RYBKA

60-72 SHORTS GARDENS & 16 BETTERTON STREET

ENERGY REPORT

MAY 2012

Inspired logic

AMENDMENT RECORD

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13 Newton Terrace, Glasgow G3 7PJ
t +44 (0) 141 221 2334 f +44 (0) 141 221 2399 e info@rybka.co.uk w rybka.co.uk
EDINBURGH GLASGOW INVERNESS BIRMINGHAM DUBLIN
Rybka Limited, Registered in Scotland No 130511, Registered Office: 24 Rutland Street, Edinburgh EH1 2AN

CONTENTS

60-72 SHORTS GARDENS & 16 BETTERTON STREET

EXECUTIVE SUMMARY

Fulcrum Consulting prepared an *Energy Options Report* that was submitted as part of a planning application for the refurbishment and extension of properties at 60-72 Shorts Gardens & 14-16 Betterton Street, Covent Garden in 2008. Planning consent was granted but is due to expire in the near future.

The applicant is applying for an extension to the time limits for implementing planning permission. This *Energy Statement* is for submission as part of this application, to demonstrate that energy consumption and CO_2 emissions have been considered, in accordance with planning policy.

The proposed development comprises the refurbishment and extension of 60-72 Shorts Gardens & 14-16 Betterton Street, Covent Garden to provide 2,532 m² gross of accommodation, comprising:

- 1,234 m² of refurbished accommodation designated for A1-A5 and B1 uses;
- 567 m² of new accommodation designated for B1 use; and
- 731 m² of refurbished accommodation designated for D2 use.
-

The methodology used is that set out under Policy 4A.4 of the *London Plan* and amplified in Appendix D of the *Supplementary Planning Guidance: Sustainable Design and Construction*, which is consistent with local planning policy.

The *Energy Options Report* submitted as part of the original planning application was based on benchmark data. This *Energy Statement* is based on Dynamic Simulation Modelling and is therefore more accurate.

The baseline CO_2 emissions are 138.6 t/yr.

The proposed development incorporates the following energy efficiency measures.

- Insulated building fabric with low air permeability;
- Glazing with suitable U-value, g-value and daylight transmittance;
- Variable Refrigerant Flow (VRF) systems for heating and cooling;
- Mechanical ventilation with heat recovery;
- Power Factor Correction;
- Automatic monitoring and targeting with alarms for out of range values;
- Light Emitting Diode (LED) lamps in luminaires; and
- Automatic lighting control using occupancy sensors.

These measures reduce the CO_2 emissions by 0.4 %, in comparison with the baseline, to 138.0 t/yr.

The heating and cooling systems for the proposed development have been considered in accordance with the order of preference set out in Policy 4A.6 of the *London Plan*.

- At its closest, the site lies approximately 950 m, as the crow flies, from the closest existing or emerging Decentralised Energy (DE) network. Given that the capital cost of laying heat mains in London is typically in the range 1,000-1,500 £/m, connection to the Whitehall network is not considered feasible.
- The base heat load is just 37 kWh per day, an average of 1.5 kW over a 24-hour period. This is level demand is too low to support CHP, which is therefore not technically feasible for the proposed development.

- The VRF systems would be connected by a common condenser water circuit, to allow heat recovery between systems and future connection to DE networks and/or LZCTs.

Although the proposed arrangement would in practice improve the seasonal efficiency of the heating and cooling systems, determining the effect on CO_2 emissions relies on the manufacturer's data. For the purposes of this *Energy Statement*, it is assumed that the clean building's annual carbon emissions would be the same as those of the lean building.

The feasibility of the renewable energy technologies listed in the *London Plan* and covered by the Feed-In Tariff and Renewable Heat Incentive has been considered. Photovoltaic cells are technically feasible and are proposed. This technology reduces the CO_2 emissions by a further 7.5 %, to 127.6 t/yr. (The VRF systems included in the energy efficiency measures are also considered to be 'renewable' when operating in heating mode. The reduction in CO_2 emissions in comparison with gas boilers is 1.5 t/yr.)

Overall the proposed development's improvement on the baseline, which includes both regulated and non-regulated end uses of energy, is 7.9 %.

In comparison to those set out in the original *Energy Options Report*, the proposals achieve a 39.9 % reduction in CO_2 emissions.

The proposed development's improvement on 2010 Building Regulations, which includes only regulated end uses of energy is 14.8 %. The proposed development therefore does not meet the current *London Plan* target for a 25 % improvement. However:

- The larger part of the proposed development comprises the refurbishment of an existing building, where there are limitations to the energy efficiency measures that can be incorporated;
- By adopting a more robust methodology and reconsidering the feasibility of evolving technologies such as VRF, LED lighting and PV cells, the proposed development's CO_2 emissions have been reduced by almost 40 % since the original application.

1.0 INTRODUCTION

1.1 PURPOSE OF REPORT

Fulcrum Consulting prepared an *Energy Options Report* that was submitted as part of a planning application for the refurbishment and extension of properties at 60-72 Shorts Gardens & 14-16 Betterton Street, Covent Garden in 2008. Planning consent was granted but is due to expire in the near future.

The applicant is applying for an extension to the time limits for implementing planning permission. Though this is generally referred to as an extension, it is actually an extension of time for the implementation of a planning permission by grant of a new permission for the development authorised by the original permission.

This *Energy Statement* is for submission as part of this application, to demonstrate that energy consumption and CO_2 emissions have been considered, in accordance with planning policy.

A basic understanding of carbon reduction technologies is assumed; further information can be found in the Technology Directory on the Carbon Trust's website.

1.2 PROJECT DESCRIPTION

The proposed development comprises the refurbishment and extension of 60-72 Shorts Gardens & 14-16 Betterton Street, Covent Garden to provide 2,532 m² gross of accommodation, comprising:

- 1,234 m² of refurbished accommodation designated for A1-A5 and B1 uses;
- 567 m² of new accommodation designated for B1 use; and
- 731 m² of refurbished accommodation designated for D2 use.

1.3 DEVELOPMENT CONTROL

The planning authority is the London Borough of Camden (LBC). While regional planning policy is applicable, the proposed development is not referable to the Greater London Authority (GLA).

1.4 BUILDING CONTROL

The proposed development would be required to comply with Building Regulations. In the context of energy and CO2 emissions, the relevant document is *Approved Document L2B: Conservation of fuel and power in new buildings other than dwellings (2010 version) (ADL2B)*. The guidance in *ADL2B* is bespoke and depends on the nature of the proposed works.
Under *ADL2B*, the proposed extension can be regarded as a new building and the guidance in *Approved Document L2A: Conservation of fuel and power in new buildings other than dwellings (2010 edition) (ADL2A 2010)* followed.
Compliance with *ADL2A* is demonstrated by meeting five criteria, of which the first three concern design:

1. Comparison of the calculated CO_2 emission rate with the Target Emission Rate (TER);
2. Limits on design flexibility;
3. Limiting solar gain in summer;
4. Building performance; and
5. Providing information.

1.5 ENERGY PERFORMANCE CERTIFICATION

The requirements in respect of energy performance certification are affected by the nature of the refurbishment and extension, use class, tenancies, and the type of heating system. For the purposes of this *Energy Statement* it is assumed that the proposed development would require the one Energy Performance Certificates (EPC).

1.6 ENVIRONMENTAL ASSESSMENT

The proposed development is targeting a Building Research Establishment Environmental Assessment Method (BREEAM) New Construction 2011 very good rating.

The preparation of this *Energy Statement* contributes evidence for the following BREEAM NC 2011 credits:

- Ene 1 – Reduction of CO_2 emissions; and
- Ene 4 – Low or Zero Carbon Technologies.

2.0 PLANNING POLICY CONTEXT

2.1 NATIONAL

"The National Planning Policy Framework (NPPF) sets out the Government's planning policies for England and how these are expected to be applied. It sets out the Government's requirements for the planning system only to the extent that it is relevant, proportionate and necessary to do so. It provides a framework within which local people and their accountable councils can produce their own distinctive local and neighbourhood plans, which reflect the needs and priorities of their communities.

"Planning law requires that applications for planning permission must be determined in accordance with the development plan, unless material considerations indicate otherwise. The National Planning Policy Framework must be taken into account in the preparation of local and neighbourhood plans, and is a material consideration in planning decisions. Planning policies and decisions must reflect and where appropriate promote relevant EU obligations and statutory requirements."

The NPPF was published on 27 March 2012 and replaced all Planning Policy Statements and all remaining Planning Policy Guidance.

2.2 REGIONAL

The Greater London Authority Act 1999 places responsibility for strategic planning in London on the Mayor, and requires him to produce a Spatial Development Strategy for London, which has become known as "the London Plan"; he is also required to keep it under review. The current *London Plan* was published in July 2011. Other key regional policy documents relevant to energy and CO_2 emissions are:

- *Delivering London's Energy Future (GLA, 2011)*, the Mayor's Climate Change Mitigation and Energy Strategy; and
- *Supplementary Planning Guidance on Sustainable Design and Construction (GLA, 2006)*.

2.2.1 LONDON PLAN

The current *London Plan* states that *"energy issues, including resilience, security of supply and infrastructure provision are likely to be increasingly important in the years to 2031" (Mayor of London, 2011, 27)*. Chapter five presents London's response to climate change and outlines how to achieve the Mayor's vision of London as a *"city that becomes a world leader in improving the environment" (Mayor of London, 2011, 32)*. It includes two strategic targets:

- An overall reduction in London's carbon dioxide emissions of 60 % (below 1990 levels) by 2025; and
- 25 % of the heat and power used in London to be generated through the use of localised decentralised energy systems by 2025.

For the first time the *London Plan* sets specific targets for CO_2 emissions from developments, which are shown in Table 1 and Table 2. These 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." (Mayor of London, 2011, 141)*

Table 1 – Target CO_2 emissions reductions for residential buildings

Year	Improvement on 2010 Building Regulations
2010 - 2013	25 % (CSH level 4)
2013 – 2016	40 %
2016 - 2031	Zero carbon

Table 2 – Target CO_2 emissions reductions for non-domestic buildings

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

The previous *"presumption that developments will achieve a reduction in carbon dioxide emissions of 20 % from on site renewable energy generation" (Mayor of London, 2008, 205)* has been dropped.

There are also more detailed requirements in respect of decentralised energy networks (policy 5.5) and overheating and cooling (policy 5.9).

2.2.2 SUPPLEMENTARY PLANNING GUIDANCE ON SUSTAINABLE DESIGN AND CONSTRUCTION

The Mayor of London's Supplementary Planning Guidance: Sustainable Design and Construction, published in May 2006, provides additional information to support the implementation of the London Plan. As Supplementary Planning Guidance (SPG), this document cannot set new policy, but has weight as a formal supplement to the London Plan. The 'essential' and 'preferred' standards set out in the SPG in section 2.3.2 are effectively superseded by the current London Plan. However Appendix D *"provides more detail on addressing the energy hierarchy through the completion of an energy statement to accompany specific planning applications" (Mayor of London, 2006, 88)*.

2.3 LOCAL

The planning authority is the London Borough of Camden (LBC). While regional planning policy is applicable, the proposed development is not referable to the Greater London Authority (GLA).

2.3.1 LOCAL DEVELOPMENT FRAMEWORK

The spatial planning strategy for LBC is the Local Development Framework (LDF), which replaced the *Unitary Development Plan* (UDP) in November 2010. The LDF is a portfolio of Local Development Documents (LDDs), including the *Core Strategy* and Development Plan Documents (DPDs).

- The *Core Strategy*, which sets out the key elements of LBC's vision for the borough, was adopted on 8th November 2010.
- The *Development Policies*, which set out detailed planning criteria used to determine planning applications, were also adopted on 8th November 2010.
- Supplementary Planning Documents (SPDs) provide detailed guidance on how planning strategy and policies will be implemented for specific topics, areas and sites.

2.3.2 CORE STRATEGY

Policy CS13 (Tackling climate change through promoting higher environmental standards) includes a requirement for "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…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".*

It also notes that *"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:

i. housing estates with community heating or the potential for community heating and other uses with large heating loads;

ii. the growth areas of King's Cross; Euston; Tottenham Court Road; West Hampstead Interchange and Holborn;

iii. schools to be redeveloped as part of Building Schools for the Future programme;

iv. existing or approved combined heat and power/local energy networks;

v. 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)"

2.3.3 SUPPLEMENTARY PLANNING DOCUMENTS

Camden Planning Guidance: Sustainability (CPG3) provides more detailed information on the information to be provided in energy statements and the council's definition of best practice.

3.0 METHODOLOGY

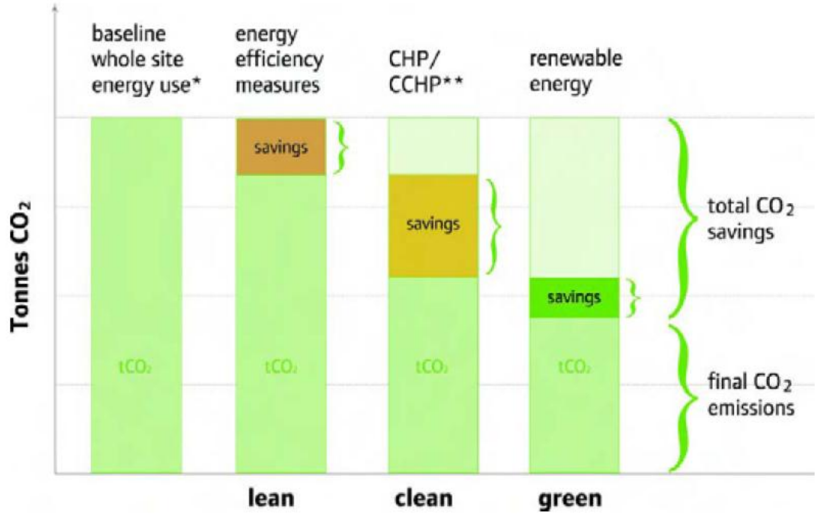
3.1 OVERVIEW

The *Energy Options Report* submitted as part of the original planning application was based on benchmark data. This *Energy Statement* is based on Dynamic Simulation Modelling and is therefore more accurate.

3.2 BASIS

The methodology is set out under Policy 5.2 (Minimising carbon dioxide emissions) of the *London Plan* and amplified in Appendix D of the *Supplementary Planning Guidance: Sustainable Design and Construction*. The process is outlined in Figure 1.

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

Figure 1 – approach to calculating energy and CO_2 savings

The calculation methodology used to predict energy consumption and CO_2 emissions is the same as that approved for demonstrating compliance with Part L of the Building Regulations.

- For dwellings, this is the Standard Assessment Procedure (SAP). *ADL1A 2010* clauses 4.2-4.14 explain how the TER and Dwelling Emission Rate (DER) are calculated.
- For buildings other than dwellings, this is the National Calculation Methodology (NCM). *ADL2A 2010* clauses 4.2-4.15 explain how the TER and Building Emission Rate (BER) are calculated.

Part L only regulates energy consumed by "fixed building services", i.e. the following end uses: heating; hot water; cooling; fans, pumps and controls; and lighting.

- Appendix L of SAP provides a formula for calculating CO_2 emissions associated with appliances and cooking.
- The NCM defines consumption from "equipment" for the purposes of assessing heating and cooling demand, though it is excluded from the calculation of the TER and BER.

The *London Plan* methodology requires other end uses to be taken in to account and therefore emissions from equipment are also included in the calculations presented in this *energy statement*.

3.3 SOFTWARE

The software used to produce the calculations used in this report is IES Virtual Environment (<VE>) version 6.4.0.9, which is accredited by the Department of Communities and Local Government (DCLG) for use in demonstrating compliance with *ADL2A* using Dynamic Simulation Modelling (DSM).

3.4 BASELINE EMISSIONS

The baseline emissions are based upon the Target Emission Rate (TER) for controlled end uses plus the CO_2 emissions from equipment.

3.5 LEAN MEASURES: ENERGY EFFICIENT DESIGN

Improvements to the building fabric and building services, in comparison to the "notional" performance criteria used to calculate the TER, are tested. The preferred range of measures is selected and the CO_2 emissions for this lean design are calculated.
At this stage the performance specification would typically demonstrate compliance with *ADL2A* in respect of:

1. Calculated CO2 emission rate (i.e. it would comply with the TER without any reliance on the contribution of clean or green measures);
2. Limits on design flexibility; and
3. Limiting solar gain in summer.

Due to the limitations of the NCM there are some lean measures that may be incorporated that have no impact on the reported predicted energy consumption or CO_2 emissions, for example water efficient showers and taps, and white goods that are 'A' rated for energy efficiency.

3.6 CLEAN MEASURES: HEATING AND COOLING SYSTEMS

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

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

The highest ranking feasible option is selected.

3.7 GREEN MEASURES: RENEWABLE ENERGY TECHNOLOGIES

The technical and economic feasibility of the following renewable energy technologies is then considered:

- Biomass CCHP/CHP (subject to clean measures proposed);
- Biomass heating;
- Renewable energy from waste;
- Photovoltaic cells;
- Solar water heating;
- Wind turbines; and
- Ground-coupled heating and cooling.

Other technologies such as solar air heating and hydroelectric may be considered on a site-specific basis.

The preferred technology or combination of technologies is selected and the residual CO_2 emissions are calculated.

3.8 FEASIBILITY

A feasibility study addresses whether something is capable of being done or achieved. In contrast a viability study considers whether it is capable of success or continuing effectiveness. In other words, if something is feasible it is possible whereas if it is viable it is practical. Typically the former places more emphasis on technical aspects and the latter on economic considerations. In practice the terms are used interchangeably.

Feasibility is always project-specific and can include many aspects, e.g. legal, technical, economic. Both planning policy and building regulations[1] refer to feasibility but neither defines its scope in any detail. The BREEAM NC 2011 assessment requires a feasibility study under Credit Ene 5 (Low or zero carbon technologies).

"This study covers as a minimum:

a. Energy generated from LZC energy source per year
b. Life cycle cost of the potential specification, accounting for payback
c. Local planning criteria, including land use and noise
d. Feasibility of exporting heat/electricity from the system
e. Any available grants
f. All technologies appropriate to the site and energy demand of the development.
g. Reasons for excluding other technologies.
h. Where appropriate to the building type, connecting the proposed building to an existing local community CHP system or source of waste heat or power OR specifying a building/site CHP system or source of waste heat or power with the potential to export excess heat or power via a local community energy scheme. (BRE, 2011, 145)

This scope could be considered to be best practice. This *Energy Statement* addresses all of these items except lifecycle cost/impact analysis and payback.

- For each technology, its appropriateness to the proposed development (f) is discussed. Where a technology is not considered appropriate reasons are provided (g).
- For each appropriate technology, the energy generated (a), relevant planning policy issues, including land use and noise (c), the feasibility of exporting energy (d) and available grants (e) are tabulated.
- Planning policy in general is covered in section 0.
- Available grants in general are discussed in section 0.
- Heating and cooling systems, including CHP and decentralised energy networks, are discussed in section 6

3.9 GRANTS

In the UK the main grant programme, the Low Carbon Buildings Programme, was closed to new applications on 24 May 2010, to be replaced by an alternative incentive schemes, based on tariffs. The 2008 Energy Act provided the legislative framework for the development of payments to ordinary energy users for the renewable energy they generate. These schemes are the:

- Feed-In Tariffs (FITs), promoting renewable electricity generation; and
- Renewable Heat Incentive (RHI), promoting renewable heat generation.

The FITs came in to force on 1st April 2010 and have three components:

1. A payment for all electricity produced;
2. A payment for any electricity exported to the grid; and
3. A reduction in the electricity bill for any energy produced and used.

These tariffs are index-linked for inflation and should cover the initial capital cost and, according to the Government, earn a return of up to 8 % per annum. In practice the capital cost should be paid back at least two to three times over the duration of the tariffs, which is 25 years for PV and 20 years for other systems.

The design of FITs has been changed on several occasions to reflect evolving government priorities. The framework was set up to have periodic reviews, the first in 2012 (to become effective from April 2013) and then at five-yearly intervals to coincide with reviews to the Renewables Obligation. However, the first review of the scheme was brought forward by the government in a statement on 7th February 2011. In practice the so-called 'first review' comprised four reviews and one additional rule change:

- Fast-track review, comprising a tariff reduction for larger solar PV systems (> 50 kW), effective from August 2011, and a tariff increase for AD systems, effective from September 2011;
- A rule change to the way in which system extensions are treated;
- Comprehensive review phase 1, the start of the review, covering reductions in PV tariffs from 03/03/2012;
- Comprehensive review phase 2A, a control mechanism to manage future tariff reductions for solar PV systems; and
- Comprehensive review phase 2B, covering changes to the non-PV tariffs and all other aspects of the FIT mechanism.

Consultation on the Phase 2B review closed on the 26th April 2012.

The RHI finally came to force on 30/11/2011 for non-domestic systems. The RHI is not expected to be introduced for domestic systems until 2013; in the interim a Renewable Heat Premium Payment can be claimed.
The RHI operates in a similar way to the FIT, being a payment for generating heat from renewable sources.

1. Reduced consumption fuel of (typically gas or oil) saves reduces utilities bills.
2. A payment is made for the useful heat produced.

These tariffs are index-linked for inflation and should cover the initial capital cost and, according to the Government, earn a return of around 12 % per annum. In practice the capital cost should be paid back in about seven to nine years. The duration of the tariff is 20 years.

This report refers to the FIT and RHI tariffs in lieu of grants. It should be noted that the tariff applicable to systems installed in the future will decrease with time, according to the scheme's annual degression rates.

Other grants are not covered in this *Energy Statement* but may be available in some cases.

Table 3 – basis of quoted fuel prices and tariffs

Parameter	Source
Fuel price (dwellings)	Average annual domestic electricity bills in 2010 for selected towns and cities in the UK with average unit costs (QEP 2.2.3) and Average annual domestic gas bills in 2010 for selected towns and cities in the UK with average unit costs (QEP 2.3.3), published on DECC website. Data is based on the London average for direct debit payment.
Export tariff (floor price)	http://www.fitariffs.co.uk/FITs/principles/export/, as at 22/12/2011
Generation tariff (Feed-In Tariff)	http://www.fitariffs.co.uk/eligible/levels/, as at 22/12/2011 (refer to section 3.7.3).
Renewable Heat Incentive (dwellings)	http://www.rhincentive.co.uk/eligible/levels/, as at 22/12/2011 (since rates for dwellings have not yet been published, proposed tariff levels within the original consultation document are used (refer to section 3.7.3)).

3.10 PURPOSE OF CALCULATIONS

The purpose of the calculations is to demonstrate compliance. The NCM prescribes design parameters for inputs such as occupancy, time scheduling, weather, internal temperatures, illuminance levels and equipment usage. Furthermore, even with DSM, there are limitations to the accuracy of the calculations. Therefore the calculations presented in this *energy statement* should not be taken as a prediction of expected energy consumption and CO_2 emissions.

4.0 ENERGY DEMAND ASSESSMENT

The baseline annual carbon emissions are shown in Table 4.

Table 4 - baseline annual carbon emissions

Description	Dwelling/ building emissions ($kgCO_2$)	Target emissions ($kgCO_2$)	Improve over target (%)	Unregulated emissions ($kgCO_2$)	Overall emissions ($kgCO_2$)	Improve over baseline (%)
Proposed development	74,127	74,127	0.0	64,453	138,580	0.00

5.0 ENERGY EFFICIENT DESIGN MEASURES

Energy efficiency is typically a more cost effective means of achieving carbon savings than LZCT. This is particularly true of passive measures (the architecture), which are simpler and have greater longevity than active systems (the building services).

With regard to the refurbishment of the existing building, *ADL2B* defines standards for the following:

- Controlled fittings (window, roof window, rooflight and door units);
- Controlled services (heating and hot water systems, mechanical ventilation, mechanical cooling/air conditioning, fixed internal lighting and renewable energy systems); and
- New, renovated and retained thermal elements (walls, roofs and floors).

The proposed development would exceed these standards.

The extension part of the proposed development would incorporate lean measures sufficient to achieve compliance with *ADL2A*, without reliance on clean and green measures.

5.1 PASSIVE DESIGN

5.1.1 FABRIC

Managing energy demand is only one of many design drivers of site layout and building form. Nonetheless, the proposed development is designed to passively manage energy demand. The building fabric is highly insulated and airtight. The new fenestration is designed to optimise daylighting and beneficial solar gain, while avoiding summer overheating.

5.1.2 THERMAL COMFORT

Policy 5.9 of the *London Plan* acknowledges the importance of thermal comfort in minimising energy demand and sets out a hierarchy for cooling buildings.

B. "Major development proposals should reduce potential overheating and reliance on air conditioning systems and demonstrate this in accordance with the following cooling hierarchy:
   a) minimise internal heat generation through energy efficient design
   b) reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls
   c) manage the heat within the building through exposed internal thermal mass and high ceilings
   d) passive ventilation
   e) mechanical ventilation
   f) 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*". (Mayor of London, 2011, 151)*

The proposed development has been designed in accordance with the cooling hierarchy.

- Heat gains from hot water storage, fans, pumps and controls and lighting are minimised.
- The building is orientated along a northeast-southwest axis, with openings located predominantly on the northeast and southwest elevations. The site lies in a high-density, urban location, where adjacent buildings provide extensive shading to glazing.
- The fenestration and building fabric balance beneficial and unwanted heat gains.
- Green and brown roofs reduces the amount of heat entering the building.
- The ceiling heights and predominantly traditional form of construction are dictated by the form of the existing building.
- Due to ambient noise and air quality, and the form of the existing building, the proposed development is mechanically ventilated and cooled. Both the ventilation and cooling systems would incorporate heat recovery to minimise CO_2 emissions.

Under Building Regulations the following checks are used to limiting solar gain in summer:

- For non-dwellings, ADL2A states *"for each space in the building that is either occupied or mechanically cooled, the solar gains through the glazing aggregated over the period from April to September inclusive are no greater than would occur through the…reference glazing systems" (HMG, 2010, 19)*.

However, under *ADL2A* spaces not intended to be occupied by the same person for a substantial part of the day, such as display windows, are exempt from this check. Therefore compliance in the retail part of the proposed development would be heavily influenced by the fit-out works.

Based on open-plan spaces, i.e. speculative development, all zones pass the *ADL2A* test.

5.2 ENERGY EFFICIENCY MEASURES

The energy efficiency measures incorporated in the proposed development are scheduled in Table 5 and Table 6. In summary these comprise:

- Insulated building fabric with low air permeability;
- Glazing with suitable U-value, g-value and daylight transmittance;
- Reverse-cycle Variable Refrigerant Flow (VRF) system for heating and cooling;
- Mechanical ventilation with heat recovery;
- Fluorescent lighting; and
- Power Factor Correction.

Table 5 – energy efficiency measures in the refurbished part of the proposed development

Energy efficiency measure	ADL2B standard	Proposed development
Controlled fittings		
Windows, roof windows, glazed rooflights, doors	U-value 1.8 W/m²K for the whole unit	U-value 1.4 W/m²K for the whole unit
Controlled services		
Space heating	Heat pumps (all types except absorption and gas engine): CoP 2.2 at the rating condition	CoP 3.7500 at the rating condition
Hot water	Point of use electrically heated water heater systems: assumed to be 100 % thermally efficient	Point of use electrically heated water heater systems: assumed to be 100 % thermally efficient
Comfort cooling	Variable Refrigerant Flow systems (cooling): cooling plant full load EER 2.5	Variable Refrigerant Flow systems (cooling): cooling plant full load EER 3.7500
Air distribution systems	Central mechanical ventilation system including heating and cooling: SFP 1.8 W/(l/s)	Central mechanical ventilation system including heating and cooling: SFP 0.9000 W/(l/s)
Lighting	Lighting efficacy 55 luminaire-lumens per circuit-Watt	Lighting efficacy 80 luminaire-lumens per circuit-Watt
General controls and insulation	As defined in the Non-Domestic Building Services Compliance Guide	As defined in the Non-Domestic Building Services Compliance Guide or better
New Thermal elements		
Walls	U-value 0.18 W/m²K	U-value 0.15 W/m²K
Roofs	U-value 0.18 W/m²K	U-value 0.15 W/m²K
Floors	U-value 0.22 W/m²K	U-value 0.15 W/m²K
Renovated and retained thermal elements (where threshold U-value is not met)		
Walls	U-value 0.30 W/m²K	U-value 0.15 W/m²K
Roofs	U-value 0.25 W/m²K	U-value 0.15 W/m²K
Floors	U-value 0.18 W/m²K	U-value 0.15 W/m²K

Table 6 – energy efficiency measures in the extension part of the proposed development.

Energy efficiency measure	ADL2A concurrent specification	Proposed development
Roofs	U-value 0.18 W/m²K; thermal capacity 21.8 kJ/m²K (1.40 kJ/m²K if metal clad)	U-value 0.1500 W/m²K; thermal capacity 21.8 kJ/m²K
Walls (including internal partitions between heated and unheated zones)	U-value 0.26 W/m²K; thermal capacity 88.3 kJ/m²K (1.40 kJ/m²K if metal clad)	U-value 0.1500 W/m²K; thermal capacity 88.3 kJ/m²K
Ground and exposed floors	U-value ≤ 0.22 W/m²K	U-value 0.1500 W/m²K
Windows, roof windows and rooflights	Dependent on NCM activity Side-lit activities: windows to be the lesser of either 40 % of exposed facade area or 1.5 m high across full facade width; U-value 1.80 W/m²K; g-value 0.40; frame factor 10 %; visible light transmittance 0.71 Top-lit activities: 12 % of exposed roof area made up of rooflights; U-value 1.80 W/m²K; g-value 0.43; frame factor 15 %; visible light transmittance 0.67 No-lit activities: no windows or rooflights	17.3 % of exposed wall by area (including display glazing and rooflights); U-value 1.40 W/m²K; g-value 0.40; frame factor 10 %; visible light transmittance 0.71
Internal wall	U-value 1.80 W/m²K; thermal capacity 8.8 kJ/m²K	U-value 1.80 W/m²K; thermal capacity 8.8 kJ/m²K
Internal floor/ceiling	U-value 1.00 W/m²K; thermal capacity 71.8 kJ/m²K from above, 66.6 kJ/m²K from below	U-value 1.00 W/m²K; thermal capacity 71.8 kJ/m²K from above, 66.6 kJ/m²K from below
Non-repeating thermal bridge heat losses	+10 % increase in U-value	+10 % increase in U-value
Air permeability	5.0 m³/hr/m² @ 50 Pa	5.0 m³/hr/m² @ 50 Pa
UK NCM system type	Dependent on NCM system type	Split or multi-split system
Heat recovery	Dependent on mechanical supply and extract ventilation provision Sensible efficiency 70 %, where appropriate	Plate heat exchanger (recuperator), seasonal efficiency 0.6500

Heating system	Dependent on NCM activity and heating fuel Electricity (heat pump), SCoP 2.430	Electricity (heat pump), SCoP 3.6782
Cooling system	SSEER 3.6	SSEER 2.8026
Domestic Hot Water	Dependent on NCM activity and heating fuel Electricity (direct), SCoP 0.855	Electricity (direct), SCoP 1.0000
Auxiliary Energy Value (AEV)	Dependent on NCM activity and NCM HVAC system Pump power density 0.30 W/m^2 Specific fan power (central) 1.80 W/(l/s)	Nil (included in SCoP for split systems) Specific fan power (central) 1.50 W/(l/s)
Demand control of ventilation	None	None
Management features	Electric power factor > 0.95	Electric power factor > 0.95
Metering provision	Automatic monitoring and targeting with alarms for out of range values	Automatic monitoring and targeting with alarms for out of range values
Lighting power density	General lighting: dependent on room geometry and based on efficacy of 55 luminaire lumens per circuit-watt Display lighting: dependent on NCM activity and based on efficacy of 15 luminaire lumens per circuit-watt	General lighting: dependent on room geometry and based on efficacy of 75 luminaire lumens per circuit-watt Display lighting: 15 luminaire lumens per circuit-watt
Lighting controls	Dependent on NCM activity and applicable to general lighting only (not display lighting) Daylight harvesting: photo-electric dimming, without back-sensor control and with continuous parasitic power (lesser of either 3 % installed lighting load or 0.3 W/m^2) No daylight harvesting: local manual switching as appropriate and provided the floor area for each zone is < 30 m^2 Occupancy sensor control: none Automatic time switch control: none	Occupancy sensor control: manual on auto off

5.3 CALCULATIONS

The lean building's energy demand is shown in Figure 2.

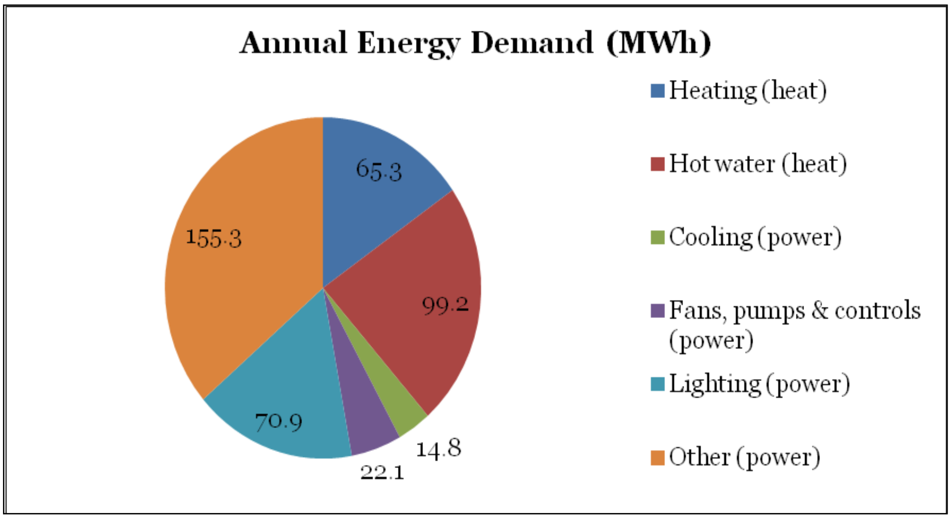


Figure 2 – the 'lean' building's annual energy demand

The lean building's annual carbon emissions are shown in Table 7.

Table 7 – 'lean' building's annual carbon emissions

Description	Dwelling/ building emissions ($kgCO_2$)	Target emissions ($kgCO_2$)	Improve over target (%)	Unregulated emissions ($kgCO_2$)	Overall emissions ($kgCO_2$)	Improve over baseline (%)
Proposed development	63,158	74,127	14.8	64,453	127,611	7.9

6.0 HEATING AND COOLING SYSTEMS

6.1 OPTIONS

The heating system for the proposed development has been considered in accordance with Policy 5.9 of the *London Plan*. There is no cooling system.

A. "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.

B. 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." (Mayor of London, 2011, 148)

6.1.1 CONNECTION TO EXISTING HEATING OR COOLING NETWORKS

At its closest, the site lies approximately 950 m, as the crow flies, from the closest existing or emerging Decentralised Energy (DE) network, as shown in Figure 3.

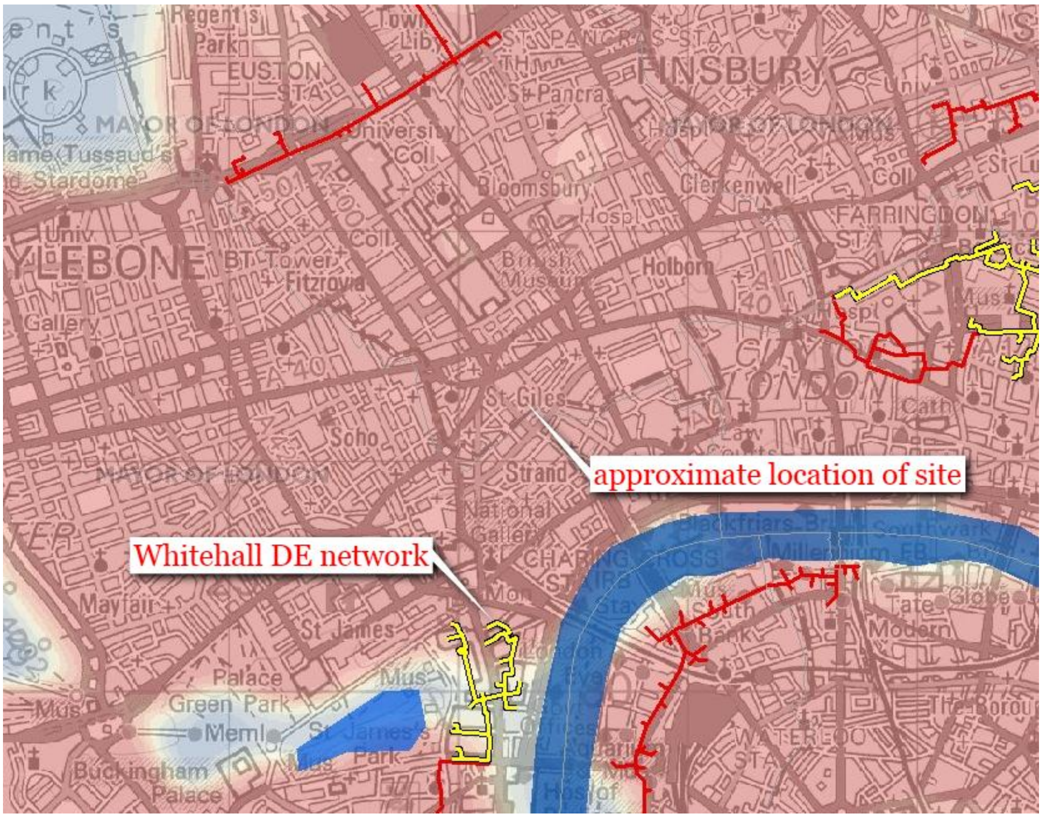


Figure 3 – excerpt from London Heat Map

Given that the capital cost of laying heat mains in London is typically in the range 1,000-1,500 £/m, connection to the Whitehall network is not considered feasible.

6.12 SITE-WIDE CHP NETWORK

Figure 4 shows the annual profile for heat and power demand

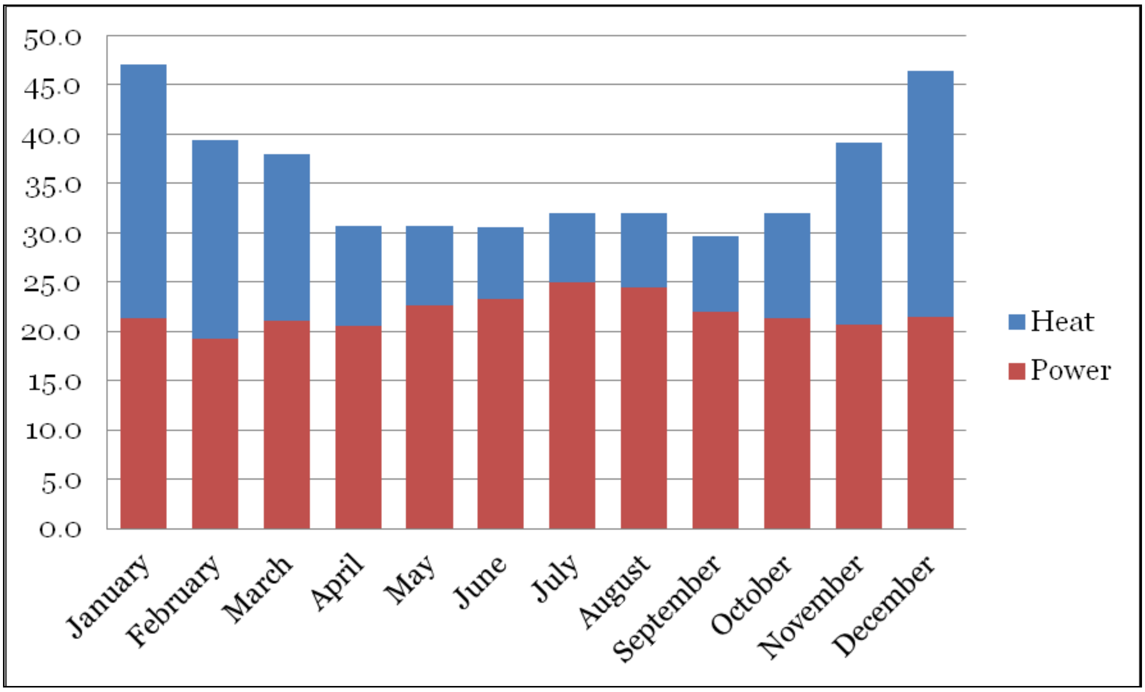


Figure 4 – annual profile for energy demand

CHP units typically generate 1-2 times as much heat as power. Carbon savings are achieved where both the power and heat is utilised. Though CHP units can often operate at part load, full load operation for long periods is preferable. The resultant supply profile is 'flat' (i.e. constant), whereas demand, particularly for heat, typically fluctuates, an imbalance that can be rectified by the use of storage. Electricity can be 'stored' via connection to the national grid, and a thermal store fulfils the same function for heat. Traditionally water is used as storage medium but more recently Phase Change Materials (PCMs) have been adopted as they store significantly more heat for a given volume.

It is rarely practical to store high-grade heat, such as that produced by CHP units, for more than 24 hours, as the size of the thermal store becomes very large. A further consideration is that between 00:00 and 07:00 electricity is available from the national grid at very low tariffs, so economic feasibility can be undermined by operating CHP plant overnight.

The base heat load is just 37 kWh per day, an average of 1.5 kW over a 24-hour period. This is level demand is too low to support CHP, which is therefore not technically feasible for the proposed development.

6.1.3 COMMUNAL HEATING AND COOLING

Community heating and cooling systems are preferred for their capacity to integrate LZCT, either on construction or at a later date; they do not in themselves significantly reduce carbon emissions. While there are benefits in terms of load diversity facilitating reduced overall plant capacity and better plant operating efficiency, there are 'parasitic' loads: electrical demand for circulating pumps and thermal losses through distribution pipework.

The energy efficiency measures include VRF systems for heating and cooling. These systems could be connected by a common condenser water circuit, which would allow:

- Heat recovery between systems (e.g. where one system is operating in cooling mode and another is simultaneously operating in heating mode); and
- Future connection to DE networks and/or LZCTs.

6.2 PROPOSALS

The proposed development incorporates heating and cooling systems connected to a communal condenser water circuit.

6.3 CALCULATIONS

Although the proposed arrangement would in practice improve the seasonal efficiency of the heating and cooling systems, determining the effect on CO_2 emissions relies on the manufacturer's data. For the purposes of this *Energy Statement*, it is assumed that the clean building's annual carbon emissions would be the same as those of the lean building.

7.0 RENEWABLE ENERGY TECHNOLOGIES

7.1 OPTIONS

The feasibility of the renewable energy technologies listed in the London Plan has been considered. Additionally, Air Source Heat Pumps (ASHPs) have been appraised, since they are considered to be 'renewable' under both BREEAM and the RHI

7.2 BIOMASS CCHP/CHP

The load profile of the proposed development indicates that CHP is not technically feasible, regardless of whether it is fuelled by gas or biomass.

7.3 BIOMASS HEATING

There are three primary technical considerations affecting the use of biomass:
1. Air quality;
2. Fuel delivery; and
3. Fuel Storage

In October 2000, LBC declared an Air Quality Management Area (AQMA) order covering several areas, extended to the whole of the borough in 2002, on account of elevated levels of Nitrogen Dioxide (NO_2) and PM_{10} particulate matter (PM_{10}). Biomass combustion typically releases relatively high level of Nitrous Oxides (NO_x) emissions. Therefore an air quality impact assessment would be required and it is highly likely that mitigation measures would be required. Typically each item of biomass plant would need to be fitted with a catalytic converter, at a capital cost of ~ £ 50,000.

In summary, air quality is not necessarily a problem, though it does limit the number, and/or increase the cost, of products that would be suitable for this location.

A fuel store for wood pellets, which have the highest calorific value density of the solid biomass fuels, would have a volume of ~ 1.534 m³, based on fortnightly deliveries.

The original Energy Options Report proposed the use of liquid biofuel, which is easier to transport and store. Due to its high calorific value density, a storage tank of 475 litres would be adequate, based on fortnightly deliveries. In either case the fuel store could be accommodated at basement level.

However both Shorts Gardens and Betterton Street are narrow side-streets with parking restrictions (double-yellow lines), which are not well suited to regular fuel deliveries.

In summary, this technology is not considered feasible for the proposed development.

7.13 RENEWABLE ENERGY FROM WASTE

The site is connected to the municipal sewer network. It is believed to be served by Thames Water's Beckton Sewage Treatment Works (STW), where a by-product of the process, methane, fuels CHP plant, generating renewable electricity for onsite use, with the exhaust heat being captured and used to pasteurise the sewage sludge. Therefore, strategically, there is no benefit in providing decentralised, onsite anaerobic digesters to generate biogas.

7.14 PHOTOVOLTAIC CELLS

Using the data from the Photovoltaic Geographical Information System (PVGIS), the optimum positioning of PV cells on the site is at an azimuth of -1° (almost due south) and an inclination of 36° (from horizontal). This arrangement maximises annual yield and, therefore, economic feasibility.

The building's orientation is 47 ° skew to the north-south axis. Arranging the arrays perpendicular to the Watts Grove elevation changes the optimum inclination to 30 ° and reduces the annual yield by ~ 6.0 %.

The arrays must be spaced to prevent mutual overshadowing and to allow access for maintenance. A further consideration is the space required by any solar collector array (refer to section 7.1.5).

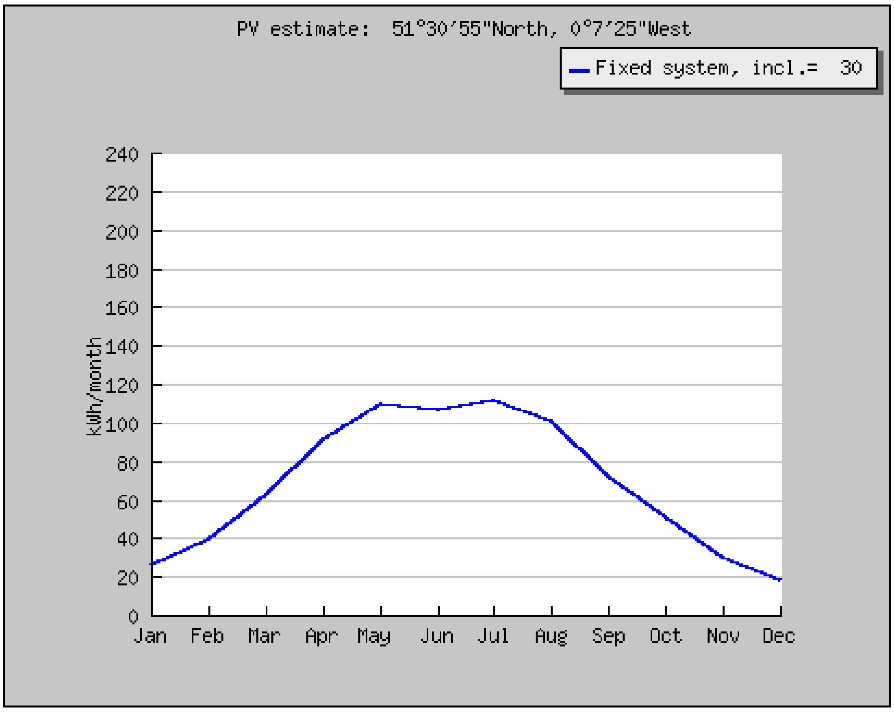


Figure 5 – typical energy output from 1 kW_{peak} PV system for the proposed development

The arrays must be spaced to prevent mutual overshadowing and to allow access for maintenance. A further consideration is the space required by any solar collector array (refer to section 7.1.5). The roof is predominantly flat with an area of circa 600m². It could accommodate an array of approximately $25kW_{peak}$, which would achieve an annual CO_2 saving of 10.4 t.

Table 8 - feasibility considerations for a PV system

Energy generation	Electricity: 19.6 MWh per annum
Local planning criteria	Land use: the PV array would be located on roof-mounted framing, indicated on the architect's general arrangement drawings, and the inverters would be located in the electrical risers.
Energy export	Electricity would be exported to the grid via landlord's main LV switchgear, which would be provided with G59 or G83 protection as applicable.
Grants	Feed-In Tariff • 37.8 p/kWh for 25 years for new systems with a rated output of ≤ 4kW • 43.3 p/kWh for 25 years for retrofit systems with a rated output of ≤ 4kW

	• 37.8 p/kWh for 25 years for systems with a rated output of between > 4kW and 10 kW • 32.9 p/kWh for 25 years for systems with a rated output of between > 10kW and 50 kW • 19.0 p/kWh for 25 years for systems with a rated output of between > 50kW and 150 kW • 15.0 p/kWh for 25 years for systems with a rated output of between > 150 kW and 250 kW • 8.5 p/kWh for 25 years for systems with a rated output of between > 250kW and 5 MW

7.1.5 SOLAR WATER HEATING

Solar Water Heating (SWH) is not feasible given the thermal load profile (refer to section 0), which shows very low heat demand during the summer, the period in which SWH output is highest.

7.1.6 WIND TURBINES

Wind turbines tend to perform poorly in urban environments, due to turbulence and low average wind speed.

- A widely reported study in 2007, by the Building Research Establishment (BRE), concluded that *"in many urban areas they are unlikely to pay back either their carbon emissions or the home owner's costs for installation and maintenance"*.
- In 2008, the Carbon Trust commissioned a review of small wind power technology from the UK Meteorological Office and Entec, which drew a similar conclusion: *"in many urban situations, roof-mounted turbines may not pay back the carbon emitted during their production, installation and operation"*.
- The Encraft Warwick Wind Trials Project, covering 168,950 hours of operation of 26 building-mounted wind turbines from five manufacturers across the UK during 2007-2008, found that the industry and technology is *"still at development stage and is likely to make a tangible contribution to energy and carbon saving only on the most exposed sites and tallest buildings"*. Excluding data from periods when turbines were switched off or broken the average capacity factor was 4.15 %, significantly lower than the 10-30 % typical for larger turbines on free standing sites in good areas.

According to the Department of Energy & Climate Change's windspeed database, the average wind speed at the site is 4.8, 5.5 and 6.0 m/s at 10, 25 and 45 m above ground level respectively. However, the data is derived from an air flow model, with a resolution of 1 km square, that simply estimates the effect of topography on wind speed, without taking in to account local thermally driven winds or topography, which can have a considerable effect on wind speed. The site lies within an urban area characterised by high density development that is generally of a similar but varying height. Consequently the average wind speed on the site is believed to be < 5 m/s, considered the lower limit for commercial viability by RenewableUK, with a wind microclimate characterised by high levels of turbulence.

Therefore this technology is not considered feasible for the proposed development.

7.1.7 GROUND-COUPLED HEATING AND COOLING

There are three types of ground-coupling. In all cases, successful application is highly dependent on geological and hydrogeological conditions, so specialist input is required at an early stage. It is not known whether the ground is contaminated; further investigation is understood to be required to confirm that remediation and/or mitigation measures would not be required. System efficiency is improved where the annual heating and cooling demand is in balance, particularly for vertical systems.

1. Horizontal, closed-loop heat exchangers are plastic pipework loops buried in the ground, typically at a depth of around 2 m.
2. Vertical, closed-loop heat exchangers are plastic pipework loops inserted in to drilled boreholes.
a. One type is the energy pile, where one or two loops are inserted in to a structural pile. This minimises additional ground works and can be cost-effective, the reported additional cost being circa £ 400 per pile. However, there are only a limited number of piling contractors capable of this work. The capacity of energy piles in clay is typically 30-40 W/m, though it may be possible to increase this by around half by using two loops in each pile.
b. The alternative type is deeper, dedicated boreholes, which are typically spaced on a six-metre grid to minimise their mutual impact on thermal performance.
3. Vertical, open-loop heat exchangers extract water from an aquifer, typically injecting the used water, at a different temperature, in to the same aquifer, a short distance away. The heat exchanger footprint is smaller but the yield (the sustainable flow rate, which is proportionate to system capacity) is unpredictable. Securing the relevant consents and drilling the boreholes is an expensive process, typically costing circa £ 250,000 per pair, regardless of yield. Licenses are granted by the Environment Agency, usually for a period of ten years, after which the licensee must apply for renewal.

Since the proposed development comprises the refurbishment and extension of an existing building, the footprint of which occupies most of the site, it is questionable whether ground coupling is technically feasible. Certainly the area available would be inadequate for a horizontal heat exchanger.

The addendum to the original *Energy Options Report* considered this point in detail, as requested by the planning authority, and concluded that ground coupling is an unsuitable technology on account of:

- Archaeology and programme risk;
- Limited headroom to accommodate a drilling rig;
- Replacing and raising the floor to accommodate the header pipework; and
- Capital cost.

This assessment is considered to remain valid. Furthermore, the improvement in Coefficient of Seasonal Performance (CoSP) achieved by ground-coupling over conventional air-coupling (refer to section 0) is limited which, given the additional capital cost, undermines the economic feasibility.

Consequently, ground-coupled heating and/or cooling is not considered feasible.

7.1.8 AIR-SOURCE HEAT PUMPS

Demand for heating can be met by heat pumps. The most efficient form of heat pump is Variable Refrigerant Flow (VRF), as the number of heat exchangers is limited and heat recovery can be achieved when there is simultaneous heating and cooling demand in different parts of the building.

VRF is proposed, as discussed in sections 5.2 and 6.1.3. VRF is only considered to be a RET in heating mode. In comparison to a gas boiler with a SCoP of 0.792[2], VRF heating would achieve an annual CO_2 saving of 1.5 t.

Table 9 - feasibility considerations for ASHPs

Energy generation	Thermal: 36.7 MWh per annum
Local planning criteria	Land use: the ASHPs would be located in a dedicated plant compound at roof level. Noise and vibration: location, attenuation and isolation would need to be considered to ensure that there is no significant adverse impact on sensitive receptors.
Energy export	The thermal energy generated is unsuitable for export to a DE network.
Grants	Renewable Heat Incentive: • 7.5 p/kWh for 18 years for small installations (rated at up to 45 kW); or • 2.0 p/kWh for 20 years for medium installations (rated at 45 to 350 kW)

7.2 PROPOSALS

The proposed development incorporates the following renewable energy technologies:

- VRF systems sized to meet the space heating and cooling demand; and
- A PV system, rated at 25 kW_{peak}.

7.3 CALCULATIONS

The green building's annual carbon emissions are shown in Table 9.

Table 9 – 'green' building's annual carbon emissions

Description	Dwelling/ building emissions ($kgCO_2$)	Target emissions ($kgCO_2$)	Improve over target (%)	Unregulated emissions ($kgCO_2$)	Overall emissions ($kgCO_2$)	Improve over baseline (%)
Proposed development	63,158	74,127	14.8	64,453	127,611	7.9

The VRF systems are included in the energy efficiency measures, so the difference between the 'lean' and 'green' building's CO_2 emissions are attributable entirely to the PV system.

[2] This is SCoP for gas boilers under the NCM concurrent specification.

8.0 COMPLIANCE

8.1 DEVELOPMENT CONTROL

This *Energy Statement* is intended to demonstrate compliance with planning policy, and is for submission as part of a planning application. Figure 6 illustrates the hierarchical approach adopted and the resultant reduction in overall CO_2 emissions.

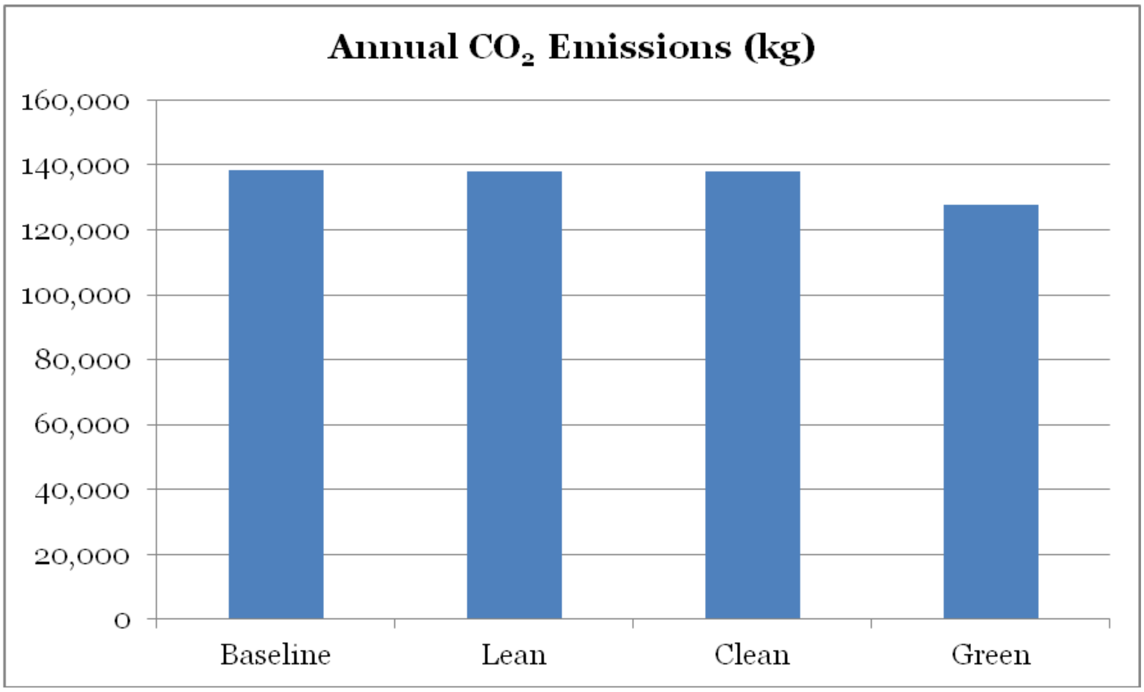


Figure 6 – hierarchical approach to energy strategy

The key metrics are listed below.

- The improvement over the baseline attributable to lean measures, i.e. energy efficient design: 0.4 %
- The carbon saving attributable to clean measures, i.e. heating and cooling systems: 0.0 %.
- The carbon saving attributable to green measures, i.e. renewable energy technologies: 7.5 %
- The proposed development's overall improvement over the baseline: 7.9 %
- The proposed development's overall improvement over the TER: 14.8 %

The proposed development's improvement on 2010 Building Regulations, which includes only regulated end uses of energy is 14.8 %. The proposed development therefore does not meet the current *London Plan* target for a 25 % improvement. However:

- The larger part of the proposed development comprises the refurbishment of an existing building, where there are limitations to the energy efficiency measures that can be incorporated;
- By adopting a more robust methodology and reconsidering the feasibility of evolving technologies such as VRF, LED lighting and PV cells, the proposed development's CO_2 emissions have been reduced by almost 40 % since the original application.

8.2 BUILDING CONTROL

The as-designed BRUKL output document demonstrates that the proposed development would comply with *ADL2A*.

In terms of CO_2 emissions, the BER represents a 14.8 % improvement over the TER.

8.3 ENERGY PERFORMANCE CERTIFICATES

The draft EPC shows an Energy Performance Asset Rating of 22 (Band A)

8.4 ENVIRONMENTAL ASSESSMENTS

The *BREEAM pre-assessment estimator* demonstrates how the target rating of very good could be achieved. The preparation of this Energy Statement contributes evidence for the following credits.

- Ene 1 (Reduction of CO_2 emissions): 4 of 15
- Ene 4 (Low or Zero Carbon Technologies): 1 of 5

LIST OF ABBREVIATIONS AND ACRONYMS

Abbreviation or acronym	Definition
ADL1A	Approved Document L1A: Conservation of fuel and power in new dwellings
ADL2A	Approved Document L2A: Conservation of fuel and power in new buildings other than dwellings
AQMA	Air Quality Management Area
ASHP	Air Source Heat Pump
BER	Building Emission Rate
BRE	Building Research Establishment
BREEAM	Building Research Establishment Environmental Assessment Method
BS	British Standard
CCHP	Combined Cooling Heat and Power
CHP	Combined Heat and Power
CIBSE	Chartered Institution of Building Services Engineers
CO_2	Carbon dioxide
CoSP	Coefficient of Seasonal Performance
CPSU	Combined Primary Storage Unit
CSH	Code for Sustainable Homes
dBA	A-weighted decibels
DCLG	Department for Communities and Local Government
DE	Decentralised Energy
DECC	Department of Energy and Climate Change
DER	Dwelling Emission Rate
DHW	Domestic Hot Water
DPD	Development Planning Documents
DSM	Dynamic Simulation Modelling
DX	Direct Expansion
EiP	Examination in Public
EPC	Energy Performance Certificate
FEE	Fabric Energy Efficiency
FIT	Feed-In Tariff
G59	Engineering Recommendations G59/1: Recommendations for the connection of embedded generating plant to the Regional Electricity Companies' distribution systems
G83	Engineering Recommendations G83/1: Recommendations for the connection of small scale embedded generators (up to 16A per phase) in parallel with public low voltage distribution networks
GLA	Greater London Authority
GSHP	Ground Source Heat Pump
HLP	Heat Loss Parameter
HMG	Her Majesty's Government
ISO	International Organization for Standardization
LBE	London Borough of Enfield
LCC	Life Cycle Cost (also referred to as lifecycle cost)
LDF	Local Development Framework
Low-E	Low emissivity
LTHW	Low Temperature Hot Water
LZC	Low or Zero Carbon
LZCT	Low or Zero Carbon Technologies
NCM	National Calculation Methodology
NO_2	Nitrogen Dioxide
NO_x	Nitrous Oxides
ODPM	Office of the Deputy Prime Minister
PCM	Phase Change Material
PFC	Power Factor Correction

PM_{10}	Particle matter of 10 µm or less
PPS 22	Planning Policy Statement 22: Renewable Energy
PV	Photovoltaic
PVGIS	Photovoltaic Geographical Information System
QEP	Quarterly Energy Prices
RHI	Renewable Heat Incentive
SAP	Standard Assessment Procedure
SCoP	Seasonal Coefficient of Performance
SEDBUK	Seasonal Efficiency of Domestic Boilers in the UK
SPD	Supplementary Planning Document
SPG	Supplementary Planning Guidance
SSEER	System Seasonal Energy Efficiency Ratio
STW	Sewage Treatment Works
SWH	Solar Water Heating
tds	Tonnes dry solids
TER	Target Emission Rating
TfL	Transport for London
TM	Technical Memorandum
TMP	Thermal Mass Parameter
UDP	Unitary Development Plan
VRF	Variable Refrigerant Flow
WEEE	Waste Electrical and Electronic Equipment
WHMV	Whole House Mechanical Ventilation
WLC	Whole Life Cost