Report

Energy Statement

32 JAMESTOWN ROAD

London & Regional Properties

CONFIDENTIAL

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Norman Disney & Young

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Record of amendments

Revision	Amendment details	Revision prepared by	Revision approved by
1.0	1st draft issue	Kavita Ramchandra	David Turner
2.0	For information	Joseph Pavitt	David Turner

1 EXECUTIVE SUMMARY

Norman Disney & Young has been commissioned by London & Regional Properties to prepare an Energy Statement to accompany the planning application for the proposed office refurbishment at 32 Jamestown Road, London NW1 7BY.

The project is a major refurbishment of a building previously known as Bewlay House which is an existing commercial building located in London Borough of Camden.

The refurbishment proposal will consist of:

a) Addition of new offices on part of the 4th floor and full 5th floor level;

b) Replace the buildings HVAC systems and services.

The energy statement addresses the following main objectives for the proposed building:

1. Comply with 2013 Building Regulations, Approved Document (AD) L2B
2. Meet the London Plan targets for Non-Domestic building as below:

a) Minimise CO_2 emissions in accordance with the Energy Hierarchy (London Plan 2011 Policy 5.2):

   I. Be Lean - Use energy efficient measures.
   II. Be Clean - Carry out feasibility studies on systems to supply energy efficiently.
   III. Be Green - Use renewable energy to achieve a proportion of the total building's energy demand.

b) Reduce CO_2 emissions by at least 20% through the use of on-site renewable energy generation, wherever feasible (London Plan 2011 policy 5.7).

3. Achieve a BREEAM Very Good rating.

A preliminary assessment of the concept design of the building against the above objectives results in the following conclusions:

1.1 Building Regulations requirements

Prior to application of any clean and green measures, the lean building design will comply with ADL2B 2013.

The key lean measures assumed on the base build include the following:

- Thermally efficient building fabric.
- Air-permeability applied is 6m^3/h/m^2 @ 50Pa.
- Efficient external lighting (where fitted) with dimming or control timer.
- Light metering and whole building lighting has automatic monitoring & targeting with alarms for out-of range values.
- LED lighting.
- Efficient glazing to reduce the effect of solar overheating.
- Use of high efficiency condensing boilers.
- Heat recovery primary ventilation to office areas.
- For the purposes of compliance with 2013 Building Regulations the CO_2 emissions are calculated for the proposed and notional buildings, using approved dynamic simulation modelling (DSM) software TAS v9.3.2.

1.2 London Plan Policy requirements

In addition to Lean measures, at this stage, consideration has been given to possible Green measures i.e. renewable technologies (e.g. wind turbines, photovoltaic (PV), solar thermal, biomass heating, ground source heat pump (GSHP) and air source heat pumps (ASHP)).

It is proposed that 60m^2 of photovoltaic panels will be included in the scheme in addition to energy efficiency measures. In summary, the total provision for Lean and Green measures leads to a predicted 54.47% improvement over the baseline notional model of existing building compliant with 2013 Building Regulations; provided that the technologies continue to be viable through detailed design, they will be incorporated into the scheme. The following Table 1 summarises the predicted results with Lean and Green measures.

Table 1: Summary Results show annual CO_2 Emissions

Description	Proposed Building	Notional Building	% Reduction
Annual CO_2 Emission rate	24.77 kgCO_2/m²	54.40 kgCO_2/m²	54.47%

The notional building is a building compliant with 2013 showing the total energy uses including an estimate of small power (small power refers to energy consumption from electrical equipment and portable appliances that are not accounted for in Building Regulations). At this stage assumptions have been made regarding target performance efficiencies for the building services systems to be specified and installed by future tenants.

This report indicates a comparative predicted carbon dioxide reduction of 54.47% for the building. The design prioritises energy demand reduction followed by energy generation by use of renewable technology. Therefore, the use of energy efficiency measures and PV panels is the proposed solution. The tables 2, 3, and 4 below demonstrate compliance with the energy hierarchy as per Greater London Authority (GLA) guidance on preparing energy assessments (2014).

Table 2: Carbon Dioxide Emissions after each stage of the Energy Hierarchy

Scenario Description	Carbon Dioxide Emissions (Tonnes CO_2 per annum)	
	Regulated	**Unregulated**
Baseline existing building (notional comparative)	418.57 (A)	207.98
After energy demand reduction	193.97 (B)	207.98
After CHP	193.97 (C)	207.98
After Renewable energy	190.59 (D)	207.98

Table 3: Regulated carbon dioxide savings from each stage of the Energy Hierarchy

Scenario Description	Carbon Dioxide Emissions (Tonnes CO_2 per annum and % of CO_2 emissions)	
	Tonnes CO_2 pa	**%**
Savings from energy demand reduction	224.60 (A-B)	53.66
Savings from CHP	0 (B-C)	0
Savings from renewable energy	3.39 (C-D)	1.75
Total cumulative savings	227.98 (A-D =E)	54.47
Total target savings	146.50 [A*0.35]=F	35%
CO_2 emissions to be offset via a financial contribution (Annual surplus)	81.48 (E-F)	

Table 4: Shortfall in Regulated carbon dioxide savings

	Annual Shortfall (Tonnes CO_2 pa)	Cumulative Shortfall
Shortfall	-81.48 (F-E=G)	-81.48*30 = -2444.4 (G*30)

The Table 4 above is completed as per the GLA guidance on preparing energy assessments to calculate the shortfall. The calculations show a negative shortfall and imply the 35% target has been met. The shortfall result is then multiplied by the assumed lifetime of the development's services (e.g. 30 years) to give the cumulative shortfall. The cumulative shortfall is multiplied by the carbon dioxide offset price to determine the required cash-in-lieu contribution. However, a negative shortfall does not require carbon offsetting provisions with the local borough and therefore no contributions.

1.3 BREEAM pre-assessment requirements

During the early stages of the feasibility and concept design a BREEAM Pre-assessment exercise was carried out. It shows the proposed office building has the potential to achieve a BREEAM rating of Very Good.

2 INTRODUCTION

2.1 Purpose

Norman Disney & Young has been commissioned by London Regional Properties to prepare an Energy Statement to accompany the planning application for the proposed office refurbishment at 32 Jamestown Road, London NW1 7BY.

The project is a major refurbishment of a building previously called Bewlay House which is an existing commercial building located in the London Borough of Camden.

The report outlines sustainability measures likely to be employed and the feasibility of renewable energy in order to deliver a design which achieves the greatest reduction in carbon dioxide emissions while remaining consistent with the objectives of the client and aligning with the Mayor of London policy requirements within the London Plan 2011. It draws directly on the requirements set out in the London Renewables Toolkit and outlines proposals in a consistent method to those outlined in the document.

2.2 Proposed building

The proposed offices development has a total gross internal area (GIA) of 7,988 m^2:

- 6,726 m^2 of refurbished offices;
- 1,262 m^2 of new build offices.

2.3 Site location and building description

Figure 2.3: Location of site marked at 32 Jamestown Road

2.4 Engineering services description

The proposed systems shall be simple and robust, and aim to minimise energy consumption within the building. The major contributors to this low energy design will be the incorporation of:

- A thermally efficient façade
- Efficient comfort cooling via water cooled chillers in the basement with a cooling tower at roof level.
- High efficiency LED lighting solutions

Consideration has been given to minimise the effect of solar overheating to the office areas by providing a façade treatment with a high level of solar control with a g-value of 0.35. Due to the large % of glazing in the reception area a g-value of 0.30 is required to meet Building regulations criterion 3 ''Limiting the effects of solar gains''. This has enabled a cooling system to be selected that offers high occupant comfort combined with low energy demand.

The general office areas shall be ventilated by 2 air handling units (AHUs) located in the basement. These AHU's will incorporate heat recovery, in the form of a thermal wheel system 70% efficient , transferring the heat energy from exhaust air, to pre-heat the building's fresh air supply, thus, minimising energy consumption. To allow for a future tenancy split on the floors, the 2 AHU's and their associated risers have been located on opposite sides of the floor plate.

The AHUs shall deliver tempered fresh air to the back of each fan coil unit servicing the tenancies via exposed supply air ductwork. Extract air from each of the tenancy shall be via exposed ductwork with an extract air bell mouth located at high level in each tenancy.

The 4-pipe Fan Coil Units (FCU) shall provide heating and cooling to the office tenancies. The fan coil units and associated services are to an exposed to view strategy.

The heat rejection for this system will be via water cooled chillers located in the basement. The chilled water will be circulated by high efficiency variable speed pumps.

Low temperature hot water (LTHW) shall be generated via gas fired condensing boilers located in the basement. Flues for this system shall discharge at roof level and shall be located to minimise contamination to the fresh air intakes.

Heating hot water shall be pumped around the building via Variable Speed pumps that shall turn down at times of low heating demand.

A variable temperature secondary heating water circuit shall serve the stair core radiators. A constant temperature, variable speed secondary heating water circuit shall serve the central AHUs in the basement, frost coils on the AHUs at roof level and the FCUs to each tenancy.

Lighting to the office areas will be by low energy, electronic, suspended LED luminaries designed to achieve an illuminance of 400lux level on the working plane using no more than 10W/m^2. The lighting shall be DALI controlled to enable the lighting layout to be easily reconfigured for partitioning works without major alterations. The lighting design will be in accordance with the CIBSE guidance documents including LG7.

2.5 Guiding Principles for system selection

The general principles applied in selection of technologies include:

- The mix of technologies ("low carbon "and "conventional" engineering) should be carefully balanced to reduce design complexity and enable efficient integration;

- Selection of systems that is easy to maintain. This approach ensures that systems are more likely to run at maximum efficiency and be quickly repaired when they fail, leading to the projected CO2 emissions savings being more likely to be achieved.

3 DRIVERS AND TARGETS

3.1 European Union (EU) Directives

The following are EU directives concerning the energy policies for the built environment:

Limiting Global Climate Change to 2°C – The way ahead for 2020 and beyond, Communication from the EU Commission, 10 January 2007, which recommends the following measures for energy usage:

- Improve the EU's energy efficiency by 20% by 2020;
- Increasing the share of renewable energy to 20% by 2020;
- Developing an environmentally safe carbon-capture and geological storage policy;
- Directive 32/2006 recommends employees to save energy.

3.1.1 Energy Performance of Buildings Directive

The directive requires all member states to have in place legislation covering the following:

- Produce feasibility studies for application of Combined Heat and Power (CHP) and community heating for all new developments greater than 1000 m² (gross area).
- Ensure that Energy Performance Certificates (EPCs) are in place for all buildings on construction, sale, or let by 2009. EPCs must be produced by accredited energy assessors, and accompanied by a recommendation report on how to improve cost effectively the Energy performance of the building.

Design of buildings and services shall take equal account of renewable energy solutions as to building fabric and plant efficiency measures. This must include assessment of the technical, environmental and economic feasibility of systems such as:

- Decentralised energy supplies from renewable energy sources;
- Combined Heat and Power;
- District or block heating and/or cooling;
- Heat pumps.

Regimes must be in place to allow for the inspection of air conditioning systems greater than 12kW, and the servicing, inspection and testing of boiler plant.

The following legislation relevant to the development location has been identified at both national and local level.

3.2 United Kingdom Legislation

The following legislation relevant to the development location has been identified at both national and local level.

3.2.1 National

- The Building Regulations Act 2000 (as amended 2010), Articles 3, 4, and 5 of the European Energy Performance of Buildings Directive, including the adoption of the National Calculation Methodology for

the assessment of the energy performance of buildings, and the requirement for improvements in existing buildings.

- The Energy Performance Regulations (England and Wales) 2007 implements Articles 7, 8, 9 and 10 of the European Energy Performance of Buildings Directive, including the requirements for Energy Performance Certificates on construction, sale or let of all buildings, and for inspections of all air conditioning installations greater than 12 kW capacity.
- Planning Policy Statement PPS22 'Renewable Energy' – provides guidance on how local government authorities should implement their powers of planning approval to implement the national government's energy policy.

3.2.2 Regional driver – Greater London Authority

The London Plan 2011, prepared by the Mayor of London, has specific requirements for energy efficiency and renewable energy for developments. The relevant policy extracts are below:

Policy 5.2 - Minimising Carbon Dioxide Emissions

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

- *Be lean - Use less energy*
- *Be clean - Supply energy efficiently*
- *Be green - Use renewable energy*

B) The Mayor will work with boroughs and developers to ensure 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 non-domestic buildings from 2019.

Year	Improvement on 2010 Building Regulations
2010 – 2013	*25 per cent*
2013 – 2016	***40 per cent***
2016 – 2019	*As per building regulations requirements*
2019 – 2031	*Zero carbon*

Policy 5.6 - Decentralised Energy in Development Proposals

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

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

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

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

Policy 5.7 - Renewable Energy

Within the framework of the energy hierarchy (see Policy 5.2 above), 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

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

- *Minimise internal heat generation through energy efficient design*
- *Reduce the amount of heat entering a building in summer through orientation, shading, fenestration, insulation and green roofs and walls*
- *Manage the heat within the building through exposed internal thermal mass and high ceilings*
- *Passive ventilation*
- *Mechanical ventilation*

3.3 London Borough of Camden

Camden's Core Strategy is an over-arching, strategic, spatial planning vision adopted by the Council for the period of 2010-2025. The core strategy sets out the strategic context for developments in Camden and is central to the Local Development Framework (LDF), a set of planning policies and strategy documents. The policy extracts relating to an energy strategy for the building are below.

Core Strategy Policy CS13 – Tackling climate change through promoting higher environmental standards

Reducing the effects of and adapting to climate change

The Council will require all development to take measures to minimise the effects of, and adapt to, climate change and encourage all development to meet the highest feasible environmental standards that are financially viable during construction and occupation by:

a) ensuring patterns of land use that minimise the need to travel by car and help support local energy networks;

b) promoting the efficient use of land and buildings;

c) minimising carbon emissions from the redevelopment, construction and occupation of buildings by implementing, in order, all of the elements of the following energy hierarchy:

1. ensuring developments use less energy,

2. *making use of energy from efficient sources, such as the King's Cross, Gower Street, Bloomsbury and proposed Euston Road decentralised energy networks;*

3. *generating renewable energy on-site; and*

d) ensuring buildings and spaces are designed to cope with, and minimise the effects of, climate change.

The Council will have regard to the cost of installing measures to tackle climate change as well as the cumulative future costs of delaying reductions in carbon dioxide emissions

Local energy generation

The Council will promote local energy generation and networks by:

e) working with our partners and developers to implement local energy networks in the parts of Camden most likely to support them, i.e. in the vicinity of:

- *housing estates with community heating or the potential for community heating and other uses with large heating loads;*
- *the growth areas of King's Cross; Euston; Tottenham Court Road; West Hampstead Interchange and Holborn;*
- *schools to be redeveloped as part of Building Schools for the Future programme;*
- *existing or approved combined heat and power/local energy networks (see Map 4);*

and other locations where land ownership would facilitate their implementation.

f) protecting existing local energy networks where possible (e.g. at Gower Street and Bloomsbury) and safeguarding potential network routes (e.g. Euston Road);

Water and surface water flooding

We will make Camden a water efficient borough and minimise the potential for surface water flooding by:

g) protecting our existing drinking water and foul water infrastructure, including Barrow Hill Reservoir, Hampstead Heath Reservoir, Highgate Reservoir and Kidderpore Reservoir;

h) making sure development incorporates efficient water and foul water infrastructure;

i) requiring development to avoid harm to the water environment, water quality or drainage systems and prevents or mitigates local surface water and down-stream flooding, especially in areas uphill from, and in, areas known to be at risk from surface water flooding such as South and West Hampstead, Gospel Oak and King's Cross (see Map 5).

Camden's carbon reduction measures

The Council will take a lead in tackling climate change by:

j) taking measures to reduce its own carbon emissions;

k) trialling new energy efficient technologies, where feasible; and

l) raising awareness on mitigation and adaptation measures.

Development Policy DP22 – Promoting sustainable design and construction

The Council will require development to incorporate sustainable design and construction measures. Schemes must:

a) demonstrate how sustainable development principles, including the relevant measures set out in paragraph 22.5 below, have been incorporated into the design and proposed implementation; and

b) incorporate green or brown roofs and green walls wherever suitable.

The Council will promote and measure sustainable design and construction by:

c) expecting new build housing to meet Code for Sustainable Homes Level 3 by 2010 and Code Level 4 by 2013 and encouraging Code Level 6 (zero carbon) by 2016.;

d) expecting developments (except new build) of 500 sq m of residential floorspace or above or 5 or more dwellings to achieve "very good" in EcoHomes assessments prior to 2013 and encouraging "excellent" from 2013;

e) expecting non-domestic developments of 500sqm of floorspace or above to achieve "very good" in BREEAM assessments and "excellent" from 2016 and encouraging zero carbon from 2019.

f) The Council will require development to be resilient to climate change by ensuring schemes include appropriate climate change adaptation measures, such as:

g) summer shading and planting;

h) limiting run-off;

i) reducing water consumption;

j) reducing air pollution; and

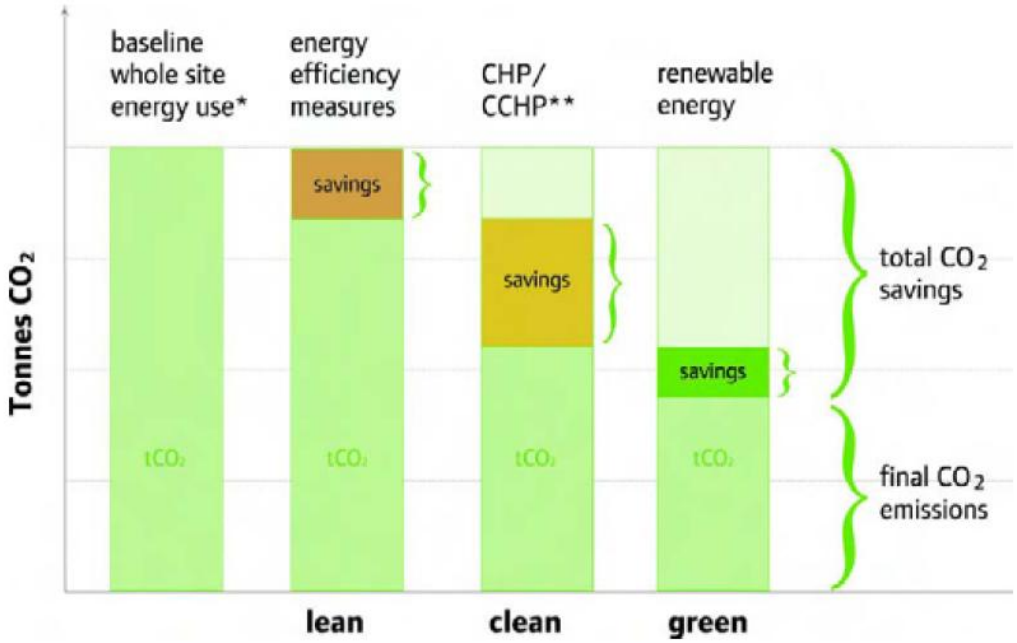
k) not locating vulnerable uses in basements in flood-prone areas.

4 METHODOLOGY

4.1 Basis

The methodology is set out under Policy 5.2 of the London Plan.

figure 4A.1 Calculation of energy/carbon dioxide savings



note *calculated using current Building Regulations (at time of publication 2006) plus the CO_2 emissions associated with other energy uses not covered by Building Regulations.
** including district heating and cooling.
source GLA, adapted from the London Climate Change Agency

The calculation methodology used to predict energy consumption and carbon dioxide emissions is the same as that approved for demonstrating compliance with Part L of the Building Regulations:

- For non-dwellings, the Simplified Building Energy Model (SBEM), within certain limits, or, approved Detailed Simulation Model calculation tools (DSMs);

Considering this development is a major refurbishment project, the actual (proposed) building modelled using approved Thermal Analysis Software (TAS) is compared to the notional model of the existing building. Note the BRUKL outputs in Appendices C and D where the 'actual' of the existing building model becomes the baseline notional to compare with the 'actual' of the proposed building model.

The notional building is defined in the National Calculation Methodology (NCM) modelling guide. In essence, it is a building of the same size, shape and use as the actual building, with U-values etc. that are just compliant with Building Regulations 2013.

The Building Regulations only control certain end uses of energy (heating, hot water, cooling, fans, pumps and controls; and lighting) whereas the London Plan requires all end uses to be taken in to account.

The approved software also calculates the major non-controlled end uses. The modelling for this project has included small power (required to calculate heat gains) and lifts.

4.2 Software

The software package used to produce the Energy Model for this building is EDSL's TAS Version 9.3.2.

4.3 Baseline Emissions

The baseline emissions are calculated as the Target CO_2 emissions rate (TER) for controlled end uses.

4.4 Lean Measures

Improvements to the building fabric and building services, in comparison to the "reference" or "notional" performance criteria used to calculate the TER, are tested. The preferred ranges of measures are selected and the carbon dioxide emissions for a design with Lean measures are calculated.

At this stage the performance specification should demonstrate compliance with ADL2A, in respect of:

- Criterion 1 - Calculated carbon dioxide emission rate (i.e. it would comply with the TER without any reliance on the contribution of clean or green measures).
- Criterion 2 - Limitations on design flexibility.
- Criterion 3 - Limiting effects of solar heat gains in summer.

Due to the limitations of Simplified Building Energy Model (SBEM) and Dynamic Simulation Models (DSM) there are some Lean measures that may be incorporated that have no impact on the reported comparative predicted energy consumption or carbon dioxide emissions, for example water efficient showers and taps, and white goods that are 'A' rated for energy efficiency.

4.5 Clean Measures

The feasibility of the following heating and cooling systems are then considered sequentially:

- Connection to existing CCHP/CHP distribution networks;
- Site-wide CCHP/CHP or hydrogen fuel cells;
- Communal heating and cooling.

The highest ranking feasible option is selected, where viable.

4.6 Green Measures

The feasibility of the following renewable energy technologies listed in the London Plan are then considered:

- Wind turbines
- Photovoltaic cells
- Solar water heating
- Biomass heating
- Hydrogen fuel cells
- Ground Source Heat Pumps
- Air Source Heat Pumps

Other technologies such as hydroelectric may be considered on a site specific basis but have not been included in this study due to the obvious constraints of the site and lack of available hydroelectric potential. The preferred technology is selected and the residual carbon dioxide emissions are calculated.

5 ENERGY ASSESSEMENT AND ANALYSIS

The predicted energy consumption is based on the scheme design stage. Actual energy demands for the proposed design may vary from the consumption figures used for modelling purposes at this stage. This project is a major refurbishment with a new extension. The development's baseline energy consumption and carbon dioxide (CO_2) emission rate for the building have been comparatively assessed using the National Calculation Methodology for, as required for Building Regulations Part L (2013) compliance calculations.

5.1 Baseline Carbon Dioxide Emission Rate

The predicted emission rates are summarised in table 5.1 below. The Part L compliant building refers to the Existing Building's CO_2 Emission Rate of a notional building achieving the minimum requirements set out in Part L2B of the 2013 Building Regulations.

	Part L 2B emissions
Existing - Building CO_2 Emissions Rating (BER)	54.40 $kgCO_2/m^2$/annum
Proposed - Building CO_2 Emissions Rating (BER)	24.77$kgCO_2/m^2$/annum
Percentage (%) Improvement on existing BER	54.46%

Table 5.1 Proposed Building's Emission Rates

5.2 Building Energy Consumption

Prior to considering renewable technologies, it is important to identify the breakdown of energy demand by application. This will help to target the main energy uses within the building to ensure the impact of reduction is maximised. A complete energy breakdown has been completed as part of the Building Regulations Part L 2013 assessment. A comparison is shown of the predicted carbon dioxide emissions from the actual (proposed) building and the notional (existing building) model. The following tables summarise the results of the preliminary studies.

Description	Actual (proposed) building	Notional (existing) building
	KWh/m^2	KWh/m^2
Heating	7.39	23.33
Cooling	8.92	5.37
Auxiliary	14.32	61.77
Lighting	21.84	26.95
DHW	3.68	2.48
Displaced Electricity	-0.84	0.00
Total regulated	**55.31**	**119.90**
Small Power equipment	53.25	52.07
Total regulated + small power	108.56	171.97

Table 5.2 - Annual predicted energy consumption by end use: Actual building versus Notional building

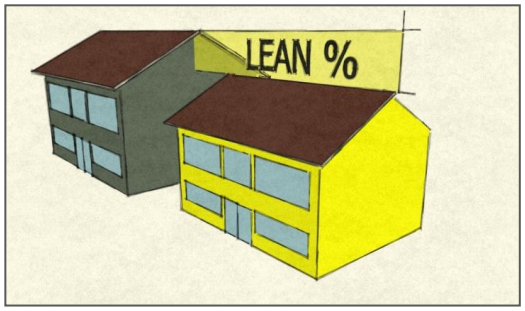
Description	Actual (proposed) building	Notional (existing) building
	$kgCO_2/m^2$	$kgCO_2/m^2$
Heating	1.60	5.04
Cooling	4.51	2.78
Auxiliary	7.24	32.06
Lighting	11.05	13.99
DHW	0.80	0.53
Displaced Electricity	-0.44	0.00
Total regulated	**24.77**	**54.40**
Small Power equipment	26.95	27.03

Table 5.3 - Annual predicted Carbon Emissions by end use: Actual building versus Notional building

6 BE LEAN - ENERGY EFFICIENT DESIGN AND CONSTRUCTION

6.1 Energy Efficiency Design

The development will aim to meet the requirements of AD L2B, 2013, by implementing a combination of passive building design features and active building services systems. The design will endeavour to reduce the energy demand through energy efficient design features.



6.2 Demand Reduction

At this stage it is proposed that the following measures be included to minimise the energy consumption of the building.

6.2.1 Façade Performance

New building facade elements including glazing will comply with the limiting U-values set out in AD L2B, 2013. The glazing G-values have been selected in order to strike the optimum balance between minimising solar gains and allowing natural light to enter the building.

6.2.2 Air Permeability of Building Envelope

New elements of the building envelope will have a maximum air leakage rate no worse than that set out in ADL2B, 2013 ($10m^3/h/m^2$ @ 50Pa will be targeted for these new elements though this cannot be guaranteed for the building as a whole). An air pressure test will be required for the building.

6.2.3 Light Fittings & Controls

Addressable LED lighting is proposed for all office areas with appropriately controlled fluorescent or LED lighting in circulation areas, corridors and reception.

6.2.4 Outside Air Ventilation

The AHUs will deliver tempered fresh air to the back of each FCU. This air will be extracted from the space at high level and returned to the AHU where heat energy will be recovered from it before it is exhausted to atmosphere.

The fresh air intake and exhaust discharge for these systems shall be located at roof level. Intakes and discharges shall be located separately to maximise separation between supply and exhaust, minimising the chance of any local pollutants from entering the fresh air stream.

6.2.5 Controls/Building Management Systems

The Building Management System (BMS) will control and monitor all major Landlord's building services systems. The controls strategy will optimise the operation of the systems to ensure efficient performance. A

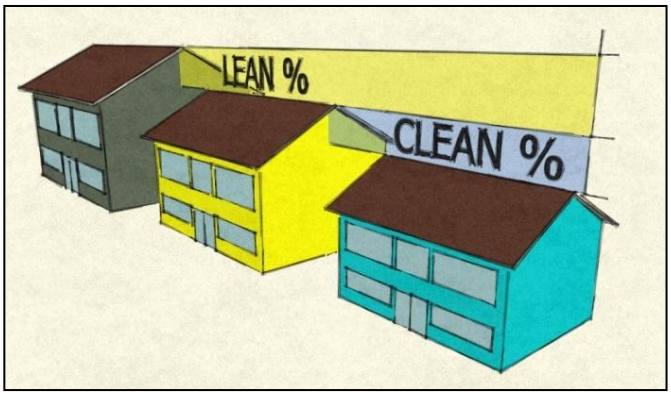
user interface will be provided via a personal computer, providing a point for central monitoring and adjustment of the controls. The energy consumption of the building will be monitored on a system by system and floor by floor basis. The BMS system will be sufficiently flexible to allow tenants energy consumption to be monitored.

6.2.6 Design Criteria

The design criteria that have been used to develop the energy efficient building are given in Appendix A.

7 BE CLEAN - COMBINED HEAT & POWER

In compliance with The London Plan and Camden Council's Core Strategy, the feasibility of connection to district Combined Heat and Power (CHP) and Combined Cooling, Heat and Power (CCHP) schemes has been considered.



7.1 Existing District CHP/CCHP Networks

The London Heat map was investigated reference district heating (DH) networks existing or potential in the neighbourhood. The screen print of the London heat map below shows the location of the site and there are no existing and potential DH networks in the neighbourhood for over 2 miles from the site location. Therefore connection to decentralised network is considered unviable at this stage.

Figure 7.1: London Heat Map for show no District Energy Networks near 32 Jamestown Road

7.1.1 Connection to Future District Heating Networks

The scheme will include at detailed design the following provisions to enable a connection if district heating networks are provided in the future:

- Capped pipe work connections in the heating water distribution pipe work for the future connection within the building to an incoming heating distribution network.
- An area within the plant rooms to accommodate future heat exchangers and pumps to link to an incoming heating network.
- The provision of incoming pipe sleeves through the external walls, soft slabs, if any to facilitate the future incoming district heating mains.

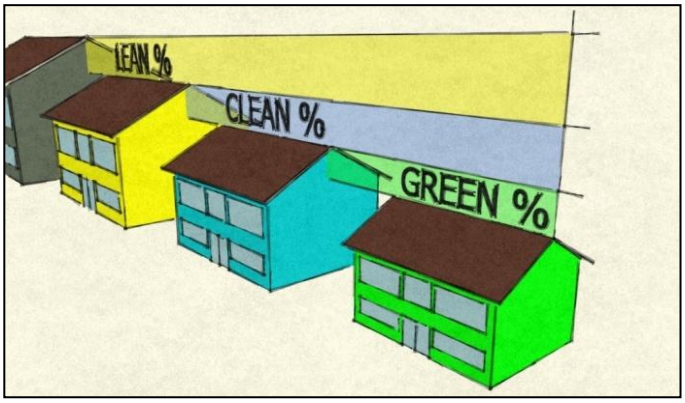
7.2 On-site or beyond site Combined Heat and Power (CHP)

The development's heating and domestic hot water demand is small when compared to the cooling demand for an office building. Therefore, a CHP system is deemed unviable.

7.3 Conclusion

A CHP solution is deemed unviable for the development. Connection to the district heating network is not feasible due to distance of existing networks being far. There will be provision in the design for future connection to district heating network when feasible as described in section 7.1.1.

8 BE GREEN - RENEWABLE ENERGY



This section summarises the renewable energy options reviewed for the scheme. The technologies are assessed using the methodologies outlined in the GLA Toolkit.

The system sizing suggested in this report is suitable only to provide an early indication of energy contribution and carbon dioxide emissions reduction.

8.1 Renewable Technologies not considered

The following technologies were evaluated and not considered viable for incorporation on this site. Details of this assessment can be found in Appendix B.

- Solar thermal
- Wind turbines
- Biomass boilers
- Hydrogen fuel cells
- Ground source heat pumps
- Air source heat pumps

Photovoltaic's (PV) were considered and found to be feasible as shown in the following section.

8.2 Photovoltaic's

8.2.1 Photovoltaic Viability Flowchart

A potential location and size of a PV array was assessed. The identifiable suitable roof space is a total of 60m^2 of active panels. The panels are modelled at an inclination of 30 degrees.

Figure 8.2.1 illustrates that London has a global irradiation level of 1200kWh/m² with typical PV conversion efficiencies of crystalline modules of between 9-14%. Photovoltaic arrays can be installed as standalone pitched units with both roof integrated products available. The optimum positioning for photovoltaic arrays in the UK is typically a southerly orientation at a 30° pitch, with efficiency decreasing moving away from the configuration. The array efficiency can also be greatly affected by shading and the shadow path throughout the day must also be considered. Standalone pitched arrays must be spaced to avoid shading between units.

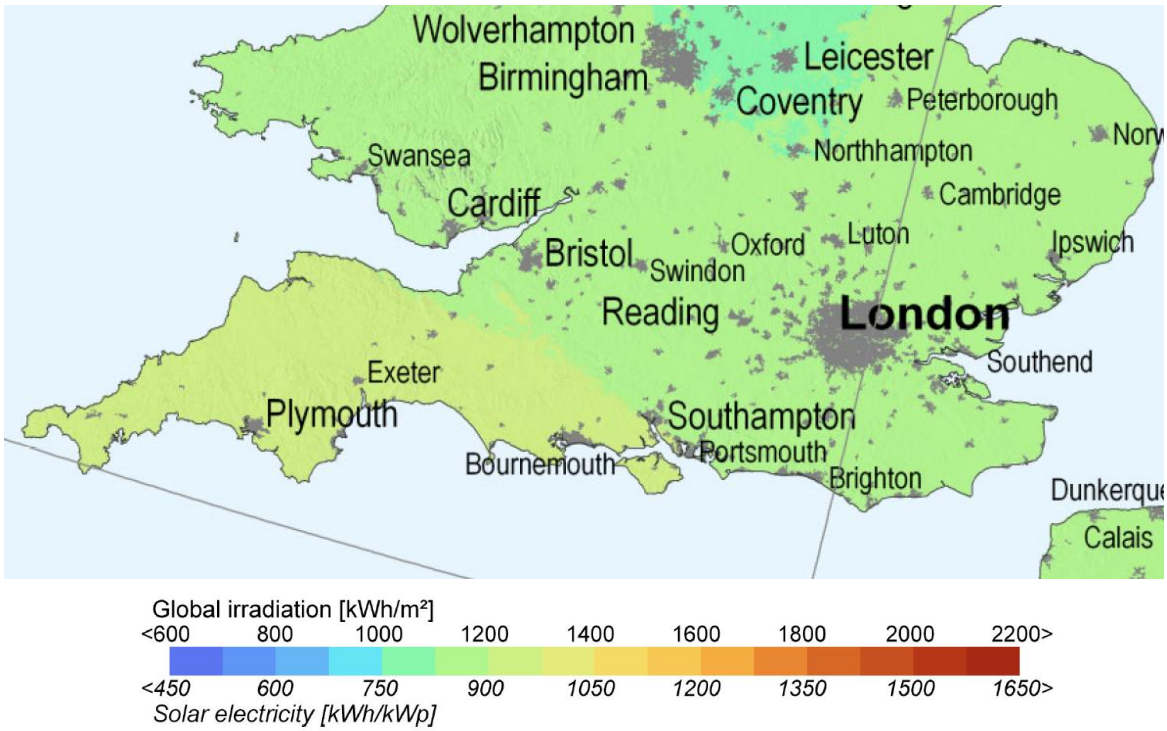


Figure 8.2.1b: Photovoltaic Solar Electricity Potential in Southern UK

8.2.2 Conclusion

The potential location and size of a PV array was assessed in combination with the allocation of roof space for plant. The identified suitable roof space is a total of 60m^2 of active panels. The panels were modelled at an inclination 30 degrees to the horizontal. The feasibility of photovoltaic (PV) panels has been assessed and the overall contribution in carbon reduction (savings) from 60m^2 of PV panels was found to be 1.75%. This saving is 0.81% of the total annual CO_2 emissions from the building.

The design has also considered the following during the early stages of design to inform the strategy:

- Availability of useable roof space
- Overshading considerations
- South facing orientation aspects

Based on the above considerations in the context of the site conditions and proposed scheme, PV will be installed.

9 SUMMARY OF ENERGY EFFICIENT DESIGN AND CONSTRUCTION

The proposed building services systems when modelled for energy demand at this stage predict approximately 54.46% improvement over the existing building and building services systems. The actual energy demands for the proposed design may vary from the consumption figures used for modelling purposes at this stage. The efficient design demand reduction measures and building services are summarised below including the mechanical and electrical services.

9.1 Demand Reduction

The following features reduce overheating risk and contribute to improved energy efficiency in the offices.

1. Low energy lighting is a key driver of energy efficiency with the lighting solution targeting low W/m^2 in the open plan office areas through the use of high efficiency LED lighting technology and appropriate but not excess light levels. All areas will be provided with high efficiency LED or fluorescent lamp technology.
2. Lighting controls will incorporate occupancy control for back of house areas (toilets, corridors, access ways etc.) and daylight harvesting for perimeter office areas.
3. High performance glazing solution with low g-value minimises solar loads and reduces overheating risk. Replacement of the glazing system provides an opportunity to significantly improve air tightness.
4. Use low water use fittings reduces the amount of hot water consumed and hence the energy used to produce hot water.
5. Low air permeability rates. This reduces the heat loss through the building
6. Ventilation plant is specified with low SFP's.

Taken together the energy efficiency features for the commercial office areas are significant however the building has a small floor-plate and significant North and South facing facades. When considered in conjunction with high occupant and equipment density associated with commercial office use, overheating cannot be avoided with passive features alone.

9.2 Mechanical and Electrical services for offices

The demand reduction features in terms of the mechanical and electrical services are listed below for the development.

1. 4-pipe Fan Coil Units (FCU) shall provide heating and cooling to the office tenancies.
2. Floor-by-floor ventilation with heat recovery
3. Central ducted toilet exhaust with plate heat exchanger.
4. Heat recovery ventilation of shower and change facility.
5. Ducted ventilation of basement plant.
6. On-floor louvre zone for tenant fresh air and extract.
7. VRF heat recovery to reception with option to be linked with hot water system and allow heat recovery from reception in summer to the hot water system.
8. Electric frost protection and background heat to basement plant rooms and stairwells.
9. Demand controlled ventilation and fixed glazing to ensure adequate fresh air ventilation while minimising infiltration and maximising air tightness.
10. Water efficient fittings and fixtures.
11. Low energy lighting and not over-designed.
12. Occupancy and daylight harvesting controls.
13. Specialist lighting to front-of-house areas.
14. Photo-Voltaic (PV) system to roof areas.

10 CONCLUSION

The proposed energy strategy seeks to address each of the major components of energy consumption by end use.

Space heating will be addressed through the efficient fabric specifications, limited glazing, an air tight construction, heat recovery systems and boilers.

Cooling demands will be reduced by a facade design with a considered percentage of high performance glazing.

Hot water requirements will be reduced through low flow fittings.

Electricity requirements will be met in part through on site PV.

The proposed measures will deliver CO_2 savings from technologies that have been shown to be feasible for the development. This approach supports the estimated reductions in energy demand and predicted CO_2 emissions.

Figure 10, Table 10.1.a, 10.1.b, 10.1.c present the improvements to the development's annual carbon dioxide emissions following energy efficiency measures and low carbon energy technologies.

As a result of the proposed strategy the total reduction in CO_2 emissions for the office areas are predicted to be 228 tonnes per year, an overall improvement of 54..46% over the existing Jamestown road scheme.

The graph below shows the breakdown of carbon emission reductions obtained through energy efficiency measures (lean measures), CHP solution (clean measures) and PV panel solutions (green measures) following the Energy Hierarchy as set out in The London Plan.

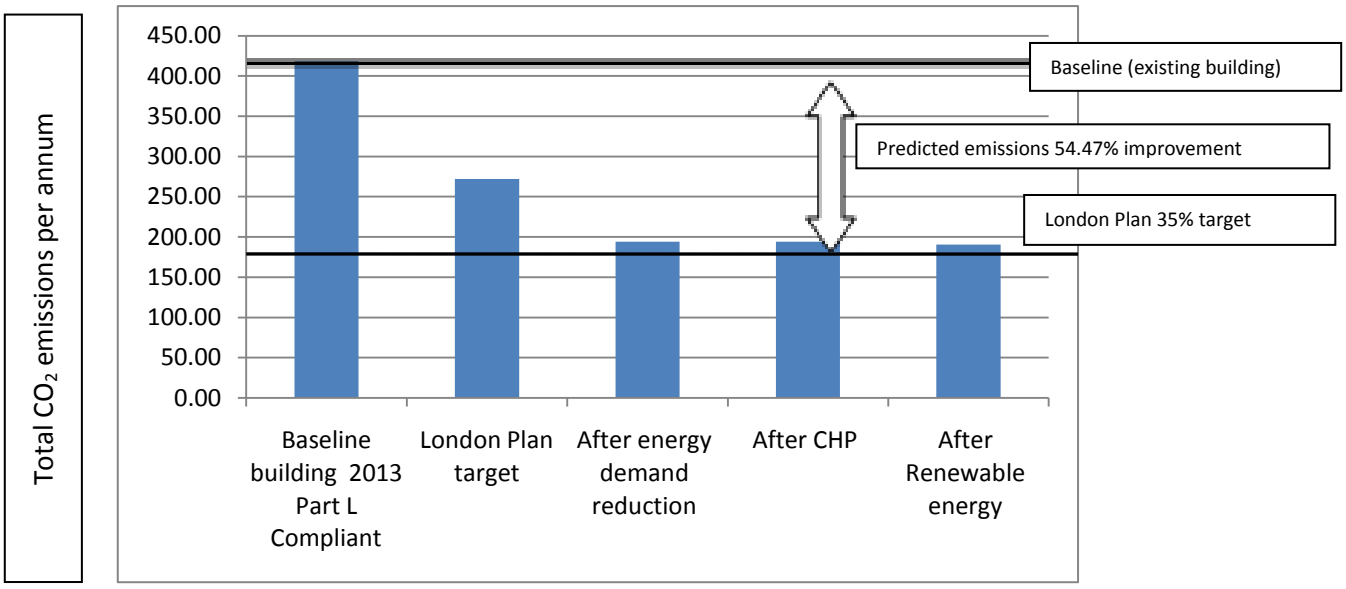


Figure 10: the Energy hierarchy

Table 10.1.a: Carbon Dioxide Emissions after each stage of the Energy Hierarchy

Scenario Description	Carbon Dioxide Emissions (Tonnes CO_2 per annum)	
	Regulated	**Unregulated**
Baseline existing building	418.57 (A)	207.98
After energy demand reduction	193.97 (B)	207.98
After CHP	193.97 (C)	207.98
After Renewable energy	190.59 (D)	207.98

Table 10.1.b: Regulated carbon dioxide savings from each stage of the Energy Hierarchy

Scenario Description	Carbon Dioxide Emissions (Tonnes CO_2 per annum and % of CO_2 emissions)	
	Tonnes CO_2 pa	**%**
Savings from energy demand reduction	224.6 (A-B)	53.66
Savings from CHP	0 (B-C)	0
Savings from renewable energy	3.39 (C-D)	1.75
Total cumulative savings	227.98 (A-D =E)	54.47
Total target savings	146.50 [A*0.35]=F	35%
CO_2 emissions to be offset via a financial contribution (Annual surplus)	81.48 (E-F)	

Table 10.1.c: Shortfall in Regulated carbon dioxide savings

	Annual Shortfall (Tonnes CO_2 pa)	Cumulative Shortfall
Shortfall	-81.48 (F-E=G)	-81.48*30 = -2,444.4 (G*30)

The Table 10.1.c calculations show a negative shortfall which confirms the 35% target of The London Plan has been met. However, a negative shortfall does not require carbon offsetting provisions with the local borough and therefore no contributions will be required.

To summarise the following active and passive measures have been included in the design to reduce the impact of heat gains in the space, by doing so, energy required to cool the space will be reduced and the comfort of occupants will be improved:

- Glazing percentages and specifications on each façade have been assessed to create the optimum balance between minimizing solar gains and introducing natural light to the space.
- Energy efficient LED lighting is proposed to minimize heat gains to the space.
- HVAC systems will be centrally controlled and monitored to ensure efficient operation.

The feasibility of photovoltaic (PV) panels has been assessed and the overall contribution in carbon reduction (savings) from 60m^2 of PV panels was found to be 1.75%. This saving is 0.81% of the total annual CO_2 emissions from the building.

11 APPENDICES

11.1 APPENDIX A - Design criteria

The following table summarises the design criteria applied to the existing and proposed buildings, alongside the limiting values as set out in the Building Regulations.

Element or System	*Existing Building*	*Part L Limits*	*Proposed Building*
Size and Shape	Existing building	N/A	Proposed Design
Window & Roof Area	Existing building	N/A	Proposed Design
Fabric Properties			
External wall u-value	0.70 W/m^{2}K	≤ 0.30 W/m^{2}K	0.70 W/m^{2}K
Ground floor u-value	1.89W/m^{2}K (Existing Concrete Slab)	≤ 0.25 W/m^{2}K	1.89 W/m^{2}K (Existing Concrete Slab)
Roof u-value	0.35 W/m^{2}K	≤ 0.35 W/m^{2}K	0.35 W/m^{2}K
Window/Curtain Walling/Rooflight			
U-value (including frame)	3.35 W/m^{2}K	≤ 1.80 W/m^{2}K	1.5 W/m^{2}K
Light Transmittance	0.80	N/A	0.71 (Window units)
Solar Transmittance (G value)	0.76	N/A	0.35 (Window units) 0.30 (Reception Units)
Air Permeability	15 m^3/h/m^2	10 m^3/h/m^2	6 m^3/h/m^2

Cooling Plant	*Existing Building*	*Part L Limits*	*Proposed Building*
Type	Air Cooled Chiller	Air Cooled Chiller	Water Cooled Chiller
COP at 100%	3.06	≥ 2.5	3.20
COP at 75%	3.06		3.80
COP at 50%	3.06		3.80
COP at 25%	3.06		3.20
COP at 0%	3.06		3.20
Distribution Efficiency (%)	85%	N/A	98%

Boiler Plant	*Existing Building*	*Part L Limits*	*Proposed Building*
Fuel & Type	Natural Gas	Gas	Natural Gas
Efficiency (Gross Calorific)	84%	≥ 84%	91%
Distribution Efficiency (%)	85%	N/A	98%

Airside Configuration (SFP)	Existing Building	Part L Limits	Proposed Building
Variable Air Volume (VAV) System	3 W/(l/s/) – with heat recovery	≤ 2.2 W/(l/s) with heat recovery	N/A
Mechanical supply and extract with heat recovery	N/A	≤ 2.2 W/(l/s) with heat recovery	1.5 W/(l/s)
Central Supply and Extract **Terminal FCU**	N/A N/A	≤ 2.2 W/(l/s) with heat recovery 0.5 W/(l/s)	1.9 W/(l/s) with heat recovery 0.5W/(l/s)
Toilet Extract only	0.6 W/(l/s)	0.5 W/(l/s)	0.5W/(l/s)

Heat Recovery	Existing Building	Part L Limits	Proposed Building
Type	Plate Heat Exchanger	N/A	Thermal Wheel
Efficiency	50%		70%

Hot Water System	Existing Building	Part L Limits	Proposed Building
Fuel & Type	Natural gas	Natural gas	Natural gas
Efficiency	84%	80%	91%
Distribution Efficiency	85%	N/A	98%

Element or System	Existing Building	Part L Limits	Proposed Building
Activity Database	NCM v5.2.4	N/A	NCM v5.2.4
Lighting & Controls			
Plant	60 lumens/circuit watt (Throughout) ($7.5W/m^2$)	**N/A**	$4.9W/m^2$
Circulation/Toilets/Changing rooms	$5W/m^2$ (Circulation) $10W/m^2$ (Toilets)	**N/A**	$3.7W/m^2$ (Circulation) $10W/m^2$ (Toilets & Changing)
Offices	($15W/m^2$) (Office & Reception)	**N/A**	$10W/m^2$ (Office & Reception)
Reception	22 lumens/circuit watt (Display lighting)	**N/A**	35 lumens/circuit watt (Display lighting)
Control	• Local manual switching in all spaces • No daylight control	**N/A**	• Presence detection (throughout) • Photocell control dimming within

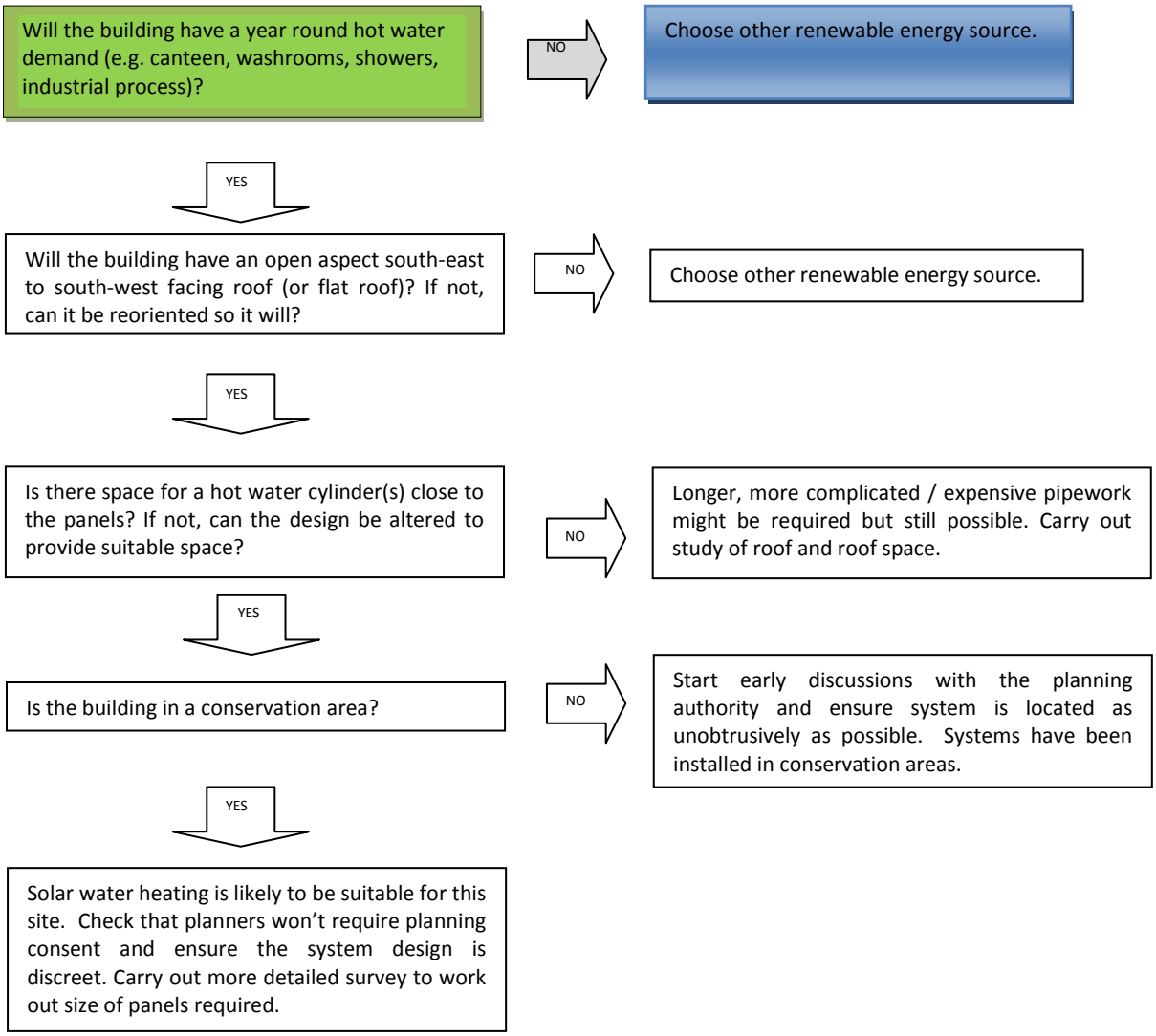
Element or System	Existing Building	Part L Limits	Proposed Building
			office areas
Weather	London TRY	London TRY	London TRY
Renewable Energy	N/A	N/A	• 60m^2 Horizontal PV located on the roof • SE facing • 30° Inclination • 14% Panel efficiency (%)
Management Features		N/A	• Automatic monitoring and targeting with alarm for out of range values • Power correction factor correction to 0.95

11.2 APPENDIX B - Renewable Technologies

This appendix provides an overview of the energy systems considered for this development however deemed unsuitable. This section discusses how the viability of the systems is determined and some of the issues that need to be considered when installing them.

11.2.1 Solar Water Heating

Solar Water Viability Flowchart

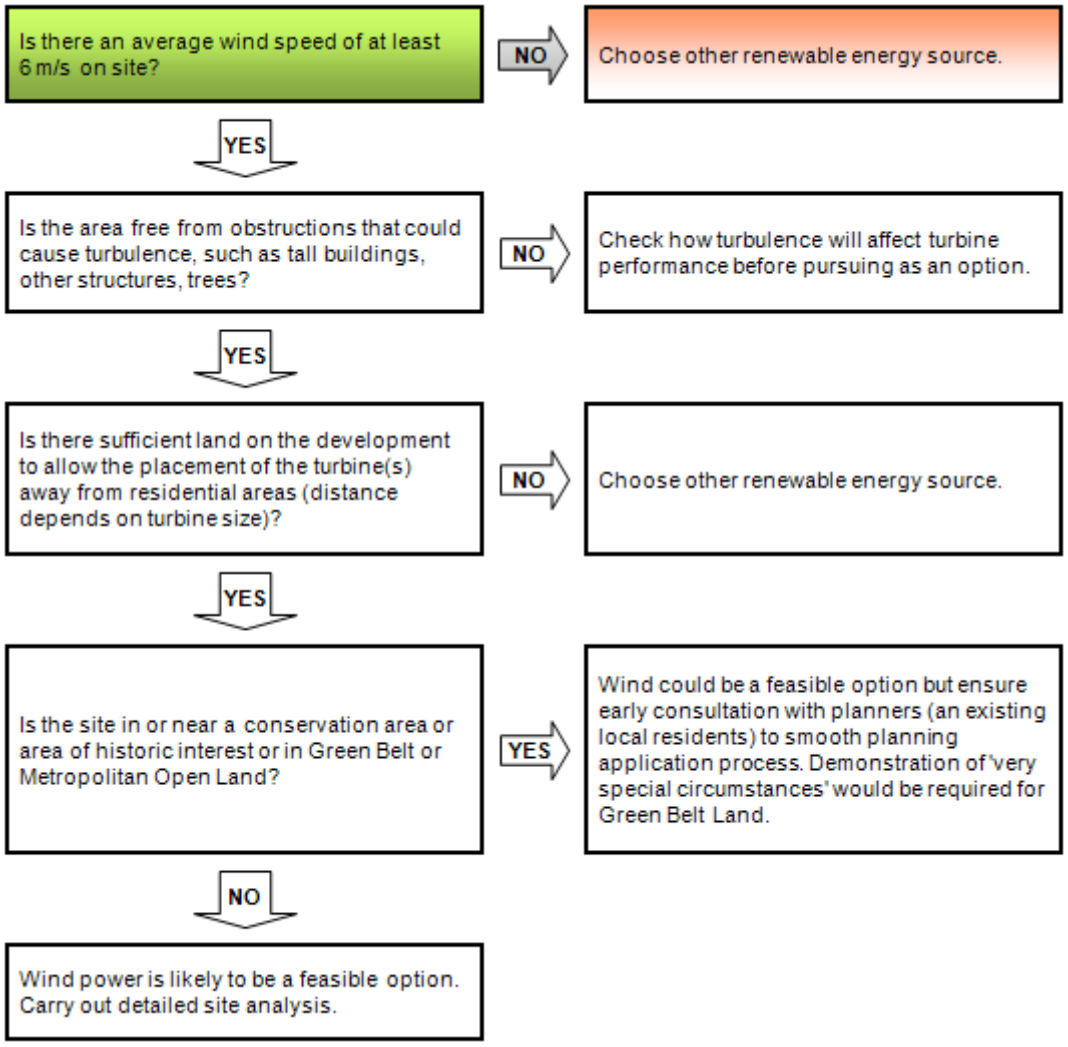


Conclusion

Consideration was given to providing a solar water heating (SWH) system. Due to the office functional use there will be minimal hot water demand from wash hand basin use. There is a small lunch time peak but this small load is not considered sufficient to warrant a SWH system.

11.2.2 Wind Turbines

Wind Turbine Viability Flowchart



Wind Turbine Viability Appraisal

The average wind speed on the site using the Department of Energy & Climate Change's Wind Speed Database is less than the recommended 6m/s to make wind a viable technology.

It is likely that the air will be turbulent which further reduces the effectiveness of turbines. In addition building mounted wind turbines can potentially place stresses on the building structure.

Wind speed at 45m agl (in m/s)

6	6	6.2
5.9	5.8	5.9
6	6	6

Wind speed at 25m agl (in m/s)

5.5	5.5	5.7
5.4	5.3	5.4
5.5	5.5	5.4

Wind speed at 10m agl (in m/s)

4.7	4.7	4.9
4.6	4.5	4.6
4.8	4.7	4.6

Blank squares indicate areas outside the land area of the UK - i.e. areas at sea or of neighbouring countries.
agl = above ground level.
Squares surrounding the central square correspond to wind speeds for surrounding grid squares.

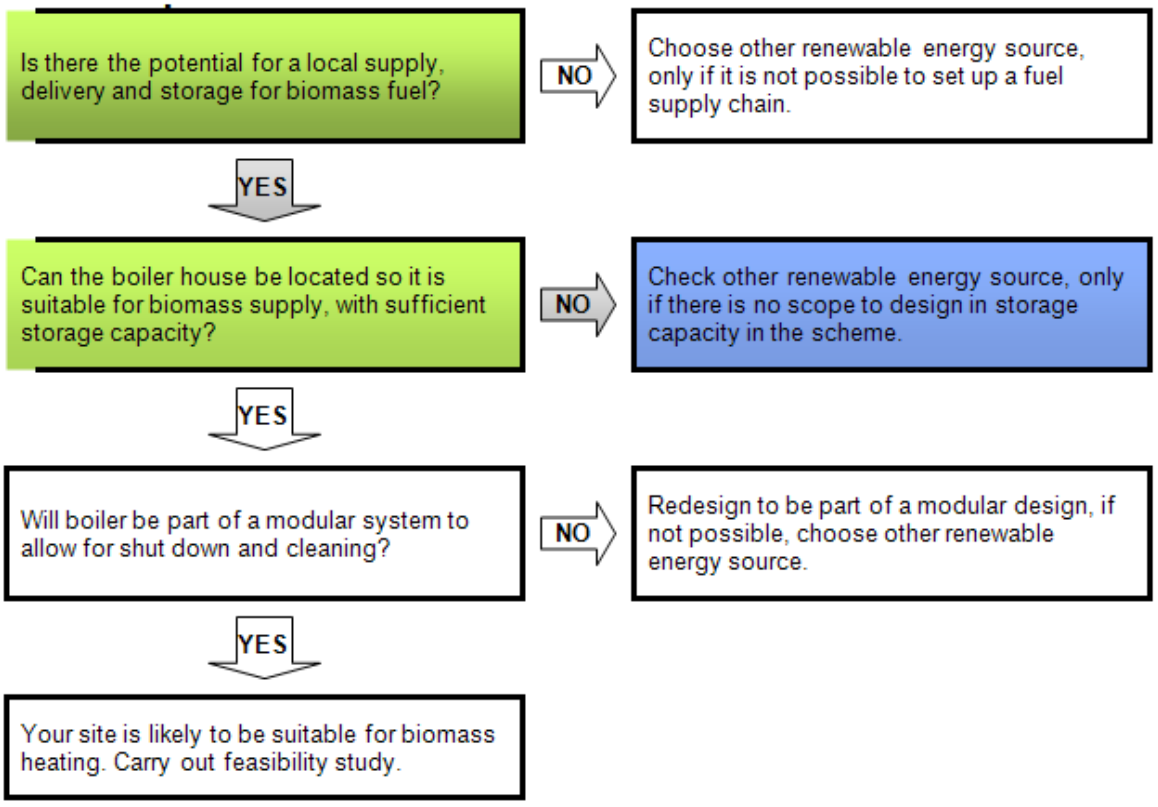
Figure 11.2.2: Wind database output

Conclusion

Due to the predicted site wind speed being below the recommended limit, the effect of turbulence within the urban environment, and the questionable efficiency of small scale units, wind turbines are not deemed appropriate as a renewable technology for this building.

11.2.3 Biomass Heating

Biomass Heating Viability Flowchart



Biomass Heating Viability Appraisal

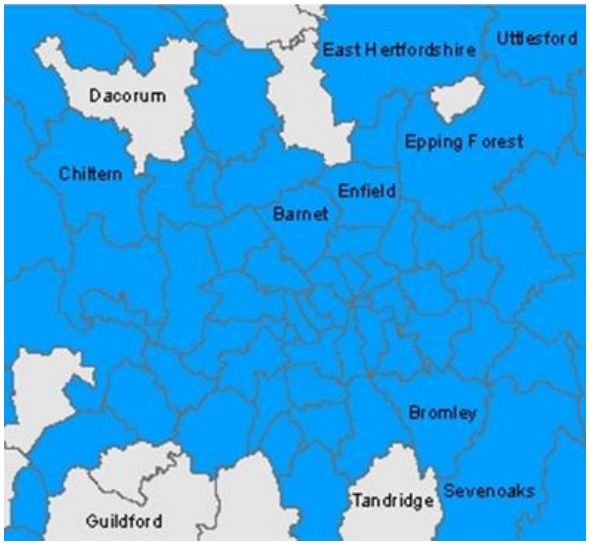
Biomass is a fuel that powers the boiler and hence a constant supply and storage of fuel will be required. This will require a loading bay, regular access for delivery and additional plant room space. Biomass boilers have a much larger footprint than conventional gas boilers and also require back up gas boilers in the event of breakdown, failure of fuel delivery and maintenance down time. Biomass wood pellets are delivered by truck, of up to 18tonne carrying capacity. The smallest available delivery vehicle for the London region is a 20ft long by 8.6ft wide 4-wheel rigid tanker. Delivery of wood pellets may lead to associated problems with noise and dust.

Currently there are local supplies available; however consideration will have to be given to the transportation of biomass supply to prevent further carbon dioxide emissions. As the fuel is relatively new, security of supply and cost of fuel cannot be confirmed.

Wood pellets would be recommended for use on site as they have a higher calorific value and are a more homogenous size, therefore requiring less storage space than wood chips. In addition, wood pellets burn more homogenously than wood chips and the flue emissions are more predictable. It is recommended where practicable and feasible that wood fuel is sourced from reputable suppliers, and should not contain any halogenated organic compounds or heavy metals as a result of treatment with wood preservatives or coatings.

Biomass boilers produce high levels of NOx, SOx and particulate matter (PM10) in their flue discharge and are discouraged in urban areas due to problems with poor air quality. This is particularly relevant in the centre of London as this has been designated an air quality management area for particulate matter.

Use of biomass boilers would require the installation of a filter or gas scrubbing system to remove particulate matter from the flue discharge. With the provision of a suitably high grade filter, the system would remove contaminates from the combustion products, prior to entering the discharge air stream, meeting the specified air quality management levels.



Map Key

The colours of the map above are explained below:

Local Authority has declared an Air Quality Management Area

Local Authority currently has no Air Quality Management Areas

Table 11.2.3: AQMA (Air Quality Management Areas) map

Conclusion

Due to the plants space requirements to locate the bio mass boilers, filter, fuel store and associated equipment and delivery, biomass is not deemed suitable for use on this site.

11.2.4 Hydrogen Fuel Cells

Hydrogen Fuel Cells Viability Appraisal

Hydrogen fuel cells combine hydrogen and oxygen, utilising the chemical energy generated to produce electricity, heat, and water with no carbon dioxide emissions. Whilst the technology offers high efficiency rates compared with traditional gas combustion, there are issues with the supporting infrastructure, durability and cost.

The fuel cell technology is rapidly being adopted in the transport industry, with an estimated 11,000 units in use globally. However use in stationary applications is still very limited. As a new and emerging technology, fuel cell technology has not yet been widely adopted within the UK.

Conclusion

Due to the lack of infrastructure and uncertainly surrounding the technology, hydrogen fuel cells are not deemed suitable for this site.

11.2.5 Ground Source Heating

Ground Source Heating Systems Viability Appraisal

There are two main types of ground source systems available, they are namely:

- Closed loop horizontal array

- Open loop or Closed loop vertical boreholes

Ground-source heating systems use loops of pipe work that draws energy from a heat sink, either a water source or the surrounding earth. The system provides low grade heat which is well suited for slow response systems such as under floor heating.

Horizontal Systems - Horizontal systems are made of lengths of pipe work laid in trenches, as shallow as 1.5-2m depth. The site boundary for this development is limited to the building footprint so there is no scope for a horizontal system.

Vertical Systems - Vertical systems use pipe work loops, usually buried beneath the building in boreholes, 70-120m in depth. These ideally need balanced heating and cooling demand, which is not the case for this building. Closed loops vertical systems are typically located within boreholes outside of the building foot print. The provision of a closed loop system would require extensive studies of the ground conditions to ensure ground stability and predicted heat exchange rates. Due to the size and foot print of the site vertical boreholes are not deemed suitable for the development.

Ground source heat pump systems come with a technical risk, where the inaccessible pipe work can be subject to collapse.

Conclusion

Due to the scope of the ground works on the existing building considering this is a major refurbishment project and the size of the building foot print, neither vertical nor horizontal ground source heating are deemed suitable for this site.

11.3 APPENDIX C – BRUKL output (Baseline existing building)

The following 12 pages show the BRUKL output of the baseline (existing building) notional model

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name Notional Building

32 Jamestown Road (Existing)

As designed

Date: Mon Apr 20 16:10:14 2015

Administrative information

Building Details

Address: 32 Jamestown Road , Camden, London, NW1 7BY

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.3"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.3

BRUKL compliance check version: v5.2.d.2

Owner Details

Name:

Telephone number:

Address: , ,

$U_{a\text{-}Calc}$ applies to retained fabric. (L2B)

Certifier details

Name: Raghav Padayachi

Telephone number: 02075539494

Address: 180 Old Street, London, EC1V9RQ

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

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	19.5
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	19.5
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	54.4
Are emissions from the building less than or equal to the target?	BER > TER
Are as built details the same as used in the BER calculations?	Separate submission

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

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

Building fabric

(L2B)

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	~~0.35~~	0.7	0.7	External Wall
Floor	~~0.25~~	1.89	1.89	Ground Floor
Roof	0.25	0.33	0.35	Roof
Windows***, roof windows, and rooflights	2.2	3.12	3.33	Roof Light Atrium
Personnel doors	2.2	-	-	No personal doors in project
Vehicle access & similar large doors	1.5	-	-	No vehicle doors in project
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]

$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

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

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

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

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

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	15

Building services

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

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

1- Extract Only - Store (24 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.85	-	-	-	-
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- Mech Vent - Circulation (6 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.85	-	-	3	0.5
Standard value	0.91*	N/A	N/A	1.1^	0.5
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.

^ Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

3- Nat Vent - Circulation

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.85	-	-	-	-
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.

4- VAV - Office

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.85	3.06	-	3	0.5
Standard value	0.91*	2.6	N/A	1.6^	0.5
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.

^ Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

5- Extract Only - Toilets (11 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.85	-	-	-	-
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.

6- Mech Vent - Plant (6 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0	-	-	3	-
Standard value	N/A	N/A	N/A	1.1^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

^ Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

7- VAV - Reception

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.85	3.06	-	3	0.5
Standard value	0.91*	2.6	N/A	1.6^	0.5
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.

^ Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

1- Nat Gas Boiler

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.84	0
Standard value	0.9*	N/A

* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.

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
0B-ST 1	0.6	-	-	-	-	-	-	-	-	-	N/A
0B-ST 2	0.6	-	-	-	-	-	-	-	-	-	N/A
0B-ST 3	0.6	-	-	-	-	-	-	-	-	-	N/A
0B-ST 4	0.6	-	-	-	-	-	-	-	-	-	N/A
0B-ST 5	0.6	-	-	-	-	-	-	-	-	-	N/A
0B-ST 6	0.6	-	-	-	-	-	-	-	-	-	N/A
0B-ST 7	0.6	-	-	-	-	-	-	-	-	-	N/A
0B-ST 8	0.6	-	-	-	-	-	-	-	-	-	N/A
0B-ST 9	0.6	-	-	-	-	-	-	-	-	-	N/A
0G-WC 1	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
0G-WC 2	0.6	-	-	-	-	-	-	-	-	-	N/A
0G-ST 1	0.6	-	-	-	-	-	-	-	-	-	N/A
0G-ST 2	0.6	-	-	-	-	-	-	-	-	-	N/A
0G-ST 3	0.6	-	-	-	-	-	-	-	-	-	N/A
0G-ST 4	0.6	-	-	-	-	-	-	-	-	-	N/A
0G-ST 5	0.6	-	-	-	-	-	-	-	-	-	N/A
01-WC 1	0.6	-	-	-	-	-	-	-	-	-	N/A
01-WC 2	0.6	-	-	-	-	-	-	-	-	-	N/A
01-WC 3	0.6	-	-	-	-	-	-	-	-	-	N/A
01-ST 1	0.6	-	-	-	-	-	-	-	-	-	N/A
01-ST 2	0.6	-	-	-	-	-	-	-	-	-	N/A
01-ST 3	0.6	-	-	-	-	-	-	-	-	-	N/A
01-ST 4	0.6	-	-	-	-	-	-	-	-	-	N/A
02-WC 1	0.6	-	-	-	-	-	-	-	-	-	N/A
02-WC 2	0.6	-	-	-	-	-	-	-	-	-	N/A
02-WC 3	0.6	-	-	-	-	-	-	-	-	-	N/A
02-ST 1	0.6	-	-	-	-	-	-	-	-	-	N/A
02-ST 2	0.6	-	-	-	-	-	-	-	-	-	N/A
02-ST 3	0.6	-	-	-	-	-	-	-	-	-	N/A
02-ST 4	0.6	-	-	-	-	-	-	-	-	-	N/A
03-WC 1	0.6	-	-	-	-	-	-	-	-	-	N/A
03-WC 2	0.6	-	-	-	-	-	-	-	-	-	N/A
03-WC 3	0.6	-	-	-	-	-	-	-	-	-	N/A
03-ST 1	0.6	-	-	-	-	-	-	-	-	-	N/A
03-ST 2	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	
0B-ST 1	60	-	-	31
0B-ST 2	60	-	-	33
0B-ST 3	60	-	-	41
0B-ST 4	60	-	-	27
0B-ST 5	60	-	-	28
0B-ST 6	60	-	-	19
0B-ST 7	60	-	-	69
0B-ST 8	60	-	-	28
0B-ST 9	60	-	-	29
0B-CIR 1	-	-	-	270
0B-CIR 2	-	-	-	296
0B-PL 1	-	-	-	730
0B-PL 2	-	-	-	532
0B-PL 3	-	-	-	698

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
0B-PL 4	-	-	-	289
0G-OFF 1	-	-	-	296
0G-OFF 2	-	-	-	473
0G-OFF 3	-	-	-	3731
0G-OFF 4	-	-	-	3805
0G-OFF 5	-	-	-	1076
0G-OFF 6	-	-	-	334
0G-OFF 7	-	-	-	453
0G-OFF 8	-	-	-	410
0G-OFF 9	-	-	-	383
0G-OFF 10	-	-	-	287
0G-OFF 11	-	-	-	285
0G-OFF 12	-	-	-	296
0G-OFF 13	-	-	-	140
0G-CIRC 1	-	-	-	109
0G-CIRC 2	-	-	-	81
0G-CIRC 3	-	-	-	108
0G-WC 1	-	-	-	149
0G-WC 2	-	-	-	179
0G-REC 1	-	-	22	1618
0G-REC 2	-	-	22	806
0G-ST 1	60	-	-	32
0G-ST 2	60	-	-	24
0G-ST 3	60	-	-	22
0G-ST 4	60	-	-	22
0G-ST 5	60	-	-	25
01-OFF 1	-	-	-	459
01-OFF 2	-	-	-	454
01-OFF 3	-	-	-	513
01-OFF 4	-	-	-	521
01-OFF 5	-	-	-	4571
01-OFF 6	-	-	-	3329
01-OFF 7	-	-	-	1969
01-OFF 8	-	-	-	566
01-OFF 9	-	-	-	459
01-OFF 10	-	-	-	421
01-OFF 11	-	-	-	446
01-OFF 12	-	-	-	251
01-OFF 13	-	-	-	425
01-OFF 14	-	-	-	345
01-OFF 16	-	-	-	282
01-OFF 17	-	-	-	285
01-OFF 18	-	-	-	287

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
01-WC 1	-	-	-	137
01-WC 2	-	-	-	179
01-WC 3	-	-	-	149
01-CIRC 1	-	-	-	109
01-CIRC 2	-	-	-	108
01-CIRC 3	-	-	-	122
01-CIRC 4	-	-	-	105
01-CIRC 5	-	-	-	91
01-CIRC 6	-	-	-	82
01-CIRC 7	-	-	-	467
01-ST 1	60	-	-	20
01-ST 2	60	-	-	16
01-ST 3	60	-	-	19
01-ST 4	60	-	-	20
02-OFF 1	-	-	-	459
02-OFF 2	-	-	-	454
02-OFF 3	-	-	-	513
02-OFF 4	-	-	-	521
02-OFF 5	-	-	-	4532
02-OFF 6	-	-	-	3368
02-OFF 7	-	-	-	1969
02-OFF 8	-	-	-	566
02-OFF 9	-	-	-	459
02-OFF 10	-	-	-	421
02-OFF 11	-	-	-	446
02-OFF 12	-	-	-	251
02-OFF 13	-	-	-	425
02-OFF 14	-	-	-	345
02-OFF 15	-	-	-	282
02-OFF 16	-	-	-	287
02-OFF 17	-	-	-	285
02-WC 1	-	-	-	137
02-WC 2	-	-	-	179
02-WC 3	-	-	-	149
02-CIRC 1	-	-	-	109
02-CIRC 2	-	-	-	108
02-CIRC 3	-	-	-	122
02-CIRC 4	-	-	-	105
02-CIRC 5	-	-	-	91
02-CIRC 6	-	-	-	82
02-CIRC 7	-	-	-	467
02-ST 1	60	-	-	20
02-ST 2	60	-	-	16

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
02-ST 3	60	-	-	19
02-ST 4	60	-	-	20
03-OFF 1	-	-	-	347
03-OFF 2	-	-	-	470
03-OFF 3	-	-	-	621
03-OFF 4	-	-	-	483
03-OFF 5	-	-	-	688
03-OFF 6	-	-	-	3743
03-OFF 7	-	-	-	4133
03-OFF 8	-	-	-	997
03-OFF 9	-	-	-	519
03-OFF 10	-	-	-	518
03-OFF 11	-	-	-	245
03-OFF 12	-	-	-	222
03-OFF 13	-	-	-	383
03-OFF 14	-	-	-	249
03-OFF 15	-	-	-	217
03-OFF 16	-	-	-	381
03-OFF 17	-	-	-	287
03-OFF 18	-	-	-	285
03-WC 1	-	-	-	137
03-WC 2	-	-	-	179
03-WC 3	-	-	-	149
03-CIRC 1	-	-	-	109
03-CIRC 2	-	-	-	108
03-CIRC 3	-	-	-	122
03-CIRC 4	-	-	-	105
03-CIRC 5	-	-	-	91
03-CIRC 6	-	-	-	355
03-ST 1	60	-	-	20
03-ST 2	60	-	-	20
RF-PL 1	-	-	-	436
RF-PL 2	-	-	-	2378

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?
0G-OFF 1	NO (-38%)	NO
0G-OFF 2	YES (+1%)	NO
0G-OFF 3	YES (+115%)	NO
0G-OFF 4	NO (-93%)	NO
0G-OFF 5	NO (-68%)	NO
0G-OFF 6	NO (-22%)	NO
0G-OFF 7	NO (-44%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
0G-OFF 8	NO (-32%)	NO
0G-OFF 9	NO (-37%)	NO
0G-OFF 10	N/A	N/A
0G-OFF 11	N/A	N/A
0G-OFF 12	N/A	N/A
0G-OFF 13	N/A	N/A
0G-REC 1	YES (+21%)	NO
0G-REC 2	NO (-97%)	NO
01-OFF 1	YES (+69%)	NO
01-OFF 2	YES (+63%)	NO
01-OFF 3	YES (+65%)	NO
01-OFF 4	YES (+81%)	NO
01-OFF 5	NO (-76%)	NO
01-OFF 6	NO (-91%)	NO
01-OFF 7	NO (-86%)	NO
01-OFF 8	NO (-36%)	NO
01-OFF 9	NO (-39%)	NO
01-OFF 10	NO (-36%)	NO
01-OFF 11	NO (-18%)	NO
01-OFF 12	N/A	N/A
01-OFF 13	N/A	N/A
01-OFF 14	N/A	N/A
01-OFF 16	N/A	N/A
01-OFF 17	N/A	N/A
01-OFF 18	N/A	N/A
02-OFF 1	YES (+70%)	NO
02-OFF 2	YES (+66%)	NO
02-OFF 3	YES (+67%)	NO
02-OFF 4	YES (+79%)	NO
02-OFF 5	NO (-76%)	NO
02-OFF 6	NO (-92%)	NO
02-OFF 7	NO (-87%)	NO
02-OFF 8	NO (-35%)	NO
02-OFF 9	NO (-38%)	NO
02-OFF 10	NO (-36%)	NO
02-OFF 11	NO (-16%)	NO
02-OFF 12	N/A	N/A
02-OFF 13	N/A	N/A
02-OFF 14	N/A	N/A
02-OFF 15	N/A	N/A
02-OFF 16	N/A	N/A
02-OFF 17	N/A	N/A
03-OFF 1	YES (+209%)	NO
03-OFF 2	YES (+497%)	NO
03-OFF 3	YES (+70%)	NO
03-OFF 4	YES (+112%)	NO
03-OFF 5	YES (+747%)	NO
03-OFF 6	NO (-34%)	NO
03-OFF 7	NO (-34%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
03-OFF 8	YES (+747%)	NO
03-OFF 9	YES (+39%)	NO
03-OFF 10	YES (+34%)	NO
03-OFF 11	YES (+87%)	NO
03-OFF 12	YES (+126%)	NO
03-OFF 13	YES (+1591%)	NO
03-OFF 14	YES (+13%)	NO
03-OFF 15	NO (-66%)	NO
03-OFF 16	N/A	N/A
03-OFF 17	N/A	N/A
03-OFF 18	N/A	N/A

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	6030	6030
External area [m²]	5030	5030
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	15	3
Average conductance [W/K]	6550	2888
Average U-value [W/m²K]	1.3	0.57
Alpha value* [%]	14.69	14.69

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

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
100	**B1 Offices and Workshop businesses**
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential 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
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others - Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	23.33	2.7
Cooling	5.37	9.27
Auxiliary	61.77	8.6
Lighting	26.95	18.58
Hot water	2.48	2.05
Equipment*	52.07	52.07
TOTAL**	119.9	91.2

* 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.

In this model the 'Actual' results are indicated for the benchmark 'Notional' Building.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	114.01	134.89
Primary energy* [kWh/m²]	320.33	114.91
Total emissions [kg/m²]	54.4	18.5

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	113.2	0	44	0	10.4	0.71	0	0.85	0
	Notional	27.6	0	9.4	0	7.3	0.82	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	42.5	0	16.5	0	13.5	0.71	0	0.85	0
	Notional	2.4	0	0.8	0	6.1	0.82	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	71.3	0	27.8	0	1.1	0.71	0	0.85	0
	Notional	19.7	0	6.7	0	1.1	0.82	0	----	----
[ST] Single-duct VAV, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	73.1	76.1	28.4	8.1	95.6	0.71	2.6	0.85	3.06
	Notional	7.6	191.7	2.6	14.8	11.8	0.82	3.6	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	47.7	0	18.6	0	18.3	0.71	0	0.85	0
	Notional	7	0	2.4	0	12.6	0.82	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----
[ST] Single-duct VAV, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	34.1	57.2	13.3	6.1	67.4	0.71	2.6	0.85	3.06
	Notional	0.7	141.2	0.3	10.9	10.9	0.82	3.6	----	----

Key to terms

Heat dem [MJ/m2] = Heating energy demand
Cool dem [MJ/m2] = Cooling energy demand
Heat con [kWh/m2] = Heating energy consumption
Cool con [kWh/m2] = Cooling energy consumption
Aux con [kWh/m2] = Auxiliary energy consumption
Heat SSEFF = Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER = Cooling system seasonal energy efficiency ratio
Heat gen SSEFF = Heating generator seasonal efficiency
Cool gen SSEER = Cooling generator seasonal energy efficiency ratio
ST = System type
HS = Heat source
HFT = Heating fuel type
CFT = Cooling fuel type

Key Features

The 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	0.7	External Wall
Floor	0.2	1.89	Ground Floor
Roof	0.15	0.13	Internal Ceiling 2-3
Windows, roof windows, and rooflights	1.5	2.97	JR WC
Personnel doors	1.5	-	No personal doors in project
Vehicle access & similar large doors	1.5	-	No vehicle doors in project
High usage entrance doors	1.5	-	No high usage entrance doors in project

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

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

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	15

11.4 APPENDIX D – BRUKL output (Proposed building)

The following 10 pages show the BRUKL output of the proposed building model

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name Proposed Building

James Town Road (Green)

As designed

Date: Mon Apr 20 16:57:53 2015

Administrative information

Building Details

Address: 32 James Town Road, London,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.3"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.3

BRUKL compliance check version: v5.2.d.2

Owner Details

Name:

Telephone number:

Address: , ,

U_a - Calc applies to retained fabric (L2B)

Certifier details

Name: Joseph Pavitt

Telephone number: 02075539494

Address: 180 Old Street, London, EC1V9RQ

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

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	22
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	22
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	24.8
Are emissions from the building less than or equal to the target?	BER > TER
Are as built details the same as used in the BER calculations?	Separate submission

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

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

Building fabric

(L2B)

Element	$U_{a\text{-Limit}}$	$U_{a\text{-Calc}}$	$U_{i\text{-Calc}}$	Surface where the maximum value occurs*
Wall**	~~0.35~~	0.69	0.69	External Wall
Floor	~~0.25~~	1.9	1.9	Basement Floor
Roof	0.25	0.43	2.19	Basement Ceiling
Windows***, roof windows, and rooflights	2.2	1.59	1.65	South Facade Reception Glazing small
Personnel doors	2.2	2.18	2.18	North Facade Small Door Grnd
Vehicle access & similar large doors	1.5	-	-	No vehicle doors in project
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

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

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

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	5.99

Building services

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

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	>0.95

1- Internal Office Zones (9 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	3.46	-	1.9	0.7
Standard value	0.91*	2.6	N/A	1.6^	0.5
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.

^ Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

2- Perimeter Office Zones (35 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	3.46	-	1.9	0.7
Standard value	0.91*	2.6	N/A	1.6^	0.5
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.

^ Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

3- WC's (7 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	-	1.5	-
Standard value	0.91*	N/A	N/A	1.1^	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.

^ Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

4- Plant (5 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0	-	-	1.5	-
Standard value	N/A	N/A	N/A	1.1^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

^ Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

5- Circulation

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	-	-	-
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.

6- Shower (B1.SH. 1)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	-	1.5	0.7
Standard value	0.91*	N/A	N/A	1.1^	0.5
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.

^ Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

7- Changing (B1.CH. 1)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	-	1.5	0.7
Standard value	0.91*	N/A	N/A	1.1^	0.5
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.

^ Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

8- Store (3 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	-	-	-
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.

9- Reception (0G.REC. 1)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	3.46	-	1.9	0.7
Standard value	0.91*	2.6	N/A	1.6^	0.5
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.

^ Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

1- Nat Gas Boiler

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.91	0
Standard value	0.9*	N/A

* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.

"No zones in project where local mechanical ventilation, exhaust, or terminal unit is applicable"

General lighting and display lighting	**Luminous efficacy [lm/W]**			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
B1.IZ. 1	-	-	-	3536
0G.IZ. 1	-	-	-	4296

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
01.IZ. 1	-	-	-	8807
02.IZ. 1	-	-	-	8807
03.IZ. 1	-	-	-	8659
04.IZ. 1	-	-	-	5578
0G.PZ. 1	-	-	-	1309
01.PZ. 1	-	-	-	582
01.PZ. 2	-	-	-	413
01.PZ. 3	-	-	-	476
01.PZ. 4	-	-	-	402
01.PZ. 5	-	-	-	260
01.PZ. 6	-	-	-	269
01.PZ. 7	-	-	-	339
02.PZ. 1	-	-	-	582
02.PZ. 2	-	-	-	413
02.PZ. 3	-	-	-	476
02.PZ. 4	-	-	-	402
02.PZ. 5	-	-	-	260
02.PZ. 6	-	-	-	269
02.PZ. 7	-	-	-	339
03.PZ. 1	-	-	-	579
03.PZ. 2	-	-	-	417
03.PZ. 3	-	-	-	471
03.PZ. 4	-	-	-	400
03.PZ. 5	-	-	-	272
03.PZ. 6	-	-	-	270
03.PZ. 7	-	-	-	338
04.PZ. 1	-	-	-	381
04.PZ. 2	-	-	-	340
04.PZ. 3	-	-	-	437
04.PZ. 4	-	-	-	649
B1.WC. 1	-	-	-	284
0G.WC. 2	-	-	-	267
01.WC. 1	-	-	-	375
02.WC. 1	-	-	-	375
03.WC. 1	-	-	-	375
04.WC. 1	-	-	-	296
B1.PL. 1	60	-	-	814
B1.PL. 2	60	-	-	828
B1.PL. 3	60	-	-	1264
0G.PL. 1	60	-	-	192
05.PL. 1	60	-	-	541
B1.CIR. 1	-	60	-	62
B1.CIR. 2	-	60	-	397

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
B1.CIR. 3	-	60	-	67
B1.CIR. 4	-	60	-	63
B1.CIR. 5	-	60	-	61
0G.CIR. 1	-	60	-	86
0G.CIR. 2	-	60	-	54
0G.CIR. 4	-	60	-	92
0G.CIR. 5	-	60	-	103
0G.CIR. 6	-	60	-	68
01.CIR. 1	-	60	-	64
01.CIR. 2	-	60	-	56
01.CIR. 3	-	60	-	66
02.CIR. 1	-	60	-	64
02.CIR. 2	-	60	-	56
02.CIR. 3	-	60	-	66
03.CIR. 1	-	60	-	60
03.CIR. 2	-	60	-	52
03.CIR. 3	-	60	-	62
04.CIR. 1	-	60	-	49
04.CIR. 2	-	60	-	51
05.CIR. 1	-	60	-	49
B1.SH. 1	-	-	-	82
B1.CH. 1	-	-	-	148
B1.STR. 1	60	-	-	51
B1.STR. 2	60	-	-	67
0G.STR. 3	60	-	-	28
0G.REC. 1	-	-	35	1604
0G.IZ. 2	-	-	-	1706
0G.PZ. 2	-	-	-	194
04.PZ. 5	-	-	-	265
04.PZ. 6	-	-	-	343
04.PZ. 7	-	-	-	390
05.PZ. 1	-	-	-	572
05.PZ. 2	-	-	-	605
05.PZ. 3	-	-	-	590
05.PZ. 4	-	-	-	490
05.PZ. 5	-	-	-	401
05.IZ. 1	-	-	-	2974
05.WC. 1	-	-	-	325
0G.IZ. 3	-	-	-	282

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?
B1.IZ. 1	N/A	N/A
0G.IZ. 1	NO (-20%)	NO
01.IZ. 1	NO (-14%)	NO
02.IZ. 1	NO (-12%)	NO
03.IZ. 1	NO (-25%)	NO
04.IZ. 1	NO (-27%)	NO
0G.PZ. 1	NO (-53%)	NO
01.PZ. 1	NO (-35%)	NO
01.PZ. 2	NO (-29%)	NO
01.PZ. 3	NO (-30%)	NO
01.PZ. 4	NO (-69%)	NO
01.PZ. 5	NO (-53%)	NO
01.PZ. 6	NO (-54%)	NO
01.PZ. 7	NO (-73%)	NO
02.PZ. 1	NO (-35%)	NO
02.PZ. 2	NO (-31%)	NO
02.PZ. 3	NO (-36%)	NO
02.PZ. 4	NO (-69%)	NO
02.PZ. 5	NO (-54%)	NO
02.PZ. 6	NO (-56%)	NO
02.PZ. 7	NO (-74%)	NO
03.PZ. 1	NO (-43%)	NO
03.PZ. 2	NO (-31%)	NO
03.PZ. 3	NO (-44%)	NO
03.PZ. 4	NO (-73%)	NO
03.PZ. 5	NO (-46%)	NO
03.PZ. 6	NO (-55%)	NO
03.PZ. 7	NO (-77%)	NO
04.PZ. 1	NO (-52%)	NO
04.PZ. 2	NO (-29%)	NO
04.PZ. 3	NO (-19%)	NO
04.PZ. 4	NO (-69%)	NO
B1.CH. 1	N/A	N/A
0G.REC. 1	NO (-20%)	NO
0G.IZ. 2	NO (-29%)	NO
0G.PZ. 2	NO (-5%)	NO
04.PZ. 5	NO (-63%)	NO
04.PZ. 6	NO (-57%)	NO
04.PZ. 7	NO (-62%)	NO
05.PZ. 1	NO (-63%)	NO
05.PZ. 2	NO (-62%)	NO
05.PZ. 3	NO (-73%)	NO
05.PZ. 4	NO (-63%)	NO
05.PZ. 5	NO (-63%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
05.IZ. 1	NO (-60%)	NO
0G.IZ. 3	NO (-61%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	7694	7694
External area [m²]	5581	5581
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	6	3
Average conductance [W/K]	6407	2204
Average U-value [W/m²K]	1.15	0.39
Alpha value* [%]	18.28	18.28

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

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
100	**B1 Offices and Workshop businesses**
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential 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
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others - Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	7.39	0.74
Cooling	8.92	11.96
Auxiliary	14.32	9.13
Lighting	21.84	20.45
Hot water	3.68	3.8
Equipment*	53.25	53.25
TOTAL**	**56.15**	**46.07**

* 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.

In this Model the 'Actual' results are Indicated for the Proposed Building.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0.84	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	139.72	165.40
Primary energy* [kWh/m²]	148.44	129.86
Total emissions [kg/m²]	24.8	22

* 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] Fan coil systems, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	18.4	150.8	5.7	12.3	17.1	0.89	3.39	0.91	3.46
	Notional	1.3	209.3	0.5	16.2	11.1	0.82	3.6	----	----
[ST] Fan coil systems, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	37.6	126.7	11.7	10.4	21.8	0.89	3.39	0.91	3.46
	Notional	5.2	183.2	1.8	14.1	12.8	0.82	3.6	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	22.8	0	7.1	0	8.2	0.89	0	0.91	0
	Notional	0	0	0	0	6.7	0.82	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	70.9	0	22.1	0	1.1	0.89	0	0.91	0
	Notional	7.9	0	2.7	0	1.1	0.82	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	141.4	0	44.1	0	7.7	0.89	0	0.91	0
	Notional	0	0	0	0	8.9	0.82	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	53.7	0	16.7	0	7	0.89	0	0.91	0
	Notional	0	0	0	0	7.4	0.82	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	85.3	0	26.6	0	10.3	0.89	0	0.91	0
	Notional	0	0	0	0	8.4	0	0	----	----
[ST] Fan coil systems, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	12.2	109.2	3.8	8.9	18.7	0.89	3.39	0.91	3.46
	Notional	0	267.3	0	20.6	11.8	0	3.6	----	----

Key to terms

Heat dem [MJ/m2] = Heating energy demand
Cool dem [MJ/m2] = Cooling energy demand
Heat con [kWh/m2] = Heating energy consumption
Cool con [kWh/m2] = Cooling energy consumption
Aux con [kWh/m2] = Auxiliary energy consumption
Heat SSEFF = Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER = Cooling system seasonal energy efficiency ratio
Heat gen SSEFF = Heating generator seasonal efficiency
Cool gen SSEER = Cooling generator seasonal energy efficiency ratio
ST = System type
HS = Heat source
HFT = Heating fuel type
CFT = Cooling fuel type

Key Features

The 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	0.69	External Wall
Floor	0.2	1.9	Basement Floor
Roof	0.15	0.13	Second Floor Ceiling
Windows, roof windows, and rooflights	1.5	1.5	Atrium Curtain Walling
Personnel doors	1.5	2.18	North Facade Small Door Grnd
Vehicle access & similar large doors	1.5	-	No vehicle doors in project
High usage entrance doors	1.5	-	No high usage entrance doors in project

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

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

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	5.99

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