19-21 High Holborn

Energy Statement

on behalf of The Royal Honourable Society of Gray's Inn

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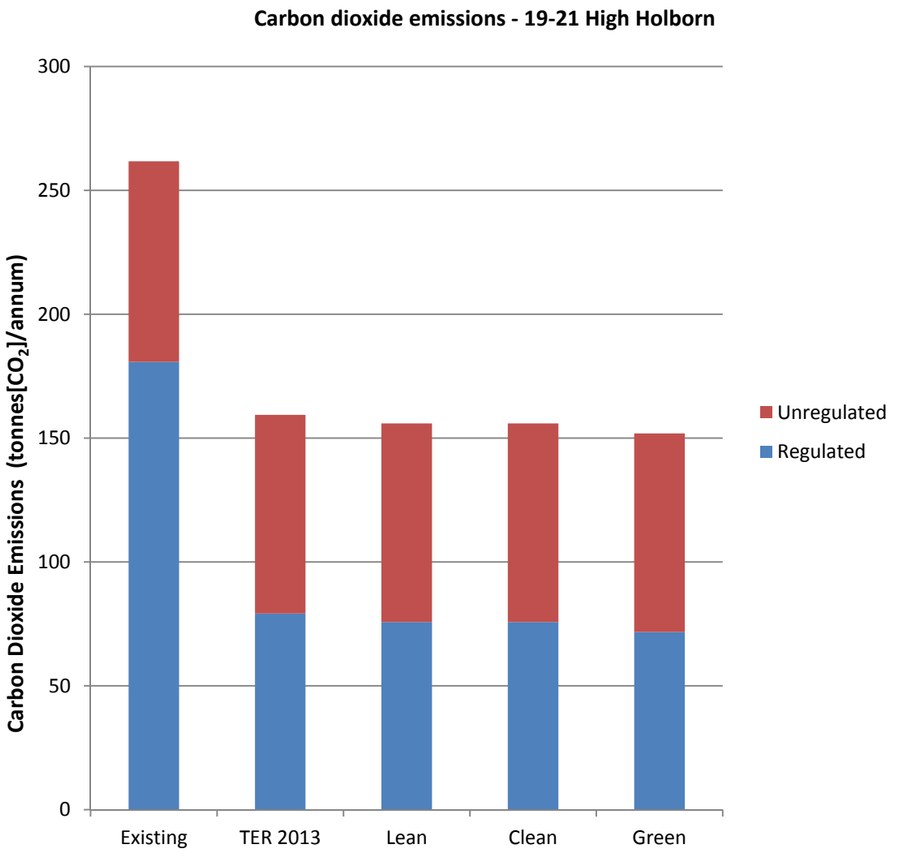
1. EXECUTIVE SUMMARY

This Energy Statement forms part of a full planning application of the 19-21 High Holborn redevelopment. The carbon dioxide (CO_2) emissions for the proposed development have been considered with respect to the approved document ADL2A 2013 of the building regulations. The building is predicted to achieve lower CO_2 emissions than required by ADL2A 2013. Following the Mayor's Energy Hierarchy, this will be achieved through investment in a high performance building fabric and energy efficient engineering systems which surpasses the requirements of the Part L2A 2013 target by approximately 9%.



	Carbon dioxide emissions (tonnes[CO_2]/annum)		
	Regulated	Unregulated	Total
Existing	181	81	262
TER 2013	79	80	159
Lean	76	80	156
Clean	76	80	156
Green	72	80	152

	Carbon dioxide savings over PART L 2013			
	(tonnes[CO_2]/annum)		(%)	
	Regulated	Total	Regulated	Total
Lean savings	3.5	3.5	4.39%	2.18%
Clean savings	0.0	0.0	0.00%	0.00%
Green savings	4.0	4.0	5.30%	2.57%
Total savings	7.5	7.5	9.46%	4.70%

The energy efficiency initiatives proposed to deliver this performance are summarised below:

- Using highly insulated building envelope and airtight construction
- Using high performance insulated glazing units to achieve low g-value and high light transmittance to reduce cooling loads, enhance daylight penetration, and increase saving in electrical lighting
- Using Variable Refrigerant Flow (VRF) Air Source Heat Pumps (ASHP) for space heating and cooling (High efficiency cooling system with seasonal efficiency exceeding 8.0)
- High efficiency energy savings from simultaneous heating and cooling operations of VRF ASHPs
- High efficiency Air Source Heat Pump used in the Air Handling Units (AHU) for heating and cooling air loads
- Using heat recovery on ventilation plant
- High efficiency photovoltaic array for onsite generated electricity
- Low energy lamps with a computer controlled lighting system incorporating dimmable ballast are used in conjunction with perimeter day lighting and presence detection control measures

The proposed development (Lean/Clean) demonstrates an improvement of circa 62% in CO_2 emissions reduction as compared to that of the existing building with a renewable content improvement of circa 5%.

As noted; the building surpasses the CO2 reduction requirements under Part L 2013 by 9%, which equates to circa 18% over Part L 2010 (considering a 9% aggregate uplift in CO2 emission reduction required under PARTL 2103).

2. INTRODUCTION

Supporting a full planning application, this report provides a technical appraisal of the regulations and guidance that apply, the energy options considered for the project and the energy conservation measures that will be adopted for the 19-21 High Holborn development. Each section summarises the proposed key investments that will be implemented in the development to reduce building energy consumption and CO_2 emissions.

The focus of the design approach has been to limit building energy consumption and CO_2 emissions through optimising the performance of the building envelope, together with energy efficiency measures. The result is a building that surpasses the requirements performance for carbon dioxide emissions of Building Regulations Part L2A 2013.

This philosophy follows the Mayor of London's "Energy Hierarchy" which identifies building design and resultant energy use to be considered in the following order of priority:

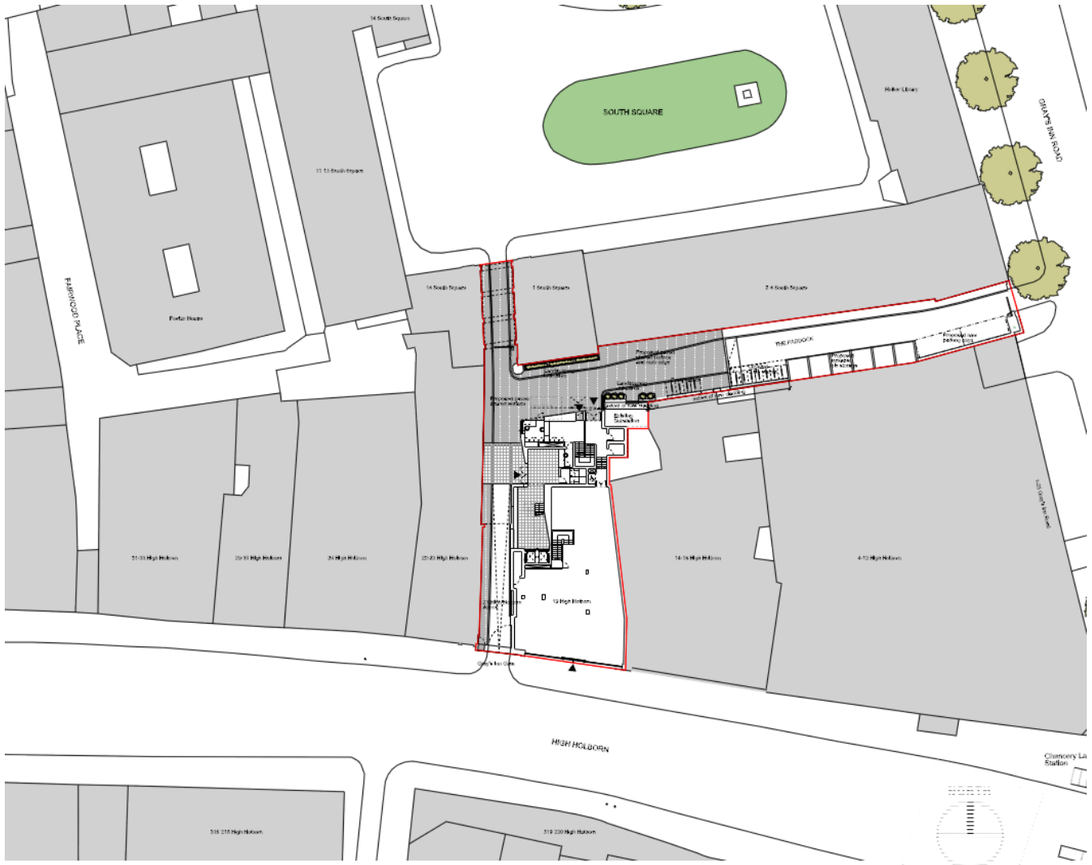
1. **Use less energy**
   "Be Lean"
2. **Supply energy efficiently**
   "Be Clean"

} 1

3. **Use renewable energy**
   "Be Green"

} 2

2.1 Description of Building



Site Plan

The proposed commercial redevelopment is located at 19-21 High Holborn, London, WC1R 5JA. The site is located on High Holborn in the City of London and forms part of the Gray's Inn South Square with frontage onto High Holborn.

The existing building is primarily in office use (1946 sqm GIA). However, on the ground and basement floor, there is a retail outlet/post office (Class A1) and admin spaces measuring 394 sqm GIA. Landlord back of house also located on ground floor (40 sqm GIA) with 176 sqm GIA for residential units provided on level 6.

The proposals are for the refurbishment and extension of the building which will result in an uplift in Class B1 office floor space of 2621 sqm (GIA). The building would be provided with an additional floor and comprise of basement, ground and seven upper stories. Plant areas would primarily be encompassed at basement, 5th and 7th Floor roof level. The building sets back from the sixth floor level.

The Proposed Development will increase the size of the existing office floorplates from ground to seventh floor, via a rear extension, while providing new office accommodation on the replaced sixth floor, new seventh floor. The proposed development maintains retail tenancy at ground and basement with an overall uplift of 589 sqm (GIA) providing a new basement extension for landlord's plant (92 sqm GIA).

A summary floor space table is set out below:

Land Use	Existing (GIA)	Proposed (GIA)	Net Change (GIA)
Office (Class B1) use	1946 sqm	2621 sqm	675 sqm
Retail (Class A1) use	394 sqm	589 sqm	195 sqm

2.2 Policy and Legislation

The following policies have been considered when developing the energy strategy for this scheme:

2.2.1 Building Regulations Approved Document L2A 2013 - New buildings other than dwellings.

In order to meet the requirements of the Energy Performance of Buildings Directive 2002/91/EC and 2010/31/EU of the European Parliament and Council on energy efficiency of buildings, the UK government introduced an updated edition of Approved Document L2A (ADL2A). The implementation of Part L2 2013 on 1st April 2014 required an aggregate ~13% improvement over the previous 2010 energy target (regulated emissions). Part L2 2010 requires each 'space' in a building to have solar gain not exceeding that of a reference east-facing elevation comprising 1m height of glazing, a 10% frame factor and a glazing g value of 0.68. The calculations appended with this report have been extracted from Bentley Hevacomp thermal modelling software which has been used to evaluate the building models performance against the notional building and to demonstrate compliance.

2.2.2 BREEAM UK Bespoke (2014) Non-domestic Refurbishment and Fit-out

The BREEAM UK Bespoke (2014) UK Non-Domestic Refurbishment and Fit-out scheme is a performance based assessment method and certification scheme for existing building refurbishment and fit-out projects. It describes an environmental performance standard against a non-domestic refurbishment and fit-out projects in the UK. The primary aim of BREEAM UK Bespoke (2014) Non-Domestic Refurbishment and Fit-out is to promote the delivery of sustainable refurbishment and fit-out, in order to mitigate the life cycle impacts of existing buildings on the environment in a robust and cost effective manner.

The overall project environmental impact has been assessed through a BREEAM UK Bespoke (2014) UK Non-domestic Refurbishment and Fit-out audit. It is intended that the building will achieve a minimum of 'Very Good'.

2.2.3 The London Plan - Spatial Development Strategy for Greater London (March 2015)

The London Plan is the overall strategic plan for London, and it sets out a fully integrated economic, environmental, transport and social framework for the development of the capital to 2031. It forms part of the Development Plan for Greater London. The March 2015 version is the current iteration of the London Plan. This document has been produced after a series of alterations to the London Plan originally published in 2004. This follows the National Planning Policy Framework. The London Plan sets the strategic planning structure for all major developments in London. Some energy related key policies stated in the plan are summarised below:

- *Policy 5.2 Minimising carbon dioxide emissions*:
  - 5.2A - Development proposals should make the fullest contribution to minimising carbon dioxide emissions in accordance with the following energy hierarchy:
    1) Be lean: use less energy
    2) Be clean: supply energy efficiently
    3) Be green: use renewable energy
  - 5.2B - The Mayor will work with boroughs and developers to ensure that major developments meet the following targets for carbon dioxide emissions reduction in buildings. These targets are expressed as minimum improvements over the Target Emission Rate (TER) outlined in the national Building Regulations leading to zero carbon residential buildings from 2016 and zero carbon non-domestic buildings from 2019:

Year	Improvement on 2010 Building Regulations
2010 – 2013	20%
2013 – 2016	40%
2016 – 2019	As per building regulations
2019 – 2031	Zero carbon

NOTE: since 6 April 2014 the Mayor has applied a 35% carbon reduction target beyond Part L 2013 of the Building Regulations - this is deemed to be broadly equivalent to the 40% target beyond Part L 2010 of the Building Regulations, as specified in Policy 5.2 of the London Plan for 2013-2016. The 35% target is a flat percentage reduction across both residential and non-domestic buildings (further detail provided in Section f2.3.4).

o 5.2C - Major development proposals should include a detailed energy assessment to demonstrate how the targets for carbon dioxide emissions reduction outlined above are to be met within the framework of the energy hierarchy

o 5.2D - As a minimum, energy assessments should include the following details:

a) calculation of the energy demand and carbon dioxide emissions covered by the Building Regulations and, separately, the energy demand and carbon dioxide emissions from any other part of the development, including plant or equipment, that are not covered by the Building Regulations at each stage of the energy hierarchy

b) proposals to reduce carbon dioxide emissions through the energy efficient design of the site, buildings and services

c) proposals to further reduce carbon dioxide emissions through the use of decentralised energy where feasible, such as district heating and cooling and combined heat and power (CHP)

d) proposals to further reduce carbon dioxide emissions through the use of on-site renewable energy technologies.

- *Policy 5.3 Sustainable design and construction:* The Mayor will expect all major developments to demonstrate that the proposed heating and cooling systems have been selected in accordance with the following order of preference:
  - o 5.3B - Development proposals should demonstrate that sustainable design standards are integral to the proposal, including its construction and operation, and ensure that they are considered at the beginning of the design process

  - o 5.3C - Major development proposals should meet the minimum standards outlined in the Mayor's supplementary planning guidance and this should be clearly demonstrated within a design and access statement. The standards include measures to achieve other policies in the Plan and the following sustainable design principles:
    - a) minimising carbon dioxide emissions across the site, including the building and services (such as heating and cooling systems)
    - b) avoiding internal overheating and contributing to the urban heat island effect
    - c) efficient use of natural resources (including water), including making the most of natural systems both within and around buildings
    - d) minimising pollution (including noise, air and urban run-off)
    - e) minimising the generation of waste and maximising reuse or recycling
    - f) avoiding impacts from natural hazards (including flooding)
    - g) ensuring developments are comfortable and secure for users, including avoiding the creation of adverse local climatic conditions
    - h) securing sustainable procurement of materials, using local supplies where feasible, and
    - i) promoting and protecting biodiversity and green infrastructure.

- *Policy 5.6 Decentralised energy in development proposals*:
  - o 5.6A - Development proposals should evaluate the feasibility of Combined Heat and Power (CHP) systems, and where a new CHP system is appropriate also examine opportunities to extend the system beyond the site boundary to adjacent sites.

- 5.6B - Major development proposals should select energy systems in accordance with the following hierarchy:
  1) Connection to existing heating or cooling networks
  2) Site wide CHP network
  3) Communal heating and cooling.

- 5.6C - Potential opportunities to meet the first priority in this hierarchy are outlined in the London Heat Map tool. Where future network opportunities are identified, proposals should be designed to connect to these networks.

- *Policy 5.7 Renewable energy*:
  - 5.7B - Within the framework of the energy hierarchy, major development proposals should provide a reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation, where feasible
- *Policy 5.9 Overheating and cooling*:
  - 5.9B - Major development proposals should reduce potential overheating and reliance on air conditioning systems and demonstrate this in accordance with the following cooling hierarchy:
    1) minimise internal heat generation through energy efficient design
    2) reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls
    3) manage the heat within the building through exposed internal thermal mass and high ceilings
    4) passive ventilation
    5) mechanical ventilation
    6) active cooling systems (ensuring they are the lowest carbon options).

  - 5.9C - Major development proposals should demonstrate how the design, materials, construction and operation of the development would minimise overheating and also meet its cooling needs. New development in London should also be designed to avoid the need for energy intensive air conditioning systems as much as possible.

- *Policy 5.13 Sustainable drainage*:
  - 5.13A - Development should utilise sustainable urban drainage systems (SUDS) unless there are practical reasons for not doing so, and should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible in line with the following drainage hierarchy:
    1) store rainwater for later use
    2) use infiltration techniques, such as porous surfaces in non-clay areas
    3) attenuate rainwater in ponds or open water features for gradual release
    4) attenuate rainwater by storing in tanks or sealed water features for gradual release
    5) discharge rainwater direct to a watercourse
    6) discharge rainwater to a surface water sewer/drain
    7) discharge rainwater to the combined sewer.

  Drainage should be designed and implemented in ways that deliver other policy objectives of the Plan, including water use efficiency and quality, biodiversity, amenity and recreation.

- *Policy 5.15 Water use and supplies:*
  - 5.15B - Development should minimise the use of mains water by:
    a) incorporating water saving measures and equipment
    b) designing residential development so that mains water consumption would meet a target of 105 litres or less per head per day.
  - 5.15C - New development for sustainable water supply infrastructure, which has been selected within water companies' Water Resource Management Plans, will be supported.

2.2.4 Energy Planning - Greater London Authority guidance on preparing energy assessments (April 2015)

This guidance note provides further detail on addressing the London Plan's energy hierarchy through the provision of an energy assessment to accompany strategic planning applications. The purpose of an energy assessment is to demonstrate that climate change mitigation measures are integral to the scheme's design and evolution, and that they are appropriate to the context of the development.

2.2.5 City of London – Local Plan (January 2015)

The Local Plan is a planning document that sets out the City Corporation's vision, strategy, objectives and policies for planning the City of London until 2026 and beyond. It takes account of projected changes in the economy, employment, transport needs, housing needs, the impact of climate change, the need to protect and

enhance the City's historic legacy and the overarching need to improve the quality of life for all the City's communities (workers, residents and visitors).

- *Policy CS15: Sustainable Development and Climate Change:*
  To enable City businesses and residents to make sustainable choices in their daily activities creating a more sustainable City, adapted to the changing climate, by:
  - Requiring all redevelopment proposals to demonstrate the highest feasible and viable sustainability standards in the design, construction, operation and "end of life" phases of development. Proposals for major development should aim to achieve a BREEAM rating of "excellent" or "outstanding". Residential development should aim to achieve a minimum standard of Code for Sustainable Homes level 4, rising to level 6 by 2016 or in line with government targets.
  - Requiring development to minimise carbon emissions and contribute to a City wide reduction in emissions:
    (i) adopting energy-efficiency measures;
    (ii) enabling the use of decentralised energy, including the safeguarded Citigen CHP network, CHP-ready designs in areas where CCHP networks are not yet available, and localised renewable energy technologies;
    (iii) adopting offsetting measures to achieve the Government's zero carbon targets for buildings.
  - Avoiding demolition through the reuse of existing buildings or their main structures, and minimising the disruption to businesses and residents, using sustainably sourced materials and conserving water resources.
  - Requiring development to positively address:
    (i) local air quality, particularly nitrogen dioxide and particulates pm^{10} (the City's Air Quality Management Area pollutants);
    (ii) protection of the City's quiet areas and quiet times of day for businesses (daytime) and residents (night time);
    (iii) the need to limit the City's contribution to 'sky glow';
    (iv) water quality and flood risk particularly in areas at risk of sewer flooding;
    (v) land contamination, ensuring development does not result in contaminated land;
    (vi) the need to enhance biodiversity and provide for its conservation and enhancement, particularly for the City's flagship species and the City's priority habitats (urban green spaces, churchyards and cemeteries, built structures and the tidal Thames).
  - Incorporating climate change adaptation measures into development and the City's infrastructure, including street scene, transport and utility infrastructure, social and emergency infrastructure, and heritage assets, having regard to the need to protect their historic significance, protecting existing trees and seeking provision of new trees on development sites.

3. REDUCING ENERGY DEMAND

In line with the London Plan (March 2015) and the City of London's Local Plan (January 2015), energy efficiency measures are proposed in order to minimise the energy used by the proposed development and consequently the associated carbon emissions. Furthermore, in order to meet the target set out in the London Plan policy 5.2B, Mayor's Sustainable Design and Construction SPG 2014 states that the proposed energy efficiency measures should ensure that the proposed development is 35% better than the minimum requirements set out in Approved Document Part L2A 2013 (ADL2A which sets out Building Regulations energy efficiency and emissions targets for new built non-domestic developments). This is deemed to be broadly equivalent to the 40% target below Part L2A 2010 as specified by Policy 5.2B. In order to realise the full potential of the building, both passive and active energy efficiency measures will be adopted.

The approach taken has been to firstly reduce the required energy for heating and cooling by minimising heat loss through building elements and improving air leakage/filtration. This approach also takes cognisance of the fact that artificial lighting is a major consumer of power in many buildings and therefore the design is not just a wall of highly reflective glazing, more an engineered façade design with carefully considered proportions of high performance neutral type glazing and solid elements.

Secondly, active elements such as high efficiency air source heat pumps, mechanical ventilation heat recovery, high efficiency motors, variable speed fans and pumps, and high efficiency lighting technology will be utilised where appropriate to achieve the target of a building which complies with Part L2A 2013.

Lastly, renewable technologies have been incorporated to provide a practical measure of on-site "green" energy. The development has been modelled utilising Bentley Hevacomp version 26u38, which has been approved by the Department for Communities and Local Government for use in calculating the energy performance of buildings, for the purpose of Regulation 17A of the Building Regulations (Part L).

3.1 Heat Transfer – Space Heating

A reduction in space heating demand not only has an advantageous impact on the overall carbon emissions of the site, but also reduces the heat emitter and heating plant size.

The space heating requirement is reduced by:

- addressing fabric heat losses with:
    - highly insulated building envelope
    - airtight construction

3.1.1 Façade Engineering

The focus of the design team approach has been to limit building energy consumption and carbon emissions through consideration of the performance of the building envelope. The approach has aimed to reduce solar gains and heat losses to levels commensurate with good practice benchmarks as opposed to reliance on energy efficient measures adopted solely to offset the weakness of a poorly performing building.

External walls will achieve an area weighted U-value of 0.21 W/m^2.K which represents a 40% improvement over the fabric U-value limits of building regulations. Roof areas will achieve an area weighted U-Value of 0.15 W/m^{2}K which represents a 40% improvement over the fabric U-value limits of building regulations

Good air tightness design will reduce heat losses in winter and heat gains in summer and will increase the efficiency of mechanical ventilation proposed. The proposed minimum air permeability for the new elements of the development is 3.0 m^3/m^2/hr at 50 Pa. This represents an improvement of 70% over the minimum requirements set out in ADL1A 2010 (i.e. minimum is 10 m^3/m^2/hr at 50 Pa) and is considered as best practice leakage rate.

3.2 Heat Transfer – Ventilation air heating

The site is in an Air Quality Management Area with high background pollutant levels typical of busy Central London locations.

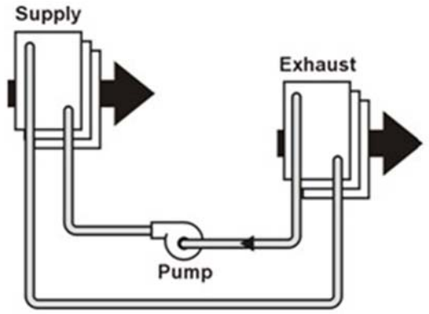
A natural ventilation strategy cannot provide effective acoustic attenuation or pollutant filtration as the driving pressures are too low to overcome the pressure drop of attenuators and filters. On that basis, mechanical ventilation must be specified for all occupied areas.

The ventilation air heating requirement will be optimised with the following strategies:

- incorporating heat recovery into ventilation systems
- control systems optimising ventilation rates for increased air flow during periods of greatest requirement

3.2.1 Air Handling Plant Heat Recovery

Central Air handling plant serving the office floors (1 – 7) will incorporate heat reclaim technology to recover approximately 50% - 60% of waste heat from the building's exhaust air system and use it to pre-warm the building primary air supply using 'run around coils' to minimise system resistances.

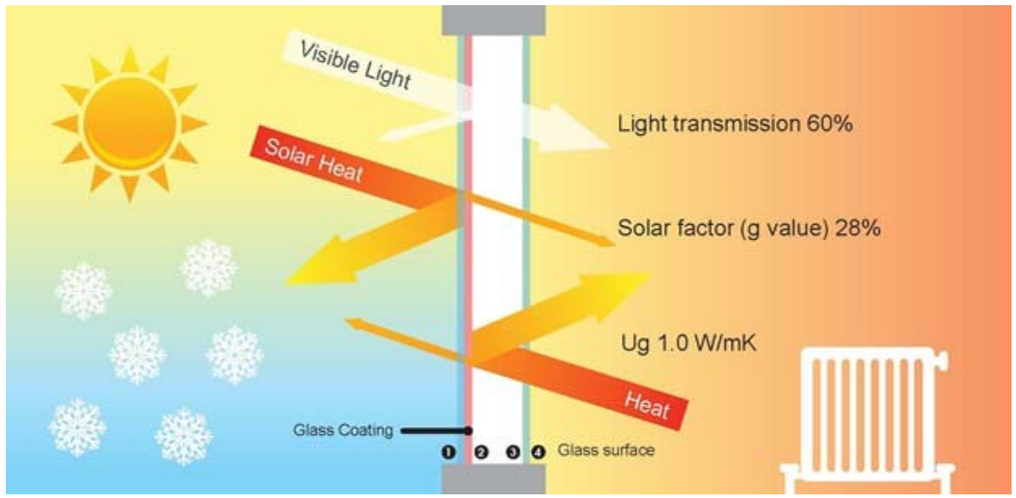


3.3 Heat Transfer – Cooling requirement

3.3.1 Solar control glazing

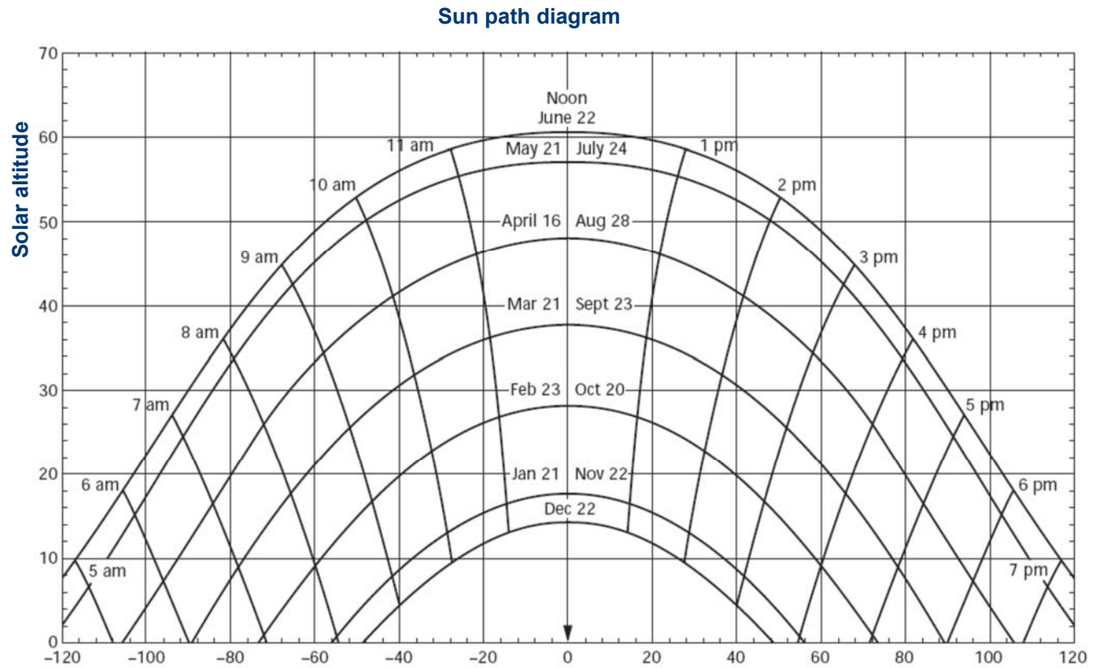
The glazing specification is proposed to incorporate solar control coatings to limit solar gain and improve occupant comfort. A high performance solar glass will reduce solar gains considerably, but the light transmission is normally reduced and so a compromise is necessary.

A good glass for overall energy performance (low g-value, high light transmittance) will be selected with g-value ≤ 0.28, visible light transmission ≥ 0.60



3.3.2 Solar shading

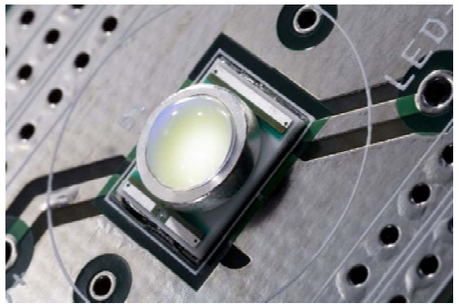
The sun path diagram below shows that during the summer months the south facade experiences a high solar altitude, whereas East and West facades experience much lower solar altitudes:



The proposed design has recessed glazing, where achievable, where the wall structures effectively work as horizontal overhangs and vertical fins. Vertical fins contribute to the reduction of unwanted solar gains occurring at low solar altitudes at West and East facades. In the South façade, the proposed design will benefit from passive solar gain in the winter when solar altitudes are low, also the horizontal overhangs will help reduce unwanted solar from high altitude sun in the summer.

3.4 Electrical energy – Lighting

Low energy lighting has become an essential feature of building design in recent years. New concepts of lamp and ballast design have led to higher efficiency fluorescent and LED lamps and higher frequency control gear becoming standard in most new office installations. It is proposed to incorporate LED lamps throughout the communal and commercial use spaces.



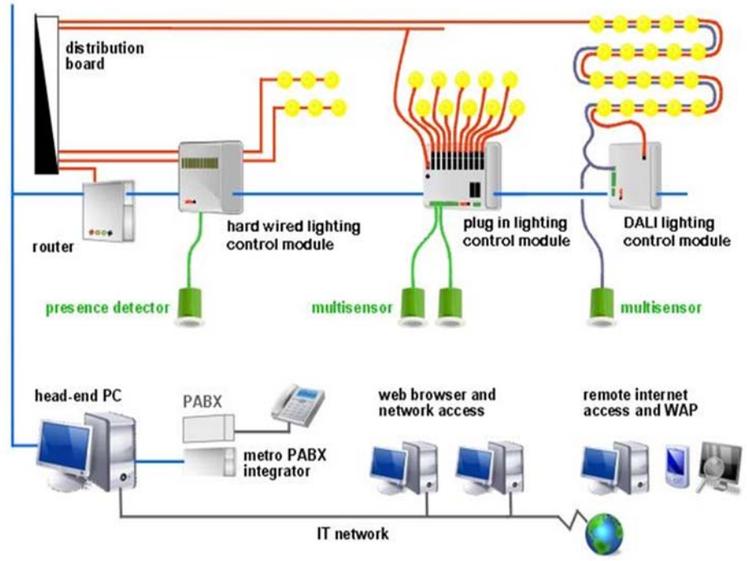
Changes to standards such as Part L Building Regulations, have pushed the standards for efficiency in lighting installations and promoted the use of lighting controls systems.

Lighting controls can comprise simple presence detection, which when combined with daylight control can switch luminaires on/off automatically, or regulate the lighting levels to suit the outside conditions. These systems will be used in conjunction with each other, for the most energy efficient installation. Daylight control can only be utilised in perimeter zones where daylight is received and this will depend upon the internal building layout.

The more functions a lighting control system has, the more costly the system becomes. However, the payback periods on lighting controls systems are very good so the investment is beneficial.

The interior lighting scheme design, will recognise the need to provide good lighting in an energy conscious and cost effective manner. The proposed development will incorporate LED lighting with daylight sensing and presence/absence detection lighting controls in communal areas and commercial use spaces.

Energy performance will be the prominent criteria for luminaire selection. High efficacy LED fittings will feature in the final lighting designs.



Target mean lighting efficacies are listed below:

Description	Efficacy (luminaire Lumens/circuit Watt)	Occupancy sensing	Daylight Control
Reception	70	none	auto dimming
Circulation	85	auto on / dimmed	manual
Office	95	auto on / dimmed	auto dimming
Store	75	auto on/off	manual
WC	85	auto on/off	manual
Plant	70	none	manual
Pub	65	none	manual

3.5 Electrical energy – Pumps / Fans

Some 40% of industrial electricity consumption is utilised as the motive power for pumps and fans. The vast majority of these motors are driven at constant speed by squirrel cage machines, and any variation in system output is generally achieved by throttling or damping in the system. However, a substantial amount of this energy is wasted. This is because most fan and pump systems are oversized, usually because of too much contingency planning in the system design, and then rounding up to the next standard motor size. Consequently, significant amounts of energy are expended unnecessarily, and the operating cost of the system is as much as 50% more than it should be.

The overall savings to be made in energy and indirect costs rely upon the effective application of variable speed AC inverter drives; for example, a 15% reduction in fan or motor speed will, based on The Affinity Laws, achieve a 40% energy saving. Substantial overall savings in energy and indirect costs can be realised relatively simply with the effective application of variable speed AC inverter drives. There are also significant indirect cost savings available by extending motor life, reducing maintenance time and cutting overall noise levels.

The development will incorporate inverter driven pumps with 2-port control for the major plant where possible so that pump energy consumption matches the varying building load. Where possible high efficiency class of electric motors will be selected.

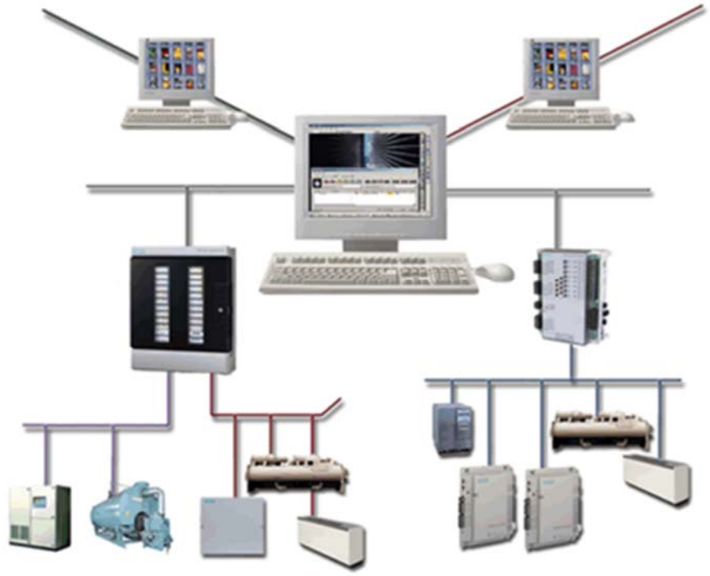
The air handling units serving office spaces will have low system resistances and will be carefully controlled to ensure that excessive energy is not consumed by the introduction of the heat exchange system.

Associated ductwork will be carefully designed for low system resistance and a low resistance run around coil heat exchanger has been selected. The combination of these measures and low resistance filtration will contribute to the reduction of energy use for the air handling unit fans.

The building will utilise Variable Refrigerant Flow (VRF) for heating and cooling applications. Systems will consist of an outdoor condenser unit connected to multiple indoor terminal units via a branch controller (BC) box. VRF systems will be specified with inverter technology which varies the speed of the compressor in the outdoor unit to meet the changing requirements of the building load.

3.6 Building Management System

A Building Management System (BMS) will be installed to increase energy efficiency. The system will monitor and control hours of plant operation, prevent simultaneous heating and cooling, and optimise daylighting usage. The BMS will be interfaced with energy meters such that the building manager can monitor and log the building's energy usage.



4. DELIVERING ENERGY EFFICIENTLY

4.1 Combined Heat and Power

A feasibility study was carried out to assess suitability of CHP at the proposed High Holborn development. Biogas CHP could be a renewable alternative to gas fired CHP however there is currently no viable commercial providers available. CHP could also be implemented via fuel cells however the capital cost, the absence of a 'hydrogen infrastructure' (no hydrogen commercially available) and the market immaturity make this a high risk option and currently untenable.

The economic justification for Combined Heat and Power (CHP) is largely dependent on the value of electricity it generates. Electricity prices are generally highest between 5.00pm and midnight, so savings are highest if all electricity produced during these times can be put to use.

If conditions are right, CHP offers unique benefits to consumers in that it improves the efficiency at which energy is used in power generation. With regard to waste minimisation, the opportunities are considerable. The average efficiency of thermal power stations in the UK in terms of converting primary energy into electrical is between 38% and 52%. The rest of the energy input is rejected as low-grade heat. There are further losses in the transmission and distribution system so that by the time it arrives at the workplace or home only between 33% and 47% of the primary energy is actually available for use. CHP installations can typically convert around 80% of the energy in the fuel into electrical power and useful heat.

By generating the electricity in an on-site CHP unit, and utilising the heat, electricity from conventional power stations is displaced and the substantial conversion, transmission and distribution losses are avoided. The resulting efficiency gives typical small-scale CHP installations, with the right load conditions, a simple payback period of between 3 and 5 years, beyond which the units continue to save energy right up until the end of the life of the plant.

The value of the electricity and heat produced by a CHP unit is greater than that of the fuel consumed. In particular, the value of a unit of electricity can be up to five times that of a unit of heat. As long as the difference offsets the capital and maintenance costs, savings are made. In order to maximise savings from the initial capital investment, running hours should be as long as possible. Guide figures from the CHPQA (Combined Heat and Power Quality Assurance) standards suggest in excess of 4500 hours per annum is required to ensure a good quality installation. According to the London Renewable Toolkit and CIBSE AM12, for CHP systems to be economically viable they need to run for at least 4,000 hours per year.

The economic and environmental benefits of CHP schemes are determined from four fundamental parameters:

- Building load profiles
- Fuel and electricity tariffs
- CHP plant rating, efficiency and heat to power ratio
- CHP plant running hours.

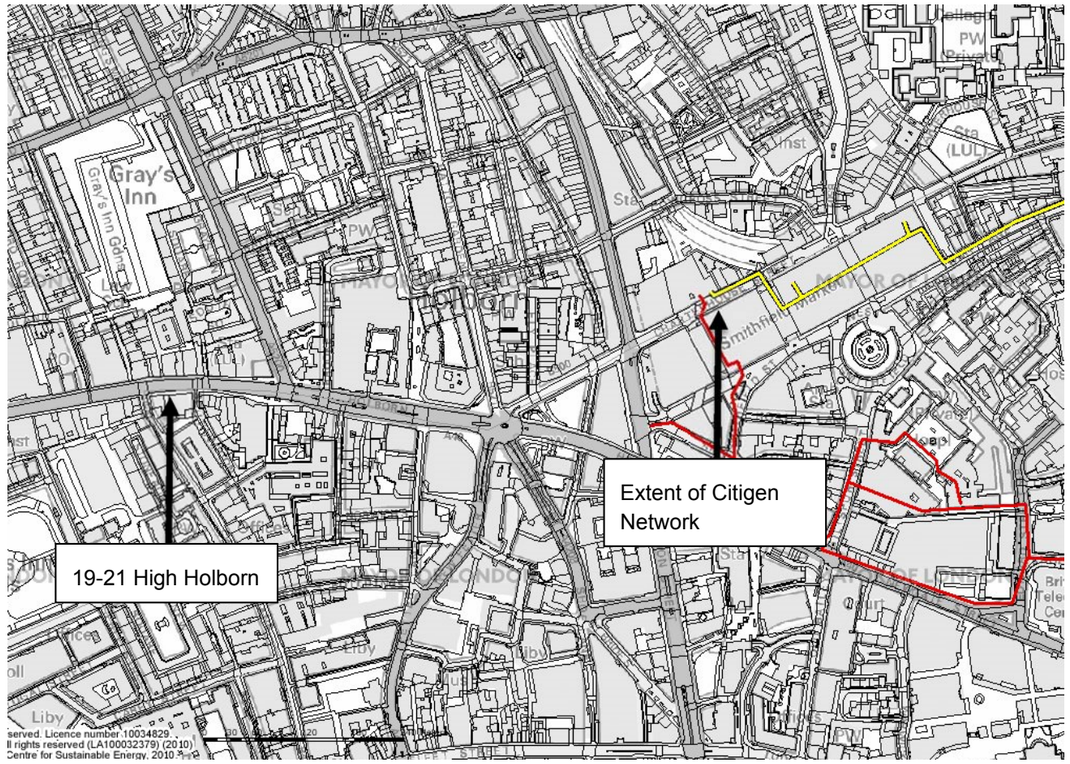
Although these are shown above to be distinct items, in reality they are all interlinked.

After consideration other energy delivery options, CHP system has not been proposed to be incorporated in the development of 19-21 High Holborn. For an office building profile, the running hours envisaged for the economic viability of CHP would not be realised. This is due in part to high internal heat loads all year round and predominantly minimal domestic hot water usage.

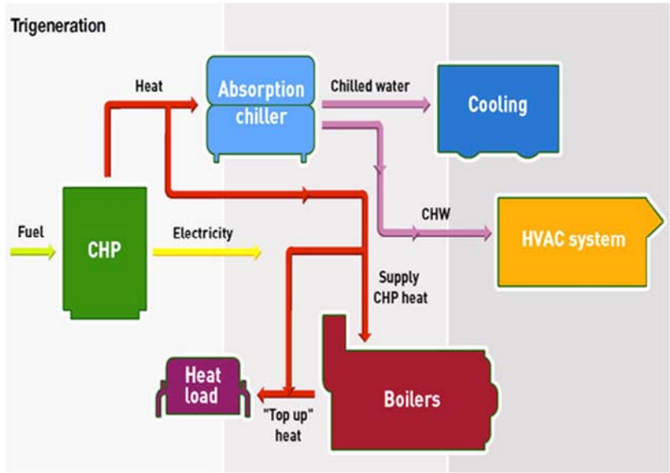
4.2 Potential District Heating Network Connection

We have researched the area surrounding the application site to establish heating networks and CHP sites from which the site could benefit. The London Heat Map website and communication with Citigen were used for this purpose. The image below shows that the Citigen district heating network is circa ~700m of the site.

Given the extent of high usage road network to be excavated to provide a connection, it was determined that connection to a district heating system would be unfeasible.



Tri –Generation has not been considered for the development given the building profile; insufficient with respect to the “running hours” requirement for an absorption chiller to satisfy the primary CHP.



4.3 Combined Cooling, Heating and Power (CCHP) Feasibility Assessment

Trigeneration consists of a CHP system combined with cooling obtained from the use of CHP waste heat in absorption chillers. Via absorption cycles, trigeneration can make it possible to meet both heating demand in winter and cooling demand during the warmer months. Absorption chillers could be added to the proposed CHP unit to generate cooling in summer in order to utilise the spare thermal load from the CHP as the thermal requirement for the building will decrease during summer (i.e. building will not be demanding heating). The main drawbacks associated to trigeneration are significantly larger plant space requirements and the poor efficiency of the absorption chillers (typical COP=0.63).

5. RENEWABLE ENERGY

High efficiency air source heat pumps (ASHPs) providing renewable heat are proposed as the low carbon technology for the development of 19-21 High Holborn. The ASHPs will provide a majority of the heating requirements for the development.

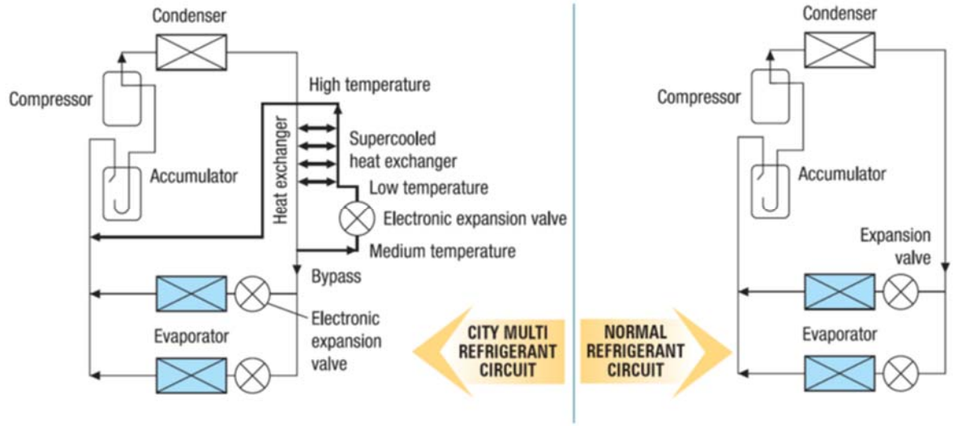
The use of biomass heating has been discounted. Biomass installations are not acceptable in the City of London because biomass fired boilers will generate high levels of particulate matter (PM10) and NOx emissions which are both detrimental to air quality. This is a particularly sensitive issue in areas where Air Quality Management Areas (AQMAs) are in force which is the case for this development and compounded by the emissions associated with the transport of biomass fuel through deliveries.

Other complimentary systems include wind turbines, solar photovoltaic cells and ground source cooling. However, ground source cooling is not viable as there is an existing building and it will not be possible to install thermal piles without damaging the elements of the existing structure which are being retained. All considered systems are described and further analysed in the following sections:

5.1 Air Source Heat Pumps

A heat pump is a device for transferring heat from a lower temperature heat source to a higher temperature heat sink. This is opposite to the natural flow of heat from a hot source to a cold sink, but is made possible by the application of an external energy source to drive a thermodynamic vapour compression cycle. The important characteristic of a heat pump is that the amount of heat that can be transferred is greater than the energy needed to drive the cycle. Typically, an air source heat pump will generate around three times as much heat energy as the electrical energy it consumes. In the case of an Air Source Heat Pump (ASHP), the external air is the heat source and the building or its associated plant is the heat sink. Air Source Heat Pumps are considered a renewable technology when used in heating.

It is proposed that VRF type air source heat pumps are used to meet the space heating and cooling loads of the 19-21 High Holborn development. Variable refrigerant flow (VRF) heat pump systems modulate the flow of refrigerant depending on the requirements of the area. Greater levels of comfort are achieved through inverter driven technology capable of precisely matching cooling and heating demands. A heat pump connecting to DX coils within the Air Handling Unit will provide heating and cooling air loads.

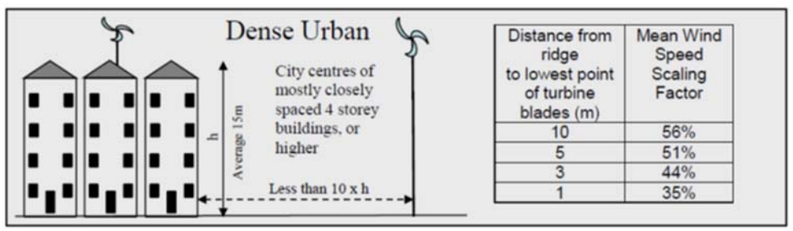


5.2 Wind Power

Wind power is conversion of wind energy into more useful forms. Common contemporary wind power is generated in the form of electricity by converting the rotation of turbine blades into electrical current by means of an electrical generator. Wind energy is renewable, widely distributed, clean, and reduces toxic atmospheric and greenhouse gas emissions if used to replace fossil-fuel-derived electricity. Horizontal or vertical axis wind turbines could be used to assist in the power requirements for a building. Not as a single solution, but part of renewable energy strategy, a turbine could be integrated into a building profile.

It is essential that turbines should be sited away from obstructions, with a clear exposure or fetch for the prevailing wind (minimum 5 to 6m/s consistent wind speed).

The most feasible location for wind turbines on the development would be the 7th floor roof area, this being the highest point of the development. However, the noise generated by wind turbines (typically up to 65 dBA) is not favourable for the site nor is it considered appropriate in a visual context due the nature of the site and surrounding area. Roof mounted wind turbines, even if they are building integrated, will transmit vibration and create visual flicker causing discomfort for the occupants.



Distance from ridge to lowest point of turbine blades (m)	Mean Wind Speed Scaling Factor
10	56%
5	51%
3	44%
1	35%

In terms of wind availability, the fact that the development is in a dense urban context, it is not ideal for wind turbines as there is a lot of interference with wind patterns causing turbulence which decreases the efficiency of wind turbines and yields insufficient wind velocities to make them viable. Scaling factors due to proximity of buildings and roofscapes can have a significant impact on the wind speed and given that the wind speed in London may reach 5-6m/s at 45m above ground uncorrected, the true corrected speeds are insufficient for wind turbine viability which typically only cut-in at 3m/s. The proximity to pedestrians would make potential topple distances hazardous too should the mast fail.

Following review, the negative impact for building occupants, visual impact and the limited usable unturbulent wind resource available makes the application of wind turbines an unfeasible proposition for the development.

5.3 Photovoltaics

Solar energy is a renewable resource that is inexhaustible and is locally available. It is a clean energy source that allows for local energy independence. The sun's power flow reaching the earth is typically about 1,000 W/m^2, although availability varies with location and time of year. Capturing solar energy typically requires equipment with a relatively high initial capital cost. However, over the lifetime of the solar equipment, these systems can prove to be cost-competitive, as compared to conventional energy technologies. The key to successful solar energy installation is to use quality components that have long lifetimes and require minimal maintenance.

Electricity can be produced from sunlight through a process called photovoltaics (PV), which can be applied, in either a centralized or decentralized fashion. "Photo" refers to light and "voltaic" to voltage. The term describes a solid-state electronic cell that produces direct current electrical energy from the radiant energy of the sun. Solar cells are made of semi-conducting material, most commonly silicon, coated with special additives.

A typical silicon PV cell is composed of a thin wafer consisting of an ultra-thin layer of phosphorus-doped (N-type) silicon on top of a thicker layer of boron-doped (P-type) silicon. An electrical field is created near the top surface of the cell where these two materials are in contact, called the P-N junction.

When sunlight strikes the surface of a PV cell, this electrical field provides momentum and direction to light-stimulated electrons, resulting in a flow of current when the solar cell is connected to an electrical load.

For efficiency, PV modules should be mounted facing south and tilted at 30° to 45° from horizontal, in an unshaded location. The most suitable location for the PV modules would be on the roof. However, much of the roof area is used by ventilation plant. Where feasible, available roof space has been given to PV array whilst allowing sufficient access to plant.

6. ENERGY DEMAND ASSESSMENT

This section of the report demonstrates that the proposed building complies with Approved Document L2A 2013 and surpasses the requirements of the target by approximately 9%. Additional developer's commitment to off-site CO_2 reductions will assist in achieving the requirements of the London Plan 2015 and Mayor's Sustainable Design and Construction SPG 2014 as detailed below.

Policy 5.2 of the London Plan 2015 states that from 2013 to 2016 energy assessments should be produced to meet a target of 40% carbon reduction below Part L 2010. This requirement was applied to stage 1 applications received by the Mayor since 1 October 2013. On 6 April 2014 Part L 2013 came into effect which sets out carbon reduction targets for individual buildings being differentiated according to building type. This change affected the percentage reduction necessary above the Part L 2013 to meet initial Mayor's target in the London Plan.

As outlined in the Sustainable Design and Construction SPG (Supplementary Planning Guidance), since 6 April 2014 the Mayor has applied a 35% carbon reduction target below Part L 2013. This is deemed to be broadly equivalent to the 40% target below Part L 2010 as specified in Policy 5.2 of the London Plan 2015.

The CO_2 emissions were calculated using Bentley Hevacomp version 26u38 thermal modelling software suite. This method of calculation compares the total energy consumption of the development and its services, expressed as CO_2 emissions of the building being assessed (its "Building Emissions Rate" or BER) with a target value (its "Target Emissions Rate" or TER) derived from similar calculations for a "notional building".

The notional building has:

- The same geometry, orientation and usage as the assessed building;
- It is exposed to the same weather conditions as the assessed building;
- Standard operating patterns (to allow consistent comparison between buildings in the same sector)
- Standardised assumptions for building fabric, glazing and HVAC plant efficiencies;
- Any service not covered by Part L (e.g. emergency lighting, specialist process lighting) is ignored in both the actual and notional building.

It should be noted Air Source Heat Pumps and Photovoltaic Technology provides a carbon dioxide saving of approximately 5%.

The results of the thermal analysis detailed herein for the RIBA Stage 2 design predict that the development will surpass the Part L2A 2013 target by approximately 9%; comparison to the criteria set out in The London plan demonstrates an overall reduction of 18% against PARTL 2010 with a 5% renewable emissions reduction content . The commercial office is predicted to meet the mandatory energy targets for BREEAM 2014 UK Non-domestic Refurbishment and Fit-out "Very Good".

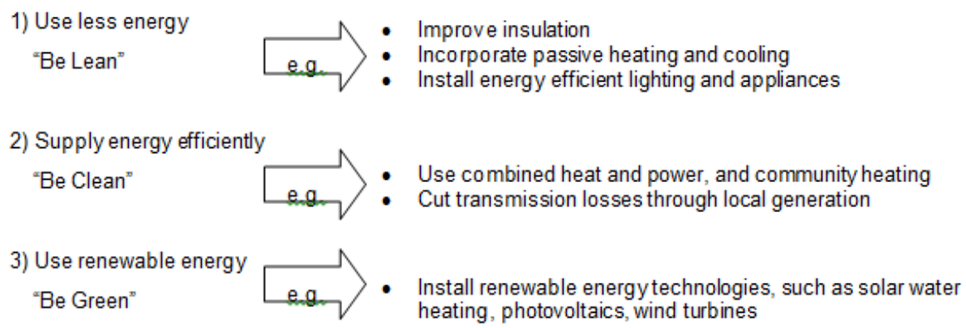
The key performance criteria used for the proposed building are set out below. These will be developed during detailed design stage with building performance reviewed to ensure overall carbon performance targets are maintained:

- Air Permeability Target 3 $m^3/hr/m^2$ @50 Pa
- Power Factor correction to 0.95 or better
- Office Cat A lighting efficacy target of 85 lumens/circuit-Watt with dimmable daylight and PIR control.
- Toilet, Shower, Changing Extract Specific Fan Power (SFP) 0.6 W/l/s
- Space Cooling VRF Air source heat pump SEER 8.21 based on bespoke building load profiling
- Space Heating VRF Air source heat pump SCOP 6.30 based on bespoke building load profiling
- Ventilation plant AHU combined supply and extract SFP 1.8 W/l/s with 50% heat recovery efficiency
- 33m² photovoltaic array, mono-crystalline; 70%efficiency.

7. CONCLUSIONS

The proposed redevelopment at 19-21 High Holborn has been assessed using approved software to demonstrate the potential energy usage and CO_2 emissions.

The strategic design approach follows the London Plan energy hierarchy outlined below:



From the charts in Section 1 it can be seen that the proposed development with the inclusion of Low Zero Carbon technologies as well as the other measures proposed, is predicted to better the Approved Document Part L2A 2013 maximum requirements for CO_2 emissions by approximately 9%. This potential reduction is achieved by the inclusion of a carefully considered façade design, energy efficient lighting systems, and renewable air source heat for the development. The change in GLA policy since the implementation of the London Plan 2015 has focused the energy strategy on carbon emission reductions, be it by efficiency measures, or with the inclusion of renewable technologies. This has allowed further investment in aspects of energy efficient design, seeking greater energy savings from high light transmittance glazing optimised with coatings to reduce g-value.

APPENDICIES

BRUKL Documents – Existing Building

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

25.09.2015 Planning Hevacomp Assessment Existing

As designed

Date: Thu Nov 19 11:52:55 2015

Administrative information

Building Details

Address: 19-21 High Holborn, London, WC1R 5JA

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.2.b.3

Interface to calculation engine: Design Database

Interface to calculation engine version: v26.02

BRUKL compliance check version: v5.2.b.1

Owner Details

Name: Information not provided by the user

Telephone number: Information not provided by the user

Address: Information not provided by the user, Information not provided by the user, Information not provided by the user

Certifier details

Name: Information not provided by the user

Telephone number: Information not provided by the user

Address: Information not provided by the user, Information not provided by the user, Information not provided by the user

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

The building does not comply with England Building Regulations Part L 2013

1.1	CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	20.9
1.2	Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	20.9
1.3	Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	69.2
1.4	Are emissions from the building less than or equal to the target?	BER > TER
1.5	Are as built details the same as used in the BER calculations?	Separate submission

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

Values which do not meet standards in the 2013 Non-Domestic Building Services Compliance Guide are displayed in red.

2.a Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	1	1	1-CIRC 1 Wall 1
Floor	0.25	-	-	"No heat loss floors"
Roof	0.25	0.6	0.6	7-CIRC Exposed Roof 1
Windows***, roof windows, and rooflights	2.2	2.2	2.2	1-OFFICE01 Window 1 (1)
Personnel doors	2.2	-	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

$U_{a\text{-}Limit}$ = 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	10

2.b Building services

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

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	<0.9

1- Office

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.89	-	-	-	-
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- Meeting Rooms

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.65	-	-	-	-
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.

1- Default DHW

	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**
1-CIRC 1	-	1.5	-	-	-	-	-	-	-	-	N/A
1-OFFICE01	-	1.5	-	-	-	-	-	-	-	-	N/A
1-OFFICE02	-	1.5	-	-	-	-	-	-	-	-	N/A
1-OFFICE03	-	1.5	-	-	-	-	-	-	-	-	N/A
1-OFFICE04	-	1.5	-	-	-	-	-	-	-	-	N/A
1-OFFICE05	-	1.5	-	-	-	-	-	-	-	-	N/A
1-OFFICE06	-	1.5	-	-	-	-	-	-	-	-	N/A
1-OFFICE07	-	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
1-OFFICE08	-	1.5	-	-	-	-	-	-	-	-	N/A
1-OFFICE10	-	1.5	-	-	-	-	-	-	-	-	N/A
1-OFFICE11	-	1.5	-	-	-	-	-	-	-	-	N/A
1-OFFICE12	-	1.5	-	-	-	-	-	-	-	-	N/A
1-OFFICE15	-	1.5	-	-	-	-	-	-	-	-	N/A
1-RECEP	-	1.5	-	-	-	-	-	-	-	-	N/A
2-CIRC	-	1.5	-	-	-	-	-	-	-	-	N/A
2-OFFIc 10	-	1.5	-	-	-	-	-	-	-	-	N/A
2-OFFIc 11	-	1.5	-	-	-	-	-	-	-	-	N/A
2-OFFIc 12	-	1.5	-	-	-	-	-	-	-	-	N/A
2-OFFICe 1	-	1.5	-	-	-	-	-	-	-	-	N/A
2-OFFICe 2	-	1.5	-	-	-	-	-	-	-	-	N/A
2-OFFICe 3	-	1.5	-	-	-	-	-	-	-	-	N/A
2-OFFICe 4	-	1.5	-	-	-	-	-	-	-	-	N/A
2-OFFICe 5	-	1.5	-	-	-	-	-	-	-	-	N/A
2-OFFICe 6	-	1.5	-	-	-	-	-	-	-	-	N/A
2-OFFICe 7	-	1.5	-	-	-	-	-	-	-	-	N/A
2-OFFICe 8	-	1.5	-	-	-	-	-	-	-	-	N/A
2-OFFIce 9	-	1.5	-	-	-	-	-	-	-	-	N/A
2-RECEP	-	1.5	-	-	-	-	-	-	-	-	N/A
3-CIRC	-	1.5	-	-	-	-	-	-	-	-	N/A
3-OFFICe01	-	1.5	-	-	-	-	-	-	-	-	N/A
3-OFFICe02	-	1.5	-	-	-	-	-	-	-	-	N/A
3-OFFICe03	-	1.5	-	-	-	-	-	-	-	-	N/A
3-OFFICe04	-	1.5	-	-	-	-	-	-	-	-	N/A
3-OFFICe05	-	1.5	-	-	-	-	-	-	-	-	N/A
3-OFFICe06	-	1.5	-	-	-	-	-	-	-	-	N/A
3-OFFICe07	-	1.5	-	-	-	-	-	-	-	-	N/A
3-OFFICe08	-	1.5	-	-	-	-	-	-	-	-	N/A
3-OFFIce09	-	1.5	-	-	-	-	-	-	-	-	N/A
3-OFFIce10	-	1.5	-	-	-	-	-	-	-	-	N/A
3-OFFIce11	-	1.5	-	-	-	-	-	-	-	-	N/A
3-OFFIce12	-	1.5	-	-	-	-	-	-	-	-	N/A
3-RECEP	-	1.5	-	-	-	-	-	-	-	-	N/A
4-CIRC	-	1.5	-	-	-	-	-	-	-	-	N/A
4-OFFICE01	-	1.5	-	-	-	-	-	-	-	-	N/A
4-OFFICE02	-	1.5	-	-	-	-	-	-	-	-	N/A
4-OFFICE03	-	1.5	-	-	-	-	-	-	-	-	N/A
4-OFFICE04	-	1.5	-	-	-	-	-	-	-	-	N/A
4-OFFICE05	-	1.5	-	-	-	-	-	-	-	-	N/A
4-OFFICE06	-	1.5	-	-	-	-	-	-	-	-	N/A
4-OFFICE07	-	1.5	-	-	-	-	-	-	-	-	N/A
4-OFFICE08	-	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
4-OFFICE09	-	1.5	-	-	-	-	-	-	-	-	N/A
4-OFFICE10	-	1.5	-	-	-	-	-	-	-	-	N/A
4-OFFICE11	-	1.5	-	-	-	-	-	-	-	-	N/A
4-OFFICE12	-	1.5	-	-	-	-	-	-	-	-	N/A
4-RECEP	-	1.5	-	-	-	-	-	-	-	-	N/A
5-CIRC	-	1.5	-	-	-	-	-	-	-	-	N/A
5-OFFICE 1	-	1.5	-	-	-	-	-	-	-	-	N/A
5-OFFICE 2	-	1.5	-	-	-	-	-	-	-	-	N/A
5-OFFICE 3	-	1.5	-	-	-	-	-	-	-	-	N/A
5-OFFICE 4	-	1.5	-	-	-	-	-	-	-	-	N/A
5-OFFICE 5	-	1.5	-	-	-	-	-	-	-	-	N/A
5-OFFICE 6	-	1.5	-	-	-	-	-	-	-	-	N/A
5-OFFICE 7	-	1.5	-	-	-	-	-	-	-	-	N/A
5-RECEP	-	1.5	-	-	-	-	-	-	-	-	N/A
7-CIRC	-	1.5	-	-	-	-	-	-	-	-	N/A
7-OFFICE 1	-	1.5	-	-	-	-	-	-	-	-	N/A
7-OFFICE 2	-	1.5	-	-	-	-	-	-	-	-	N/A
7-OFFICE 3	-	1.5	-	-	-	-	-	-	-	-	N/A
7-OFFICE 4	-	1.5	-	-	-	-	-	-	-	-	N/A
7-OFFICE 5	-	1.5	-	-	-	-	-	-	-	-	N/A
7-OFFICE 6	-	1.5	-	-	-	-	-	-	-	-	N/A
BATHROOM	-	1.5	-	-	-	-	-	-	-	-	N/A
CIRC	-	1.5	-	-	-	-	-	-	-	-	N/A
FLAT 1	-	1.5	-	-	-	-	-	-	-	-	N/A
FLAT 2	-	1.5	-	-	-	-	-	-	-	-	N/A
KIT	-	1.5	-	-	-	-	-	-	-	-	N/A
PLANT	-	1.5	-	-	-	-	-	-	-	-	N/A
STAIR	-	1.5	-	-	-	-	-	-	-	-	N/A
1-CIRC 2	-	-	-	-	-	-	-	-	-	-	N/A
1-STAIR	-	-	-	-	-	-	-	-	-	-	N/A
2-CIRC 2	-	-	-	-	-	-	-	-	-	-	N/A
2-STAIR	-	-	-	-	-	-	-	-	-	-	N/A
3-CIRC 1	-	-	-	-	-	-	-	-	-	-	N/A
3-STAIR	-	-	-	-	-	-	-	-	-	-	N/A
4-CIRC 1	-	-	-	-	-	-	-	-	-	-	N/A
4-STAIR	-	-	-	-	-	-	-	-	-	-	N/A
5-CIRC 2	-	-	-	-	-	-	-	-	-	-	N/A
5-STAIR	-	-	-	-	-	-	-	-	-	-	N/A
7-CIRC 2	-	-	-	-	-	-	-	-	-	-	N/A
7-STAIR	-	-	-	-	-	-	-	-	-	-	N/A
1-KIT	-	-	-	-	-	-	-	-	-	-	N/A
2-KIT	-	-	-	-	-	-	-	-	-	-	N/A
3-KIT	-	-	-	-	-	-	-	-	-	-	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
4-KIT	-	-	-	-	-	-	-	-	-	-	N/A
5-KIT	-	-	-	-	-	-	-	-	-	-	N/A
7-KIT	-	-	-	-	-	-	-	-	-	-	N/A
1-MEET 1	-	1.5	-	-	-	-	-	-	-	-	N/A
1-MEET 2	-	1.5	-	-	-	-	-	-	-	-	N/A
1-MEET 3	-	1.5	-	-	-	-	-	-	-	-	N/A
2-MEET 1	-	1.5	-	-	-	-	-	-	-	-	N/A
2-MEET 2	-	1.5	-	-	-	-	-	-	-	-	N/A
2-MEET 3	-	1.5	-	-	-	-	-	-	-	-	N/A
3-MEET 1	-	1.5	-	-	-	-	-	-	-	-	N/A
3-MEET 2	-	1.5	-	-	-	-	-	-	-	-	N/A
3-MEET 3	-	1.5	-	-	-	-	-	-	-	-	N/A
4-MEET 1	-	1.5	-	-	-	-	-	-	-	-	N/A
4-MEET 2	-	1.5	-	-	-	-	-	-	-	-	N/A
4-MEET 3	-	1.5	-	-	-	-	-	-	-	-	N/A
5-MEET 1	-	1.5	-	-	-	-	-	-	-	-	N/A
5-MEET 2	-	1.5	-	-	-	-	-	-	-	-	N/A
7-MEET 1	-	1.5	-	-	-	-	-	-	-	-	N/A
7-MEET 2	-	1.5	-	-	-	-	-	-	-	-	N/A
1-WC 1	1.5	-	-	-	-	-	-	-	-	-	N/A
1-WC 2	1.5	-	-	-	-	-	-	-	-	-	N/A
1-WC 3	1.5	-	-	-	-	-	-	-	-	-	N/A
2-WC 1	1.5	-	-	-	-	-	-	-	-	-	N/A
2-WC 2	1.5	-	-	-	-	-	-	-	-	-	N/A
2-WC 3	1.5	-	-	-	-	-	-	-	-	-	N/A
3-wc 1	1.5	-	-	-	-	-	-	-	-	-	N/A
3-WC 2	1.5	-	-	-	-	-	-	-	-	-	N/A
3-WC 3	1.5	-	-	-	-	-	-	-	-	-	N/A
4-WC 1	1.5	-	-	-	-	-	-	-	-	-	N/A
4-WC 2	1.5	-	-	-	-	-	-	-	-	-	N/A
4-WC 3	1.5	-	-	-	-	-	-	-	-	-	N/A
5-WC 1	1.5	-	-	-	-	-	-	-	-	-	N/A
5-WC 2	1.5	-	-	-	-	-	-	-	-	-	N/A
5-WC 3	1.5	-	-	-	-	-	-	-	-	-	N/A
7-WC 1	1.5	-	-	-	-	-	-	-	-	-	N/A
7-WC 2	1.5	-	-	-	-	-	-	-	-	-	N/A
7-WC 3	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	
1-CIRC 1	13	-	-	2355
1-OFFICE01	15	-	-	449

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
1-OFFICE02	15	-	-	469
1-OFFICE03	15	-	-	500
1-OFFICE04	15	-	-	507
1-OFFICE05	16	-	-	611
1-OFFICE06	16	-	-	684
1-OFFICE07	17	-	-	834
1-OFFICE08	16	-	-	656
1-OFFICE10	15	-	-	393
1-OFFICE11	15	-	-	445
1-OFFICE12	15	-	-	398
1-OFFICE15	14	-	-	449
1-RECEP	16	-	-	629
2-CIRC	13	-	-	2355
2-OFFIc 10	15	-	-	445
2-OFFIc 11	15	-	-	398
2-OFFIc 12	14	-	-	449
2-OFFICe 1	15	-	-	449
2-OFFICe 2	15	-	-	469
2-OFFICe 3	15	-	-	500
2-OFFICe 4	15	-	-	507
2-OFFICe 5	16	-	-	611
2-OFFICe 6	16	-	-	684
2-OFFICe 7	17	-	-	834
2-OFFICe 8	16	-	-	656
2-OFFIce 9	15	-	-	393
2-RECEP	16	-	-	629
3-CIRC	13	-	-	2355
3-OFFICe01	15	-	-	449
3-OFFICe02	15	-	-	469
3-OFFICe03	15	-	-	500
3-OFFICe04	15	-	-	507
3-OFFICe05	16	-	-	611
3-OFFICe06	16	-	-	684
3-OFFICe07	17	-	-	834
3-OFFICe08	16	-	-	656
3-OFFIce09	15	-	-	393
3-OFFIce10	15	-	-	445
3-OFFIce11	15	-	-	398
3-OFFIce12	14	-	-	449
3-RECEP	16	-	-	629
4-CIRC	13	-	-	2355
4-OFFICE01	15	-	-	449
4-OFFICE02	15	-	-	469

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
4-OFFICE03	15	-	-	500
4-OFFICE04	15	-	-	507
4-OFFICE05	16	-	-	611
4-OFFICE06	16	-	-	684
4-OFFICE07	17	-	-	834
4-OFFICE08	16	-	-	656
4-OFFICE09	15	-	-	393
4-OFFICE10	15	-	-	445
4-OFFICE11	15	-	-	398
4-OFFICE12	14	-	-	449
4-RECEP	16	-	-	629
5-CIRC	-	31	-	1956
5-OFFICE 1	14	-	-	459
5-OFFICE 2	14	-	-	513
5-OFFICE 3	14	-	-	445
5-OFFICE 4	14	-	-	458
5-OFFICE 5	16	-	-	576
5-OFFICE 6	15	-	-	520
5-OFFICE 7	15	-	-	426
5-RECEP	15	-	-	611
7-CIRC	-	29	-	1583
7-OFFICE 1	13	-	-	337
7-OFFICE 2	14	-	-	413
7-OFFICE 3	13	-	-	338
7-OFFICE 4	13	-	-	456
7-OFFICE 5	13	-	-	430
7-OFFICE 6	13	-	-	432
BATHROOM	13	-	-	337
CIRC	14	-	-	462
FLAT 1	17	-	-	1528
FLAT 2	17	-	-	1569
KIT	15	-	-	394
PLANT	16	-	-	729
STAIR	15	-	-	480
1-CIRC 2	14	-	-	349
1-STAIR	14	-	-	415
2-CIRC 2	14	-	-	349
2-STAIR	14	-	-	415
3-CIRC 1	14	-	-	349
3-STAIR	14	-	-	415
4-CIRC 1	14	-	-	349
4-STAIR	14	-	-	415
5-CIRC 2	13	-	-	342

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
5-STAIR	14	-	-	407
7-CIRC 2	-	24	-	93
7-STAIR	13	-	-	431
1-KIT	12	-	-	280
2-KIT	12	-	-	280
3-KIT	12	-	-	280
4-KIT	12	-	-	280
5-KIT	11	-	-	267
7-KIT	10	-	-	293
1-MEET 1	16	-	-	566
1-MEET 2	16	-	-	571
1-MEET 3	15	-	-	512
2-MEET 1	16	-	-	566
2-MEET 2	16	-	-	571
2-MEET 3	15	-	-	512
3-MEET 1	16	-	-	566
3-MEET 2	16	-	-	571
3-MEET 3	15	-	-	512
4-MEET 1	16	-	-	566
4-MEET 2	16	-	-	571
4-MEET 3	15	-	-	512
5-MEET 1	16	-	-	824
5-MEET 2	16	-	-	636
7-MEET 1	15	-	-	688
7-MEET 2	15	-	-	741
1-WC 1	8	-	-	129
1-WC 2	8	-	-	129
1-WC 3	10	-	-	171
2-WC 1	8	-	-	129
2-WC 2	8	-	-	129
2-WC 3	10	-	-	171
3-wc 1	8	-	-	129
3-WC 2	8	-	-	129
3-WC 3	10	-	-	171
4-WC 1	8	-	-	129
4-WC 2	8	-	-	129
4-WC 3	10	-	-	171
5-WC 1	-	20	-	85
5-WC 2	-	14	-	66
5-WC 3	-	16	-	64
7-WC 1	-	18	-	96
7-WC 2	-	13	-	75
7-WC 3	-	14	-	73

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?
1-CIRC 1	N/A	N/A
1-OFFICE01	NO (-77.6%)	NO
1-OFFICE02	N/A	N/A
1-OFFICE03	N/A	N/A
1-OFFICE04	NO (-60.6%)	NO
1-OFFICE05	NO (-34.3%)	NO
1-OFFICE06	YES (+17.2%)	NO
1-OFFICE07	NO (-49.4%)	NO
1-OFFICE08	NO (-69.7%)	NO
1-OFFICE10	YES (+9.9%)	NO
1-OFFICE11	YES (+24.8%)	NO
1-OFFICE12	YES (+9%)	NO
1-OFFICE15	NO (-76.3%)	NO
1-RECEP	N/A	N/A
2-CIRC	N/A	N/A
2-OFFIc 10	YES (+24.8%)	NO
2-OFFIc 11	YES (+9%)	NO
2-OFFIc 12	NO (-76.3%)	NO
2-OFFICe 1	NO (-77.6%)	NO
2-OFFICe 2	N/A	N/A
2-OFFICe 3	N/A	N/A
2-OFFICe 4	NO (-60.6%)	NO
2-OFFICe 5	NO (-34.3%)	NO
2-OFFICe 6	YES (+17.2%)	NO
2-OFFICe 7	NO (-49.4%)	NO
2-OFFICe 8	NO (-69.7%)	NO
2-OFFIce 9	YES (+9.9%)	NO
2-RECEP	N/A	N/A
3-CIRC	N/A	N/A
3-OFFICe01	NO (-77.6%)	NO
3-OFFICe02	N/A	N/A
3-OFFICe03	N/A	N/A
3-OFFICe04	NO (-60.6%)	NO
3-OFFICe05	NO (-34.3%)	NO
3-OFFICe06	YES (+17.2%)	NO
3-OFFICe07	NO (-49.4%)	NO
3-OFFICe08	NO (-69.7%)	NO
3-OFFIce09	YES (+9.9%)	NO
3-OFFIce10	YES (+24.8%)	NO
3-OFFIce11	YES (+9%)	NO
3-OFFIce12	NO (-76.3%)	NO
3-RECEP	N/A	N/A
4-CIRC	N/A	N/A
4-OFFICE01	NO (-77.6%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
4-OFFICE02	N/A	N/A
4-OFFICE03	N/A	N/A
4-OFFICE04	NO (-60.6%)	NO
4-OFFICE05	NO (-34.3%)	NO
4-OFFICE06	YES (+17.2%)	NO
4-OFFICE07	NO (-49.4%)	NO
4-OFFICE08	NO (-69.7%)	NO
4-OFFICE09	YES (+9.9%)	NO
4-OFFICE10	YES (+24.8%)	NO
4-OFFICE11	YES (+9%)	NO
4-OFFICE12	NO (-76.3%)	NO
4-RECEP	N/A	N/A
5-OFFICE 1	NO (-37.9%)	NO
5-OFFICE 2	YES (+16.1%)	NO
5-OFFICE 3	YES (+17.6%)	NO
5-OFFICE 4	YES (+14.1%)	NO
5-OFFICE 5	NO (-64%)	NO
5-OFFICE 6	NO (-52.7%)	NO
5-OFFICE 7	YES (+2.7%)	NO
5-RECEP	N/A	N/A
7-OFFICE 1	NO (-15.5%)	NO
7-OFFICE 2	NO (-17.1%)	NO
7-OFFICE 3	NO (-17.7%)	NO
7-OFFICE 4	NO (-18.4%)	NO
7-OFFICE 5	NO (-37.4%)	NO
7-OFFICE 6	NO (-31.4%)	NO
BATHROOM	NO (-87%)	NO
CIRC	N/A	N/A
FLAT 1	NO (-50.4%)	NO
FLAT 2	NO (-86.2%)	NO
KIT	NO (-51.6%)	NO
PLANT	NO (-78.7%)	NO
STAIR	NO (-89.1%)	NO
1-CIRC 2	N/A	N/A
1-STAIR	NO (-53.3%)	NO
2-CIRC 2	N/A	N/A
2-STAIR	NO (-53.3%)	NO
3-CIRC 1	N/A	N/A
3-STAIR	NO (-53.3%)	NO
4-CIRC 1	N/A	N/A
4-STAIR	NO (-53.3%)	NO
5-CIRC 2	N/A	N/A
5-STAIR	NO (-52.1%)	NO
7-STAIR	NO (-68%)	NO
1-KIT	N/A	N/A
2-KIT	N/A	N/A
3-KIT	N/A	N/A
4-KIT	N/A	N/A
5-KIT	N/A	N/A

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
7-KIT	N/A	N/A
1-MEET 1	NO (-46.7%)	NO
1-MEET 2	NO (-36.6%)	NO
1-MEET 3	NO (-54.3%)	NO
2-MEET 1	NO (-46.7%)	NO
2-MEET 2	NO (-36.6%)	NO
2-MEET 3	NO (-54.3%)	NO
3-MEET 1	NO (-46.7%)	NO
3-MEET 2	NO (-36.6%)	NO
3-MEET 3	NO (-54.3%)	NO
4-MEET 1	NO (-46.7%)	NO
4-MEET 2	NO (-36.6%)	NO
4-MEET 3	NO (-54.3%)	NO
5-MEET 1	NO (-51.2%)	NO
5-MEET 2	NO (-69.3%)	NO
7-MEET 1	NO (-19.5%)	NO
7-MEET 2	NO (-33.1%)	NO
1-WC 1	N/A	N/A
1-WC 2	N/A	N/A
1-WC 3	N/A	N/A
2-WC 1	N/A	N/A
2-WC 2	N/A	N/A
2-WC 3	N/A	N/A
3-wc 1	N/A	N/A
3-WC 2	N/A	N/A
3-WC 3	N/A	N/A
4-WC 1	N/A	N/A
4-WC 2	N/A	N/A
4-WC 3	N/A	N/A

Criterion 4: The performance of the building, as built, should be consistent with the 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?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	2612.2	2612.2
External area [m^2]	2245.7	2245.7
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	10	3
Average conductance [W/K]	2827.62	1659.39
Average U-value [W/m^2K]	1.26	0.74
Alpha value* [%]	11.1	18.57

* 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
28	**B1 Offices and Workshop businesses**
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Inst.: Hospitals and Care Homes
	C2 Residential Inst.: Residential schools
	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.
	Residential spaces
	D1 Non-residential Inst.: Community/Day Centre
	D1 Non-residential Inst.: Libraries, Museums, and Galleries
	D1 Non-residential Inst.: Education
	D1 Non-residential Inst.: Primary Health Care Building
	D1 Non-residential Inst.: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs and Theatres
72	**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	39.08	7.72
Cooling	0	0
Auxiliary	10.88	4.88
Lighting	103.12	30.86
Hot water	3.08	3.56
Equipment*	59.73	59.73
TOTAL**	**156.15**	**47.02**

* Energy used by equipment does not count towards the total for 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	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/m^2]	550.76	312.18
Primary energy* [kWh/m^2]	407.1	120.31
Total emissions [kg/m^2]	69.2	20.9

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	104.8	434.5	36.7	0	11.2	0.79	0	0.89	0
	Notional	23.6	282.2	8	0	5.2	0.82	0	----	----
[ST] No Heating or Cooling										
	Actual	100.7	437	0	0	0	0	0	0	0
	Notional	69.4	274.3	0	0	0	0	0	----	----
[ST] No Heating or Cooling										
	Actual	20.4	567.5	0	0	0	0	0	0	0
	Notional	23	319.1	0	0	0	0	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	166.3	429.6	79.6	0	11.5	0.58	0	0.65	0
	Notional	34.6	284.1	11.7	0	5.3	0.82	0	----	----
[ST] No Heating or Cooling										
	Actual	38.4	624.8	0	0	34.5	0	0	0	0
	Notional	38.3	342	0	0	9.2	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 BCO can give particular attention to items with specifications that 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	1	1-CIRC 1 Wall 1
Floor	0.2	-	"No heat loss floors"
Roof	0.15	0.6	7-CIRC Exposed Roof 1
Windows, roof windows, and rooflights	1.5	2.2	1-OFFICE01 Window 1 (1)
Personnel doors	1.5	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

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

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	10

BRUKL Documents – Clean-Lean Building

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

25.09.2015 Planning Hevacomp Assessment

As designed

Date: Wed Nov 25 12:25:32 2015

Administrative information

Building Details

Address: 19-21 High Holborn, London, WC1R 5JA

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.2.b.3

Interface to calculation engine: Design Database

Interface to calculation engine version: v26.02

BRUKL compliance check version: v5.2.b.1

Owner Details

Name: Information not provided by the user

Telephone number: Information not provided by the user

Address: Information not provided by the user, Information not provided by the user, Information not provided by the user

Certifier details

Name: Information not provided by the user

Telephone number: Information not provided by the user

Address: Information not provided by the user, Information not provided by the user, Information not provided by the user

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

1.1	CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	29.6
1.2	Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	29.6
1.3	Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	28.3
1.4	Are emissions from the building less than or equal to the target?	BER =< TER
1.5	Are as built details the same as used in the BER calculations?	Separate submission

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

Values which do not meet standards in the 2013 Non-Domestic Building Services Compliance Guide are displayed in red.

2.a Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.21	0.35	1-CIRC 1 Wall 1
Floor	0.25	-	-	"No heat loss floors"
Roof	0.25	0.15	0.15	6-CIRC Exposed Roof 1
Windows***, roof windows, and rooflights	2.2	1.41	1.5	1-OFFICE01 Window 1 (1)
Personnel doors	2.2	-	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

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

2.b Building services

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

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	<0.9

1- Office

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.92	3.06	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

2- Meeting Rooms

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.92	3.06	-	-	-
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

1- Default DHW

	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**
1-CIRC 1	-	-	-	1.8	-	-	-	-	-	0.6	0.45
1-OFFICE01	-	-	-	1.8	-	-	-	-	-	0.6	0.45
1-OFFICE02	-	-	-	1.8	-	-	-	-	-	0.6	0.45
1-OFFICE03	-	-	-	1.8	-	-	-	-	-	0.6	0.45
1-OFFICE04	-	-	-	1.8	-	-	-	-	-	0.6	0.45
1-OFFICE05	-	-	-	1.8	-	-	-	-	-	0.6	0.45
1-OFFICE06	-	-	-	1.8	-	-	-	-	-	0.6	0.45
1-OFFICE07	-	-	-	1.8	-	-	-	-	-	0.6	0.45
1-OFFICE08	-	-	-	1.8	-	-	-	-	-	0.6	0.45

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
1-OFFICE10	-	-	-	1.8	-	-	-	-	-	0.6	0.45
1-OFFICE11	-	-	-	1.8	-	-	-	-	-	0.6	0.45
1-OFFICE12	-	-	-	1.8	-	-	-	-	-	0.6	0.45
1-OFFICE15	-	-	-	1.8	-	-	-	-	-	0.6	0.45
1-RECEP	-	-	-	1.8	-	-	-	-	-	0.6	0.45
2-CIRC	-	-	-	1.8	-	-	-	-	-	0.6	0.45
2-OFFIc 10	-	-	-	1.8	-	-	-	-	-	0.6	0.45
2-OFFIc 11	-	-	-	1.8	-	-	-	-	-	0.6	0.45
2-OFFIc 12	-	-	-	1.8	-	-	-	-	-	0.6	0.45
2-OFFICe 1	-	-	-	1.8	-	-	-	-	-	0.6	0.45
2-OFFICe 2	-	-	-	1.8	-	-	-	-	-	0.6	0.45
2-OFFICe 3	-	-	-	1.8	-	-	-	-	-	0.6	0.45
2-OFFICe 4	-	-	-	1.8	-	-	-	-	-	0.6	0.45
2-OFFICe 5	-	-	-	1.8	-	-	-	-	-	0.6	0.45
2-OFFICe 6	-	-	-	1.8	-	-	-	-	-	0.6	0.45
2-OFFICe 7	-	-	-	1.8	-	-	-	-	-	0.6	0.45
2-OFFICe 8	-	-	-	1.8	-	-	-	-	-	0.6	0.45
2-OFFIce 9	-	-	-	1.8	-	-	-	-	-	0.6	0.45
2-RECEP	-	-	-	1.8	-	-	-	-	-	0.6	0.45
3-CIRC	-	-	-	1.8	-	-	-	-	-	0.6	0.45
3-OFFICe01	-	-	-	1.8	-	-	-	-	-	0.6	0.45
3-OFFICe02	-	-	-	1.8	-	-	-	-	-	0.6	0.45
3-OFFICe03	-	-	-	1.8	-	-	-	-	-	0.6	0.45
3-OFFICe04	-	-	-	1.8	-	-	-	-	-	0.6	0.45
3-OFFICe05	-	-	-	1.8	-	-	-	-	-	0.6	0.45
3-OFFICe06	-	-	-	1.8	-	-	-	-	-	0.6	0.45
3-OFFICe07	-	-	-	1.8	-	-	-	-	-	0.6	0.45
3-OFFICe08	-	-	-	1.8	-	-	-	-	-	0.6	0.45
3-OFFIce09	-	-	-	1.8	-	-	-	-	-	0.6	0.45
3-OFFIce10	-	-	-	1.8	-	-	-	-	-	0.6	0.45
3-OFFIce11	-	-	-	1.8	-	-	-	-	-	0.6	0.45
3-OFFIce12	-	-	-	1.8	-	-	-	-	-	0.6	0.45
3-RECEP	-	-	-	1.8	-	-	-	-	-	0.6	0.45
4-CIRC	-	-	-	1.8	-	-	-	-	-	0.6	0.45
4-OFFICE01	-	-	-	1.8	-	-	-	-	-	0.6	0.45
4-OFFICE02	-	-	-	1.8	-	-	-	-	-	0.6	0.45
4-OFFICE03	-	-	-	1.8	-	-	-	-	-	0.6	0.45
4-OFFICE04	-	-	-	1.8	-	-	-	-	-	0.6	0.45
4-OFFICE05	-	-	-	1.8	-	-	-	-	-	0.6	0.45
4-OFFICE06	-	-	-	1.8	-	-	-	-	-	0.6	0.45
4-OFFICE07	-	-	-	1.8	-	-	-	-	-	0.6	0.45
4-OFFICE08	-	-	-	1.8	-	-	-	-	-	0.6	0.45
4-OFFICE09	-	-	-	1.8	-	-	-	-	-	0.6	0.45

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
4-OFFICE10	-	-	-	1.8	-	-	-	-	-	0.6	0.45
4-OFFICE11	-	-	-	1.8	-	-	-	-	-	0.6	0.45
4-OFFICE12	-	-	-	1.8	-	-	-	-	-	0.6	0.45
4-RECEP	-	-	-	1.8	-	-	-	-	-	0.6	0.45
5-CIRC	-	-	-	1.8	-	-	-	-	-	0.6	0.45
5-OFFICE 1	-	-	-	1.8	-	-	-	-	-	0.6	0.45
5-OFFICE 2	-	-	-	1.8	-	-	-	-	-	0.6	0.45
5-OFFICE 3	-	-	-	1.8	-	-	-	-	-	0.6	0.45
5-OFFICE 4	-	-	-	1.8	-	-	-	-	-	0.6	0.45
5-OFFICE 5	-	-	-	1.8	-	-	-	-	-	0.6	0.45
5-OFFICE 6	-	-	-	1.8	-	-	-	-	-	0.6	0.45
5-OFFICE 7	-	-	-	1.8	-	-	-	-	-	0.6	0.45
5-RECEP	-	-	-	1.8	-	-	-	-	-	0.6	0.45
6-CIRC	-	-	-	1.8	-	-	-	-	-	0.6	0.45
6-OFFICE 1	-	-	-	1.8	-	-	-	-	-	0.6	0.45
6-OFFICE 2	-	-	-	1.8	-	-	-	-	-	0.6	0.45
6-OFFICE 3	-	-	-	1.8	-	-	-	-	-	0.6	0.45
6-OFFICE 4	-	-	-	1.8	-	-	-	-	-	0.6	0.45
6-OFFICE 6	-	-	-	1.8	-	-	-	-	-	0.6	0.45
7-CIRC	-	-	-	1.8	-	-	-	-	-	0.6	0.45
7-OFFICE 1	-	-	-	1.8	-	-	-	-	-	0.6	0.45
7-OFFICE 2	-	-	-	1.8	-	-	-	-	-	0.6	0.45
7-OFFICE 3	-	-	-	1.8	-	-	-	-	-	0.6	0.45
7-OFFICE 4	-	-	-	1.8	-	-	-	-	-	0.6	0.45
7-OFFICE 5	-	-	-	1.8	-	-	-	-	-	0.6	0.45
7-OFFICE 6	-	-	-	1.8	-	-	-	-	-	0.6	0.45
1-CIRC 2	-	-	-	-	-	-	-	-	-	-	N/A
1-STAIR	-	-	-	-	-	-	-	-	-	-	N/A
2-CIRC 2	-	-	-	-	-	-	-	-	-	-	N/A
2-STAIR	-	-	-	-	-	-	-	-	-	-	N/A
3-CIRC 1	-	-	-	-	-	-	-	-	-	-	N/A
3-STAIR	-	-	-	-	-	-	-	-	-	-	N/A
4-CIRC 1	-	-	-	-	-	-	-	-	-	-	N/A
4-STAIR	-	-	-	-	-	-	-	-	-	-	N/A
5-CIRC 2	-	-	-	-	-	-	-	-	-	-	N/A
5-STAIR	-	-	-	-	-	-	-	-	-	-	N/A
6-CIRC 2	-	-	-	-	-	-	-	-	-	-	N/A
6-STAIR	-	-	-	-	-	-	-	-	-	-	N/A
7-CIRC 2	-	-	-	-	-	-	-	-	-	-	N/A
7-STAIR	-	-	-	-	-	-	-	-	-	-	N/A
1-KIT	-	-	-	-	-	-	-	-	-	-	N/A
2-KIT	-	-	-	-	-	-	-	-	-	-	N/A
3-KIT	-	-	-	-	-	-	-	-	-	-	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
4-KIT	-	-	-	-	-	-	-	-	-	-	N/A
5-KIT	-	-	-	-	-	-	-	-	-	-	N/A
6-KIT	-	-	-	-	-	-	-	-	-	-	N/A
7-KIT	-	-	-	-	-	-	-	-	-	-	N/A
1-MEET 1	-	-	-	1.8	-	-	-	-	-	0.6	0.45
1-MEET 2	-	-	-	1.8	-	-	-	-	-	0.6	0.45
1-MEET 3	-	-	-	1.8	-	-	-	-	-	0.6	0.45
2-MEET 1	-	-	-	1.8	-	-	-	-	-	0.6	0.45
2-MEET 2	-	-	-	1.8	-	-	-	-	-	0.6	0.45
2-MEET 3	-	-	-	1.8	-	-	-	-	-	0.6	0.45
3-MEET 1	-	-	-	1.8	-	-	-	-	-	0.6	0.45
3-MEET 2	-	-	-	1.8	-	-	-	-	-	0.6	0.45
3-MEET 3	-	-	-	1.8	-	-	-	-	-	0.6	0.45
4-MEET 1	-	-	-	1.8	-	-	-	-	-	0.6	0.45
4-MEET 2	-	-	-	1.8	-	-	-	-	-	0.6	0.45
4-MEET 3	-	-	-	1.8	-	-	-	-	-	0.6	0.45
5-MEET 1	-	-	-	1.8	-	-	-	-	-	0.6	0.45
5-MEET 2	-	-	-	1.8	-	-	-	-	-	0.6	0.45
6-MEET 1	-	-	-	1.8	-	-	-	-	-	0.6	0.45
6-MEET 2	-	-	-	1.8	-	-	-	-	-	0.6	0.45
7-MEET 1	-	-	-	1.8	-	-	-	-	-	0.6	0.45
7-MEET 2	-	-	-	1.8	-	-	-	-	-	0.6	0.45
1-WC 1	-	-	0.6	-	-	-	-	-	-	-	N/A
1-WC 2	-	-	0.6	-	-	-	-	-	-	-	N/A
1-WC 3	-	-	0.6	-	-	-	-	-	-	-	N/A
2-WC 1	-	-	0.6	-	-	-	-	-	-	-	N/A
2-WC 2	-	-	0.6	-	-	-	-	-	-	-	N/A
2-WC 3	-	-	0.6	-	-	-	-	-	-	-	N/A
3-wc 1	-	-	0.6	-	-	-	-	-	-	-	N/A
3-WC 2	-	-	0.6	-	-	-	-	-	-	-	N/A
3-WC 3	-	-	0.6	-	-	-	-	-	-	-	N/A
4-WC 1	-	-	0.6	-	-	-	-	-	-	-	N/A
4-WC 2	-	-	0.6	-	-	-	-	-	-	-	N/A
4-WC 3	-	-	0.6	-	-	-	-	-	-	-	N/A
5-WC 1	-	-	0.6	-	-	-	-	-	-	-	N/A
5-WC 2	-	-	0.6	-	-	-	-	-	-	-	N/A
5-WC 3	-	-	0.6	-	-	-	-	-	-	-	N/A
6-WC 1	-	-	0.6	-	-	-	-	-	-	-	N/A
6-WC 2	-	-	0.6	-	-	-	-	-	-	-	N/A
6-WC 3	-	-	0.6	-	-	-	-	-	-	-	N/A
7-WC 1	-	-	0.6	-	-	-	-	-	-	-	N/A
7-WC 2	-	-	0.6	-	-	-	-	-	-	-	N/A
7-WC 3	-	-	0.6	-	-	-	-	-	-	-	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	
1-CIRC 1	95	-	-	682
1-OFFICE01	95	-	-	130
1-OFFICE02	95	-	-	136
1-OFFICE03	95	-	-	145
1-OFFICE04	95	-	-	147
1-OFFICE05	95	-	-	177
1-OFFICE06	95	-	-	198
1-OFFICE07	95	-	-	241
1-OFFICE08	95	-	-	190
1-OFFICE10	95	-	-	114
1-OFFICE11	95	-	-	129
1-OFFICE12	95	-	-	115
1-OFFICE15	95	-	-	130
1-RECEP	95	-	-	182
2-CIRC	95	-	-	682
2-OFFIc 10	95	-	-	129
2-OFFIc 11	95	-	-	115
2-OFFIc 12	95	-	-	130
2-OFFICe 1	95	-	-	130
2-OFFICe 2	95	-	-	136
2-OFFICe 3	95	-	-	145
2-OFFICe 4	95	-	-	147
2-OFFICe 5	95	-	-	177
2-OFFICe 6	95	-	-	198
2-OFFICe 7	95	-	-	241
2-OFFICe 8	95	-	-	190
2-OFFIce 9	95	-	-	114
2-RECEP	95	-	-	182
3-CIRC	95	-	-	682
3-OFFICe01	95	-	-	130
3-OFFICe02	95	-	-	136
3-OFFICe03	95	-	-	145
3-OFFICe04	95	-	-	147
3-OFFICe05	95	-	-	177
3-OFFICe06	95	-	-	198
3-OFFICe07	95	-	-	241
3-OFFICe08	95	-	-	190
3-OFFIce09	95	-	-	114
3-OFFIce10	95	-	-	129
3-OFFIce11	95	-	-	115
3-OFFIce12	95	-	-	130
3-RECEP	95	-	-	182

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
4-CIRC	95	-	-	682
4-OFFICE01	95	-	-	130
4-OFFICE02	95	-	-	136
4-OFFICE03	95	-	-	145
4-OFFICE04	95	-	-	147
4-OFFICE05	95	-	-	177
4-OFFICE06	95	-	-	198
4-OFFICE07	95	-	-	241
4-OFFICE08	95	-	-	190
4-OFFICE09	95	-	-	114
4-OFFICE10	95	-	-	129
4-OFFICE11	95	-	-	115
4-OFFICE12	95	-	-	130
4-RECEP	95	-	-	182
5-CIRC	-	95	-	566
5-OFFICE 1	95	-	-	133
5-OFFICE 2	95	-	-	148
5-OFFICE 3	95	-	-	129
5-OFFICE 4	95	-	-	133
5-OFFICE 5	95	-	-	167
5-OFFICE 6	95	-	-	151
5-OFFICE 7	95	-	-	123
5-RECEP	95	-	-	177
6-CIRC	-	95	-	732
6-OFFICE 1	95	-	-	136
6-OFFICE 2	95	-	-	133
6-OFFICE 3	95	-	-	155
6-OFFICE 4	95	-	-	167
6-OFFICE 6	95	-	-	123
7-CIRC	-	95	-	458
7-OFFICE 1	95	-	-	98
7-OFFICE 2	95	-	-	120
7-OFFICE 3	95	-	-	98
7-OFFICE 4	95	-	-	132
7-OFFICE 5	95	-	-	124
7-OFFICE 6	95	-	-	125
1-CIRC 2	85	-	-	113
1-STAIR	85	-	-	134
2-CIRC 2	85	-	-	113
2-STAIR	85	-	-	134
3-CIRC 1	85	-	-	113
3-STAIR	85	-	-	134
4-CIRC 1	85	-	-	113

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
4-STAIR	85	-	-	134
5-CIRC 2	85	-	-	111
5-STAIR	85	-	-	132
6-CIRC 2	-	85	-	28
6-STAIR	85	-	-	132
7-CIRC 2	-	85	-	30
7-STAIR	85	-	-	139
1-KIT	85	-	-	91
2-KIT	85	-	-	91
3-KIT	85	-	-	91
4-KIT	85	-	-	91
5-KIT	85	-	-	86
6-KIT	85	-	-	86
7-KIT	85	-	-	95
1-MEET 1	95	-	-	164
1-MEET 2	95	-	-	165
1-MEET 3	95	-	-	148
2-MEET 1	95	-	-	164
2-MEET 2	95	-	-	165
2-MEET 3	95	-	-	148
3-MEET 1	95	-	-	164
3-MEET 2	95	-	-	165
3-MEET 3	95	-	-	148
4-MEET 1	95	-	-	164
4-MEET 2	95	-	-	165
4-MEET 3	95	-	-	148
5-MEET 1	95	-	-	238
5-MEET 2	95	-	-	184
6-MEET 1	95	-	-	171
6-MEET 2	95	-	-	186
7-MEET 1	95	-	-	199
7-MEET 2	95	-	-	215
1-WC 1	85	-	-	42
1-WC 2	85	-	-	42
1-WC 3	85	-	-	55
2-WC 1	85	-	-	42
2-WC 2	85	-	-	42
2-WC 3	85	-	-	55
3-wc 1	85	-	-	42
3-WC 2	85	-	-	42
3-WC 3	85	-	-	55
4-WC 1	85	-	-	42
4-WC 2	85	-	-	42

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
4-WC 3	85	-	-	55
5-WC 1	-	85	-	28
5-WC 2	-	85	-	21
5-WC 3	-	85	-	21
6-WC 1	-	85	-	28
6-WC 2	85	-	-	43
6-WC 3	-	85	-	21
7-WC 1	-	85	-	31
7-WC 2	-	85	-	24
7-WC 3	-	85	-	24

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?
1-CIRC 1	N/A	N/A
1-OFFICE01	NO (-86.9%)	NO
1-OFFICE02	N/A	N/A
1-OFFICE03	N/A	N/A
1-OFFICE04	NO (-77.1%)	NO
1-OFFICE05	NO (-61.8%)	NO
1-OFFICE06	NO (-31.9%)	NO
1-OFFICE07	NO (-70.6%)	NO
1-OFFICE08	NO (-82.4%)	NO
1-OFFICE10	NO (-36.1%)	NO
1-OFFICE11	NO (-27.4%)	NO
1-OFFICE12	NO (-36.6%)	NO
1-OFFICE15	NO (-86.2%)	NO
1-RECEP	N/A	N/A
2-CIRC	N/A	N/A
2-OFFIc 10	NO (-27.4%)	NO
2-OFFIc 11	NO (-36.6%)	NO
2-OFFIc 12	NO (-86.2%)	NO
2-OFFICe 1	NO (-86.9%)	NO
2-OFFICe 2	N/A	N/A
2-OFFICe 3	N/A	N/A
2-OFFICe 4	NO (-77.1%)	NO
2-OFFICe 5	NO (-61.8%)	NO
2-OFFICe 6	NO (-31.9%)	NO
2-OFFICe 7	NO (-70.6%)	NO
2-OFFICe 8	NO (-82.4%)	NO
2-OFFIce 9	NO (-36.1%)	NO
2-RECEP	N/A	N/A
3-CIRC	N/A	N/A
3-OFFICe01	NO (-86.9%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
3-OFFICe02	N/A	N/A
3-OFFICe03	N/A	N/A
3-OFFICe04	NO (-77.1%)	NO
3-OFFICe05	NO (-61.8%)	NO
3-OFFICe06	NO (-31.9%)	NO
3-OFFICe07	NO (-70.6%)	NO
3-OFFICe08	NO (-82.4%)	NO
3-OFFIce09	NO (-36.1%)	NO
3-OFFIce10	NO (-27.4%)	NO
3-OFFIce11	NO (-36.6%)	NO
3-OFFIce12	NO (-86.2%)	NO
3-RECEP	N/A	N/A
4-CIRC	N/A	N/A
4-OFFICE01	NO (-86.9%)	NO
4-OFFICE02	N/A	N/A
4-OFFICE03	N/A	N/A
4-OFFICE04	NO (-77.1%)	NO
4-OFFICE05	NO (-61.8%)	NO
4-OFFICE06	NO (-31.9%)	NO
4-OFFICE07	NO (-70.6%)	NO
4-OFFICE08	NO (-82.4%)	NO
4-OFFICE09	NO (-36.1%)	NO
4-OFFICE10	NO (-27.4%)	NO
4-OFFICE11	NO (-36.6%)	NO
4-OFFICE12	NO (-86.2%)	NO
4-RECEP	N/A	N/A
5-OFFICE 1	NO (-63.9%)	NO
5-OFFICE 2	NO (-32.5%)	NO
5-OFFICE 3	NO (-31.6%)	NO
5-OFFICE 4	NO (-33.6%)	NO
5-OFFICE 5	NO (-79.1%)	NO
5-OFFICE 6	NO (-72.5%)	NO
5-OFFICE 7	NO (-40.3%)	NO
5-RECEP	N/A	N/A
6-OFFICE 1	NO (-9.7%)	NO
6-OFFICE 2	NO (-7.9%)	NO
6-OFFICE 3	NO (-69.4%)	NO
6-OFFICE 4	NO (-63.4%)	NO
6-OFFICE 6	NO (-17.3%)	NO
7-OFFICE 1	YES (+0.8%)	NO
7-OFFICE 2	YES (+1.1%)	NO
7-OFFICE 3	YES (+0.8%)	NO
7-OFFICE 4	NO (-1.7%)	NO
7-OFFICE 5	NO (-23.9%)	NO
7-OFFICE 6	NO (-16.7%)	NO
1-CIRC 2	N/A	N/A
1-STAIR	NO (-72.9%)	NO
2-CIRC 2	N/A	N/A
2-STAIR	NO (-72.9%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
3-CIRC 1	N/A	N/A
3-STAIR	NO (-72.9%)	NO
4-CIRC 1	N/A	N/A
4-STAIR	NO (-72.9%)	NO
5-CIRC 2	N/A	N/A
5-STAIR	NO (-72.1%)	NO
6-STAIR	NO (-61.3%)	NO
7-STAIR	NO (-61.3%)	NO
1-KIT	N/A	N/A
2-KIT	N/A	N/A
3-KIT	N/A	N/A
4-KIT	N/A	N/A
5-KIT	N/A	N/A
6-KIT	N/A	N/A
7-KIT	N/A	N/A
1-MEET 1	NO (-69%)	NO
1-MEET 2	NO (-63.1%)	NO
1-MEET 3	NO (-73.4%)	NO
2-MEET 1	NO (-69%)	NO
2-MEET 2	NO (-63.1%)	NO
2-MEET 3	NO (-73.4%)	NO
3-MEET 1	NO (-69%)	NO
3-MEET 2	NO (-63.1%)	NO
3-MEET 3	NO (-73.4%)	NO
4-MEET 1	NO (-69%)	NO
4-MEET 2	NO (-63.1%)	NO
4-MEET 3	NO (-73.4%)	NO
5-MEET 1	NO (-71.6%)	NO
5-MEET 2	NO (-82.1%)	NO
6-MEET 1	NO (-51.4%)	NO
6-MEET 2	NO (-75.1%)	NO
7-MEET 1	NO (-3.3%)	NO
7-MEET 2	NO (-18.7%)	NO
1-WC 1	N/A	N/A
1-WC 2	N/A	N/A
1-WC 3	N/A	N/A
2-WC 1	N/A	N/A
2-WC 2	N/A	N/A
2-WC 3	N/A	N/A
3-wc 1	N/A	N/A
3-WC 2	N/A	N/A
3-WC 3	N/A	N/A
4-WC 1	N/A	N/A
4-WC 2	N/A	N/A
4-WC 3	N/A	N/A
6-WC 2	N/A	N/A

Criterion 4: The performance of the building, as built, should be consistent with the 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?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	2675.6	2675.6
External area [m^2]	2364.2	2364.2
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	3
Average conductance [W/K]	1346.32	1720.14
Average U-value [W/m^2K]	0.57	0.73
Alpha value* [%]	25.09	18.5

* 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
30	**B1 Offices and Workshop businesses**
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Inst.: Hospitals and Care Homes
	C2 Residential Inst.: Residential schools
	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.
	Residential spaces
	D1 Non-residential Inst.: Community/Day Centre
	D1 Non-residential Inst.: Libraries, Museums, and Galleries
	D1 Non-residential Inst.: Education
	D1 Non-residential Inst.: Primary Health Care Building
	D1 Non-residential Inst.: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs and Theatres
70	**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	8.95	8.16
Cooling	11.42	19
Auxiliary	7.4	3.75
Lighting	28.98	30.03
Hot water	2.94	3.41
Equipment*	57.73	57.73
TOTAL**	**59.7**	**64.35**

* Energy used by equipment does not count towards the total for 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	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/m^2]	310.07	307.92
Primary energy* [kWh/m^2]	166.72	171.69
Total emissions [kg/m^2]	28.3	29.6

* 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] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	29.4	291.2	9.1	13.2	8	0.9	6.14	0.92	8.21
	Notional	25	279.4	8.5	21.6	3.9	0.82	3.6	----	----
[ST] No Heating or Cooling										
	Actual	52.7	219	0	0	0	0	0	0	0
	Notional	71	252.7	0	0	0	0	0	----	----
[ST] No Heating or Cooling										
	Actual	14.9	266.3	0	0	0	0	0	0	0
	Notional	24.8	295.8	0	0	0	0	0	----	----
[ST] Split or multi-split system, [HS] Unitary radiant heater, [HFT] Natural Gas, [CFT] Electricity										
	Actual	46.2	241.7	15	11.5	7.8	0.86	5.83	0.92	8.21
	Notional	37.2	270.7	12.6	20.9	3.8	0.82	3.6	----	----
[ST] No Heating or Cooling										
	Actual	23.9	245.4	0	0	13.4	0	0	0	0
	Notional	44.7	312.2	0	0	13.4	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 BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.15	1-CIRC 1 Wall 2
Floor	0.2	-	"No heat loss floors"
Roof	0.15	0.15	6-CIRC Exposed Roof 1
Windows, roof windows, and rooflights	1.5	1.2	1-MEET 1 Window 1
Personnel doors	1.5	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

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

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	3

BRUKL Documents – Green Building

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

25.09.2015 Planning Hevacomp Assessment

As designed

Date: Wed Nov 25 14:29:40 2015

Administrative information

Building Details

Address: 19-21 High Holborn, London, WC1R 5JA

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.2.b.3

Interface to calculation engine: Design Database

Interface to calculation engine version: v26.02

BRUKL compliance check version: v5.2.b.1

Owner Details

Name: Information not provided by the user

Telephone number: Information not provided by the user

Address: Information not provided by the user, Information not provided by the user, Information not provided by the user

Certifier details

Name: Information not provided by the user

Telephone number: Information not provided by the user

Address: Information not provided by the user, Information not provided by the user, Information not provided by the user

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

1.1	CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	29.6
1.2	Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	29.6
1.3	Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	26.8
1.4	Are emissions from the building less than or equal to the target?	BER =< TER
1.5	Are as built details the same as used in the BER calculations?	Separate submission

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

Values which do not meet standards in the 2013 Non-Domestic Building Services Compliance Guide are displayed in red.

2.a Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.21	0.35	1-CIRC 1 Wall 1
Floor	0.25	-	-	"No heat loss floors"
Roof	0.25	0.15	0.15	6-CIRC Exposed Roof 1
Windows***, roof windows, and rooflights	2.2	1.41	1.5	1-OFFICE01 Window 1 (1)
Personnel doors	2.2	-	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

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

2.b Building services

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

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	<0.9

1- Office

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	6.3	3.06	-	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

2- Meeting Rooms

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	6.3	3.06	-	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					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- Default DHW

	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**
1-CIRC 1	-	-	-	1.8	-	-	-	-	-	0.6	0.45
1-OFFICE01	-	-	-	1.8	-	-	-	-	-	0.6	0.45
1-OFFICE02	-	-	-	1.8	-	-	-	-	-	0.6	0.45
1-OFFICE03	-	-	-	1.8	-	-	-	-	-	0.6	0.45
1-OFFICE04	-	-	-	1.8	-	-	-	-	-	0.6	0.45
1-OFFICE05	-	-	-	1.8	-	-	-	-	-	0.6	0.45
1-OFFICE06	-	-	-	1.8	-	-	-	-	-	0.6	0.45
1-OFFICE07	-	-	-	1.8	-	-	-	-	-	0.6	0.45

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
1-OFFICE08	-	-	-	1.8	-	-	-	-	-	0.6	0.45
1-OFFICE10	-	-	-	1.8	-	-	-	-	-	0.6	0.45
1-OFFICE11	-	-	-	1.8	-	-	-	-	-	0.6	0.45
1-OFFICE12	-	-	-	1.8	-	-	-	-	-	0.6	0.45
1-OFFICE15	-	-	-	1.8	-	-	-	-	-	0.6	0.45
1-RECEP	-	-	-	1.8	-	-	-	-	-	0.6	0.45
2-CIRC	-	-	-	1.8	-	-	-	-	-	0.6	0.45
2-OFFIc 10	-	-	-	1.8	-	-	-	-	-	0.6	0.45
2-OFFIc 11	-	-	-	1.8	-	-	-	-	-	0.6	0.45
2-OFFIc 12	-	-	-	1.8	-	-	-	-	-	0.6	0.45
2-OFFICe 1	-	-	-	1.8	-	-	-	-	-	0.6	0.45
2-OFFICe 2	-	-	-	1.8	-	-	-	-	-	0.6	0.45
2-OFFICe 3	-	-	-	1.8	-	-	-	-	-	0.6	0.45
2-OFFICe 4	-	-	-	1.8	-	-	-	-	-	0.6	0.45
2-OFFICe 5	-	-	-	1.8	-	-	-	-	-	0.6	0.45
2-OFFICe 6	-	-	-	1.8	-	-	-	-	-	0.6	0.45
2-OFFICe 7	-	-	-	1.8	-	-	-	-	-	0.6	0.45
2-OFFICe 8	-	-	-	1.8	-	-	-	-	-	0.6	0.45
2-OFFIce 9	-	-	-	1.8	-	-	-	-	-	0.6	0.45
2-RECEP	-	-	-	1.8	-	-	-	-	-	0.6	0.45
3-CIRC	-	-	-	1.8	-	-	-	-	-	0.6	0.45
3-OFFICe01	-	-	-	1.8	-	-	-	-	-	0.6	0.45
3-OFFICe02	-	-	-	1.8	-	-	-	-	-	0.6	0.45
3-OFFICe03	-	-	-	1.8	-	-	-	-	-	0.6	0.45
3-OFFICe04	-	-	-	1.8	-	-	-	-	-	0.6	0.45
3-OFFICe05	-	-	-	1.8	-	-	-	-	-	0.6	0.45
3-OFFICe06	-	-	-	1.8	-	-	-	-	-	0.6	0.45
3-OFFICe07	-	-	-	1.8	-	-	-	-	-	0.6	0.45
3-OFFICe08	-	-	-	1.8	-	-	-	-	-	0.6	0.45
3-OFFIce09	-	-	-	1.8	-	-	-	-	-	0.6	0.45
3-OFFIce10	-	-	-	1.8	-	-	-	-	-	0.6	0.45
3-OFFIce11	-	-	-	1.8	-	-	-	-	-	0.6	0.45
3-OFFIce12	-	-	-	1.8	-	-	-	-	-	0.6	0.45
3-RECEP	-	-	-	1.8	-	-	-	-	-	0.6	0.45
4-CIRC	-	-	-	1.8	-	-	-	-	-	0.6	0.45
4-OFFICE01	-	-	-	1.8	-	-	-	-	-	0.6	0.45
4-OFFICE02	-	-	-	1.8	-	-	-	-	-	0.6	0.45
4-OFFICE03	-	-	-	1.8	-	-	-	-	-	0.6	0.45
4-OFFICE04	-	-	-	1.8	-	-	-	-	-	0.6	0.45
4-OFFICE05	-	-	-	1.8	-	-	-	-	-	0.6	0.45
4-OFFICE06	-	-	-	1.8	-	-	-	-	-	0.6	0.45
4-OFFICE07	-	-	-	1.8	-	-	-	-	-	0.6	0.45
4-OFFICE08	-	-	-	1.8	-	-	-	-	-	0.6	0.45

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
4-OFFICE09	-	-	-	1.8	-	-	-	-	-	0.6	0.45
4-OFFICE10	-	-	-	1.8	-	-	-	-	-	0.6	0.45
4-OFFICE11	-	-	-	1.8	-	-	-	-	-	0.6	0.45
4-OFFICE12	-	-	-	1.8	-	-	-	-	-	0.6	0.45
4-RECEP	-	-	-	1.8	-	-	-	-	-	0.6	0.45
5-CIRC	-	-	-	1.8	-	-	-	-	-	0.6	0.45
5-OFFICE 1	-	-	-	1.8	-	-	-	-	-	0.6	0.45
5-OFFICE 2	-	-	-	1.8	-	-	-	-	-	0.6	0.45
5-OFFICE 3	-	-	-	1.8	-	-	-	-	-	0.6	0.45
5-OFFICE 4	-	-	-	1.8	-	-	-	-	-	0.6	0.45
5-OFFICE 5	-	-	-	1.8	-	-	-	-	-	0.6	0.45
5-OFFICE 6	-	-	-	1.8	-	-	-	-	-	0.6	0.45
5-OFFICE 7	-	-	-	1.8	-	-	-	-	-	0.6	0.45
5-RECEP	-	-	-	1.8	-	-	-	-	-	0.6	0.45
6-CIRC	-	-	-	1.8	-	-	-	-	-	0.6	0.45
6-OFFICE 1	-	-	-	1.8	-	-	-	-	-	0.6	0.45
6-OFFICE 2	-	-	-	1.8	-	-	-	-	-	0.6	0.45
6-OFFICE 3	-	-	-	1.8	-	-	-	-	-	0.6	0.45
6-OFFICE 4	-	-	-	1.8	-	-	-	-	-	0.6	0.45
6-OFFICE 6	-	-	-	1.8	-	-	-	-	-	0.6	0.45
7-CIRC	-	-	-	1.8	-	-	-	-	-	0.6	0.45
7-OFFICE 1	-	-	-	1.8	-	-	-	-	-	0.6	0.45
7-OFFICE 2	-	-	-	1.8	-	-	-	-	-	0.6	0.45
7-OFFICE 3	-	-	-	1.8	-	-	-	-	-	0.6	0.45
7-OFFICE 4	-	-	-	1.8	-	-	-	-	-	0.6	0.45
7-OFFICE 5	-	-	-	1.8	-	-	-	-	-	0.6	0.45
7-OFFICE 6	-	-	-	1.8	-	-	-	-	-	0.6	0.45
1-CIRC 2	-	-	-	-	-	-	-	-	-	-	N/A
1-STAIR	-	-	-	-	-	-	-	-	-	-	N/A
2-CIRC 2	-	-	-	-	-	-	-	-	-	-	N/A
2-STAIR	-	-	-	-	-	-	-	-	-	-	N/A
3-CIRC 1	-	-	-	-	-	-	-	-	-	-	N/A
3-STAIR	-	-	-	-	-	-	-	-	-	-	N/A
4-CIRC 1	-	-	-	-	-	-	-	-	-	-	N/A
4-STAIR	-	-	-	-	-	-	-	-	-	-	N/A
5-CIRC 2	-	-	-	-	-	-	-	-	-	-	N/A
5-STAIR	-	-	-	-	-	-	-	-	-	-	N/A
6-CIRC 2	-	-	-	-	-	-	-	-	-	-	N/A
6-STAIR	-	-	-	-	-	-	-	-	-	-	N/A
7-CIRC 2	-	-	-	-	-	-	-	-	-	-	N/A
7-STAIR	-	-	-	-	-	-	-	-	-	-	N/A
1-KIT	-	-	-	-	-	-	-	-	-	-	N/A
2-KIT	-	-	-	-	-	-	-	-	-	-	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
3-KIT	-	-	-	-	-	-	-	-	-	-	N/A
4-KIT	-	-	-	-	-	-	-	-	-	-	N/A
5-KIT	-	-	-	-	-	-	-	-	-	-	N/A
6-KIT	-	-	-	-	-	-	-	-	-	-	N/A
7-KIT	-	-	-	-	-	-	-	-	-	-	N/A
1-MEET 1	-	-	-	1.8	-	-	-	-	-	0.6	0.45
1-MEET 2	-	-	-	1.8	-	-	-	-	-	0.6	0.45
1-MEET 3	-	-	-	1.8	-	-	-	-	-	0.6	0.45
2-MEET 1	-	-	-	1.8	-	-	-	-	-	0.6	0.45
2-MEET 2	-	-	-	1.8	-	-	-	-	-	0.6	0.45
2-MEET 3	-	-	-	1.8	-	-	-	-	-	0.6	0.45
3-MEET 1	-	-	-	1.8	-	-	-	-	-	0.6	0.45
3-MEET 2	-	-	-	1.8	-	-	-	-	-	0.6	0.45
3-MEET 3	-	-	-	1.8	-	-	-	-	-	0.6	0.45
4-MEET 1	-	-	-	1.8	-	-	-	-	-	0.6	0.45
4-MEET 2	-	-	-	1.8	-	-	-	-	-	0.6	0.45
4-MEET 3	-	-	-	1.8	-	-	-	-	-	0.6	0.45
5-MEET 1	-	-	-	1.8	-	-	-	-	-	0.6	0.45
5-MEET 2	-	-	-	1.8	-	-	-	-	-	0.6	0.45
6-MEET 1	-	-	-	1.8	-	-	-	-	-	0.6	0.45
6-MEET 2	-	-	-	1.8	-	-	-	-	-	0.6	0.45
7-MEET 1	-	-	-	1.8	-	-	-	-	-	0.6	0.45
7-MEET 2	-	-	-	1.8	-	-	-	-	-	0.6	0.45
1-WC 1	-	-	0.6	-	-	-	-	-	-	-	N/A
1-WC 2	-	-	0.6	-	-	-	-	-	-	-	N/A
1-WC 3	-	-	0.6	-	-	-	-	-	-	-	N/A
2-WC 1	-	-	0.6	-	-	-	-	-	-	-	N/A
2-WC 2	-	-	0.6	-	-	-	-	-	-	-	N/A
2-WC 3	-	-	0.6	-	-	-	-	-	-	-	N/A
3-wc 1	-	-	0.6	-	-	-	-	-	-	-	N/A
3-WC 2	-	-	0.6	-	-	-	-	-	-	-	N/A
3-WC 3	-	-	0.6	-	-	-	-	-	-	-	N/A
4-WC 1	-	-	0.6	-	-	-	-	-	-	-	N/A
4-WC 2	-	-	0.6	-	-	-	-	-	-	-	N/A
4-WC 3	-	-	0.6	-	-	-	-	-	-	-	N/A
5-WC 1	-	-	0.6	-	-	-	-	-	-	-	N/A
5-WC 2	-	-	0.6	-	-	-	-	-	-	-	N/A
5-WC 3	-	-	0.6	-	-	-	-	-	-	-	N/A
6-WC 1	-	-	0.6	-	-	-	-	-	-	-	N/A
6-WC 2	-	-	0.6	-	-	-	-	-	-	-	N/A
6-WC 3	-	-	0.6	-	-	-	-	-	-	-	N/A
7-WC 1	-	-	0.6	-	-	-	-	-	-	-	N/A
7-WC 2	-	-	0.6	-	-	-	-	-	-	-	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
7-WC 3	-	-	0.6	-	-	-	-	-	-	-	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	
1-CIRC 1	95	-	-	689
1-OFFICE01	95	-	-	131
1-OFFICE02	95	-	-	137
1-OFFICE03	95	-	-	146
1-OFFICE04	95	-	-	148
1-OFFICE05	95	-	-	178
1-OFFICE06	95	-	-	199
1-OFFICE07	95	-	-	242
1-OFFICE08	95	-	-	191
1-OFFICE10	95	-	-	115
1-OFFICE11	95	-	-	130
1-OFFICE12	95	-	-	116
1-OFFICE15	95	-	-	131
1-RECEP	95	-	-	183
2-CIRC	95	-	-	689
2-OFFIc 10	95	-	-	130
2-OFFIc 11	95	-	-	116
2-OFFIc 12	95	-	-	131
2-OFFICe 1	95	-	-	131
2-OFFICe 2	95	-	-	137
2-OFFICe 3	95	-	-	146
2-OFFICe 4	95	-	-	148
2-OFFICe 5	95	-	-	178
2-OFFICe 6	95	-	-	199
2-OFFICe 7	95	-	-	242
2-OFFICe 8	95	-	-	191
2-OFFIce 9	95	-	-	115
2-RECEP	95	-	-	183
3-CIRC	95	-	-	689
3-OFFICe01	95	-	-	131
3-OFFICe02	95	-	-	137
3-OFFICe03	95	-	-	146
3-OFFICe04	95	-	-	148
3-OFFICe05	95	-	-	178
3-OFFICe06	95	-	-	199
3-OFFICe07	95	-	-	242
3-OFFICe08	95	-	-	191
3-OFFIce09	95	-	-	115

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
3-OFFIce10	95	-	-	130
3-OFFIce11	95	-	-	116
3-OFFIce12	95	-	-	131
3-RECEP	95	-	-	183
4-CIRC	95	-	-	689
4-OFFICE01	95	-	-	130
4-OFFICE02	95	-	-	136
4-OFFICE03	95	-	-	145
4-OFFICE04	95	-	-	147
4-OFFICE05	95	-	-	178
4-OFFICE06	95	-	-	199
4-OFFICE07	95	-	-	242
4-OFFICE08	95	-	-	191
4-OFFICE09	95	-	-	115
4-OFFICE10	95	-	-	130
4-OFFICE11	95	-	-	116
4-OFFICE12	95	-	-	131
4-RECEP	95	-	-	183
5-CIRC	-	95	-	615
5-OFFICE 1	95	-	-	138
5-OFFICE 2	95	-	-	155
5-OFFICE 3	95	-	-	143
5-OFFICE 4	95	-	-	147
5-OFFICE 5	95	-	-	179
5-OFFICE 6	95	-	-	164
5-OFFICE 7	95	-	-	136
5-RECEP	95	-	-	192
6-CIRC	-	95	-	750
6-OFFICE 1	95	-	-	144
6-OFFICE 2	95	-	-	141
6-OFFICE 3	95	-	-	162
6-OFFICE 4	95	-	-	170
6-OFFICE 6	95	-	-	130
7-CIRC	-	95	-	458
7-OFFICE 1	95	-	-	98
7-OFFICE 2	95	-	-	120
7-OFFICE 3	95	-	-	98
7-OFFICE 4	95	-	-	132
7-OFFICE 5	95	-	-	124
7-OFFICE 6	95	-	-	125
1-CIRC 2	85	-	-	114
1-STAIR	85	-	-	135
2-CIRC 2	85	-	-	114

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
2-STAIR	85	-	-	135
3-CIRC 1	85	-	-	114
3-STAIR	85	-	-	135
4-CIRC 1	85	-	-	114
4-STAIR	85	-	-	135
5-CIRC 2	85	-	-	126
5-STAIR	85	-	-	146
6-CIRC 2	-	85	-	30
6-STAIR	85	-	-	139
7-CIRC 2	-	85	-	30
7-STAIR	85	-	-	139
1-KIT	85	-	-	92
2-KIT	85	-	-	92
3-KIT	85	-	-	92
4-KIT	85	-	-	92
5-KIT	85	-	-	102
6-KIT	85	-	-	95
7-KIT	85	-	-	95
1-MEET 1	95	-	-	165
1-MEET 2	95	-	-	166
1-MEET 3	95	-	-	149
2-MEET 1	95	-	-	165
2-MEET 2	95	-	-	166
2-MEET 3	95	-	-	149
3-MEET 1	95	-	-	165
3-MEET 2	95	-	-	166
3-MEET 3	95	-	-	149
4-MEET 1	95	-	-	165
4-MEET 2	95	-	-	166
4-MEET 3	95	-	-	149
5-MEET 1	95	-	-	247
5-MEET 2	95	-	-	197
6-MEET 1	95	-	-	174
6-MEET 2	95	-	-	193
7-MEET 1	95	-	-	199
7-MEET 2	95	-	-	215
1-WC 1	85	-	-	42
1-WC 2	85	-	-	42
1-WC 3	85	-	-	56
2-WC 1	85	-	-	42
2-WC 2	85	-	-	42
2-WC 3	85	-	-	56
3-wc 1	85	-	-	42

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
3-WC 2	85	-	-	42
3-WC 3	85	-	-	56
4-WC 1	85	-	-	42
4-WC 2	85	-	-	42
4-WC 3	85	-	-	56
5-WC 1	-	85	-	34
5-WC 2	-	85	-	25
5-WC 3	-	85	-	26
6-WC 1	-	85	-	31
6-WC 2	85	-	-	49
6-WC 3	-	85	-	24
7-WC 1	-	85	-	31
7-WC 2	-	85	-	24
7-WC 3	-	85	-	24

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?
1-CIRC 1	N/A	N/A
1-OFFICE01	NO (-86.9%)	NO
1-OFFICE02	N/A	N/A
1-OFFICE03	N/A	N/A
1-OFFICE04	NO (-77.1%)	NO
1-OFFICE05	NO (-61.8%)	NO
1-OFFICE06	NO (-31.9%)	NO
1-OFFICE07	NO (-70.6%)	NO
1-OFFICE08	NO (-82.4%)	NO
1-OFFICE10	NO (-36.1%)	NO
1-OFFICE11	NO (-27.4%)	NO
1-OFFICE12	NO (-36.6%)	NO
1-OFFICE15	NO (-86.2%)	NO
1-RECEP	N/A	N/A
2-CIRC	N/A	N/A
2-OFFIc 10	NO (-27.4%)	NO
2-OFFIc 11	NO (-36.6%)	NO
2-OFFIc 12	NO (-86.2%)	NO
2-OFFICe 1	NO (-86.9%)	NO
2-OFFICe 2	N/A	N/A
2-OFFICe 3	N/A	N/A
2-OFFICe 4	NO (-77.1%)	NO
2-OFFICe 5	NO (-61.8%)	NO
2-OFFICe 6	NO (-31.9%)	NO
2-OFFICe 7	NO (-70.6%)	NO
2-OFFICe 8	NO (-82.4%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
2-OFFIce 9	NO (-36.1%)	NO
2-RECEP	N/A	N/A
3-CIRC	N/A	N/A
3-OFFICe01	NO (-86.9%)	NO
3-OFFICe02	N/A	N/A
3-OFFICe03	N/A	N/A
3-OFFICe04	NO (-77.1%)	NO
3-OFFICe05	NO (-61.8%)	NO
3-OFFICe06	NO (-31.9%)	NO
3-OFFICe07	NO (-70.6%)	NO
3-OFFICe08	NO (-82.4%)	NO
3-OFFIce09	NO (-36.1%)	NO
3-OFFIce10	NO (-27.4%)	NO
3-OFFIce11	NO (-36.6%)	NO
3-OFFIce12	NO (-86.2%)	NO
3-RECEP	N/A	N/A
4-CIRC	N/A	N/A
4-OFFICE01	NO (-86.9%)	NO
4-OFFICE02	N/A	N/A
4-OFFICE03	N/A	N/A
4-OFFICE04	NO (-77.1%)	NO
4-OFFICE05	NO (-61.8%)	NO
4-OFFICE06	NO (-31.9%)	NO
4-OFFICE07	NO (-70.6%)	NO
4-OFFICE08	NO (-82.4%)	NO
4-OFFICE09	NO (-36.1%)	NO
4-OFFICE10	NO (-27.4%)	NO
4-OFFICE11	NO (-36.6%)	NO
4-OFFICE12	NO (-86.2%)	NO
4-RECEP	N/A	N/A
5-OFFICE 1	NO (-63.9%)	NO
5-OFFICE 2	NO (-32.5%)	NO
5-OFFICE 3	NO (-31.6%)	NO
5-OFFICE 4	NO (-33.6%)	NO
5-OFFICE 5	NO (-79.1%)	NO
5-OFFICE 6	NO (-72.5%)	NO
5-OFFICE 7	NO (-40.3%)	NO
5-RECEP	N/A	N/A
6-OFFICE 1	NO (-9.7%)	NO
6-OFFICE 2	NO (-7.9%)	NO
6-OFFICE 3	NO (-69.4%)	NO
6-OFFICE 4	NO (-63.4%)	NO
6-OFFICE 6	NO (-17.3%)	NO
7-OFFICE 1	NO (-3.8%)	YES
7-OFFICE 2	NO (-3.5%)	YES
7-OFFICE 3	NO (-3.8%)	YES
7-OFFICE 4	NO (-1.7%)	NO
7-OFFICE 5	NO (-23.9%)	NO
7-OFFICE 6	NO (-16.7%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
1-CIRC 2	N/A	N/A
1-STAIR	NO (-72.9%)	NO
2-CIRC 2	N/A	N/A
2-STAIR	NO (-72.9%)	NO
3-CIRC 1	N/A	N/A
3-STAIR	NO (-72.9%)	NO
4-CIRC 1	N/A	N/A
4-STAIR	NO (-72.9%)	NO
5-CIRC 2	N/A	N/A
5-STAIR	NO (-72.1%)	NO
6-STAIR	NO (-61.3%)	NO
7-STAIR	NO (-61.3%)	NO
1-KIT	N/A	N/A
2-KIT	N/A	N/A
3-KIT	N/A	N/A
4-KIT	N/A	N/A
5-KIT	N/A	N/A
6-KIT	N/A	N/A
7-KIT	N/A	N/A
1-MEET 1	NO (-69%)	NO
1-MEET 2	NO (-63.1%)	NO
1-MEET 3	NO (-73.4%)	NO
2-MEET 1	NO (-69%)	NO
2-MEET 2	NO (-63.1%)	NO
2-MEET 3	NO (-73.4%)	NO
3-MEET 1	NO (-69%)	NO
3-MEET 2	NO (-63.1%)	NO
3-MEET 3	NO (-73.4%)	NO
4-MEET 1	NO (-69%)	NO
4-MEET 2	NO (-63.1%)	NO
4-MEET 3	NO (-73.4%)	NO
5-MEET 1	NO (-71.6%)	NO
5-MEET 2	NO (-82.1%)	NO
6-MEET 1	NO (-51.4%)	NO
6-MEET 2	NO (-75.1%)	NO
7-MEET 1	NO (-3.3%)	NO
7-MEET 2	NO (-18.7%)	NO
1-WC 1	N/A	N/A
1-WC 2	N/A	N/A
1-WC 3	N/A	N/A
2-WC 1	N/A	N/A
2-WC 2	N/A	N/A
2-WC 3	N/A	N/A
3-wc 1	N/A	N/A
3-WC 2	N/A	N/A
3-WC 3	N/A	N/A
4-WC 1	N/A	N/A
4-WC 2	N/A	N/A
4-WC 3	N/A	N/A

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
6-WC 2	N/A	N/A

Criterion 4: The performance of the building, as built, should be consistent with the 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?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	2675.6	2675.6
External area [m^2]	2446.8	2446.8
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	3
Average conductance [W/K]	1360.74	1785.89
Average U-value [W/m^2K]	0.56	0.73
Alpha value* [%]	24.81	17.86

* 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
30	**B1 Offices and Workshop businesses**
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Inst.: Hospitals and Care Homes
	C2 Residential Inst.: Residential schools
	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.
	Residential spaces
	D1 Non-residential Inst.: Community/Day Centre
	D1 Non-residential Inst.: Libraries, Museums, and Galleries
	D1 Non-residential Inst.: Education
	D1 Non-residential Inst.: Primary Health Care Building
	D1 Non-residential Inst.: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs and Theatres
70	**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	1.32	2.93
Cooling	11.42	19.17
Auxiliary	7.4	3.75
Lighting	29.39	30.41
Hot water	2.94	3.41
Equipment*	57.73	57.73
TOTAL**	**52.47**	**59.67**

* Energy used by equipment does not count towards the total for 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	0.74	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]	310.34	312.49
Primary energy* [kWh/m^2]	161.08	172.15
Total emissions [kg/m^2]	26.8	29.6

* 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] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	29.6	291.2	1.3	13.2	8	6.18	6.14	6.3	8.21
	Notional	26.5	281.8	3	21.7	3.9	2.43	3.6	----	----
[ST] No Heating or Cooling										
	Actual	53.3	219.4	0	0	0	0	0	0	0
	Notional	73.7	257	0	0	0	0	0	----	----
[ST] No Heating or Cooling										
	Actual	14.6	268.9	0	0	0	0	0	0	0
	Notional	25.5	299.7	0	0	0	0	0	----	----
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	46.6	241.3	2.2	11.5	7.8	5.87	5.83	6.3	8.21
	Notional	40.2	273.9	4.6	21.1	3.8	2.43	3.6	----	----
[ST] No Heating or Cooling										
	Actual	24.5	247.7	0	0	13.4	0	0	0	0
	Notional	47.1	318.5	0	0	13.4	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 BCO can give particular attention to items with specifications that are better than typically expected.

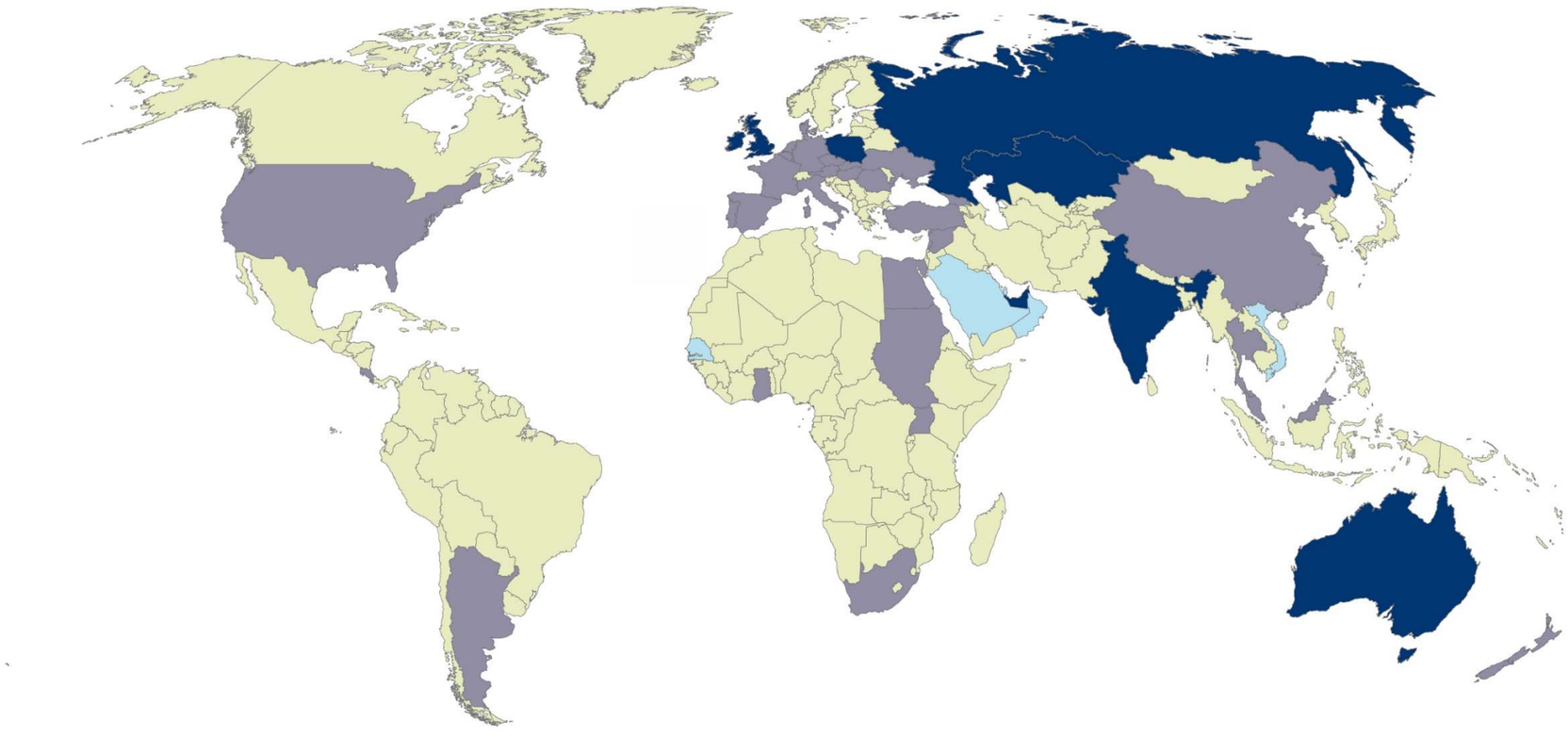
Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.15	1-CIRC 1 Wall 2
Floor	0.2	-	"No heat loss floors"
Roof	0.15	0.15	6-CIRC Exposed Roof 1
Windows, roof windows, and rooflights	1.5	1.2	1-MEET 1 Window 1
Personnel doors	1.5	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

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

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	3



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Russia
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UK

Associate companies

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Austria
Belgium
China
Costa Rica
Czech Republic
Denmark
Egypt
France
Georgia
Germany
Ghana
Hong Kong
Hungary
Italy
Lebanon
Malaysia
Netherlands
New Zealand
Portugal
Romania
Singapore
Slovakia
South Africa
Spain
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Syria
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Project countries

Oman
Qatar
Saudi Arabia
Senegal
Vietnam