PRICE&MYERS

84 Hatton Garden, Camden

Energy Strategy Report

CIBSE LOW CARBON ENERGY ASSESSORS

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Project ref: 23000

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Executive Summary

This energy strategy report has been prepared to support a minor material amendment application for the proposed redevelopment of 84 Hatton Garden to a hotel with 31 bedrooms, further to an existing planning consent (2015/1925/P).

The scheme entails demolition of 5 stories of an existing 7 storey mixed used development. The existing lower ground floor and ground, which provides a small commercial space and work shop space shall be retained and refurbished. The scheme comprises 7 storey construction over 2 existing storey accommodating 31 suites including a small breakfast room provided on the lower ground floor. The mixed use scheme is located within the London Borough of Camden.

The proposed development addresses national planning policies on energy; in particular, mitigation of climate change and energy security through energy efficiency enhancements and use of alternative energy technologies. In order to reduce the carbon footprint of the building beyond the requirements of current regulatory and market standards, the development will benefit from the following integrated systems:

- Passive design features (Be Lean)
- Energy efficiency measures (Be Clean)
- Low and zero carbon technologies (Be Green)

The building fabric performance will meet or exceed the Part L 2013 requirements where applicable.

An energy assessment has been carried out based on design information to identify the most appropriate renewable strategy. The proposed strategy has the potential to provide a 35% improvement over the Building Regulations 2013 minimum target; through passive design measures, energy efficient equipment and renewable technologies. LZCs technologies have been specified to achieve overall 11.1% saving in carbon emissions.

Based on the proposed energy strategy, 10 credits can also be achieved under Ene 1 of the BREEAM New Construction 2014 assessment. Further details can be found in the Price & Myers BREEAM 2014 Pre-assessment report.

1 Introduction

1.1 Site Analysis

The 84 Hatton Garden development is located within the London Borough of Camden.

The proposal entails the demolition of 5 stories of an existing 7 storey mixed use development. The existing lower ground floor and ground, which provides a small commercial space and workshop shall be retained and refurbished. The new scheme comprises 7 storey construction over 2 existing storey accommodating 31 hotel suites including a small breakfast room provided on the lower ground floor. This application is for a minor material amendment to a previous consented scheme.

The flat roof of the development may be utilised for plant enclosure, services and renewables, if required.

1.2 Objective

This report summarises the work undertaken to support the development of an energy strategy for the 84 Hatton Garden scheme. This work has resulted in a strategy that requires design, technical and commercial decisions in order to continue the design development and ultimately select the final solution for ensuring a low carbon development.

This report outlines the energy strategy for the development, including passive design, energy and CO_2 footprint of the proposed scheme, and renewable energy options.

The final proposed strategy would allow the scheme to demonstrate compliance with the guidelines set out by the London Borough of Camden and the London Plan in demonstrating a positive commitment to sustainability through providing environmental improvements.

2 Policy

2.1 London Borough of Camden Policies on Energy

Policy DP22 – Promoting sustainable design and construction

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

- Expecting new build housing to meet Code Level 4 by 2013 and encouraging Code Level 6 (zero carbon) by 2016;
- Expecting developments (except new build) of 500 sq m of residential floor space or above or 5 or more dwellings to achieve "very good" in BREEAM for Domestic Refurbishment assessments prior to 2013 and encouraging "excellent" from 2013;

Policy CPG3 Sustainability

Developments are to target a 20% reduction in carbon dioxide emissions from on-site renewable energy technologies.

All residential new build should achieve a Code for Sustainable Homes level 4 with 50% of the unweighted Energy, Water and Materials credits.

Residential refurbishments of 500sqm floorspace or more to achieve a BREEAM for Domestic Refurbishment Very Good.

Pre App Principle Issues

Sustainability

It is indicated that the proposal will utilise an energy efficient building fabric, high efficiency boiler and rooftop photovoltaics. As the proposal would entail the change of use of more than 500sqm of commercial floorspace, an energy statement would be required to demonstrate how the proposed development would reduce carbon dioxide emissions in line with policy CS13 (Tackling climate change through promoting higher environmental standards). Camden Planning Guidance (CPG3 – Sustainability) requires an improvement of 40% on the 2010 Building Regulations for new buildings. Please refer to CPG3 for more information about energy statements.

It is considered that, due to the commercial nature of the proposed use, the relevant sustainability assessment should be BREEAM as opposed to the Code for Sustainable Homes which is for permanent residential schemes. A pre-assessment will be required to accompany any application which a minimum rating of "very good" and a minimum score of 60% in the energy and material categories, and 40% in the water category. This would be verified by a post-construction review. Such a review would be secured as part of a section 106 agreement.

Hatton Garden is to be assessed under BREEAM New Construction 2014 due to all the apartments being C1 serviced.

Part L 2010 has now been superseded by Part L 2013. The calculations for the Hatton Garden project have therefore been based on the methodologies for Part L 2013. As set out in the GLA Guidance on Preparing Energy Assessments 2014 and section 2.4.3 of the London Plan Sustainable Design and Construction SPG, the equivalent target to a 40% improvement over Part L 2010 is a 35% improvement over Part L 2013.

To avoid additional unnecessary calculations and to ensure all the targets for the building are using the same methodology, the 35% improvement over 2013 regulations approach has been taken. We believe that this should be acceptable.

2.2 The London Plan Policies on Energy

Policy 5.2: Minimising Carbon Dioxide Emissions

Planning Decisions

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

1. Be Lean: use less energy
2. Be Clean: supply energy efficiently
3. Be Green: use Renewable energy

The Mayor will work with boroughs and developers to ensure that major developments meet the following targets for carbon dioxide emissions reduction in buildings. These targets are expressed as minimum improvements over the Target Emission Rate (TER) outlined in the national Building Regulations leading to zero carbon residential buildings from 2016 and zero carbon non-domestic buildings from 2019.

2013 – 2016: 40% improvement on 2010 Building Regulations

2016- 2031: Zero carbon

The GLA guidance on preparing energy assessments (April 2015) states that a 35 per cent carbon reduction target beyond Part L 2013 of the Building Regulations will be required for major developments. As outlined in the Sustainable, Design and Construction SPG, since 6 April 2014 the Mayor has applied a 35 per cent carbon reduction target beyond Part L 2013 of the Building Regulations - this is deemed to be broadly equivalent to the 40 per cent target beyond Part L 2010 of the Building Regulations, as specified in Policy 5.2 of the London Plan for 2013-2016

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

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

- calculation of the energy demand and carbon dioxide emissions covered by Building Regulations and, separately, the energy demand and carbon dioxide emissions from any other part of the development, including plant or equipment, that are not covered by the Building Regulations (see paragraph 5.22) at each stage of the energy hierarchy
- proposals to reduce carbon dioxide emissions through the energy efficient design of the site, buildings and services
- proposals to further reduce carbon dioxide emissions through the use of decentralised energy where feasible, such as district heating and cooling and combined heat and power (CHP)
- proposals to further reduce carbon dioxide emissions through the use of on-site renewable energy technologies.

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

Policy 5.5 Decentralised Energy Networks

The Mayor expects 25 per cent of the heat and power used in London to be generated through the use of localised decentralised energy systems by 2025. In order to achieve this target the

Mayor prioritises the development of decentralised heating and cooling networks at the development and area wide levels, including larger scale heat transmission networks.

As minimum boroughs should require developers to prioritise connection to existing or planned decentralised energy networks where feasible.

Policy 5.6: Decentralised Energy in Development Proposals

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.

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.

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

Policy 5.7: Renewable Energy

Within the framework of the energy hierarchy (see Policy 5.2), major development proposals should provide a reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation, where feasible.

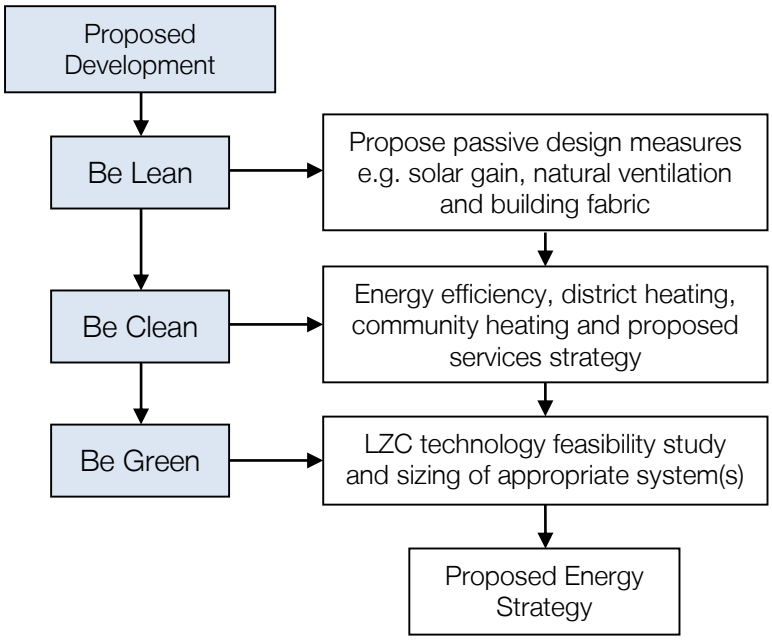
3 Approach

The approach to achieving the planning policy energy objectives has been to consider strategies and technologies to achieve a low energy and carbon footprint for the scheme.

The development will adopt the following energy hierarchy:

- Use less energy through passive design measures (Be Lean)
- Supply and consume energy efficiently (Be Clean)
- Utilise renewable energy sources to reduce carbon emissions (Be Green)

This energy strategy examines the energy performance of the proposed 84 Hatton Gardens development based on the following methodology:



The performance of the development in terms of energy consumption and carbon emissions is calculated at each stage of the assessment, ensuring that both regulated and unregulated energy is considered when determining the performance of the proposed energy strategy.

3.1 Accredited Energy Assessor

This report has been checked and reviewed by Deepika Singhal who is an accredited Low Carbon Energy Assessor (LCEA). The energy consumption and carbon emission figures within this report have been calculated using the latest version of approved Dynamic Simulation Modelling software EDSL TAS.

4 Energy Targets

The target for the project is a 35% improvement over Building regulations Part L 2013 to meet the London Plan and the London Borough of Camden policy. Table 4-1 details the energy broken down by fuel types and fuel use categories for the site taking into account the regulated and unregulated energy. These are the target energy and carbon calculations before any passive design and energy efficient measures.

Building Regulations Target Emission Rate Breakdown															
Regulated Energy & CO2														Unregulated Energy & CO2	
Type	Gas Demand				Electricity Demand							Total Energy (kWh/yr)	Total CO_2 (kg/yr)		
	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Total (kWh/yr)	Gas CO_2 (kg/yr)	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Cooling (kWh/yr)	Pumps & Fans (kWh/yr)	Lighting (kWh/yr)	Total (kWh/yr)	Electricity CO_2 (kgCO2/yr)			Energy (kWh/yr)	CO2 (kg/yr)
Hotel	36,368	187,779	224,147	48,416	0	0	6,710	203	12,703	19,616	10,181	243,763	58,596	24,416	12671.9
Commercial & workshop	972	177	1,150	248	0	0	1,603	434	5,981	8,018	4,161	9,168	4,410	1,927	999.983
Total	37,340	187,957	225,297	48,664	0	0	8,313	637	18,684	27,634	14,342	252,931	63,006	26,343	13,672

Table 4-1 Estimated regulated and unregulated energy demand and carbon emissions per energy source

The energy consumption calculations for this and all subsequent stages of the assessment include regulated energy (space and water heating, lighting, pumps and fans) and unregulated energy (appliances and equipment) derived from outputs of dynamic thermal modelling using Tas.

5 Be Lean: Passive Design

As part of the Be Lean approach, passive design measures have been considered throughout the pre-planning stage to reduce energy demand.

5.1 Solar Gain Control and Daylighting

Where possible, windows and natural daylight have been provided to ensure appropriate daylighting levels throughout the development and reduce the lighting demand. The size and orientation of external windows has been considered carefully to balance daylight with excessive solar gains. Windows are specified to incorporate low emissivity coatings to limit overheating while ensuring adequate daylight. The front façade facing busy main road will be triple glazed in order to achieve better acoustic value. The glazing specifications are given in Table 5-1 below:

Glazing Parameters	Triple glazing (East facing front façade)	Double glazing (All other windows)
U-value	1.0 W/m^{2}K	1.27 W/m^{2}K
G-value	0.316	0.313
Light Transmittance	0.536	0.754

Table 5-1 Proposed glazing parameters for the commercial doors and windows

5.2 Building Fabric Efficiency

To further improve the passive design of the development, the thermal fabric has been specified to meet or exceed current Building Regulations targets. Table 5-2 shows the proposed U-values that will be considered for the development and have been assumed for the energy strategy analysis at this stage.

Element	Proposed Measure	Feature
External Walls	0.11 W/m^{2}K	—
Party Walls	0.2 W/m^{2}K	Unfilled cavity with no effective edge sealing
Roof	0.12 W/m^{2}K	—
Ground Floor	0.11 W/m^{2}K	—
Windows/ Rooflights	1.27 W/m^{2}K	Double Glazed
Front Windows	1.0 W/m^{2}K	Triple Glazed
External Doors	1.2 W/m^{2}K	—
Internal Doors	1.6 W/m^{2}K	—
Air Tightness	4 m^3/m^2/h	Pressure test will be carried out to determine air tightness. This is only a target value
Thermal Bridging	Y value = Approved Thermal Bridging by DSM Software	(To be calculated by Approved Accreditor at detailed design)

Table 5-2 Proposed Be Lean passive design measures

5.3 Improvement Over Part L

Based on the performance of development once the passive design measures proposed in Sections 5 are incorporated energy and carbon calculations have been undertaken. Table 5-3 and Figure 5-1 confirm that the development can achieve a 7% improvement over Part L before any energy efficiency or low or zero carbon technologies have been considered. The breakdown of energy use and carbon emissions has been calculated, as shown in Table 5-4.

Site Wide	CO_2 Emissions (tonnes /annum)	CO_2 Savings (tonnes /annum)	% Saving
Building Regulations 2013 Baseline	63.01		
Be Lean (after demand reduction)	58.51	4.49	7%

Table 5-3 Carbon savings

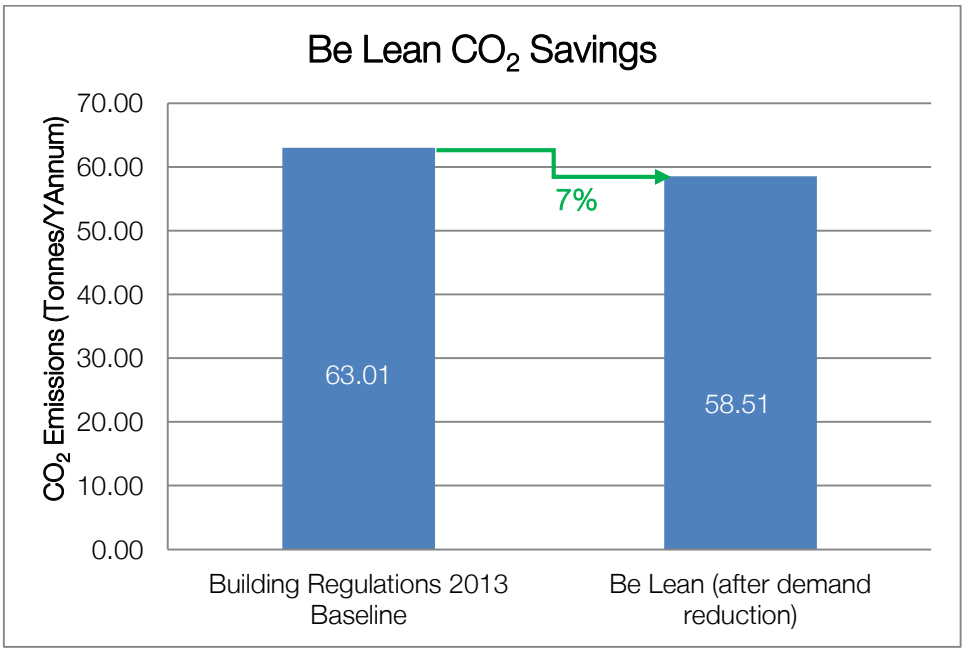


Figure 5-1 Improvement over Building Regulations Part L 2013 with passive design measures

The Be Lean stage has the potential to provide a 7% improvement over the Building Regulations 2013 minimum target; through passive design measures, and the energy use for the Be Lean case is broken down (Table 5-4).

Be Lean															
Regulated Energy & CO2														Unregulated Energy & CO2	
	Gas Demand				Electricity Demand							Total Energy (kWh/yr)	Total CO_2 (kg/yr)		
Type	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Total (kWh/yr)	Gas CO_2 (kg/yr)	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Cooling (kWh/yr)	Pumps & Fans (kWh/yr)	Lighting (kWh/yr)	Total (kWh/yr)	Electricity CO_2 (kgCO2/yr)			Energy (kWh/yr)	CO2 (kg/yr)
Hotel	31,037	182,042	213,079	46,025	0	0	5,233	159	10,131	15,523	8,056	228,602	54,082	24,416	12671.9
Commercial & workshop	342	187	529	114	0	0	2,018	513	5,790	8,321	4,319	8,850	4,433	1,927	999.983
Total	31,380	182,229	213,609	46,139	0	0	7,251	673	15,920	23,844	12,375	237,453	58,515	26,343	13,672

Table 5-4 Estimated regulated and unregulated energy demand and carbon emissions per energy source

6 Be Clean: Energy Efficiency

As part of the Be Clean approach, the use of heat networks, community heating and cooling and energy efficient equipment has been considered for this development.

6.1 District Energy Systems

District energy systems produce steam, hot water or chilled water at a central energy centre. The steam or water is distributed in pre-insulated pipework to individual buildings for space heating, domestic hot water and air conditioning. As a result, individual buildings served by a district energy system don't required their own boilers or chillers.

London Borough of Camden heat network has been identified shown in Figure 6-1 below.

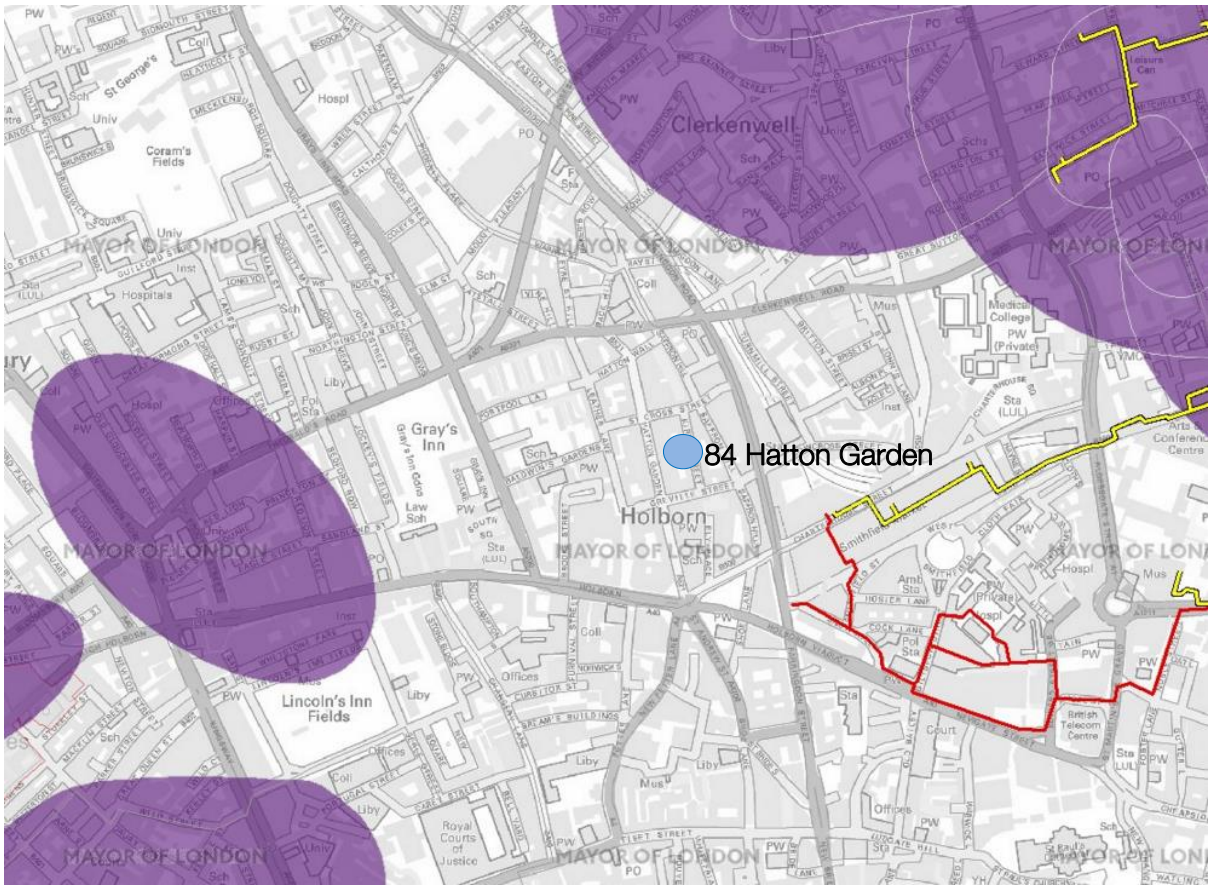


Figure 6-1: London Heat Map (blue circle indicates location of development)

The connection to a district heating system will be considered at the detailed design stage and further investigation into the provision of appropriate ducts and risers will be carried out to make this possible should such an energy supply become available.

6.2 Community Heating

Community heating involves distributing space and water heating services throughout the development served from a central plant, making use of higher efficiencies available from larger systems.

As this development is relatively small, the installation of a community energy system would not be cost effective. A CHP system would not be viable for such small development due to low peak demand. The potential savings associated with a communal gas heating system would not be significant enough to justify the additional cost. Fabric improvements would have a greater impact and are therefore more cost effective for this development.

6.3 Services Strategy

In addition to the passive design measures identified in Section 4, energy efficient equipment has been proposed where possible to support the services strategy.

Table 6-1shows the proposed services strategy and energy efficiency measures for the development.

Services	Hotel	Commercial and Workshop
Space Heating and Hot Water	95.5% Efficient Gas Boiler	
Ventilation	Rooms/Stairs/circulation/breakfast room- Natural Ventilation Kitchen – MVHR 85% efficiency Supply SFP: 0.7 W/l/s Extract SFP: 0.4 W/l/s	MV and Heat Recovery 85% Supply SFP: 0.7 W/l/s Extract SFP: 0.4 W/l/s
Comfort Cooling	VRF system (Grid supplied electricity) COP 3.6	
Lighting	90 Lumens/circuit watt Auto on/Auto off with manual daylight control	

Table 6-1 Proposed energy efficient design measures

6.4 Improvement Over Part L

Based on the performance of the passive design and energy efficient measures proposed in Sections 5 and 6, as calculated using EDSL Tas Dynamic Simulation Modelling (DSM) software.

Table 6-2 demonstrates the percentage improvement these have over the notional baseline levels in each type of use on the development before incorporating any on-site renewables.

Site Wide	CO_2 Emissions (tonnes /annum)	CO_2 Savings (tonnes /annum)	% Saving
Building Regulations 2013 Baseline	63.01		
Be Lean (after demand reduction)	58.51	4.49	7%
Be Clean (after efficiency measures)	54.40	4.11	7%
Total Cumulative Savings		8.61	14%

Table 6-2 Area Weighted Average % improvement over Part L 2013 at Be Clean Stage

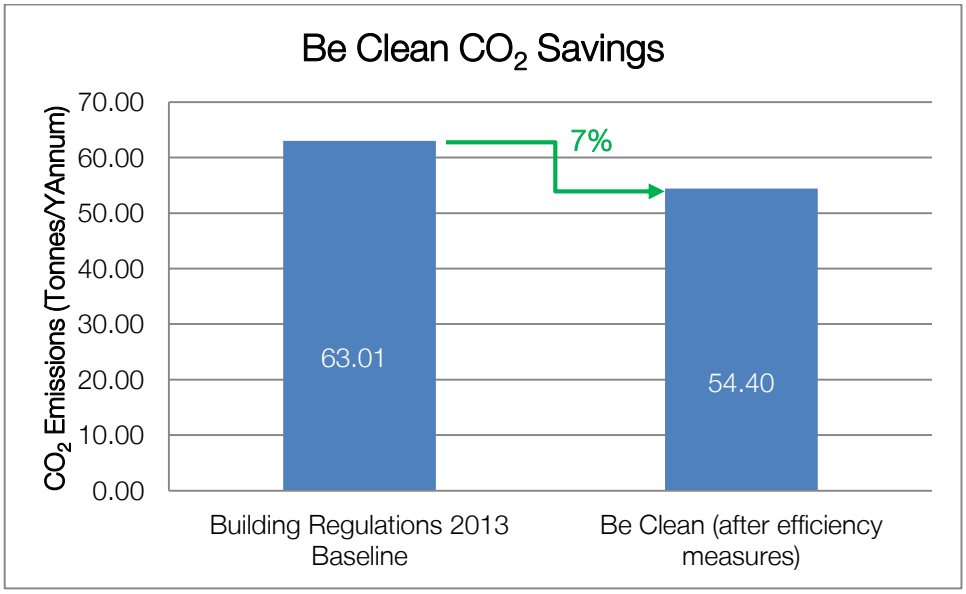


Figure 6-2 Improvement over Building Regulations Part L 2013 before LZC's

Figure 6-2 confirms that the development can achieve 7% improvement over Part L 2013 before any on-site renewables have been considered.

The energy use for the Be Clean case is broken down in Table 6-3.

Be Clean															
Regulated Energy & CO2														Unregulated Energy & CO2	
Type	Gas Demand				Electricity Demand							Total Energy (kWh/yr)	Total CO_2 (kg/yr)		
	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Total (kWh/yr)	Gas CO_2 (kg/yr)	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Cooling (kWh/yr)	Pumps & Fans (kWh/yr)	Lighting (kWh/yr)	Total (kWh/yr)	Electricity CO_2 (kgCO2/yr)			Energy (kWh/yr)	CO2 (kg/yr)
Hotel	29,473	170,780	200,253	43,255	0	0	3,951	159	9,309	13,419	6,965	213,672	50,219	24,416	12671.9
Commercial & workshop	277	170	447	97	0	0	1,712	513	5,645	7,870	4,084	8,317	4,181	1,927	999.983
Total	29,750	170,950	200,700	43,351	0	0	5,663	673	14,953	21,289	11,049	221,989	54,400	26,343	13,672

Table 6-3 Estimated regulated and unregulated energy demand and carbon emissions per energy source

7 Be Green: Low and Zero Carbon (LZC) Technologies Feasibility Study

The final level of the energy hierarchy is to Be Green, therefore the following table discusses the options for on-site low and zero carbon technologies and their feasibility on this development to contribute to meeting the relevant London Plan and the London Borough of Islington's sustainability targets.

LZC Technologies	Description	Advantages	Disadvantages	Feasibility	
Solar Thermal Collectors	Solar thermal collectors can be used to provide hot water using the irradiation from the sun They can generally provide approx. 50% of the hot water demand	No noise issues associated with Solar thermal collectors No additional land use from the installation of solar thermal collectors Low maintenance and easy to manage Favourable payback periods	The hot water cylinder will need to be larger than a traditional cylinder Needs unobstructed space on roof Low efficiencies Often not compatible with other LZC technologies Saves less carbon when offsetting gas systems	There is a flat roof spaces where solar thermal panels can be installed. Evacuated Tubes may lead to higher savings.	✓
Solar Photovoltaic Panels (PV)	Solar PV panels provide noiseless, low-maintenance, carbon free electricity	Can have significant impact on carbon emissions by offsetting grid electricity (which has a high carbon footprint) Low maintenance, No noise issues No additional land use from the installation of PV panels Bolt on technology that does not need significant amounts of auxiliary equipment Favourable payback periods	Needs unobstructed space on roof Low efficiencies per unit area of PV Often used to supplement landlord's electricity so savings not always transferred to individual properties	There is flat roof space on which Solar PV panels could be installed to contribute to the electricity demand of the building. However, as there is a high hot water demand solar thermal would be preferable.	✓

CHP (Combined Heat & Power)	CHP systems use an engine driven alternator to generate electricity while using the waste heat from the engine, jacket and exhaust to provide heating and hot water Economic viability relies on at least 4,000 hours running time per annum	Mature technology High CO_2 savings	Cost of the system is relatively high for small schemes Only appropriate for large development with high heat loads	CHP is not technically viable for a development of this scale.	✗
Biomass Heating	Solid, liquid or gaseous fuels derived from plant material can provide boiler heat for space and water heating	Potential to reduce large component of the total CO_2 A biomass boiler would supplement a standard gas heating system so some of the cost may be offset through money saved on using smaller traditional boilers	Regular maintenance is required Reliability of fuel access/supply can be a problem The noise generated by a biomass boiler is similar to that of a gas boiler. It is advisable not to locate next to particularly sensitive areas such as bedrooms A plant room and fuel store will be required which may take additional land from the proposed development or surroundings Biomass is often not a favoured technology in new development due to the potential local impacts of NO_x emissions and delivery vehicles for the fuel	Biomass is not considered feasible for this development due to issues with fuel storage, access for delivery vehicles and local NO_x emissions	✗

Wind Turbines	Vertical and horizontal axis wind turbines enable electricity to be generated using the power within the wind	Low noise Bolt on technology that does not need significant amounts of auxiliary equipment	Not suitable for urban environments due to low wind conditions and obstructions High visual impact Noise impact (45-65dB at 3m) High capital cost and only achieve good paybacks in locations with strong wind profiles Requires foundations or vibration supports for building installations (generally not recommended)	This development is in an urban environment and so a wind turbine will not generate much energy	✗
Ground Source Heat Pumps (GSHP)	Utilising horizontal loops or vertical boreholes, GSHP make use of the grounds almost constant temperature to provide heating and/or cooling using a heat exchanger connected to a space/water heating delivery system	Low maintenance and easy to manage High COP (ratio of energy output per energy input) Optimum efficiency with underfloor heating systems As heat pumps would replace standard heating systems, some of the cost may offset through savings on a traditional boiler	The heat pump has a noise level around 35-60dB so some attenuation may be required and it should be sensibly located Relatively high capital cost Requires electricity to run the pump, therefore limited carbon savings in some cases For communal systems a plant room is required which may take additional land from the proposed development/surroundings	GSHP are not a feasible technology for the site since there is a limited external space available for installation of boreholes	✗

Air Source Heat Pumps (ASHP)	Air Source Heat Pumps extract latent energy from the external air in a manner similar to ground source heat pumps	ASHP systems are generally cheaper than GSHP as there is no requirement for long lengths of buried piping or boreholes Low maintenance and easy to manage Optimum efficiency with underfloor heating systems As heat pumps would replace standard heating systems, some of the cost may offset through savings on a traditional boiler	The ASHP unit has a noise level around 50-60dB so some attenuation may be required and it should be sensibly located The potential noise from the external unit may mean there is local opposition to their installation Requires electricity to run the pump, therefore limited carbon savings in some cases For communal systems a plant room is required which may take additional land from the proposed development/surroundings	The use of ASHP is technically feasible for the development however it's being discounted because of high noise levels.	✗

Table 7-1 Feasibility of LZC technologies for the development

Having reviewed potential LZC technologies for the development it has been identified that the most appropriate system would be Solar Thermal which would most suitably be installed within the systems. The chosen should be accurately sized during the detailed design stages and MCS (Microgeneration Certification Scheme) approved equipment and installers used.

7.1 Summary of CO2 Emission Savings

The most appropriate LZC technology for the development has been identified as Solar Thermal in order to meet the London Plans and the London Borough of Camden's target for on-site renewables. Table 7-2 shows the energy use breakup for the Be Green case.

Table 7-3 shows the proposed system size and estimated energy and carbon emissions savings for this development.

Be Green																
Regulated Energy & CO2															Unregulated Energy & CO2	
Type	Gas Demand					Electricity Demand							Total Energy (kWh/yr)	Total CO_2 (kg/yr)		
	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Solar Thermal (kWh/yr)	Total (kWh/yr)	Gas CO_2 (kg/yr)	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Pumps & Fans (kWh/yr)	Lighting (kWh/yr)	Cooling (kWh/yr)	Total (kWh/yr)	Electricity CO_2 (kgCO2/yr)			Energy (kWh/yr)	CO2 (kg/yr)
Hotel	29,473	141,564	-31875	139161	30059	0	0	0	0	0	0	0	0	0	0	0
Commercial & workshop	277	170	0	447	97	0	0	3,951	159	9,309	0	13,419	6,965	184,455	37,023	24,416
Total	29,750	141,734	-31875	139608	30,155	0	0	1,712	513	5,645		7,870	4,084	8,317	4,181	1,927

Table 7-2 Estimated regulated and unregulated energy demand and carbon emissions per energy source

	Energy & CO_2				Life Cycle Carbon and Cost Analysis
Proposed LZC Technologies	Energy Generated (kWh/yr)	% site energy demand met	CO_2 saved by system (kgCO2/yr)	% reduction in site CO_2 emissions	25 year CO_2 saving ($kgCO_2$)
Solar thermal (80% efficient) 75sq.m Evacuated Tube Inclination 0˚, S facing Heat loss coefficient 1.162/0.005	31875	14.5%	6885	11.1%	172,125

Table 7-3 Energy, carbon and financial performance of the proposed LZC technologies

7.2 Improvement Over Part L with LZC

Table 7-4 and demonstrates the percentage improvement over the notional baseline levels for the development incorporating the air source heat pumps for providing space heating to the entire development and hot water to hotel only. This confirms that the development can achieve 35% improvement over the Part L 2013 target emissions with proposed strategy.

Site Wide	CO_2 Emissions (tonnes /annum)	CO_2 Savings (tonnes /annum)	% Saving
Building Regulations 2013 Baseline	63.01		
Be Lean (after demand reduction)	58.51	4.49	7%
Be Clean (after efficiency measures)	54.40	4.11	7%
Be Green (after renewable energy)	41.20	13.20	21%
Total Cumulative Savings		21.80	35%

Table 7-4 summarises the carbon savings in the interim strategy after LZCs

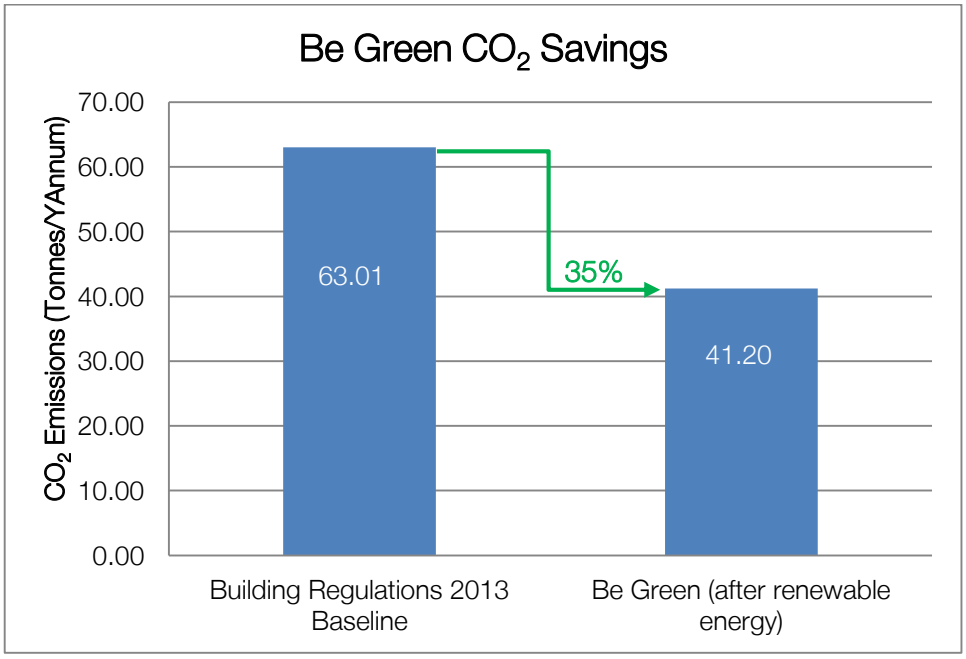


Figure 7-1 Site Wide Improvement over Building Regulations Part L 2013 after LZCs

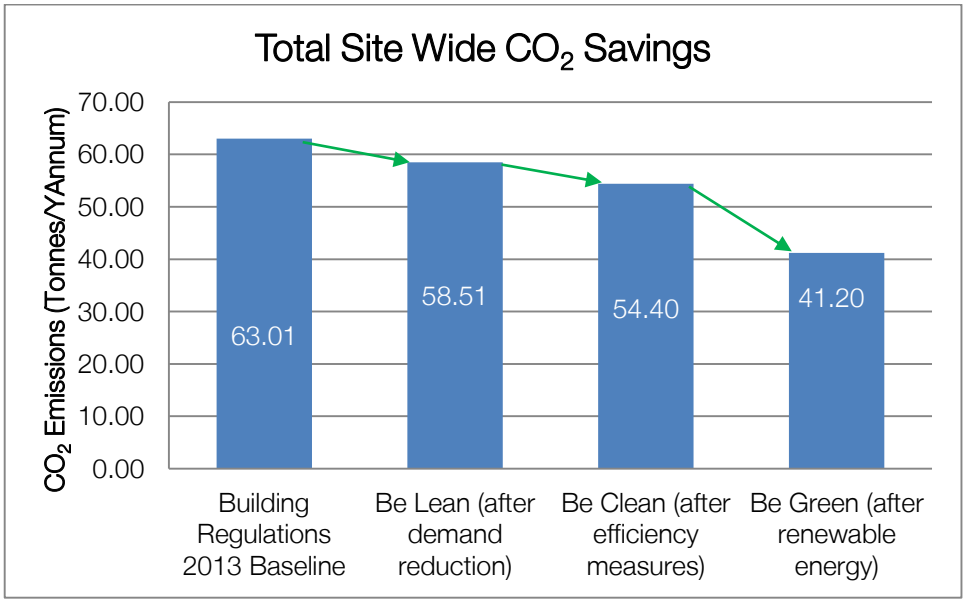


Figure 7-2 Summary of CO2 savings (tonnes CO2/annum) over Building Regulations 2013 baseline

8 Conclusion

Following the Be Lean, Be Clean and Be Green energy hierarchy, passive design measures, energy efficient equipment and LZC technologies have been shown to provide a 35% improvement over the Building Regulations Part L 2013 Target Emissions Rate (TER) and overall 11.1% saving in carbon emissions from the LZCs technologies.

The design team have made all reasonable endeavours to achieve the minimum requirements of the London Plan and the London Borough of Camden. Although the saving from renewables does not meet the required 20% under Camden Planning policy, the development, achieves an improvement over Part L in line with the London Plan. In addition, fabric improvements have been prioritised for the development, which will have a longer lasting impact on energy use than renewable technologies with a finite lifetime. The fabric U-Values are extremely low and far exceed current Building Regulations. Energy efficiency has been maximised throughout the M&E strategy and in the reduction of unregulated energy uses. The strategy therefore represents the best possible savings that could be achieved for this development.

Based on the results of the DSM calculations, the development can achieve a total of 10 credits under the BREEAM New Construction 2014 Pre-Assessment Ene 01.

The figures within this report are based on preliminary analysis only and further detailed studies will be required at the detailed design stage before specifying any of the proposed systems.

9 Appendix A

The following tables show figures used in the energy and CO_2 calculations to estimate energy produced and CO_2 savings from LZC technologies. These figures can be used to validate the results.

CO_2 Intensity Values	
Gas Intensity	0.216 $kgCO_2/kWh$
Electricity Intensity	0.519 $kgCO_2/kWh$
Grid Displaced Electricity Intensity	0.529 $kgCO_2/kWh$

Table B-1: Energy intensity values

Fuel Prices (as of Dec 2013)	
Natural Gas	4.37 p/kWh
Electricity (Grid)	13.7 p/kWh

Table B-2: Natural Gas and Electricity fuel prices

10 Appendix B

The following grants may be available with the use of renewable technologies on this development.

Grant	
Feed-in Tariff	By generating your own renewable electricity your energy supplier may pay you money, called a 'Feed-in Tariff' (FIT). Using an MCS certified installer, the system could entitle you to a rate for each unit (kilowatt hour or kWh) of electricity you generate. As well as the FIT, you can sell any excess electricity back to your electricity supplier through an 'Export Tariff'. To qualify, the installation must have a total installed capacity (TIC) of 5 MW or less, with the following technologies covered: • Solar photovoltaic (PV) panels • Wind turbines • Water (Hydro) turbines • Anaerobic digestion (biogas energy) • Micro combined heat and power (micro-CHP) https://www.gov.uk/feed-in-tariffs
Renewable Heat Incentive (RHI)	The RHI is a scheme for both the domestic and non-domestic sector. It provides payments to those that use renewable energy to heat their buildings. In the domestic sector the scheme is open to homeowners, private landlords, social landlords and self-builders. In the non-domestic sector it is open to industry, business and public sector organisations. Payments are made to the owner of the heat installation over a 20-year period, for the following technologies: • Biomass boilers (including CHP biomass boilers) • Ground Source Heat Pumps (GSHP) • Air to Water Heat Pumps (AWHP) • Water Source Heat Pumps • Deep Geothermal Heat Pumps • All solar thermal collectors • Biomethane Injection and Biogas • Energy from Waste (EfW) Domestic RHI • Biomass only boilers and biomass pellet stoves • Air Source Heat Pumps (ASHP) • Ground and Water Source Heat Pumps • Solar thermal panels (flat plate or evacuated tube for hot water only) https://www.gov.uk/government/policies/increasing-the-use-of-low-carbon-technologies/supporting-pages/renewable-heat-incentive-rhi https://www.ofgem.gov.uk/environmental-programmes/domestic-renewable-heat-incentive https://www.ofgem.gov.uk/environmental-programmes/non-domestic-renewable-heat-incentive-rhi

Green Deal	The Green Deal is a Government backed initiative to promote the installation of energy efficiency measures in households in order to reduce energy consumption and bills. There will be no upfront costs, instead consumers will pay through their household energy bills. Consumers can see the Green Deal charge alongside the reductions in energy use which generate savings on their bill. It also means that if they move out (and cease to be the bill payer) the financial obligation remains at the property for the next bill payer: the charge is only paid where/whilst the benefits are enjoyed. https://www.gov.uk/green-deal-energy-saving-measures/how-the-green-deal-works
ECO (Energy Company Obligation)	ECO is a requirement for all large gas and electricity suppliers to fund energy efficiency improvements to dwellings in the UK. Energy suppliers have specific carbon reduction targets to achieve, and therefore must buy ECO 'credits' of CO_2 on a free market, either from installers (and home owners) or from other energy suppliers. Therefore the price of ECO 'credits' is not fixed. The installer (home owner or private renter with owner's permission) can claim back the money for the installation of the improvement measures from the energy suppliers (full payback or partial refund depending on type of improvement(s) and value of ECO 'credits'). The scheme can be used to fund a number of domestic energy efficiency improvements. If householders are applying for the Green Deal and are eligible for ECO, they will receive a lower quote from their Green Deal Provider and will benefit from lower repayments. The scheme has been extended until 31st March 2017, however there are certain Eligibility requirements. See https://www.gov.uk/energy-company-obligation for more information. Energy Companies Obligation - Guidance for suppliers

Table C-1: A selection of available grants as of 23rd September 2014

11 Appendix C

Final BRUKL

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

84 Hatton Garden hotel

As designed

Date: Wed Mar 23 17:06:11 2016

Administrative information

Building Details

Address: , EC1N 8JR

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.3.3"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.3.3

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

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name:

Telephone number:

Address: , ,

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

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	66
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	66
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	49.5
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	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.11	0.11	External Wall
Floor	0.25	0.11	0.11	Ground Floor
Roof	0.25	0.12	0.12	Roof
Windows***, roof windows, and rooflights	2.2	1.25	1.42	Glazing wall DG -Courtyard
Personnel doors	2.2	1.62	1.63	Internal Door
Vehicle access & similar large doors	1.5	-	-	No vehicle doors in project
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

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

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

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	4

Building services

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

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

1- kitchen (LG kitchen)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0	-	-	1.1	0.85
Standard value	N/A	N/A	N/A	1.6^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
^ Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.					

2- NV

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.96	-	-	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

3- hotel (48 Zones)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.96	3.6	-	-	-
Standard value	0.91*	2.6	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

1- New DHW Circuit

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	0.96	0
Standard value	0.9*	N/A
* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.		

Local mechanical ventilation, exhaust, and terminal units

ID	**System type in Non-domestic Building Services Compliance Guide**
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	**SFP [W/(l/s)]**									**HR efficiency**	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
LG kitchen	-	-	-	-	1.1	-	-	-	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
B1c workshop	-	90	22	589
B1c Waste & recycle	90	-	-	8
C3 Waste & recycle	90	-	-	12
LG room 1	-	90	-	36
LG Corridor	-	90	-	48
LG breakfast room	-	90	22	111
LG kitchen	-	90	-	101
LG Plant	90	-	-	40
LG circulation	-	90	-	34
B1c workshop Storage	90	-	-	17
LG fire exit	-	90	-	28
Ground Room 1	-	90	-	39
Ground Room 2	-	90	-	45
Ground Room 3	-	90	-	45
Ground Reception	-	90	22	90
Ground Entry	-	90	22	95
Ground A1 existing Commercial Unit	-	90	22	508
Ground Circulation	-	90	-	21
Ground Corridor with glazing	-	90	-	54
Ground storage	90	-	-	5
1st Room 1	-	90	-	31
1st Room 2	-	90	-	40
1st Room 3	-	90	-	42
1st Room 4	-	90	-	43
1st Room 5 duplex	-	90	-	63
1st circulation	-	90	-	19
1st corridor 1	-	90	-	12
1st glazing corridor	-	90	-	27
1st stairs to courtyard	-	90	-	14
1st corridor 2	-	90	-	38
2nd Room 1	-	90	-	31
2nd Room 2	-	90	-	40
2nd Room 3	-	90	-	43
2nd Room 4	-	90	-	34
2nd Plant	90	-	-	73
2nd circulation	-	90	-	19
2nd corridor	-	90	-	23
3rd Room 1	-	90	-	31
3rd Room 2	-	90	-	40
3rd Room 3	-	90	-	43
3rd Room 4	-	90	-	34
3rd circulation	-	90	-	19

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
3rd corridor	-	90	-	23
4th Room 1	-	90	-	31
4th Room 2	-	90	-	40
4th Room 3	-	90	-	43
4th Room 4	-	90	-	34
4th circulation	-	90	-	19
4th corridor	-	90	-	23
5th Room 1	-	90	-	31
5th Room 2	-	90	-	40
5th Room 3	-	90	-	43
5th Room 4	-	90	-	34
5th circulation	-	90	-	19
5th corridor	-	90	-	23
6th Room 1	-	90	-	47
6th Room 2	-	90	-	41
6th Room 3	-	90	-	32
6th circulation	-	90	-	19
6th corridor	-	90	-	24
7th circulation	-	90	-	19
7th corridor	-	90	-	13
7th Room 1	-	90	-	55
7th Room 2	-	90	-	41
7th Room 3	-	90	-	32

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
B1c workshop	N/A	N/A
LG room 1	NO (-10%)	NO
LG Corridor	N/A	N/A
LG breakfast room	NO (-58%)	NO
B1c workshop Storage	N/A	N/A
LG fire exit	NO (-81%)	NO
Ground Room 1	NO (0%)	NO
Ground Room 2	NO (-63%)	NO
Ground Room 3	NO (-88%)	NO
Ground Reception	NO (-98%)	NO
Ground Entry	NO (-3%)	NO
Ground A1 existing Commercial Unit	NO (-80%)	NO
Ground Corridor with glazing	NO (-59%)	NO
Ground storage	NO (-97%)	NO
1st Room 1	NO (-29%)	NO
1st Room 2	NO (-12%)	NO
1st Room 3	NO (-29%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
1st Room 4	NO (-82%)	NO
1st Room 5 duplex	NO (-78%)	NO
1st corridor 1	N/A	N/A
1st glazing corridor	NO (-33%)	NO
1st stairs to courtyard	NO (-45%)	NO
1st corridor 2	NO (-18%)	NO
2nd Room 1	NO (-29%)	NO
2nd Room 2	NO (-12%)	NO
2nd Room 3	NO (-23%)	NO
2nd Room 4	NO (-69%)	NO
2nd corridor	N/A	N/A
3rd Room 1	NO (-29%)	NO
3rd Room 2	NO (-12%)	NO
3rd Room 3	NO (-22%)	NO
3rd Room 4	NO (-69%)	NO
3rd corridor	N/A	N/A
4th Room 1	NO (-29%)	NO
4th Room 2	NO (-12%)	NO
4th Room 3	NO (-22%)	NO
4th Room 4	NO (-69%)	NO
4th corridor	N/A	N/A
5th Room 1	NO (-29%)	NO
5th Room 2	NO (-12%)	NO
5th Room 3	NO (-22%)	NO
5th Room 4	NO (-68%)	NO
5th corridor	N/A	N/A
6th Room 1	NO (-77%)	NO
6th Room 2	NO (-87%)	NO
6th Room 3	NO (-78%)	NO
6th corridor	NO (-48%)	NO
7th corridor	N/A	N/A
7th Room 1	NO (-78%)	NO
7th Room 2	NO (-79%)	NO
7th Room 3	NO (-62%)	NO

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	884	884
External area [m²]	1237	1237
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	4	3
Average conductance [W/K]	482	645
Average U-value [W/m²K]	0.39	0.52
Alpha value* [%]	15.89	15.89

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

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
100	**C1 Hotels**
	C2 Residential Inst.: Hospitals and Care Homes
	C2 Residential Inst.: Residential schools
	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.
	Residential spaces
	D1 Non-residential Inst.: Community/Day Centre
	D1 Non-residential Inst.: Libraries, Museums, and Galleries
	D1 Non-residential Inst.: Education
	D1 Non-residential Inst.: Primary Health Care Building
	D1 Non-residential Inst.: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others - Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	33.34	41.14
Cooling	4.47	7.59
Auxiliary	0.18	0.23
Lighting	10.53	14.37
Hot water	160.14	212.42
Equipment*	27.62	27.62
TOTAL**	**208.65**	**275.75**

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

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	33.23	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	181.66	231.23
Primary energy* [kWh/m²]	281.47	375.77
Total emissions [kg/m²]	49.5	66

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	0	0	0	0	23.9	0	0	0	0
	Notional	0.5	0	0.2	0	31.7	0.82	0	----	----
[ST] No Heating or Cooling										
	Actual	31.3	0	9.1	0	0	0.96	0	0.96	0
	Notional	28.3	0	9.6	0	0	0.82	0	----	----
[ST] Central heating using air distribution, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	136.5	70.5	39.7	5.4	0	0.95	3.6	0.96	3.6
	Notional	58.7	119.6	19.9	9.2	0	0.82	3.6	----	----

Key to terms

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

Key Features

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

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.11	External Wall
Floor	0.2	0.11	Ground Floor
Roof	0.15	0.12	Roof
Windows, roof windows, and rooflights	1.5	1.07	2.3X3.1 Triple Glazing
Personnel doors	1.5	1.36	External Door
Vehicle access & similar large doors	1.5	-	No vehicle doors in project
High usage entrance doors	1.5	-	No high usage entrance doors in project

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

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

Air Permeability	Typical value	This building
$m^3/(h.m^2)$ at 50 Pa	5	4

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

84 Hatton Garden Be Green Comm& Workshop

As designed

Date: Wed Mar 23 13:22:29 2016

Administrative information

Building Details

Address: , EC1N 8JR

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.3.3"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.3.3

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

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name:

Telephone number:

Address: , ,

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

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	41
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	41
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	38.8
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	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.11	0.11	External Wall
Floor	0.25	0.11	0.11	Ground Floor
Roof	0.25	0.12	0.12	Roof
Windows***, roof windows, and rooflights	2.2	1.25	1.42	Glazing wall DG -Courtyard
Personnel doors	2.2	1.62	1.63	Internal Door
Vehicle access & similar large doors	1.5	-	-	No vehicle doors in project
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

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

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

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	4

Building services

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

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

1- Commercial & workshop (3 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	3.2	-	1.1	0.85
Standard value	0.91*	2.6	N/A	1.6^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

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

1- commercial/workshop

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.95	0
Standard value	1	N/A

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
B1c workshop	-	-	-	-	1.1	-	-	-	-	-	N/A
B1c workshop Storage	-	-	-	-	1.1	-	-	-	-	-	N/A
Ground A1 existing Commercial Unit	-	-	-	-	1.1	-	-	-	-	-	N/A

General lighting and display lighting

Zone name	Luminous efficacy [lm/W]			General lighting [W]
	Luminaire	**Lamp**	**Display lamp**	
Standard value	60	60	22	
B1c workshop	-	90	22	589
B1c Waste & recycle	90	-	-	8
C3 Waste & recycle	90	-	-	12
LG room 1	-	90	-	36
LG Corridor	-	90	-	48
LG breakfast room	-	90	22	111

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
LG kitchen	-	90	-	101
LG Plant	90	-	-	40
LG circulation	-	90	-	34
B1c workshop Storage	90	-	-	17
LG fire exit	-	90	-	28
Ground Room 1	-	90	-	39
Ground Room 2	-	90	-	45
Ground Room 3	-	90	-	45
Ground Reception	-	90	22	90
Ground Entry	-	90	22	95
Ground A1 existing Commercial Unit	-	90	22	508
Ground Circulation	-	90	-	21
Ground Corridor with glazing	-	90	-	54
Ground storage	90	-	-	5
1st Room 1	-	90	-	31
1st Room 2	-	90	-	40
1st Room 3	-	90	-	42
1st Room 4	-	90	-	43
1st Room 5 duplex	-	90	-	63
1st circulation	-	90	-	19
1st corridor 1	-	90	-	12
1st glazing corridor	-	90	-	27
1st stairs to courtyard	-	90	-	14
1st corridor 2	-	90	-	38
2nd Room 1	-	90	-	31
2nd Room 2	-	90	-	40
2nd Room 3	-	90	-	43
2nd Room 4	-	90	-	34
2nd Plant	90	-	-	73
2nd circulation	-	90	-	19
2nd corridor	-	90	-	23
3rd Room 1	-	90	-	31
3rd Room 2	-	90	-	40
3rd Room 3	-	90	-	43
3rd Room 4	-	90	-	34
3rd circulation	-	90	-	19
3rd corridor	-	90	-	23
4th Room 1	-	90	-	31
4th Room 2	-	90	-	40
4th Room 3	-	90	-	43
4th Room 4	-	90	-	34
4th circulation	-	90	-	19
4th corridor	-	90	-	23

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
5th Room 1	-	90	-	31
5th Room 2	-	90	-	40
5th Room 3	-	90	-	43
5th Room 4	-	90	-	34
5th circulation	-	90	-	19
5th corridor	-	90	-	23
6th Room 1	-	90	-	47
6th Room 2	-	90	-	41
6th Room 3	-	90	-	32
6th circulation	-	90	-	19
6th corridor	-	90	-	24
7th circulation	-	90	-	19
7th corridor	-	90	-	13
7th Room 1	-	90	-	55
7th Room 2	-	90	-	41
7th Room 3	-	90	-	32

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
B1c workshop	N/A	N/A
LG room 1	NO (-10%)	NO
LG Corridor	N/A	N/A
LG breakfast room	NO (-58%)	NO
B1c workshop Storage	N/A	N/A
LG fire exit	NO (-81%)	NO
Ground Room 1	NO (0%)	NO
Ground Room 2	NO (-63%)	NO
Ground Room 3	NO (-88%)	NO
Ground Reception	NO (-98%)	NO
Ground Entry	NO (-3%)	NO
Ground A1 existing Commercial Unit	NO (-80%)	NO
Ground Corridor with glazing	NO (-59%)	NO
Ground storage	NO (-97%)	NO
1st Room 1	NO (-29%)	NO
1st Room 2	NO (-12%)	NO
1st Room 3	NO (-29%)	NO
1st Room 4	NO (-82%)	NO
1st Room 5 duplex	NO (-78%)	NO
1st corridor 1	N/A	N/A
1st glazing corridor	NO (-33%)	NO
1st stairs to courtyard	NO (-45%)	NO
1st corridor 2	NO (-18%)	NO
2nd Room 1	NO (-29%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
2nd Room 2	NO (-12%)	NO
2nd Room 3	NO (-23%)	NO
2nd Room 4	NO (-69%)	NO
2nd corridor	N/A	N/A
3rd Room 1	NO (-29%)	NO
3rd Room 2	NO (-12%)	NO
3rd Room 3	NO (-22%)	NO
3rd Room 4	NO (-69%)	NO
3rd corridor	N/A	N/A
4th Room 1	NO (-29%)	NO
4th Room 2	NO (-12%)	NO
4th Room 3	NO (-22%)	NO
4th Room 4	NO (-69%)	NO
4th corridor	N/A	N/A
5th Room 1	NO (-29%)	NO
5th Room 2	NO (-12%)	NO
5th Room 3	NO (-22%)	NO
5th Room 4	NO (-68%)	NO
5th corridor	N/A	N/A
6th Room 1	NO (-77%)	NO
6th Room 2	NO (-87%)	NO
6th Room 3	NO (-78%)	NO
6th corridor	NO (-48%)	NO
7th corridor	N/A	N/A
7th Room 1	NO (-78%)	NO
7th Room 2	NO (-79%)	NO
7th Room 3	NO (-62%)	NO

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	105	105
External area [m²]	1237	1237
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	4	3
Average conductance [W/K]	482	341
Average U-value [W/m²K]	0.39	0.28
Alpha value* [%]	15.89	15.89

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

Building Use

% Area	Building Type
100	**A1/A2 Retail/Financial and Professional services**
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Inst.: Hospitals and Care Homes
	C2 Residential Inst.: Residential schools
	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.
	Residential spaces
	D1 Non-residential Inst.: Community/Day Centre
	D1 Non-residential Inst.: Libraries, Museums, and Galleries
	D1 Non-residential Inst.: Education
	D1 Non-residential Inst.: Primary Health Care Building
	D1 Non-residential Inst.: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others - Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	2.64	9.26
Cooling	16.3	15.27
Auxiliary	4.89	4.13
Lighting	53.76	56.96
Hot water	1.62	1.69
Equipment*	18.35	18.35
TOTAL**	**79.21**	**87.32**

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

Energy Production by Technology [kWh/m²]

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

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	206.68	237.1
Primary energy* [kWh/m²]	229.53	241.93
Total emissions [kg/m²]	38.8	41

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using air distribution, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	9	197.7	2.8	17.2	5.2	0.9	3.2	0.95	3.2
	Notional	28.3	208.3	9.6	16.1	4.4	0.82	3.6	----	----

Key to terms

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

Key Features

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

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.11	External Wall
Floor	0.2	0.11	Ground Floor
Roof	0.15	0.12	Roof
Windows, roof windows, and rooflights	1.5	1.07	2.3X3.1 Triple Glazing
Personnel doors	1.5	1.36	External Door
Vehicle access & similar large doors	1.5	-	No vehicle doors in project
High usage entrance doors	1.5	-	No high usage entrance doors in project

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

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

Air Permeability	Typical value	This building
$m^3/(h.m^2)$ at 50 Pa	5	4