CUNDALL

Span Group
Shorts Gardens

Energy and Sustainability Statement

Job No: 1014196

Doc No: 1014196-RPT-SU002

Latest Revision: B

Date: 12/04/2017

Cundall Johnston and Partners LLP One Carter Lane London EC4V 5ER Tel +44 (0)20 7438 1600 www.cundall.com

Document Revision History

Project name	Shorts Gardens	Job Number
Report Name	Energy & Sustainability Statement	1014196

Revision Ref	Issue Date	Purpose of issue / description of revision
-	01/03/2017	Draft issue for comment
A	24/03/2017	First issue
B	12/04/2017	Amended site address and floor areas

Document Validation (latest issue)

11/04/2017

X Christina Iona

Principal author

Signed by: Iona, Christina

11/04/2017

X Chris Turner

Checked by

Signed by: Turner, Chris

11/04/2017

X

Verified by

Signed by: Wyatt, Simon

1. Executive Summary

Low environmental impact will be key to the design of the proposed Shorts Gardens development. This Energy and Sustainability Statement outlines the development's approach to sustainability, energy efficiency and renewable energy strategies in order to meet the London Borough of Camden and the Greater London Authority's (GLA's) planning requirements.

Shorts Gardens is a refurbishment, extension and alteration of 60-70 Shorts Gardens and 14-16 Betterton Street, London.

The principal objective is to minimise the development's contribution to climate change through the reduction in CO_2 emissions. This will be achieved by reducing the development's demand for energy, meeting this demand through decentralised energy sources and incorporating renewable technologies.

The following measures have been incorporated into the design:

- Thermal insulation levels for all building elements to be enhanced beyond minimum Building Regulation standards;
- Good solar control will be provided by the selection of glazing so as to avoid overheating in summer and encourage good daylighting levels;
- Individual variable refrigerant flow (VRF) systems will be specified for each residential unit, retail unit and the office development;
- All elements will be mechanically ventilated with heat recovery to reduce the heating demands associated with incoming fresh air. NOx filters will be specified to improve indoor air quality on units in sensitive areas;
- Indoor environments have been demonstrated to have a low-risk of overheating in line with the GLA's Cooling and Overheating requirements;
- For the residential units, mechanical ventilation with heat recovery units will provide background ventilation and reduce the heat demand associated with incoming fresh air. Comfort cooling will be provided in all units to be used at the occupant's discretion;
- Natural daylighting will improve occupant comfort and reduce the requirement for artificial lighting, reducing energy consumption;
- The development will use low energy lighting throughout;

This combination of passive design measures and energy efficient systems should result in a **32%** reduction in CO_2 emissions over the site-wide area weighted baseline.

An investigation into the feasibility of connecting to a district energy network as per Policy 5.6 of the London Plan concluded that there were no existing or proposed networks within a feasible connection distance to the development. Further investigation into supporting a combined heat and power (CHP) unit on site was undertaken.

The nature of the development as a six storey office building means heat demand will be relatively low due to the high heat gains generally present in office spaces. Domestic hot water (DHW) demand is generally low in offices and electric point of use water heaters are considered a more feasible solution. The piping requirements of a centralised DHW system and the costs associated with this make a centralised system less cost effective than an electric point of use. The above reasoning along with the limited plant space in the basement constitute to CHP not being a feasible option for this development.

A study into low and zero carbon (LZC) technologies was undertaken as per Policy 5.7. Photovoltaic panels, solar thermal and wind turbines are being discounted as the development is within a conservation area of Camden and these items would not be permitted on the exterior of the building.

The use of variable refrigerant flow heat pumps will be specified for the commercial and residential units. The use of this technology for both commercial and residential developments could reduce CO_2 emissions by a further **16%**.

The combination of the above measures results in a site wide CO_2 emissions reduction of **48%** over the baseline, thus complying with Policy 5.2 of the London Plan. Non-domestic elements exceed the GLA's 35% reduction target. As the residential units are not classified as a major development there is not a requirement to achieve Zero Carbon. Instead, efforts have been maximised to reduce CO_2 emissions as far as possible within the constraints of the site.

Sustainable measures that feature in this development include:

- All insulation materials used within the proposed development will be selected to be CFC free both in manufacture and composition;
- Building materials, where possible, will be sourced locally to reduce transportation pollution & support the local economy;
- All timber will be purchased from responsible forest sources;
- Recycling facilities will be provided on site for construction and operational waste;
- Water use will be minimised by the specification of water efficient taps, shower heads, dual flush toilets and low water use appliances;
- The construction site will be managed in an environmentally sound manner in terms of resource use, storage, waste management, pollution. A Site Waste Management Plan (SWMP) will be produced for the works.
- A preliminary BREEAM assessment has been undertaken, indicating that a 'Very Good' rating could be achieved with an aspiration of 'Excellent'.

Site Wide Emissions

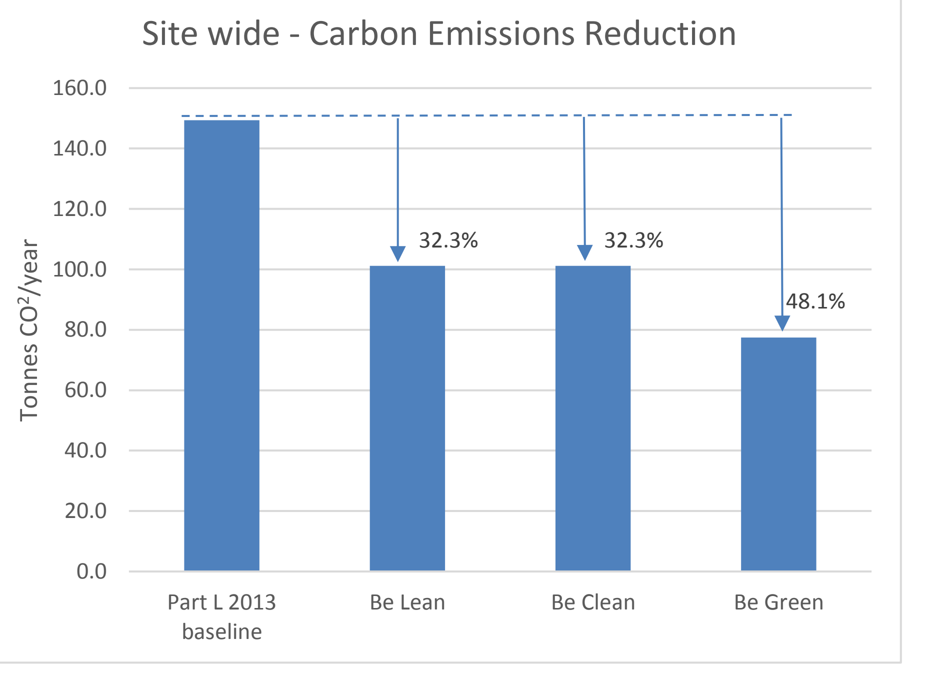


Figure 1: Estimated CO_2 Emission Savings

Site Wide

Table 6: Site wide regulated carbon dioxide emissions and savings	Total regulated emissions (Tonnes CO2/year)	CO2 savings (Tonnes CO2/year)	Percentage saving (%)
Baseline	149.3		
Be Lean	101.1	48.2	32.3%
Be Clean	101.1	0.0	0.0%
Be Green	77.5	23.7	15.9%
	CO_2 savings off-set (Tonnes CO_2)		
Off-set	N/A		

Non-Domestic

Table 3: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for non-domestic buildings	Carbon dioxide emissions for non-domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline	135.4	59.8
After energy demand reduction	88.3	59.8
After CHP	88.3	59.8
After renewable energy	66.9	59.8

Table 4: Regulated carbon dioxide savings from each stage of the Energy Hierarchy for non-domestic buildings	Regulated Carbon dioxide savings	
	Tonnes CO_2 per annum	%
Savings from energy demand reduction	47.1	34.8%
Savings from district heating	47.1	34.8%
Savings from renewable energy	21.4	15.8%
Total Cumulative Savings	68.5	50.6%

Domestic

Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings	Carbon dioxide emissions for domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations	13.9	22.7
After energy demand reduction	12.8	22.7
After district heating	12.8	22.7
After renewable energy	10.5	22.7

Table 2: Regulated carbon dioxide savings from each stage of the Energy Hierarchy for domestic buildings	Regulated Carbon dioxide savings	
	Tonnes CO_2 per annum	%
Savings from energy demand reduction	1.1	7.8%
Savings from district heating	0.0	0.0%
Savings from renewable energy	2.3	16.2%
Total Cumulative Savings	3.3	24.0%
Annual Savings from off-set payment	N/A*	N/A*
	(Tonnes CO_2)	
Cumulative savings for off-set payment	N/A*	

CUNDALL

Contents

2. Introduction

This Energy and Sustainability Statement has been prepared to accompany planning applications for the proposed Shorts Gardens development. It aims to meet the energy and climate change requirements of the London Borough of Camden and the Greater London Authority (GLA).

The structure of this report follows the approach in the 'GLA's Guidance on Preparing Energy Assessments' document, March 2016, which provides guidance on addressing the London Plan's energy hierarchy.

The principal objectives are to reduce the site's contribution to the cause of climate change by minimising the emissions of CO_2, by reducing the site's needs for energy and by providing some of the requirement by renewable/sustainable means. Issues such as water and waste, biodiversity, construction site impacts and material usage have also been addressed in the present study.

The GLA London Plan and GLA Energy Strategy are considered to be the benchmark for local planning regulation. Together they provide a useful tool against which to undertake energy and sustainability assessment. They have been used in an advisory nature secondary to the requirements of the local councils, to help incorporate a number of energy efficiency measures into the proposed development.

As per the requirements of the GLA, a BREEAM NC2014 pre-assessment has been undertaken, indicating that as a minimum the commercial development will attain a 'Very Good' rating, with an aspiration for 'Excellent'. The summary of the commercial assessment is presented in Appendix C.

As the residential development is classified as a minor development, there is not a requirement for a BREEAM assessment. The Code for Sustainable Homes scheme has been wound up by the Government and new assessments are no longer accepted. It has instead been used as guidance for the residential units to ensure that sustainable housing is delivered.

2.1 Description of Development

The refurbishment, extension and alteration of 60-70 Short Gardens and 14-16 Betterton Street to provide a two storey roof extension to both properties and a mix of B1/A1/A3/D1/D/C3 uses. The development proposes the refurbishment of the basement and the installation of a mezzanine floor at basement and ground floor levels of Shorts Gardens to provide a mix of A3/D1/D2 uses with B1 uses on the upper floors; and the change of use of Betterton Street to provide a mix of C3/A1/A2 uses. Ancillary uses and plant would be provided within the basement of Betterton Street, with cycle storage at ground and basement mezzanine levels and a waste storage area at ground floor. Waste storage for the commercial uses and a substation are proposed at the ground floor of Shorts Gardens.

The proposed GIAs, including the addition of floors are as follows:

Element	Proposed GIA
Residential units	467
Office areas	2,619
Speculative retail units	1018
Back of house plant areas	145

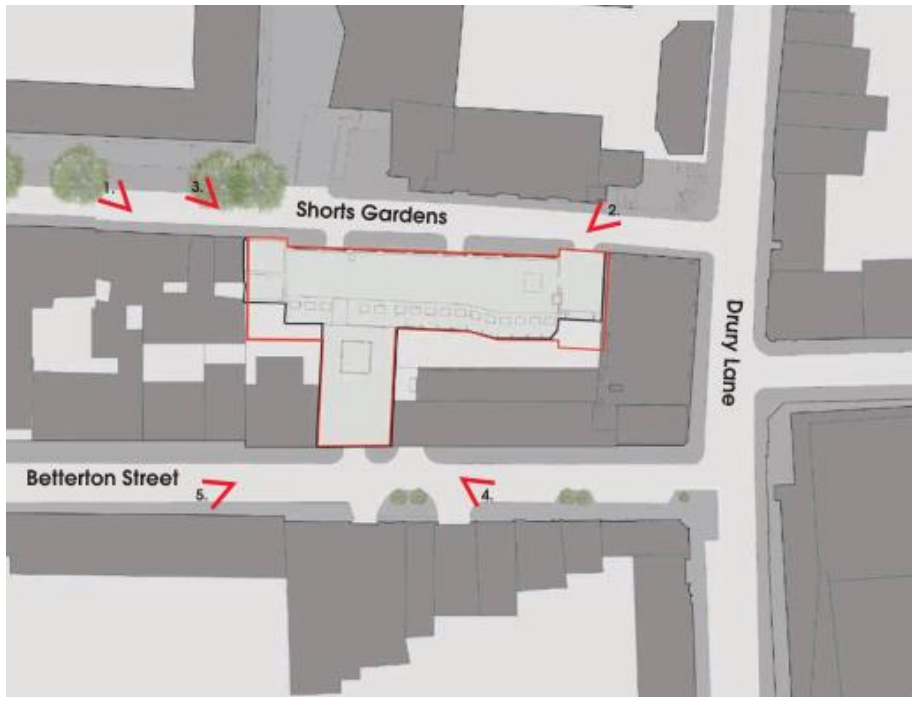


Figure 2: Site Location

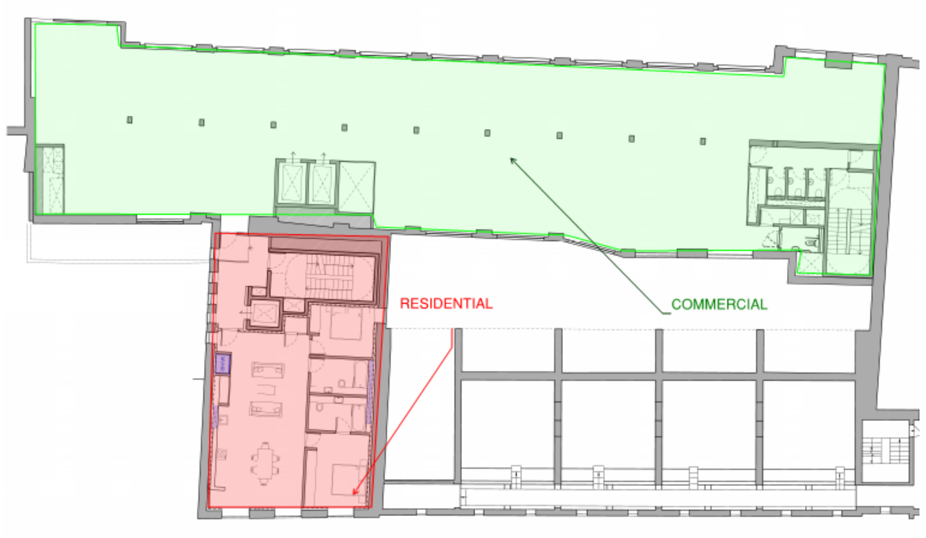


Figure 3: Typical floor plan

CUNDALL

3. Planning Policy

The National Planning Policy Framework (NPPF) was published in March 2012, which states a clear presumption in favour of sustainable development. The NPPF supports the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change, and encourages the reuse of existing resources, including conversion of existing buildings, and encourages the use of renewable resources.

The NPPF replaces PPS22 and in Section 10 outlines its energy and climate change policies. To support the move to a low carbon future, local planning authorities should:

- Plan for new development in locations and ways which reduce greenhouse gas emissions;
- Actively support energy efficiency improvements to existing buildings; and
- When setting any local requirement for a building's sustainability, do so in a way consistent with the Government's zero carbon buildings policy and adopt nationally described standards.

In determining planning applications, local planning authorities should expect new developments to:

- comply with adopted Local Plan policies on local requirements for decentralised energy supply unless it can be demonstrated that this is not feasible or viable; and
- take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption;
- have a positive strategy to promote energy from renewable and low carbon sources;
- identify opportunities where development can draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co-locating potential heat customers and suppliers.

The key focus of the NPPF is to support local and regional planning authorities.

3.1 The London Plan

The GLA London Plan 2015, London Plan REMA October 2013 and GLA's Guidance on Preparing Energy Assessments April 2015 document are considered to be the benchmark for local planning regulation. Together they provide a useful tool against which to undertake energy and sustainability assessments. The London Plan sets out a number of core policies for major developments with regards reducing CO_2 emissions and providing energy in a sustainable manner.

As the residential development, does not qualify as 'major' the London Plan targets are not technically applicable and therefore they have been used in an advisory way secondary to the requirements of the Borough of Camden, to help incorporate a number of energy efficiency measures into the proposed development.

Policy 5.2 - requires that major non-domestic developments achieve a 35% improvement over the 2013 Building Regulations CO2 Target Emission Rate. Major domestic development is required to be Zero Carbon, with at least a 35% improvement over 2013 Building Regulations CO2 Target Emission Rate achieved on site. The remaining regulated carbon dioxide emissions of major developments, are to be offset through a cash in lieu contribution to Camden Council.

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

- Be lean: use less energy
- Be clean: supply energy efficiently
- Be green: use renewable energy

Policy 5.6 - requires all major developments to evaluate the feasibility of connecting to existing or proposed district heating networks and where no opportunity existing consider a site wide combined heat and power (CHP) system.

Policy 5.7 - requires that all major developments seek to reduce their CO_2 emissions by at least 20% through the use of onsite renewable energy generation wherever feasible. Individual development proposals will also help to achieve these targets by applying the energy hierarchy in Policy 5.2.

3.2 London Borough of Camden

The London Borough of Camden set out their approach to sustainable development through their Core Strategy, Development Policies and Supplementary Planning Documents. Core Strategy Policy 13 sets out the overarching approach to sustainability in the borough, with the aims of mitigating and adapting to climate change, promoting local energy generation, managing water resources and reducing carbon dioxide emissions.

The Development Policies provide further detail as to how the Core Strategy policies can be achieved. In this instance *"Development Policy 22 – Promoting Sustainable Design and Construction*" provides the details as to how the targets of CS13 will be meet and states:

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

- Demonstrate how sustainable development principles, including relevant measures set out in paragraph 22.5 below, have been incorporated into the design and proposed implementation; and
- Incorporate green or brown roofs and green walls wherever suitable."

The council will promote and measure the sustainable design and construction by:

- Expecting non-domestic developments of 500sq m of floor space or above to achieve *"very good"* in BREEAM assessments and *"excellent"* from 2016 and encouraging zero carbon from 2019.

The council will require developments to be resilient to climate change by ensuring scheme include appropriate climate change adaption measures, such as:

- Summer shading and planting;
- Limiting run-off;
- Reducing water consumption;
- Reducing air pollution;
- No locating vulnerable uses in basements in floor-prone areas.

In addition to this policy, the Supplementary Planning Document *"Camden Planning Guidance 3 – Sustainability"* provides greater detail on the targets for developments and the approach that should be adopted in meeting these targets.

CUNDALL

4. Energy Strategy

The design has been developed to reduce its annual energy consumption, whilst providing energy in the most environmentally friendly manner to reduce its annual CO_2 footprint.

The initial focus is on passive building measures such as high levels of insulation and air tightness, followed by energy efficiency. In order to achieve this, a "Steps to Low Carbon" methodology has been applied.

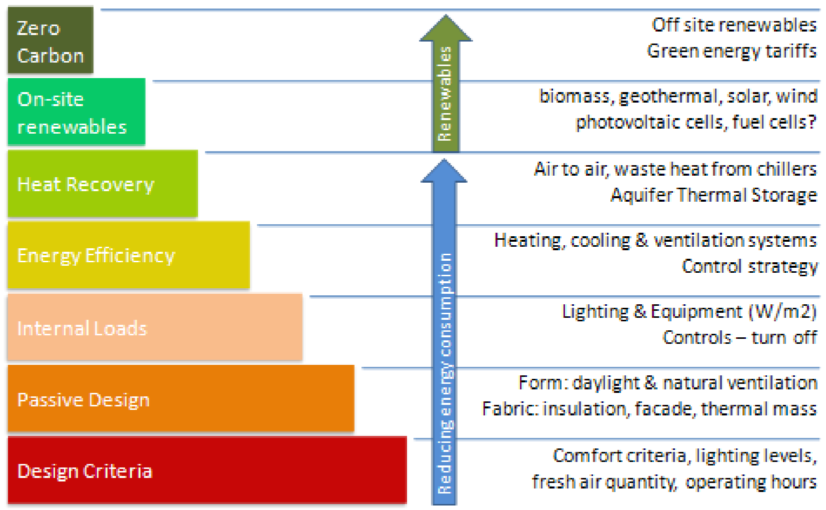


Figure 4: Steps to Low Carbon

The energy strategy will consider the different requirements of the residential and commercial elements. The proposed measures are in response to the requirements of Part L1A for new dwellings, Part L1B for existing dwellings and Part L2B of the Building Regulations for existing non-domestic development.

The energy strategy follows the GLA's Energy Hierarchy, which is thus:

- Be Lean: energy reduction through passive design measures and energy efficient systems;
- Be Clean: potential to connect to a district heating network or host a combined heat and power unit;
- Be Green: the inclusion of low and zero carbon technologies in the scheme.

4.1 Passive Design

Substantial reductions in energy usage for the scheme will be achieved through the consideration of the passive elements of the design, together with improved occupant comfort. The aim is to optimise the passive building elements and hence reduce the energy consumption associated with the mechanical systems. This is balanced between a range of requirements and accounting for factors such as site constraints and acoustic considerations.

Each building usage type has been considered in terms of optimising passive design for each usage.

Passive Solar Design – Day Lighting vs. Solar Control

Glazing types and window locations have been carefully considered, so that low angle winter solar gains and sun light are able to enter the space providing 'free' heating and lighting in winter. Solar gain is controlled in summer through solar coatings on the glazing to reduce the risk of 'overheating'. This has been achieved by the careful selection of glazing types and areas.

The quantities of solar radiation entering the internal spaces have been limited by the specification of high performance (HP) glass. HP glazing limits the amount of solar radiation in summer whilst maintaining a good level of daylight penetration.

Visible light transmission (VLT) will be maximised into commercial spaces to promote the use of photocell controlled daylight dimming in perimeter areas, reducing the need for artificial lighting in these areas.

Building Envelope

Improving the thermal insulation standards beyond the minimum Building Regulation standards will help to reduce the annual CO_2 emissions associated with all of the building's heating and cooling systems, by limiting the heat loss through the building's fabric.

Varying levels of thermal insulation will be specified for the domestic and non-domestic elements. The residential units are to be specified with better U-values, to reflect the greater proportion of total energy that is used on space heating than non-domestic units.

The non-domestic units will use relaxed U-values to reflect the higher internal gains generally present, reducing the space heating demand as a proportion of total energy consumption.

All new thermal elements will therefore be specified to achieve an improvement over the minimum standards of the Building Regulations:

Building Element	Part L1A (new built) minimum standards	Targeted new built design values
Floors [W/m^{2}K]	0.25	0.13
Roofs [W/m^{2}K]	0.20	0.13
External Walls [W/m^{2}K]	0.30	0.18
Glazing [W/m^{2}K]	2.00	1.40
g-value [%]	-	0.60
Doors [W/m^{2}K]	2.00	1.8
Air Permeability [m^3/(h·m^2] at 50Pa	10	3
Thermal Bridging Y-value [W/m^{2}K]	0.15	0.05

Table 4: Domestic new construction elements design values

Building Element	Part L1B retained elements minimum standards	Targeted refurbishment design values
Floors [W/m^{2}K]	0.25	0.25
Roofs [W/m^{2}K]	0.18	0.18
External Walls [W/m^{2}K]	0.30	0.25
Glazing [W/m^{2}K]	-	-
g-value [%]	-	0.60
Doors [W/m^{2}K]	-	-
Air Permeability [m^3/(h·m^2] at 50Pa	N/A	5.0
Thermal Bridging Y-value [W/m^{2}K]	N/A	0.08

Building Element	Part L1B minimum standards for new elements	Targeted new elements design values
Floors [W/m^{2}K]	0.22	0.20
Roofs [W/m^{2}K]	0.18	0.16
External Walls [W/m^{2}K]	0.28	0.25
Glazing [W/m^{2}K]	1.60	1.40
g-value [%]	-	0.60
Doors [W/m^{2}K]	1.8	1.8

Air Permeability [m³/(h·m²] at 50Pa	N/A	5.0
Thermal Bridging Y-value [W/m²K]	N/A	0.08

Table 5: Domestic refurbishment design values

Building Element	Part L2B minimum standards for new elements	Targeted new elements design values
Floors [W/m2K]	0.22	0.20
Roofs [W/m2K]	0.18	0.16
External Walls [W/m2K]	0.28	0.26
Glazing [W/m2K]	1.8	1.6
g-value [%]	-	
High usage entrance doors [W/m2K]	3.5	3.5
All other pedestrian doors [W/m2K]	1.8	1.6
Air Permeability [m3/(h·m2] at 50Pa	-	5.0

Building Element	Part L2B retained elements minimum standards	Targeted refurbishment design values
Floors [W/m2K]	0.25	0.25
Roofs [W/m2K]	0.18	0.18
External Walls [W/m2K]	0.30	0.30
Glazing [W/m2K]	1.8	1.6
g-value [%]	-	
High usage entrance doors [W/m2K]	3.5	3.5
All other pedestrian doors [W/m2K]	1.8	1.6
Air Permeability [m3/(h·m2] at 50Pa	-	5.0

Table 6: Non-domestic refurbishment design values

For any areas with curtain walling, an area-weighted U-value of 1.0W/m²K will be targeted.

Thermal Bridging

Linear thermal bridge Ψ values if not considered carefully will have a high conductivity which will require a greater enhancement of the other elements of the building envelope to compensate. Where this is not possible, all architectural details will be in accordance with the enhanced construction details listed on the Energy Trust website or as an absolute minimum as per the requirements of Accredited Construction Details document.

Accredited Construction Details (ACD's) have been developed to assist the construction industry to comply with the performance standards in Part L of the Building Regulations. They focus on issues concerning insulation continuity and airtightness and suggest a common approach to design, construction and testing methodology, and general improvements of the process.

Air Permeability

An air pressure test of sample units will be carried out in order to determine the air leakage rates and take any remedial actions to improve it. An air leakage rate of 3m³/hr/m² at 50Pa will be targeted for the domestic development in comparison with the Building Regulation minimum standards for new buildings other than dwellings of 10m³/hr/m² at 50Pa. For the domestic elements utilising the retained façade, a relaxed air permeability of 5m³/hr/m² will be targeted.

For the non-domestic elements, air permeability of 5m³/hr/m² at 50Pa through the façade will be targeted.

Good air tightness will be achieved by prefabrication of a number of key building components under factory conditions, robust detailing of junctions and good building practices on site.

4.2 Energy Efficient Systems & Appliances

After assessing the contribution of the passive elements to the overall energy balance, the aim is to further reduce CO_2 emissions by selecting efficient mechanical and electrical systems and efficient controls to manage the energy used during operation. On the basis of good practice the following principles will be adopted throughout the proposed development where possible:

Ventilation – Mechanically Ventilated

The development will be predominantly mechanically ventilated, with high efficiency heat exchangers that will greatly reduce the heating load associated with incoming fresh air for space heating.

Historically, fresh air in buildings was supplied through window openings and trickle vents, but as these are uncontrolled systems they result in large amounts of wasted heat. In order to minimise the heating load associated with the fresh air, individual mechanical ventilation with heat recovery (MVHR) units are proposed for the dwellings. Centralised air handling units (AHU)s with heat recovery will serve office and retail areas, ensuring the heating load associated with incoming fresh air is minimised.

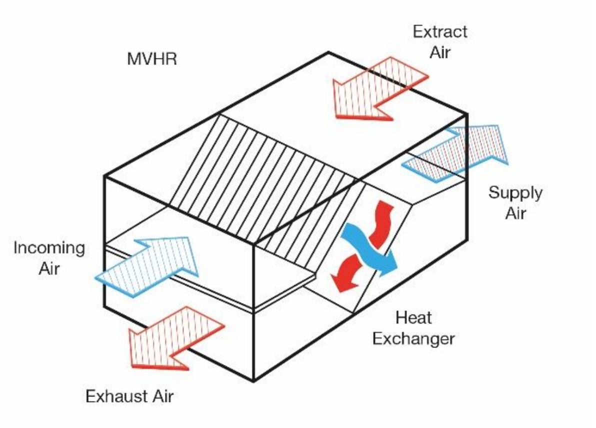


Figure 4: MVHR heat exchanger

The mechanical ventilation system will incorporate high efficiency heat recovery with a ErP Directive compliant target efficiency of 85%, minimising the heating loads associated with conditioning the supply air. It should be noted that the MVHR system will be sized to provide the fresh air requirement for all spaces served and NOT to maintain internal temperatures in summer. Separate kitchen hood extracts will also be provided where needed.

The initial analysis of residential layouts indicates that all of the occupied spaces will achieve the CIBSE Guide A "Environmental Design" recommended internal conditions assuming that each space has a minimum equivalent openable free area of at least 5% of the space's floor area.

Comfort cooling will be provided to all units to be used at the occupant's discretion, when windows are not operated for acoustic reasons.

In-line NOx filters will be specified for the incoming air ductwork, in order to remove harmful nitrous oxides from the external air. This will only be included on units where elevated levels of NOx are anticipated.

Eco-Labelled Goods

As lights and appliances account for about a third of the CO_2 emissions in development, where domestic appliances are installed energy efficient units will be incorporated, including A and A+ rated appliances.

Figure 5: White Goods efficiency rating

Low-Energy Lighting

Installing efficient low energy light fittings internally and externally can significantly reduce a building's overall lighting load hence lowering its annual CO_2 emissions.

To reduce the energy consumption associated with artificial lighting, 100% of internal lighting fittings will be energy efficient with high luminous efficacies in excess of 95 lumens/circuit Watt for all spaces. The fixing must be permanently fitted to the ceiling or wall and can contain one or more lamps.

The development has been designed to maximise daylight into offices and circulation areas, reducing the need for artificial lighting in the first place. In all the office areas located in the perimeter zone of the building, daylight dimming and absence detection controls will be specified.

In the circulation, storage, waiting, reception, changing and WC areas passive infrared (PIR) sensors with an Auto ON/Auto OFF control strategy will be utilised.

HVAC System Plant Efficiencies

The design team will specify all equipment and plant to exceed the minimum requirements of the Non-Domestic Building Services Compliance Guide. This provides guidance on the means of complying with the requirements of Part L2B of the Building Regulations for conventional space heating systems, hot water systems and cooling systems.

Variable Speed Pumps and Drives

All fans and pumps should be specified with variable-speed drives, which will reduce their energy consumption by more than two-thirds compared with equivalent non-variable speed alternatives, by only supplying the required flow rate to meet the demand.

Controls

The heating systems will be appropriately zoned, allowing fast local response to changes in loads. Appropriate lighting controls, including timers, occupancy controls and dimming shall be specified where applicable for all internal lighting.

Where both heating and cooling is available for spaces, interlocks will be provided to prevent simultaneous operation and therefore wasted energy.

Energy Metering

Metering of the energy uses within the development separately, will help the building users identify areas of increased consumption and highlight potential energy-saving measures for the future, hence reducing the associated annual CO_2 emissions from these systems.

Metering will allow the FM Teams to identify where faults are causing excess energy consumption to occur.

For the proposed development, all energy supplies will be metered by end energy use, with energy display devices located in a visible place to enable building users to monitor and therefore take actions to reduce their CO_2 emissions.

Figure 6: 2013 Non-Domestic and Domestic Building Services Compliance Guide - used in the selection of HVAC equipment

5. Overheating and Cooling

The proposed development has been designed to minimise its use of energy intensive cooling systems through passive design and efficiency measures.

5.1 GLA Cooling Hierarchy

To reduce the need for cooling and reduce the risk of overheating, the following measures have been taken in accordance with Policy 5.9 of the GLA's Cooling Hierarchy:

1) Minimising internal heat generation:

Low energy lighting will be used throughout the development to minimise internal gains. In addition to this, daylight dimming is provided to all occupied areas of the office elements with access to daylight. This will reduce the internal gains from lighting during hours when external temperatures are higher. The VRF distribution pipework and any storage cylinders will be well insulated, beyond the requirements of the Building Regulations, to minimise heat gain and any risk of overheating within internal corridors. Domestic hot water within all elements will be generated locally with minimal distribution losses.

2) Reducing the amount of heat entering the building:

Shorts Gardens is an existing development in a conservation area of Camden (refer to Appendix D for area map), and as such there are limited changes that can be made to the façade. Therefore, secondary glazing will be installed to achieve targeted u-values. Once heat gains through the glazing have been minimised through this approach the heat entering the offices will be further reduced through the specification of glazing with a low solar transmission (g-value) of 32% or lower for the windows.

Glazing units of the residential development will be pushed back on the walls, to minimise solar gains incident on the glazing. Double glazing units will be used with a maximum U-value of 1.40 W/m^{2}K.

The combination of these measures will provide a significant reduction in the heat entering the building.

3) Use of thermal mass and high ceilings to manage heat:

Due to the refurbishment nature of the development and the construction techniques used, it is not possible to incorporate thermal mass.

4) Passive Ventilation:

Shorts Gardens is located in a central location of London. A study into applying natural ventilation in commercial and domestic areas has been made. Concerns over external noise levels and air quality suggest that a mechanical ventilation system would be a more appropriate solution for this location. As such passive ventilation is not considered a feasible solution for this development.

5) Mechanical Ventilation:

As the natural ventilation is an uncontrolled system and it results in large amounts of wastage, a mechanical ventilation is being proposed for this development. In order to minimise the heating load associated with the fresh air, controlled Mechanical Ventilation with Heat Recovery (MVHR) systems are being proposed for all elements. MVHR uses the heat in the extract air to pre-warm the incoming air, thereby reducing the heating load. The design of an MVHR system will need to ensure that the fan powers are minimised and that the ductwork is insulated to avoid heat losses to unconditioned spaces.

6) Active Cooling:

Comfort cooling will be provided to all elements of the development. In the residential units local cooling will serve living areas and bedrooms to ensure that thermal comfort can still be achieved during the warmer days of the year. This is to be provided from individual variable refrigerant (VRF) systems.

5.2 Criterion 3 – Limiting Solar Gains

The results of the criterion 3 for the non domestic analysis included in the BRUKL document shows that all spaces are achieving the solar gain limits by a significant margin.

As part of the SAP 2012 calculations, the risk of high internal temperatures is considered. Based on the inputs detailed in this report, the results of this assessment found the following likelihoods in the apartments tested:

Space	Overheating Risk
One storey flat	Slight
Two storey flat	Medium

6. Estimated Annual Energy Consumption

In accordance with the London Plan and London Borough of Camden's Policy DP22, the estimated energy consumption for the development has been calculated. The estimated energy consumption for the development has been based on the National Calculation Methodology (NCM).

The energy assessment has been carried out for the proposed scheme with the aforementioned passive and energy efficient measures.

The proposed residential units within the existing fabric have been compared against a base case comprising of minimum fabric and system efficiency standards, as per the guidance of the Approved Document Part L1B.

New residential units have been compared against the Part L1A notional building.

The office/retail development was compared against a base case scenario, which was modelled to the Part L2B 2015 minimum standards for a refurbished development.

6.1 Residential Units

The residential units were based on the latest architectural layouts, received on 22/02/2017. A representative sample of the proposed unit types were modelled using the Standard Assessment Procedure (SAP) through the approved software Elmhurst Energy 2012.

The following parameters were assigned to the residential development in order to assess compliance with Part L, as per Policy 5.2 of the London Plan:

- Heating provided by electric panel heaters;
- Cooling provided by a split unit with a Seasonal Energy Efficiency Ratio (SEER) of 2.5;
- Domestic hot water (DHW) will be produced by an electric hot water storage cylinders in each apartment;
- Mechanical ventilation through a balanced unit with a low specific fan power of less than 1.5W/l/s and high heat exchanger thermal efficiency (>90%);
- Hot water daily usage to be less than 125l/person/day;
- All ductwork to be semi-rigid, all hot water pipework to be fully insulated;
- All light fittings to be low energy light (L.E.L.) fittings.

Area Weighted Results

Area Weighted Results	Be Lean	
	Absolute	per sqm
Heating (kWh)	11877	52.2
Hot water (kWh)	9230	37.3
Lights (kWh)	1780	7.3
Fans & Pumps(MWh)	1517	6.6
Cooling (kWh)	263	1.3
Total Energy (kWh)	24667	52.7
DER ($kgCO_2$)	12802	27.4
TER ($kgCO_2$)	13887	29.7
Improvement (%)	**8%**	

The proposed new build and retained residential development could achieve an area-weighted **8%** reduction in CO_2 emissions over a base-case scenario.

6.2 Commercial Elements

A combined energy assessment of the proposed non-domestic elements of the development have been carried in line with the National Calculation Methodology (NCM).

Office Areas

The ground to fourth floor of the Shorts Gardens building will accommodate B1 office accommodation developed to a CAT A fit out.

The following parameters were assigned to the residential development in order to assess compliance with Part L, as per Policy 5.2 of the London Plan:

- Conventional boiler and chiller arrangement providing heating and cooling, with a boiler efficiency of 89%;
- Direct Point of Use Domestic Hot Water;
- AHU specific fan power (SFP) of 1.8 W/l/s;
- Heat recovery system sensible efficiency of 85%;
- High efficiency cooling systems with SEER of 5;
- All fans & pumps will be fitted with variable speed equipment;
- General lighting efficacy – 95 luminaire lumens/circuit watt;
- Display lighting efficacy – 25 lumens/circuit watt;
- Full BEMS system with the ability to draw attention to 'out of range' values for all HVAC and lighting systems;
- Power factor correction to achieve a whole-building power factor of at least 0.95.

Retail Units

It is currently being proposed to have a mixture of A3/B1/D1/D2 retail units at ground floor and basement level in the two buildings. The units will be only be developed to serviced shell standard, and therefore the following good practice design parameters are recommended for consideration and have been used in the assessment in order to reduce the CO_2 emissions of the development. The prospective tenant fit-out team should use this information for reference, with individual parameters given as guidance only:

- Conventional boiler and chiller arrangement providing heating and cooling, with a boiler efficiency of 89%;
- Direct Point of Use Domestic Hot Water;
- AHU specific fan power (SFP) of 1.8 W/l/s;
- Heat recovery system sensible efficiency of 85%;
- High efficiency cooling systems with SEER of 5;
- All fans & pumps will be fitted with variable speed equipment;
- General lighting efficacy – 95 luminaire lumens/circuit watt;
- Display lighting efficacy – 25 lumens/circuit watt;
- Full BEMS system with the ability to draw attention to 'out of range' values for all HVAC and lighting systems;
- Power factor correction to achieve a whole-building power factor of at least 0.95.

System	CO_2 Emissions ($kgCO_2/m^2$)	
	Baseline (TER)	Be Lean (BER)
Heating	10.95	6.90
DHW	3.95	3.89
Cooling	3.55	1.34
Aux	9.86	6.35
Lighting	7.50	4.88
Renewables	0.00	0.00
Total ($kgCO2/m^2$)	35.81	23.36
CO2 reduction from baseline		**34.8%**

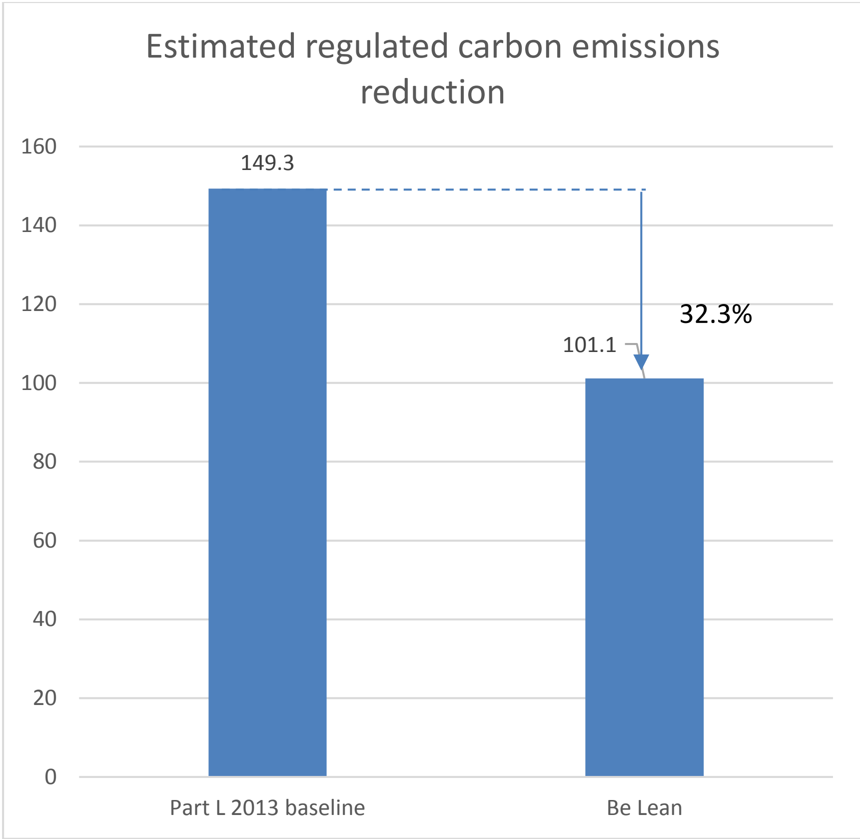
Based on the assumed fit-out and described fabric parameters, the commercial elements achieve a **34.8%** reduction in CO_2 emissions compared to the baseline.

6.3 Area Weighted Site Wide CO_2 Emissions

The estimated regulated CO_2 emissions for the development, by end use, and the savings from energy efficiency measures are detailed below:

Table 6: Site wide regulated carbon dioxide emissions and savings	Total regulated emissions (Tonnes CO2/year)	CO2 savings (Tonnes CO2/year)	Percentage saving (%)
Baseline	149.3		
Be Lean	101.1	48.2	32.3%

The combination of passive design measures and energy efficient systems across the development gives a combined **32.3%** reduction in area weighted CO_2 emissions over the Building Regulations standards.



7. Decentralised Energy Networks

The feasibility of connecting to an existing district network has been investigated for the site in accordance with Policy 5.6 of the London Plan. The London Heat Map indicates that there are two existing district networks, Whitehall and Pimlico within approximately 0.62 miles from site and Citigen District Heating Scheme within 0.88 miles from the site.

There is a proposal to expand the Citigen district heating system, however this is not planned to be extended nearer to the site. Connection to one of the existing district networks is not considered feasible due to the size of the development and the cost of extending the existing district heating system nearer to the site.

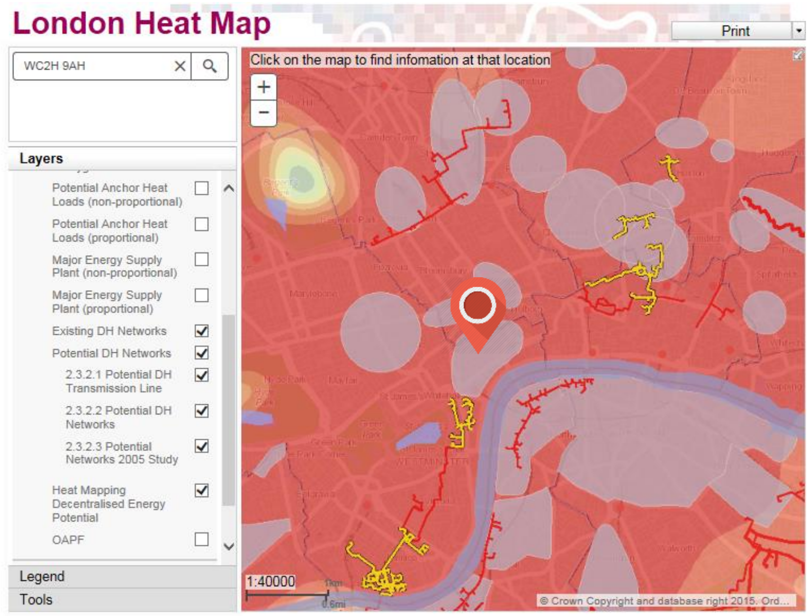


Figure 7: London Heat Map: Red = Proposed, Purple = Potential, Yellow = Installed

8. Combined Heat & Power (CHP)

As part of the energy centre design the feasibility of incorporating a Combined Heat & Power system (CHP) will have to be reviewed in detail in accordance with the GLA's Decentralised Energy Hierarchy in Policy 5.6. The site is within an Air Quality Management Area and therefore if a CHP unit is installed there is a chance that a catalytic converter will also have to be installed to ensure local air pollution is kept to a minimum.

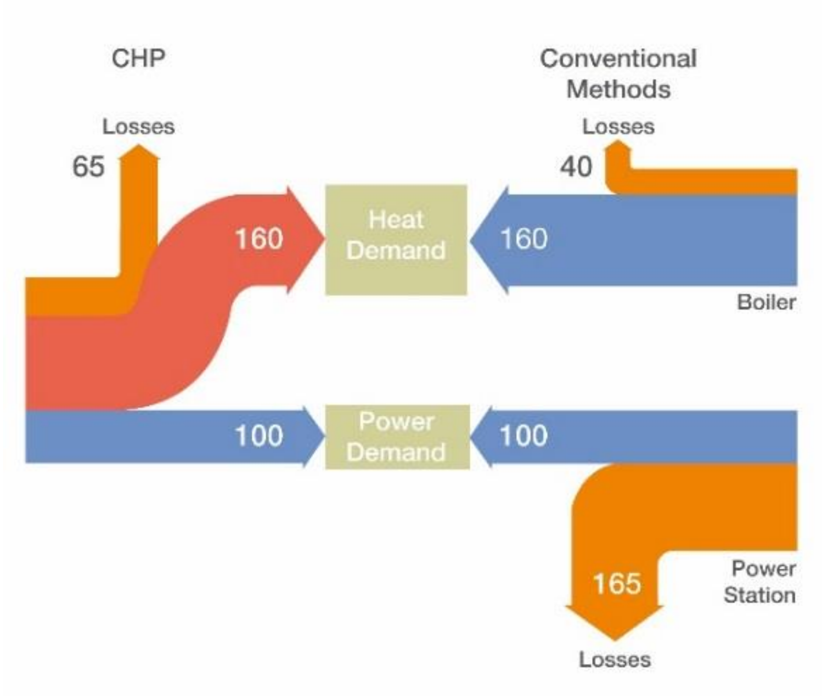


Figure 8: CHP Efficiency Diagram

An initial assessment shows that the nature of the development as a six storey office building means heat demand will be relatively low due to the high heat gains generally present in office spaces. Domestic hot water requirements are generally low in offices and electric point of use water heaters are considered a more feasible solution. The piping requirements of a centralised DHW system and the costs associated with this make a centralised system less cost efficient than an electric point of use. The above reasoning along with the limited plant space in the basement constitute to CHP not being a feasible option for this development.

9. Low and Zero Carbon Energy Sources

Policy 5.7 of the London Plan requires that all major developments seek to reduce their CO_2 emissions by at least 20% through the use of onsite renewable energy generation wherever feasible. The following technologies have been investigated to determine the feasibility of delivering a reduction in the CO_2 emissions through renewables.

The feasibility of each of the energy sources listed has been assessed with regard to the potential contribution each could make to supply a proportion of the development's delivered energy requirement, whilst considering the technical, planning, land use and financial issues.

9.1 GSHP (Ground Source Heat Pumps)

Ground source heat pumps require either horizontal trenches or vertical boreholes to be excavated in order to accommodate piles or loops.

The Shorts Gardens scheme is the refurbishment of an existing building. As such, installing piles or trenches underneath the existing slab would be technically and financially challenging.

Furthermore, GSHPs only work when there is a relatively balanced heating and cooling load. The proposed residential units have a far larger heating than cooling demand. Over time, this would result in the abstraction of heat permenantly from the ground, reducing the ground temperature to a point whereby the seasonal effciency of the heat pumps drops off to a point where they are no more efficient than direct electric heating.

For these reasons, ground source heat pumps have not been considered for the Shorts Gardens scheme.

9.2 Biomass Heating

Biomass boilers work best when they are meeting a constant load, as they modulate slowly and with a detrimental effect on their efficiency.

Biomass boilers are no longer recommended for inner city and urban deployment due to concerns related to air quality. Even with comprehensive treatment of exhaust gases, biomass boilers will exhume more local pollutants than gas fired CHP units and high efficiency boilers. Many London boroughs now prohibit the installation of biomass boilers for this reason.

Additionally, biomass boilers require significant space for storage and delivery of fuel. Therefore, biomass boilers have not been considered feasible for the proposed development.

9.3 Photovoltaic Panels

Photovoltaic solar cells convert solar energy directly into electricity. The cells consist of two layers of silicon with a chemical layer between. The incoming solar energy charges the electrons held within the chemical. The energised electrons move through the cell into a wire creating an electrical current.

The advantage of photovoltaic cells is once they are installed they require minimal maintenance over their operational life and have no primary fuel requirements.

The development is located within the Seven Dials conservation area of Camden and as such it is not proposed to include photovoltaic panels as part of the development.

9.4 Solar Thermal

Solar thermal collectors utilise solar radiation to heat water for use in buildings. The optimum orientation for a solar collector in the UK is a south facing surface, tilted at an angle of 30º from the horizontal.

Solar collectors are typically designed to meet a development's base heat load, associated with its domestic hot water requirements. For residential development, these usually equates to 60-70% of the total DHW annual load, with the natural gas-fired boilers meeting the remainder of the load.

As the development is located within a conservation area of Camden, solar thermal collectors cannot be considered for this scheme (refer to Appendix D for area map),

9.5 Wind Turbines

The output from wind turbines is highly sensitive to wind speed. Hence it is essential that turbines should be sited away from obstructions, with a clear exposure or fetch for the prevailing wind.

The development is located within a conservation area of Camden and as such it is not proposed to include wind turbines as part of the development.

9.6 ASHP (Air Source Heat Pumps)

Air source heat pumps exchange heat between the outside air and a building to provide space heating in winter and cooling in the summer months. The efficiency of these systems is inherently linked to the ambient air temperatures.

Heat pumps supply more energy than they consume, by extracting heat from their surroundings. Heat pumps can supply as much as 4kW of heat output for just 1kW of electrical energy input. The CO_2 emissions associated with heat pumps will further decrease in the future as the National Grid continues to decrease in carbon intensity.

Typically, there are two main types of air sourced heat pump systems, one which is refrigerant-based system (VRF) and one which is water based system (Air to water heat pumps). VRF system transfer heat from one location another using a refrigerant. The volume or flow rate of refrigerant is accurately matched to the required heating or cooling loads thereby saving energy and providing more accurate control.

It is proposed to install air source heat pumps (ASHP) to the development which will be connected with variable refrigerant systems (VRF). Individual VRF system for the office, retail units and residential developments are currently proposed.

Replacing conventional boiler and chiller plant with the VRF system could result in a further **15.9%** reduction in CO_2 emissions across the scheme.

9.7 Renewable Energy Strategy

Analysis of the non-domestic elements of the development indicate that the proposed conventional heating and cooling solution for shell and core units could be replaced with a variable refrigerant flow air source heat pump. This would result in a further 15.9% reduction in CO_2 emissions for the whole development non-domestic elements.

Table 6: Site wide regulated carbon dioxide emissions and savings	Total regulated emissions (Tonnes CO2/year)	CO2 savings (Tonnes CO2/year)	Percentage saving (%)
Baseline	149.3		
Be Lean	101.1	48.2	32.3%
Be Clean	101.1	0.0	0.0%
Be Green	77.5	23.7	15.9%

10. Proposed Energy Strategy

As the proposed development is a major development, the strategy has followed the methodology of the Mayor's Energy Hierarchy with the estimated energy consumption for the development based on the National Calculation Methodology (NCM). As per the GLA's Guidance on Preparing Energy Assessments Document, the domestic and non-domestic elements of the mixed-use scheme have been assessed separately before being combined for a site-wide calculation.

'Be Lean' – Passive Design and Efficient Systems

The proposed development will be well insulated ensuring that heat losses are kept to a minimum with enhanced U-values in the building envelope exceeding Building Regulations standards. This will reduce heat losses via conduction. Mechanical ventilation with heat recovery will reduce the heating load associated with incoming fresh air and improve the internal air quality.

Energy efficient lighting will be specified throughout, with zonal controls and daylight dimming used in applicable non-domestic areas to further reduce electrical consumption. Metering will be used in all elements to inform building users of their energy consumption.

Cooling will be provided to the office areas and all residential units. Recommendations for the shell and core retail units it will be specified in the fit-out guide for high Seasonal Energy Efficiency Ratios.

The combination of passive design features and energy efficient systems across domestic and non-domestic development results could result in a site wide reduction in CO_2 emissions of **32%** over the baseline.

'Be Clean' – Decentralised Energy and CHP

The feasibility of connecting to an existing or proposed district heating network has been investigated for the site in accordance with Policy 5.6 of the London Plan. There are no existing or proposed district heating networks within a viable connection distance to the site. The site itself has an inadequate heat load to act as an anchor for a new district network in the local vicinity.

The site is within an Air Quality Management Area and therefore if a CHP unit is installed there is a chance that a catalytic converter will also have to be installed to ensure local air pollution is kept to a minimum. The low base heat load does not lend itself to the effective operation of CHP, and therefore this technology has not been considered for the development.

An initial assessment shows that the nature of the development as a six storey office building means heat demand will be relatively low due to the high heat gains generally present in office spaces. Domestic hot water requirements are generally low in offices and electric point of use water heaters are considered a more feasible solution. The piping requirements of a centralised DHW system and the costs associated with this make a centralised system less cost efficient than an electric point of use. The above reasoning along with the limited plant space in the basement constitute to CHP not being a feasible option for this development.

'Be Green' – Low and Zero Carbon Technologies

In accordance with Policy 5.7 of the London Plan, investigations into providing a proportion of the site's energy requirements through renewables was undertaken.

Ground source heat pumps are considered unviable for the development due to the unbalanced heating and cooling loads and the development's status as an existing building.

Biomass boilers are considered unviable due to local air quality concerns and competing for the base heat load with the preferred solution, the combined heat and power unit.

Solar thermal collectors, photovoltaics and wind turbines are not considered for this development as it is located within a conservation area of Camden.

Variable refrigerant flow air source heat pumps are proposed to provide the cooling and heating to all elements of the development. Recommendation for the use of this technology will be written into the retail tenant's fit out guide. This could result in a **16%** reduction in the CO_2 emissions of the whole development.

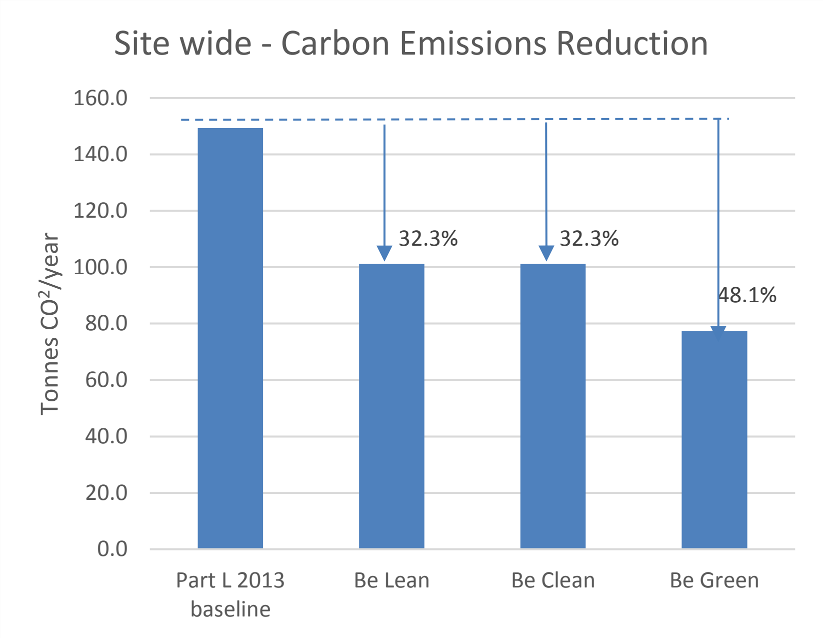
10.1 Summary

The area-weighted calculation for the scheme indicates that the proposed development is achieving a **48%** improvement over the baselines with the major non-domestic elements exceeding the 35% target, thus achieving Policy 5.2 of the London Plan.

After all stages of the GLA's energy hierarchy have been applied, the non-domestic elements are demonstrating a 51% improvement over the baseline, thus complying with Policy 5.2 of the London Plan.

After all stages of the GLA's energy hierarchy have been applied, the residential development is achieving a 24% improvement over the baseline. As the residential units qualify as 'minor' development, there is no requirement to achieve zero carbon emissions on site.

This reduction in carbon emissions means that the development complies with the requirements of London Borough of Camden and the GLA.



Site Wide

Table 6: Site wide regulated carbon dioxide emissions and savings	Total regulated emissions (Tonnes CO2/year)	CO2 savings (Tonnes CO2/year)	Percentage saving (%)
Baseline	149.3		
Be Lean	101.1	48.2	32.3%
Be Clean	101.1	0.0	0.0%
Be Green	77.5	23.7	15.9%
	CO_2 savings off-set (Tonnes CO_2)		
Off-set	N/A		

Non-Domestic

Table 3: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for non-domestic buildings	Carbon dioxide emissions for non-domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline	135.4	59.8
After energy demand reduction	88.3	59.8
After CHP	88.3	59.8
After renewable energy	66.9	59.8

Table 4: Regulated carbon dioxide savings from each stage of the Energy Hierarchy for non-domestic buildings	Regulated Carbon dioxide savings	
	Tonnes CO_2 per annum	%
Savings from energy demand reduction	47.1	34.8%
Savings from district heating	47.1	34.8%
Savings from renewable energy	21.4	15.8%
Total Cumulative Savings	68.5	50.6%

Domestic

Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings	Carbon dioxide emissions for domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations	13.9	22.7
After energy demand reduction	12.8	22.7
After district heating	12.8	22.7
After renewable energy	10.5	22.7

Table 2: Regulated carbon dioxide savings from each stage of the Energy Hierarchy for domestic buildings	Regulated Carbon dioxide savings	
	Tonnes CO_2 per annum	%
Savings from energy demand reduction	1.1	7.8%
Savings from district heating	0.0	0.0%
Savings from renewable energy	2.3	16.2%
Total Cumulative Savings	3.3	24.0%
Annual Savings from off-set payment	N/A*	N/A*
	(Tonnes CO_2)	
Cumulative savings for off-set payment	N/A*	

CUNDALL

11. Sustainability Strategy

The following sections outline the sustainable features of the proposed Shorts Gardens development. These features have been developed in response to (the now-defunct) Code for Sustainable Homes requirements for domestic development and BREEAM requirement for non-domestic development.

As part of the Government's response to the Housing Standards Review it has been confirmed that the Code for Sustainable Homes (CSH) will be wound down, with many of its requirements consolidated into the Building Regulations. Whilst this means that a formal certification of the scheme will not be possible, the methodology and targets are still a useful tool in benchmarking the sustainable design of residential development. As such, the CSH methodology has been informally used to guide the design.

To benchmark the non-domestic design process, the Building Research Establishment's Environmental Assessment Methodology (BREEAM) has been used. This considers the broad environmental concerns of climate change, pollution, impact on occupants and the wider community. This is balanced with the need for a high quality, safe and healthy internal environment. These standards go beyond the requirements of the Building Regulations.

Together they ensure that a high-quality, healthy and sustainable scheme is delivered. Initial assessment of the different aspects of the development indicate that it is likely to score highly on transport and land use and ecology.

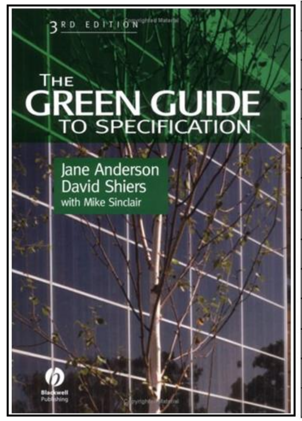
12. Materials

Building and construction activities worldwide consume 3 billion tons of raw material each year, which account for approximately 50% of total global consumption. Using green/sustainable building materials and products promotes conservation of dwindling non-renewable resources. In addition, integrating sustainable building materials into building projects can help reduce the environmental impacts associated with the extraction, transport, processing, fabrication, installation, reuse, recycling, and disposal of these source materials.

The aim for the proposed Shorts Gardens development will be for its overall environmental impact to be minimised through the specification of sustainable materials.

12.1 Environmental Impact of Materials

New materials with low overall environmental impact will be chosen and advice from the Green Guide to Specification will be taken into consideration for the selection. The Green Guide rates the environmental impact of different materials and components, taking into account factors like toxicity, ozone depletion, ease of recycling, waste disposal etc. Where viable, at least 80% (by area) of the new main elements in the building, fabric & building services insulation should be specified to achieve the best performing “A” and “A+” ratings from the Green Guide.



Environmental Issue
Climate Change*
Water extraction
Mineral extraction
Stratospheric ozone depletion*
Human toxicity
Ecotoxicity to freshwater
Higher level nuclear waste
Ecotoxicity to land
Waste disposal
Fossil fuel depletion
Eutrophication*
Photochemical ozone creation*
Acidification*

Figure 12: The 13 Environmental Issues assessed by the Green Guide

12.2 Sustainable Timber

All timber used for basic or finishing building elements in the scheme will be sourced from responsibly managed and sustainable forests or plantations. Such timber products are the only truly renewable construction material in common use and growing trees also absorb and fix CO_2. Forests can also provide the habitat for a wide variety of plant and animal life, preserving important ecology and promoting biodiversity.

12.3 Locally Sustainable Materials

A building that is truly sustainable must be constructed using locally sourced, sustainable materials i.e. materials that can be supplied without any adverse effect on the environment. Therefore, where practical, materials should be sourced from local suppliers, reducing the environmental impacts and CO_2 emissions associated with transportation to the site.

12.4 Recycled Materials

Scope for increased recycling will be incorporated by specifying recycled materials where possible and ensuring that even where new materials are used, as much as possible can be recycled at the end of the buildings’ life.

Specifying materials with a high-recycled content is also another method of saving processing or manufacturing energy. The recycled content of a material can be described as either post-consumer or post-industrial to indicate at what point in the life cycle a material is reclaimed.

12.5 Ozone Depletion and Global Warming

CFCs and HCFCs, compounds commonly used in insulation materials and refrigerants, can cause long-term damage to the Earth’s stratospheric ozone layer, exposing living organisms to harmful radiation from the sun. They also significantly increase global-warming if they leak into the atmosphere. Following the Montreal Protocol, production and use of CFCs is no longer permitted and EC regulations required phasing out of HCFCs by 2015. However, the products that replaced these gases are often still potent global warming contributors.

All insulation materials specified for the proposed scheme will have zero Ozone Depleting Potential and low Global Warming Potential, (GWP<5) in either manufacture or composition in line with the CfSH requirements. This will include insulation for building elements (roof, internal & external walls, floor) as well as insulation for hot water vessels and pipe or duct work.

13. Water Conservation

Water consumption in the UK has risen by 70% over the last 30 years. Trying to meet the increasing demand by locating new sources of water supply is both expensive and damaging to the environment. Therefore, the design team have focused on reducing the demand for water and managing the existing resources.

The Code for Sustainable Homes proposes limits on flow rates for sanitary ware fittings that will be used to inform the architect's eventual choice of bathroom fittings.

For non-domestic units, water fittings will be expected to meet the performance requirements for BREEAM.

13.1 Demand Reduction and Water Efficiency

The aim is to minimise internal and external potable water use within the development. The following water saving measures are being considered:

Dual Flush Cisterns on WC's - These units have the ability to provide a partial flush of 3L and/or a full flush of 6L.

Flow Restrictors to Taps - Flow restrictors reduce the volume of water discharging from the tap. Spray taps have a similar effect and are recommended to reduce both hot and cold-water consumption. Low flow taps in one of the above forms will be installed in all areas.

The use of aerating taps means that the perceived pressure of a shower is the same as a standard flow model, however water consumption can be decreased by over 30%.

Water Meters - In 1995 approximately 33,200 million litres of water a day were extracted in England and Wales, this increased to 44,130 million litres/day in 2001, and much of this was for domestic water supply. To reduce this figure, accurate information on usage is required for management of a building's consumption. Water meters will be specified on the main supply.

Rainwater Harvesting – there is potential to capture rainwater from roofs and reuse, thus reducing potable water consumption. This proposal will be investigated in more detail at a later stage.

14. Sustainable Urban Drainage

The site's drainage strategy will aim to reduce the impact of development on the natural drainage patterns, by retaining water on site by the incorporation of Sustainable Urban Drainage techniques (SUDs).

As the site is currently largely impermeable with hard landscaping and building areas, the main aim for the development will be to improve the water retention of the site.

The Environment Agency's Flood Map indicates that the site is located within Flood Zone 1 and therefore there is a less than 1 in 1000 annual probability of river or sea flooding.

Figure 13: Flood Map for Shorts Gardens building

As a minimum, the design will ensure that the peak rate of runoff into watercourses is no worse than the existing site's run off rate. This will comply with the Interim Code of Practice for Sustainable Drainage systems (SUDS) (CIRIA, 2004) or for at least the 1 year and 100-year return period events.

It is recommended that any proposed SUDS are included in the FRA for submission to the Borough.

As a minimum, the surface water run-off from the development will be no worse than the existing site. The proposed green and brown roofs will offer a degree of attenuation for the site.

15. Waste Management

Buildings and building sites produce a significant amount of waste annually. Most of the waste produced in the UK is disposed of in landfill sites and only a small percentage of it is recycled or reused.

15.1 Waste Targets

Under EU legislation the UK will have to ensure that less than a third of its waste is sent for burial in landfill sites by 2020 and the figure at present is about 80%. To achieve this, target a number of measures are implemented, including landfill tax, aiming to discourage disposal of waste to landfill. Good waste management is a key component of sustainable development. Reducing waste is an important means of:

- Reducing unnecessary expenditure;
- Reducing the amount of natural resources used for production of new materials;
- Reducing energy for waste disposal;
- Reducing levels of contamination and pollution arising from waste disposal.

The proposed development will minimise the impact of waste in the environment where possible.

15.2 Demolition & Construction

During the construction phase a large amount of waste material will be generated through construction, demolition and land clearing procedures. In building construction, the primary waste products in descending percentages are: wood, asphalt/concrete/masonry, drywall, roofing, metals, and paper products, depending on the ultimate construction proposed.

Prior to commencement on site a Site Waste Management Plan (SWMP) that complies with the requirements of current legislation and CSH will be prepared. This plan will identify the local waste haulers and recyclers, determine the local salvage material market, identify and clearly label site spaces for various waste material storage and require a reporting system that will quantify the results and set targets. As a minimum, the SWMP will contain:

a. The target benchmark for resource efficiency e.g. m^3 of waste per $100m^2$ or tonnes of waste per $100m^2$;
b. Procedures and commitments for minimising non-hazardous waste in line with the benchmark;
c. Procedures for minimising hazardous waste;
d. Procedures for monitoring, measuring and reporting hazardous and non-hazardous site waste;
e. Procedures for sorting, reusing and recycling construction waste into defined waste groups either on site or through a licensed external contractor;
f. The name or job title of the individual responsible for implementing the above.

Opportunities for introducing more reused or reusable materials/components will be explored during detailed design.

15.3 Waste Management & Reporting in Operation

The detailed design phases will identify the potential waste streams that the development will produce. As a minimum, plans will be formulated to handle the separation, collection, and storage of common recyclable materials such as paper, glass, plastics, and metals. The collection points will facilitate easy access for all users.

The main aim will be to recycle as much waste as possible; this will be achieved by making sure that waste recycling facilities are strategically placed in convenient locations.

A section will be included in the Building User Guide outlining the options for recycling on site and explaining the different waste streams for the end user.

It is recommended that area is set aside to securely locate the necessary waste disposal bins. The development will include waste disposal area in the ground floor with easy access to the users.

Figure 14: Recycling waste streams

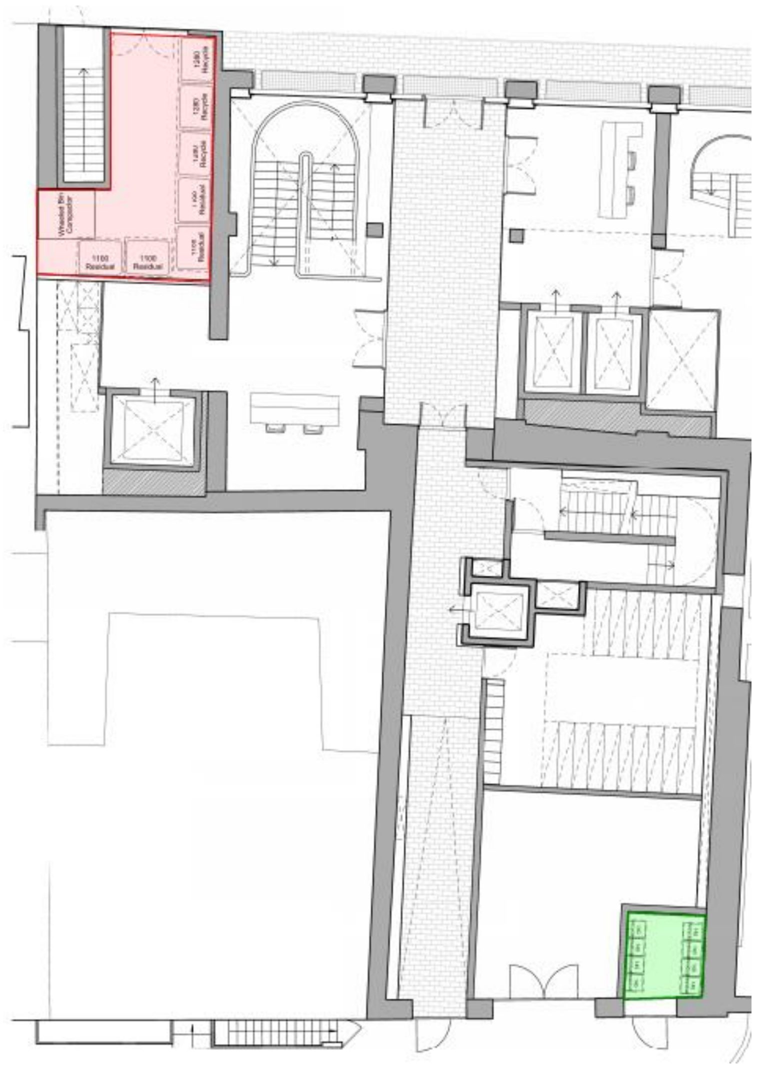


Figure 15: Waste disposal area in the ground floor for residential (green) and commercial (red) developments

16. Environmental Management

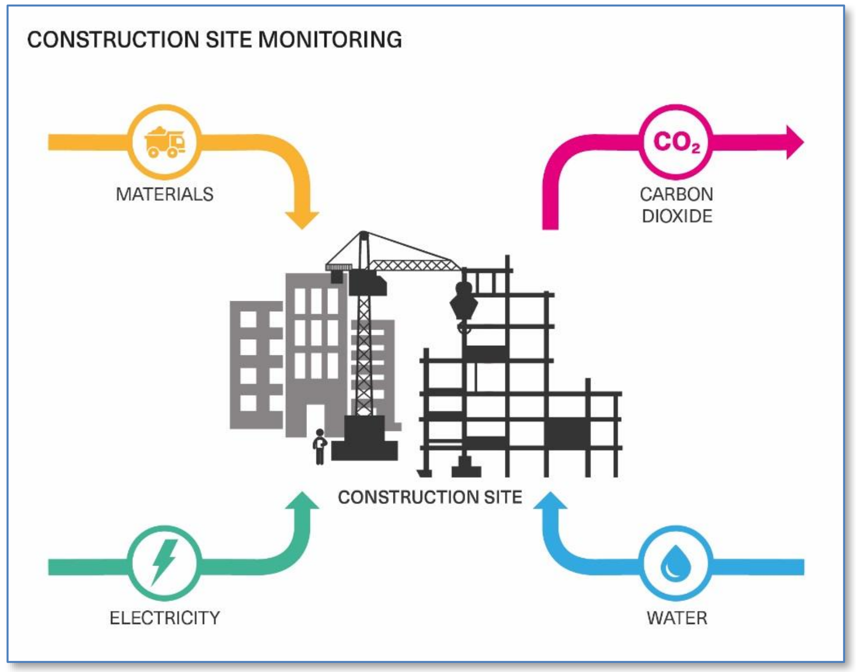
16.1 Construction

Construction sites are responsible for significant impacts, especially at a local level. These arise from noise, potential sources of pollution and waste and other disturbances. Impacts such as increased energy and water use are also significant. Therefore, attention is being given to site-related parameters with the aim to protect and enhance the existing site and its ecology.

The aim is to have a construction site managed in an environmentally sound manner in terms of resource use, storage, waste management, pollution and good neighbourliness. To achieve this, there will be a commitment to comply with the Considerate Constructors Scheme. As a minimum, a score of greater than 35 of out 50 will be achieved with an aspiration to exceed 40, with no individual section achieving a score of less than 7.

Areas that can be taken into consideration in order to minimise the impact of the construction site on its surroundings and the global environment are as follows:

- Monitor, report and set targets for CO_2 or energy usage arising from site activities;
- Monitor, report and set targets for CO_2 or energy usage arising from transport to and from site;
- Monitor, report and set targets for water consumption arising from site activities;
- Monitor construction waste on site, sorting and recycling construction waste where applicable;
- Adopt best practice policies in respect of air and water pollution arising from site activities;
- Operates an Environmental Management System;
- Additionally, all timber used on site should be responsibly sourced.



17. Land Use and Ecology

The site currently consists of existing development on hard standing, with limited site ecology. The new development is proposed to include green/brown roofs at high level to increase the number of plant species and habitats available to wildlife.

The proportion of green/brown roof to be delivered with the scheme will be developed at later design stages. Consideration will be made for hosting both photovoltaic panels and sedum roofs together.

18. Pollution

Global concern for environmental pollution has risen in recent years, as concentrations of harmful pollutants in the atmosphere are increasing. Buildings have the potential to create major pollution both from their construction and operation, largely through pollution to the air (dust emissions, NOx emissions, ozone depletion and global warming) but also through pollution to watercourses and ground water. The proposed development will aim to minimise the above impacts, both at the design stage and on-site.

18.1 Ozone Depletion

CFCs and HCFCs, compounds commonly used in insulation materials and refrigerants, can cause long-term damage to the Earth's stratospheric ozone layer, exposing living organisms to harmful radiation from the sun. They also significantly increase global-warming if they leak into the atmosphere. Following the Montreal Protocol, production and use of CFCs is no longer permitted and EC regulations will require phasing out of HCFCs by 2015. However, products that replace these gases are often still potent global warming contributors. Where refrigerants are used for air-conditioning and comfort cooling they will be CFC and HCFC-free.

18.2 Internal pollutants

Volatile organic compounds (VOCs) are emitted as gases (commonly referred to as offgassing) from certain solids or liquids. VOCs include a variety of chemicals, some of which are known to have short-term and long-term adverse health effects. Concentrations of many VOCs are consistently higher indoors (up to ten times higher) than outdoors.

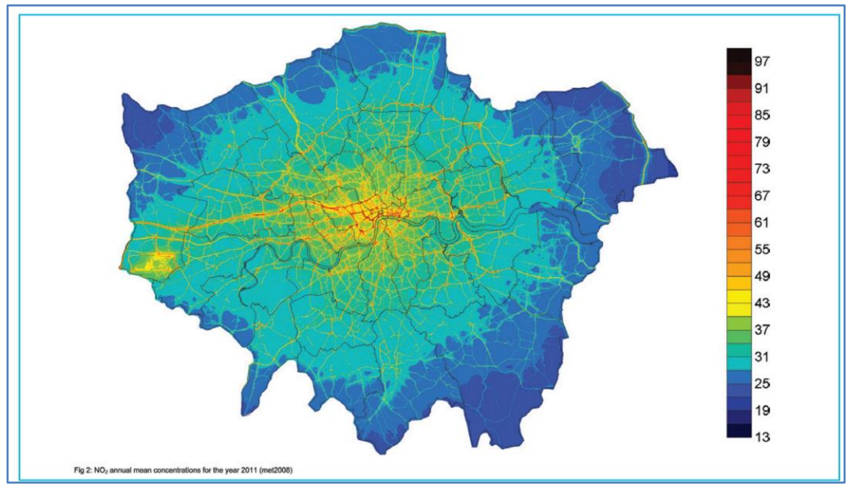
VOCs are emitted by a wide array of products numbering in the thousands. Examples include: paints and lacquers, paint strippers, cleaning supplies, pesticides, building materials, furnishings, adhesives, Urea-formaldehyde foam insulation (UFFI), pressed wood products (hardwood plywood wall panelling, particleboard, fibreboard) and furniture made with these pressed wood products.

'No' or 'low' VOC paints are available from most standard mainstream paint manufacturers. These 'eco-friendly' paints are made from organic plant sources and also powdered milk based products.

The design team will seek to select internal finishes and fittings with low or no emissions of VOCs and comply with European best practice levels as a minimum.

18.3 NOx emissions from boilers

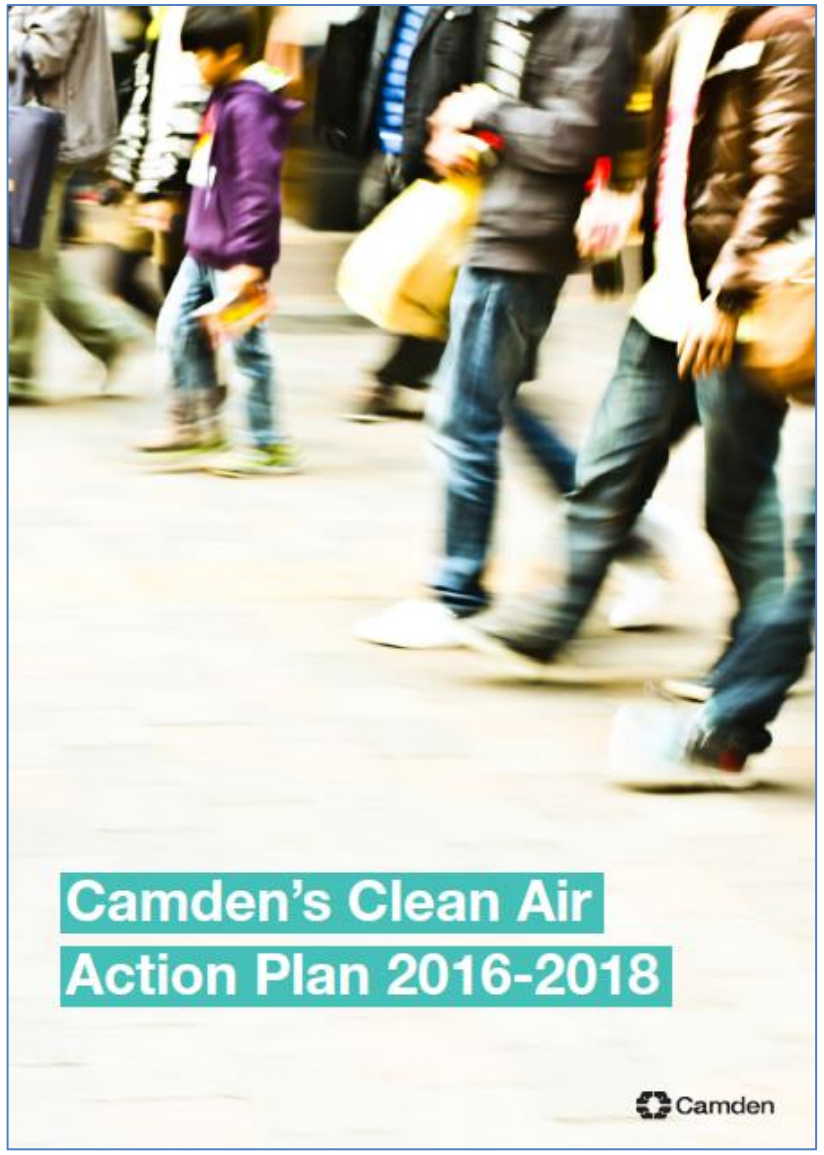
Nitrous oxides (NOx) are emitted from the burning of fossil fuels and contribute to both acid rain and to global warming in the upper atmosphere. At ground level, they react to form ozone, a serious pollutant and irritant at low level. Burners in heating systems are a significant source of low-level NOx, while power stations (and therefore electric heating) are a significant source of NOx in the upper atmosphere.



NO2 Annual Mean Concentrations

The amount of NOx emissions varies between products. New gas boilers vary from 40 NOx/kW to <70mg NOx/kWh (class 5). The proposed heat pumps will emit no local NOx emissions.

The entire London Borough of Camden was declared an Air Quality Management Area (AQMA) in 2000 and remains an AQMA for both NOx and particulates to the present day. Camden is committed to strict regulation of large new boilers and combined heat and power systems within its boundaries.



19. Green Transport

The transport of people between buildings is the second largest source of CO_2 emissions in the UK after energy use in buildings and remains the main source of many local pollutants. Energy use and emissions from transport are growing at 4% per year, and at the same time, the effects of climate change are becoming more severe; there will be greater pressure to control CO_2 emissions from transport and sites without good access to public transport will be at much greater risk from these controls.

19.1 Site Location

60-70 Shorts Gardens and the interconnected building 14-16 Betterton Street is located in central London within the Borough of Camden and within the Seven Dials Conservation Area. The area has good public transport access with Covent Garden station in the south side of the development and Holborn station in the North-East. As such it has excellent local and regional transport links within easy walking distance of the site. Covent Garden and Holborn stations are just 4 min and 7 min walk from the site, respectively. Tottenham Court road is also within a 7 minutes' walk from the site.

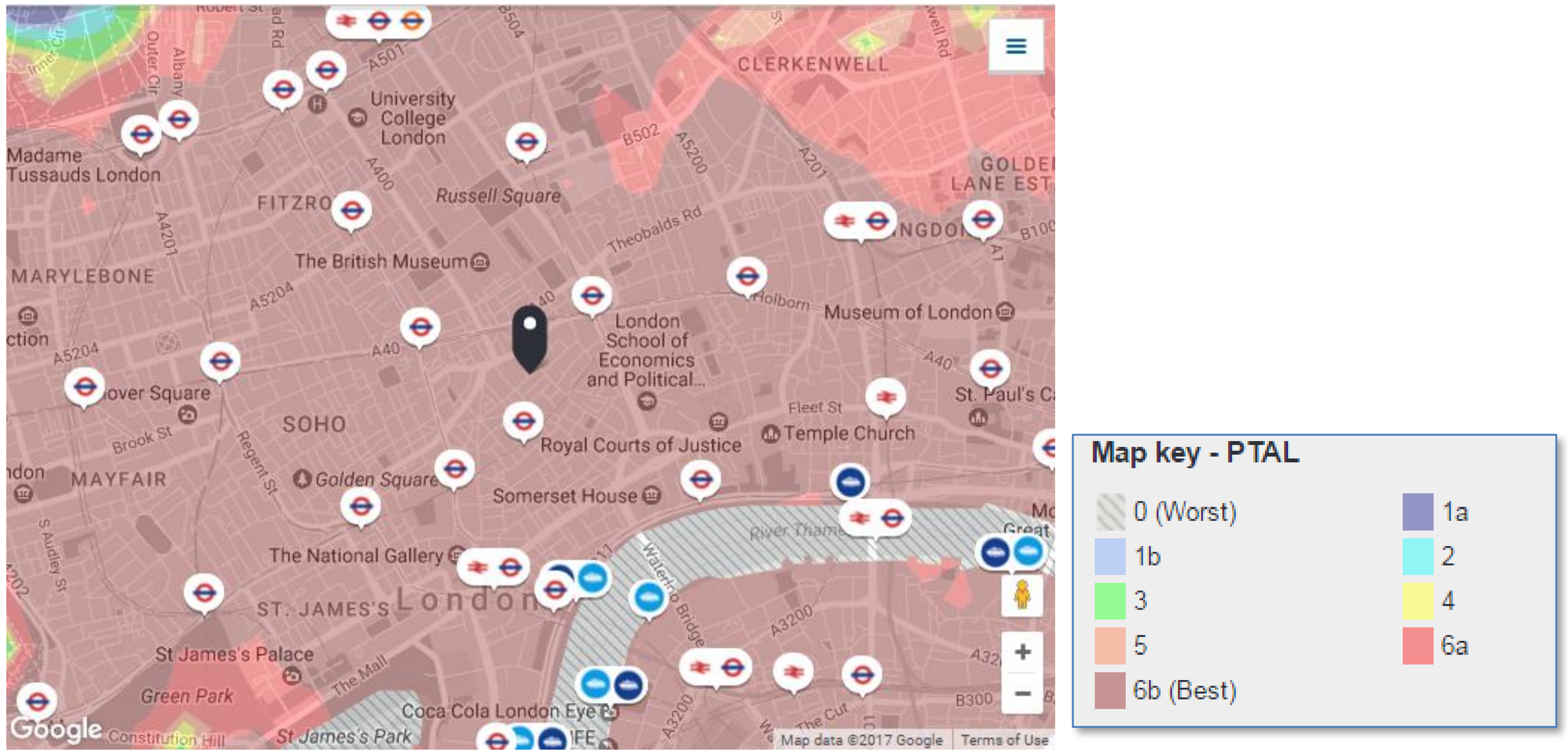
A total of 7 distinct bus services (24, 134, 38, 29, 176, 14, 19) are available within a 278m radius of the site, at Shaftesbury Avenue.

Further Underground stations are located within a walkable distance, opening the entire network up easily.

Charring Cross rail station is also accessible from the site, just 854m away. The Public Transport Accessibility Level for the development is 6b, the highest possible, indicating that the site has excellent public transportation links.

19.2 Cycling Facilities

Cycle storage facilities are proposed for the site at both ground and lower ground levels, allowing building users to secure their bicycles.



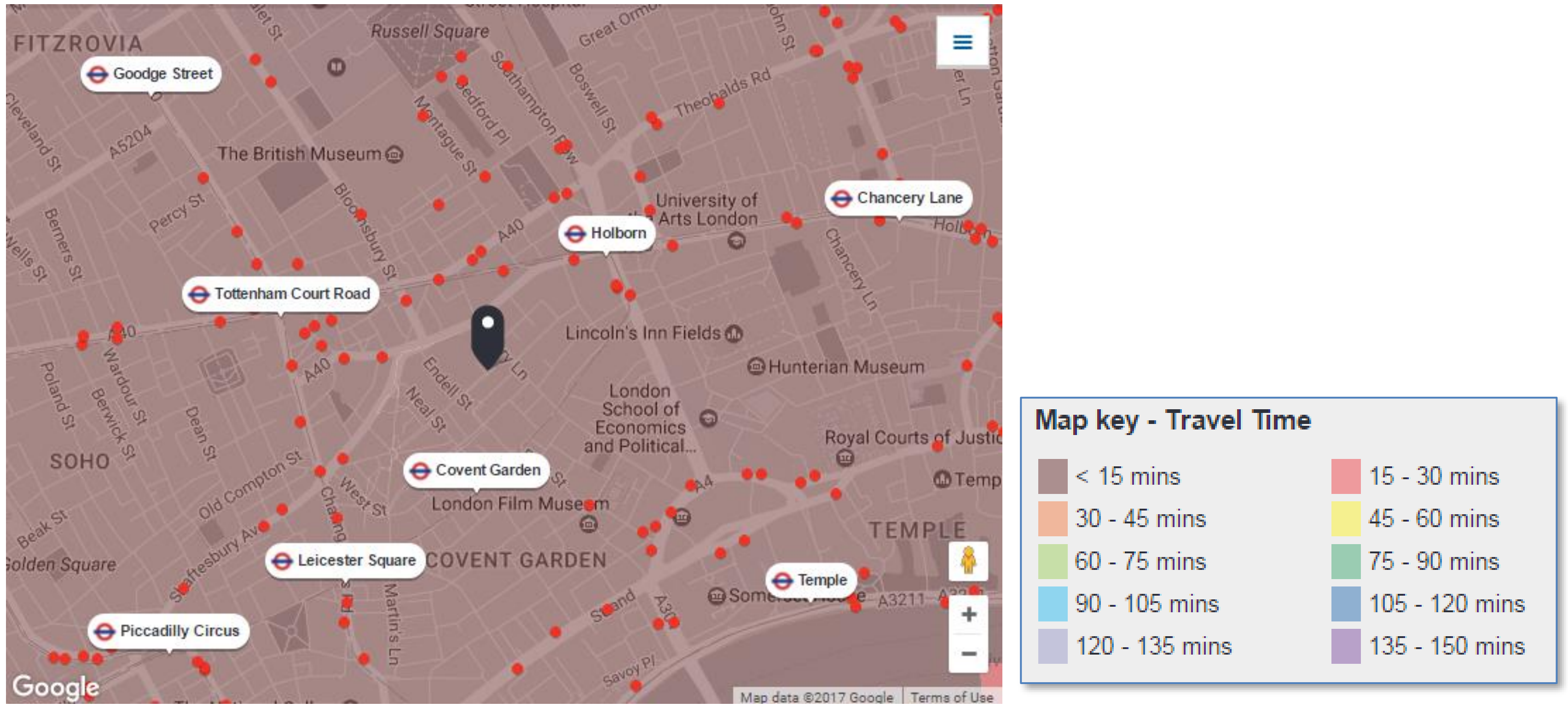


Figure 18: Public transport availability maps for Shorts Gardens building

Appendix A – Representative SAP Calculations

One storey apartment

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	Shorts gardensRevB	Issued on Date	
Survey Reference	One storey flat - Be lean	Prop Type Ref	
Property			

SAP Rating	84 B	DER	16.30	TER	17.27
Environmental	86 B	% DER<TER	5.60		
CO_2 Emissions (t/year)	1.48	DFEE	43.73	TFEE	50.29
General Requirements Compliance	Pass	% DFEE<TFEE	13.04		

Surveyor	admin Admin, Tel: 4, Fax: s@l.f	Surveyor ID	Admin
Client			

SAP2012 - 9.92 input data (DesignData) -

[illegible]

elmhurst energy

Page 1 of 30

Regs Region: England
Elmhurst Energy Systems
SAP2012 Calculator (Design System) version 4.02r03

Two storey apartment

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	Shorts gardensRevB	Issued on Date	
Survey Reference	5th Floor flat - Be lean	Prop Type Ref	
Property			

SAP Rating	83 B	DER	16.57	TER	17.34
Environmental	84 B	% DER<TER	4.45		
CO_2 Emissions (t/year)	2.09	DFEE	53.77	TFEE	61.38
General Requirements Compliance	Pass	% DFEE<TFEE	12.40		

Surveyor	admin Admin, Tel: 4, Fax: s@l.f	Surveyor ID	Admin
Client			

SAP2012 - 9.92 input data (DesignData) -

[illegible]

elmhurst energy

Page 1 of 30

Regs Region: England
Elmhurst Energy Systems
SAP2012 Calculator (Design System) version 4.02r03

Appendix B – BRUKL Output Documents

Basecase scenario

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

1014196_001_Basecase As designed

Date: Fri Feb 24 14:38:15 2017

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.6

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.6

BRUKL compliance check version: v5.2.g.3

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

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	22.4
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	22.4
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	35.8
Are emissions from the building less than or equal to the target?	BER > TER
Are as built details the same as used in the BER calculations?	Separate submission

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

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

Building fabric

Element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	Surface where the maximum value occurs*
Wall**	0.35	0.63	0.7	DJ000004:Surf[1]
Floor	0.25	0.7	0.7	DJ000004:Surf[0]
Roof	0.25	0.37	0.7	BM000024:Surf[0]
Windows***, roof windows, and rooflights	2.2	1.8	1.8	GF000030:Surf[3]
Personnel doors	2.2	-	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	3.5	3.5	GF000035:Surf[5]

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

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

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

Be Green case

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

1014196_001_Be_Green As designed

Date: Fri Feb 24 14:57:29 2017

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.6

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.6

BRUKL compliance check version: v5.2.g.3

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

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	17.5
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	17.5
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	17.7
Are emissions from the building less than or equal to the target?	BER > TER
Are as built details the same as used in the BER calculations?	Separate submission

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

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

Building fabric

Element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	Surface where the maximum value occurs*
Wall**	0.35	0.29	0.3	DJ000004:Surf[1]
Floor	0.25	0.25	0.25	DJ000004:Surf[0]
Roof	0.25	0.17	0.18	BM000024:Surf[0]
Windows***, roof windows, and rooflights	2.2	1.6	1.6	GF000030:Surf[3]
Personnel doors	2.2	-	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	3.02	3.02	GF000035:Surf[5]

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

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

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	5

Appendix C – BREEAM Pre-assessment

BREEAM UK New Construction 2014 Assessment Report

BREEAM® UK

General information

BRE Assessment reference no.	To be confirmed
Client name	Shorts Gardens LLP
Building end user/occupier	To be confirmed
Assessor name	Kavita Kumari
Assessors role	BREEAM Assessor
Assessor organisation	Cundall

Building details

Building name	Shorts Gardens
Building address	60-72 Shorts Gardens and 14-16 Betterton Street
	Covent Garden
County	London
Post code	WC2H 9AH
Country	England
Building type (main description)	Office
Building type (sub-group)	Office - General office building
Building floor area (GIA) m²	2000
Building floor area (NIFA) m²	1900
BREEAM scheme	New Construction
BREEAM version	2014 (SD5076)
BREEAM UK 2014 technical manual issue number	SD5076 Issue 2.0
Project type	New Construction (shell and core)
Assessment stage	Design (interim)
Location type	London Borough
Building services - heating system type	Air system
Building services - cooling system type	Air-conditioning
Building services - domestic hot water system type	Point of use
Building service - controls	Standard controls (time/temperature)
If applicable, does this industrial building have a heated or cooled operational area?	Option not applicable to building type
es water heating contribute less than 10% of the buildings total energy consumption?	Yes
Commercial/industrial refrigeration and storage systems	No
Building user transportation systems (lifts and/or escalators)	Yes
Laboratory function/area and size category	No laboratory
Laboratory containment level	No laboratory
Fume cupboard(s) and/or other containment devices	No
Unregulated water uses present? (e.g. vehicle wash system, irrigation)	No
If applicable, will this healthcare building house inpatients?	Option not applicable to building type
If applicable, does this industrial building have an office area?	Option not applicable to building type
If applicable, does this building contain areas requiring SAP assessment?	Option not applicable to building type
If SAP used, what proportion of the building's total floor area (GIA) does it apply to?	Option not applicable to building type

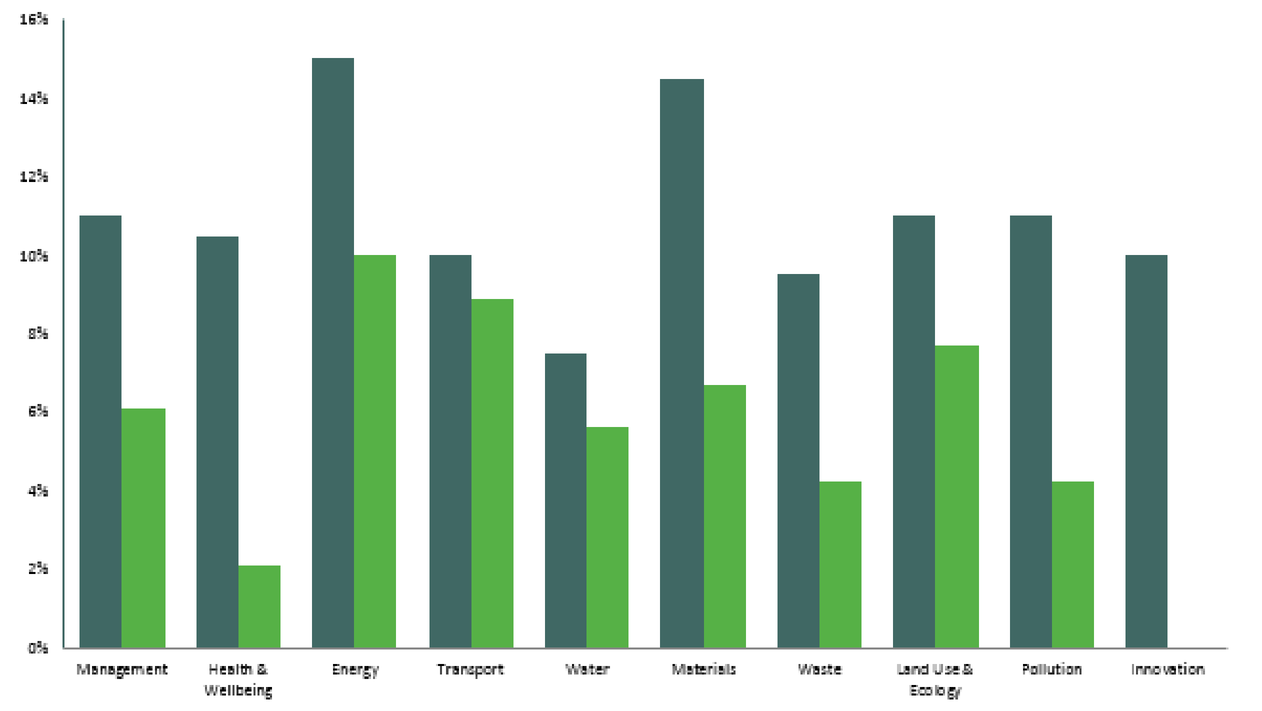
Project team details

Developer	TBC
Principal contractor	TBC
Architect	Stanton Williams
Project management	TBC
Building services	Cundall
BREEAM Accredited Professional	TBC
Other project team member 1	TBC
Other project team member 2	TBC
Other project team member 3	TBC
Other project team member 4	TBC

Overall Building Performance

Building name	Shorts Gardens
BREEAM rating	Very Good
Total Score	55.57%
Min. standards level achieved	Excellent level

Building Performance by Environment Section



Environmental Section	No. credits available	No. credits Achieved	% credits achieved	Section Weighting	Section Score
Management	18	10	55.56%	11.00%	6.11%
Health & Wellbeing	10	2	20.00%	10.50%	2.10%
Energy	21	14	66.67%	15.00%	10.00%
Transport	9	8	88.89%	10.00%	8.89%
Water	8	6	75.00%	7.50%	5.63%
Materials	13	6	46.15%	14.50%	6.69%
Waste	9	4	44.44%	9.50%	4.22%
Land Use & Ecology	10	7	70.00%	11.00%	7.70%
Pollution	13	5	38.46%	11.00%	4.23%
Innovation	10	0	0.00%	N/A	0

CUNDALL

BREEAM assessor declaration of assessment accuracy and quality

I, Kavita Kumari, a qualified BREEAM assessor working on behalf of Cundall confirm that the content of this report is to the best of my knowledge a true and accurate reflection of the performance of the above named building, as measured against the assessment criteria and reporting requirements of the BREEAM Scheme Document (SD5076). Furthermore, I confirm that this assessment and the information on which it is based has been checked and verified in accordance with BRE Global Ltd's UKAS accredited BREEAM operating procedures for BREEAM assessments and assessors, as described in the technical scheme document (SD5076) and associated BREEAM operational documents.

BREEAM Assessor Signature	Kavita Kumari	Date	24/02/2017

Disclaimer

This report is made on behalf of Cundall. By receiving the report and acting on it, the client - or any third party relying on it - accepts that no individual is personally liable in contract, tort or breach of statutory duty (including negligence).

Disclaimer

Conflict of Interest - Where an assessor is employed by the same company as a project/design team member(s) (e.g. energy assessor, suitably qualified ecologist or client representative etc) they must identify and manage any potential conflicts of interest and inform BRE Global Ltd as soon as they become aware of such a conflict. Where possible this should be made clear to BREEAM upon registration of the assessment.

BRE Global do prohibit an assessor from verifying compliance with scheme criteria where they themselves have been directly involved in achieving or implementing a compliant solution, i.e. an assessor cannot assess their own work, for example they cannot be the architect on a project and the assessor. A current exception to this rule is where the assessor is also acting as an accredited Sustainability Champion or BREEAM Accredited Professional on the project.

Where there is a conflict of interest or potential for one, BRE Global Ltd will escalate the assessment report to a more detailed level of quality assurance checking. This will be done to reduce the risk to assessors and clients in the event that a certification outcome is challenged. Additional levels of monitoring may result in additional charges (FS036) being made to the licensed organisation that employs the assessor.

Appendix D: Conservation area