKL compliance check version: v5.6.b.0

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	26
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	26
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	23.7
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	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	Surface where the maximum value occurs*
Wall**	0.35	0.15	0.15	"LG000001_W1"
Floor	0.25	0.1	0.1	"LG000001_F"
Roof	0.25	0.1	0.1	"LG000001_C"
Windows***, roof windows, and rooflights	2.2	1.3	1.3	"LG00000F_W4_O0"
Personnel doors	2.2	1.5	1.5	"GF000019_W4_O1"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

$U_{a-Limit}$ = 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)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ 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- GREEN

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1.43	-	-	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* 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.

2- DHW

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1.43	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* 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.

1- SYST0000-DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	Hot water provided by HVAC system	-
Standard value	N/A	N/A

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**
LGF_Bathroom	-	-	-	1	-	-	-	-	-	0.75	0.5
LGF_Sluice	-	-	-	1	-	-	-	-	-	0.75	0.5
LGF_Shower	-	-	-	1	-	-	-	-	-	0.75	0.5
LGF_Changing room	-	-	-	1	-	-	-	-	-	0.75	0.5
LGF_Kitchen	-	-	-	1	-	-	-	-	-	0.75	0.5
LGF_Storage	-	-	-	1	-	-	-	-	-	0.75	0.5
LGF_Plant room	-	-	-	1	-	-	-	-	-	0.75	0.5
LGF_Laundry	-	-	-	1	-	-	-	-	-	0.75	0.5

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
LGF_WC	-	-	-	1	-	-	-	-	-	0.75	0.5
LGF_Bathroom	-	-	-	1	-	-	-	-	-	0.75	0.5
LGF_Bedroom	-	-	-	1	-	-	-	-	-	0.75	0.5
LGF_Bathroom	-	-	-	1	-	-	-	-	-	0.75	0.5
LGF_Bedroom	-	-	-	1	-	-	-	-	-	0.75	0.5
LGF_Treatement room	-	-	-	1	-	-	-	-	-	0.75	0.5
LGF_Nurse	-	-	-	1	-	-	-	-	-	0.75	0.5
LGF_Store	-	-	-	1	-	-	-	-	-	0.75	0.5
LGF_Dining area	-	-	-	1	-	-	-	-	-	0.75	0.5
LGF_Store	-	-	-	1	-	-	-	-	-	0.75	0.5
LGF_Corridors	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Orangery	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Bedroom	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Store	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Bathroom	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Nurse	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Treatment room	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Bedroom	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Bathroom	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Dining area	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Cinema	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Salon	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_WC	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Bistro Dining area	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Office	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Bathroom	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Office	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Store	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Store	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_WC	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Bathroom	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Bedroom	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Bathroom	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Bedroom	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Corridor	-	-	-	1	-	-	-	-	-	0.75	0.5
GF_Corridor	-	-	-	1	-	-	-	-	-	0.75	0.5
2F_Bedroom	-	-	-	1	-	-	-	-	-	0.75	0.5
2F_Bathroom	-	-	-	1	-	-	-	-	-	0.75	0.5
2F_Treatment room	-	-	-	1	-	-	-	-	-	0.75	0.5
2F_Bedroom	-	-	-	1	-	-	-	-	-	0.75	0.5
2F_Bathroom	-	-	-	1	-	-	-	-	-	0.75	0.5
2F_Corridor	-	-	-	1	-	-	-	-	-	0.75	0.5

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
LGF_Bathroom	-	85	-	46
LGF_Sluice	77	-	-	27
LGF_Shower	-	85	-	19
LGF_Changing room	77	-	-	138
LGF_Kitchen	-	85	-	283
LGF_Storage	77	-	-	50
LGF_Plant room	77	-	-	101
LGF_Laundry	-	85	-	287
LGF_WC	-	85	-	55
LGF_Bathroom	-	85	-	19
LGF_Bedroom	-	85	-	50
LGF_Bathroom	-	85	-	19
LGF_Bedroom	-	85	-	51
LGF_Treatement room	77	-	-	102
LGF_Nurse	77	-	-	51
LGF_Store	77	-	-	83
LGF_Dining area	-	85	-	48
LGF_Store	77	-	-	24
LGF_Corridors	-	85	-	981
GF_Orangery	77	-	-	221
GF_Bedroom	-	85	-	48
GF_Store	77	-	-	19
GF_Bathroom	-	85	-	19
GF_Nurse	77	-	-	59
GF_Treatment room	77	-	-	76
GF_Bedroom	-	85	-	48
GF_Bathroom	-	85	-	21
GF_Dining area	-	85	-	37
GF_Cinema	77	-	-	127
GF_Salon	77	-	-	116
GF_WC	-	85	-	33
GF_Bistro Dining area	-	85	-	254
GF_Office	77	-	-	120
GF_Bathroom	-	85	-	45
GF_Office	77	-	-	60
GF_Store	77	-	-	21
GF_Store	77	-	-	19
GF_WC	-	85	-	39
GF_Bathroom	-	85	-	18
GF_Bedroom	-	85	-	49
GF_Bathroom	-	85	-	20
GF_Bedroom	-	85	-	43

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
GF_Corridor	-	85	-	13
GF_Corridor	-	85	-	721
2F_Bedroom	-	85	-	48
2F_Bathroom	-	85	-	17
2F_Treatment room	77	-	-	52
2F_Bedroom	-	85	-	48
2F_Bathroom	-	85	-	16
2F_Corridor	-	85	-	275

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?
LGF_Changing room	N/A	N/A
LGF_Bedroom	NO (-13.2%)	YES
LGF_Bedroom	NO (-30.8%)	YES
LGF_Treatement room	N/A	N/A
LGF_Nurse	N/A	N/A
LGF_Dining area	YES (+2.4%)	YES
GF_Orangery	YES (+31.9%)	YES
GF_Bedroom	NO (-24.6%)	YES
GF_Nurse	N/A	N/A
GF_Treatment room	N/A	N/A
GF_Bedroom	NO (-50.1%)	YES
GF_Dining area	YES (+22.5%)	YES
GF_Cinema	YES (+16.1%)	YES
GF_Salon	NO (-56.6%)	YES
GF_Bistro Dining area	NO (-18.8%)	YES
GF_Office	NO (-74.9%)	YES
GF_Office	N/A	N/A
GF_Bedroom	NO (-67.8%)	YES
GF_Bedroom	NO (-66.6%)	YES
2F_Bedroom	NO (-63.8%)	YES
2F_Treatment room	N/A	N/A
2F_Bedroom	NO (-76.1%)	YES

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]	1602.2	1602.2
External area [m²]	2196.2	2196.2
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	491.7	1014.81
Average U-value [W/m²K]	0.22	0.46
Alpha value* [%]	33.69	20.45

* 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
100	**C2 Residential Institutions: Hospitals and Care Homes**
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	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	4.82	16.36
Cooling	0	0
Auxiliary	13.71	11.42
Lighting	18.6	18.04
Hot water	20.87	21.95
Equipment*	67.5	67.5
TOTAL**	**58**	**67.77**

* 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	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	341.42	343.34
Primary energy* [kWh/m²]	138.92	152.04
Total emissions [kg/m²]	23.7	26

* 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: radiators, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	23.3	318.1	4.8	0	13.7	1.34	0	1.43	0
	Notional	72.2	271.2	16.4	0	11.4	1.23	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
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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	**$U_{i\text{-}Typ}$**	**$U_{i\text{-}Min}$**	**Surface where the minimum value occurs***
Wall	0.23	0.15	"LG000001_W1"
Floor	0.2	0.1	"LG000001_F"
Roof	0.15	0.1	"LG000001_C"
Windows, roof windows, and rooflights	1.5	1.3	"LG00000F_W4_O0"
Personnel doors	1.5	1.5	"GF000019_W4_O1"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = 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**
$m^3/(h.m^2)$ at 50 Pa	5	3

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