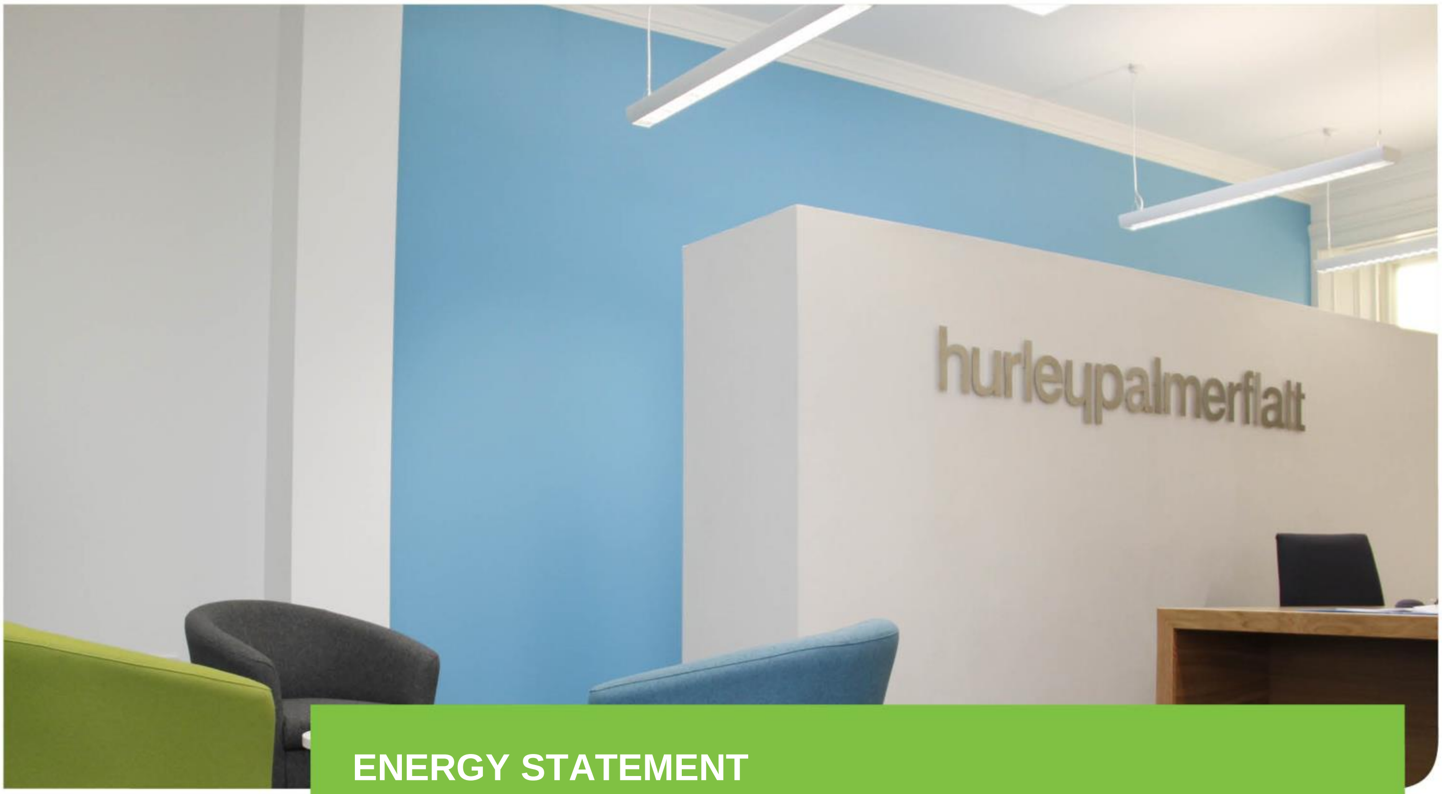

ENERGY STATEMENT

NEW OXFORD STREET,
LONDON

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1.0 EXECUTIVE SUMMARY

This Energy Statement has been developed to detail the energy strategy for the refurbishment of New Oxford Street, located within London Borough of Camden. This report relates to the final proposals, and is submitted as part of a full planning application for the development.

The refurbishment proposal has followed the London Plan's energy hierarchy when considering reducing CO_2 emissions and related planning policy and Building Regulations. The energy hierarchy has considered incorporation of energy efficiency measures including passive design, supplying energy efficiently and using renewable energy technologies, wherever feasible within the constraints of such a refurbishment.

The Proposed Development has been designed following Part L1B and L2B 2010 (incorporating 2010, 2011 and 2013 amendments) requirements.

The total predicted regulated CO_2 savings currently anticipated by the energy strategy is **99.5 tonnes CO_2** when compared against the existing building normalised baseline scenario. The predicted savings equate to a **65.4% reduction** in regulated CO_2 emissions.

Table 1 and Table 2 below show the breakdown in savings for each stage of the energy hierarchy.

Table 1: Predicted Carbon Dioxide Emissions for each stage of the Energy Hierarchy

	Predicted Carbon Dioxide Emissions (tCO_2/yr)	
	Regulated	Unregulated
Existing Building (normalised)	**152**	**51**
After energy demand reduction	**62**	**51**
After CHP	**56**	**51**
After renewable energy	**53**	**51**

Table 2: Predicted Regulated Carbon Dioxide emissions savings from each stage of the Energy Hierarchy

	Predicted Regulated Carbon Dioxide savings	
	(Tonnes CO_2 / year)	(%)
Savings from Energy Demand Reduction	**90.6**	**59.5**
Savings from CHP	**5.7**	**3.7**
Savings from Renewable energy	**3.2**	**2.1**
Total cumulative savings	**99.5**	**65.4**

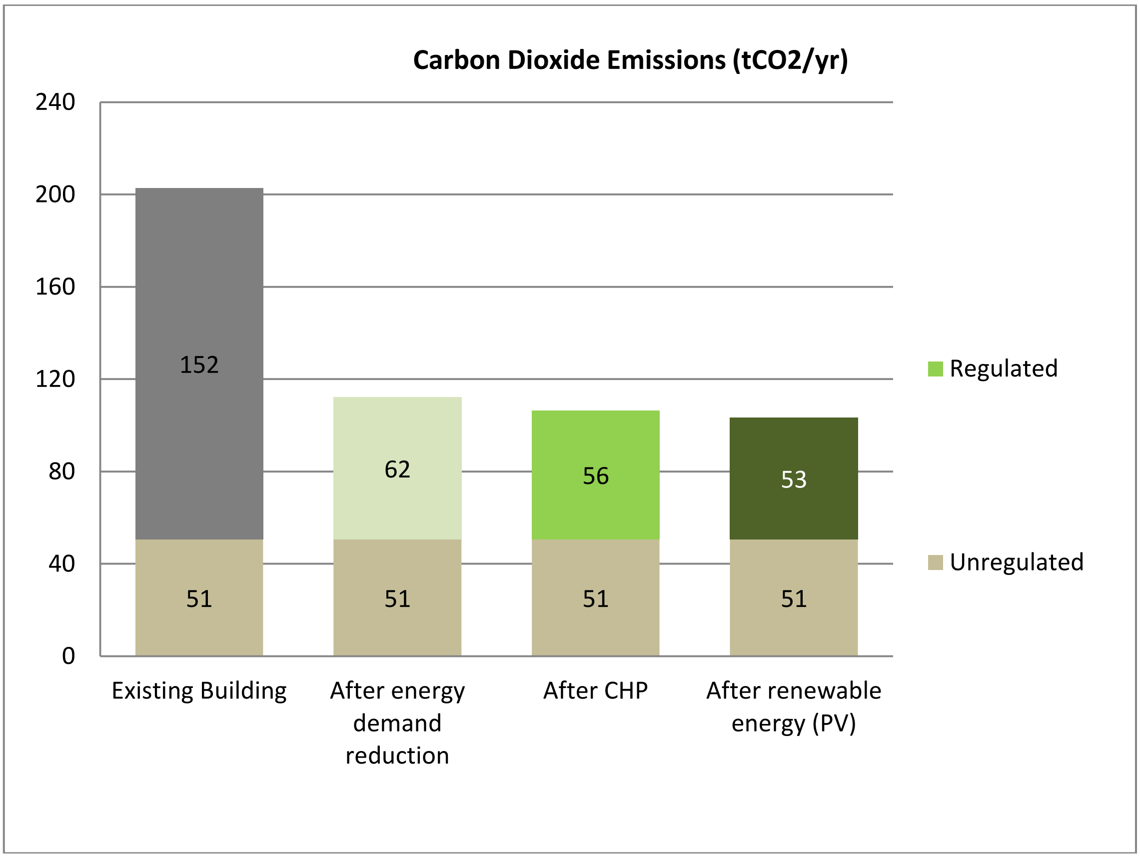

Figure 1: Summary of predicted total Carbon Dioxide emissions for each stage of the hierarchy against existing building (normalised) baseline

2.0 INTRODUCTION

This energy strategy demonstrates how the development addresses the energy policy requirements of the Camden Council and the Mayor of London, in particular the Core Strategy, adopted 2010, Camden Planning Guidance and the Greater London Authority (GLA) London Plan. The report details the assessment process and the estimated CO_2 savings achieved through integrating passive design, energy efficiency and Low and Zero Carbon (LZC) technology.

The approach taken for the energy assessment is in line with Greater London Authority (GLA)[1] guidance for energy:

- ‘Be Lean’ - A review of the energy efficient measures incorporated to reduce energy demand (form, building fabric and building services);
- ‘Be Clean’ - Investigation of the feasibility of CHP/CCHP for the site;
- ‘Be Green’ - An assessment of the feasibility of a range of low and zero carbon technologies for the site; and
- Predicted performance against baseline.

2.1 Project Background

In May 2015, Triangle acquired the site which is bounded by New Oxford Street, Museum Street and West Central Street, with the view of redeveloping and refurbishing the site for a mixed use consisting of residential, retail, leisure and offices. A number of existing façades and architectural details within the development will be restored.

The proposals are a sensitive and well-crafted response to this and would deliver 21 new homes and many new jobs, through improved retail, leisure and office space. Importantly, a number of existing façades and architectural details within the development will be restored.

The refurbishment will result in the provision of;

- 21 new dwellings
- 815 m^2 retail (A1-A5) space
- 402 m^2 office (B1a) space
- 383 m^2 leisure space

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[1] Energy Planning - GLA Guidance on preparing energy assessments (April 2015)

3.0 PLANNING POLICY AND BUILDING REGULATION TARGETS

The development has been designed to meet sustainability and energy targets which are driven through:

- Building Regulations Part L1B and L2B 2013
- Camden planning policy
- GLA planning policy

3.1 Building Regulation Part L Summary

The development will comply with Building Regulations Part L (Conservation of fuel and power in buildings).

Part L1B – Existing Dwellings and Part L2B – Existing Buildings other than Dwellings

These documents provide practical guidance on ways of complying with energy efficiency requirements by setting out legal requirements contained in Building Regulations.

3.2 Camden Policy

Camden Core Strategy 2010-2025, adopted 2010

The core strategy of the London Borough of Camden sets out to manage the council's growth to encourage sustainability, meet the needs of homes, jobs and services and; protect and enhance the quality of life.

Policy CS13 – Tackling climate change through promoting higher environmental standards

Policy CS13 above and policy DP22 in Camden Development Policies set out Council's approach to ensuring that design in the borough is sustainable and that schemes include measures to minimise the effects of, and adapt to, climate change.

Camden Development Policies, adopted 2010

Camden Development Policies forms part of the Council's Local Development Framework (LDF), the group of documents setting out our planning strategy and policies. The Development strategy includes more detailed policies designed to realise the Core Strategy. There are a number of sustainability related policies the most pertinent of which is DP22 and covering sustainable design and construction;

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 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 floor space 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 floor space or above to achieve “very good” in BREEAM assessments and “excellent” from 2016 and encouraging zero carbon from 2019.

Camden Planning Guidance – Sustainability, July 2015

The latest version of the Supplementary Planning policy requires; BREEAM ‘Excellent’ for Domestic Refurbishment from 2013 onwards and, all other BREEAM Non domestic to achieve a ‘Very Good’ rating between 2010-2015 and an ‘Excellent’ rating from 2016. The guidance also includes minimum standards for energy water and materials.

All buildings, whether being updated or refurbished, are expected to reduce their carbon emissions by making improvements to the existing building. Work involving a change of use or an extension to an existing property is included. As a guide, at least 10% of the project cost should be spent on the improvements.

3.3 GLA Planning Policy (London Plan), March 2015

The Greater London Authority (GLA) has set out guidance relating to sustainable design within the London Plan (Spatial Development Strategy for Greater London). The current adopted plan is dated March 2015, with alterations since 2011, and includes the following policies:

Policy 5.2 Minimising carbon dioxide emissions

Planning decisions

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

1) Be lean: use less energy

2) Be clean: supply energy efficiently

3) Be green: use renewable energy

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 residential buildings from 2016 and zero carbon non-domestic buildings from 2019.

Residential buildings:

Year Improvement on 2013 Building Regulations

2010 – 2013 25 per cent (Code for Sustainable Homes level 4)
2013 – 2016 35 per cent
2016 – 2031 Zero carbon

Non-Domestic Buildings:

Year Improvement on 2013 Building Regulations

2010 – 2013 25 per cent
2013 – 2016 35 per cent
2016 – 2019 As per building regulations requirements
2019 – 2031 Zero carbon

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

D. As a minimum, energy assessments should include the following details:

a. calculation of the energy demand and carbon dioxide emissions covered by the Building Regulations and, separately, the energy demand and carbon dioxide emissions from any other part of the development, including plant or equipment, that are not covered by the Building Regulations (see paragraph 5.22) at each stage of the energy hierarchy

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

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

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

E. The carbon dioxide reduction targets should be met on-site. Where it is clearly demonstrated that the specific targets cannot be fully achieved on-site, any shortfall may be provided off-site or through a cash in lieu contribution to the relevant borough to be ring fenced to secure delivery of carbon dioxide savings elsewhere.

Policy 5.6 Decentralised energy in development proposals

Planning decisions

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

A. Major development proposals should select energy systems in accordance with the following hierarchy:

1. Connection to existing heating or cooling networks
2. Site wide CHP network
3. Communal heating and cooling

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

Strategic

A. The Mayor seeks to increase the proportion of energy generated from renewable sources, and expects that the projections for installed renewable energy capacity outlined in the Climate Change Mitigation and Energy Strategy and in supplementary planning guidance will be achieved in London.

Planning decisions

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

Strategic

A. The Mayor seeks to reduce the impact of the urban heat island effect in London and encourages the design of places and spaces to avoid overheating and excessive heat generation, and to reduce overheating due to the impacts of climate change and the urban heat island effect on an area wide basis.

Planning decisions

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

1. Minimise internal heat generation through energy efficient design

2. Reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls
3. Manage the heat within the building through exposed internal thermal mass and high ceilings
4. Passive ventilation
5. Mechanical ventilation
6. Active cooling systems (ensuring they are the lowest carbon options).

C. Major development proposals should demonstrate how the design, materials, construction and operation of the development would minimise overheating and also meet its cooling needs. New development in London should also be designed to avoid the need for energy intensive air conditioning systems as much as possible. Further details and guidance regarding overheating and cooling are outlined in the London Climate Change Adaptation Strategy.

4.0 METHODOLOGY / ENERGY HIERARCHY

The project team has developed a holistic approach to energy and carbon performance, expanding on the Mayor's Energy Hierarchy. This approach is designed to reduce energy consumption and related CO_2 emissions in the first instance before considering how energy is to be supplied, as per the following methodology.

Use less energy

Form and façade – review the natural/energy resources at the site and consider adapting façades to respond to these studies.

Building fabric and passive design – develop passive heating and cooling design concepts for the buildings.

Supply energy efficiently

Energy efficient building services – develop an energy efficient building services strategy, through design and specification.

Operations – consider life-cycle issues, operational and maintenance factors.

Use low carbon technology

Low-carbon energy generation – consider decentralised vs. centralised plant including combined heat and power (CHP).

Use renewable energy

Renewable energy – analyse the suitability of the site for renewable energy generation and recommend appropriate technologies.

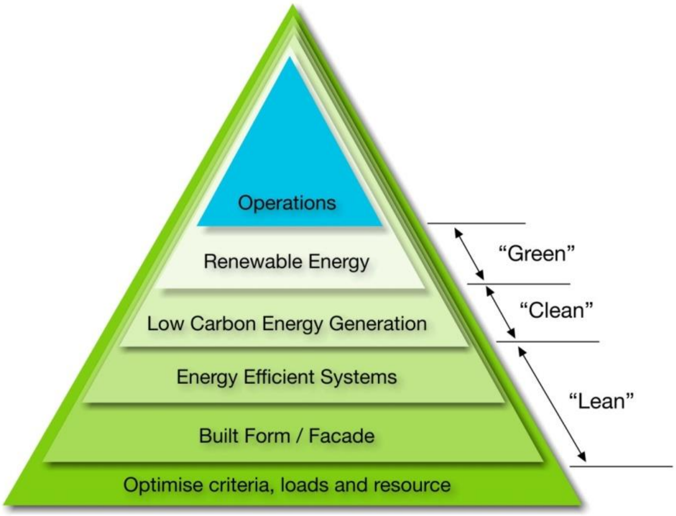


Figure 2: Energy hierarchy approach

Each step in the Energy Hierarchy has been followed and carbon savings quantified separately for the 'Lean', 'Clean' and 'Green' scenarios within this statement.

5.0 BASELINE ENERGY CONSUMPTION AND CO_2 EMISSIONS

The strategy considers an existing building baseline.

In order to determine predicted energy and CO_2 figures for the dwellings, a representative selection of residential units have been modelled using Stroma FSAP software, according to the SAP methodology and following Building Regulations Part L1B. This software calculates the Dwelling CO_2 Emissions Rate (DER) and SAP rating, as well as unregulated energy consumption from cooking and appliances.

In order to determine predicted energy and CO_2 figures for the non-domestic areas of the development these areas have been modelled using Integrated Environmental Solutions (IES), Virtual Environment software v.2014.2.1.0. This software creates a dynamic thermal model of the building, using ApacheSIM module to calculate the building's loads, energy consumption and resulting CO_2 emissions. This software calculates the Building CO_2 Emissions Rate (BER) using the Building Regulations methodology based on the National Calculation Methodology (NCM).

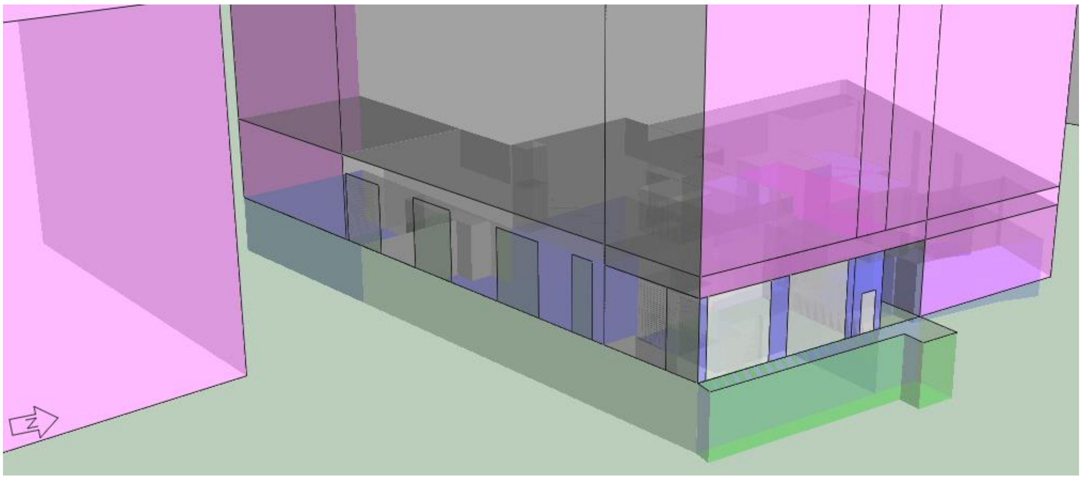


Figure 3: IES Model Screenshot

IES calculates regulated energy consumption i.e. energy uses considered under Part L: heating, cooling, domestic hot water (DHW), and electricity for lighting, pumps and fans.

An estimation of unregulated energy consumption has been calculated using the results from IES for equipment energy (as defined in the NCM methodology) to provide a total development carbon footprint.

In order to allow meaningful comparison and evaluation of the proposed interventions as split into the energy hierarchy steps (lean, clean, green), the total carbon emissions of the existing buildings were normalised according to the modelled floor area of the proposed refurbishment.

Carbon emission factors are based upon the Part L 2013 published figures:

Table 3: Part L 2013 carbon emissions factors

Gas	0.216	$kgCO_2/kWh$
Grid Supplied Electricity	0.519	$kgCO_2/kWh$
Grid Displaced Electricity	0.519	$kgCO_2/kWh$

5.1 Baseline Scheme: CO_2 Emissions

The tables below demonstrate the predicted CO_2 emissions for the existing building normalised by area.

Table 4: Predicted CO_2 emissions for the Baseline Scheme (existing building)

BASELINE	CO_2 emissions (tCO_2 / year)	
	Part L 2013	
	Regulated	Unregulated
Existing Building (normalised)	**152**	**51**

The predicted total baseline CO_2 emissions are **$152tCO_2$** (regulated energy uses) and **$51tCO_2$** (unregulated energy uses).

6.0 IMPACT OF PASSIVE DESIGN AND ENERGY EFFICIENCY MEASURES

A key element of the energy strategy has been to maximise the energy efficiency of the building, through passive design and efficient servicing. The measures included within the design are described in greater detail below.

6.1 Building Fabric and Passive Design

A key objective for New Oxford Street development was to maximise retention of existing building elements so as to minimise carbon emissions associated with demolition and new construction, but also reduce the embodied carbon of the development.

Detailed analysis has been undertaken to assess the impact of various building fabric and passive design solutions. The resulting design includes the following key features:

- The building fabric (glazing, walls, roof etc.) has been improved to achieve the highest thermal performance possible for the construction element type versus other sustainable design and buildability constraints.
- Glazing areas have been balanced in order to maximise the benefits from natural daylighting without incurring overheating, reducing the need for electric lighting whilst minimising heat loss from the buildings.
- The glazing g-value specification has been balanced to control solar gain whilst still providing a reasonably high degree of light transmission.
- The building will be improved to achieve best practice air tightness levels, with an air permeability of $5m^3/m^2/hr$ at 50 Pa for dwellings and $10m^3/m^2/hr$ at 50 Pa for other areas currently targeted.

A summary of the proposed fabric and glazing specification for the new and improved elements of the refurbishment is contained within the table below:

Table 5: Target new fabric and glazing specifications

Element	Existing Building (RdSAP values)	Proposed Targets
External walls	2.1 W/m^2K	0.25 W/m^2K
Flat roof	2.3 W/m^2K	0.18 W/m^2K
Ground floor	1.2 W/m^2K	0.20 W/m^2K
Windows (inc. frame)	4.8 W/m^2K	1.5 W/m^2K

As part of the holistic and integrated design development process, on-going studies will be carried out through detailed design to ensure the optimum façade and building envelope solution is carried forward i.e. the solution considered to provide the best result in terms of predicted: energy consumption, CO_2 emissions and thermal and visual comfort.

6.2 Energy Efficient Building Services

The following energy efficiency measures within the building services systems are proposed for the development:

- Central gas boilers and CHP plant linked to BMS/EMS and include central time control, weather compensation and metering;
- Cooling and heating to all shell and core areas proposed to be from high efficiency VRF system, subject to future fit out by incoming tenants;
- Energy performance standards for future fit-outs have been assumed for this assessment, including energy efficient general lighting, display lighting, lighting controls, and energy efficient ventilation (low specific fan power and heat recovery). A form of green fit-out guidance will be provided to incoming tenants to detail the fit-out energy performance standards required to deliver the CO_2 savings predicted in this energy strategy;
- All areas to be fitted with high efficiency lighting. Time based PIR detectors with PIR/daylight sensing to perimeter zones, where feasible;
- Residential ventilation supplied from Mechanical Ventilation Heat Recovery units (MVHR) with low specific fan power and highly efficient heat recovery;
- Variable Speed Drives for pumps and fans will be installed; and
- Measures to reduce water consumption within the building via water efficient fittings will have an impact on the energy consumption. A reduction in water consumption should result in lower energy demand due to the reduction in electricity required to pump water, and reduction in energy for heating the domestic hot water (DHW) supply.

Whilst these are the design standards currently targeted, their achievability will be reviewed through detailed design stages to ensure the overall CO_2 reduction targets are achieved, and to take into account any design changes.

6.3 Energy Efficient Scheme: Predicted CO_2 Emissions

Energy consumption and CO_2 emissions have been calculated taking into account the passive design and energy efficiency measures (detailed within the previous section). Referring back to the baseline scheme, the resulting predicted CO_2 savings for the energy efficient scheme are detailed in the table below:

Table 6: Predicted CO_2 Savings for the Energy Efficient Scheme

"LEAN"	**Predicted Carbon Dioxide Emissions**	
	Part L 2013	
	Regulated	**Unregulated**
Emissions after demand reduction (tCO_2/yr)	**62**	**51**
Savings (tCO_2/yr)	**90.6**	**-**
Savings (%)	**59.5%**	**-**

The above table demonstrates that there is a predicted **59.5% reduction in regulated CO_2** emissions for the development after energy demand reduction.

7.0 ASSESSMENT OF LOW CARBON TECHNOLOGIES

The second stage of the Lean, Clean, Green methodology concerns low-carbon energy generation and considers decentralised energy generation, including combined heat and power (CHP).

The following opportunities have been assessed within the development:

- Connection to existing heat networks beyond the site boundary
- Connection to existing low carbon heat distribution networks including combined heat and power (CHP)
- Providing a site-wide heating network including combined heat and power (CHP)
- Providing a low carbon cooling strategy including combined cooling heat and power (CCHP)

7.1 Centralised Energy Centre and Connection to the Surrounding Community

The London Heat Map indicates that the nearest existing CHP installation in the Oasis Sports Centre is around 300m distant (marked with yellow marker in Figure 4) and therefore connection to this network is not deemed economically feasible.

Building services systems will be designed to ensure the site is future-proofed for connection to any potential future heat networks in the vicinity of the site. Future connectability will be implemented through spatial and access considerations, tap-offs and configuration of LTHW distribution systems. Plant room layout drawings are provided in Appendix C.

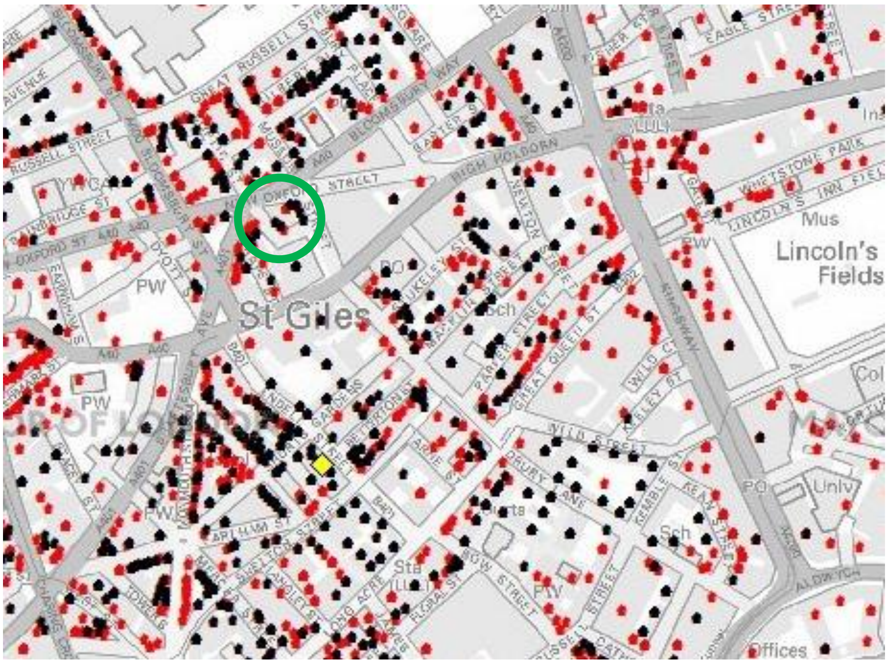


Figure 4: Extract from the London Heat Map

7.2 Combined Heat and Power (CHP)

CHP converts a single fuel into both electricity and heat in a single process at the point of use. Communal CHP is particularly suitable for applications where there is a constant demand for both heat and electricity throughout the year; as is the case at the refurbishment of New Oxford Street.

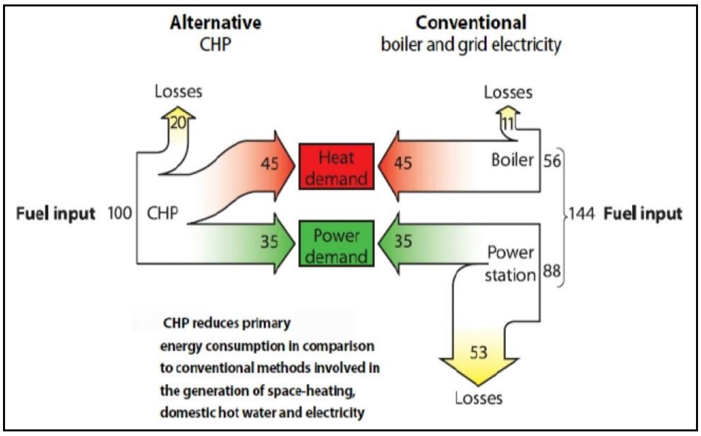
As no current opportunities can be confirmed for connection to existing district heat networks, the proposed strategy incorporates decentralised energy generation from an on-site CHP engine. Gas fired combined heat and power (CHP) plant located in a central plant room will act as lead heat source and supply LTHW to the apartments, meeting a significant proportion of the DHW and space heating requirements.

All dwellings will obtain their heat from the site's heating network. LTHW pipework from the Energy Centre will run throughout the development and serve the HIUs.

The plant areas for the building are located in the basement with 67m² allocated for the main heating plant room (see layout in Appendix C).

Communal heating has several advantages compared to individual heating:

- The central plant room can be centrally and efficiently maintained by the building's facilities management team;
- Improved economies of scale with the use of larger heating plant and systems, and centralised plant provides additional space within other areas of the building;
- It is estimated that the running costs of the communal heating scheme will be lower than for a conventional system; and
- Having a single heating plant set will bring flexibility in the future in terms of heat energy source options and will allow an increased opportunity for potential integration of low of zero carbon (LZC) energy systems.



CHP reduces primary energy consumption in comparison to conventional methods involved in the generation of space-heating, domestic hot water and electricity

Figure 5: Comparison of heat supply, power supply and losses for CHP and conventional sources

When sizing CHP plant, it is fundamental to ensure that 100% of the outputs (both electrical and thermal) will be used for a minimum number of hours per year, to ensure CO_2 savings and cost viability. Good quality CHP installations should run for a minimum of 5000hrs per year.

In line with the London Plan energy hierarchy, the size of the CHP has been optimised based on the base thermal load profile before renewable systems have been considered for the site.

Anticipated thermal and electrical load profiles have been assessed by the design team for initial CHP sizing purposes. Loads generated by the Part L NCM profiles have been reviewed, and anticipated hot water loads have been calculated manually and also reviewed against industry benchmarks (Plumbing Guide Rules of Thumb).

Given the measures to reduce space heating loads described in previous sections, the base thermal load of the development will be driven by domestic hot water usage. To ensure year round operation of the CHP, it must be able to operate during the summer months for a reasonable number of hours per day, whilst meeting the base thermal load. Thermal storage can be used to "smooth" demand profiles, and prolong running hours if needed.

Based on the estimated base thermal load prediction, the anticipated size of the CHP is considered as 12.5-15.5kW$_{th}$ (5.5kW$_{e}$), based on a BAXI Dachs, or similar, in conjunction with a thermal store. Figure 6 and Figure 7 below show that for a typical summer and winter day, it will be possible to operate such a CHP engine, in conjunction with a thermal store.

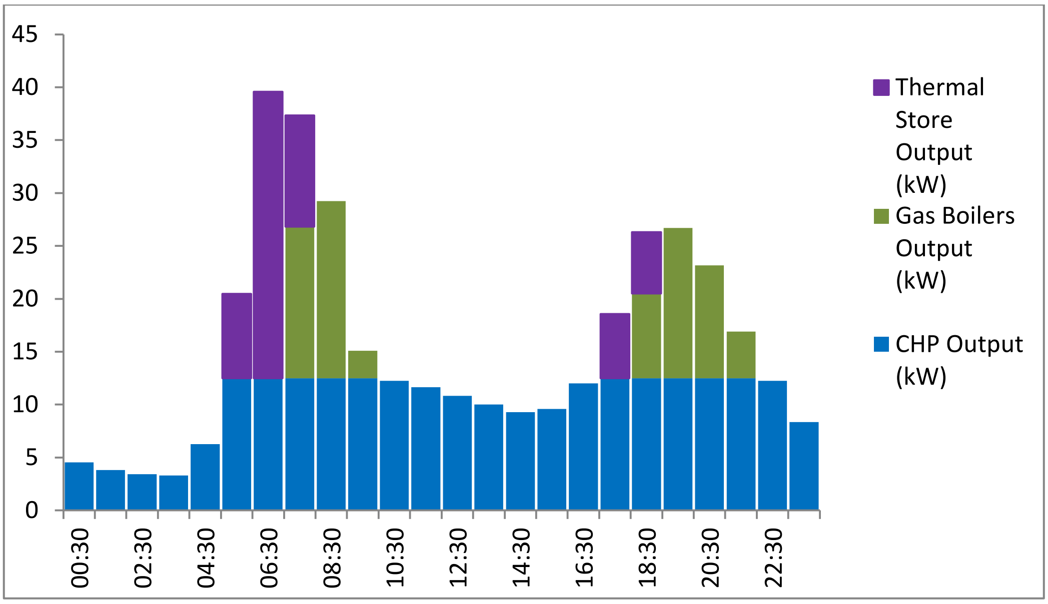


Figure 6: Estimated Typical Winter Daily Load Profile (Apartments)

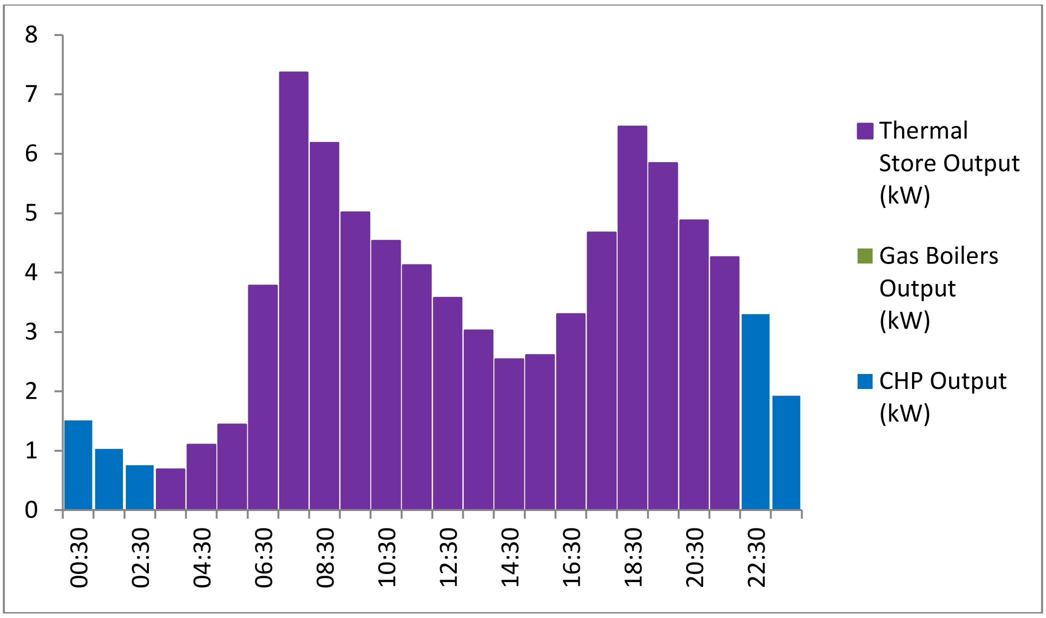


Figure 7: Estimated Typical Summer Daily Load Profile (Apartments)

Based on the above prediction, base operating hours of approximately 5400 hours per year could be achieved. During the winter heating season it is anticipated that space heating loads would enable the CHP to operate at 100% capacity, and for extended daily run hours.

This approach demonstrates the proposed development is predicted to have a sufficient thermal base-load to enable a single communal gas fired CHP engine to be installed which may be in the order of the unit and thermal store identified above. Final CHP unit size and associated thermal store volume will be identified during the detailed design stage of the project.

The CHP unit is intended to meet the majority of the DHW demand and a proportion of the space heating demand. The thermal store will act as a buffer to increase the running hours of the engine and reduce the number of start times.

It has also been determined that there is likely to be sufficient electrical base-load on site to ensure the electricity generated from the CHP unit will be used within the building, for the majority of the time. In instances when the electrical base load is exceeded, electricity can be fed into the national grid. An agreement with the DNO will be sought in case detailed calculations show electricity export will be required, but this is not envisaged at the moment.

The actual number of operating hours will need to be optimised by the operator and the figures shown here are considered for the purpose of the energy strategy assessment at the planning stage.

Due to the anticipated size of the CHP and overall number of units within the Proposed Development it is likely to be considered too small to enable an ESCO to be deemed financially viable. The management and on-going maintenance of the development's building services is anticipated to be provided by a professional Facilities Management company and run on-behalf of the Client. Bills will be managed via reporting from the proposed energy meters. As the CHP will be optimised in size during detailed design and further optimised on site by the operator it is deemed, for the purposes of the energy strategy, to be cost viable, subject to future changes in fuel costs and associated balance between mains gas and grid electricity.

7.3 Clean Scheme: Predicted CO_2 Emissions

Predicted energy consumption and CO_2 emissions have been calculated taking into account the decentralised energy measures (detailed within the previous section). Referring back to the baseline scheme, the resulting predicted CO_2 savings for the "Clean" scheme are detailed in the table below:

“CLEAN”	**Predicted Carbon Dioxide Emissions**	
	Part L 2013	
	Regulated	**Unregulated**
Emissions after demand reduction and CHP (tCO_2/yr)	**56**	**51**
Savings from CHP (tCO_2/yr)	**5.7**	**-**
Savings from CHP (%)	**3.7%**	**-**

The above table demonstrates that there is a predicted **3.7% reduction in regulated CO_2** emissions over **Part L 2013** for the development achieved through integration of a communal gas-fired CHP system.

8.0 ASSESSMENT OF RENEWABLE TECHNOLOGIES

A feasibility study has been carried out to establish the most appropriate local renewable energy source for the building. The study has assessed the natural resources available on site, and analysed the feasibility of each LZC energy source against the building's energy demands.

The following LZC technologies are identified within both the London Plan and BREEAM credit guidance. These technologies have been considered for use at the Proposed Development.

Table 7: Renewable and low carbon technologies considered for the development

Solar	• Solar thermal • Solar photovoltaics
Wind	• Wind turbines
Biomass	• Biomass single room heaters/stoves • Biomass boilers • Biomass community heating scheme
Combined heat and power (CHP)	• Biomass • Natural gas • Sewerage gas and other biogases
Heat Pumps	• Ground source heat pumps • Water source heat pumps • Air source heat pumps • Geothermal heating systems
Fuel Cells	• Fuel cells using hydrogen generated from any of the above 'renewable' sources.

The implementation of such technologies should be pursued in parallel to the detailing of the proposed energy strategy. It is expected that subject to further studies, if any of the technologies proves feasible, its implementation will not jeopardise the carbon emission reduction and in fact may improve the overall performance of the development.

8.1 Feasibility of Renewable Technologies

An initial assessment has been carried out to determine which technologies are technically feasible on the site. For technologies which are identified as feasible, the following factors have been considered to determine which technologies are appropriate in terms of economic and local planning feasibility:

- Energy generated from each LZC energy source per year;
- Payback;
- Land Use;
- Local Planning Criteria;
- Noise;

- Life cycle cost/lifecycle impact of the potential specification in terms of carbon emissions; and

- Any available grants.

All technologies appropriate to the site and energy demand of the development have been assessed. Where technologies are not considered appropriate, justification for their exclusion has been provided.

8.2 Solar Panels (Solar Thermal and Photovoltaic PV)

The table below summarises the desktop study undertaken to determine the feasibility of solar thermal or photovoltaic panels at the site:

Table 8: Key considerations of solar technology

Technology	Criteria	Requirement Met?
Solar Thermal		
Roof orientation	Are available roofs facing south-west to south-east (through south), or flat?	Yes
Roof space	Is there sufficient un-shaded roof area?	Yes
Hot water demand	Is there year round hot water demand?	Yes
Heating system	Would a solar thermal collector be compatible with the proposed heating system?	Yes
Hot water storage	Is there space for a hot water storage vessel?	Yes
Conflicts with other systems?	Will solar thermal conflict with other systems (e.g. CHP) which are higher up the energy hierarchy?	Yes
PV		
Roof orientation	Are available roofs facing south-west to south-east (through south), or flat?	Yes
Roof space	Is there sufficient un-shaded roof area?	Yes
Electrical demand	Is there electrical demand on site	Yes

Solar thermal panels are not considered appropriate for the site as the thermal output would conflict with the output from a CHP unit as both are sized to provide either all or part of the development's base thermal load. Preference has been given to a CHP unit as this can be optimised to provide a greater carbon reduction for the whole development at a lower cost.

PV panels, however, are considered appropriate and are investigated in further detail within Section 8.8.

8.3 Wind Turbines

The table below summarises the desktop study undertaken to determine the feasibility of either roof mounted or stand alone wind turbines at the site:

Table 9: Key considerations of wind technology

Technology	Criteria	Requirement Met?
Stand-alone Wind Turbine		
Clear air flow to turbine	Is the area free from obstructions that could cause turbulence?	No
Open land around proposed site	Is there sufficient open land for a turbine to be installed?	No
Distance to nearest property	Are surrounding properties far away enough to avoid noise disturbance?	No
Wind speed	Is average wind speed greater than 6m/s at hub height?	N/A

To investigate the potential of using wind turbines to provide an on-site renewable energy supply, average wind speed at roof level should be determined. The Carbon Trust online wind speed tool suggests that wind speeds of 6 m/s are feasible at roof level in urban areas; however this is based on a relatively crude methodology. The data uses an air flow model to estimate the effect of topography on wind speed. The model uses a 1 kilometre square resolution and does not take account of topography on a small scale, or local surface roughness (such as tall crops, stone walls or trees), which may have a considerable effect on the wind speed.

Although this data suggests that appropriate average wind-speeds may exist on-site, accurately predicting mean wind-speeds in urban locations is rarely possible without on-site anemometer testing. Furthermore, although locations higher up the building will experience higher wind speeds, these wind-flows are also more likely to feature high gust levels rather than bulk mean speeds. These conditions are not ideal for energy generation from turbines which usually need to operate within both minimum and maximum wind speeds.

Additional issues which would require investigation include structural vibration and the risk of visual discomfort to occupants (flicker)

Wind technology is therefore not recommended for the proposed development.

8.4 Biofuel Community Heating Scheme

The table below summarises the desktop study undertaken to determine the feasibility of a biofuel heating scheme at the site:

Table 10: Key considerations of biofuel technology

Technology	Criteria	Requirement Met?
Woody Biomass		
Heat demand	Is there a year round heat demand?	Yes
Supply chain	Is there an established supply chain in the local area?	No
Delivery logistics	Is the site accessible for deliveries? Is there sufficient space for a supply vehicle to access a biomass storage tank?	No
Storage	Is there sufficient space for fuel storage to allow a	No

	reasonable number of deliveries?	
Plant room	Is there sufficient space for a biofuel boiler and associated auxiliary equipment?	Yes
Flue	Can the flue be designed to meet planning authority requirements?	N/A
Liquid Biofuel		
Heat demand	Is there a year round heat demand?	Yes
Supply chain	Is there an established supply chain in the local area? And can the required quantities of biofuel be guaranteed?	No
Security of supply	Is the future supply of biofuel guaranteed?	No
Running costs	Are the high running costs acceptable?	No
Delivery logistics	Is the site accessible for deliveries? Is there sufficient space for a supply vehicle to access a biofuel storage tank?	N/A
Storage	Is there sufficient space for fuel storage to allow a reasonable number of deliveries?	N/A

Wood chips/pellets would require additional deliveries and storage, not compatible with a city centre location. Liquid biofuel requires less storage space, and has been considered in further detail by the design team.

The biodiesel is typically tested against EN14214, and supplied as pure Biodiesel at B100. Certain suppliers have plans to supply liquid biodiesel to sites around London via tanker. The tanker is anticipated to be sized to hold between 3,000 and 5,000 litres per delivery. Once delivered, the fuel would be pumped to a holding tank onsite, so the location of this tank would need to be accommodated.

Suppliers link their prices to crude oil and kerosene, reviewing prices monthly against the Rotterdam Exchange which considers waste oil prices. As waste oil is now traded as a commodity, prices are high and subject to fluctuation.

Suppliers sell Biodiesel as both road transport fuel and heating oil. When sold as a road transport fuel, the supply company can claim 25p/litre back through the Renewable Fuel Certificates (RFC’s). This subsidy is not available for biodiesel heating fuel so, to compensate, this additional cost is added into the fuel price and passed onto the client.

Typical prices of Biodiesel are based upon the supplier’s fixed processing costs (15p) + RFC (25p) + price of waste cooking oil (variable, but potentially 45p – 60p). This means that the overall fuel cost is likely to be in the region of 85p - £1.00 per litre, compared to gas which is currently in the region of 30-50p per litre. Discussions with various suppliers determined that there is a lot of uncertainty regarding pricing in the market and this fuel price is likely to fluctuate over the next few years.

Liquid Biofuel, including FAME (fatty acid methyl ester), are not currently included as recognised fuels within the Renewable Heat Incentive (RHI) Scheme, so unlike other renewable heating fuels, additional funding is not available.

Due to uncertainties in the market, regarding pricing and supply, as well as the demand from the transport industry, liquid biofuel is not recommended for the proposed development.

The inclusion of centralised heating plant will ensure that biofuel technology could be implemented in the future, if viability improves.

8.5 Combined Heat and Power (CHP)

The table below summarises the previous discussions regarding the feasibility of gas-fired and biofuel heating schemes at the site:

Table 11: Key considerations of Combined Heat and Power (CHP) technology

Technology	Criteria	Requirement Met?
Gas-fired		
Feasible	Is gas-fired CHP to be implemented	Yes
Biomass		
Feasible	Is a biomass heating source recommended?	No
Biofuel		
Feasible	Is a biofuel heating source recommended?	No

A gas-fired CHP system has been analysed within Section 7.2 and is recommended for the site.

A biomass/biofuel system is not recommended due to the reasons explained in the section above.

The inclusion of centralised heating plant will ensure that biofuel technology could be implemented in the future, if viability improves.

8.6 Heat Pumps (Ground / Water / Air / Geothermal)

The table below summarises the desktop study undertaken to determine the feasibility of ground source, air source or water source heat pumps at the site (there is no geo-thermal resource available):

Table 12: Key considerations of heat pump technology

Technology	Criteria	Requirement Met?
Heat distribution system	Is it possible to have a low-grade distribution system e.g. under floor heating?	Yes
Cooling distribution system	Is it compatible with the proposed cooling system?	Yes
Technology conflict	Is it compatible with other heat sources e.g. CHP?	No
Ground-source Heat Pump		
Ground conditions	Has a basic ground study concluded that the site is suitable for GSHP?	TBC

Horizontal piping	Is there a large area of open land where horizontal piping could be installed?	No
Vertical piping	Is the ground suitable for vertical piping? Can underground obstacles be avoided?	No
Plant room	Is there sufficient space for a GSHP and associated auxiliary equipment?	Yes
Water-source Heat Pump		
Resource	Is there an available water source close to the site?	No
Access	Can the available water source be accessed?	No
Air Source Heat Pump		
Roof space	Is there available roof space for air-source heat pumps?	No

Due to the limited space available at the site, a horizontal closed loop system is not feasible.

In order to assess feasibility of a vertical closed loop system, a survey of the ground conditions is required, including reviews of local borehole test records, to determine whether conditions are suitable for a closed loop ground source heat-pump system. Maximum yield would then need to be investigated based on the feasibility of vertical boreholes or loops integrated into the structural pilling (thermopiles). The added risk and potential restriction on this site is the tube lines running beneath the site.

A heat pump solution would also conflict with the current proposals for a centralised energy centre with CHP, providing heating and domestic hot water to the development via LTHW. A heat pump system would need to operate at different temperatures to ensure optimum efficiency, and would therefore conflict with the CHP-led heating strategy. This would result in reduced CHP requirement and potential future connection capability of local/district heat network.

8.7 Fuel Cells

The table below summarises the desktop study undertaken to determine the feasibility of fuel cell technology at the site:

Table 13: Key considerations of fuel cell technology

Technology	Criteria	Requirement Met?
Fuel Cells		
Fuel Supply	Is there a source of hydrogen available	No
Market Availability	Is the equipment commercially available at the required size?	No
Fuel Supply	Is there an alternate fuel source available?	Yes
Plant room	Is there sufficient space for a fuel cell and associated auxiliary equipment?	Yes

The primary fuel source for fuel cells is hydrogen. This can be obtained (using a reformer) from a wide range of fuel supplies including natural gas, coal gas, methanol, landfill gas and other fuels containing hydrogen.

Fuel cells produce zero emissions (at the point of use) when running on pure hydrogen. However most building applications to date have involved the use of carbon based fuels (primarily natural gas) requiring the use of a reformer. A consequence of the reforming process is the emission of carbon dioxide, although emissions are still lower than conventional combustion processes due to the higher operating efficiency of the fuel cell.

The efficiencies of fuel-cell plants are in the range of 40 to 55% (electrical power generation) and waste heat is generated making it a co-generation energy source.

There is not currently a hydrogen network in London, although there is a very good natural gas infrastructure hence the majority of fuel cells are operating using natural gas. Analysis has shown that the carbon savings realised from gas fired CHP are very similar and sometimes outweigh those from a hydrogen fuel cell that is powered by natural gas due to the conversion process from gas to hydrogen.

Currently there is no commercially available fuel cell unit to meet the estimated capacity for New Oxford Street redevelopment. Available units have a much higher capital cost compared to similar sized gas-fired CHP. As such fuel cell technology is not considered appropriate at this time for the Proposed Development.

8.8 Viability of Solar Photovoltaics

In the London area there is an annual average solar energy availability of 1MWh/m^2 at the optimum (south facing) angle of 30^o from the horizontal plane. The amount of this energy that can be utilised is dependent upon the availability of un-shaded roof space and efficiency of the solar panels considered.

The potential locations of solar panels have been investigated in conjunction with the Architect, Structural Engineer and Building Services Engineers, to identify any aesthetic, safety and structural implications. Facade integrated and roof mounted systems have been considered, and the study has determined that the top floor roof area is the only suitable space for locating panels and optimising cost viability.

The roof in this location is accessible for maintenance, and is currently 100% un-shaded by surrounding buildings over the year.

Good practice efficiency panels have been considered within this study (18.2% minimum panel efficiency). An indicative PV array delivering 6,206kWh/year is proposed to be located on the roof, leaving additional space for maintenance access and to prevent overshadowing. This relates to approximately 34no 240Wp panels. Appendix D contains the roof layout and anticipated location of the current PV proposal.

The panels are to be inclined on ‘A’ frame at 10° and be south-east facing, an optimised angle and orientation given the building orientation and the need for reduced height given sensitive views form surroundings.

The PV is to be located away from the immediate vicinity of any locally roof mounted ventilation system or plant. Details to be further investigated during detailed design.

The electrical output from the PV is to be connected into the mains supply for the building and directly reduce the electricity demand from the national grid to the Landlord areas. It is not anticipated that the PV panels will produce more electricity than is used within the building so no export arrangement will be required.

The predicted energy generation and related CO_2 savings of applying a solar PV system can be seen in the Table below:

Table 14: Predicted Potential Photovoltaic Outputs and Savings

Technology	Collector area	Electricity generated	Energy saving	CO_2 savings (2013)
	(m^2)	(kWh/yr)	(kWh/yr)	(tCO_2/yr)
8.2 kWp PV System	26	6,206	6,206	3.2

The technical and commercial feasibility of a photovoltaic system for the Proposed Development is presented in the table below:

Table 15: Feasibility of Solar Photovoltaic Technology

Indicative Capital Cost (£)	£16,000
Indicative Maintenance Costs (£)	£400 - £1200 NB: Assumes 2no inverters, replaced twice over the panels lifetime
Indicative Payback (years)	8-12 years NB: Lifetime of panel = min 25 years
Land Use	The panels are to be roof mounted and space would be required for the inverter within a plant room or cupboard.
Local Planning Requirements	Appropriately designed Photovoltaic arrays mounted on flat roofs are typically looked upon favourably by local planners and the GLA.
Noise	None
Life cycle cost / lifecycle impact of the potential specification in terms of carbon emissions	PV systems typically result in life-cycle CO_2 savings (typical embodied CO_2 payback is 3-6 years) Lifecycle cost savings are dependent on FIT rates at the time of installation.

Available grants	Feed-In Tariffs (FITs) were introduced in April 2010 by the Government to help increase the level of renewable energy in the UK. The main financial benefits are: ▪ Revenue for energy produced and used on-site ▪ Additional payment is available if the energy produced is sold back to the grid ▪ Save money by reducing the amount of energy supplied by energy supplier The current rate for a 4.8kWp installation of this type is 11.71p/kWh (higher rate). It should be noted that the FIT rate achieved would be the FIT rate at the time of installation.

8.9 Green Scheme: Predicted CO_2 Emissions

Energy consumption and CO_2 emissions have been calculated taking into account renewable energy technologies (detailed within the previous section). Referring back to the baseline scheme, the resulting predicted CO_2 savings for the "Green" scheme are detailed in the table below.

Table 16: Predicted Carbon Dioxide emissions savings as a result of renewables (PV)

"GREEN"	**Predicted Carbon Dioxide Emissions**	
	Part L 2013	
	Regulated	**Unregulated**
Emissions after demand reduction, CHP & Renewables (PV) (tCO_2/yr)	**53**	**51**
Savings from PV (tCO_2/yr)	**3.2**	**-**
Savings from PV (%)	**2.1%**	**-**

The above table demonstrates that there is a predicted **2.1% reduction in regulated CO_2** emissions could be achieved for the development through integration of PV panels.

9.0 CONCLUSIONS

The total predicted regulated CO_2 savings achieved by the energy strategy is **99.5 tonnes CO_2 per annum** when compared against the existing building normalised baseline scenario.

The table below shows the breakdown in predicted savings for each stage of the energy hierarchy. The predicted savings equate to a **65.4% reduction** in regulated scheme CO_2 emissions.

Table 17: Predicted Carbon Dioxide Emissions for each stage of the Energy Hierarchy

	Predicted Carbon Dioxide Emissions (tCO_2/yr)	
	Regulated	Unregulated
Existing Building (normalised)	**152**	**51**
After energy demand reduction	**62**	**51**
After CHP	**56**	**51**
After renewable energy	**53**	**51**

Table 18: Predicted Regulated carbon dioxide emissions savings from each stage of the Energy Hierarchy

	Predicted Regulated Carbon dioxide savings	
	(Tonnes CO_2 / year)	(%)
Savings from Energy Demand Reduction	**90.6**	**59.5**
Savings from CHP	**5.7**	**3.7**
Savings from Renewable energy	**3.2**	**2.1**
Total cumulative savings	**99.5**	**65.4**

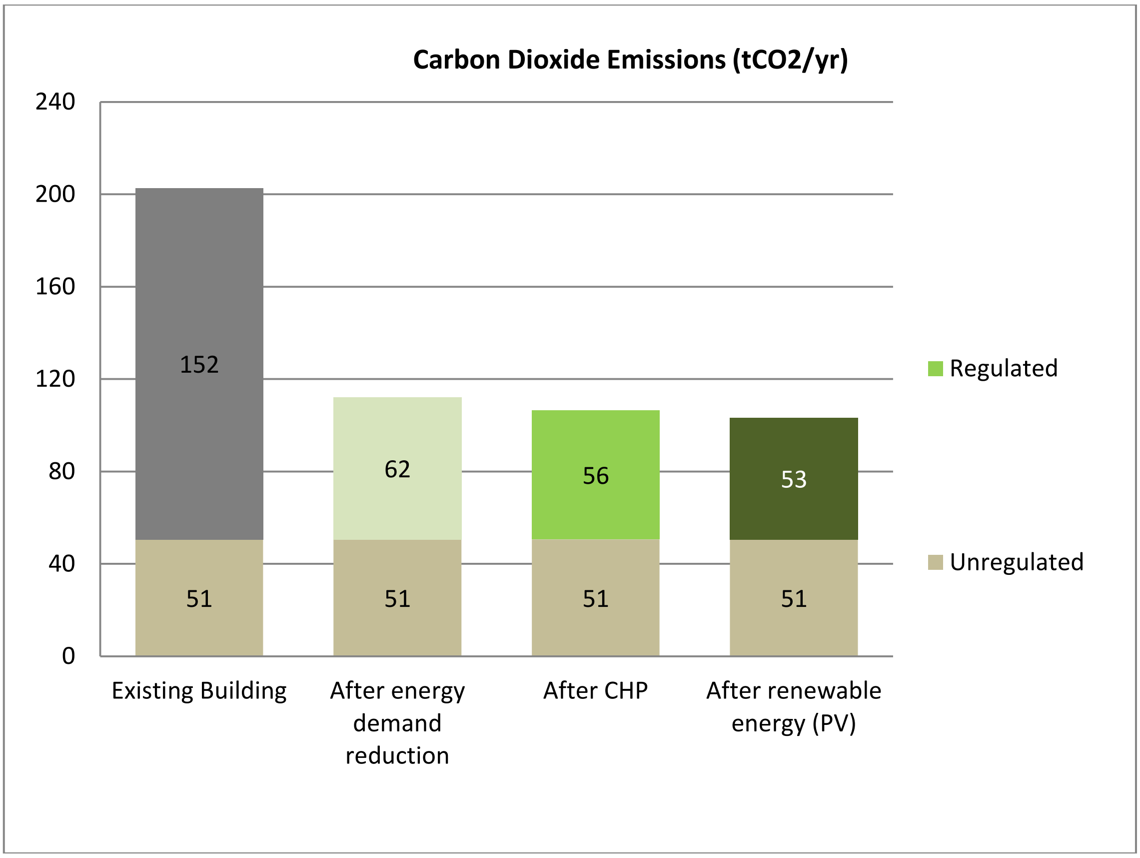


Figure 8: Summary of predicted total Carbon Dioxide emissions for each stage of the hierarchy against existing building (normalised) baseline

APPENDIX A

SAP REPORTS

Predicted Energy Assessment

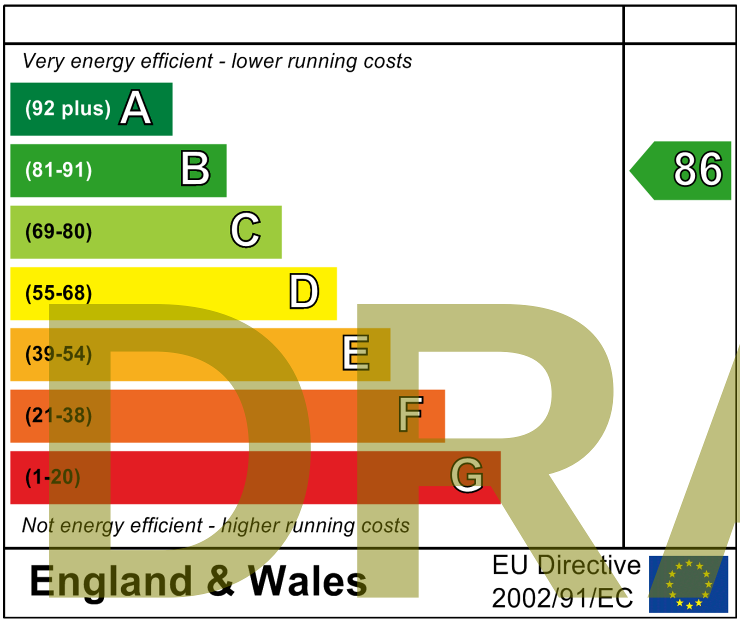
New Oxford Street

Dwelling type:	Mid floor Flat
Date of assessment:	03 November 2015
Produced by:	Stroma Certification
Total floor area:	96.2 m²

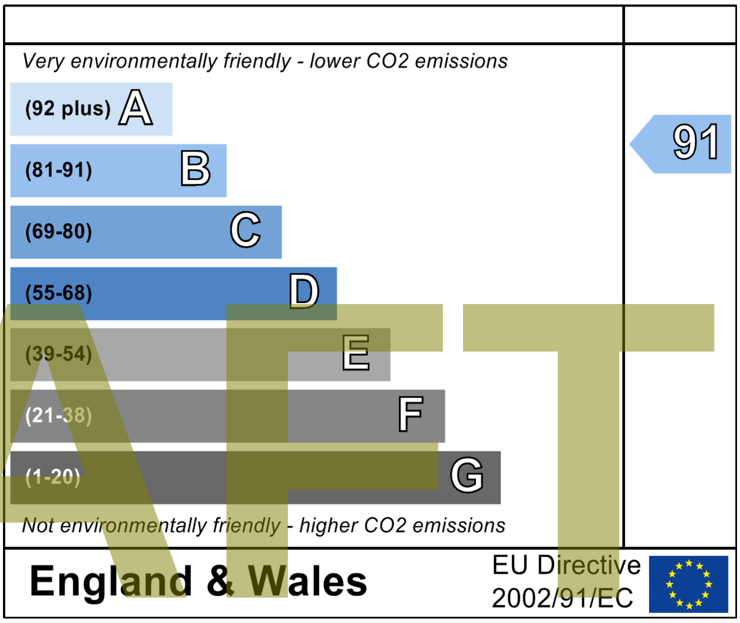
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home’s impact on the environment in terms of carbonn dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

Predicted Energy Assessment

New Oxford Street
London

Dwelling type: Mid floor Flat
Date of assessment: 03 November 2015
Produced by: Stroma Certification
Total floor area: 60 m²

This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

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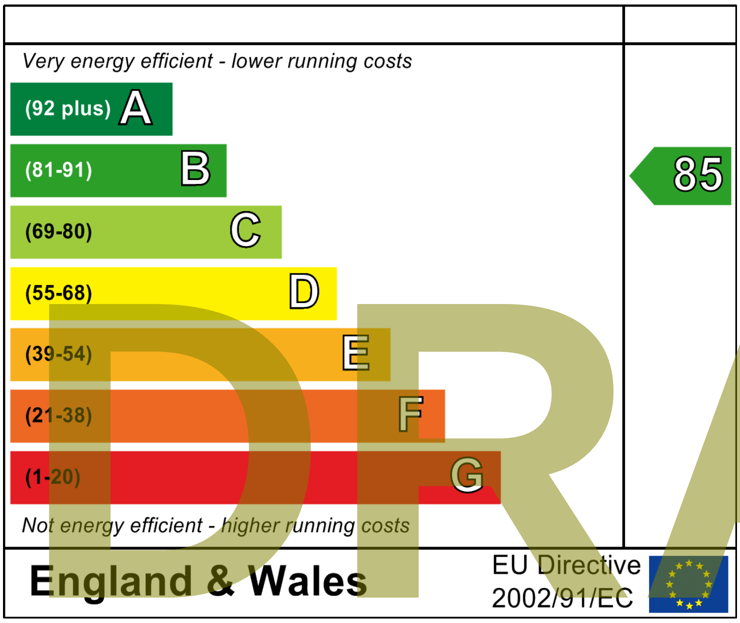
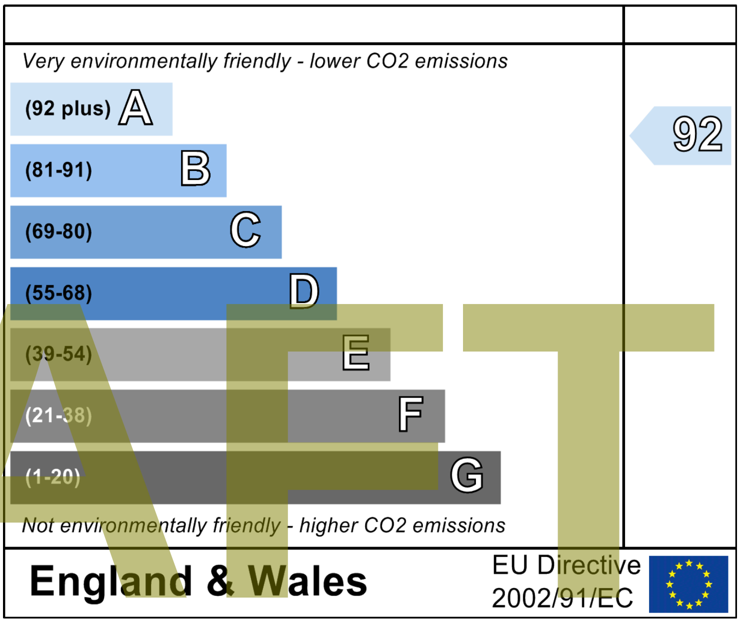


Environmental Impact (CO$_2$) Rating



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Predicted Energy Assessment

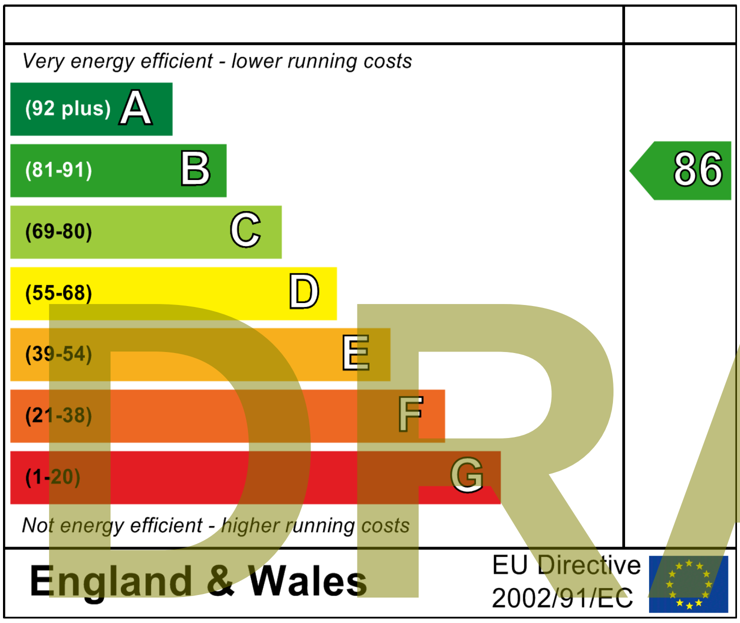
New Oxford Street

Dwelling type: Mid floor Flat
Date of assessment: 03 November 2015
Produced by: Stroma Certification
Total floor area: 81.8 m²

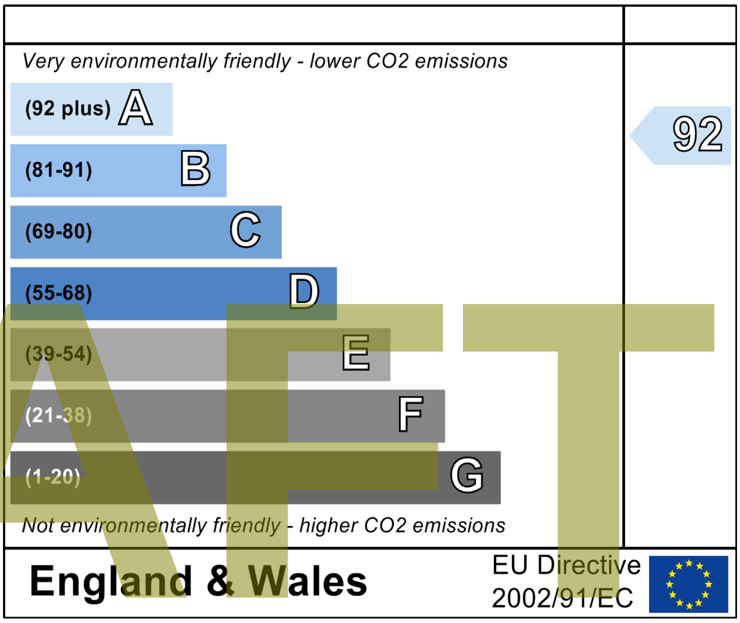
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



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The environmental impact rating is a measure of a home’s impact on the environment in terms of carbonn dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

Predicted Energy Assessment

New Oxford Street

Dwelling type: Mid floor Flat
Date of assessment: 03 November 2015
Produced by: Stroma Certification
Total floor area: 55.1 m²

This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

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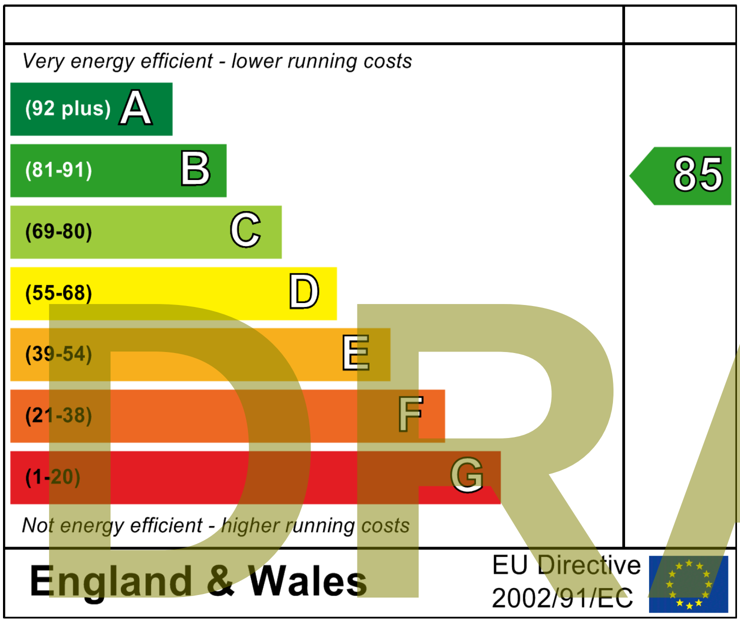
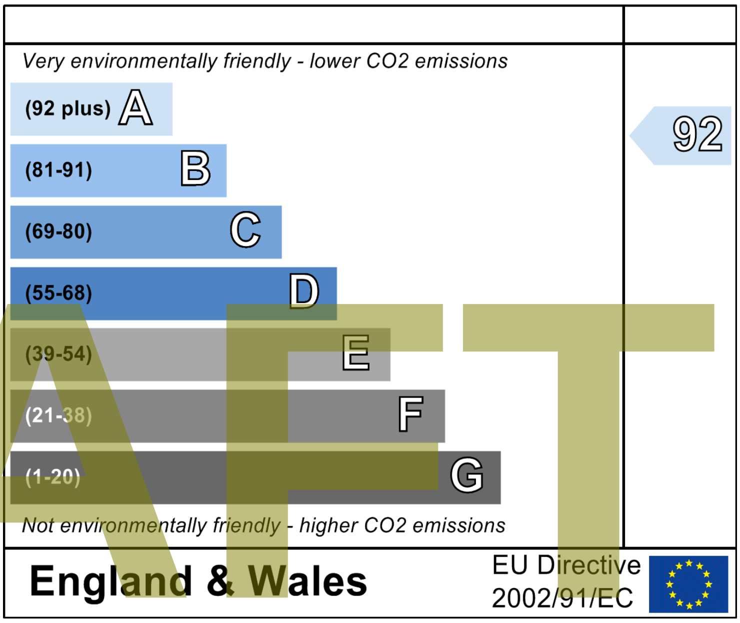
Energy Efficiency Rating



Environmental Impact (CO_2) Rating



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The environmental impact rating is a measure of a home’s impact on the environment in terms of carbonn dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

Predicted Energy Assessment

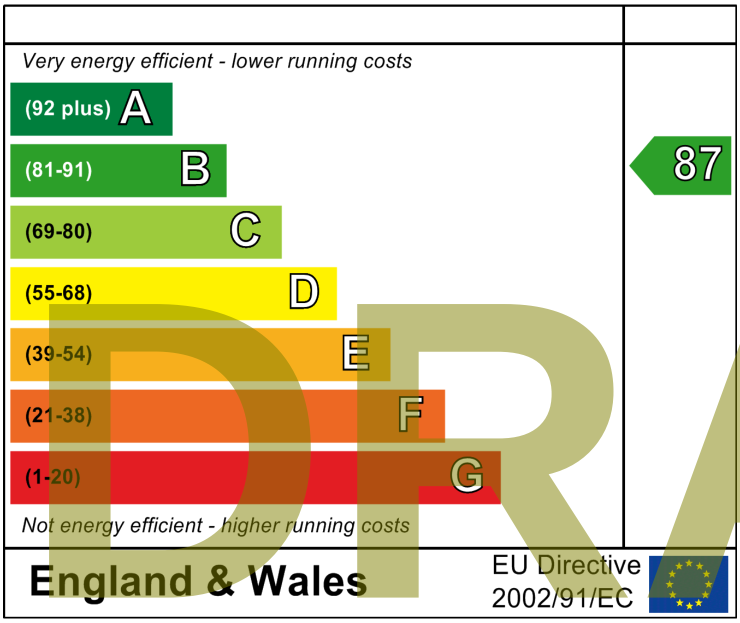
New Oxford Street

Dwelling type: Mid floor Flat
Date of assessment: 03 November 2015
Produced by: Stroma Certification
Total floor area: 96.2 m²

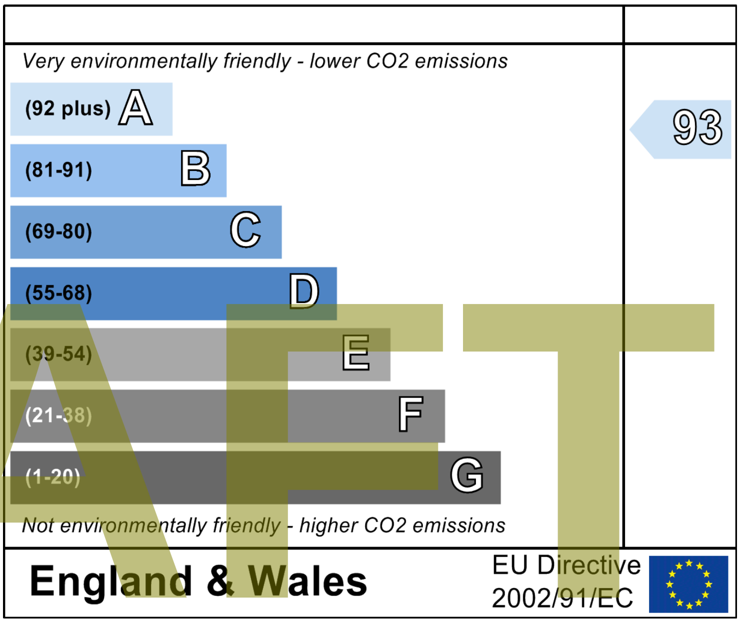
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



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Predicted Energy Assessment

New Oxford Street
London

Dwelling type: Mid floor Flat
Date of assessment: 03 November 2015
Produced by: Stroma Certification
Total floor area: 60 m²

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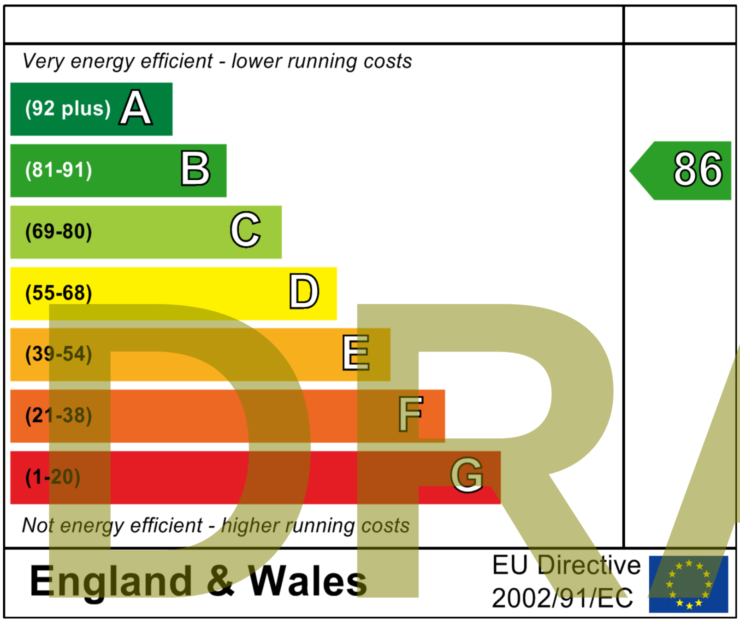
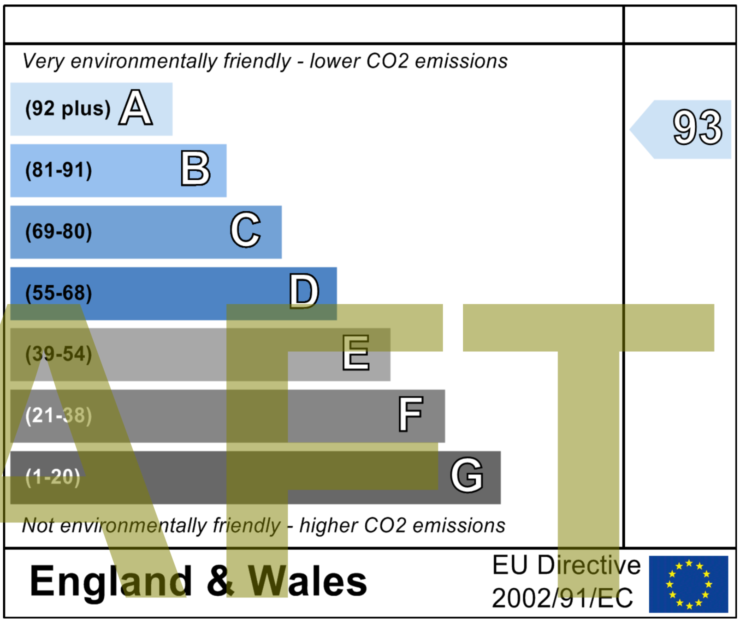
Energy Efficiency Rating



Environmental Impact (CO_2) Rating



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Predicted Energy Assessment

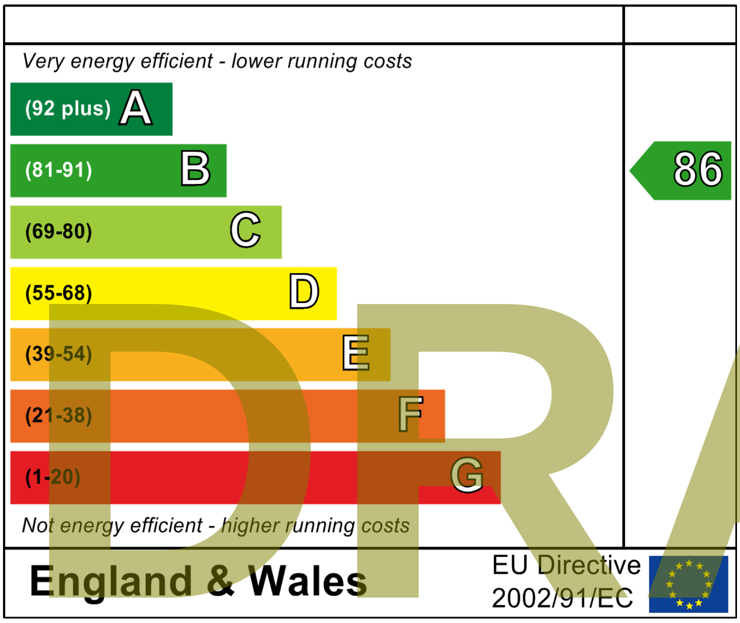
New Oxford Street

Dwelling type:	Mid floor Flat
Date of assessment:	03 November 2015
Produced by:	Stroma Certification
Total floor area:	55.1 m²

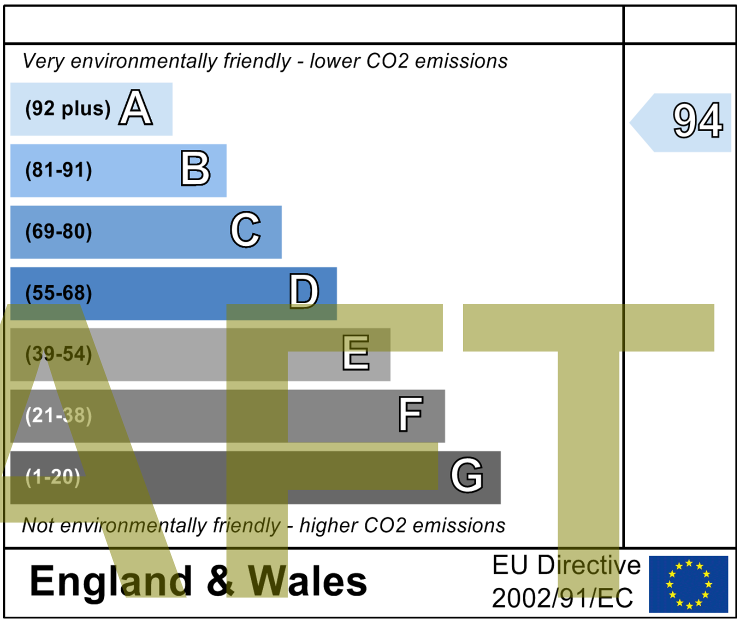
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



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The environmental impact rating is a measure of a home’s impact on the environment in terms of carbonn dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

Predicted Energy Assessment

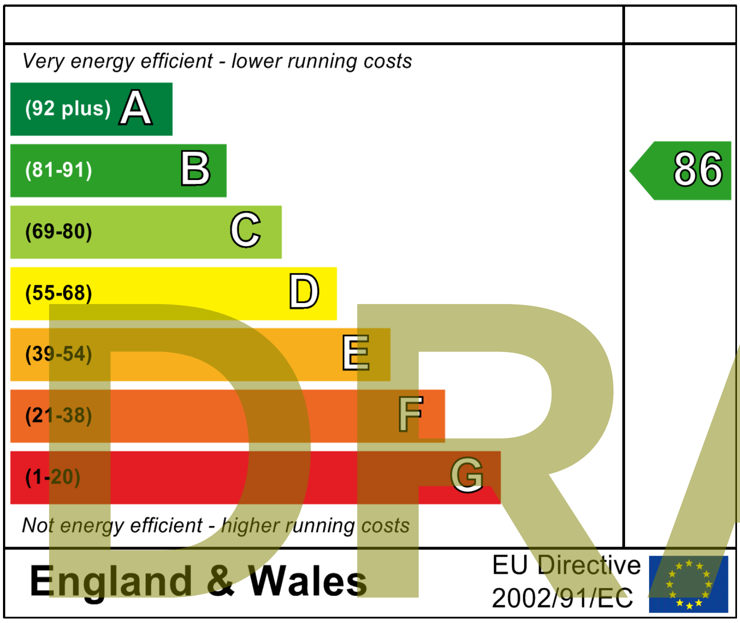
New Oxford Street

Dwelling type:	Mid floor Flat
Date of assessment:	03 November 2015
Produced by:	Stroma Certification
Total floor area:	55.1 m²

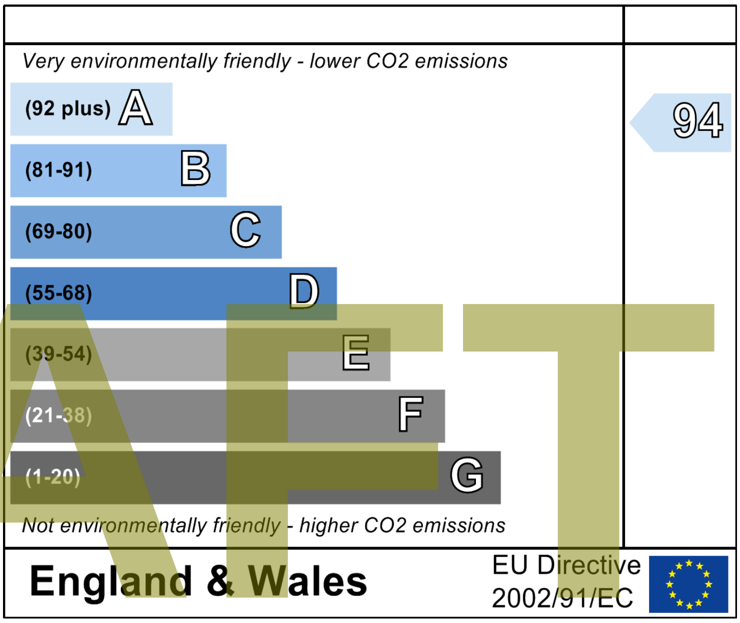
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home’s impact on the environment in terms of carbonn dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

APPENDIX B

BRUKL REPORTS

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

New Oxford Street - Be Lean

As designed

Date: Thu Dec 03 14:56:50 2015

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.2

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.2

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

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

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

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

1.1	CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	24.9
1.2	Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	24.9
1.3	Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	31.6
1.4	Are emissions from the building less than or equal to the target?	BER > TER
1.5	Are as built details the same as used in the BER calculations?	Separate submission

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

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

2.a Building fabric

Element	**$U_{a\text{-}Limit}$**	**$U_{a\text{-}Calc}$**	**$U_{i\text{-}Calc}$**	**Surface where the maximum value occurs***
Wall**	0.35	0.25	0.25	BF000004:Surf[2]
Floor	0.25	0.2	0.2	BF000005:Surf[0]
Roof	0.25	0.18	0.18	BF000004:Surf[1]
Windows***, roof windows, and rooflights	2.2	1.5	1.5	GF000006:Surf[1]
Personnel doors	2.2	2.2	2.2	GF000002:Surf[1]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(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	10

2.b Building services

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

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	>0.95

1- Electric radiators

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

2- VRF

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	3.6	3.7	0	0	0.65
Standard value	2.5*	3.2	N/A	N/A	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.

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

"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	
BF - Comms Room	96	-	-	42
BF - Store	52	-	-	151
BF - Store	62	-	-	54
BF - Circulation	-	125	-	163
BF - Plant	69	-	-	116
BF - Store	64	-	-	63
BF - Circulation	-	158	-	76
BF - Leisure	-	101	-	2365
BF - Plant	52	-	-	618
BF - Circulation	-	204	-	32
GF - Resi Circulation	-	153	-	73
GF - Retail	-	106	25	3505
GF - Retail	-	112	25	1142
GF - Circulation	-	116	-	95
GF - Circulation	-	203	-	38
GF - Circulation	-	111	-	95
GF - Retail	-	98	25	3560
GF - Retail	-	98	25	3560
GF - Retail	-	115	25	1131

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?
BF - Leisure	N/A	N/A
GF - Retail	NO (-20.4%)	NO
GF - Retail	NO (-22%)	NO
GF - Retail	NO (-88.4%)	NO
GF - Retail	NO (-78.7%)	NO
GF - Retail	NO (-35.8%)	NO

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	1477.8	1477.8
External area [m^2]	1628.3	1628.3
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	10	3
Average conductance [W/K]	564.23	553.92
Average U-value [W/m^2K]	0.35	0.34
Alpha value* [%]	10.06	10

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

Building Use

% Area	Building Type
81	**A1/A2 Retail/Financial and Professional services**
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	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.
2	**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
18	**D2 General Assembly and Leisure, Night Clubs and Theatres**
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others - Stand alone utility block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	3.2	3.77
Cooling	8.58	6.51
Auxiliary	6.7	3.01
Lighting	42.75	36.15
Hot water	2.71	2.15
Equipment*	35.55	35.55
TOTAL**	**63.93**	**51.59**

* Energy used by equipment does not count towards the total for calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m^2]

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

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	132.8	103.2
Primary energy* [kWh/m^2]	187.64	145.64
Total emissions [kg/m^2]	31.6	24.9

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

HVAC Systems Performance

System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity									
Actual	6.9	181.1	0.5	12.9	10.1	3.53	3.89	3.6	5.2
Notional	6.2	133.9	0.7	9.8	4.5	2.56	3.79	----	----
[ST] Other local room heater - unfanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity									
Actual	63.4	0	22	0	0	0.8	0	1	0
Notional	80.2	0	25.9	0	0	0.86	0	----	----

Key to terms

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

Key Features

The BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

Element	**$U_{i\text{-}Typ}$**	**$U_{i\text{-}Min}$**	**Surface where the minimum value occurs***
Wall	0.23	0.25	BF000004:Surf[2]
Floor	0.2	0.2	BF000005:Surf[0]
Roof	0.15	0.18	BF000004:Surf[1]
Windows, roof windows, and rooflights	1.5	1.5	GF000006:Surf[1]
Personnel doors	1.5	2.2	GF000002:Surf[1]
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building

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

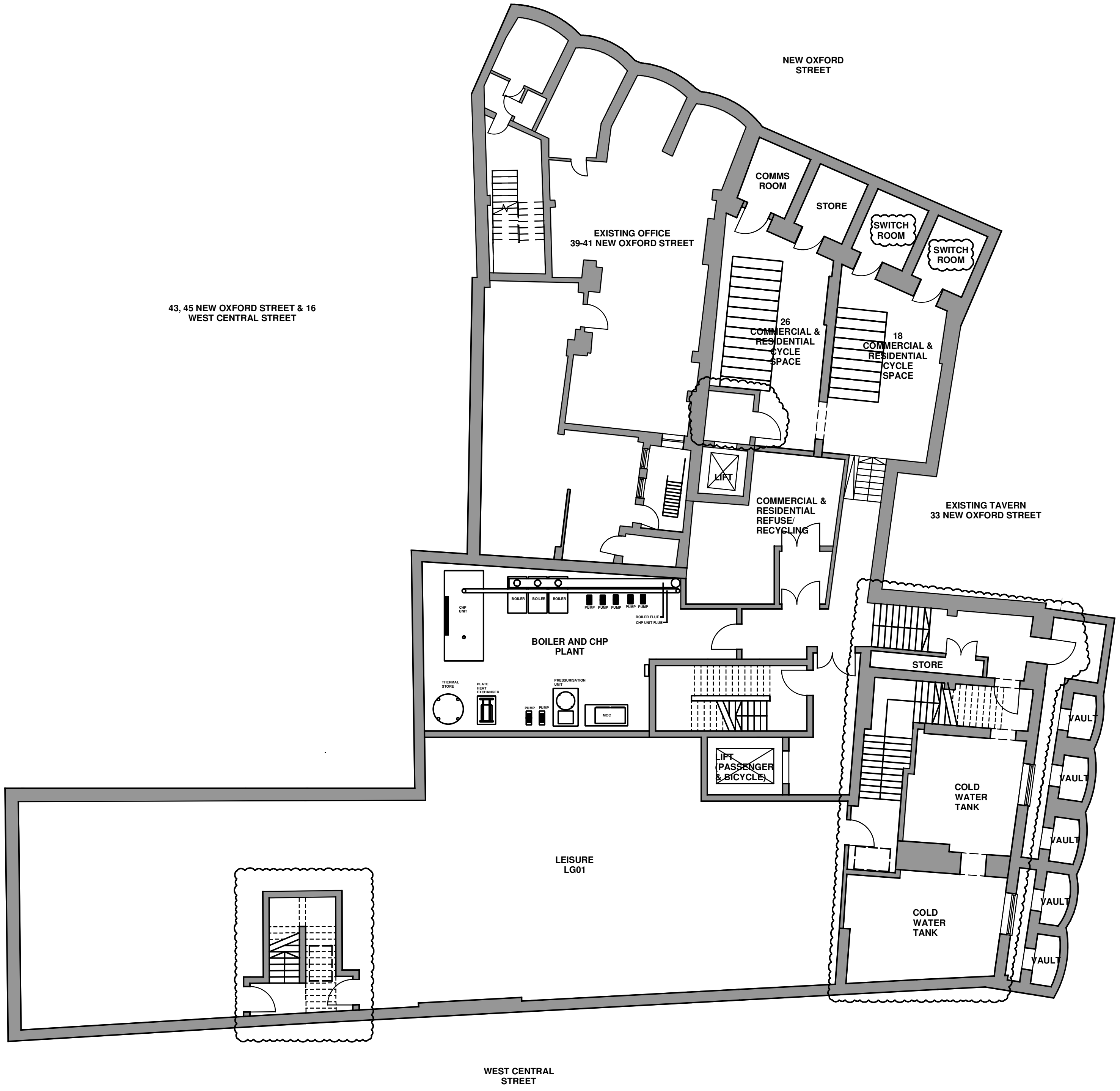
$U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

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

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

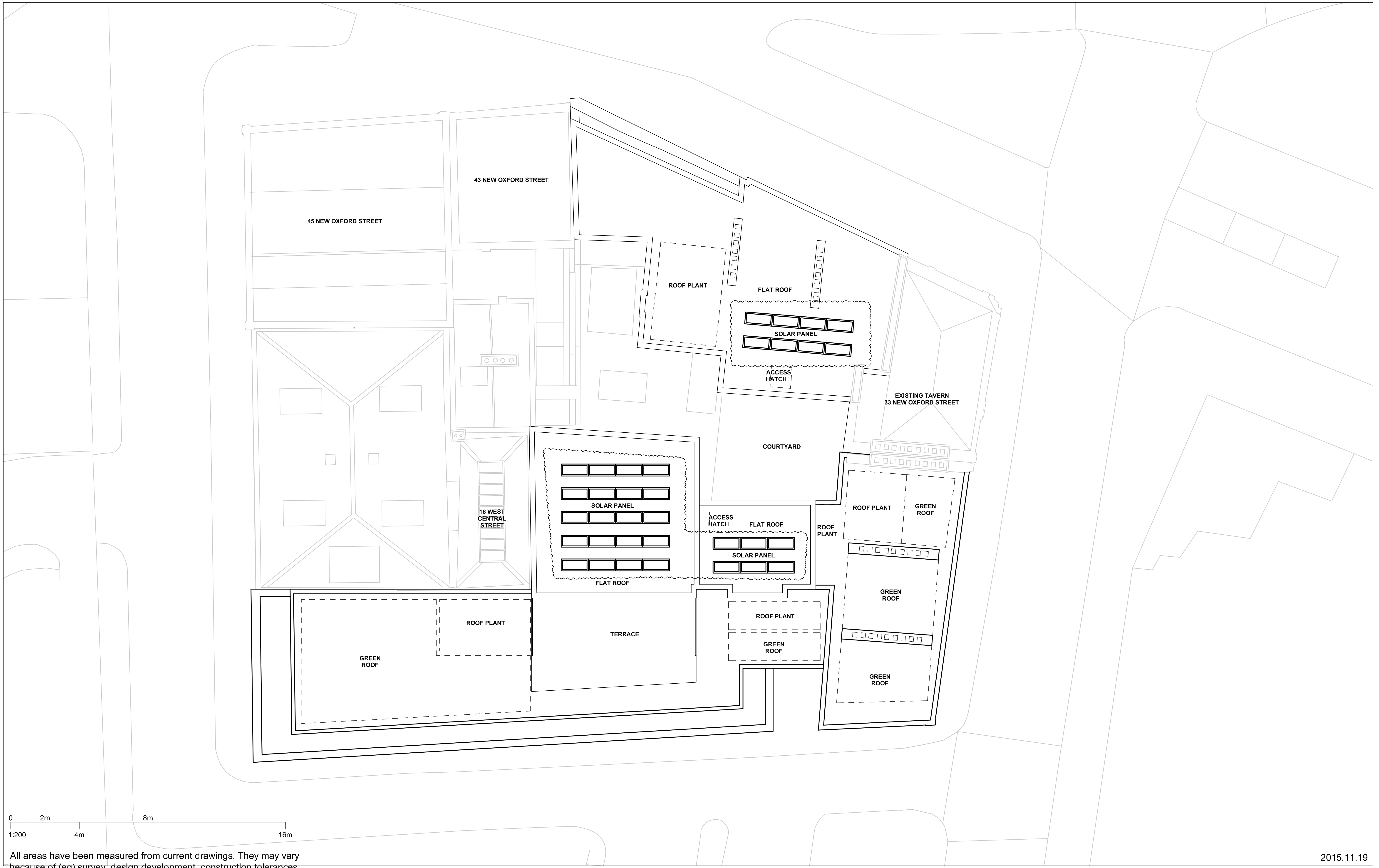
APPENDIX C

PLANT ROOM LAYOUT


NEW OXFORD STREET
43, 45 NEW OXFORD STREET & 16 WEST CENTRAL STREET
EXISTING OFFICE 39-41 NEW OXFORD STREET
COMMS ROOM
STORE
SWITCH ROOM
SWITCH ROOM
26 COMMERCIAL & RESIDENTIAL CYCLE SPACE
18 COMMERCIAL & RESIDENTIAL CYCLE SPACE
LIFT
COMMERCIAL & RESIDENTIAL REFUSE/ RECYCLING
EXISTING TAVERN 33 NEW OXFORD STREET
CHP UNIT
BOILER
BOILER
BOILER
PUMP
PUMP
PUMP
PUMP
PUMP
BOILER FLUE
CHP UNIT FLUE
BOILER AND CHP PLANT
THERMAL STORE
PLATE HEAT EXCHANGER
PUMP
PUMP
PRESSURISATION UNIT
MCC
STORE
LIFT (PASSENGER & BICYCLE)
COLD WATER TANK
COLD WATER TANK
VAULT
VAULT
VAULT
VAULT
VAULT
MUSEUM STREET
LEISURE LG01
WEST CENTRAL STREET

APPENDIX D

PV LAYOUT



All areas have been measured from current drawings. They may vary because of (eg) survey, design development, construction tolerances, statutory requirements or re-definition of the areas to be measured.

2015.11.19

A10862 B2105 rev P2

tp bennett Roof Plan New Oxford Street