mba
CONSULTING ENGINEERS

ENERGY STRATEGY

FOR:
BICESTER GATEWAY, PHASE 1B
(RESERVED MATTERS)

A PROJECT FOR:
BICESTER GATEWAY LIMITED

AUTHOR:
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ISSUE:
P1

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PLANNING ISSUE

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DOCUMENT MANAGEMENT

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DOCUMENT REVISIONS

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EXECUTIVE SUMMARY

1. MBA Consulting Engineers Ltd. have been commissioned by Bicester Gateway Limited to produce an energy strategy in support of the Full Planning Application for the proposed development of Bicester Gateway, Phase 1B.

2. The planning application proposes:

   "Reserved matters to 16/02586/OUT – Access, layout, scale, appearance and landscaping details for Phase 1B for no. 12 knowledge economy units in Use Class E (11,745 sqm GIA) with associated parking, landscaping, utilities and access."

3. The energy strategy has been developed in accordance with the relevant energy and carbon policies of the Cherwell Local Plan 2011-2031 (July 2015):

   - Policy ESD 2: Energy Hierarchy and Allowable Solutions
   - Policy ESD 3: Sustainable Construction
   - Policy ESD 4: Decentralised Energy Systems
   - Policy ESD 5: Renewable Energy

4. The proposed development energy strategy can achieve carbon and energy reductions through the inclusion of energy efficient measures and low and zero carbon technologies. As shown below, the energy strategy improves upon the Building Regulations Part L2A (2013) baseline and achieves the minimum 4no. credits required for a BREEAM New Construction 2018 'Excellent' rating under the Ene 01 credit issue.

UNIT	PART L2A (2013) - TARGET EMISSION RATE (TER) KGCO2/M2	PART L2A (2013) - BUILDING EMISSION RATE (BER) KGCO2/M2	% IMPROVEMENT VS. PART L2A (2013) TER	BREEAM ENE 01 COMPLIANCE
Unit A	14.4	9.1	36.8%	Yes
Unit B	14.5	9.2	36.6%	Yes
Unit C	14.1	9.0	36.2%	Yes
Unit D	15.6	10.3	34.0%	Yes
Unit E	14.2	9.0	36.6%	Yes
Unit F	14.1	9.1	35.5%	Yes
Unit G	14.2	9.3	34.5%	Yes
Unit H	14.1	9.3	34.0%	Yes
Unit J	14.1	9.2	34.8%	Yes
Unit K	14.1	9.2	34.8%	Yes
Unit L	13.5	8.6	36.3%	Yes
Unit M	13.1	8.0	38.9%	Yes

CONTENTS

1.0 INTRODUCTION

1. MBA Consulting Engineers Ltd. have been commissioned by Bicester Gateway Limited to produce an energy strategy in support of the Full Planning Application for the proposed development of Bicester Gateway, Phase 1B.

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1.1 ENERGY STRATEGY SCOPE

1. In accordance with best practice, the energy strategy has been developed through the application of an energy hierarchy approach. In doing so, the energy strategy demonstrates how the proposals can meet the planning requirements and Building Regulations Part L2A (2013).

2. The energy hierarchy describes a set of principles to guide design development and decisions regarding energy, balanced with the need to optimise environmental and economic benefits. These guiding principles can be summarised as follows:

   - Using less energy, in particular by adopting sustainable design and construction measures; and
   - Utilise low and zero carbon energy.

3. A dynamic simulation model using TAS Version 9.5.2 has been produced to predict the proposed development's energy demand usage. To calculate the regulated energy use associated with the proposed development, NCM internal condition templates are assigned to each distinct internal space to account for the NCM defined energy factors that are unique to each type of space.

4. The calculations in this document are indicative of system size and carbon emissions based on guidance documents, approved software and practical experience. They are not design calculations, but establish the viability and feasibility of various technologies for the proposed development suited to a Use Class E building type.

5. The associated energy strategy calculation (BRUKL) outputs are included in Appendix B.

2.0 ENERGY EFFICIENCY MEASURES

1. In accordance with the energy hierarchy a range of energy efficiency measures are implemented, which encompasses the adoption of a fabric first approach (passive design measures) and energy efficient building servicing (active design measures).

2. The passive and active design measures incorporated in the energy strategy are detailed below.

2.1 Passive Measures

1. In order to achieve a building that complies with 2010 Building regulations Part L2A (2013 edition) and improve upon the baseline Target Emission Rate (TER), the following passive design measures are incorporated into the design:

    - Efficient building envelope with enhanced U-values beyond the Part L2A (2013) limiting values (as shown in Table 1 and 2).
    - Enhanced air permeability to reduce heating demand in the winter months.
    - Glazed façades throughout to provide natural daylighting and reduce reliance on artificial lighting.
    - Balanced g-value for translucent elements to ensure optimised internal conditions in the winter and summer months.

2. The current Building Regulations Part L2A (2013) specify that all developments must have U-Values limited to the following levels:

ELEMENT	U-VALUE (W/M².K)
Walls (external)	0.35
Ground floors	0.25
Roofs	0.25
Windows	2.2
Roof-lights	2.2
Personnel Doors	2.2
Vehicle access & similar large doors	1.5
High usage entrance doors	3.5

Table 1- U-Value limits as per Building Regulations Part L 2013

3. The building fabric values for the proposed development are shown in Table 2.

ELEMENT	U-VALUE ($W/m^2.K$)
External walls	0.35
Insulated wall (dividing wall between office/core & warehouse space)	0.35
Ground floors	0.25
Insulated ceiling (dividing slab between office & warehouse space)	0.25
Roof	0.16
Windows/curtain walls	1.4 (g-value 0.36) (VLT value 0.50)
Rooflights	1.3 (g-value 0.45) (VLT value 0.43)
Personnel Doors	2.2
Vehicle access & similar large doors	1.5

Table 2 – Proposed development U-Values

2.2 Air Permeability

1. The proposed development will have an improved air permeability to a maximum of 3 $m^3/h.m^2$ @50Pa, which is an improvement upon the standard Part L2A (2013) value of 10 $m^3/h.m^2$ @50Pa.

2.3 Active Design Measures (Energy Efficient Services)

1. To ensure that planning targets and Building Regulations are met and exceeded, the proposed development will be designed and constructed to operate with a very high level of energy efficiency, and consequently a low level of carbon emissions. The design and installation of the mechanical and electrical services will make a significant contribution towards this.

2. The following active design measures are incorporated into the design:

    - Dedicated high efficiency mechanical ventilation heat recovery (MVHR) systems to serve office areas.
    - High efficiency LED lighting to reduce electrical consumption and heat gains from lighting.
    - Passive infrared (PIR) presence detection and daylight dimming control for lighting within the office core and warehouse space.

3. Energy sub-metering to BREEAM standards to enable monitoring of energy usage.

3.0 LOW AND ZERO CARBON TECHNOLOGIES

1. A feasibility assessment of low and zero carbon (LZC) technologies can be found in Appendix A of this report.

2. The assessment provided gives an indication of whether technologies would be feasible at the site. The assessment included consideration for wind turbines, solar thermal collectors, biomass heating and ground source heat pumps.

3. The most suitable technologies for the site were found to be photovoltaic panels and air source heat pumps. These technologies are described below.

3.1 Photovoltaic Array

3.1.1 Technology Description

1. Solar Photovoltaics (PVs) are solar panels, which generate electricity through photon-to-electron energy transfer, which takes place in the dielectric materials that make up the cells. The cells are made up from layers of semi-conducting silicon material which, when illuminated by the sun, produces an electrical field which generates an electrical current.

2. PVs can generate electricity even on overcast days, requiring daylight, rather than direct sunlight. This makes them viable even in the UK, although peak output is obtained at midday on a sunny summer's day. PVs offer a simple, proven solution to generating renewable electricity.

3. The main types of commercially available PV panels on offer in the UK are constructed from crystalline cells as described below.

- Crystalline silicon cells are the most efficient of the PV technologies with a conversion efficiency of between 18-20% (available solar energy to electricity produced). They are cut from single ingots of silicon, have an unbroken crystal lattice and are the most expensive of PV systems.
- Thin film cells have a conversion efficiency of between 5-10%. These are less efficient than silicone derived cells. Thin films can be mounted on folded or curved surfaces and are used extensively in Building Integrated PV products.

Figure 1 – Photovoltaic Array

3.1.2 Feasibility for Site

1. The proposed development has unshaded roof areas which are suitable for mounting solar PV panels. Photovoltaic arrays are proposed for the development for generation of partial power of the buildings. This would be to typically offset the energy used in the energising of equipment and lighting.

2. The estimated PV arrays proposed for the development, subject to detailed design, are presented within Table 3, in terms of estimated kWp output, area and the specific required target annual generation output in kWh in order to meet the targets for the site. The final PV arrays required to meet the generation targets are dependent upon a number of factors, including types of panels selected, panel efficiency and orientation. The final specification of PV arrays would therefore be confirmed at a detailed design stage and verified by subsequent BRUKL calculations.

3. A life-cycle cost exercise has been carried out based upon the results from the initial energy modelling. The associated estimated costs and payback periods for this LZC technology are outlined below.

Unit	Est'd PV output (kWp)	Est'd Total PV area (m2)	Target PV Generation (kWh/yr)	CO_2 saving (T/yr)	Capital cost est'd. (£)	Maintenance (£/yr)	Annual saving (£)	Simple payback (yrs)
Unit A	9	40	6,784	4	5,882	63	1,200	5.2
Unit B	9	40	6,787	4	5,882	63	1,200	5.2
Unit C	9	40	6,786	4	5,882	63	1,200	5.2
Unit D	9	40	6,786	4	5,882	63	1,200	5.2
Unit E	9	40	6,787	4	5,882	63	1,200	5.2
Unit F	9	40	6,787	4	5,882	63	1,200	5.2
Unit G	9	40	6,780	4	5,882	63	1,200	5.2
Unit H	9	40	6,780	4	5,882	63	1,200	5.2
Unit J	9	40	6,780	4	5,882	63	1,200	5.2
Unit K	9	40	6,780	4	5,882	63	1,200	5.2
Unit L	9	40	6,788	4	5,882	63	1,200	5.2
Unit M	9	40	6,787	4	5,882	63	1,200	5.2

Table 3 – PV energy generation and life cycle cost

4. Depending on the final design of the scheme, the development may benefit from the 'Smart Export Guarantee'. This would need to be coordinated and reviewed as the design progresses.

5. There are no foreseen land use issues attributed to the system, and it is anticipated that there will be no local planning issues which will impact the feasibility of the implementation of this technology. There is also no noise impact associated with this technology.

3.2 Air Source Heat Pumps

3.2.1 Technology Description

1. Air source heat pumps (ASHP) work on the same principal as ground source heat pumps (GSHP). The difference is the medium in which the heat is extracted is the external air rather than the ground. An ASHP can be used for both heating and cooling and can also be used to provide simultaneous heating and cooling to different rooms as required.

3.2.2 Feasibility for Site

1. A typical light industrial building would have a layout that would support the use of air-to-air heat pumps instead of a more typical boiler plant and an air conditioning system. The calculation below demonstrates that an electric air source heat pump system becomes more efficient than a 90% gas boiler system when the co-efficient of performance is above 2.35.

$$\frac{CO2\ Emissions\ from\ Electricity\ x\ Boiler\ Efficiency}{CO2\ Emissions\ from\ Gas\ per\ unit} = \text{Break Even COP}$$

$$\frac{0.517kgCO2\ x\ 0.9\%}{0.198kgCO2} = 2.35$$

2. Air-to-air heat pumps are considered an alternative to ground source heat pumps despite the latter having a COP of around 5 as GSHPs have a significantly high installation cost making it unattractive for this development.

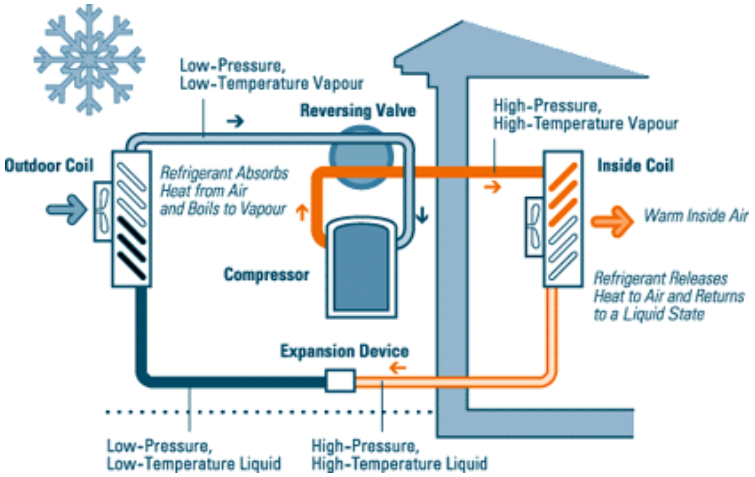

Figure 2 – Diagram of Air Source Heat Pump

3. Air source heat pumps are proposed to provide heating and cooling to the office areas of the proposed units.

4. The system will be sized suitably to meet the demand for the site therefore exporting of energy would not be appropriate.

5. Measures can be taken to reduce the noise levels associated with an external ASHP system such as suitable enclosures if required. Systems are typically circa 85dB at 1.0m.

6. As the system will be designed to include for cooling, it is considered that this would not be suitable for the RHI or grants available for LZC technologies.

7. A typical payback for this indicative system tends to be greater than 25 years when compared to a gas boiler system for heating only. As the design progresses and a specific system is identified costs can be accurately calculated.

4.0 CONCLUSION

1. The energy strategy has been developed in accordance with the relevant energy and carbon policies of the Cherwell Local Plan 2011-2031 (July 2015):

    - Policy ESD 2: Energy Hierarchy and Allowable Solutions
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2. The proposed development energy strategy can achieve carbon and energy reductions through the inclusion of energy efficient measures and low and zero carbon technologies. As shown below, the energy strategy improves upon the Building Regulations Part L2A (2013) baseline and achieves the minimum 4no. credits required for a BREEAM New Construction 2018 'Excellent' rating under the Ene 01 credit issue.

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Unit F	14.1	9.1	35.5%	Yes
Unit G	14.2	9.3	34.5%	Yes
Unit H	14.1	9.3	34.0%	Yes
Unit J	14.1	9.2	34.8%	Yes
Unit K	14.1	9.2	34.8%	Yes
Unit L	13.5	8.6	36.3%	Yes
Unit M	13.1	8.0	38.9%	Yes

Table 4 – Building Regulations Part L2a and BREEAM performance

3. The preliminary BRUKL calculation outputs can be found in Appendix B of this report.

APPENDIX A – LOW AND ZERO CARBON FEASIBILITY ASSESSMENT

1.1 Wind Generation

1.1.1 Technology Description

1. Wind turbines are an established means of capturing wind energy and converting it into usable electricity. Wind turbines come in various sizes depending on requirements. A wind turbine usually consists of a nacelle containing a generator connected, sometimes via a gearbox, to a rotor consisting of three blades.

2. The two main types of commercially available wind turbines on offer in the UK are described below:

- Horizontal axis wind turbines (HAWT) are traditionally the most common form of wind turbines installed in the UK. They are usually formed of three blades and work best when provided with a constant laminar air flow; and
- Vertical axis wind turbines (VAWT) are less efficient compared to HAWTs but have the advantage that they can cope with variable wind flows as they do not have to 'face' the wind.

3. Wind turbines can also be classified according to their size:

- Micro-wind: under 15kW rated capacity;
- Small-scale wind: between 15kW to 100kW rated capacity;
- Medium-scale wind: between 100kW to 500kW rated capacity; and
- Large-scale wind: greater than 500kW rated capacity.

1.1.2 Feasibility for Site

1. Referring to the NOABL (Numerical Objective Analysis of Boundary Layer) wind speed database as adopted by the Department of Energy & Climate Change (DECC), the proposed development site experiences fairly low wind speeds, averaging 4.9 m/s assuming a rotor height at around 10m above ground level.

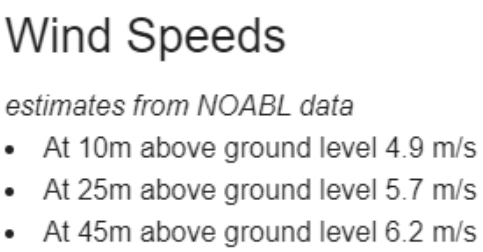

Figure 1 – Average Wind Speeds (source: NOABL)

2. As demonstrated in Figure 1, taking a turbine with a rotor at 45m above ground level may increase wind speeds to 6.2 m/s, but given the local environment, it is unlikely that average speeds will meet this estimate.

3. Freestanding horizontal axis wind turbines require a large area of land, which would have a detrimental effect on the viability of the site.

4. Smaller freestanding vertical axis wind turbines have smaller operational footprints. However, anticipated wind turbulence at low level rules out their application.

5. Roof mounted wind turbines specifically designed to make best use of the wind flows around a building and mounted on the roof edge can often be appropriate for urban environments. However, place additional forces on structures and the effect of potential noise, vibration and visual intrusion. A roof mounted system would have a significant effect on the total height of the building, and is not considered appropriate for this development.

6. Due to the above and the wind speed available, this technology has not been considered further.

1.2 Solar Thermal Evacuated Tube Panels

1.2.1 Technology Description

1. Solar thermal panels are used to produce hot water and consist of roof mounted collector panels that make use of heat energy from the sun and use it to heat water circulating in a closed loop. Usually this heat is transferred via a heat exchanger into a hot water storage tank that is also heated by a gas or other boiler.

2. Two main types of solar water heating system are used in the UK:

- Flat plate collectors circulate water around a black coloured receiver plate that is heated by direct sunlight and to some extent by indirect light; heat being retained by a thermally glazed panel above.
- Evacuated glass heat tubes are more efficient, particularly in the UK, as they can work more effectively at low solar radiation levels. They are however, more expensive than flat plate collectors. They consist of rows of parallel transparent glass tubes, each containing an absorber tube which converts the sunlight into heat energy.

Figure 2 – Evacuated Tube Solar Collector

1.2.2 Feasibility For Site

1. The site will have a low anticipated requirement for hot water except for hand wash sinks in toilets and tea-making areas and occasional shower usage.

2. Priority on the roof has been given to providing photovoltaic panels and roof lights.

3. Solar thermal water heating has not been considered further for this assessment.

1.3 Geothermal Heat Pump

1.3.1 Technology Description

1. Ground source heat pumps (GSHP) extract heat from the ground. GSHPs work on the principle that the below ground temperature is more constant compared to above ground. In the winter months, the below-ground temperature is warmer than above ground and the heat carrier fluid circulating within the absorber pipes absorbs the heat. This heat energy is then raised by a compressor (using the compression cycle) and through a heat exchanger, distributed via a low temperature distribution system such as under floor heating, to satisfy a proportion of space heating requirements.

2. In the summer months, the below-ground temperature is colder than above ground and the heat carrier fluid circulating within the absorber pipes rejects building's heat. This heat rejecting capacity is then raised by a compressor (using the compression cycle) and through a heat exchanger, distributed via a chilled water distribution system to satisfy a proportion of space cooling requirements.

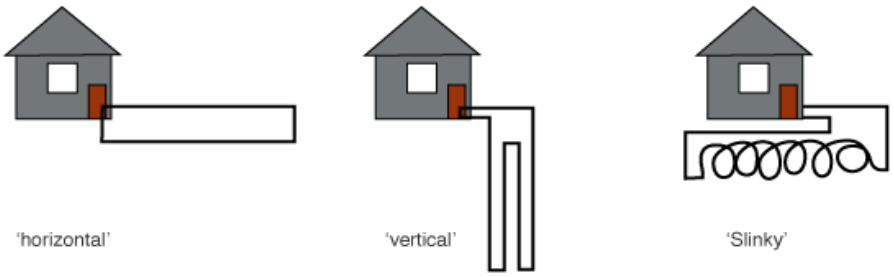

Figure 3: Ground Source Heat Pump Loop Arrangements

3. As Figure 3 indicates, there are a number of configurations for GSHP systems. A vertical collector system is considered the most appropriate in the context of the proposed development given the scale of the system and limited area available for horizontal collectors. Vertical collectors can be between 15–180m deep with minimum spacing between adjacent boreholes should be maintained at 5-15m to prevent thermal interference.

1.3.2 Feasibility for Site

1. The costs involved in installing a GSHP, particularly the drilling of boreholes will make it economically unviable for the development. Ground source heat pumps are therefore not considered further as part of this assessment.

1.4 Biomass Boilers & Heating

1.4.1 Technology Description

1. Biomass boilers can replace conventionally powered boilers with an almost carbon neutral fuel such as wood pellets or wood chips. The CO_2 released during the burning of biomass is balanced by that absorbed by the plants during their growth, making the technology almost carbon neutral. However, fossil fuels are utilised in the production, processing and transportation of biomass fuels. Therefore, a key issue when choosing the biomass fuel supplier is the distance between the grower and the boilers as well as the method of transportation.

2. Biomass energy can be derived from a number of sources, but are principally divided into three main types: first, second and third generation:

- Traditional first-generation woody biomass, which can be a by-product of forest industries or agriculture.
- Second generation biomass consists of residual food parts of crops (e.g. stems, leaves) as well as other crops that are not used for food purposes, and also industry waste.
- Third generation biofuel whereby algae culture, which is farmed at low cost, produces biofuels at high yield, is and considered to be further efficient to the other generations.

1.4.2 Feasibility for Site

1. Combustion of wood biomass releases higher quantities of NOx, SOx and particulates (PM10 and PM2.5) compared to a comparable system fuelled by natural gas. This would have a negative impact upon the air quality in the vicinity of the area.

2. Biomass boilers typically have a high maintenance cost when compared to traditional gas fired boilers, which can make the technology economically unviable.

3. There are associated logistical issues associated with Biomass Boilers. The system requires significant space for both the Biomass boiler and fuel storage required.

4. Biomass Boilers are not considered appropriate due to reasons detailed above.

1.5 Energy Storage

1.5.1 Technology Description

1. Energy storage works by capturing energy produced by both renewable and non-renewable resources and storing it for discharge when required. The solution allows users to come off the grid and switch to stored energy, at a time most beneficial, giving greater flexibility and control of electrical usage.

2. At times of low demand, when there is excess supply energy it can be stored for use at times of high demand, with low supply, thus adjusting to provide the required balance between supply and demand. This approach is especially effective with renewable generation, which is intermittent by its nature. Solar and wind, for example, generate little amounts of power in the absence of sunshine or wind. Energy storage is able to smooth out the supply from these sources to provide a more reliable supply that matches demand.

3. Energy storage systems provide a wide array of technological approaches to managing power supplies in order to create a more resilient energy infrastructure and bring cost savings to utilities and consumers. The diverse approaches currently being deployed around the world can be divided into six main categories:

    - Solid State Batteries - a range of electrochemical storage solutions, including advanced chemistry batteries and capacitors.
    - Flow Batteries - batteries where the energy is stored directly in the electrolyte solution for longer cycle life, and quick response times.
    - Flywheels - mechanical devices that harness rotational energy to deliver instantaneous electricity.
    - Compressed Air Energy Storage - utilising compressed air to create an energy reserve.
    - Thermal - capturing heat and cold to create energy on demand.
    - Pumped Hydro-Power - creating large-scale reservoirs of energy with water.

1.5.2 Feasibility for Site

1. Energy storage in the form of batteries are suitable for integration. However, it is not considered necessary in this case, as it is expected that there will be no excess energy generated by the PV array.

APPENDIX B – BUILDING REGULATIONS PART L2A OUTPUTS

Unit A

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name **Shell and Core**

22-205 Bicester Gateway, Unit A

FOR PLANNING

Date: Wed Jun 29 15:14:24 2022

Administrative information

Building Details

Address: 22-205 Bicester Gateway, Unit A, ,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.5.2"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.5.2

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

Certifier details

Name:

Telephone number:

Address: , ,

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

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	14.4
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	14.4
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	9.1
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	0.35	0.35	External Wall
Floor	0.25	0.25	0.25	Ground Floor
Roof	0.25	0.16	0.16	Roof
Windows***, roof windows, and rooflights	2.2	1.39	1.4	Ware wall light GF
Personnel doors	2.2	-	-	No personal doors in project
Vehicle access & similar large doors	1.5	1.5	1.5	Level Access Door
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

$U_{a\text{-}Limit}$ = 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	3

Building services

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

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- EPH Nat Vent

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	1	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

2- EPH Extract only (4 Zones)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	1	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

3- VRF (Occupied Areas) (4 Zones)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	3.5	3.5	-	-	0.7
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- Elec DHW with storage

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	1	0.01
Standard value	1	N/A

2- Elec Shw

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	1	0
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
Reception GF	-	-	-	1.6	-	-	-	-	-	-	N/A
WC Female 1F	-	-	0.5	-	-	-	-	-	-	-	N/A
WC Male 1F	-	-	0.5	-	-	-	-	-	-	-	N/A
Open Off1 1F (DL)	-	-	-	1.6	-	-	-	-	-	-	N/A
Open Off1 1F (Non DL)	-	-	-	1.6	-	-	-	-	-	-	N/A
GF Acc_Shw	-	-	0.5	-	-	-	-	-	-	-	N/A
WC Acc 1F	-	-	0.5	-	-	-	-	-	-	-	N/A
Open Off2 1F (DL)	-	-	-	1.6	-	-	-	-	-	-	N/A

Shell and core configuration

Zone	Assumed shell?
Reception GF	NO
GF Stair	NO
1F Off Stair	NO
WC Female 1F	NO
WC Male 1F	NO
Open Off1 1F (DL)	NO
Open Off1 1F (Non DL)	NO
GF Acc_Shw	NO
1F Landing	NO
WC Acc 1F	NO
Open Off2 1F (DL)	NO

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
Reception GF	-	100	22	137
GF Stair	-	90	-	32
Warehouse	120	-	-	2141
1F Off Stair	-	90	-	35
WC Female 1F	-	90	-	21
WC Male 1F	-	90	-	22
Open Off1 1F (DL)	100	-	-	477
Open Off1 1F (Non DL)	100	-	-	500
Warehouse (Office undercroft)	120	-	-	621
GF Acc_Shw	-	90	-	52
1F Landing	-	90	-	30
WC Acc 1F	-	90	-	24
Open Off2 1F (DL)	100	-	-	125

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?
Reception GF	NO (-45%)	NO
Warehouse	NO (-38%)	NO
Open Off1 1F (DL)	NO (-41%)	NO
Open Off1 1F (Non DL)	NO (-36%)	NO
Warehouse (Office undercroft)	NO (-16%)	NO
Open Off2 1F (DL)	NO (-36%)	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?	YES
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	979	979
External area [m²]	2393	2393
Weather	SWI	SWI
Infiltration [m³/hm²@ 50Pa]	3	7
Average conductance [W/K]	907	797
Average U-value [W/m²K]	0.38	0.33
Alpha value* [%]	4.15	4.15

* 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/m²]

	Actual	Notional
Heating	3.03	4.2
Cooling	1.15	1.46
Auxiliary	1.7	1.12
Lighting	8.23	15.81
Hot water	10.27	10.96
Equipment*	21.61	21.61
TOTAL**	**24.4**	**33.56**

* 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	6.93	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]	34.13	41.04
Primary energy* [kWh/m²]	74.89	74.23
Total emissions [kg/m²]	9.1	14.4

* 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] Other local room heater - unfanned, [HS] LTHW boiler, [HFT] Electricity, [CFT] Electricity										
	Actual	125.3	0	34.8	0	0	1	0	1	0
	Notional	121.8	0	41.3	0	0	0.82	0	----	----
[ST] Other local room heater - unfanned, [HS] Room heater, [HFT] Electricity, [CFT] Electricity										
	Actual	160.4	0	44.6	0	18.6	1	0	1	0
	Notional	255.9	0	86.8	0	22.3	0.82	0	----	----
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	52.8	65.1	4.2	5.2	6.2	3.5	3.5	3.5	3.5
	Notional	53.6	89.2	6.1	6.9	3.6	2.43	3.6	----	----

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	0.35	External Wall
Floor	0.2	0.25	Ground Floor
Roof	0.15	0.16	Roof
Windows, roof windows, and rooflights	1.5	1.3	Rooflight 7.14 x 1
Personnel doors	1.5	-	No personal doors in project
Vehicle access & similar large doors	1.5	1.5	Level Access Door
High usage entrance doors	1.5	-	No high usage entrance doors in project

$U_{i\text{-}Typ}$ = 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	3

Unit B

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name **Shell and Core**

22-205 Bicester Gateway, Unit B

FOR PLANNING

Date: Wed Jun 29 12:00:24 2022

Administrative information

Building Details

Address: 22-205 Bicester Gateway, Unit B, ,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.5.2"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.5.2

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

Certifier details

Name:

Telephone number:

Address: , ,

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

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	14.5
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	14.5
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	9.2
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	0.35	0.35	External Wall
Floor	0.25	0.25	0.25	Ground Floor
Roof	0.25	0.16	0.16	Roof
Windows***, roof windows, and rooflights	2.2	1.38	1.4	Ware wall light GF
Personnel doors	2.2	-	-	No personal doors in project
Vehicle access & similar large doors	1.5	1.5	1.5	Level Access Door
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

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

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

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	3

Building services

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

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- EPH Nat Vent

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	1	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

2- EPH Extract only (4 Zones)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	1	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

3- VRF (Occupied Areas) (4 Zones)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	3.5	3.5	-	-	0.7
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- Elec DHW with storage

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	1	0.01
Standard value	1	N/A

2- Elec Shw

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	1	0
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
Reception GF	-	-	-	1.6	-	-	-	-	-	-	N/A
WC Female 1F	-	-	0.5	-	-	-	-	-	-	-	N/A
WC Male 1F	-	-	0.5	-	-	-	-	-	-	-	N/A
Open Off1 1F (DL)	-	-	-	1.6	-	-	-	-	-	-	N/A
Open Off1 1F (Non DL)	-	-	-	1.6	-	-	-	-	-	-	N/A
GF Acc_Shw	-	-	0.5	-	-	-	-	-	-	-	N/A
WC Acc 1F	-	-	0.5	-	-	-	-	-	-	-	N/A
Open Off2 1F (DL)	-	-	-	1.6	-	-	-	-	-	-	N/A

Shell and core configuration

Zone	Assumed shell?
Reception GF	NO
GF Stair	NO
1F Off Stair	NO
WC Female 1F	NO
WC Male 1F	NO
Open Off1 1F (DL)	NO
Open Off1 1F (Non DL)	NO
GF Acc_Shw	NO
1F Landing	NO
WC Acc 1F	NO
Open Off2 1F (DL)	NO

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
Reception GF	-	100	22	136
GF Stair	-	90	-	32
Warehouse	120	-	-	2135
1F Off Stair	-	90	-	33
WC Female 1F	-	90	-	22
WC Male 1F	-	90	-	22
Open Off1 1F (DL)	100	-	-	477
Open Off1 1F (Non DL)	100	-	-	499
Warehouse (Office undercroft)	120	-	-	622
GF Acc_Shw	-	90	-	52
1F Landing	-	90	-	28
WC Acc 1F	-	90	-	24
Open Off2 1F (DL)	100	-	-	126

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?
Reception GF	NO (-40%)	NO
Warehouse	NO (-39%)	NO
Open Off1 1F (DL)	NO (-34%)	NO
Open Off1 1F (Non DL)	NO (-30%)	NO
Warehouse (Office undercroft)	NO (-4%)	NO
Open Off2 1F (DL)	NO (-31%)	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?	YES
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	978	978
External area [m²]	2393	2393
Weather	SWI	SWI
Infiltration [m³/hm²@ 50Pa]	3	7
Average conductance [W/K]	905	797
Average U-value [W/m²K]	0.38	0.33
Alpha value* [%]	4.63	4.63

* 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/m²]

	Actual	Notional
Heating	3.35	4.91
Cooling	1.27	1.28
Auxiliary	1.7	1.12
Lighting	8.23	15.8
Hot water	10.18	10.85
Equipment*	21.61	21.61
TOTAL**	**24.72**	**33.97**

* 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	6.94	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]	38.02	42.41
Primary energy* [kWh/m²]	75.89	74.86
Total emissions [kg/m²]	9.2	14.5

* 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] Other local room heater - unfanned, [HS] LTHW boiler, [HFT] Electricity, [CFT] Electricity										
	Actual	139.2	0	38.7	0	0	1	0	1	0
	Notional	144.7	0	49.1	0	0	0.82	0	----	----
[ST] Other local room heater - unfanned, [HS] Room heater, [HFT] Electricity, [CFT] Electricity										
	Actual	164.1	0	45.6	0	18.7	1	0	1	0
	Notional	282.9	0	96	0	22.4	0.82	0	----	----
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	60.9	71.4	4.8	5.7	6.2	3.5	3.5	3.5	3.5
	Notional	64.7	78.1	7.4	6	3.6	2.43	3.6	----	----

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	0.35	External Wall
Floor	0.2	0.25	Ground Floor
Roof	0.15	0.16	Roof
Windows, roof windows, and rooflights	1.5	1.3	Rooflight 7.14 x 1
Personnel doors	1.5	-	No personal doors in project
Vehicle access & similar large doors	1.5	1.5	Level Access Door
High usage entrance doors	1.5	-	No high usage entrance doors in project
$U_{i\text{-}Typ}$ = 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	3

Unit C

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name **Shell and Core**

22-205 Bicester Gateway, Unit C

FOR PLANNING

Date: Wed Jun 29 14:27:59 2022

Administrative information

Building Details

Address: 22-205 Bicester Gateway, Unit C, ,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.5.2"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.5.2

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

Certifier details

Name:

Telephone number:

Address: , ,

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

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	14.1
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	14.1
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	9
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	0.35	0.35	External Wall
Floor	0.25	0.25	0.25	Ground Floor
Roof	0.25	0.16	0.16	Roof
Windows***, roof windows, and rooflights	2.2	1.36	1.4	Ware wall light GF
Personnel doors	2.2	-	-	No personal doors in project
Vehicle access & similar large doors	1.5	1.5	1.5	Level Access Door
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

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

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

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	3

Building services

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

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- EPH Nat Vent

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	1	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

2- EPH Extract only (4 Zones)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	1	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

3- VRF (Occupied Areas) (6 Zones)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	3.5	3.5	-	-	0.7
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- Elec DHW with storage

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	1	0.01
Standard value	1	N/A

2- Elec Shw

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	1	0
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
Reception GF	-	-	-	1.6	-	-	-	-	-	-	N/A
WC Female 1F	-	-	0.5	-	-	-	-	-	-	-	N/A
WC Male 1F	-	-	0.5	-	-	-	-	-	-	-	N/A
Open Off1 1F (DL)	-	-	-	1.6	-	-	-	-	-	-	N/A
Open Off1 1F (Non DL)	-	-	-	1.6	-	-	-	-	-	-	N/A
GF Acc_Shw	-	-	0.5	-	-	-	-	-	-	-	N/A
1F Off Circ	-	-	-	1.6	-	-	-	-	-	-	N/A
WC Acc 1F	-	-	0.5	-	-	-	-	-	-	-	N/A
Open Off2 1F (DL)	-	-	-	1.6	-	-	-	-	-	-	N/A
Open Off2 1F (Non DL)	-	-	-	1.6	-	-	-	-	-	-	N/A

Shell and core configuration

Zone	Assumed shell?
Reception GF	NO
GF Stair	NO
1F Off Stair	NO
WC Female 1F	NO
WC Male 1F	NO
Open Off1 1F (DL)	NO
Open Off1 1F (Non DL)	NO
GF Acc_Shw	NO
1F Off Circ	NO
1F Landing	NO
WC Acc 1F	NO
Open Off2 1F (DL)	NO
Open Off2 1F (Non DL)	NO

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
Reception GF	-	100	22	138
GF Stair	-	90	-	32
Warehouse	120	-	-	2255
1F Off Stair	-	90	-	33
WC Female 1F	-	90	-	22
WC Male 1F	-	90	-	22
Open Off1 1F (DL)	100	-	-	291
Open Off1 1F (Non DL)	100	-	-	462
Warehouse (Office undercroft)	120	-	-	599
GF Acc_Shw	-	90	-	52
1F Off Circ	-	90	-	21
1F Landing	-	90	-	29
WC Acc 1F	-	90	-	23

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Open Off2 1F (DL)	100	-	-	125
Open Off2 1F (Non DL)	100	-	-	119

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?
Reception GF	NO (-49%)	NO
Warehouse	NO (-41%)	NO
Open Off1 1F (DL)	NO (-49%)	NO
Open Off1 1F (Non DL)	NO (-92%)	NO
Warehouse (Office undercroft)	NO (-52%)	NO
1F Off Circ	NO (-97%)	NO
Open Off2 1F (DL)	NO (-48%)	NO
Open Off2 1F (Non DL)	NO (-95%)	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?	YES
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	998	998
External area [m²]	2189	2189
Weather	SWI	SWI
Infiltration [m³/hm²@ 50Pa]	3	7
Average conductance [W/K]	733	735
Average U-value [W/m²K]	0.33	0.34
Alpha value* [%]	3.68	3.68

* 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/m²]

	Actual	Notional
Heating	2.63	4.71
Cooling	1.01	1.47
Auxiliary	1.64	1.09
Lighting	8.89	15.09
Hot water	9.99	10.65
Equipment*	21.02	21.02
TOTAL**	**24.17**	**33.01**

* 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	6.8	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]	29.16	42.7
Primary energy* [kWh/m²]	74.19	72.2
Total emissions [kg/m²]	9	14.1

* 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] Other local room heater - unfanned, [HS] LTHW boiler, [HFT] Electricity, [CFT] Electricity										
	Actual	108	0	30	0	0	1	0	1	0
	Notional	145.6	0	49.4	0	0	0.82	0	----	----
[ST] Other local room heater - unfanned, [HS] Room heater, [HFT] Electricity, [CFT] Electricity										
	Actual	163.5	0	45.4	0	18.7	1	0	1	0
	Notional	312.3	0	105.9	0	22.4	0.82	0	----	----
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	43.9	59.8	3.5	4.7	6.2	3.5	3.5	3.5	3.5
	Notional	55.4	93.9	6.3	7.2	3.6	2.43	3.6	----	----

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	0.35	External Wall
Floor	0.2	0.25	Ground Floor
Roof	0.15	0.16	Roof
Windows, roof windows, and rooflights	1.5	1.3	Rooflight 7.14x1
Personnel doors	1.5	-	No personal doors in project
Vehicle access & similar large doors	1.5	1.5	Level Access Door
High usage entrance doors	1.5	-	No high usage entrance doors in project

$U_{i\text{-}Typ}$ = 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	3

Unit D

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name **Shell and Core**

22-205 Bicester Gateway, Unit D

FOR PLANNING

Date: Wed Jun 29 14:42:33 2022

Administrative information

Building Details

Address: 22-205 Bicester Gateway, Unit D, ,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.5.2"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.5.2

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

Certifier details

Name:

Telephone number:

Address: , ,

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

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	15.6
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	15.6
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	10.3
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	0.35	0.35	External Wall
Floor	0.25	0.25	0.25	Ground Floor
Roof	0.25	0.16	0.16	Roof
Windows***, roof windows, and rooflights	2.2	1.38	1.4	Ware wall light GF
Personnel doors	2.2	-	-	No personal doors in project
Vehicle access & similar large doors	1.5	1.5	1.5	Level Access Door
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

$U_{a\text{-}Limit}$ = 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	3

Building services

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

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- EPH Nat Vent

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	1	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

2- EPH Extract only (4 Zones)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	1	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

3- VRF (Occupied Areas) (6 Zones)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	3.5	3.5	-	-	0.7
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- Elec DHW with storage

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	1	0.01
Standard value	1	N/A

2- Elec Shw

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	1	0
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
Reception GF	-	-	-	1.6	-	-	-	-	-	-	N/A
WC Female 1F	-	-	0.5	-	-	-	-	-	-	-	N/A
WC Male 1F	-	-	0.5	-	-	-	-	-	-	-	N/A
Open Off1 1F (DL)	-	-	-	1.6	-	-	-	-	-	-	N/A
Open Off1 1F (Non DL)	-	-	-	1.6	-	-	-	-	-	-	N/A
GF Acc_Shw	-	-	0.5	-	-	-	-	-	-	-	N/A
1F Off Circ	-	-	-	1.6	-	-	-	-	-	-	N/A
WC Acc 1F	-	-	0.5	-	-	-	-	-	-	-	N/A
Open Off2 1F (DL)	-	-	-	1.6	-	-	-	-	-	-	N/A
Open Off2 1F (Non DL)	-	-	-	1.6	-	-	-	-	-	-	N/A

Shell and core configuration

Zone	Assumed shell?
Reception GF	NO
GF Stair	NO
1F Off Stair	NO
WC Female 1F	NO
WC Male 1F	NO
Open Off1 1F (DL)	NO
Open Off1 1F (Non DL)	NO
GF Acc_Shw	NO
1F Off Circ	NO
1F Landing	NO
WC Acc 1F	NO
Open Off2 1F (DL)	NO
Open Off2 1F (Non DL)	NO

General lighting and display lighting

	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
Reception GF	-	100	22	136
GF Stair	-	90	-	32
Warehouse	120	-	-	1728
1F Off Stair	-	90	-	34
WC Female 1F	-	90	-	22
WC Male 1F	-	90	-	22
Open Off1 1F (DL)	100	-	-	290
Open Off1 1F (Non DL)	100	-	-	499
Warehouse (Office undercroft)	120	-	-	641
GF Acc_Shw	-	90	-	53
1F Off Circ	-	90	-	26
1F Landing	-	90	-	27
WC Acc 1F	-	90	-	24

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Open Off2 1F (DL)	100	-	-	121
Open Off2 1F (Non DL)	100	-	-	136

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?
Reception GF	NO (-53%)	NO
Warehouse	NO (-38%)	NO
Open Off1 1F (DL)	NO (-45%)	NO
Open Off1 1F (Non DL)	NO (-93%)	NO
Warehouse (Office undercroft)	NO (-57%)	NO
1F Off Circ	NO (-94%)	NO
Open Off2 1F (DL)	NO (-45%)	NO
Open Off2 1F (Non DL)	NO (-93%)	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?	YES
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	879	879
External area [m²]	1853	1853
Weather	SWI	SWI
Infiltration [m³/hm²@ 50Pa]	3	6
Average conductance [W/K]	666	622
Average U-value [W/m²K]	0.36	0.34
Alpha value* [%]	3.42	3.42

* 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/m²]

	Actual	Notional
Heating	3.13	4.53
Cooling	1.67	2.15
Auxiliary	1.94	1.28
Lighting	9.14	16.15
Hot water	11.64	12.44
Equipment*	21.67	21.67
TOTAL**	**27.52**	**36.55**

* 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	7.72	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]	39.82	50.69
Primary energy* [kWh/m²]	84.5	79.55
Total emissions [kg/m²]	10.3	15.6

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

HVAC Systems Performance										
System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Other local room heater - unfanned, [HS] LTHW boiler, [HFT] Electricity, [CFT] Electricity										
	Actual	122	0	33.9	0	0	1	0	1	0
	Notional	116.5	0	39.5	0	0	0.82	0	----	----
[ST] Other local room heater - unfanned, [HS] Room heater, [HFT] Electricity, [CFT] Electricity										
	Actual	158	0	43.9	0	17.9	1	0	1	0
	Notional	275.2	0	93.4	0	21.4	0.82	0	----	----
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	39.7	82.2	3.2	6.5	6.2	3.5	3.5	3.5	3.5
	Notional	42.4	114.3	4.9	8.8	3.6	2.43	3.6	----	----

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	0.35	External Wall
Floor	0.2	0.25	Ground Floor
Roof	0.15	0.16	Roof
Windows, roof windows, and rooflights	1.5	1.3	Rooflight 7.14x1
Personnel doors	1.5	-	No personal doors in project
Vehicle access & similar large doors	1.5	1.5	Level Access Door
High usage entrance doors	1.5	-	No high usage entrance doors in project

$U_{i\text{-}Typ}$ = 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	3

Unit E

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name **Shell and Core**

22-205 Bicester Gateway, Unit E

FOR PLANNING

Date: Wed Jun 29 14:58:14 2022

Administrative information

Building Details

Address: 22-205 Bicester Gateway, Unit E, ,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.5.2"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.5.2

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

Certifier details

Name:

Telephone number:

Address: , ,

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

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	14.2
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	14.2
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	9
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	0.35	0.35	External Wall
Floor	0.25	0.25	0.25	Ground Floor
Roof	0.25	0.16	0.16	Roof
Windows***, roof windows, and rooflights	2.2	1.38	1.4	Ware wall light GF
Personnel doors	2.2	-	-	No personal doors in project
Vehicle access & similar large doors	1.5	1.5	1.5	Level Access Door
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

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

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

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	3

Building services

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

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- EPH Nat Vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

2- EPH Extract only (4 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

3- VRF (Occupied Areas) (6 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.5	3.5	-	-	0.7
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- Elec DHW with storage

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	0.01
Standard value	1	N/A

2- Elec Shw

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	0
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
Reception GF	-	-	-	1.6	-	-	-	-	-	-	N/A
WC Female 1F	-	-	0.5	-	-	-	-	-	-	-	N/A
WC Male 1F	-	-	0.5	-	-	-	-	-	-	-	N/A
Open Off1 1F (DL)	-	-	-	1.6	-	-	-	-	-	-	N/A
Open Off1 1F (Non DL)	-	-	-	1.6	-	-	-	-	-	-	N/A
GF Acc_Shw	-	-	0.5	-	-	-	-	-	-	-	N/A
1F Off Circ	-	-	-	1.6	-	-	-	-	-	-	N/A
WC Acc 1F	-	-	0.5	-	-	-	-	-	-	-	N/A
Open Off2 1F (DL)	-	-	-	1.6	-	-	-	-	-	-	N/A
Open Off2 1F (Non DL)	-	-	-	1.6	-	-	-	-	-	-	N/A

Shell and core configuration

Zone	Assumed shell?
Reception GF	NO
GF Stair	NO
1F Off Stair	NO
WC Female 1F	NO
WC Male 1F	NO
Open Off1 1F (DL)	NO
Open Off1 1F (Non DL)	NO
GF Acc_Shw	NO
1F Off Circ	NO
1F Landing	NO
WC Acc 1F	NO
Open Off2 1F (DL)	NO
Open Off2 1F (Non DL)	NO

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
Reception GF	-	100	22	138
GF Stair	-	90	-	32
Warehouse	120	-	-	2267
1F Off Stair	-	90	-	33
WC Female 1F	-	90	-	22
WC Male 1F	-	90	-	22
Open Off1 1F (DL)	100	-	-	291
Open Off1 1F (Non DL)	100	-	-	460
Warehouse (Office undercroft)	120	-	-	603
GF Acc_Shw	-	90	-	52
1F Off Circ	-	90	-	21
1F Landing	-	90	-	28
WC Acc 1F	-	90	-	23

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Open Off2 1F (DL)	100	-	-	129
Open Off2 1F (Non DL)	100	-	-	125

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?
Reception GF	NO (-44%)	NO
Warehouse	NO (-30%)	NO
Open Off1 1F (DL)	NO (-57%)	NO
Open Off1 1F (Non DL)	NO (-61%)	NO
Warehouse (Office undercroft)	NO (-52%)	NO
1F Off Circ	NO (-97%)	NO
Open Off2 1F (DL)	NO (-43%)	NO
Open Off2 1F (Non DL)	NO (-94%)	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?	YES
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	1004	1004
External area [m²]	2260	2260
Weather	SWI	SWI
Infiltration [m³/hm²@ 50Pa]	3	7
Average conductance [W/K]	808	762
Average U-value [W/m²K]	0.36	0.34
Alpha value* [%]	3.66	3.66

* 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/m²]

	Actual	Notional
Heating	2.67	3.99
Cooling	1.46	2.06
Auxiliary	1.64	1.08
Lighting	8.43	15.36
Hot water	9.95	10.62
Equipment*	21.03	21.03
TOTAL**	**24.15**	**33.1**

* 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	6.76	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]	34.6	47.09
Primary energy* [kWh/m²]	74.14	73.51
Total emissions [kg/m²]	9	14.2

* 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] Other local room heater - unfanned, [HS] LTHW boiler, [HFT] Electricity, [CFT] Electricity										
	Actual	118.1	0	32.8	0	0	1	0	1	0
	Notional	114.7	0	38.9	0	0	0.82	0	----	----
[ST] Other local room heater - unfanned, [HS] Room heater, [HFT] Electricity, [CFT] Electricity										
	Actual	158.2	0	44	0	18.6	1	0	1	0
	Notional	285.9	0	97	0	22.3	0.82	0	----	----
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	41.5	86	3.3	6.8	6.2	3.5	3.5	3.5	3.5
	Notional	46.1	130.9	5.3	10.1	3.6	2.43	3.6	----	----

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	0.35	External Wall
Floor	0.2	0.25	Ground Floor
Roof	0.15	0.16	Roof
Windows, roof windows, and rooflights	1.5	1.3	Rooflight 7.14x1
Personnel doors	1.5	-	No personal doors in project
Vehicle access & similar large doors	1.5	1.5	Level Access Door
High usage entrance doors	1.5	-	No high usage entrance doors in project

$U_{i\text{-}Typ}$ = 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	3