clancy consulting

ARC Oxford – Plot 4200

Energy Statement

31/01/2023

Rev. P2

Graham Hirst
Associate
[redacted]

enquiries@clancy.co.uk
www.clancy.co.uk

Clancy Consulting Limited
4th Floor
Windmill Green
24 Mount Street
Manchester
M2 3NX

Ref: 7_10537-CCL-XX-XX-RP-MEP-5902

CAVEAT

This document has been prepared for the titled project, or named part thereof, and should not be relied upon or used for any other project or part as the case may be, without an independent check being made on it. Clancy Consulting shall not be liable for the consequences of using this document other than for the purpose for which it was commissioned, and any user and any other person using or relying on this document for such other purpose, agrees and will by such use or reliance be taken to confirm this agreement to indemnify Clancy Consulting for all loss or damage resulting therefrom.

DOCUMENT ORIGIN

Revision	Date	Revision Description		Name	Signature
P1	17/11/23	Original	Prepared	Graham Hirst	GHirst
			Checked	Jeremy Silvester	J Silvester
			Approved	Jeremy Silvester	J Silvester
P2	31/01/24	Amended Energy Statement to suit new layout plans	Prepared	Graham Hirst	GHirst
			Checked	Jeremy Silvester	J Silvester
			Approved	Jeremy Silvester	J Silvester

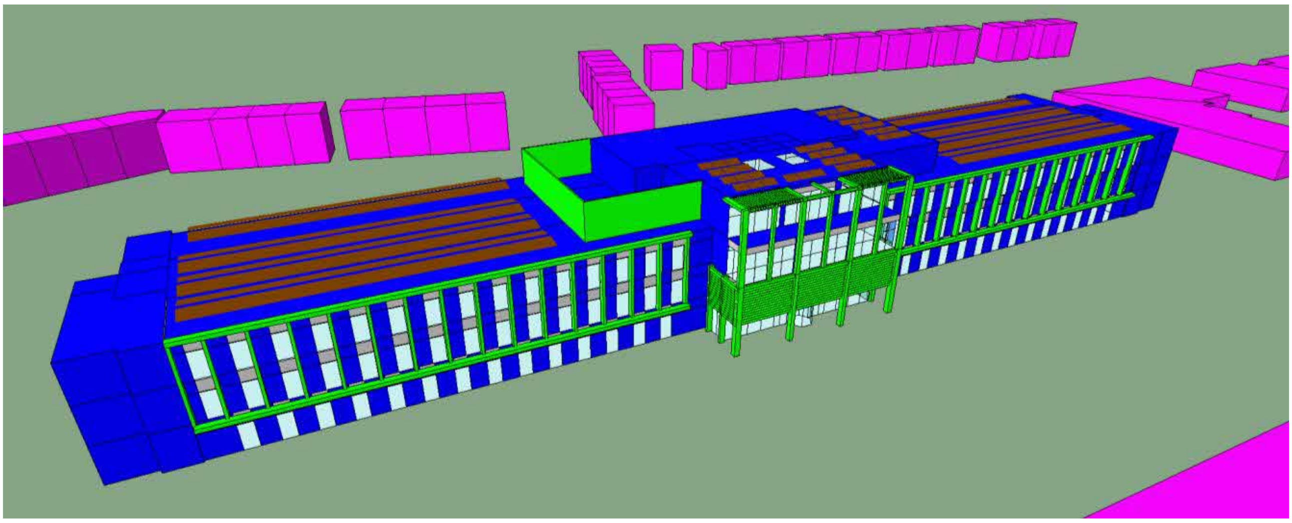


Figure 1: Thermal Model Image of Proposed Building

CONTENTS

1. Introduction

This report has been prepared at the request of Dalkia UK.

The following document outlines the planning energy strategy required for the proposed development at: Plot 4200 Arc Oxford, John Smith Drive, Oxford,OX4 2RU

ARC is Europe's leading network of science and innovation clusters. At the cutting edge of major knowledge economies, it supports businesses in the science and technology sector by creating the best possible environments for innovation, allowing them to thrive and make a difference in the world. It currently operates from several locations in London and Oxfordshire – including ARC Uxbridge, ARC West London, the Harwell Campus and ARC Oxford.

1.1 Site Description

Formerly known as Oxford Business Park, ARC Oxford is a well-established employment site comprising 88 acres in the Cowley area of Oxford. It is home to several businesses, including several focused on science and innovation, set within a landscaped 'Campus' environment. In addition to employment space, other uses at ARC Oxford include Oxford Factory (café/restaurant), Oxford Works, a Premier Inn hotel and restaurant, a David Lloyd Racket & Health Centre and a Bright Horizons day nursery.

Plot 4200 lies within the southern part of ARC Oxford to the west of John Smith Drive. It currently comprises of 7 individual office buildings organised around areas of car parking and intermittent tree planting. Residential development lies to the west and an existing private footpath runs alongside the southern side of the site. It is located in a commercial context, with other development forming part of ARC Oxford located to the north, east and south. Further commercial development is found on the eastern side of the By-Pass, including the Oxford Retail Park and MINI plant. The residential properties are located on Phipps Road, Bailey Road and Frederick Road to the northwest of the site. The site is 1.3ha

Figure 1: Site Location

1.2 Development description

The proposals involve the demolition of all existing buildings on the site, making way for the redevelopment of a single laboratory-enabled office building. The building will contain internal ancillary amenity on upper floors. Some ancillary servicing infrastructure will be provided in the landscape. The proposals will also deliver enhancements to the existing private footpath leading into the ARC Oxford site from Boswell Road, alongside car and cycle parking.

The proposed building is a three-storey high building with a Ground floor shared reception area. There are external plant compounds with evacuation stairs located on each floor on either end of the buildings with a rooftop plant room and compound.

The building has external car-parking around the perimeter of the building.

The proposed development has been designed as a Laboratory ready facility. The initial design is to be based on a shell and core with space planning to accommodate laboratory and administration facilities as a 60:40 split. Future laboratory fitout will be to Category CL2 (Containment Level 2).

All works will comply with legislative requirements current at the time the Building Contract is let and in accordance with the latest edition (including amendments) of the Building Regulations, British Standards and approved Codes of Practice.

The building will obtain Building Regulations approval, which will also include acknowledgement of the Equality Act provisions and will conform to the Fire Prevention Act, Health and Safety at Work Act, Workplace regulations 1992, Environmental Health, Local Bye Laws, Town, and country Planning Acts and the CDM regulations 2015.

The project proposals have been reviewed and it is considered that the scheme can be constructed utilising sustainable design methods to ensure that the Council's aspirations are met.

- Table A outlines building fabric criteria which can be utilised to achieve compliance.
- Table B outlines system performance criteria which can be utilised to achieve compliance.
- Appendix A provides the rationale for the allocation of on-site Low and Zero Carbon technologies and renewables.

During the design period the proposals will be examined in detail and will be the subject of more refined analysis. This detailed analysis will be based on the actual details intended for construction to confirm and / or modify the following information.

2 Terms of Reference

This Sustainability Statement seeks to demonstrate that the design intent for the scheme as well as the commitment to aligning with the Councils aspirations to deliver sustainable developments. The environmental and energy strategy for the scheme has been developed using the following regulations and planning policies.

2.1 Building Regulations

The Building Regulations Approved Document Part L (Conservation of Fuel and Power) 2021 outline the requirements for reductions in carbon emissions and primary energy usage required for new developments.

The scheme has been initially reviewed against the requirements of Building Regulations Part L Vol 2 'Building other than dwellings' utilising Dynamic Simulation Modelling (DSM).

2.2 Oxford Local Plan 2036 (Adopted June 2020)

City Council aims to tackle the causes of climate change by ensuring developments use less energy and assess the opportunities for using renewable energy technologies . The City Council is committed to a 100% reduction in total carbon dioxide (CO_2) emissions produced in the city by 2050 from 1990 levels to limit climate change.

Planning permission will only be granted where it can be demonstrated that the following sustainable design and construction principles have been incorporated, where relevant:

2.2.1 Policy RE1 Sustainable Design & Construction

Energy Statement

An Energy Statement will be submitted to demonstrate compliance with this policy for new-build residential developments (other than householder applications) and new-build non-residential schemes over 1,000m. The Energy Statement will include details as to how the policy will be complied with and monitored.

Carbon Reduction in New Build Non-Residential Developments of 1000m^2 or more

Planning permission will only be granted for non-residential development proposals that meet BREEAM excellent standard (or recognised equivalent assessment methodology) in addition to the following reductions in carbon emissions which are also required .

Planning permission will only be granted for development proposals of 1,000m^2 or more which achieve **at least a 40% reduction** in the carbon emissions compared with a 2013 Building Regulations (or **future equivalent legislation**) compliant base case. This reduction is to be secured through on-site renewables and other low carbon technologies and/ or energy efficiency measures . The requirement will increase from 31 March 2026 to at least a 50% reduction in carbon emissions.

Heat Networks

The City Council will encourage the development of city-wide heat networks . If a heat network exists in close proximity to a scheme it is expected to connect to it, and this will count towards the development's carbon reduction requirements . Evidence will be required to demonstrate why connection to the network is not possible .

Water Efficiency

Proposals for non-residential development are to meet the minimum standard of four credits under the BREEAM assessment .

2.2.2 Policy RE6 Air Quality

Planning permission will only be granted where the impact of new development on air quality is mitigated and where exposure to poor air quality is minimised or reduced.

The exposure of both current and new occupants to air pollution during the development's operational and construction phases, and the overall negative impact that proposals may cause to the city's air quality, will be considered in determining planning applications . Where additional negative air quality impacts from a new development are identified, mitigation measures will be required to ameliorate these impacts .

Planning applications for major proposals (10 or more dwellings or 1000 square metres) which would carry a risk of exposing individuals to unacceptable levels of air pollution must be accompanied by an Air Quality Assessment (AQA) .

Further guidance on meeting the requirements of the policy is set out in the Oxford City Council's Air Quality Planning Application Guidance Note and the up-to-date IAQM guidelines which applicants are expected to follow .

2.3 Sustainable Design & Construction Technical Advice Note 14 (July 2022)

The City Council is committed to a 100% reduction in total carbon dioxide (CO_2) emissions produced in the city by the national policy target of 2050 in order to limit its impacts on climate change. As well as declaring a climate emergency in 2019, the City Council has recently (February 2021) signed a pledge to achieve net zero carbon emissions as a city by 2040.

The technical advice note (TAN) aims to provide advice and guidance on Local Plan Policy RE1 – Sustainable Design and Construction as well as on how development should be designed in order to achieve net zero carbon objectives.

Energy Hierarchy

Applicants are encouraged to follow the principles of the energy hierarchy when designing their development.

- Reduce energy need – through passive design measures
- Be efficient in energy use – use energy efficient systems for lighting, heating/cooling, operation etc.
- Source energy from renewables – after energy use has been reduced as much as possible, source remaining needs from renewable technologies including decentralised sources

Utilise sustainable heat sources

Applicants will therefore be strongly encouraged to avoid installation of heat sources which rely on fossil-fuel burning, such as gas boilers, and to instead aim to meet heating and hot water needs through low carbon alternatives, such as heat pumps.

Selecting low carbon heat sources would be in keeping with policy RE1's aspiration of limiting carbon dioxide emissions from new development wherever possible, as well as principles (a) (Maximising energy efficiency and the use of low carbon energy) and (f) (Being flexible and adaptable to future occupier needs) of the policy. Principally, it means that applicants will avoid committing occupiers to potentially expensive and disruptive alterations in future.

Renewable energy technology

Applicants should be proactive in seeking to meet energy and heat needs of the development through onsite renewable technology wherever possible. Where a proposal incorporates renewable technologies, such as solar PV or air source heat pumps, these should be clearly demonstrated on the plans/elevations submitted with the application.

Design for net zero operational carbon

The Local Plan sets out the requirement for reducing emissions by 40% and has a stepped set of targets moving towards full net zero by 2030. However, these future targets should not prevent applicants from delivering net zero development in advance of these dates.

True net zero development will not only consider regulated energy sources as controlled through Building Regulations and accounted for through SBEM reports but should also consider unregulated sources of energy. Where possible, energy needs ought to be met renewably and should be able to accommodate these unregulated sources, as well as the regulated sources, if the building is to achieve true net zero carbon in operation.

LETI have produced a set of guidance, including targets for various built elements within a range of building typologies. Whilst appropriate targets are likely to differ from site to site, applicants could consider this guidance in the first instance when designing for net zero and show how they have incorporated it into the design of their proposals.

Water Efficiency

Policy RE1 states: "Proposals for non-residential development are to meet the minimum standard of four credits under the BREEAM assessment". Four credits under the BREEAM assessment is the equivalent to a 50% improvement in water efficiency against a BREEAM approved baseline. Water consumption for the assessed building is compared against a baseline performance.

Monitoring

Policy RE1 includes a requirement that the Energy Statement "will include details as to how the policy will be complied with and monitored". Although Policy RE1 does not place any formal requirements on precisely how monitoring of development proposals should take place, This TAN therefore provides advice as to the type of monitoring the City Council would like to see carried out by applicants.

The Building Regulations (2010) (L2A Conservation of Fuel and Power) require that in new buildings (other than dwellings) over 1,000m2 automatic meter reading and data collection facilities are provided. The requirement for energy meters also features under the BREEAM accreditation scheme for levels 'Very Good', 'Excellent' and 'Outstanding'.

3 Confirmation of Scope and Route to Compliance

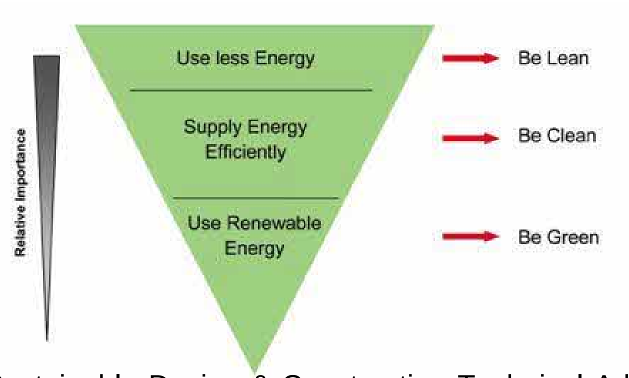
3.1 Energy Hierarchy

This development follows the principles to 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



This is the same hierarchy as suggested in Sustainable Design & Construction Technical Advice Note 14.

3.2 Fabric Performance

The intention is to adopt an enhanced building fabric based on values which are equal or better than the minimum required for compliance with Building Regulations AD Part L 2021 as outlined in Table ‘A’ below. This will minimise the building energy demand and contribute towards Building Regulations compliance. Also, the performance against the LETI design guide suggested fabric U-values for a commercial office have been shown for reference.

Description	Part L upper limit 2021	LETI Suggested Measures	Proposed requirement for Building	Improvement Relative to Part L
External Wall U-Value	*0.26 W/m^2.K area-weighted average*	*0.12 - 0.15 W/m^2.K*	**0.18 W/m^2.K (average) 0.15 W/m^2.K (wall element) 0.5 W/m^2.K (Spandrel Panel)**	31% Improvement
Ground Floor U-Value	*0.18 W/m^2.K area-weighted average*	*0.10 - 0.12 W/m^2.K*	**0.12 W/m^2.K**	33% Improvement
Roof U-Value	*0.16 W/m^2.K area-weighted average*	*0.10 - 0.12 W/m^2.K*	**0.12 W/m^2.K**	25% Improvement
Window U-Value	*1.6 W/m^2.K area-weighted average*	*1.0 – 1.2 W/m^2.K*	**1.3 W/m^2.K**	19% Improvement
Curtain Glazing U-value	*1.6 W/m^2.K area-weighted average*	*1.0 – 1.2 W/m^2.K*	**1.4 W/m^2.K (Glazing & spandrel Panel combination)**	12% Improvement
Glass G-value	*N/A*	*0.4 – 0.3*	**0.22-0.33 (BS EN 410)**	

Description	Part L upper limit 2021	LETI Suggested Measures	Proposed requirement for Building	Improvement Relative to Part L
Door U-Value	*1.6 W/m^2.K area-weighted average*	*1.2 W/m^2.K*	**1.4 W/m^2.K**	12% Improvement
High Usage Entrance Door	*3.0 W/m^2.K area-weighted average*	*1.9 W/m^2.K*	**1.8 W/m^2.K**	40% Improvement
Building Air Permeability	*8 m^3/(h.m^2) @ 50 Pa*	*<1 m3/(h.m2) @ 50 Pa*	**2 m^3/(h.m^2) @ 50 Pa**	75% Improvement

Table A – Proposed fabric performance

3.3 Passive design Measures

Trees and green spaces can significantly cool the surrounding area by evaporation and 30% vegetation could provide a significant reduction noon time air temperature. Trees, planting, and green areas are being maintained/provided which shall help assist minimising summertime microclimate temperatures. This will provide better thermal conditions around the building and reduce cooling energy requirements for the comfort cooling system.

There is a use of Brise-Soleil to minimise the solar gain to some areas including the reception area, there is also shading used throughout the façade design to limit the solar gain.

3.3.1 Building Services Performance

Furthermore, efficient systems will be adopted as outlined in Table B below to minimise the building energy consumption and contribute further towards a passive and sustainable building which is compliant with Building Regulations.

Description	System		
	Tenant Fitout Out Areas (Labs & Offices),Gym Café, Reception	Core WC, Changing Areas	Circulation
Space Heating & Cooling	**System Type: Fan Coils** Heating SCOP: 3.5 Cooling SEER: 4.5 Terminal Unit SFP: 0.27 W/l/s Variable speed pumps	**System Type: Tempered Air/ Rads** Heating SCOP: 3.5 Variable speed pumps	**System Type: LTHW Radiators** Heating SCOP: 3.5 Variable speed pumps
Ventilation	**Central AHU** SFP 1.85 W/l/s AHU Leakage: Class L2 Heat Recovery Efficiency: 78%.	**Extract Ventilation** SFP 0.5 W/l/s	**Natural Ventilation**

<table>
<tr><th rowspan="2">Description</th><th colspan="3">System</th></tr>
<tr><th>Tenant Fitout Out Areas (Labs & Offices),Gym Café, Reception</th><th>Core WC, Changing Areas</th><th>Circulation</th></tr>
<tr><td>Domestic Hot Water</td><td colspan="3">Air Source Heat Pump
SCOP: 2.2
Hot water Storage 4No 1000 litre vessels
2600 metres of flow and return pipework allowed for. (To be confirmed on development of design)
2No 0.2kW DHW Secondary Return pumps</td></tr>
<tr><td>Lighting</td><td>130 Luminaire
Lumens per circuit
Watt
Daylight Dimming
Absence Detection</td><td>100 Luminaire
Lumens per circuit
Watt
Presence Detection</td><td>100 Luminaire
Lumens per circuit
Watt
Presence Detection</td></tr>
<tr><td>Management & Control Features</td><td colspan="3">Power Factor Correction
Automatic Monitoring & Targeting with alarms with out-of-range values</td></tr>
</table>

Table B – Proposed efficient building services system

3.3.2 Renewable Energy Systems

Renewable and low carbon energy systems have been considered inline with Building Regulations regulation 25A. Details of the assessment can be seen in section 9 (Appendix A). From this assessment photovoltaic panels and air source heat pumps (Chiller with heat recovery) were deemed the best renewable or low carbon systems that were appropriate to the building and aligned with Oxford Councils aspirations.

BRE's report on heat networks for Oxford report included 3 options for developing a network, however, none of the options were anywhere near the ARC Oxford area but rather centred around the City Centre and University

Provision for a new photovoltaic system is proposed on the third-floor roof and above the fourth-floor roof area plant space. This currently has space for approximately 1212m^2 of panel area facing east-west at an inclination of 10°, which will provide approximately 263 kWp. The modelling of the PV estimates an annual output of 212 MWh of electricity.

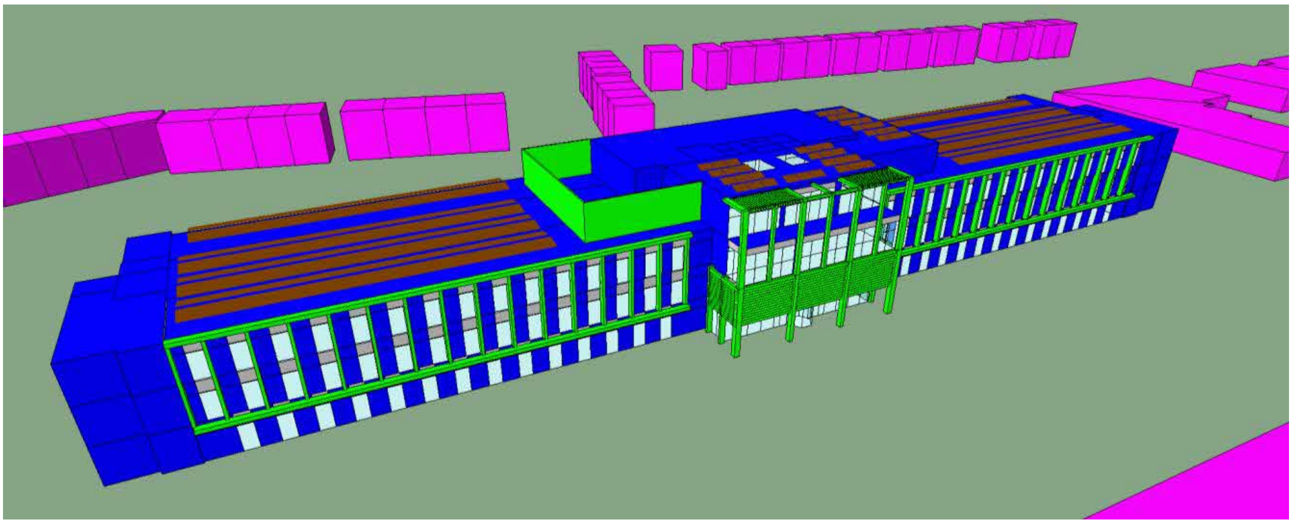
Air source heat pumps are also proposed for both space heating and domestic hot water production. Space heating will be provided by a 4-pipe outdoor air source heat pump which will be able to recover heat energy rejected by the cooling circuit and inject it into the heating.

A high temperature air source heat pump is proposed to serve the domestic hot water system.

4 Building Regulation Part L Thermal Modelling

4.1 Introduction

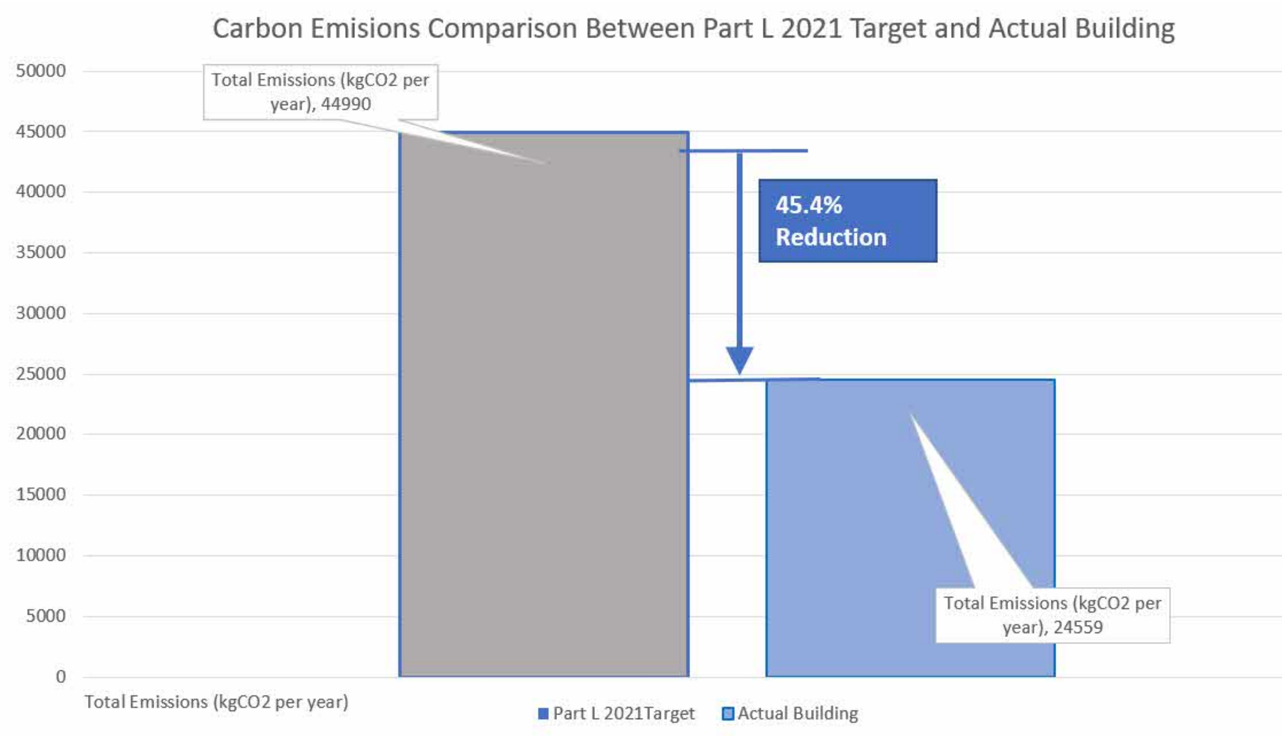
IES accredited software, version 2023.1.0.0 was used to create a model of the building. IES automatically generates the Notional Building from which the Notional Building CO_2 emission rate and primary energy rate are calculated. The Target emission rate (TER) and Target Primary Energy Rate (TPER) is subsequently calculated and compared with the Actual Building emission rate (BER) and Actual Primary Energy Rate.



The thermal model used the fabric performance of Table A along with the Building Services equipment and efficiencies as shown in Table B. The relevant excerpts from BRUKL document are shown in Section 10 (Appendix B)

The building is classed as Class E(g)(i) [Offices to carry out any operational or administrative functions] and E(g)(ii) [Research and development of products or processes]. However, there are no laboratory room types within the NCM (National Calculation Methodology) Building type “Offices and Workshop Business”. The closest NCM building types which include a laboratory room type is “General Industrial and Special Industrial Groups” and “Residential Institutions: Universities and Colleges”. Neither of these building types match the proposed building, however after further analysis it decided that “Residential Institutions: Universities and Colleges” was a better fit. This was because the “General industrial building” is defined in the NCM as a top lit space and therefore mid-level lab floors would have no external glazing. It was also thought that the research status of the building may be more similar to a university.

4.2 Results



The Part L thermal dynamic simulations shows that the proposed building and building services can achieve a 40% improvement on Part L 2021 target in line with planning policy RE1. This is a reduction of 20.4 Metric tonnes of carbon dioxide emissions per year.

The proposal is to provide a fabric first solution by minimising heat loss through the thermal elements. The thermal elements are within the suggested performance range of the LETI guide except for the building air leakage, windows, spandrel panels and door U-values. (Door U-values will have negligible impact on the overall fabric performance).

All building services systems utilise electric and will not use fossil fuels for regulated energy and therefore will take advantage of the decarbonisation of grid electricity and meet the ‘nearly zero carbon emissions’ standard within Part L 2021.

During the design stage, the proposals will be subject to more refined modelling based on the final building form, construction details and building services systems to optimise the design.

The carbon reduction target for RE1 will be monitored through the design stage and modification to the building services strategy will be made if required. The ‘as built’ BRUKL will also confirm whether the building has met the RE1 target.

End use energy metering will also be included to record at least 90% of the utility meter energy against an end use category, along with sub metering on the photovoltaic system. This will include the provision of automatic meter reading and data collection facilities.

5 Consideration for Pollution

ARC Oxford is situated within an Air Quality Management Area (AQMA). An AQMA is declared for areas which are not likely to meet the air quality objectives and hence is an area that will be addressed by the Council for improvement.

The proposed fixed building services will not include any energy generation from gas or other fossil or solid fuel (e.g., Biomass) therefore there are no additional local pollutants generated from equipment flues associated with the building services within these buildings.

Ventilation will be via air handling units (AHU) at each floor level complete with filters, along with the landlords AHU located in the roof top plant room. This will provide good indoor air quality for occupants from indoor pollutants such as volatile organic compounds (VOC's), allergens (e.g., dust mites), odours from cooking/ body perspiration, moisture etc.

6 BREEAM

The building is targeting BREEAM 'Excellent' Rating in line with planning requirements. As part of the assessment 4No credits are being targeted for Wat 01 water consumption by achieving a 50% improvement on the BREEAM Wat 01 notional baseline. This will meet the planning requirement for water consumption reductions.

7 Conclusion

This development follows the principles to make the fullest contribution to minimising carbon dioxide emissions in accordance with the energy hierarchy as follows:

Be Lean

Passive design measure including excellent building fabric performance and a good form factor have minimised the regulated energy demand. These measures will have the longest impact on carbon savings, most of them for the life of the building.

Be Clean

BRE's report on heat networks for Oxford report included 3 options for developing a network, however, none of the options were anywhere near ARC Oxford area but rather centred around the City Centre and University

Due to changes in grid carbon factors, gas CHP is not appropriate as it increases carbon emissions over that of using direct electricity.

All building services systems utilise electric and will not use fossil fuels for regulated energy and therefore, will take advantage of the decarbonisation of grid electricity and meet the 'nearly zero carbon emissions' standard within Part L 2021.

Be Green

The building services exclude the use of combustion equipment for providing space heating and hot water and therefore will not impose any additional local pollution associated with the regulated building services.

Provision for a new photovoltaic system is proposed on the third-floor roof and above the fourth-floor roof area plant space. This currently has space for approximately 1212m^2 of panel area facing east-west at an inclination of 10°, which will provide approximately 263kWp. The modelling of the PV estimates an annual output of 212 MWh of electricity.

Part L 2021 target in line with planning policy RE1

The building is predicted to achieve a 45.4% carbon emission reduction against Part L 2021 in excess of the 40% required by policy RE1 of the Oxford Local Plan. This has been achieved through passive design, excellent building fabric performance and renewable technology.

A summary of the design measures employed linking to the associated planning guidance is shown in section 8 for reference.

8 Summary

Design Measure	Associated Planning Requirement / Guidance
The building is designed following the energy hierarchy principles. The building achieves a 40% improvement on Building Regulations Part L 2021 requirement	TAN14 (Energy Hierarchy) Policy RE1(Carbon Emissions)
No heat networks are currently proposed for the ARC Oxford area	Policy RE1 (Heat Networks)
As part of the BREEAM assessment 4No credits are being targeted for Wat 01 water consumption by achieving a 50% improvement	Policy RE1 (Water Efficiency) TAN 14 (Water Efficiency)
The proposed fixed building services will not include any energy generation from gas or other fossil or solid fuel	Policy RE6 (Air Pollution) TAN 14 (Sustainable Heat Sources)
The building is targeting BREEAM 'Excellent' Rating	TAN 14 (BREEAM)
Provision for a new photovoltaic system is proposed of approximately 1212m^2 of panel area to provide 263 kWp with an estimated annual output of 212 MWh of electricity. Air source heat pumps are proposed for Space and Water heating	TAN 14 (Renewable)
The carbon reduction target for RE1 will be monitored through the design stage and 'as bult' stage confirming that the building has met the RE1 target of 40% improvement. End use energy metering will also be included to record at least 90% of the utility meter energy against an end use category, along with sub metering on the photovoltaic system. This will include the provision of automatic meter reading and data collection facilities.	TAN 14 (Monitoring)

9 APPENDIX A: Regulation 25A Assessment

9.1 Introduction

9.1.1 Purpose of Study

This report considers the technical, environmental, and economic feasibility of using high-efficient alternative systems in the construction.

The Building Regulations are technology neutral and do not require that high-efficiency alternative systems or other low and zero carbon systems are installed. However, where a technology is feasible but not included in the design, then consideration of making the building easily adaptable by facilitating the integration of any feasible technology will be included if appropriate.

This assessment has been carried out at RIBA Stage 2 (Concept Design).

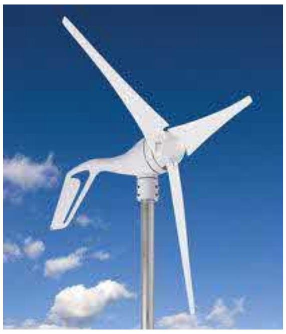
9.1.2 Limitation

This report considers high efficient systems at a high level and considers its feasibility on physical limitations of the site and known issues associated with each technology. It is recognised that the development of any energy strategy is an iterative process that takes into account development needs, end user's requirements, site restrictions and changes to legislation and incentive programmes. Any considered system will need further detailed analysis prior to specification and installation.

9.2 High Efficient Alternative Systems

9.2.1 Wind – Micro scale

Technology Description
Wind turbines harness energy from wind and convert it into electricity. Wind passing over the blades causes them to rotate, and the blade rotor axle passes through an electricity generator. The electrical output is passed through a control system and then an inverter which is connected to the buildings mains electrical system. The inverter ensures that the alternating current electricity produced by the turbine is synchronous and in phase with the mains electrical supply.



Not Economically Feasible - Wind speed results would suggest that a wind turbine would not be economically viable.

9.2.2 Wind – Large and Medium scale

Technology Description

Medium (30m – 80m overall height to blade tip) and large turbine (80m+) can be used for a large building or groups of buildings. A 'private wire' system can deliver electricity to each building with any surplus being exported to the grid. Other factors to consider include risk of collision with low flying aircraft and interference with radar as well as visual impacts, shadow flicker and noise.

Not Technically Feasible - No suitable location for wind turbine

Technology Description

Photovoltaic (PV) systems convert energy from the sun into electricity through semiconductor cells. When sunlight reaches the semiconductor material, direct current is generated. In most systems, this is then converted into alternating current by means of an inverter, which is fed into the dwelling's mains electrical system.

Feasible - It is currently proposed to include PV's within the design

9.2.4 Solar Thermal

Technology Description

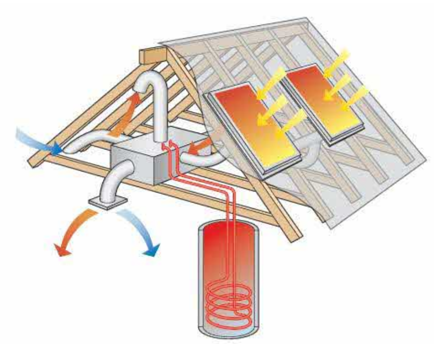
Solar thermal systems harness energy from the sun to heat water. Various systems are available, but generally a solar thermal collector, installed at roof level, absorbs the sun's energy, and transfers it into a liquid (normally a water/antifreeze solution). This liquid is circulated through a heat exchange coil where its heat is transferred. Generally solar thermal systems are used to heat domestic hot water or swimming pool water.

Less Desriable - Savings in energy and carbon are greatly reduced when paired with ASHP generated domestic hot water

9.2.5 Solar Air Heating

Technology Description

Solar air heating systems collect solar energy to heat air. The air can be used to pre-heat ventilation air, heat air inside a building or to heat water. A basic system comprises a solar collector and a hot air distribution system. Solar air systems can also incorporate thermal storage using either the thermal mass of the building or dedicated thermal stores, such as a rock store. The solar collectors can be purpose-built panels or a glazed cavity over an existing façade.



Not Technically Feasible - No adequate space for solar air collector or correct building type for a transpired air collector.

9.2.6 Aero-Thermal / Air Source Heat Pump

Technology Description

Air source heat pumps extract heat from the outside air or warm exhaust air. The heat can then be used for heating and domestic hot water. The heat pump efficiency is related to the difference between the source temperature and supply temperature, therefore in winter, when heat is most needed the efficiency and output reduces. Noise from the external unit also has to be considered.

Feasible - It is currently proposed to include air source heat pumps for space heating and domestic hot water generation

9.2.7 Ground Source Heat pumps

Technology Description

Ground source heat pumps extract heat from the ground by either horizontal coils or vertical bore holes. The heat can then be used for heating and domestic hot water. A ground source heat pump system absorbs heat from the ground and releases it at a higher temperature for use within a building. The ground has a more stable temperature than ambient air which often results in higher overall efficiencies than an air source heat pump.

Not Economically Feasible - Much higher cost solution than airsource for approximately 25% improvement in efficiency

9.2.8 Hydrothermal / Surface Water Source Heat Pumps

Technology Description
Surface water (rivers, lakes, sea canal) can be used in an open –loop or via submerged heat exchanger to extract heat to be used for heating and domestic hot water. The choice of system will depend on environmental consideration, quality of the water and risk of biofouling of the pipework and heat exchanger (for open-source systems)

Not Technically Feasible - No suitable surface water bodies which can be used for heat extraction

9.2.9 Hydropower

Technology Description
The energy from flowing water is used to generate electricity using a turbine. Depending on the water flow and head of the water course, different types of turbines are used. An abstraction licence is required for all turbines, as the part of the water course between extraction and insertion can be affected by the reduced flow (this is known as the depleted or deprived reach). This can impact on ecology, amenity, and navigation needs.

Not Technically Feasible - No suitable water course within the boundaries of the development.

9.2.10 Biomass

Technology Description
Biomass is any plant-derived organic material that renews itself over a short period. Biomass energy systems are based on either the direct or indirect combustion of fuels derived from those plant sources. The amount of carbon released from burning the biomass is equal to the carbon absorbed when growing. The only carbon associated with biomass is related to processing and transportation.

Not Technically Feasible: Biomass heating does not align with the Council's Air Quality objectives

9.2.11 Biogas

Technology Description

Biogas can be obtained from the breakdown of various organic materials, by natural digestion. The gas generated can be used for burning or may be used in internal combustion engines as part of CHP systems. Farm, food, and market waste products are particularly good as source materials. Generally, plant is of an industrial nature and is more ideal co-located with light industrial or agricultural buildings.

Not Technically Feasible - Inappropriate location for industrial type plant

9.2.12 Cogeneration (Also Known as Combined Heat and Power [CHP])

Technology Description

Combined heat and power is the generation of thermal and electrical energy in a single process where both energy streams can be utilised within buildings. Although the production of electricity by CHP is less efficient than that achieved from national power stations, the use of the heat that would otherwise be rejected leads to net saving in primary energy.

Not Technically feasible - Due to changes in grid carbon factors, gas CHP is not appropriate as it increases carbon emissions over that of using direct electricity.

9.2.13 Onsite Community Heating or Block Heating

A community heating scheme provides heat from a central source to more than one building or dwelling via a network of heating mains. Heat can be supplied from conventional boilers or from renewable energy sources or waste heat from power generation (Combined Heat and Power). Community heating is most appropriate were heating demand is required over a small area. This is known as the heat usage density and is measured in kWh/m^2 per annum.

Not Applicable - The building will utilise space heating and hot water from a centralised plant rooms

9.2.14 Offsite District Heating

Large scale or city centre district heating schemes have greater efficiency where there is a greater energy density and diversity of load served. Where buildings are in the locality of such systems consideration should be given to using the thermal energy provided.

Not Technically Feasible - The heat networks for Oxford report carried out by BRE included 3 options for developing a heat network, however, non of the options include the ARC Oxford area.

10 APPENDIX B: BRUKL Document

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Plot 4200 Nash Court

As designed

Date: Mon Jan 29 13:43:57 2024

Administrative information

Building Details

Address: 4200 Nash Court, Oxford, OX4 2RU

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.24

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.24

BRUKL compliance module version: v6.1.e.1

Certifier details

Name: Graham Hirst

Telephone number:

Address: 4th Floor, Windmill Green, 24 Mount Street, Manchester, Manchester, M2 3NX

Foundation area [m²]: 2398.22

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

Target CO_2 emission rate (TER), $kgCO_2/m^2annum$	4.36	
Building CO_2 emission rate (BER), $kgCO_2/m^2annum$	2.38	
Target primary energy rate (TPER), kWh_{PE}/m^2annum	47.81	
Building primary energy rate (BPER), kWh_{PE}/m^2annum	24.48	
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	0.18	0.5	00000056:Surf[0]
Floors	0.18	0.12	0.18	02000005:Surf[19]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	0.12	0.12	0000000A:Surf[16]
Windows** and roof windows	1.6	1.34	1.8	MR000000:Surf[2]
Rooflights***	2.2	1.4	1.4	03000008:Surf[25]
Personnel doors^	1.6	1.4	1.4	0000000A:Surf[4]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	1.8	1.8	MR000000:Surf[2]

$U_{a-Limit}$ = 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
m³/(h.m²) at 50 Pa	8	2

Page 1 of 10

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	YES
Whole building electric power factor achieved by power factor correction	>0.95

1- Rads + Extract

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.5	-	0.2	-	-
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.

2- Indirect Rads + Extract

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.5	-	0	-	-
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.

3- Rads + AHU

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.5	-	0.2	-	0.78
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.

4- Fan coils + AHU

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.5	4.5	0	1.85	0.78
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					YES

* 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.

5- Split DX Cooling

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.2	6	-	-	-
Standard value	2.5*	5	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.

6- indirect fan coil heating + Extract

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.5	4.5	0	0	-
Standard value	2.5*	4.5**	N/A	N/A	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.

** Standard shown is for air-cooled chillers >=400 kW. For chillers <400 kW, limiting SEER is 4.

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

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
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 balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter
NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.	

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	2.3	2	0.5	0.5	0.4	1	Zone	Standard
00 Bathroom	-	-	0.5	-	-	-	-	-	-	-	N/A
00 Cleaners	-	-	0.5	-	-	-	-	-	-	-	N/A
00 Cleaners Access	-	-	-	1.9	-	-	-	-	-	-	N/A
00 Corridor	-	-	-	1.9	-	-	-	-	-	-	N/A
00 Cubicle	-	-	0.5	-	-	-	-	-	-	-	N/A
00 Cubicle	-	-	0.5	-	-	-	-	-	-	-	N/A
00 Cubicle	-	-	0.5	-	-	-	-	-	-	-	N/A
00 Cubicle	-	-	0.5	-	-	-	-	-	-	-	N/A
00 Cubicle	-	-	0.5	-	-	-	-	-	-	-	N/A
00 Cubicle	-	-	0.5	-	-	-	-	-	-	-	N/A
00 Cubicle	-	-	0.5	-	-	-	-	-	-	-	N/A
00 Cubicle	-	-	0.5	-	-	-	-	-	-	-	N/A
00 Cubicle	-	-	0.5	-	-	-	-	-	-	-	N/A
00 Facilities	-	-	-	1.9	-	-	-	-	-	-	N/A
00 Post	-	-	-	1.9	-	-	-	-	-	-	N/A
00 Shower	-	-	0.5	-	-	-	-	-	-	-	N/A
00 Shower	-	-	0.5	-	-	-	-	-	-	-	N/A
00 Shower	-	-	0.5	-	-	-	-	-	-	-	N/A
01 Bathroom	-	-	0.5	-	-	-	-	-	-	-	N/A
01 Cubicle	-	-	0.5	-	-	-	-	-	-	-	N/A
01 Cubicle	-	-	0.5	-	-	-	-	-	-	-	N/A
01 Cubicle	-	-	0.5	-	-	-	-	-	-	-	N/A
01 Cubicle	-	-	0.5	-	-	-	-	-	-	-	N/A
01 Cubicle	-	-	0.5	-	-	-	-	-	-	-	N/A
01 Cubicle	-	-	0.5	-	-	-	-	-	-	-	N/A
01 Cubicle	-	-	0.5	-	-	-	-	-	-	-	N/A
01 Cubicle	-	-	0.5	-	-	-	-	-	-	-	N/A
01 Cubicle	-	-	0.5	-	-	-	-	-	-	-	N/A
01 Meeting Room	-	-	-	-	-	-	-	0.3	-	-	N/A
02 Bathroom	-	-	0.5	-	-	-	-	-	-	-	N/A

Page 3 of 10

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	2.3	2	0.5	0.5	0.4	1	Zone	Standard
02 Cubicle	-	-	0.5	-	-	-	-	-	-	-	N/A
02 Cubicle	-	-	0.5	-	-	-	-	-	-	-	N/A
02 Cubicle	-	-	0.5	-	-	-	-	-	-	-	N/A
02 Cubicle	-	-	0.5	-	-	-	-	-	-	-	N/A
02 Cubicle	-	-	0.5	-	-	-	-	-	-	-	N/A
02 Cubicle	-	-	0.5	-	-	-	-	-	-	-	N/A
02 Cubicle	-	-	0.5	-	-	-	-	-	-	-	N/A
02 Cubicle	-	-	0.5	-	-	-	-	-	-	-	N/A
02 Cubicle	-	-	0.5	-	-	-	-	-	-	-	N/A
02 Stairs	-	-	-	1.9	-	-	-	-	-	-	N/A
00 Shower	-	-	0.5	-	-	-	-	-	-	-	N/A
00 Shower	-	-	0.5	-	-	-	-	-	-	-	N/A
00 Shower	-	-	0.5	-	-	-	-	-	-	-	N/A
00 Shower	-	-	0.5	-	-	-	-	-	-	-	N/A
00 Changing	-	-	0.5	-	-	-	-	-	-	-	N/A
00 Changing	-	-	0.5	-	-	-	-	-	-	-	N/A
00 Changing	-	-	0.5	-	-	-	-	-	-	-	N/A
00 Back Lobby	-	-	-	1.9	-	-	-	-	-	-	N/A
00 Lab Bot	-	-	-	-	-	-	-	0.3	-	-	N/A
00 Lab Top	-	-	-	-	-	-	-	0.3	-	-	N/A
00 Lab Mid	-	-	-	-	-	-	-	0.3	-	-	N/A
00 Office Bot	-	-	-	-	-	-	-	0.3	-	-	N/A
00 Corridor	-	-	-	1.9	-	-	-	-	-	-	N/A
00 Office TOP	-	-	-	-	-	-	-	0.3	-	-	N/A
00 Office Mid	-	-	-	-	-	-	-	0.3	-	-	N/A
00 Shower hall	-	-	0.5	-	-	-	-	-	-	-	N/A
00 Shower	-	-	0.5	-	-	-	-	-	-	-	N/A
00 Reception	-	-	-	-	-	-	-	0.3	-	-	N/A
01 Lab Top	-	-	-	-	-	-	-	0.3	-	-	N/A
01 Office Top	-	-	-	-	-	-	-	0.3	-	-	N/A
01 Office	-	-	-	-	-	-	-	0.3	-	-	N/A
01 Circulation	-	-	-	1.9	-	-	-	-	-	-	N/A
01 Cleaners	-	-	0.5	-	-	-	-	-	-	-	N/A
01 Corridor	-	-	-	1.9	-	-	-	-	-	-	N/A
01 Lab Bot	-	-	-	-	-	-	-	0.3	-	-	N/A
01 Lab Mid	-	-	-	-	-	-	-	0.3	-	-	N/A
01 Office Mid	-	-	-	-	-	-	-	0.3	-	-	N/A
01 Office Bot	-	-	-	-	-	-	-	0.3	-	-	N/A
01 Lab Bot	-	-	-	-	-	-	-	0.3	-	-	N/A
02 Landing	-	-	-	1.9	-	-	-	-	-	-	N/A
02 Gym	-	-	-	-	-	-	-	0.3	-	-	N/A
02 Lab Mid	-	-	-	-	-	-	-	0.3	-	-	N/A
02 Office Mid	-	-	-	-	-	-	-	0.3	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
02 Office Top	-	-	-	-	-	-	-	0.3	-	-	N/A
02 Lab Top	-	-	-	-	-	-	-	0.3	-	-	N/A
03 Lobby	-	-	-	1.9	-	-	-	-	-	-	N/A
03 WC Cubicle	-	-	0.5	-	-	-	-	-	-	-	N/A
03 WC Cubicle	-	-	0.5	-	-	-	-	-	-	-	N/A
03 Lobby	-	-	-	1.9	-	-	-	-	-	-	N/A
03 Lobby	-	-	-	1.9	-	-	-	-	-	-	N/A
03 Stairs	-	-	-	1.9	-	-	-	-	-	-	N/A
02 Lab Mid	-	-	-	-	-	-	-	0.3	-	-	N/A
02 Corridor	-	-	-	1.9	-	-	-	-	-	-	N/A
02 Office Bot	-	-	-	-	-	-	-	0.3	-	-	N/A
02 Lab Bot	-	-	-	-	-	-	-	0.3	-	-	N/A
02 Shower	-	-	0.5	-	-	-	-	-	-	-	N/A
02 Shower	-	-	0.5	-	-	-	-	-	-	-	N/A
02 Shower	-	-	0.5	-	-	-	-	-	-	-	N/A
02 Shower Circualtion	-	-	-	1.9	-	-	-	-	-	-	N/A
02 Shower	-	-	0.5	-	-	-	-	-	-	-	N/A
03 Cafe	-	-	-	-	-	-	-	0.3	-	-	N/A

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
00 Bathroom	100	-	-
00 Cleaners	100	-	-
00 Cleaners Access	100	-	-
00 Corridor	100	-	-
00 Cubicle	100	-	-
00 Cubicle	100	-	-
00 Cubicle	100	-	-
00 Cubicle	100	-	-
00 Cubicle	100	-	-
00 Cubicle	100	-	-
00 Cubicle	100	-	-
00 Cubicle	100	-	-
00 Cubicle	100	-	-
00 Facilities	130	-	-
00 Post	130	-	-
00 Shower	100	-	-
00 Shower	100	-	-
00 Shower	100	-	-
00 Store	100	-	-
01 Bathroom	100	-	-
01 Cubicle	100	-	-

Page 5 of 10

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
01 Cubicle	100	-	-
01 Cubicle	100	-	-
01 Cubicle	100	-	-
01 Cubicle	100	-	-
01 Cubicle	100	-	-
01 Cubicle	100	-	-
01 Cubicle	100	-	-
01 Cubicle	100	-	-
01 Meeting Room	130	-	-
01 Store	100	-	-
02 Bathroom	100	-	-
02 Cubicle	100	-	-
02 Cubicle	100	-	-
02 Cubicle	100	-	-
02 Cubicle	100	-	-
02 Cubicle	100	-	-
02 Cubicle	100	-	-
02 Cubicle	100	-	-
02 Cubicle	100	-	-
02 Cubicle	100	-	-
02 Stairs	100	-	-
02 Store	100	-	-
00 Shower	100	-	-
00 Shower	100	-	-
00 Shower	100	-	-
00 Shower	100	-	-
00 Changing	100	-	-
00 Changing	100	-	-
00 Changing	100	-	-
00 Back Lobby	100	-	-
00 Transformer	100	-	-
00 ACC WC	100	-	-
00 LV Switchroom	130	-	-
00 Lab Bot	130	-	-
00 Lobby	100	-	-
00 Lab Top	130	-	-
00 Lab Mid	130	-	-
00 Office Bot	130	-	-
00 Corridor	100	-	-
00 Office TOP	130	-	-
00 Office Mid	130	-	-
00 Shower hall	100	-	-
00 Shower	100	-	-

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
00- Entrance Door	100	-	-
00 Reception	100	90	1.5
01 Lab Top	130	-	-
01 Office Top	130	-	-
01 IT	130	-	-
01 Office	130	-	-
01 Circulation	100	-	-
01 Cleaners	100	-	-
01 Corridor	100	-	-
01 Lab Bot	130	-	-
01 Corridor	100	-	-
01 Lab Mid	130	-	-
01 Office Mid	130	-	-
01 Office Bot	130	-	-
01 Lobby	100	-	-
01 Lobby	100	-	-
01 Lab Bot	130	-	-
02 Landing	100	-	-
02 Gym	130	-	-
02 Lab Mid	130	-	-
02 Office Mid	130	-	-
02 Office Top	130	-	-
02 Lab Top	130	-	-
03 Servery Counter	100	-	-
03 Lobby	100	-	-
03 WC Cubicle	100	-	-
03 WC Cubicle	100	-	-
03 Lobby	100	-	-
03 Kitchen	100	-	-
03 Lobby	100	-	-
03 Stairs	120	-	-
00 Bike Store	100	-	-
03 Plant	130	-	-
00 Lobby	100	-	-
02 Lab Mid	130	-	-
02 Corridor	100	-	-
02 Office Bot	130	-	-
02 Lab Bot	130	-	-
02 Lobby	100	-	-
02 Lobby	100	-	-
02 Lobby	100	-	-
02 Shower	130	-	-
02 Shower	130	-	-

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
02 Shower	130	-	-
02 Shower Circualtion	130	-	-
02 Shower	130	-	-
03 Cafe	130	-	-

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?
00 Post	N/A	N/A
01 Meeting Room	N/A	N/A
00 Lab Bot	NO (-55.4%)	NO
00 Lab Top	NO (-65.3%)	NO
00 Lab Mid	NO (-91.1%)	NO
00 Office Bot	NO (-54.1%)	NO
00 Office TOP	NO (-65.6%)	NO
00 Office Mid	NO (-91%)	NO
00 Reception	NO (-9.8%)	NO
01 Lab Top	NO (-57.9%)	NO
01 Office Top	NO (-58.8%)	NO
01 IT	N/A	N/A
01 Office	N/A	N/A
01 Lab Bot	NO (-45.4%)	NO
01 Lab Mid	NO (-88.8%)	NO
01 Office Mid	NO (-88.7%)	NO
01 Office Bot	NO (-48.2%)	NO
01 Lab Bot	NO (-47.2%)	NO
02 Gym	NO (-20.3%)	NO
02 Lab Mid	NO (-86.7%)	NO
02 Office Mid	NO (-86.9%)	NO
02 Office Top	NO (-49.1%)	NO
02 Lab Top	NO (-48.7%)	NO
03 Servery Counter	N/A	N/A
03 Kitchen	N/A	N/A
02 Lab Mid	NO (-45.1%)	NO
02 Office Bot	NO (-47%)	NO
02 Lab Bot	NO (-45.3%)	NO
03 Cafe	NO (-34.3%)	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]	10318.7	10318.7
External area [m²]	12586.8	11516.6
Weather	SWI	SWI
Infiltration [m³/hm²@ 50Pa]	2	3
Average conductance [W/K]	6843.21	3082.59
Average U-value [W/m²K]	0.54	0.27
Alpha value* [%]	14.89	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
58	**Offices and Workshop Businesses**
	General Industrial and Special Industrial Groups
	Storage or Distribution
	Hotels
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential Schools
42	**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	1.59	0.99
Cooling	3.55	4.52
Auxiliary	14.37	9.03
Lighting	7.91	13.2
Hot water	9.67	4.74
Equipment*	43.3	43.3
TOTAL**	**37.09**	**32.5**

* 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	20.57	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*20.57*	*0*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	63.16	85.38
Primary energy [kWh_{PE}/m²]	24.48	47.81
Total emissions [kg/m²]	2.38	4.36

Page 9 of 10

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] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	26.7	0	2.3	0	8.6	3.29	0	3.5	0
	Notional	18	0	1.8	0	2.3	2.78	0	----	----
[ST] Fan coil systems, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	18.2	50.7	1.6	4	15.8	3.22	3.49	3.5	4.5
	Notional	8.9	86.1	0.9	5.2	9.9	2.78	4.63	----	----
[ST] Central heating using water: radiators, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	76.1	0	6.4	0	10.2	3.29	0	3.5	0
	Notional	67.1	0	6.7	0	11.1	2.78	0	----	----
[ST] Split or multi-split system, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	0	0	0	0	0	4.12	4.48	4.2	6
	Notional	0	0	0	0	0	2.78	4.63	----	----
[ST] Fan coil systems, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	0.2	712.7	0	53	15.7	2.69	3.74	3.5	4.5
	Notional	0	919.8	0	55.2	25.6	2.78	4.63	----	----
[ST] Central heating using water: radiators, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	23	0	1.9	0	10	3.29	0	3.5	0
	Notional	10.5	0	1	0	10.9	2.78	0	----	----
[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

Page 10 of 10