SUSTAINABILITY STATEMENT

ALBION LAND

UNIT 7A, CATALYST BICESTER PHASE 2

ALBION LAND

Issued by:

Engineering Services Consultancy Ltd

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ALBION LAND

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1. EXECUTIVE SUMMARY

The Energy Statement supports the full planning application for the E(g)(i) development, **Unit 7a**. The building is part of a larger multi-phase development, denoted by the Cherwell District Council as 'Bicester Gateway', which is situated adjacent to the A41 dual carriageway to the south of the retail area known as Wyvale Garden Centre.

The statement addresses to how the new **Unit 7a** shall seek to comply with Building Regulation's Approved Document Part L2A (ADL2A) 2010 (2013 Edition), with Policies ESD 1 – 5 of the Cherwell District Council's *The Cherwell Local Plan 2011-2031*, *Policy Bicester 10: Bicester Gateway* and an Energy Performance Certificate rating of 'A'.

An energy/carbon assessment in accordance to Building Regulation's Approved Document Part L2A (ADL2A) 2010 (2013 Edition) was performed in order to comply with the above requirements.

To comply with Building Regulation's ADL2A, Policies ESD 1 – 5 and EPC rating of 'A', the following was proposed…

- A stage-by-stage energy hierarchy which encourages:
    - Stage 1: Employment of passive design solutions, i.e. exploiting natural daylight and providing good building fabric performance to maximise energy saving
    - Stage 2: Provision of highly efficient mechanical and electrical building services systems
    - Stage 3: The feasibility of low and zero carbon technologies to attain further carbon reduction, if required to comply with Building Regulation's ADL2A AND achieve EPC Rating of 'A'
- Target associated BREEAM NC 2018 credits in regard to sustainable construction and water consumption

The proposed strategy resulted in the following…

- **Unit 7a** achieved compliance with Building Regulation's ADL2A Criterion One through the use of efficient building fabric and Air Source Heat Pumps. High efficacy lighting and lighting controls were also used.
- **Unit 7a** achieves an EPC rating of 'B' without the use of Photovoltaic Panels. To achieve a rating of 'A', 250 m^2 of Photovoltaic Panels is required. The annual generation equates to **45,146.90 kWh/yr**.

2. INTRODUCTION

Engineering Services Consultancy Ltd have been commissioned by Albion Land to produce an Energy Statement that will support the full planning application for the building, Unit 7a. The statement aims to address the following…

- Building Regulation's Approved Document Part L2A (ADL2A) 2013
- Policies ESD 1 – 5 set out within Cherwell District Council's *The Cherwell Local Plan 2011-2031*.
- Energy Performance Certificate Rating of 'A'

The ADL2A is England's legal guideline standard for non-domestic buildings which regards energy efficiency and limiting carbon emissions.

The Energy Performance Certificate is a legal requirement for domestic and non-domestic buildings, that are constructed, sold or rented out, to display their energy efficiency rating as public information.

Policies ESD 1 – 5 aim towards new large domestic and non-domestic developments that are under the Council's jurisdiction and their key objective is to mitigate climate change, reduce energy usage, increase resource efficiency, promote the use of renewable energy and reduce carbon emissions and embodied carbon.

To comply with ADL2A 2013 and Policies ESD 1 – 5, we shall propose an energy hierarchy that will be staged as follows…

- Stage 1: Employ passive design solutions, such as good building fabric performance, improve air tightness and exploitation of natural daylight to maximise reduction in energy and carbon emissions
- Stage 2: Provide highly efficient HVAC and lighting systems so energy can be supplied and used efficiently
- Stage 3: Assessment of the feasibility of low and zero carbon (LZC) technologies to further reduce carbon emissions, if required to comply with Building Regulations ADL2A

However, this energy hierarchy does not address the items in Policy ESD 3 that encompasses the use of sustainable construction methods and reducing water consumption. Therefore, the statement shall reference the associated BREEAM credits required to fully comply with Policy ESD 3, these credits are highlighted in Section 7. The five policies will be further elaborated.

This report has been produced by Kim Nguyen, of Engineering Services Consultancy Ltd. Kim Nguyen is a certified Low Carbon Energy Assessor (Ref: LCEA203717).

2.1 SITE DESCRIPTION

The development under the full planning application comprises of a four-storey building, known as Unit 7a, with Use Class E(g)(i). Across the four-storeys, the building will comprise of open plan office spaces complete with amenity accommodation. Figure 1 illustrates the current layout of Unit 7a's site. It is located on a site denoted by the Cherwell District Council as 'Bicester Gateway', which is situated adjacent to the A41 dual carriageway to the south of the retail area known as Wyvale Garden Centre.

In accordance to the Cherwell District Council's *The Cherwell Local Plan 2011-2031, Policy Bicester 10: Bicester Gateway*, the new development is to be part of a 'high-tech' and 'knowledge-based' employment development that shall create approximately 3,500 new science, research and technology jobs.

The four-storey building shall have a gross internal floor area of approximately 6,503.2 m^2. It is to note that this area excludes the glass links.

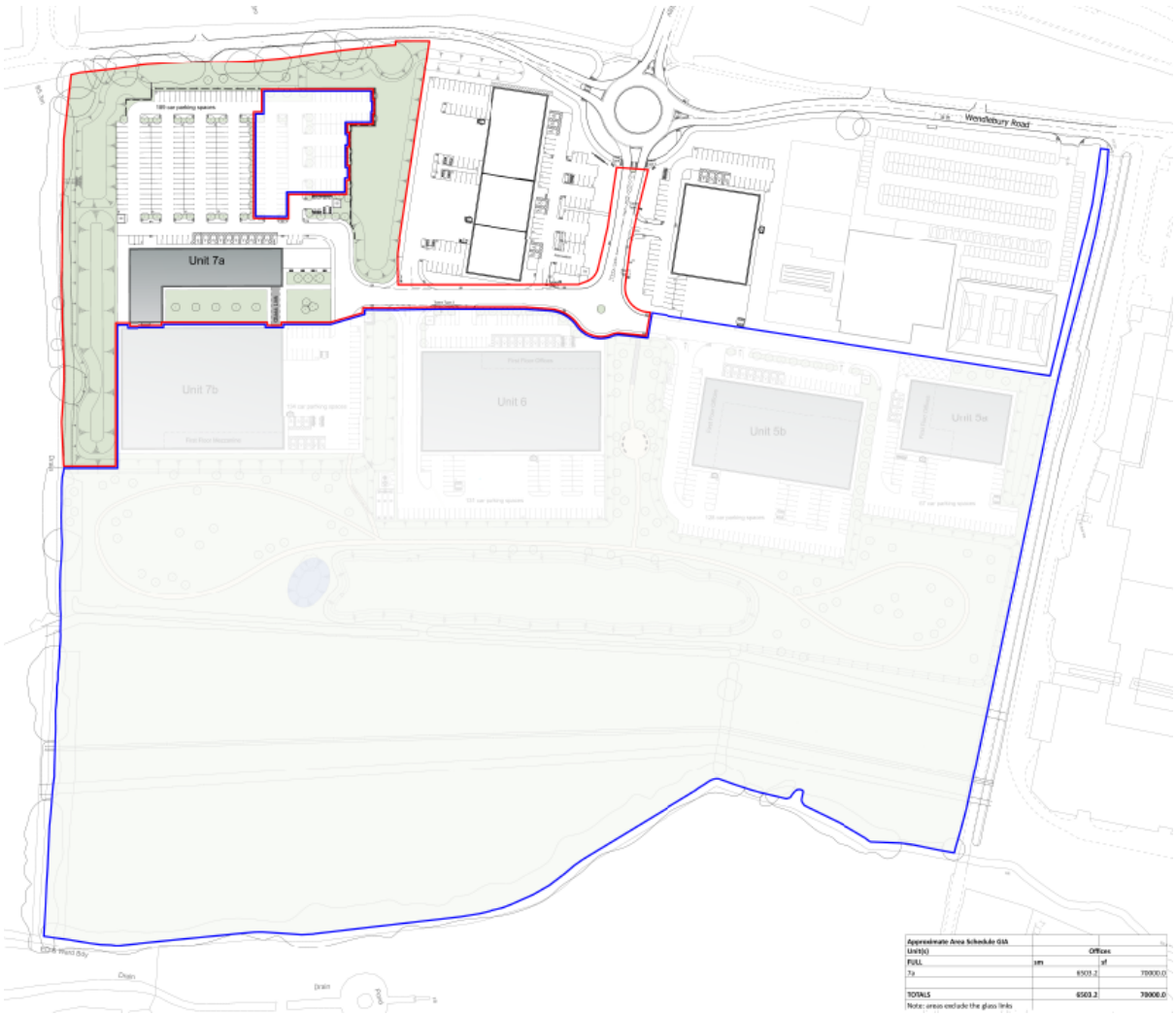


Figure 1: Proposed site plan. Source: Cornish Architects

This report shall only focus on Unit 7a, located at top left of the site within the red boundary line.

3. DEVELOPMENT REQUIREMENTS

The proposed development is required to be constructed in a certain manner to meet energy efficiency and sustainability requirements. The minimum benchmark requirements are as follows…

- Building Regulation's Approved Document Part L2A (ADL2A) 2013
- Policies ESD 1 – 5 set out within Cherwell District Council's *The Cherwell Local Plan 2011-2031*.
- Energy Performance Certificate Rating of 'A'

3.2 BUILDING REGULATION'S APPROVED DOCUMENT PART L2A 2013

The ADL2A is England's legal guideline standard document for new non-domestic buildings with an objective to regulate how much carbon dioxide is emitted, by assessing the building's intrinsic energy performance via its building fabric and internal building services. Within the document, three criteria are required to be met.

As such, the development shall aim to be meet ADL2A's standard as a minimum requirement in terms of carbon emissions and energy efficiency.

3.2.1 ADL2A CRITERION ONE

Criterion One is concerned with the amount of carbon dioxide emitted from a building per annum. The amount of carbon dioxide emitted is calculated by an approved Energy Assessor, using approved software tools. Within the approved software, the Energy Assessor creates a virtual building model which reflects the actual building and incorporates actual design features including building envelope, building orientation, glazing, air permeability, geographical location, and building services. This particular virtual model is referred to as the "Actual Building". The Energy Assessor also applies a standard database of internal environmental conditions and activities which take place within, known as NCM templates.

When concerned with the Criterion One assessment, the Actual Building is compared against a "Notional Building". The Notional Building is generated automatically within the accredited software and mimics the physical size, shape, orientation, location, and layout of the Actual Building. However, the design features (fabric and building services) of the Notional Building are not related to the Actual Building and may be better in performance. In order to pass the Criterion One assessment for compliance with ADL2A 2013, the carbon emission of the Actual Building must be equal to, or less than, the carbon dioxide emission of the Notional Building.

The annual carbon dioxide emission per square metre of floor area calculated for the Actual Building is known as the Building Emission Rate (BER), whilst the annual carbon dioxide emission per square metre of floor area for the Notional Building is known as the Target Emission Rate (TER). Therefore, in order to satisfy Criterion One, the BER must be equal to or less than the TER.

3.2.2 ADL2A CRITERION TWO

Criterion Two assesses the performance of the building fabric to ensure that reasonable provision is made to limit heat gains and heat losses. During the calculation, the software assesses building fabric U-values and building air permeability to ensure that minimum standards prescribed by the Building Regulations are met.

Criterion Two also requires M&E building services to meet minimum energy efficiency standards. Whilst the efficiency of such plant and equipment is entered into the software to calculate building carbon emission, it is not automatically checked during the assessment for compliance with Criterion Two. The BRUKL Output Document therefore provides a schedule of plant and equipment efficiency for review by the Building Control Officer (BCO).

3.2.3 ADL2A CRITERION THREE

Criterion Three limits the effect of solar gains during the period of April to September, whether air conditioning is installed or not. The intention of Criterion Three is to reduce the need for air conditioning or reduce the installed capacity of air conditioning if present. Where comfort cooling is not provided, it is recommended that detailed thermal simulations are undertaken on a room-by-room basis to ensure that overheating criteria are satisfied, irrespective of Criterion Three results.

Similarly, to Criterion One, the Actual Building is compared to the Notional Building. The Notional Building is automatically created by the software to incorporate specific features which relate to a room's end use, the orientation of glazing, and specification of glazing in terms of g-value. To pass Criterion Three assessment, the Actual Building must have a solar heat gain less than or equal to the Notional Building benchmark.

3.2 CHERWELL DISTRICT COUNCIL'S 'THE CHERWELL LOCAL PLAN 2011 – 2031'

The Cherwell Local Plan 2011 – 2031 is The Cherwell District Council's local plan with purpose to expand its district to increase job employment, improve local and national economy and improve connections on rail and road. It is their aim to execute this plan in a sustainable and environmentally conscious manner.

To encourage this in the construction and use of any new domestic and non-domestic development, *The Cherwell Local Plan 2011 – 2031* introduced five policies known as Policies ESD 1 – 5. These policies aim to mitigate a development's involvement in climate change as well as reduce its energy usage, carbon emissions and embodied carbon.

3.2.1 THE CHERWELL LOCAL PLAN 2011 – 2031 – POLICY BICESTSER 10: BICESTER GATEWAY

The Catalyst Bicester development is an allocated site within Local Plan, known as 'Bicester Gateway', whereby its associated policies is highlighted in section *Policy Bicester 10: Bicester Gateway* of *The Cherwell Local Plan 2011 – 2031*.

Within *Policy Bicester 10*, it includes the development's requirement to comply with Policies ESD 1 – 5, these policies are elaborated below.

3.2.1.1 POLICY ESD 1: MITIGATING AND ADAPTING TO CLIMATE CHANGE

Policy ESD 1 states:

Measures will be taken to mitigate the impact of development within the district on climate change. At a strategic level, this will include:

- *Distributing growth to the most sustainable locations as defined in this Local Plan*
- *Delivering development that seeks to reduce the need to travel and which encourages sustainable travel options including walking, cycling and public transport to reduce dependence on private cars*
- *Designing developments to reduce carbon emissions and use resources more efficiently, including water (see Policy ESD 3 Sustainable Construction)*
- *Promoting the use of decentralised and renewable low carbon energy where appropriate (see Policies ESD 4 Decentralised Energy Systems and ESD 5 Renewable Energy)*

3.2.1.2 POLICY ESD 2: ENERGY HEIRARCHY AND ALLOWABLE SOLUTIONS

Policy ESD 2 states:

In seeking to achieve carbon emissions reductions, we will promote an 'energy hierarchy' as follows:

- *Reducing energy use, in particular by the use of sustainable design and construction measures*
- *Supplying energy efficiently and giving priority to decentralised energy supply*
- *Making use of renewable energy*
- *Making use of allowable solutions*

3.2.1.3 POLICY ESD 3: SUSTAINABLE CONSTRUCTION

Policy ESD 3 states:

…Cherwell District is in an area of water stress and as such the Council will seek a higher level of water efficiency than required in the Building Regulations, with developments achieving a limit of 110 litres/person/day.

All new non-residential development will be expected to meet at least BREEAM 'Very Good' with immediate effect, subject to review over the plan period to ensure the target remains relevant. The demonstration of this standard should be set out in the Energy Statement.

The strategic site allocations identified in this Local Plan are expected to provide contributions to carbon emissions reductions and to wider sustainability.

All development proposals will be encouraged to reflect high quality design and high environmental standards, demonstrating sustainable construction methods including but not limited to:

- *Minimising both energy demands and energy loss*
- *Maximising passive solar lighting and natural ventilation*
- *Maximising resource efficiency*
- *Incorporating the use of recycled and energy efficient materials*
- *Incorporating the use of locally sourced building materials*
- *Reducing waste and pollution and making adequate provision for the recycling of waste*
- *Reducing the impact on the external environment and maximising opportunities for cooling and shading (by provision of open space and water, planting, and green roofs, for example); and*
- *Making use of the embodied energy within buildings wherever possible and re-using materials where proposals involve demolition or redevelopment*

3.2.1.4 POLICY ESD 4: DECENTRALISED ENERGY SYSTEMS

Policy ESD 4 states the following…

The use of decentralised energy systems, providing either heating (District Heating (DH)) or heating and power (Combined Heat and Power (CHP)) will be encouraged in all new developments.

A feasibility assessment for DH/CHP, including consideration of biomass fuelled CHP, will be required for:

- *All residential developments for 100 dwellings or more*
- *All residential developments in off-gas areas for 50 dwellings or more*
- *All applications for non-domestic developments above 1000m^2 floorspace.*

…Where feasibility assessments demonstrate that decentralised energy systems are deliverable and viable, such systems will be required as part of the development unless an alternative solution would deliver the same or increased benefit.

3.2.1.5 POLICY ESD 5: RENEWABLE ENERGY

Policy ESD 5 states:

The Council supports renewable and low carbon energy provision wherever any adverse impacts can be addressed satisfactorily. The potential local environment, economic and community benefits of renewable energy schemes will be a material consideration in determining planning applications.

…A feasibility assessment of the potential for significant on site renewable energy provision (above any provision required to meet national building standards) will be required for:

- *All residential developments for 100 dwellings or more*
- *All residential developments for off-gas areas for 50 dwellings or more*
- *All applications for non-domestic developments above 1000m^2 floorspace*

Where feasibility assessments demonstrate that on site renewable energy provision is deliverable and viable, this will be required as part of the development unless an alternative solution would deliver the same or increased benefit.

4. PROPOSED 'LEAN, CLEAN AND GREEN' ENERGY HIERARCHY

To address Building Regulation's ADL2A and Policies ESD 1 – 5, the adoption of an energy hierarchy known as 'Lean, Clean and Green' shall be proposed. This energy hierarchy originated from the London Councils' *The London Plan*, used to minimise carbon dioxide emissions from buildings within Greater London.

The proposed lean, clean and green energy hierarchy (as highlighted in the Outline Energy Statement for the outline planning application 19/01746/OUT, ref no: 1463-ESC-00-ZZ-RP-0014 P3) for will be followed to demonstrate that intrinsically low energy buildings can be achieved and that carbon emissions can be reduced to the requirements of Building Regulations. The definitions are described:

- Lean – Reduce the energy demand and energy loss by designing efficiency into the thermal fabric of the building, focusing on air tightness, thermal mass and thermal bridging.
- Clean – Increase energy efficiency of the building services and controls to significantly reduce energy consumption. This includes space heating, hot water generation, ventilation and lighting systems and controls.
- Green – The potential use of LZC technologies to offset carbon emissions and energy usage, if feasible and required to comply with Building Regulation's ADL2A.

Under 'Lean' and 'Clean', passive design measures shall be incorporated. These shall include good building fabric performance, glazing systems offering good solar control and daylight dimming control for the artificial lighting system.

The following energy/carbon assessment shall provide the methodology and results of each element and highlight what Policy it addresses.

5. ENERGY AND CARBON ASSESSMENT

An initial energy assessment based on using the worst permissible building fabric efficiencies, heating and cooling efficiencies and lighting efficacies shall be performed. This assessment shall serve as the 'baseline' comparator for each element of the energy hierarchy.

All energy/carbon calculations were undertaken using software programme IES: Virtual Environment v2021.4.0.0 which is a Dynamic Simulation Model (DSM) tool accredited by the Department of Communities and Local Government for the generation Energy Performance and BRUKL Certification.

Table 1: Schedule of Drawings and Documents

REF	TITLE	REVISION	FROM
21023-TP-202	Proposed Site Plan	A	Cornish Architects
21023-TP-204	Unit 7a Ground and First Floor Plans	-	Cornish Architects
21023-TP-205	Unit 7a Second and Third Floor Plans	-	Cornish Architects
21023-TP-206	Unit 7a Roof Plan	-	Cornish Architects
21023-TP-207	Unit 7a Elevations	A	Cornish Architects
21023-TP-208	Unit 7a Sections	A	Cornish Architects
1463-ESC-00-ZZ-RP-0014	Outline Energy Statement	P3	Engineering Services Consultancy Ltd

The CL2.1 SBEM Weather Location Look-up tool was used to determine the suitable weather file for the development. Using the post area 'OX', the weather file applicable is SwindonTRY05. This weather file shall be used for all analysis.

5.1 BASELINE MODEL

The baseline model shall be set using the following building fabric and building services strategy and efficiencies.

Table 2: Building Envelope Performance

ELEMENT	WORST PERMISSIBLE
External Wall U-value	0.35 W/m^2.K
Roof U-value	0.25 W/m^2.K
Ground Floor Slab U-value	0.25 W/m^2.K
Door U-value	2.20 W/m^2.K
Window U-value (frame & glass)	2.20 W/m^2.K
Window g-value / light transmission	0.40 / 70%
Air Permeability	5.0 m^3/(h.m^2) @ 50Pa

Table 3: Thermal Model Zone and System Assignment

ZONE	SYSTEM
Open Plan Offices	VRV/F with mechanical ventilation with heat recovery via central air handling unit with thermal wheel
Reception	VRV/F with natural ventilation
All Circulation Areas	Electric panel heaters with natural ventilation
Link Corridor	Unconditioned
Toilets and Showers	Electric panel heaters with mechanical ventilation with heat recovery via central air handling unit with thermal wheel
Cleaner's Store	Electric panel heaters with mechanical ventilation with heat recovery via central air handling unit with thermal wheel

Table 4: Thermal Model HVAC System Description

SYSTEM	SYSTEM DESCRIPTION
Central Air Handling Unit with Thermal Wheel	Specific Fan Power = 2.0 W/(l/s). Heat recovery efficiency = 65%
VRV/F Air-Conditioning System (Air-Source Heat Pumps)	Heating efficiency: SCOP = 2.5 Cooling efficiency: SEER = 2.6
General Domestic Hot Water Services	Local instantaneous electric water heaters
Cleaner's Store Domestic Hot Water Services	Local storage electric water heaters with total cumulative storage capacity of 120 litres. Insulation thickness of 10mm, factory insulated.

Table 5: Thermal Model Electrical Lighting Performance

ROOM	LUMINAIRE EFFICACY (LLM/CW) UNLESS OTHERWISE STATED	DESIGN ILLUMINANCE (LUX)	OCCUPANCY DETECTION	DAYLIGHT CONTROL	PARASITIC POWER (W/M^2)
Open Plan Offices	60	500	Manual On/Auto Off	Photocell control dimming	0.10
Reception	60	300	None	Photocell control dimming	0.10
Landing	60	200	Auto On/Off	Photocell control dimming	0.10
Circulation Areas	60	200	Auto On/Off	No daylight control	0.10
Toilets	60	200	Auto On/Off	No daylight control	0.10
Cleaner's Store	60	150	Auto On/Off	No daylight control	0.10
Link Corridor	60	200	Auto On/Off	Photocell control dimming	0.10

5.1.1 BASELINE RESULTS

By implementing the worst permissible building fabric and building services efficiencies, the building does not comply with Building Regulations Part L2A Criterion One and does not achieve an EPC rating of 'A'. The results are as follows…

Table 6: Thermal Model 'As Designed' Carbon Emission Results and EPC Rating

BUILDING	TARGET EMISSION RATE (TER)	BUILDING EMISSION RATE (TER)	BUILDING REGULATIONS COMPLIANCE?	EPC RATING
Unit 7a	18.4 kg.CO_2/m^2.annum	27.6 kg.CO_2/m^2.annum	No	B

Below is the breakdown of the energy consumption, extracted directly from the BRUKL document…

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	10.81	3.44
Cooling	5.27	6.35
Auxiliary	7.21	2.42
Lighting	24.15	21.26
Hot water	5.76	5.69
Equipment*	37.93	37.93
TOTAL**	53.19	39.16

* 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]	122.22	108.05
Primary energy* [kWh/m²]	163.3	103.26
Total emissions [kg/m²]	27.6	18.4

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

Figure 2: Baseline BRUKL Output Document results

5.2 LEAN

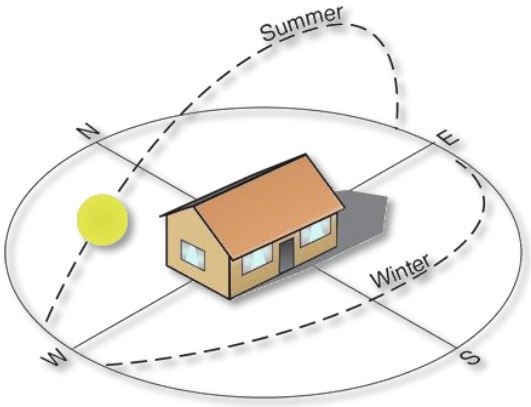
The Sustainability Statement shall investigate and identify the opportunities to implement passive design solutions in order to reduce the demands for the energy consuming building services for the building.

Passive design measures have been considered as a means to reduce the total heating, cooling, lighting loads and energy consumption with the aim of reducing the total heating/cooling energy demand and carbon emission rate.

5.2.1 PASSIVE DESIGN SOLUTIONS

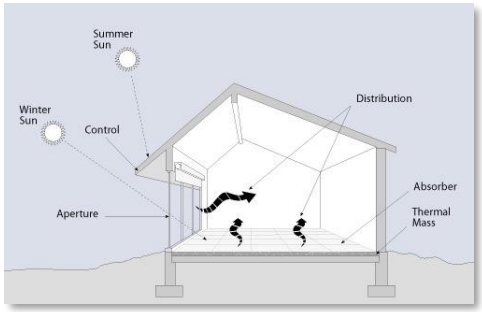
The table below summarises the main passive design solutions and their benefits:

BUILDING LAYOUT	
Description	Rooms must also be located to take advantage of the sun in order to reduce energy use, but different types of rooms differ in solar requirements. North, east, west and south facing rooms each having different solar gains and receive different amounts of daylight.
Advantages	North facing – living spaces, such as living, family and dining rooms: • Good daylight for the majority of the day. • Solar gain for most of the day and throughout the year. • Good passive solar gain in winter. East facing – kitchen and breakfast areas: • Good morning light. • Solar gain in the morning throughout the year providing initial warming. • Cooler in the late afternoon during food preparation times. West facing – living areas in households where occupants are away during the daytime but home in the evening. • Good afternoon daylight. • Good direct solar gain for thermal mass heating of living spaces in the evenings.
Disadvantages	South facing rooms may require horizontal shading to prevent overheating during summer months. West facing rooms may overheat in the later afternoon during most of the year, and they may require vertical shading to prevent excessive overheating and glare in the afternoon. North facing rooms are not suitable for habitable spaces because they have lower levels of daylight during parts of the year and have little/no solar gain. Garage, laundry, bathroom, toilet, workroom and stairs would work best as north facing rooms/areas.

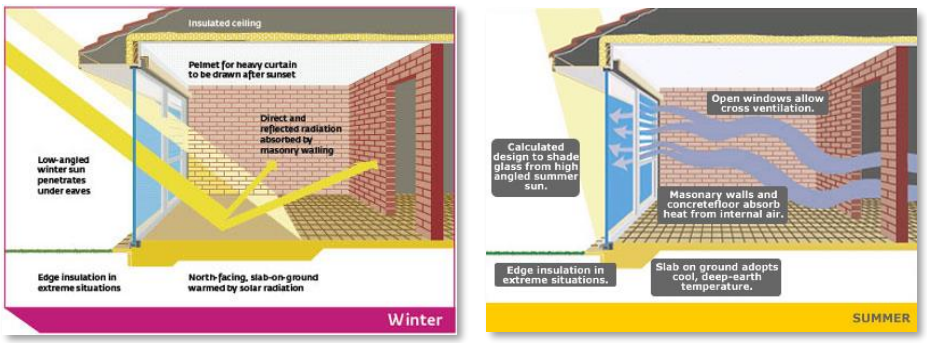
BUILDING ORIENTATION	
Description	The orientation of the building will have a strong impact on the solar gains. Very high solar gains are undesirable as they can lead to overheating of the building, however the right amount of solar gain is desirable as it will reduce the heating and lighting demands. Through the correct orientation of the building energy loads can be minimised and solar gains can be maximised. The glazed areas and the thermal properties of the glass are fundamental to the building's energy consumption. The specification of the glass will provide a balance between the light it lets through and the amount of solar gain it reflects away. 
Advantages	• Reduced need for artificial lighting and heating. • No extra costs for building.
Disadvantages	• The correction location is needed depending on factors such as climate and building size. • Old buildings may need costly upgrades to maximise benefits.

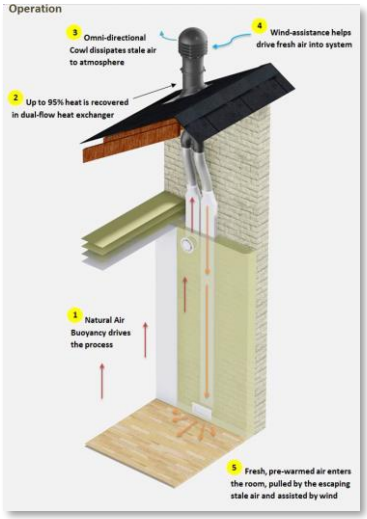
BUILDING FORM	
Description	The shape or form of a building can greatly improve the occupant comfort. The building form determines the airflow pattern around the building, which will have a direct effect on the ventilation. The shape of the building will also influence heat losses, as more compact shapes are more efficient in storing heat. The depth of the building is likely to have an influence on the requirements for artificial lighting, the deeper the building the higher the need will be for artificial lighting.
Advantages	Costs would be reduced as energy usage is lessened.
Disadvantages	Certain building types that are more beneficial for heating and energy (small, high-rise, cylindrical) are less likely to be used.

BUILDING FABRIC	
Description	Good building design and use of building fabrics can allow for reduced heating and cooling loads, lower energy use and lower carbon emissions.
Advantages	Building fabrics aim to: • Protect building occupants from weather (wind, rain, solar radiation, snow etc.). • Regulate indoor environment (temperature, humidity, moisture etc.). • Prevent noise transmission. • Provide safety e.g., prevent spread of fire or smoke. • Provide views into and out of the building.
Disadvantages	It is more difficult to improve the performance of existing buildings through the building fabric. Retrofitting, i.e., the provision of materials that were not original fitted during original manufacture/construction, can be used in these cases. Retrofitting can include: • Improvements to air tightness. • Introduction of double glazing. • Installation of cavity wall insulation. • Internal/external solid wall insulation. However, retrofitting could be costly and time consuming.

THERMAL MASS OR OTHER FABRIC THERMAL STORAGE	
Description	A material that has thermal mass in one with the capacity to absorb, store and release the sun's heat energy. The density and levels of conductivity aid in stabilising the internal temperature of a building. Thermal mass can be used to keep a structure cool during the summer and release stored heat to keep the building warmer in the winter. These materials are most commonly used in flooring or inside walls so they can store and release energy from the sun. Such materials are generally dense such as concrete, brick and ceramic tile. 
Advantages	• Reduction in energy fuels as less mechanical heating and cooling will be required.
Disadvantages	• Most beneficial in hotter climates. • Is heavily dependent upon the weather. • Thermal mass alone cannot create a thermally comfortable building.

BUILDING OCCUPANCY TYPE	
Description	Commercial buildings have different characteristics to residential buildings, for example, higher ventilation requirements, varied occupancy trends, greater heating gains internally from lighting and equipment. Therefore, commercial buildings benefit more from passive cooling. Residential buildings generally experience higher night-time occupancies and lower internal heat gains.

DAYLIGHTING STRATEGY	
Description	Using daylighting is a key strategy for passive design. Allowing more sunlight into the building impacts the visual comfort and thermal comfort. A daylighting system can be comprised of features such as skylights and windows but is coupled with a daylight-responsive lighting control system. Daylighting involves a balance between heat gains and losses, glare control and variations in daylight availability. All window sizes and spacing, glass selection, the reflection of interior finishes and the location of any interior partitions must be evaluated. 
Advantages	• Reliable source of light. • Reducing electric lighting and saving energy.
Disadvantages	• Daylighting components are normally integrated within the original design on the building, so it may not be possible to retrofit.

VENTILATION STRATEGY	
Description	Natural ventilation can provide and move fresh air without the need for mechanical equipment. This can provide a significant reduction in the building's energy usage through the elimination of mechanical air conditioning systems. Natural ventilation depends heavily upon pressure differences to move fresh air through buildings. Therefore, the amount of ventilation is likely to depend on the size and placement of openings in the building. 
Advantages	• Can save between 10-30% in total energy consumption.
Disadvantages	• Buildings within areas with high acoustic levels will be less suitable for natural ventilation as the noise pollution level will be increased. • Buildings in locations with poor air quality may also be less suitable. • Cannot reduce the humidity of incoming air.

ADAPTATION TO CLIMATE CHANGE	
Description	Due to the constantly changing climate and future scenarios for possible climate change, it is unlikely that the nature of weather will remain the same throughout a building's lifetime. Climate change modelling has suggested a future increase in global temperatures, coupled with an increase in rainfall and more extreme events such as tropical storms. It is important to take this into consideration during the design stage of the building. Several passive design strategies could be used to mitigate against future fluctuations in climate, these include: • Thermal mass to reduce the internal temperature variation. • Insulation to reduce the rate of heat transfer through the building structures. • External shading of the vulnerable building services. • A suspended floor to mitigate against possible increased flooding. • Provide landscaping to reduce cooling requirements within the building. • Raise buildings off the ground in flood prone areas. • Maximise summer cooling through natural ventilation.

5.2.2 APPROPRIATE SOLUTIONS

The table below summarises the design solutions which are considered appropriate for the development:

MEASURE	REASON FOR USE
Building Orientation	The industrial unit's orientation can help reduce the cooling/heating energy demand based on where the consulting rooms, reception and offices are located relative to the Sun's position.
Building Fabric	Improved thermal performance for the external wall, roof and glazing and good airtightness to reduce heating energy consumption. Improve glazing solar transmittance to reduce incoming solar gain entering the occupied and air-conditioned space.
Building Form	Spaces with access to daylight from side-lit glazing can take advantage by having glazing on both sides of the office. Currently the building's design implements this.
Adaptation to Climate Change	The air-conditioning system can be sized for a future climate scenario. This will need to be executed by the project's mechanical contractor.
Ventilation Strategy	Natural ventilation can be provided to potentially save energy on cooling and reduce its demand.

5.2.3 EXCLUDED SOLUTIONS

The table below summarises the design solutions which are not appropriate for the development, and why:

MEASURE	REASON FOR EXCLUSION
Thermal Mass or Other Fabric Thermal Storage	No inclusion of thermal mass or other fabric thermal storage is proposed for the development. It is assumed that as the building is a typical office block, the internal walls will be plasterboard and the internal floor will have a carpet finish. No exposed concrete is assumed.
Building Layout	There are no building layout features that are directly influenced by passive design as the majority of the space is open plan office.
Daylight Strategy	Most windows are near full height and curtain walls are incorporated into the reception to take full advantage of the sunlight. All areas already have photocell dimming incorporated into their design, where it is applicable.
Building Orientation	Unit's orientation does not need to be adapted as the heat & cooling demand reduction would be negligible or worsened by a change in building orientation. This could also alter site plans and the building front is North facing, potential failure to Building Regulation's Part L2A Criterion Three is expected if the building entrance is orientated to the South.
Building Occupancy Type	The office is constructed to a standard open plan Category A specification so variations in occupancy or heat gains are unknown at this point.

5.2.4 IMPLEMENTED SOLUTIONS

The table below summarises the design solutions that were implemented into the new development.

MEASURE	REASON FOR USE
Building Fabric	Improved thermal performance for external wall, roof and glazing and good air tightness to reduce heating demand and consumption for the building. Improved glazing solar transmittance to reduce incoming solar gains and cooling demand and consumption for the building.

To implement the above solution, the building shall adopt the building fabric and air tightness highlighted in the table below. It is aimed to be above the Building Regulation's Part L2A's worst permissible and notional requirements for building fabric performance.

Table 7: Building Envelope Performance

ELEMENT	WORST PERMISSIBLE	PROPOSED
External Wall U-value	0.35 W/m^2.K	0.24 W/m^2.K
Roof U-value	0.25 W/m^2.K	0.16 W/m^2.K
Ground Floor Slab U-value	0.25 W/m^2.K	0.20 W/m^2.K
Window U-value (frame & glass)	2.20 W/m^2.K	1.50 W/m^2.K
General Office Window g-value / light transmission	-	0.35 / 70%
Reception Curtain Wall g-value / light transmission	-	0.18 / 29%
Air Permeability	5.0 m^3/(h.m^2) @ 50Pa	4.0 m^3/(h.m^2) @ 50Pa

5.2.5 LEAN RESULTS

By implementing the proposed building fabric and building services efficiencies, the building does not yet comply with Building Regulations Part L2A Criterion One and does not yet achieve an EPC rating of 'A'. The results are as follows…

Table 8: Thermal Model 'As Designed' Carbon Emission Results and EPC Rating

BUILDING	TARGET EMISSION RATE (TER)	BUILDING EMISSION RATE (TER)	BUILDING REGULATIONS COMPLIANCE?	EPC RATING
Unit 7a	18.4 kg.CO_2/m^2.annum	25.7 kg.CO_2/m^2.annum	No	B

Below is the breakdown of the energy consumption, extracted directly from the BRUKL document…

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	6.09	3.43
Cooling	6.39	6.35
Auxiliary	7.17	2.42
Lighting	24.14	21.26
Hot water	5.76	5.69
Equipment*	37.93	37.93
TOTAL**	49.55	39.14

* 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]	98.64	107.87
Primary energy* [kWh/m²]	152.11	103.19
Total emissions [kg/m²]	25.7	18.4

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

Figure 3: Lean BRUKL Output document results

From the results, the percentage reduction on the heating/cooling demand, building energy consumption and total carbon emissions are as follows…

Table 9: Percentage reduction on building energy consumption, heating/cooling demand and carbon emission rate

STRATEGY	TOTAL BUILDING ENERGY CONSUMPTION (KWH/M^2)	PERCENTAGE REDUCTION (%)
Baseline	53.19	-
Lean	49.55	6.84
Clean	-	-
Green	-	-
	Total Reduction from Baseline	6.84
	HEATING & COOLING ENERGY DEMAND (MJ/m^2)	**PERCENTAGE REDUCTION (%)**
Baseline	122.22	-
Lean	98.64	19.29
Clean	-	-
Green	-	-
	Total Reduction from Baseline	19.29
	BUILDING EMISSION RATE (kg.CO_2/m^2.annum)	**PERCENTAGE REDUCTION (%)**
Baseline	27.60	-
Lean	25.70	6.88
Clean	-	-
Green	-	-
	Total Reduction from Baseline	6.88

This shall demonstrate compliance with the following items for each policy…

POLICY	ITEM
Policy ESD 1	Designing developments to reduce carbon emission and use resources more efficiently, including water (regarding water, this shall be covered by BREEAM NC 2018 Pre-Assessment)
Policy ESD 2	Reducing energy use, in particular by the use of sustainable design and construction measures
Policy ESD 3	Minimising both energy demands and energy loss

5.3 CLEAN

At this stage of the energy hierarchy, the building shall seek to greatly improve the efficiency of the heating and cooling system and the lighting system.

The development shall seek to employ the following services and efficiencies.

Table 10: Thermal Model Zone and System Assignment

ZONE	SYSTEM
Open Plan Offices	VRV/F with mechanical ventilation with heat recovery via central air handling unit with thermal wheel
Reception	VRV/F with natural ventilation
All Circulation Areas	Electric panel heaters with natural ventilation
Link Corridor	Unconditioned
Toilets and Showers	Electric panel heaters with mechanical ventilation with heat recovery via central air handling unit with thermal wheel
Cleaner's Store	Electric panel heaters with mechanical ventilation with heat recovery via central air handling unit with thermal wheel

Table 11: Thermal Model HVAC System Description

SYSTEM	SYSTEM DESCRIPTION
Central Air Handling Unit with Thermal Wheel	Specific Fan Power = 1.5 W/(l/s). Heat recovery efficiency = 75%
VRV/F Air-Conditioning System (Air-Source Heat Pumps)	Heating efficiency: SCOP = 4.0. Cooling efficiency: SEER = 5.0
General Domestic Hot Water Services	Local instantaneous electric water heaters
Cleaner's Store Domestic Hot Water Services	Local storage electric water heaters with total cumulative storage capacity of 120 litres. Insulation thickness of 10mm, factory insulated.

Table 12: Thermal Model Electrical Lighting Performance

ROOM	LUMINAIRE EFFICACY (LLM/CW) UNLESS OTHERWISE STATED	DESIGN ILLUMINANCE (LUX)	OCCUPANCY DETECTION	DAYLIGHT CONTROL	PARASITIC POWER (W/M^2)
Open Plan Offices	100	500	Manual On/Auto Off	Photocell control dimming	0.10
Reception	100	300	None	Photocell control dimming	0.10
Landing	100	200	Auto On/Off	Photocell control dimming	0.10
Circulation Areas	100	200	Auto On/Off	No daylight control	0.10
Toilets	100	200	Auto On/Off	No daylight control	0.10
Cleaner's Store	100	150	Auto On/Off	No daylight control	0.10
Link Corridor	100	200	Auto On/Off	Photocell control dimming	0.10

5.3.1 CLEAN RESULTS

By implementing the proposed building fabric and building services efficiencies, the building now complies with Building Regulations Part L2A Criterion One but does not yet achieve an EPC rating of 'A'. The results are as follows…

Table 13: Thermal Model 'As Designed' Carbon Emission Results and EPC Rating

BUILDING	TARGET EMISSION RATE (TER)	BUILDING EMISSION RATE (TER)	BUILDING REGULATIONS COMPLIANCE?	EPC RATING
Unit 7a	18.4 kg.CO_2/m^2.annum	17.8 kg.CO_2/m^2.annum	Yes	B

Below is the breakdown of the energy consumption, extracted directly from the BRUKL document…

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	5.26	3.43
Cooling	2.67	6.35
Auxiliary	5.38	2.42
Lighting	15.23	21.26
Hot water	5.76	5.69
Equipment*	37.93	37.93
TOTAL**	34.3	39.14

* 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]	85.99	107.87
Primary energy* [kWh/m²]	105.31	103.19
Total emissions [kg/m²]	17.8	18.4

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

Figure 4: Clean BRUKL Output document results

From the results, the percentage reduction on the heating/cooling demand, building energy consumption and total carbon emissions are as follows…

Table 14: Percentage reduction on building energy consumption, heating/cooling demand and carbon emission rate

STRATEGY	TOTAL BUILDING ENERGY CONSUMPTION (KWH/M^2)	PERCENTAGE REDUCTION (%)
Baseline	53.19	-
Lean	49.55	6.84
Clean	34.30	30.78
Green	-	-
	Total Reduction from Baseline	35.51
	HEATING & COOLING ENERGY DEMAND (MJ/m^2)	**PERCENTAGE REDUCTION (%)**
Baseline	122.22	-
Lean	98.64	19.29
Clean	85.99	12.82
Green	-	-
	Total Reduction from Baseline	29.64
	BUILDING EMISSION RATE (kg.CO_2/m^2.annum)	**PERCENTAGE REDUCTION (%)**
Baseline	27.60	-
Lean	25.70	6.88
Clean	17.80	30.74
Green	-	-
	Total Reduction from Baseline	35.51

This shall demonstrate compliance with the following items for each policy…

POLICY	ITEM
Policy ESD 1	Designing developments to reduce carbon emission and use resources more efficiently, including water (regarding water, this shall be covered by BREEAM NC 2018 Pre-Assessment)
Policy ESD 2	Reducing energy use, in particular by the use of sustainable design and construction measures
Policy ESD 3	Minimising both energy demands and energy loss Maximising passive solar lighting and natural ventilation

5.4 GREEN

A list of commercially available low and zero carbon technologies are described below. This section shall highlight which technologies could be considered either appropriate or unfeasible for this development.

5.4.1 AVAILABLE TECHNOLOGIES

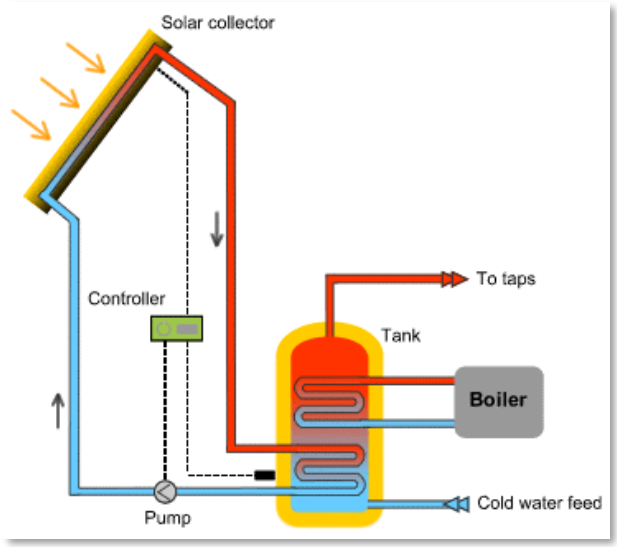
SOLAR HOT WATER

Description

Solar water heating systems use energy from the sun to heat water. A fluid within the wall/roof mounted panel is heated by the sun. The fluid is then used to heat water.

There are two types of collectors available:

- Flat plate
- Evacuated tube



Advantages

- Government Renewable Heat Incentive payments.
- Relies on a natural source (the sun).
- Low maintenance.

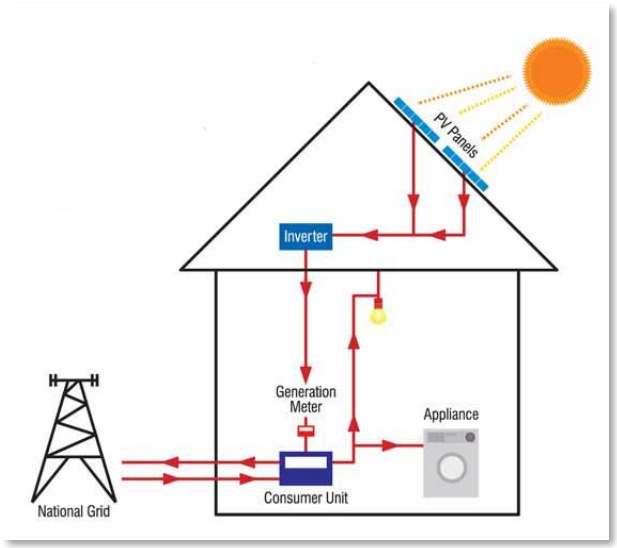
Disadvantages

- Panels ideally need to face South and at an incline of 30º to the horizontal.
- The system must be unshaded.

PHOTOVOLTAICS (PV)

Description

Photovoltaic (PV) systems convert energy from the sun into electricity through semi-conductor cells, connected together in mounted modules.



Advantages

- Panels can be incorporated into the building.
- Government Feed in Tariff payments.
- Relies on a natural source (the sun).
- Low maintenance.
- Silent in operation.
- No emissions.

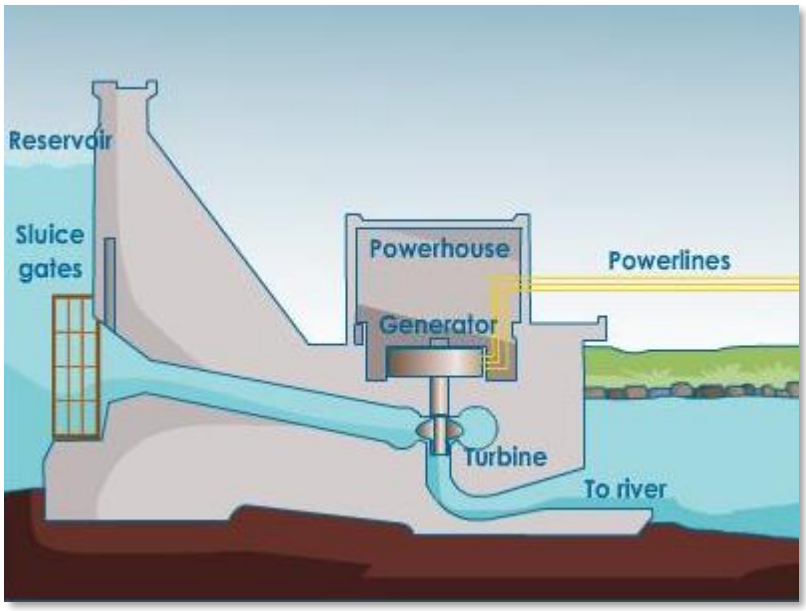
Disadvantages

- PV panels ideally need to face South and at an incline of 30º to the horizontal.
- The system must be unshaded.
- Amount of energy generated is dependent upon the daylight availability.

HYDRO POWER

Description

Hydro power is the process of using river water to generate electricity. Water is used to drive a turbine to generate electricity.



Advantages

- Government Feed in Tariff payments.
- Surplus energy can be sold to the grid.
- Low running and maintenance costs.

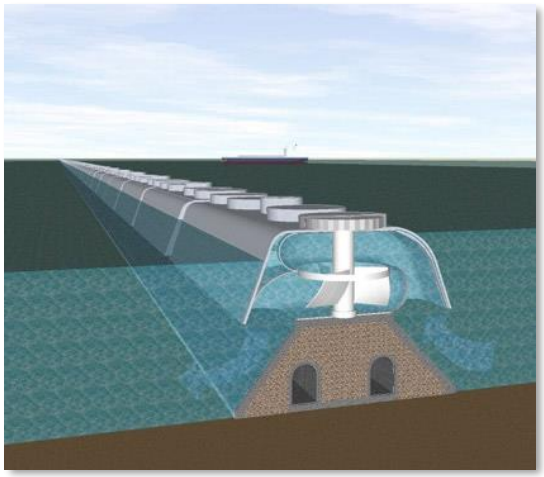
Disadvantages

- Installation is expensive.
- Very site specific – need an adequate water supply all year round.

TIDAL & WAVE POWER

Description

Tidal/wave power is the process of using tidal waves to generate electricity. Water is used to drive a turbine to generate electricity.



Advantages

- Government Feed in Tariff payments.
- Surplus energy can be sold to the grid.
- Low running and maintenance costs.
- The tide moves a huge amount of water each day and has the potential to produce a lot of energy.

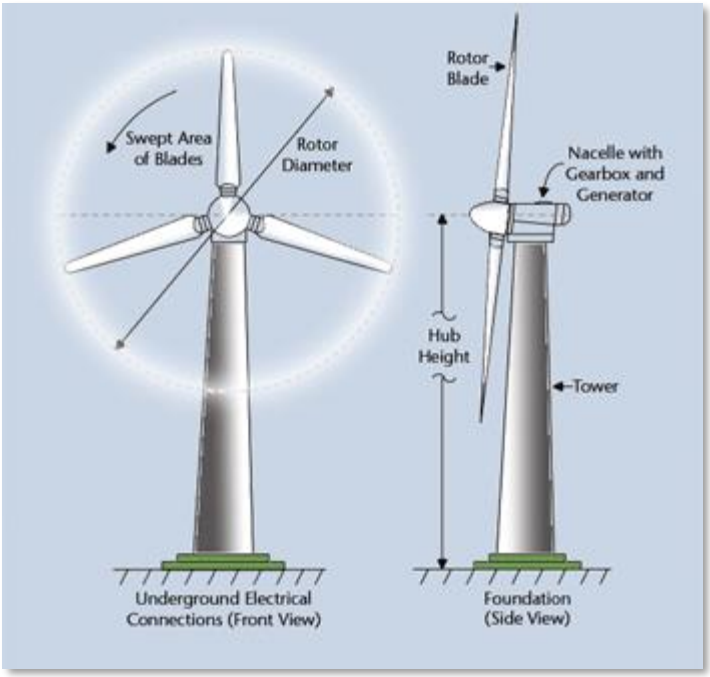
Disadvantages

- Installation is expensive.
- Very site specific – requires a tidal location.

WIND TURBINES

Description

Wind turbines harness the power of the wind to generate electricity through a vertical or horizontal axis propeller which harnesses the kinetic energy in wind and converts it to electrical power through a generator. Requires an average wind speed greater than 5m/s according to CIBSE TM 38. (Refer to https://www.rensmart.com/Maps to find the average wind speed for the site.)



Advantages

- Wind is free.
- Surplus energy can be sold to the grid.
- Extremely beneficial in exposed or coastal sites.

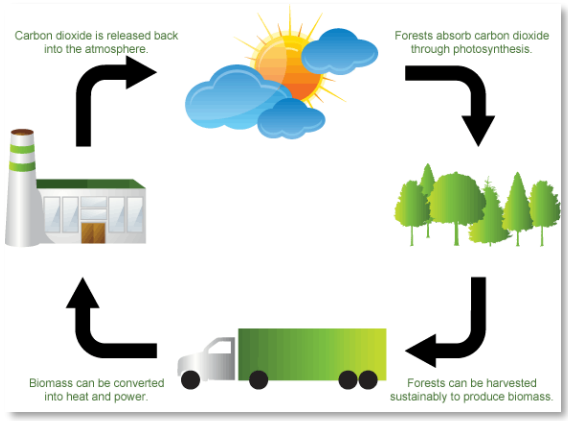
Disadvantages

- Highly dependent on the speed of the wind at the site of the turbine.
- Wind speed is dependent upon location within the UK and nearby obstructions.
- Very visible.
- High noise levels.
- Creates a flickering shadow.

BIOMASS

Description

Wood is burned to provide heat to either a single room, a central heating system or to heat water.



Advantages

- May be eligible for Renewable Heat Incentives.
- Affordable fuel.

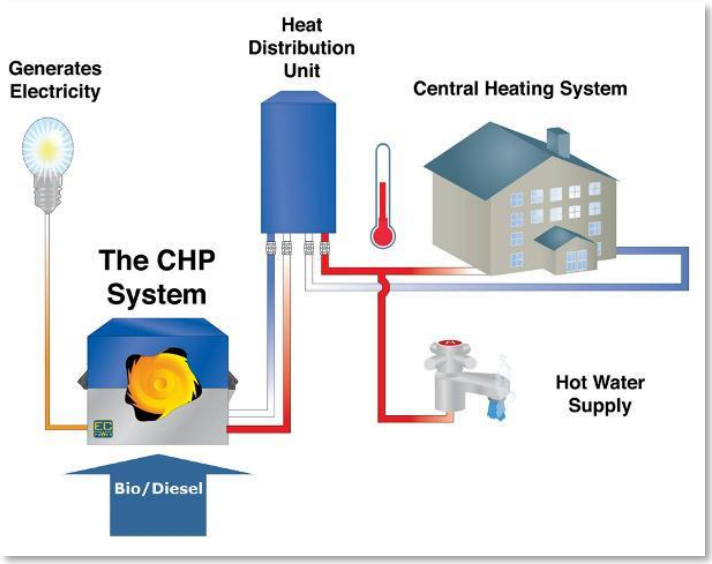
Disadvantages

- Wood is renewable but trees take a longer time to grow than to burn.
- CO_2 emitted when wood is burned.
- Requires regular deliveries of wood pellets.
- The chimney must be carefully considered as it is generally significantly taller than the building.

COMBINED HEAT AND POWER (CHP)

Description

A CHP system generates heat and electricity simultaneously through an internal combustion engine that drives an electrical alternator.



Advantages

- Electricity generated as a by-product of heat.
- Can burn a variety of fuels, such as natural gas, diesel oil, or biofuels such as bioethanol.
- Government Feed in Tariff payments.
- Easy installation.
- Cheap maintenance costs.

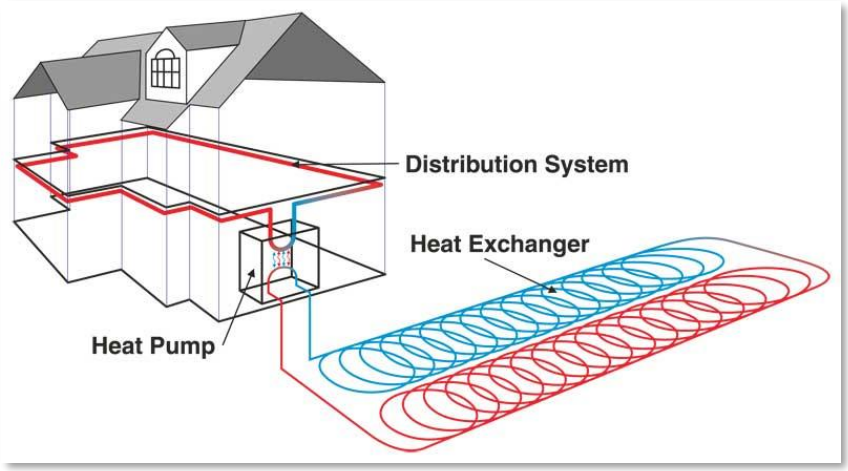
Disadvantages

- Typically powered by mains gas or LPG.

GROUND SOURCE HEAT PUMPS

Description

Ground source heat pumps extract heat from the ground via pipes buried in the ground. The pipes contain a fluid which is heated, this heat can then be used for heating or hot water.



Advantages

- Government Renewable Heat Incentive payments.
- Can be used throughout the entire year as the ground remains at a consistent temperature.

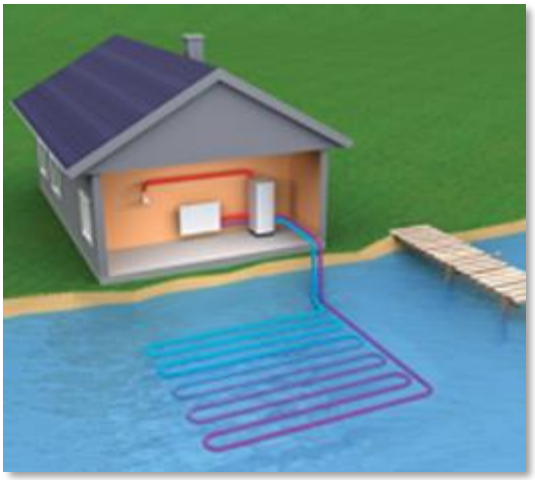
Disadvantages

- The ground must be suitable for digging a trench or boreholes.
- Require regular maintenance.
- Initial installation can be expensive.

WATER SOURCE HEAT PUMPS

Description

Water source heat pumps absorb heat from a water source which can then be used for heating or hot water.



Advantages

- Government Renewable Heat Incentive payments.
- High rate of heat transfer.

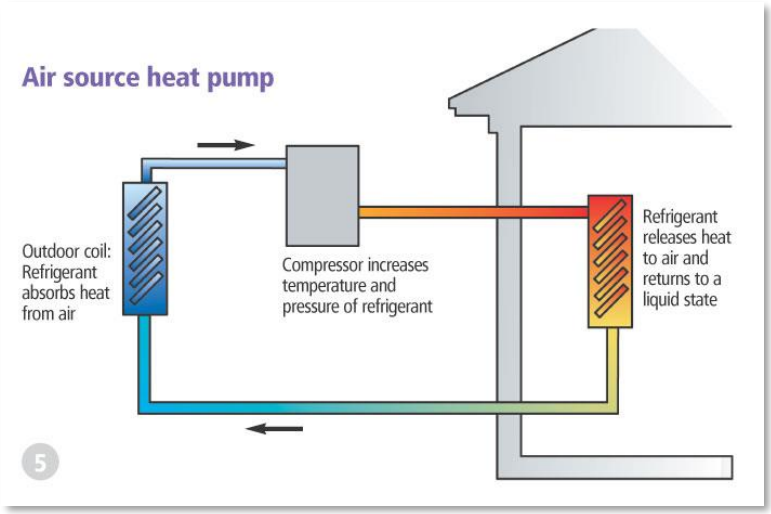
Disadvantages

- Require regular maintenance.
- The ground must be suitable for digging a trench or boreholes.
- Site specific as it requires an adequate water source.

AIR SOURCE HEAT PUMPS

Description

Air source heat pumps absorb heat from the outside air which can then be used for heating or hot water.



Advantages

- Government Renewable Heat Incentive payments.
- Relatively low capital costs.

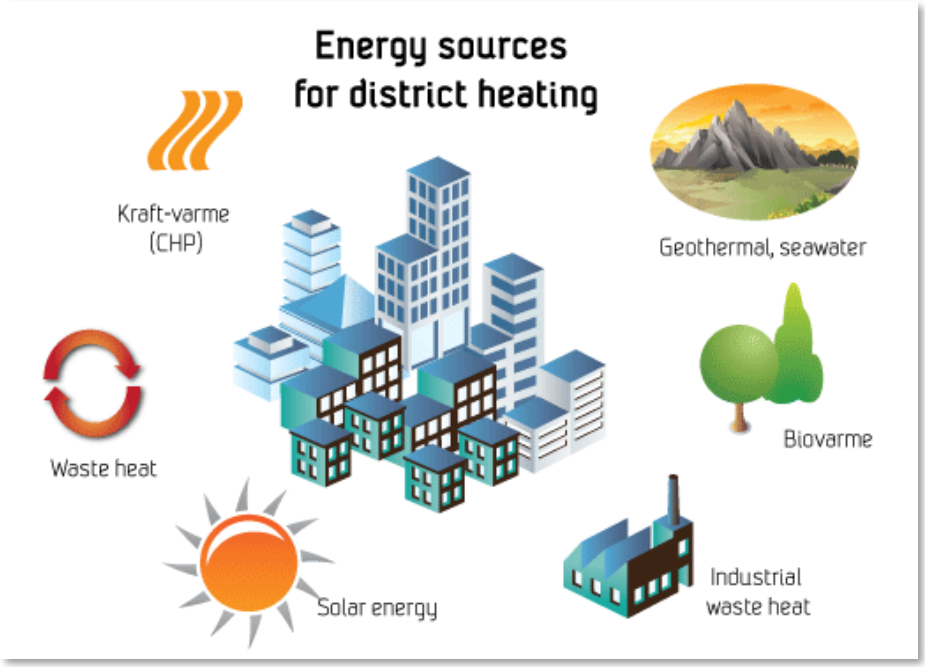
Disadvantages

- Require regular maintenance.
- Requires additional plant space.

COMMUNITY/DISTRICT HEATING

Description

A centralised heating network supplies heat from a central source to businesses/homes through a network of pipes carrying hot water.



Advantages

- Cost-effective.
- Government funding often available.

Disadvantages

- Expensive installation.
- Often requires existing network to allow a connection.

5.4.2 APPROPRIATE TECHNOLOGIES

The tables below summarise the technologies which could be considered feasible for use on this development:

Table 15: Appropriate LZC Technology Information

TECHNOLOGY	REASON FOR USE
Air Source Heat Pumps (VRV/F Air-conditioning)	Industry standard heating/cooling equipment for smaller office type buildings. Its high efficiency will ensure low energy consumption. Currently, the building already includes this technology.
Photovoltaics	Unit 7a will have an allocated space on the roof available for PV installation. As the building currently does not achieve an EPC rating of 'A', this technology shall be implemented.

5.4.3 EXCLUDED TECHNOLOGIES

A number of technologies have been excluded due to location or resource availability; these have been summarised in the table below:

Table 16: Excluded LZC Technology Information

TECHNOLOGY	REASON FOR EXCLUSION
Hydro Power	There is no suitable water source to allow for a hydroelectric power installation.
Tidal & Wave Power	There is no suitable water source to allow for a tidal or wave power installation.
Ground Source Heat Pumps	Ground source heat pumps can be suitable for this development, however, capital cost will be greater than air source heat pumps. As the price difference between electricity and gas fuel can sometimes be a factor of three, payback will potentially be very long.
Water Source Heat Pumps	There is no suitable water source to enable the installation of a water source heat pump system.
Solar Hot Water	The domestic hot water demand is low due to the office environment and capital cost would outweigh any potential energy saving.
Wind Turbines	The average wind speed shown in RenSMART's wind map show it is generally below or equal to 5.0 m/s. Wind turbines require average wind speeds greater than 5.0 m/s to generate meaningful amount of energy.
Biomass	Unit 7a is an office building which has a hot water operational profile unsuitable for this technology. However, spare ducts shall be provided within site for future connections onto any future decentralised energy networks

Combined Heat and Power	Unit 7a is an office building which has a hot water operational profile unsuitable for this technology. However, spare ducts shall be provided within site for future connections onto any future decentralised energy networks, should the hot water system calls for traditional gas-fired hot water system.
Community / District Heating	Unit 7a is an office building which has a hot water operational profile unsuitable for this technology. However, spare ducts shall be provided within site for future connections onto any nearby district heating network.

5.4.4 IMPLEMENTED TECHNOLOGIES

Unit 7a shall implement the relevant appropriate technologies highlighted previously. It is to note that highly efficient Air-Source Heat Pumps were already implemented during the Clean stage of the energy hierarchy, nevertheless the technology is detailed below again.

Table 17: Thermal Model LZC System Description

LOW AND ZERO CARBON TECHNOLOGY	SYSTEM DESCRIPTION
VRV/F Air-Conditioning System (Air-Source Heat Pumps)	Heating efficiency: SCOP = 4.0. Cooling efficiency: SEER = 5.0

Table 18: Thermal Model Renewable Technology Information to EPC Rating of 'A'.

RENEWABLE TECHNOLOGY	DESCRIPTION
Photovoltaic Panels	250m^2 of monocrystalline photovoltaic panels mounted on the roof with inclination of 30° and an orientation of 116° from North. Cell efficiency is 20.1%, degradation factor of the modules is 0.99 and solar conversion factor is 0.96.

5.4.5 GREEN RESULTS

By implementing the proposed building fabric and building services efficiencies, the building now complies with Building Regulations Part L2A Criterion One and achieves an EPC rating of 'A'. The results are as follows…

Table 19: Thermal Model 'As Designed' Carbon Emission Results and EPC Rating

BUILDING	TARGET EMISSION RATE (TER)	BUILDING EMISSION RATE (TER)	BUILDING REGULATIONS COMPLIANCE?	EPC RATING
Unit 7a	18.4 kg.CO_2/m^2.annum	14.0 kg.CO_2/m^2.annum	Yes	A

Below is the breakdown of the energy consumption, extracted directly from the BRUKL document…

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	5.26	3.43
Cooling	2.67	6.35
Auxiliary	5.38	2.42
Lighting	15.23	21.26
Hot water	5.76	5.69
Equipment*	37.93	37.93
TOTAL**	34.3	39.14

* 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	7.24	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]	85.99	107.87
Primary energy* [kWh/m²]	105.31	103.19
Total emissions [kg/m²]	14	18.4

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

Figure 5: Green BRUKL Output document results

From the results, the percentage reduction on the heating/cooling demand, building energy consumption and total carbon emissions are as follows…

Table 20: Percentage reduction on building energy consumption, heating/cooling demand and carbon emission rate

STRATEGY	TOTAL BUILDING ENERGY CONSUMPTION (KWH/M^2)	PERCENTAGE REDUCTION (%)
Baseline	53.19	-
Lean	49.55	6.84
Clean	34.30	30.78
Green	27.06 (Clean – PV Energy Generation)	21.11
	Total Reduction from Baseline	49.13
	HEATING & COOLING ENERGY DEMAND (MJ/m^2)	**PERCENTAGE REDUCTION (%)**
Baseline	122.22	-
Lean	98.64	19.29
Clean	85.99	12.82
Green	85.99	N/A
	Total Reduction from Baseline	29.64
	BUILDING EMISSION RATE (kg.CO_2/m^2.annum)	**PERCENTAGE REDUCTION (%)**
Baseline	27.60	-
Lean	25.70	6.88
Clean	17.80	30.74
Green	14.00	21.35
	Total Reduction from Baseline	49.28

The annual generation of the PV system required to achieve an EPC rating of 'A' is **45,146.90 kWh/annum**. This equates to a carbon reduction of approximately **23,431.00 kg.CO_2/annum**.

The number of BREEAM Ene01 credits the building achieves is 5 credits.

This demonstrates compliance with the following items for each policy…

POLICY	ITEM
Policy ESD 1	Designing developments to reduce carbon emission and use resources more efficiently, including water (regarding water, this shall be covered by BREEAM NC 2018 Pre-Assessment)
Policy ESD 2	Supplying energy efficiently and giving priority to decentralised energy supply Making use of renewable energy Making use of allowable solutions
Policy ESD 3	Minimising both energy demands and energy loss
Policy ESD 4	Please refer to Section 6.4.6
Policy ESD 5	All items

5.4.6 POLICY ESD 4: DESCENTRALISED ENERGY SYSTEMS

Highlighted in Table 16, decentralised energy systems – which includes combined heat and power, district heating, biomass – are described to be unfeasible at this outline stage for the employment units. However, should future tenants require a centralised hot water system for the building, then decentralised energy systems shall be considered.

The closest decentralised energy centre is the Ardley Energy Recovery Facility (ERF), located approximately 5.3 km from the development, which produces electricity from the incineration of non-recyclable waste. The facility exports the electricity generated to the national grid which is then freely available via the conventional electricity providers. The facility can also generate waste heat which can be utilised locally via heating water mains. This offers potential for the hot water to be generated via this medium. The constituent parts for any energy centre can be maximised via the use of biomass fuelled CHP or gas fired CHP (profile dependant) to offer heating and electric supply. It should be considered that the Ardley ERF is local to the site and already offers waste recovery electrical supply.

If district heating mains are available from the Ardley ERF, there is potential for the building's hot water to be generated via this medium. Hot water can be generated via a plate heat exchanger which can heat-up cold water stored within a hot water calorifier up to 60^{o}C, this can be interfaced to an electric or gas boiler to top-up any unmet demands.

The office spaces are currently proposed to be heated and cooled via an air source heat pump system which represents the most practical system for this size and type of space. Integration to a heat network is not possible for this type of system so the office spaces will not benefit from any heat network. The efficiency of the air source heat pumps system can still achieve very good efficiency ratings, so we don't assess this non interface potential as a negative.

At this current outline stage, the building has potential for a wide range of hot water demand, as the building is currently designed to a Category A industry standard. This makes the feasibility of connection to a local heat network, whether private or public, very difficult to assess. On the current basis that the majority of the building will be an open plan office with

provision of toilet accommodation and no kitchen or eating/drinking spaces, the provision and connection to a decentralised heat network would be unfeasible at this current time.

To facilitate the potential for future heat network delivery however, the buildings could be provided with service ducts capable of supporting the routing of heating mains from the site boundary to the building. This means a clear and unobstructed below ground service strip finishing in service ducts routing through the ground floor slab into the building.

Below shows the location of both the Ardley ERF and the new development.

Figure 6: Location of Ardley ERF with respect to the location of the new development

6. BREEAM NEW CONSTRUCTION SCHEME 2018

Under Policy ESD 3, the new development is required to achieve a BREEAM NC 2018 rating of at least 'Very Good'. The BREEAM UK New Construction scheme (Building Research Establishment Environmental Assessment Method) is an environmental performance standard which new, non-domestic buildings in the UK can be assessed against. Within the scheme, there are rating benchmarks that a building may achieve through good or best practice, these ratings are:

BREEAM RATING	% SCORE
Outstanding	≥ 85
Excellent	≥ 70
Very Good	≥ 55
Good	≥ 45
Pass	≥ 30
Unclassified	< 30

Each rating represents performance equivalent to:

- Outstanding: Less than the top 1% of UK new non-domestic buildings (innovator)
- Excellent: Top 10% of UK new non-domestic buildings (best practice)
- Very Good: Top 25% of UK new non-domestic buildings (advanced good practice)
- Good: Top 50% of UK new non-domestic buildings (intermediate good practice)
- Pass: Top 75% of UK new non-domestic buildings (standard good practice)

How a building achieves any of the above ratings is by assessing how it is managed, constructed and operated. This is broken down into categories, which are:

- Management,
- Health and Wellbeing,
- Energy,
- Transport,
- Water,
- Materials,
- Waste,
- Land Use and Ecology, and
- Pollution

Another category is 'Innovation', though it is optional. Each category includes criteria a building may meet to achieve one or more credits. These credits will add up to score an overall BREEAM rating.

For this development, Unit 7a is targeting to achieve a BREEAM 2018 rating of 'Very Good'. This development's BREEAM NC 2018 Pre-Assessment shall account for the following…

- Material efficiency
- Use of recycled & sustainably sourced aggregates
- Construction waste management (construction resource efficiency)
- Reduction of energy use & carbon emissions
- Energy monitoring
- Low carbon design
- Water consumption

In specific response to the items set out in Policy ESD 3, the appropriate BREEAM credits to be targeted are:

ITEM	ASSOCIATED AND TARGETED BREEAM CREDIT FOR POLICY ESD 3
Maximising resource efficiency	Mat 06 – Material Efficiency Wst 01 – Construction Waste Management Wat 01 – Water consumption
Incorporating the use of recycled and energy efficient materials	Wst 02 – Use of recycled and sustainably sourced aggregates Mat 06 – Material efficiency – Minimise environmental impact of materials
Incorporating the use of locally sourced building materials	Mat 3 – Responsible sourcing of construction materials
Reducing the impact on the external environment and maximising opportunities for cooling and shading (by provision of open space and water, planting, and green roofs, for example); and	Hea 07 – Safe and healthy surroundings Land use and Ecology Section
Making use of the embodied energy within buildings wherever possible and re-using materials where proposals involve demolition or redevelopment	Mat 06 - Material Efficiency Wst 06 – Design for disassembly and adaptability

7. CONCLUSION

The aim of minimising building energy usage, carbon emissions and embodied carbon shall be met by employing the design strategy described in this report. The extent to how energy efficient the building is shall focus on complying with…

- Building Regulation's ADL2A and Policies ESD 1, 2, 4 & 5 (in terms of carbon emissions and energy efficiency),
- and Policy ESD 3 (in terms of BREEAM Rating of 'Very Good')
- EPC rating of 'A'

To meet the above energy efficiency targets, high performance building fabric, highly efficient Air-Source Heat Pumps and Photovoltaic Panels shall be implemented.

APPENDIX A

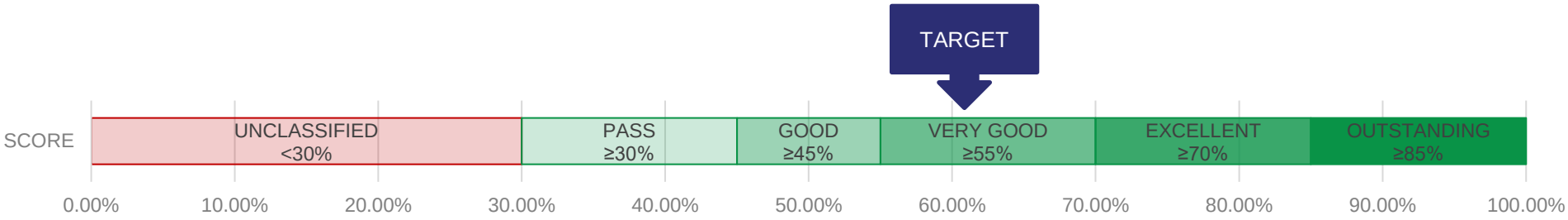
UNIT 7A BREEAM NC 2018 PRE-ASSESSMENT

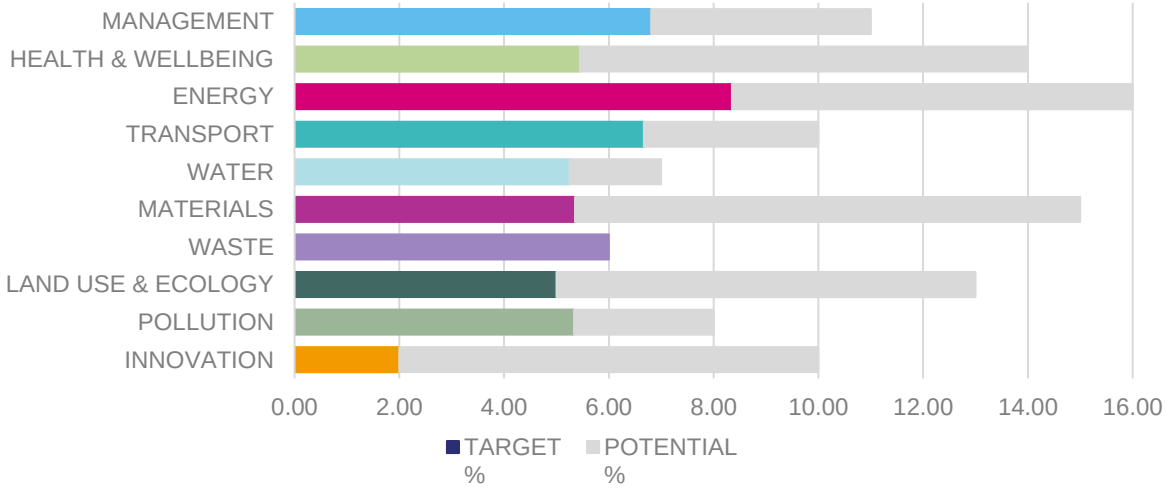
BREEAM NC 2018 PRE-ASSESSMENT

UNIT 7a CATALYST PHASE 2

MARCH 2022

The pre-assessment estimator outlines an indicative strategy to achieve a BREEAM NC 2018 rating of Very Good. This requires an overall score of 55%.
Mandatory credits required are written in red. **P** indicates criteria that is a pre-requisite for other credits.





MANAGEMENT				AVAILABLE	TARGET
UNIT 7a	Project Brief & Design	Project Delivery Planning	Concept Design	1	0
		Stakeholder Consultation (Interested Parties)	Concept Design	1	0
		Formally Agree Strategic Performance Targets	Concept Design	**P**	**0**
		BREEAM AP (Concept Design)	Concept Design	1	0
		BREEAM AP (Developed Design)	Developed Design	1	0
Man 02	Life Cycle Cost & Service Life Planning	Elemental LCC	Concept Design	2	0
		Component Level LCC Options Appraisal	Technical Design	1	0
		Capital Cost Reporting	Technical Design	1	1
Man 03	Responsible Construction Practices	Legally Harvested & Traded Timber	Construction	**P**	**P**
		Environmental Management	Construction	1	1
		Formally Agree Strategic Performance Targets	Construction	**P**	**P**
		BREEAM AP (Site)	Construction	1	1
		Responsible Construction Management	Construction	2	2
		Utility Consumption	Construction	1	1
		Transportation of Construction Materials & Waste	Construction	1	1
Man 04	Commissioning & Handover	Commissioning - Testing Schedule & Responsibilities	Developed Design	1	1
		Commissioning - Design & Preparation	Design Stage	1	1
		Testing & Inspection Building Fabric	Post-Construction	1	0
		Handover	Handover	1	1
Man 05	Aftercare	Aftercare Support	Occupation	1	1
		Commissioning - Implementation	Post-Occupancy	1	1
		Post-Occupancy Evaluation	Post-Occupancy	1	1
			Section Total	21	13
			Section Score %	11.00	6.81
			Single Credit Value %	0.52	

HEALTH AND WELLBEING				AVAILABLE	TARGET
Hea 01	Visual Comfort	Control of Glare from Sunlight	Developed Design	1	1
		Daylighting	Developed Design	2	0
		View Out	Developed Design	1	0
		Internal & External Lighting Levels, Zoning & Controls	Technical Design	1	1
Hea 02	Indoor Air Quality	Indoor Air Quality Plan	Concept Design	**P**	**0**
		Ventilation	Technical Design	1	0
		Emissions from Construction Products	Technical Design	2	0
		Post-Construction Indoor Air Quality Measurement	Pre-Handover	1	0
Hea 04	Thermal Comfort	Thermal Modelling	Developed Design	1	1
		Design for Future Thermal Comfort	Developed Design	1	1
		Thermal Zoning & Controls	Technical Design	1	1
Hea 05	Acoustic Performance	Sound Insulation	Developed Design	1	0
		Indoor Ambient Noise Level	Developed Design	1	0
		Reverberation Times	Developed Design	1	0
Hea 06	Security	Security of Site & Building	Concept Design	1	0
Hea 07	Safe & Healthy Surroundings	Safe Access	Developed Design	1	1
		Outdoor Space	Developed Design	1	1
			Section Total	18	7
			Section Score %	14.00	5.44
			Single Credit Value %	0.78	

ENERGY				AVAILABLE	TARGET
Ene 01	Reduction of Energy Use & Carbon Emissions	Energy Performance	Developed Design	9	5
		Energy Modelling & Reporting	Developed Design	4	0
Ene 02	Energy Monitoring	Sub-Metering of End-Use Categories	Technical Design	1	1
		Sub-Metering of High Energy Load & Tenancy Areas	Technical Design	1	1
Ene 03	External Lighting	External Lighting	Developed Design	1	1
Ene 04	Low Carbon Design	Passive Design Analysis	Concept Design	1	1
		Free Cooling	Concept Design	1	0
		Low & Zero Carbon Technologies	Concept Design	1	1
Ene 06	Energy Efficient Transportation Systems	Energy Consumption	Developed Design	1	1
		Energy Efficient Features - Lifts	Technical Design	1	1
Ene 08	Energy Efficient Equipment	Unregulated Energy Reduction	Technical Design	2	0
			Section Total	23	12
			Section Score %	16.00	8.35
			Single Credit Value %	0.70	

TRANSPORT				AVAILABLE	TARGET
Tra 01	Transport Assessment & Travel Plan	Travel Plan	Feasibility	2	2
Tra 02	Sustainable Transport Measures	Transport Options Implementation - cycle storage - 10% EVC - 5% car share - transport info board - new amenity - outdoor space	Feasibility	10	6
			Section Total	12	8
			Section Score %	10.00	6.67
			Single Credit Value %	0.83	

WATER				AVAILABLE	TARGET
Wat 01	Water Consumption	Reduction in Potable Water Use	Technical Design	5	3
Wat 02	Water Monitoring	Water Monitoring	Technical Design	1	1
Wat 03	Water Leak Detection & Prevention	Leak Detection System	Technical Design	1	1
		Flow Control Devices	Technical Design	1	1
			Section Total	8	6
			Section Score %	7.00	5.25
			Single Credit Value %	0.88	

MATERIALS				AVAILABLE	TARGET
Mat 01	Building Life Cycle Assessment	Superstructure	Concept Design	6	0
		Substructure & Hard Landscaping Options Appraisal	Concept Design	1	0
Mat 02	Environmental Product Declarations	Specification of Products with a Recognised EPD	Technical Design	1	0
Mat 03	Responsible Sourcing of Construction Products	Legally Harvested & Traded Timber	Construction	**P**	**P**
		Enabling Sustainable Procurement	Concept Design	1	1
		Measuring Responsible Sourcing	Construction	3	2
Mat 05	Designing for Durability & Resilience	Protect Vulnerable & Exposed Elements from Damage & Degradation	Technical Design	1	1
Mat 06	Material Efficiency	Minimise Environmental Impact of Materials	Preparation & Brief	1	1
			Section Total	14	5
			Section Score %	15.00	5.36
			Single Credit Value %	1.07	

WASTE				AVAILABLE	TARGET
Wst 01	Construction Waste Management	Construction Resource Efficiency	Construction	3	3
		Diversion of Resources from Landfill	Construction	1	1
Wst 02	Use of Recycled & Sustainably Sourced Aggregates	Project Sustainable Aggregate Points	Construction	1	1
Wst 03	Operational Waste	Operational Waste	Technical Design	1	1
Wst 04	Speculative Finishes	Speculative Floor & Ceiling Finishes	Technical Design	1	1
Wst 05	Adaptation to Climate Change	Resilience of Structure, Fabric, Building Services & Renewables Installation	Concept Design	1	1
Wst 06	Functional Adaptability	Design for Disassembly & Functional Adaptability - Recommendations	Concept Design	1	1
		Design for Disassembly & Functional Adaptability - Implementation	Concept Design	1	1
			Section Total	10	10
			Section Score %	6.00	6.00
			Single Credit Value %	0.60	

LAND USE AND ECOLOGY				AVAILABLE	TARGET
Le 01	Site Selection	Previously Occupied Land	Developed Design	1	0
		Contaminated Land	Developed Design	1	0
Le 02	Identifying & Understanding the Risks & Opportunities for the Project	Assessment Route Selection	Preparation & Brief	**P**	**P**
		Survey & Evaluation	Preparation & Brief	1	1
		Determining the Ecological Outcomes for the Site	Concept Design	1	1
Le 03	Managing Negative Impacts on Ecology	Identification & Understanding the Risks & Opportunities of the Site	Concept Design	**P**	**P**
		Planning, Liaison, Implementation & Data	Concept Design	1	1
		Managing Negative Impacts of the Project	Concept Design	2	1
Le 04	Change & Enhancement of Ecological Value	Identification & Understanding the Risks & Opportunities of the Site	Concept Design	**P**	**P**
		Liaison, Implementation & Data Collection	Concept Design	1	1
		Enhancement of Ecology	Concept Design	3	0
Le 05	Long Term Ecology Management & Maintenance	Roles & Responsibilities, Implementation, Statutory Obligations	Concept Design	**P**	**0**
		Planning, Liaison, Data, Monitoring & Review Management & Maintenance	Concept Design	1	0
		Landscape & Ecology Management Plan Development	Concept Design	1	0
			Section Total	13	5
			Section Score %	13.00	5.00
			Single Credit Value %	1.00	

POLLUTION				AVAILABLE	TARGET
Pol 01	Impact of Refrigerants	Pre-Requisite - BS EN 378:2018	Technical Design	**P**	**P**
		Impact of Refrigerants	Technical Design	2	1
		Leak Detection	Technical Design	1	0
Pol 02	Local Air Quality	NOx, PPM, VOC Emissions	Technical Design	2	2
Pol 03	Flood & Surface Water Management	Appropriate Consultant	Developed Design	**P**	**P**
		Flood Resilience	Developed Design	2	1
		Bespoke Surface Water Run-Off Design Solutions	Technical Design	**P**	**P**
		Surface Water Run-Off - Rate	Technical Design	1	1
		Surface Water Run-Off - Volume	Technical Design	1	0
		Minimise Watercourse Pollution	Technical Design	1	1
Pol 04	Reduction of Night Time Light Pollution	Reduction of Night Time Light Pollution	Technical Design	1	1
Pol 05	Reduction of Noise Pollution	Reduction of Noise Pollution	Developed Design	1	1
			Section Total	12	8
			Section Score %	8.00	5.33
			Single Credit Value %	0.67	

INNOVATION				AVAILABLE	TARGET
Exemplary Performance	Man 03	Responsible Construction Practices - All Criteria	Construction	1	0
	Hea 01	Visual Comfort - Daylighting	Developed Design	1	0
	Hea 01	Visual Comfort - Dimmer Switches	Developed Design	1	0
	Hea 02	Indoor Air Quality - Emission Levels	Concept Design	2	0
	Hea 06	Security - SABRE	Concept Design	1	0
	Ene 01	Reduction of Energy Use & Carbon Emissions	Concept Design	5	0
	Wat 01	Water Consumption	Technical Design	1	0
	Mat 01	Building Life Cycle Assessment	Concept Design	3	0
	Mat 03	Responsible Sourcing of Construction Products	Construction	1	0
	Wst 01	Construction Waste Management	Construction	1	1
	Wst 02	Use of Recycled & Sustainably Sourced Aggregate	Construction	1	1
	Wst 05	Adaptation to Climate Change	Concept Design	1	0
	Le 02	Identifying & Understanding the Risks & Opportunities for the Project	Concept Design	1	0
	Le 04	Change & Enhancement of Ecological Value	Concept Design	1	0
	Inn	BRE Approved Innovations	Developed Stage	1	0
			Section Total	10	2
			Section Score %	10.00	2.00
			Single Credit Value %	1.00	

SCORE	
Target Score %	56.21
Target Rating	**Very Good**

APPENDIX B

UNIT 7A BRUKL OUTPUT DOCUMENT – GREEN STAGE

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Unit 7a - Green 20220316

As designed

Date: Wed Mar 16 13:27:29 2022

Administrative information

Building Details

Address: Unit 7a, BICESTER, OX25 2PA

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.13

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.13

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

Certifier details

Name: Kim Nguyen

Telephone number: 0121 214 8998

Address: ESC Ltd, Griffin House, 19 Ludgate Hill, Birmingham, B3 1DW

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	18.4
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	18.4
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	14
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

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

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

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.23	0.23	0F000001:Surf[0]
Floor	0.25	0.2	0.2	0F00000A:Surf[0]
Roof	0.25	0.16	0.16	0F000001:Surf[1]
Windows***, roof windows, and rooflights	2.2	1.5	1.5	0F00001A:Surf[0]
Personnel doors	2.2	-	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]

$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

* 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	4

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	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- EPH w/ NV

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0	0	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

2- VRV w/ NV

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4	5	0	0	-
Standard value	2.5*	2.6	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. For types <=12 kW output, refer to EN 14825 for limiting standards.					

3- EPH w/ MVHR (Improved)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0	1.5	-
Standard value	N/A	N/A	N/A	1.5^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.					

4- VRV w/ MVHR

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4	5	0	0	0.75
Standard value	2.5*	2.6	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

1- Instant Electric Hot Water

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

2- Cleaner's Local Electric Hot Water

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	-
Standard value	1	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
0F-Open Plan Office DL4-ID_space132	-	-	-	1.5	-	-	-	-	-	-	N/A
0F-Open Plan Office DL1-ID_space139	-	-	-	1.5	-	-	-	-	-	-	N/A
0F-Open Plan Office DL2-ID_space140	-	-	-	1.5	-	-	-	-	-	-	N/A
0F-Open Plan Office DL3-ID_space141	-	-	-	1.5	-	-	-	-	-	-	N/A
0F-Open Plan Office Non-DL3-ID_space142	-	-	-	1.5	-	-	-	-	-	-	N/A
0F-Open Plan Office Non-DL1-ID_space143	-	-	-	1.5	-	-	-	-	-	-	N/A
0F-Open Plan Office Non-DL2-ID_space144	-	-	-	1.5	-	-	-	-	-	-	N/A
1F-Open Plan Office DL5-ID_space71	-	-	-	1.5	-	-	-	-	-	-	N/A
1F-Open Plan Office DL4-ID_space76	-	-	-	1.5	-	-	-	-	-	-	N/A
1F-Open Plan Office DL1-ID_space101	-	-	-	1.5	-	-	-	-	-	-	N/A
1F-Open Plan Office DL2-ID_space102	-	-	-	1.5	-	-	-	-	-	-	N/A
1F-Open Plan Office DL3-ID_space103	-	-	-	1.5	-	-	-	-	-	-	N/A
1F-Open Plan Office Non-DL3-ID_space104	-	-	-	1.5	-	-	-	-	-	-	N/A
1F-Open Plan Office Non-DL1-ID_space105	-	-	-	1.5	-	-	-	-	-	-	N/A
1F-Open Plan Office Non-DL2-ID_space106	-	-	-	1.5	-	-	-	-	-	-	N/A
2F-Open Plan Office DL6-ID_space36	-	-	-	1.5	-	-	-	-	-	-	N/A
2F-Open Plan Office DL5-ID_space40	-	-	-	1.5	-	-	-	-	-	-	N/A
2F-Open Plan Office DL1-ID_space65	-	-	-	1.5	-	-	-	-	-	-	N/A
2F-Open Plan Office DL2-ID_space66	-	-	-	1.5	-	-	-	-	-	-	N/A
2F-Open Plan Office DL4-ID_space67	-	-	-	1.5	-	-	-	-	-	-	N/A
2F-Open Plan Office Non-DL1-ID_space69	-	-	-	1.5	-	-	-	-	-	-	N/A
2F-Open Plan Office Non-DL2-ID_space70	-	-	-	1.5	-	-	-	-	-	-	N/A
3F-Open Plan Office Non-DL3-ID_space2	-	-	-	1.5	-	-	-	-	-	-	N/A
3F-Open Plan Office DL1-ID_space5	-	-	-	1.5	-	-	-	-	-	-	N/A
3F-Open Plan Office DL3-ID_space29	-	-	-	1.5	-	-	-	-	-	-	N/A
3F-Open Plan Office DL4-ID_space30	-	-	-	1.5	-	-	-	-	-	-	N/A
3F-Open Plan Office DL2-ID_space31	-	-	-	1.5	-	-	-	-	-	-	N/A
3F-Open Plan Office DL6-ID_space32	-	-	-	1.5	-	-	-	-	-	-	N/A
3F-Open Plan Office DL5-ID_space33	-	-	-	1.5	-	-	-	-	-	-	N/A
3F-Open Plan Office Non-DL1-ID_space34	-	-	-	1.5	-	-	-	-	-	-	N/A
3F-Open Plan Office Non-DL2-ID_space35	-	-	-	1.5	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
0F-Open Plan Office DL5-ID_space1	-	-	-	1.5	-	-	-	-	-	-	N/A
2F-Open Plan Office DL3-ID_space64	-	-	-	1.5	-	-	-	-	-	-	N/A
2F-Open Plan Office Non-DL3	-	-	-	1.5	-	-	-	-	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
0F/1F/2F/3F-Staircase 3-ID_space4	-	100	-	7
0F/1F/2F/3F-Staircase 2-ID_space8	-	100	-	5
0F/1F/2F/3F-Staircase 3-ID_space39	-	100	-	7
0F/1F/2F/3F-Staircase 2-ID_space43	-	100	-	5
0F/1F/2F/3F-Staircase 3-ID_space75	-	100	-	5
0F/1F/2F/3F-Staircase 2-ID_space79	-	100	-	5
0F-Lobby/Lockers-ID_space111	-	100	-	155
0F-Reception Circulation-ID_space112	-	100	22	154
0F-Amb WC-ID_space113	-	100	-	28
0F-WC 2-ID_space116	-	100	-	25
0F-WC 3-ID_space117	-	100	-	26
0F-WC 1-ID_space118	-	100	-	25
0F-Acc WC-ID_space119	-	100	-	27
0F-WC 5-ID_space121	-	100	-	27
0F-WC 4-ID_space122	-	100	-	28
0F-WC 6-ID_space124	-	100	-	27
0F-Acc WC & Shower-ID_space128	-	100	-	32
0F/1F/2F/3F-Staircase 2-ID_space131	-	100	-	51
0F-Open Plan Office DL4-ID_space132	100	-	-	783
0F-Cleaner's Store-ID_space133	100	-	-	19
0F-Acc WC 2-ID_space135	-	100	-	27
0F-Staircase 3 Lobby-ID_space136	-	100	-	46
0F-Staircase 2 Lobby-ID_space137	-	100	-	47
0F-Open Plan Office DL1-ID_space139	100	-	-	313
0F-Open Plan Office DL2-ID_space140	100	-	-	2779
0F-Open Plan Office DL3-ID_space141	100	-	-	1828
0F-Open Plan Office Non-DL3-ID_space142	100	-	-	2043
0F-Open Plan Office Non-DL1-ID_space143	100	-	-	552
0F-Open Plan Office Non-DL2-ID_space144	100	-	-	922
1F-Open Plan Office DL5-ID_space71	100	-	-	545
1F-Landing-ID_space73	-	100	-	102
1F-Open Plan Office DL4-ID_space76	100	-	-	781
1F-Staircase 3 Lobby-ID_space77	-	100	-	57
1F-Staircase 2 Lobby-ID_space81	-	100	-	47
1F-WC 7-ID_space83	-	100	-	27
1F-WC 6-ID_space84	-	100	-	27

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
1F-WC 5-ID_space85	-	100	-	27
1F-WC 4-ID_space86	-	100	-	28
1F-WC 1-ID_space87	-	100	-	25
1F-WC 2-ID_space88	-	100	-	25
1F-Acc WC-ID_space93	-	100	-	27
1F-Amb WC-ID_space94	-	100	-	28
1F-WC 3-ID_space95	-	100	-	26
1F-Lobby/Lockers-ID_space96	-	100	-	153
1F-Acc WC 2-ID_space98	-	100	-	29
1F-Cleaner's Store-ID_space100	100	-	-	21
1F-Open Plan Office DL1-ID_space101	100	-	-	312
1F-Open Plan Office DL2-ID_space102	100	-	-	2776
1F-Open Plan Office DL3-ID_space103	100	-	-	1826
1F-Open Plan Office Non-DL3-ID_space104	100	-	-	2041
1F-Open Plan Office Non-DL1-ID_space105	100	-	-	548
1F-Open Plan Office Non-DL2-ID_space106	100	-	-	921
2F-Open Plan Office DL6-ID_space36	100	-	-	545
2F-Open Plan Office DL5-ID_space40	100	-	-	781
2F-Staircase 3 Lobby-ID_space41	-	100	-	57
2F-Staircase 2 Lobby-ID_space45	-	100	-	47
2F-Cleaner's Store-ID_space46	100	-	-	21
2F-WC 6-ID_space47	-	100	-	27
2F-WC 5-ID_space48	-	100	-	27
2F-WC 4-ID_space49	-	100	-	28
2F-WC 1-ID_space50	-	100	-	25
2F-WC 2-ID_space51	-	100	-	25
2F-Acc WC-ID_space55	-	100	-	27
2F-Amb WC-ID_space56	-	100	-	28
2F-WC 3-ID_space57	-	100	-	26
2F-Lobby/Lockers-ID_space58	-	100	-	256
2F-WC 7-ID_space59	-	100	-	27
2F-Changing (Dry)-ID_space60	100	-	-	50
2F-Changing (Wet)-ID_space62	-	100	-	25
2F-Acc WC 2-ID_space63	-	100	-	29
2F-Open Plan Office DL1-ID_space65	100	-	-	312
2F-Open Plan Office DL2-ID_space66	100	-	-	2777
2F-Open Plan Office DL4-ID_space67	100	-	-	1826
2F-Open Plan Office Non-DL1-ID_space69	100	-	-	548
2F-Open Plan Office Non-DL2-ID_space70	100	-	-	921
3F-Open Plan Office Non-DL3-ID_space2	100	-	-	2043
3F-Open Plan Office DL1-ID_space5	100	-	-	316
3F-Staircase 3 Lobby-ID_space6	-	100	-	59
3F-Staircase 2 Lobby-ID_space10	-	100	-	48

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
3F-Roof Escape-ID_space11	-	100	-	31
3F-WC 6-ID_space12	-	100	-	31
3F-WC 5-ID_space13	-	100	-	30
3F-WC 4-ID_space14	-	100	-	31
3F-WC 1-ID_space15	-	100	-	28
3F-WC 2-ID_space16	-	100	-	28
3F-Acc WC-ID_space20	-	100	-	30
3F-Amb WC-ID_space21	-	100	-	31
3F-WC 3-ID_space22	-	100	-	29
3F-Lobby/Lockers-ID_space23	-	100	-	265
3F-WC 7-ID_space24	-	100	-	30
3F-Changing (Dry)-ID_space25	100	-	-	55
3F-Changing (Wet)-ID_space27	-	100	-	28
3F-Acc WC 2-ID_space28	-	100	-	32
3F-Open Plan Office DL3-ID_space29	100	-	-	319
3F-Open Plan Office DL4-ID_space30	100	-	-	1831
3F-Open Plan Office DL2-ID_space31	100	-	-	2783
3F-Open Plan Office DL6-ID_space32	100	-	-	548
3F-Open Plan Office DL5-ID_space33	100	-	-	784
3F-Open Plan Office Non-DL1-ID_space34	100	-	-	550
3F-Open Plan Office Non-DL2-ID_space35	100	-	-	922
0F-Link Corridor 1	-	100	-	44
0F-Link Corridor 2	-	100	-	243
0F-Open Plan Office DL5-ID_space1	100	-	-	545
2F-Open Plan Office DL3-ID_space64	100	-	-	315
2F-Open Plan Office Non-DL3	100	-	-	2042
1F-Changing (Dry)	100	-	-	70
1F-Changing (Wet)	-	100	-	34
0F/1F/2F/3F-Staircase 3	-	100	-	77
0F-Changing (Dry)	100	-	-	51
0F-Changing (Wet)	-	100	-	25
0F/1F-Reception Double Height-ID_space138	-	100	22	337
0F/1F/2F/3F-Staircase 1-ID_space114	-	100	-	239

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?
0F-Reception Circulation-ID_space112	NO (-64.7%)	NO
0F-Open Plan Office DL4-ID_space132	NO (-87.6%)	NO
0F-Open Plan Office DL1-ID_space139	NO (-45.9%)	NO
0F-Open Plan Office DL2-ID_space140	NO (-48.5%)	NO
0F-Open Plan Office DL3-ID_space141	NO (-64.2%)	NO
0F-Open Plan Office Non-DL3-ID_space142	NO (-83.8%)	NO
0F-Open Plan Office Non-DL1-ID_space143	NO (-90.7%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
0F-Open Plan Office Non-DL2-ID_space144	NO (-89.2%)	NO
1F-Open Plan Office DL5-ID_space71	NO (-51.4%)	NO
1F-Open Plan Office DL4-ID_space76	NO (-85.7%)	NO
1F-Open Plan Office DL1-ID_space101	NO (-50.5%)	NO
1F-Open Plan Office DL2-ID_space102	NO (-53%)	NO
1F-Open Plan Office DL3-ID_space103	NO (-58%)	NO
1F-Open Plan Office Non-DL3-ID_space104	NO (-82.7%)	NO
1F-Open Plan Office Non-DL1-ID_space105	NO (-77.4%)	NO
1F-Open Plan Office Non-DL2-ID_space106	NO (-88.2%)	NO
2F-Open Plan Office DL6-ID_space36	NO (-50.5%)	NO
2F-Open Plan Office DL5-ID_space40	NO (-81.5%)	NO
2F-Changing (Dry)-ID_space60	N/A	N/A
2F-Open Plan Office DL1-ID_space65	NO (-50.2%)	NO
2F-Open Plan Office DL2-ID_space66	NO (-51.9%)	NO
2F-Open Plan Office DL4-ID_space67	NO (-52.2%)	NO
2F-Open Plan Office Non-DL1-ID_space69	NO (-73.4%)	NO
2F-Open Plan Office Non-DL2-ID_space70	NO (-86.5%)	NO
3F-Open Plan Office Non-DL3-ID_space2	NO (-79.5%)	NO
3F-Open Plan Office DL1-ID_space5	NO (-50.2%)	NO
3F-Changing (Dry)-ID_space25	N/A	N/A
3F-Open Plan Office DL3-ID_space29	NO (-33.2%)	NO
3F-Open Plan Office DL4-ID_space30	NO (-51.1%)	NO
3F-Open Plan Office DL2-ID_space31	NO (-52%)	NO
3F-Open Plan Office DL6-ID_space32	NO (-50.5%)	NO
3F-Open Plan Office DL5-ID_space33	NO (-80.2%)	NO
3F-Open Plan Office Non-DL1-ID_space34	NO (-71.5%)	NO
3F-Open Plan Office Non-DL2-ID_space35	NO (-86%)	NO
0F-Open Plan Office DL5-ID_space1	NO (-47.3%)	NO
2F-Open Plan Office DL3-ID_space64	NO (-33.2%)	NO
2F-Open Plan Office Non-DL3	NO (-80.1%)	NO
1F-Changing (Dry)	N/A	N/A
0F-Changing (Dry)	N/A	N/A
0F/1F-Reception Double Height-ID_space138	NO (-14.1%)	NO

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 [m^2]	6237.1	6237.1
External area [m^2]	7827.4	7827.4
Weather	SWI	SWI
Infiltration [m^3/hm^2@ 50Pa]	4	3
Average conductance [W/K]	3434.6	3415.96
Average U-value [W/m^2K]	0.44	0.44
Alpha value* [%]	9.23	10

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

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
100	**B1 Offices and Workshop businesses**
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	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/m^2]

	Actual	Notional
Heating	5.26	3.43
Cooling	2.67	6.35
Auxiliary	5.38	2.42
Lighting	15.23	21.26
Hot water	5.76	5.69
Equipment*	37.93	37.93
TOTAL**	**34.3**	**39.14**

* 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/m^2]

	Actual	Notional
Photovoltaic systems	7.24	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/m^2]	85.99	107.87
Primary energy* [kWh/m^2]	105.31	103.19
Total emissions [kg/m^2]	14	18.4

* 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] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	24.5	54.5	1.7	3	5.9	4	5	4	5
	Notional	17.1	98.7	1.9	7.2	2.1	2.56	3.79	----	----
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	235.4	66.1	16.4	3.7	0	4	5	4	5
	Notional	104.5	77.7	11.4	5.7	0	2.56	3.79	----	----
[ST] Central heating using air distribution, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	153.8	0	40	0	0	1.07	0	1	0
	Notional	55.3	0	17.8	0	6.1	0.86	0	----	----
[ST] Central heating using air distribution, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	102.8	0	26.8	0	7.3	1.07	0	1	0
	Notional	44.5	0	14.3	0	5.9	0.86	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

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	0.23	0F000001:Surf[0]
Floor	0.2	0.2	0F00000A:Surf[0]
Roof	0.15	0.16	0F000001:Surf[1]
Windows, roof windows, and rooflights	1.5	1.5	0F00001A:Surf[0]
Personnel doors	1.5	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building

$U_{i\text{-}Typ}$ = 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
m³/(h.m²) at 50 Pa	5	4

APPENDIX C

UNIT 7A ENERGY PERFORMANCE CERTIFICATE – GREEN STAGE

Energy Performance Certificate

Non-Domestic Building

HM Government

Unit 7a
Gateway Bicester
Address 3
Address 4
BICESTER
OX25 2PA

Certificate Reference Number:
4766-3061-9853-7423-7476

This certificate shows the energy rating of this building. It indicates the energy efficiency of the building fabric and the heating, ventilation, cooling and lighting systems. The rating is compared to two benchmarks for this type of building: one appropriate for new buildings and one appropriate for existing buildings. There is more advice on how to interpret this information in the guidance document *Energy Performance Certificates for the construction, sale and let of non-dwellings* available on the Government's website at www.gov.uk/government/collections/energy-performance-certificates.

Energy Performance Asset Rating

More energy efficient

A+

Net zero CO_2 emissions

A 0-25

B 26-50

C 51-75

D 76-100

E 101-125

F 126-150

G Over 150

25 This is how energy efficient the building is.

Less energy efficient

Technical information

Main heating fuel:	Grid Supplied Electricity
Building environment:	Air Conditioning
Total useful floor area (m^2):	6237.058
Building complexity:	Level 5
Building emission rate ($kgCO_2/m^2$ per year):	14.05
Primary energy use (kWh/m^2 per year):	105.31

Benchmarks

Buildings similar to this one could have ratings as follows:

33 If newly built

87 If typical of the existing stock

Administrative information

This is an Energy Performance Certificate as defined in the Energy Performance of Buildings Regulations 2012 as amended.

Assessment Software:	Virtual Environment v7.0.13 using calculation engine ApacheSim v7.0.13
Property Reference:	UPRN-000000000000
Assessor Name:	Kim Nguyen
Assessor Number:	LCEA203717
Accreditation Scheme:	CIBSE Certification Limited
Assessor Qualifications:	NOS5
Employer/Trading Name:	Engineering Services Consultancy Ltd
Employer/Trading Address:	ESC Ltd, Griffin House, 19 Ludgate Hill
Issue Date:	16 Mar 2022
Valid Until:	15 Mar 2032 (unless superseded by a later certificate)
Related Party Disclosure:	Not related to the owner

Recommendations for improving the energy performance of the building are contained in the associated Recommendation Report: 6391-5284-1922-9653-6116

About this document and the data in it

This document has been produced following an energy assessment undertaken by a qualified Energy Assessor, accredited by CIBSE Certification Limited. You can obtain contact details of the Accreditation Scheme at www.cibsecertification.com.

A copy of this certificate has been lodged on a national register as a requirement under the Energy Performance of Buildings Regulations 2012 as amended. It will be made available via the online search function at www.ndepcregister.com. The certificate (including the building address) and other data about the building collected during the energy assessment but not shown on the certificate, for instance heating system data, will be made publicly available at www.opendatacommunities.org.

This certificate and other data about the building may be shared with other bodies (including government departments and enforcement agencies) for research, statistical and enforcement purposes. For further information about how data about the property are used, please visit www.ndepcregister.com. To opt out of having information about your building made publicly available, please visit www.ndepcregister.com/optout.

There is more information in the guidance document *Energy Performance Certificates for the construction, sale and let of non-dwellings* available on the Government website at: www.gov.uk/government/collections/energy-performance-certificates. It explains the content and use of this document and advises on how to identify the authenticity of a certificate and how to make a complaint.

Opportunity to benefit from a Green Deal on this property

The Green Deal can help you cut your energy bills by making energy efficiency improvements at no upfront costs. Use the Green Deal to find trusted advisors who will come to your property, recommend measures that are right for you and help you access a range of accredited installers. Responsibility for repayments stays with the property - whoever pays the energy bills benefits so they are responsible for the payments.

To find out how you could use Green Deal finance to improve your property please call 0300 123 1234.