

173-175 Friar Street and 27-32 Market Place, Reading

Energy Strategy Report



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STRUCTURAL ENGINEERING GEOMETRICS SUSTAINABILITY CIVIL ENGINEERING

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Acronyms	
ASHP	Air Source Heat Pumps
BRE	Building Research Establishment
CHP	Combined Heat and Power
GSHP	Ground Source Heat Pumps
LZC	Low and zero carbon
PV	Photovoltaic
SAP	Standard Assessment Procedure

Executive Summary

This report details the proposed energy strategy for the 173-175 Friar Street and 27-32 Market Place scheme. The proposed development involves the demolition of an existing vacant building as well as the refurbishment of three listed buildings. The proposed scheme at 173-175 Friar Street provides a 7 storey mixed-use development which comprises commercial space lower 4 storeys and 35 new 1 to 3 beds residential units arranged over four upper storeys. The refurbishment of 27-32 Market Place provides additional commercial space measuring approx. 423.2sq.m and 8 residential units on the first to third floor.

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); and
- 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.

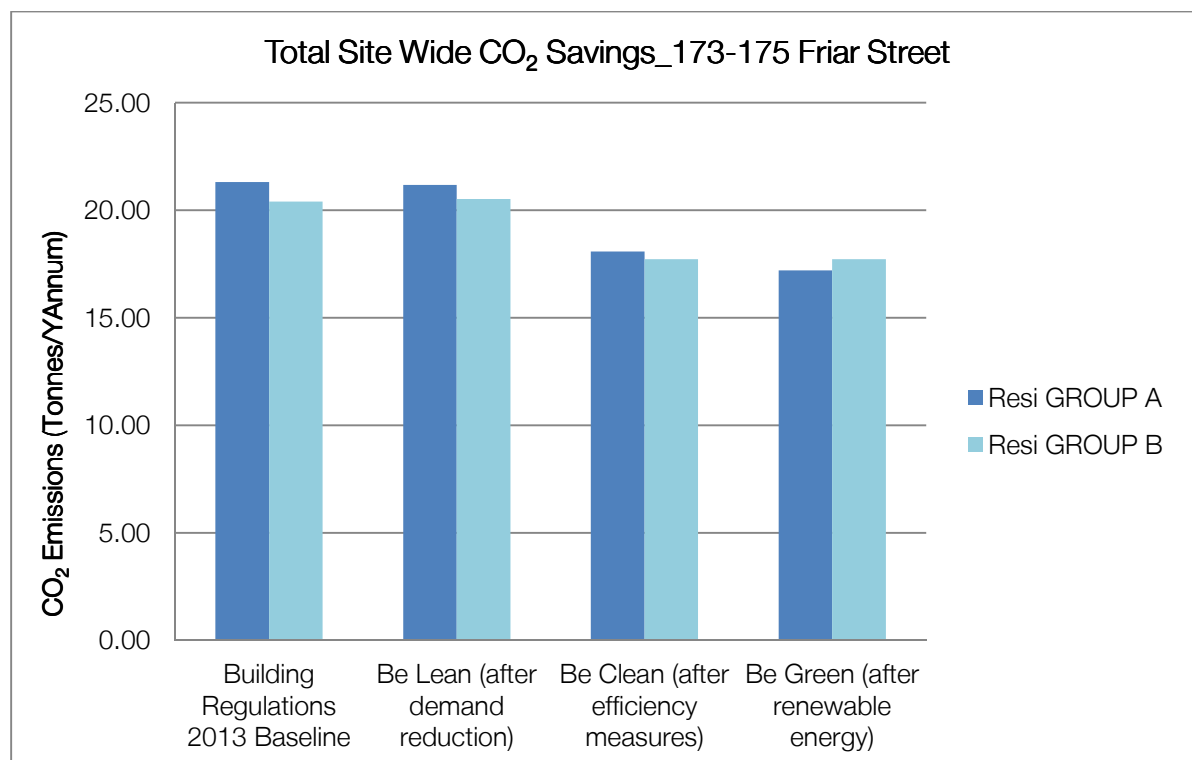


Figure 1 Summary of CO₂ savings over Building Regulations 2013 baseline – Residential part of 173-175 Friar Street

The proposed strategy has been prepared in accordance with the Reading Councils pre-app response dated 24th January 2016. 50% (18 out of 35) of the residential units in the new development has the potential to achieve an improvement of 19.3% over Building Regulations Part L 2013. This is achieved through passive design measures, energy efficient equipment and

2.1kW peak of high efficiency PV panels. The remaining 17 residential units will meet the Building Regulation Part L 2013's carbon emission target achieving 13.1% improvement.

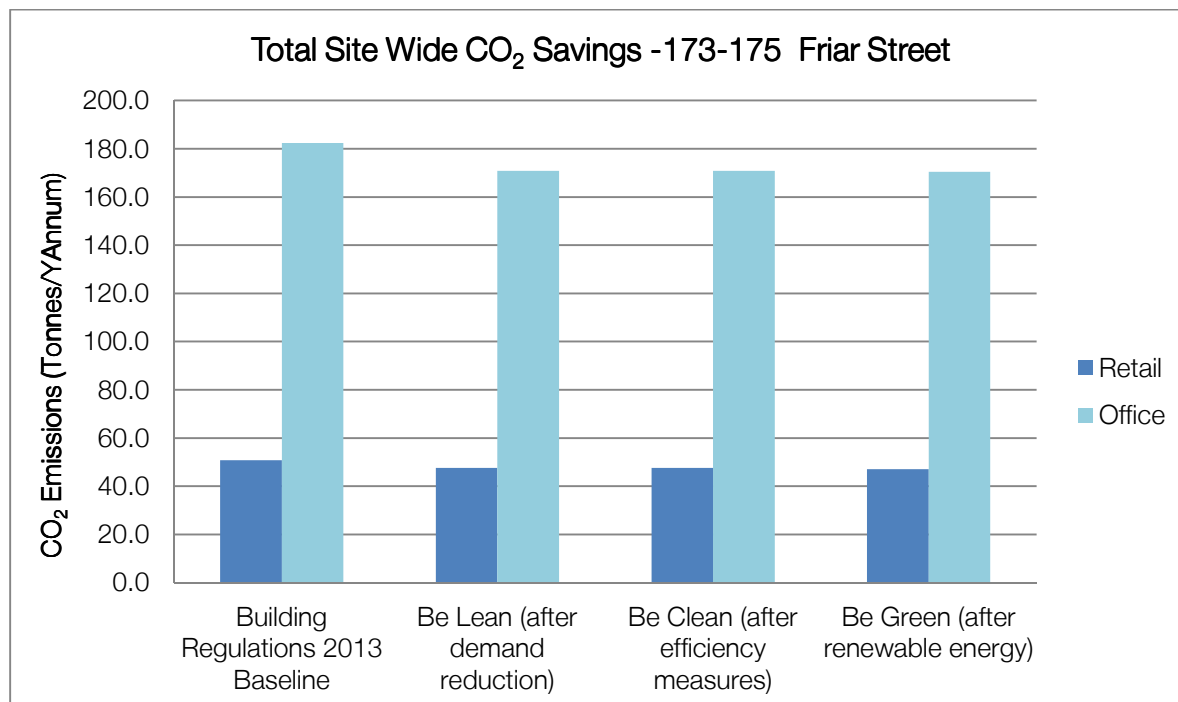
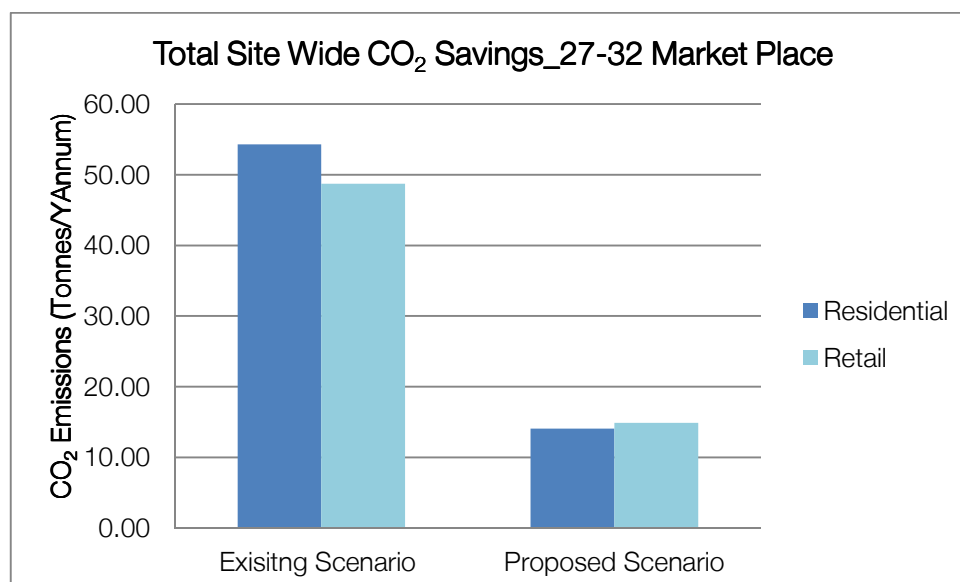


Figure 2 1 Summary of CO₂ savings over Building Regulations 2013 baseline – non-resi part of 173-175 Friar Street

The retail units of 173-175 Friar Street can achieve 7.4% improvement and the office units can achieve 6.7% improvement over the Part L baseline. These units also able to achieve the minimum energy credits required to achieve the required BREEAM rating in line with Reading council's requirement.



The proposed strategy for the 27-32 Market Place part of the development has the potential to provide a 74% & 69% improvement over the existing cases, for the domestic and commercial developments; through passive design measures and energy efficient equipment.

1 Introduction

1.1 Site Analysis

Price & Myers have been commissioned to produce an Energy Strategy Report for the proposed development at 173-175 Friar Street & 27-32 Market Place. The development is in Reading.

The proposed development at 173-175 Friar Street & 27-32 Market Place involves the demolition of an existing vacant building as well as the refurbishment of an existing vacant building as well as the refurbishment of three listed buildings. The 173-175 Friar Street development shall replace the demolished building, with commercial space measuring circa 5,400sq.m and a mixture of 35 new 1 to 3 bed apartments. The refurbishment of 27-32 Market Place will provide additional commercial space measuring 423.2sq.m and 8 residential units on the first to third floors.



Figure 1.1: Design Statement extract indicating site location of 173-175 Friar Street & 27-32 Market Place

Our assessment has been based on drawings and details provided by Rodic Davidson architects.

1.2 Objectives

This report summarises the work done to support the development of an energy strategy for the scheme. The strategy 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 CO2 footprint of the proposed scheme, and renewable energy options.

The final proposed strategy allows the scheme to demonstrate compliance with the guidelines set out by the Reading Borough Council in demonstrating a positive commitment to sustainability through providing environmental improvements.

2 Policy

2.1 Reading Borough Local Development Framework, Core Strategy

Policy CS1: Sustainable Construction and Design

Proposals for new development, including the construction of new buildings and the redevelopment and refurbishment of existing building stock, will be acceptable where the design of buildings and site layouts use energy, water, minerals, materials and other natural resources appropriately, efficiently and with care and take account of the effects of climate change.

To meet these requirements:

- All new housing is required to meet the most up to date Eco-Homes 'Very Good' as a minimum standard, and all new commercial developments are required to meet the most up to date BREEAM 'Very Good' as a minimum standard;
- On larger developments of more than 10 dwellings or 1,000 m² of floor space, ensure that 50% of the provision meets the most up to date Eco-Homes and BREEAM 'Excellent' standards;
- All new developments maximise the use of energy efficiency and energy conservation measures in their design, layout and orientation to reduce overall energy demand;
- All developments of more than 10 dwellings or 1000m² floor space incorporate on-site generation of energy from renewable sources and energy efficient design measures (including the use of CHP where appropriate) to off-set at least 20% of predicted carbon dioxide emissions from the estimated energy usage of the completed and occupied development

2.2 Reading Borough Council

Enquiry Reference & Address: 161748/PREAPP 29-32 Market Place and 173-175 Friar Street, Reading. Pre app response

6. Sustainability

The 'Code for Sustainable Homes' is no longer applicable but new residential development is still required to comply with LDF Policies CS1, DM1 and DM2. The Council requires written documentary evidence demonstrating that 50% of the dwellings sought would achieve a minimum of a 19% improvement in the dwelling emission rate over the target emission rate, as defined in The Building Regulations for England Approved Document L1A: Conservation of Fuel and Power in New Dwellings (2013 edition). Such evidence shall be in the form of a Design Stage Standard Assessment Procedure (SAP) Assessment, produced by an accredited energy assessor.

In relation to the non-residential element of the scheme as the development is classified as 'major' application the construction is required to meet a BREEAM rating of 'Excellent' for 50 % and 'Very good' for the remaining 50%.

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); and
- Utilise renewable energy sources to reduce carbon emissions (Be Green).

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

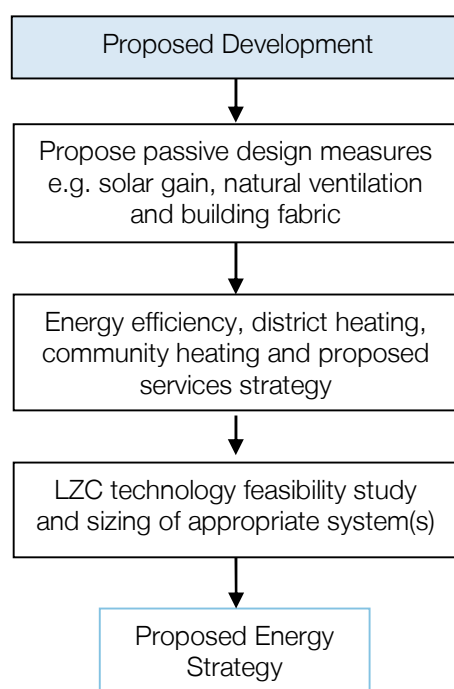


Figure 3.1 Methodology for Energy Performance Strategy.

The performance of the development in terms of energy consumption and carbon emissions is calculated at each stage of the assessment.

3.1 Accredited Energy Assessor

This report has been checked and reviewed by Deepika Singhal who is an accredited Low Carbon Energy Assessor and Fraser Wilson who is an On Construction Domestic Energy Assessor. The energy consumption and carbon emission figures within this report have been calculated using the approved Standard Assessment Procedure for the Energy Rating of Dwellings (SAP), current SAP 2012 version and Dynamic Simulation Modelling software by EDSL Tas.

4 Energy Targets

The target for the 173-175 Friar Street part of the project is for 50% of the flats to achieve a 19% improvement over Part L 2013 and the remaining 50% to meet Building Regulations Part L1 2013. The units have been divided into group 'A' and 'B'. Refer to Appendix A. The non-residential part of the development must meet Part L2 2013. Also, 50% of the non-residential element should achieve BREEAM 'Excellent' and remaining 50% should achieve 'Very Good'. Thus, proposed office measuring 4,224sq.m will therefore achieve 'Excellent' rating and retail measuring 1,177sq.m will achieve 'Very Good' rating. The target for both the residential and commercial parts of the 27-32 Market Place part of the development is to show an improvement over the existing development and meet Part L1B and L2B respectively.

Table 4.1 details the energy broken down by fuel types and fuel use categories for the Friar Street part of the development. These values are the baseline energy and carbon calculations before any passive design and energy efficient measures. Table 4.2 details the energy broken down by fuel types and fuel use categories for the Market Place part of the development.

Building Regulations Baseline Target Values: Regulated Energy Demand & CO ₂ Emissions														
173-175 Friar Street	Gas				Electricity							Total Energy (kWh/yr)	Total CO ₂ (kg/yr)	
	Demand (kWh/yr)			CO ₂ (kg/yr)	Demand (kWh/yr)						CO ₂ (kg/yr)			
	Space Heating	Hot Water	Total		Space Heating	Hot Water	Cooling	Pumps & Fans	Lighting	LZCs				Total
Residential A	49,399	35,383	84,782	18,313	0	0	0	1,350	4,424		5,774	2,997	90,555	21,309
Residential B	45,441	35,099	80,540	17,397	0	0	0	1,275	4,507		5,782	3,001	86,322	20,397
Retail	12,559	151,044	163,603	35,338	0	0	6,097	6,909	16,855		29,860	15,498	193,463	50,836
Office	45,070	542,066	587,136	126,821	0	0	21,880	24,795	60,488		107,163	55,618	694,299	182,439
Total	152,468	763,592	916,061	197,869	0	0	27,977	34,329	86,273		148,579	77,113	1,064,640	274,982

Table 4.1 Estimated regulated energy demand and carbon emissions per energy source for the new construction

Existing Case: Regulated Energy Demand & CO ₂ Emissions														
27-32 Market Place	Gas				Electricity								Total Energy (kWh/yr)	Total CO ₂ (kg/yr)
	Demand (kWh/yr)			CO ₂ (kg/yr)	Demand (kWh/yr)							CO ₂ (kg/yr)		
	Space Heating	Hot Water	Total		Space Heating	Hot Water	Coolin g	Pump s & Fans	Lighting	LZCs	Total			
Existing Residential (Market Place)	213,754	21,919	235,673	50,905			0	1,608	4,976		6,584	3,417	242,257	54,322
Existing Commercial (Market Place)	98,979	52,671	151,650	32,756			0	1,448	29,309		30,757	15,963	182,407	48,719
Total	312,733	74,590	387,323	83,662			0	3,056	34,285		37,341	19,380	424,664	103,042

Table 4.2 Estimated regulated energy demand and carbon emissions per energy source for the refurbishment

Sections 5,6 and 7 will show how the proposed passive design, energy efficiency measures and low and zero carbon technologies improve the design over these baseline figures.

The energy consumption calculations include regulated energy fuel uses. Regulated energy is that used for space and water heating, lighting, pumps and fans. Energy consumption figures for these are calculated using SAP calculations & dynamic thermal modelling for the site.

5 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. Windows are specified to incorporate low emissivity coatings to limit overheating while ensuring adequate daylight.

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. Some of the windows that belong to the commercial part of the development have been designed to have a fixed, angled louvers on south-east and south-west façade to block direct views to the outside. It is expected to help to reduce solar gain for the associated areas.

The glazing specifications used in the development are given in Table 5.1 below:

173-175 Friar Street (New development)		
Glazing Parameters	Commercial	Residential
U-value	1.2 W/m ² K	1.2 W/m ² K
G-value (Solar Transmittance)	0.256	0.63

Table 5.1 Proposed glazing parameters for the commercial doors and windows

5.2 Overheating

The impact of solar gains has been incorporated into the SAP analysis for compliance with Part L and the risk of solar overheating has been concluded to be insignificant for the residential part of the development. Risks of excessive solar gain for the non-residential areas have been checked as Part of the Part L analysis for these spaces and most areas comply with the minimum criteria.

5.3 Building Fabric Efficiency

To further improve the passive design of the 173-175 Friar street 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.

To carry out the energy performance of the refurbishment scheme at 27-32 Market place, the Reduced Data SAP (RdSAP) were used that has been developed by government for use in existing dwellings. It consists of a system of data collection with defaults and inference procedures that generate a complete set of input data for the SAP calculation.

The existing property has been classified as Age band D, which is assumed to be built between 1950 and 1966. Table 5.3 shows the figures that were used to model the existing and proposed cases for both residential and commercial parts being refurbished.

173-175 Friar Street (New development)			
Measure	Element	Residential	Commercial
U Values	External Walls	0.11 W/m ² K	0.11 W/m ² K
	Basement Walls	N/A	0.13 W/m ² K
	Corridor shelter Walls	0.15 W/m ² K	N/A
	Lift/Stairwell shelter Walls	0.25 W/m ² K	0.25 W/m ² K
	Roof	0.11 W/m ² K	0.11 W/m ² K
	Exposed Floor	0.11 W/m ² K	N/A
	Ground Floor	N/A	0.14 W/m ² K
	Basement Floor	N/A	0.14 W/m ² K
	Party Walls	*0.00 W/m ² K	*0.00 W/m ² K
	Entrance Doors	1.00 W/m ² K	N/A
Thermal Bridging		Y Value = 0.150 (default) Details to be calculated at the detailed design stage	Default
Air Tightness		Pressure testing will be carried out to determine air tightness. This will be an assumed: 4 m ³ /m ² /h	Pressure testing will be carried out to determine air tightness. This will be an assumed: 5 m ³ /m ² /h

Table 5.2 Proposed passive design measures for 173-175 Friar Street

27-32 Market Place (Existing Residential & Commercial Refurbishment)				
Measure	Element	Existing Residential & Commercial	Proposed Residential	Proposed Commercial
U Values	External Walls	2.10 W/m ² K	0.20 W/m ² K	
	Basement Walls	1.90 W/m ² K	N/A	0.45 W/m ² K
	Corridor Shelter Wall	2.50 W/m ² K	0.55 W/m ² K	0.55 W/m ² K
	Lift/Stair Shelter Wall	2.50 W/m ² K	0.20 W/m ² K	0.20 W/m ² K
	Party Walls*	0.00 W/m ² K	0.00 W/m ² K	0.00 W/m ² K
	Roof (Flat/Sloped)	2.30 W/m ² K	0.18 W/m ² K	0.18 W/m ² K
	Basement Floor (Commercial)	1.00 W/m ² K	N/A	1.20 W/m ² K
	Ground Floor (Commercial)	1.20 W/m ² K	N/A	1.20 W/m ² K
	Exposed Floor (Residential)	1.20 W/m ² K	0.25 W/m ² K	N/A
	External Doors (Commercial)	1.40 W/m ² K	N/A	1.00 W/m ² K
	Commercial Windows	3.28 W/m ² K (Double glazed)	N/A	1.80 W/m ² K (Double glazing or secondary glazing)
	Residential Windows	4.80 W/m ² K (Single glazed)	1.80 W/m ² K (Secondary glazing)	N/A
	Entrance Doors (Residential)	1.40 W/m ² K	1.00 W/m ² K	N/A
Thermal Bridging		Y Value = 0.150 (default)		
Air Tightness		Worst case scenario assumed: 15 m ³ /m ² /h	Pressure testing will be carried out to determine air tightness. This will be an assumed: 10 m ³ /m ² /h	

Table 5.3 Proposed passive design measures for 27-32 Market Place

*Where party walls have a cavity these are to meet the following requirements:

- Sealed to prevent air going in and out of any cavity
- Sealed at the top, bottom and vertically
- All cavities are to be fully filled

6 Energy Efficiency Equipment

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 require their own boilers or chillers.

This is no network or possible network within close enough proximity of the site to consider connecting at this time. The new development at 173-175 Friar Street will utilise community heating, which will provide the necessary infrastructure to connect in the future should another network be realised. This includes the provision of pipework to the site boundary to facilitate future connection.

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 the new part of the development is large, with 35 units and GIA of 5392sq.m commercial space. At this scale, community heating is a viable solution. This provides a greater efficiency than individual systems. This solution also allows the opportunity to consider larger scale technologies and future proofs the development for potential connection to a district heating system.

6.3 Services Strategy

In addition to the passive design measures identified in Section 5, energy-efficient equipment has been proposed where possible to support the services strategy.

Table 6.1 shows the proposed services strategy and energy efficiency measures for the development. Table 6.2 and Table 6.3 shows the assumed existing and proposed services strategy and energy efficiency measures for the Market Place development.

173-175 Friar Street (Residential and Commercial)				
Services	Residential		Commercial	
Space Heating	Communal Gas Boiler 95% efficient			
Heating Controls	Time and temperature zone control			
Hot Water Heating	Communal Gas Boiler 95% efficient			
Hot Water Storage	Hot water cylinders 100mm foam insulated Fully insulated primary pipework		Office	Combined hot water tank 1000lt
	1 bed flats	100lt HW cylinder		
	2 bed flats	150lt HW cylinder	Retail	Combined hot water tank 2000lt
	3 bed flats	200lt HW cylinder		
Ventilation	Mechanical Ventilation with Heat Recovery 90% efficient SPF 0.5 W/l/s		Office & Retail Units	MVHR 80% efficient SFP 0.4 W/l/s (extract fan) SFP 0.7 W/l/s (supply fan)
			Toilet & Kitchen	Extract only SFP 0.3 W/l/s
Comfort Cooling	No comfort cooling		VRF Cooling system COP 4.0	
Lighting & Controls	100% low energy lighting		80 lumens/circuit-watt Auto on/Auto off	
Electricity power factor			<0.9	

Table 6.1 Proposed energy efficient design measures -173-175 Friar Street

27-32 Market Place (Residential)		
Services	Existing Residential	Proposed Residential
Space Heating	Pre 1998 Gas Combi boiler 71% efficient Space heating from radiators	Condensing combi gas boiler 90% efficient Space heating from radiators
Heating Controls	TRVs and bypass	Time and temperature zone control
Hot Water Heating	Pre 1998 Gas Combi boiler 71% efficient	Condensing combi gas boiler 90% efficient Boiler interlock
Ventilation	Natural ventilation, localised extract in wet rooms	Natural ventilation, localised extract in wet rooms
Comfort Cooling	Natural	Natural
Lighting	0% energy efficient lighting	100% energy efficient lighting

Table 6.2 Proposed energy efficient design measures – Residential part at 27-32 Market Place

27-32 Market Place (Commercial)				
Services	Existing Commercial		Proposed Commercial	
Space Heating	Gas Boiler 71% Efficient		Communal boiler 95% Efficient	
Heating Controls	No cooling		Time and temperature zone control	
DHW	Gas Boiler 71% Efficient		Combined hot water tank 1000lt	
Ventilation	Retail units	Natural ventilation	Retail Units	MVHR 80% efficient SFP 0.4 W/l/s (extract fan) SFP 0.7 W/l/s (supply fan)
	Toilet & Kitchen	Extract Only SFP 0.8 W/l/s	Toilet & Kitchen	Extract Only SFP 0.3 W/l/s
Comfort Cooling	No cooling		VRF Cooling system COP 4.0	
Lighting & Controls	45 lumens/circuit-watt Manual On/ Dimmed		80 lumens/circuit-watt PIR: Auto on/Auto off	
Electricity power factor	<0.9			

Table 6.3 Proposed energy efficient design measures –Commercial part at 27-32 Market Place

6.4 Carbon Savings

Based on the performance of the passive design and energy efficient measures proposed in Sections 5 and 6, following tables demonstrate the percentage improvement these have over the notional baseline levels. These shown for each type of building use on the development. They are calculated using SAP 2012 and EDSL Tas Dynamic Simulation Modelling software. These figures are for performance before incorporating any on-site renewables.

Table 6.4 shows Residential A comprising 18 of 35 residential units can achieve a 15 % improvement and Residential B can achieve a 13.1% improvement over the Part L minimum baseline. Table 6.5 shows that both retail and the office parts of the new development can achieve a 6.4 % improvement over the Part L minimum baseline respectively. These are before any energy efficiency or low or zero carbon technologies have been considered. Each unit number separated into 2 groups have been appended in Appendix B.

New Construction 173-175 Friar Street	Residential Group A (18 units out of 35 units)			Residential Group B (17 units out of 35 units)		
	Target of a 19% improvement			Target to meet the Part L		
	CO2 Emissions (T/yr)	CO2 Savings (T/yr)	% Saving	CO2 Emissions (T/yr)	CO2 Savings (T/yr)	% Saving
Building Regulations 2013 Baseline	21.31			20.40		
Before LZCs	18.07	3.24	15 %	17.72	2.68	13.1 %
Total Cumulative Savings		3.24	15 %		2.68	13.1 %

Table 6.4 Carbon savings for the residential part of the new construction before incorporating LZCs

New Construction 173-175 Friar Street	Retail			Office		
	CO2 Emissions (T/yr)	CO2 Savings (T/yr)	% Saving	CO2 Emissions (T/yr)	CO2 Savings (T/yr)	% Saving
Building Regulations 2013 Baseline	50.84			182.44		
Before LZCs	47.6	3.24	6.4%	170.82	11.61	6.4%
Total Cumulative Savings		3.24	6.4%		11.61	6.4%

Table 6.5 Carbon savings for the non-residential part of the new construction before incorporating LZCs

The breakdown of energy use and carbon emissions have been calculated, as shown in Table 6.6.

Proposed Case: Regulated Energy Demand & CO ₂ Emissions														
173-175 Friar Street	Gas				Electricity							Total Energy (kWh/yr)	Total CO ₂ (kg/yr)	
	Demand (kWh/yr)			CO ₂ (kg/yr)	Demand (kWh/yr)						CO ₂ (kg/yr)			
	Type	Space Heating	Hot Water		Total	Space Heating	Hot Water	Cooling	Pumps & Fans	Lighting				LZCs
Residential A	34,964	32,817	67,781	14,641	0	0	0	2,199	4,415	0	6,614	3,433	74,395	18,073
Residential B	33,274	32,459	65,734	14,199	0	0	0	2,271	4,506	0	6,777	3,517	72,511	17,716
Retail	7,862	144,689	152,551	32,951	0	0	4,520	8,168	15,536	0	28,224	14,648	180,775	47,600
Office	28,216	519,256	547,473	118,254	0	0	16,220	29,315	55,757	0	101,292	52,570	648,764	170,824
Total	104,317	729,221	833,538	180,044	0	0	20,740	41,956	80,182	0	142,907	74,169	976,446	254,213

Table 6.6 Estimated regulated energy demand and carbon emissions per energy source for the new construction before incorporating LZCs

The refurbishment scheme has not been classified as a major development and there is no obligation to adopt any renewable sources to achieve extra carbon savings. The results below, therefore, represent the possible improvements that can be achieved with the most appropriate strategy for the scheme and this is in line with the council's policy.

Table 6.7 shows the percentage improvements over the energy performance of the existing development. The results demonstrate that the residential part of the refurbishment scheme can achieve a 74% improvement and the non-residential part can achieve a 69% improvement over the Part L minimum baseline. The breakdown of energy use and carbon emissions have been calculated, as shown in Table 6.8.

Refurbishment 27-32 Market Place	Residential			Non-Residential		
	CO2 Emissions (T/yr)	CO2 Savings (T/yr)	% Saving	CO2 Emissions (T/yr)	CO2 Savings (T/yr)	% Saving
Building Regulations 2013 Baseline	54.32			48.72		
Passive Design and Energy efficient measures	14.06	40.26	74 %	14.88	33.84	69 %
Total Cumulative Savings			74 %			69 %

Table 6.7 Carbon savings for the residential part of the refurbishment scheme before incorporating LZCs

Proposed Case: Regulated Energy Demand & CO ₂ Emissions														
	Gas				Electricity									
	Demand (kWh/yr)			CO ₂ (kg/yr)	Demand (kWh/yr)						CO ₂ (kg/yr)	Total Energy (kWh/yr)	Total CO ₂ (kg/yr)	
Type	Space Heating	Hot Water	Total		Space Heating	Hot Water	Cooling	Pumps & Fans	Lighting	LZCs				Total
Residential	41,987	16,479	58,466	12,629			0	240	2,527		2,767	1,436	61,233	14,065
Retail	7,278	17,832	25,111	5,424			3,224	2,037	12,952		18,213	9,453	43,324	14,877
Total	49,265	34,312	83,577	18,053			3,224	2,277	15,479		20,980	10,889	104,557	28,941

Table 6.8 Estimated regulated energy demand and carbon emissions per energy source for the residential part of the refurbishment scheme before incorporating LZCs

7 Be Green: Low and Zero Carbon 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 (LZC) technologies and their feasibility on this development to contribute to meeting the relevant 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 south facing flat roof where solar thermal panels can be installed. However, solar PV is favoured due to greater potential carbon 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 a flat roof on which Solar PV panels could be installed to contribute to the electricity demand of the building	✓

LZC Technologies	Description	Advantages	Disadvantages	Feasibility	
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	Communal CHP is not viable for such a small development Micro CHP would be technically feasible but is unlikely to save enough carbon to meet the targets with incorporating multiple technologies	✗
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 NOx 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 NOx emissions	✗

LZC Technologies	Description	Advantages	Disadvantages	Feasibility	
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 no external space available for installation of boreholes	✗

LZC Technologies	Description	Advantages	Disadvantages	Feasibility
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 but is discounted due to noise issues and locating the unsightly units ✘

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 PV panels, which would most suitably be installed on the roof space. The chosen system 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 PV panels in order to meet the Reading Borough Council target for 50% of the proposed residential units to achieve 19% improvement over building regulations, and 50% of the commercial element to achieve BREEAM 'Excellent' and rest 50% to achieve 'Very Good' rating.

Table 7.2 shows the proposed system size and the estimated energy and carbon emissions savings and financial feasibility for this development. The breakdown of energy use and carbon emissions for the final case have been calculated, as shown in Table 7.3.

		Energy & CO ₂				Life Cycle Carbon and Cost Analysis
Use type	Proposed LZC Technologies Horizontal, South facing	Energy generated (kWh/yr)	% site energy demand met	CO ₂ saved by system (kgCO ₂ /yr)	% reduction in site CO ₂ emissions	25 year CO ₂ saving (kgCO ₂)
Residential	Total Solar PV = 2.2 kWp 7 high efficiency panels (11.42m ²)	1,691	2.27%	878	4.9%	21,945
Retail	Total Solar PV = 1.5 kWp 5 high efficiency panels (8m ²)	989	0.12 %	513	0.2%	12,828
Office	Total Solar PV = 1.75 kWp 6 high efficiency panels (10m ²)	1,183	0.14%	614	0.3%	15,346

Table 7.2 Energy, carbon and financial performance of the proposed LZC technologies

	Gas				Electricity									
	Demand (kWh/yr)			CO ₂ (kg/yr)	Demand (kWh/yr)								Total Energy (kWh/yr)	Total CO ₂ (kg/yr)
Type	Space Heating	Hot Water	Total		Space Heating	Hot Water	Cooling	Pumps & Fans	Lighting	PV Generation	Total	CO ₂ (kg/yr)		
Residential A	34,964	32,817	67,781	14,641			0	2,199	4,415	-1,691	4,923	2,555	72,704	17,195
Residential B	33,274	32,459	65,734	14,199			0	2,271	4,506	0	6,777	3,517	72,511	17,716
Retail	7,862	144,689	152,551	32,951			4,520	8,168	15,536	-989	27,236	14,135	179,787	47,086
Office	28,216	519,256	547,473	118,254			16,220	29,315	55,757	-1,183	100,109	51,956	647,581	170,211
Total	104,317	729,221	833,538	180,044	0	0	20,740	41,956	80,182	-3,863	139,044	72,164	972,583	252,208

Table 7.3 Estimated regulated energy demand and carbon emissions per energy source

7.2 Carbon Savings

The energy assessment for the new development at 173-175 Friar Street has followed the energy hierarchy and all feasible measures are incorporated to achieve the targets including renewable energy systems.

Table 7.4 shows that more than 50% of the residential units can achieve 19.3% improvement and the remaining units can achieve 13.1% improvement over the Part L baseline.

Table 7.5 also shows that the retail units of the non-residential part can achieve 7.4% improvement and the office units can achieve 6.7% improvement over the Part L baseline. As a result, the retail units can achieve 5 credits and the office units can achieve 6 credits under Ene 01 in the Energy category of BREEAM 2014. It demonstrates that the non-residential part has the potential to achieve BREEAM 'Excellent' standards.

New Construction 173-175 Friar Street	Residential Group A			Residential Group B		
	Target of a 19% improvement			Target to meet Part L		
	CO2 Emissions (T/yr)	CO2 Savings (T/yr)	% Saving	CO2 Emissions (T/yr)	CO2 Savings (T/yr)	% Saving
Building Regulations 2013 Baseline	21.31			20.40		
Before LZCs	18.07	3.24	15 %	17.72	2.68	13.1 %
After LZCs	17.20	0.88	4.1%	-	-	-
Total Cumulative Savings		4.11	19.3%		2.68	13.1 %

Table 7.4 Carbon savings for the residential part of the new construction before incorporating LZCs

New Construction 173-175 Friar Street	Retail			Office		
	CO2 Emissions (T/yr)	CO2 Savings (T/yr)	% Saving	CO2 Emissions (T/yr)	CO2 Savings (T/yr)	% Saving
Building Regulations 2013 Baseline	50.84			182.44		
Before LZCs	47.60	3.24	6.4%	170.82	11.61	6.4 %
After LZCs	47.09	0.51	1.0%	170.21	0.61	0.3 %
Total Cumulative Savings		3.75	7.4 %		12.23	6.7 %

Table 7.5 Carbon savings for the non-residential part of the new construction before incorporating LZCs

The energy assessment for the refurbishment scheme at 27-32 has also followed the energy hierarchy incorporating passive design and energy efficient measures. Table 6.7 in section 6 demonstrate that the residential part of the refurbishment scheme can achieve a 74% improvement and the non-residential part can achieve a 69% improvement over the Part L minimum baseline.

8 Conclusion

Following the energy hierarchy, passive design measures, energy efficient equipment and provision of LZCs have shown that 50% of the residential units of 173-175 Friar Street are able to achieve an improvement of 19.3% over the Building Regulations Part L 2013 target emissions rate. The remaining residential units meet and exceed the building regulations carbon emissions target. The retail units of 173-175 Friar Street can achieve 7.4% improvement and the office units can achieve 6.7% improvement over the Part L baseline. Both office and retail units of 173-175 Friar Street are able to achieve the minimum energy credits (Ene01) under BREEAM assessment to achieve a rating of 'Excellent' and 'Very Good', respectively.

The residential units in Market Place have shown an improvement of 74% and commercial units an improvement of 69% over the existing case. This is in line with the relevant building regulations.

The design team have made all reasonable endeavours to achieve the minimum requirements of the Reading Borough Council. The energy hierarchy has been followed, fabric improvements have been made to improve the windows, a high efficiency heating has been specified. PV panels have incorporated into the design to reduce carbon emissions from the site.

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.

Appendix A

Figures used in Calculations

1 Figures used in Low and Zero Carbon Technology Calculations

The following tables show figures used in the energy and CO₂ calculations to estimate energy produced and CO₂ 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
Oil Intensity	0.266 kgCO ₂ /kWh
Biodiesel Intensity	0.025 kgCO ₂ /kWh

Table B.2

Energy & Renewable Technology Outputs	
PV energy produced per kWp	858.4 kWh/kWp
PV Panel rated output (kWp)	0.327 kWp/m ²
Gas boiler efficiency	90%
Communal Gas boiler efficiency	95%
Electricity efficiency	100%
Gas boiler efficiency	90%

Table B.3

Fuel Prices (as of Feb 2015)	
Natural Gas	4.29 p/kWh
Electricity (Grid)	14.05 p/kWh

Table B.4

Appendix B

Block Compliance for Group A flats of 173-175 Friar Street Block

Block Compliance for Group B flats of 173-175 Friar Street Block

SAP Calculations with proposed scenario of 27-32 Market Place Block

Appendix C

BRUKL for the proposed Retail (A1/A2) units for the 173-175 Friar Street

BRUKL for the proposed R Office (B1) units for the 173-175 Friar Street

BRUKL with proposed scenario of the 27-32 Market Place

BLOCK COMPLIANCE

Calculation Type: New Build (As Designed)

Block Reference	GROUP A 20% Improvement	Issued on Date	19/02/2018
Block Name	173-175 Friar Street		
Surveyor	admin Admin, Tel: 4, Fax: s@l.f	Surveyor ID	Admin
Client			

Block Compliance Report - DER

Block Reference: GROUP A 20% Improvement		Block Name: 173-175 Friar Street		
Property-Survey Reference	Multiplier	Floor Area (m²)	DER (kgCO₂/m²)	TER (kgCO₂/m²)
Unit 9 / 20-Be Lean	2	42.9	24.63	24.59
Unit 1 / 14-With PV	2	51.3	18.54	21.51
Unit 2 / 15-with PV	2	47.1	18.63	21.84
Unit 3 / 16-with PV	2	51.5	18.02	21.07
Unit_4-with PV	1	61.3	17.41	20.17
Unit_5-with PV	1	63.2	20.59	22.88
Unit_6-with PV	1	61.8	21.55	23.94
Unit_7-with PV	1	76.4	17.41	20.45
Unit_8-with PV	1	58.8	18.15	21.47
Unit_10-with PV	1	51.5	20.57	23.42
Unit_11-with PV	1	42.6	19.94	22.75
Unit_12-with PV	1	53.4	17.82	20.97
Unit_13-with PV	1	54.9	18.04	20.94
Unit_17-with PV	1	51.6	18.03	20.50
Totals:	18	961.1	269.33	306.51
Average DER = 19.25 kgCO₂/m²			PASS	
Average TER = 21.89 kgCO₂/m²				

BLOCK COMPLIANCE

Calculation Type: New Build (As Designed)

Block Compliance Report - DFEE

Block Reference: GROUP A 20% Improvement		Block Name: 173-175 Friar Street		
Property-Survey Reference	Multiplier	Floor Area (m²)	DFEE (kWh/m²/yr)	TFEE (kWh/m²/yr)
Unit 9 / 20-Be Lean	2	42.9	64.19	68.82
Unit 1 / 14-With PV	2	51.3	53.89	59.69
Unit 2 / 15-with PV	2	47.1	52.67	58.74
Unit 3 / 16-with PV	2	51.5	51.59	57.61
Unit_4-with PV	1	61.3	51.13	57.07
Unit_5-with PV	1	63.2	64.79	71.68
Unit_6-with PV	1	61.8	68.57	76.52
Unit_7-with PV	1	76.4	53.85	63.58
Unit_8-with PV	1	58.8	54.43	63.16
Unit_10-with PV	1	51.5	62.59	69.44
Unit_11-with PV	1	42.6	56.81	59.95
Unit_12-with PV	1	53.4	51.29	57.85
Unit_13-with PV	1	54.9	53.92	58.44
Unit_17-with PV	1	51.6	51.88	54.66
Totals:	18	961.1	791.61	877.23
Average DFEE = 56.30 kWh/m²/yr			PASS	
Average TFEE = 62.51 kWh/m²/yr				

BLOCK COMPLIANCE

Calculation Type: New Build (As Designed)

Block Reference	GROUP B_PART L	Issued on Date	09/02/2018
Block Name	173-175 Friar Street		
Surveyor	admin Admin, Tel: 4, Fax: s@l.f	Surveyor ID	Admin
Client			

Block Compliance Report - DER

Block Reference: GROUP B_PART L		Block Name: 173-175 Friar Street		
Property-Survey Reference	Multiplier	Floor Area (m²)	DER (kgCO₂/m²)	TER (kgCO₂/m²)
Unit_18-Be Clean	1	68.2	19.31	20.27
Unit_19-Be Clean	1	56.9	16.28	18.68
Unit_25-Be Clean	1	74.4	15.29	17.47
Unit_24-Be Clean	1	54.9	16.51	18.63
Unit_21-Be Clean	1	51.5	21.29	23.37
Unit_22-Be Clean	1	42.6	23.45	24.47
Unit_23-Be Clean	1	53.4	20.28	21.85
Unit_26-Be Clean	1	65.9	17.29	18.99
Unit_27-Be Clean	1	65.7	18.51	19.67
Unit_28-Be Clean	1	62.7	17.72	19.38
Unit_29-Be Clean	1	50.6	19.87	21.37
Unit_30-Be Clean	1	43.2	18.81	20.95
Unit_32-Be Clean	1	73.2	18.80	19.84
Unit_33-Be Clean	1	61.9	20.08	20.82
Unit_34-Be Clean	1	42.9	22.07	23.17
Unit_35-Be Clean	1	69.4	20.07	20.74
Unit_31-Be Clean	1	55.5	16.58	18.79
Totals:	17	992.9	322.21	348.44
Average DER = 18.76 kgCO₂/m²			PASS	
Average TER = 20.29 kgCO₂/m²				

BLOCK COMPLIANCE

Calculation Type: New Build (As Designed)

Block Compliance Report - DFEE

Block Reference: GROUP B_PART L		Block Name: 173-175 Friar Street		
Property-Survey Reference	Multiplier	Floor Area (m²)	DFEE (kWh/m²/yr)	TFEE (kWh/m²/yr)
Unit_18-Be Clean	1	68.2	56.56	59.98
Unit_19-Be Clean	1	56.9	42.03	48.29
Unit_25-Be Clean	1	74.4	41.06	47.53
Unit_24-Be Clean	1	54.9	43.33	46.69
Unit_21-Be Clean	1	51.5	61.39	69.21
Unit_22-Be Clean	1	42.6	67.25	68.92
Unit_23-Be Clean	1	53.4	57.13	62.12
Unit_26-Be Clean	1	65.9	47.66	52.78
Unit_27-Be Clean	1	65.7	52.77	55.76
Unit_28-Be Clean	1	62.7	49.11	53.77
Unit_29-Be Clean	1	50.6	55.37	58.50
Unit_30-Be Clean	1	43.2	46.90	50.88
Unit_32-Be Clean	1	73.2	55.56	59.38
Unit_33-Be Clean	1	61.9	58.54	60.68
Unit_34-Be Clean	1	42.9	61.80	62.72
Unit_35-Be Clean	1	69.4	59.71	63.01
Unit_31-Be Clean	1	55.5	43.12	47.96
Totals:	17	992.9	899.29	968.20
Average DFEE = 52.53 kWh/m²/yr			PASS	
Average TFEE = 56.66 kWh/m²/yr				

BLOCK COMPLIANCE

Calculation Type: New Build (As Designed)

Block Reference	Market Place Refurbishment	Issued on Date	09/02/2018
Block Name	173-175 Friar Street		
Surveyor	admin Admin, Tel: 4, Fax: s@l.f	Surveyor ID	Admin
Client			

Block Compliance Report - DER

Block Reference: Market Place Refurbishment		Block Name: 173-175 Friar Street		
Property-Survey Reference	Multiplier	Floor Area (m²)	DER (kgCO₂/m²)	TER (kgCO₂/m²)
Unit_36-Proposed Up	1	49.99	23.63	19.55
Unit_37-Proposed Up	1	100.9	25.69	21.19
Unit_38-Proposed Up	1	58.91	23.05	18.80
Unit_39-Proposed Up	1	49.99	21.81	18.86
Unit_40-Proposed Up	1	101.7	22.71	17.85
Unit_41-Proposed Up	1	84.84	24.30	19.13
Unit_42-Proposed Up	1	50.04	26.33	20.94
Unit_43-Proposed Up	1	68.76	31.34	24.19
Totals:	8	565.13	198.86	160.51
Average DER = 24.89 kgCO₂/m²			FAIL	
Average TER = 20.02 kgCO₂/m²				

Block Compliance Report - DFEE

Block Reference: Market Place Refurbishment		Block Name: 173-175 Friar Street		
Property-Survey Reference	Multiplier	Floor Area (m ²)	DFEE (kWh/m ² /yr)	TFEE (kWh/m ² /yr)
Unit_36-Proposed Up	1	49.99	58.21	46.89
Unit_37-Proposed Up	1	100.9	87.42	73.52
Unit_38-Proposed Up	1	58.91	59.02	47.51
Unit_39-Proposed Up	1	49.99	52.92	42.72
Unit_40-Proposed Up	1	101.7	67.71	54.30
Unit_41-Proposed Up	1	84.84	73.51	57.10
Unit_42-Proposed Up	1	50.04	72.11	53.38
Unit_43-Proposed Up	1	68.76	100.99	77.86
Totals:	8	565.13	571.87	453.29
Average DFEE = 73.48 kWh/m ² /yr			FAIL	
Average TFEE = 58.55 kWh/m ² /yr				

Project name

**Friar Street New development B1 Use
6PVs**

As designed

Date: Mon Feb 19 09:18:07 2018

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.4.1"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.4.1

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

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name:

Telephone number:

Address: , ,

Criterion 1: The calculated CO₂ emission rate for the building should not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	21.1
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	21.1
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	19.4
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

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

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

Building fabric

Element	U _a -Limit	U _a -Calc	U _i -Calc	Surface where the maximum value occurs*
Wall**	0.35	0.12	0.13	Basement Wall
Floor	0.25	0.14	0.14	Ground Floor
Roof	0.25	0.11	0.11	Roof
Windows***, roof windows, and rooflights	2.2	1.25	1.26	Glazing W0.7
Personnel doors	2.2	1.73	1.82	Internal Door 0.89
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-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

Building services

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

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

1- Gas Boiler heating (25 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	4	-	1.1	0.8
Standard value	0.91*	2.6	N/A	1.1^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					
^ Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.					

2- Extract only (30 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

3- Natural ventilation

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	-	-	-
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

1- New HWS Circuit

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.95	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	Zone	Standard
	Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1		
LG WC 1		-	-	0.3	-	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]										HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I			
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard	
1st Office 1	-	-	-	1.1	-	-	-	-	-	-	N/A	
1st Office 2	-	-	-	1.1	-	-	-	-	-	-	N/A	
1st Office 3	-	-	-	1.1	-	-	-	-	-	-	N/A	
1st Office 4	-	-	-	1.1	-	-	-	-	-	-	N/A	
1st Office 5	-	-	-	1.1	-	-	-	-	-	-	N/A	
1st Office 6	-	-	-	1.1	-	-	-	-	-	-	N/A	
1st Office 7	-	-	-	1.1	-	-	-	-	-	-	N/A	
1st Office 8	-	-	-	1.1	-	-	-	-	-	-	N/A	
1st WC circulation	-	-	0.3	-	-	-	-	-	-	-	N/A	
1st toilet 1	-	-	0.3	-	-	-	-	-	-	-	N/A	
1st toilet 2	-	-	0.3	-	-	-	-	-	-	-	N/A	
1st toilet 3	-	-	0.3	-	-	-	-	-	-	-	N/A	
1st toilet 4	-	-	0.3	-	-	-	-	-	-	-	N/A	
1st toilet 5	-	-	0.3	-	-	-	-	-	-	-	N/A	
2nd Office 1	-	-	-	1.1	-	-	-	-	-	-	N/A	
2nd Office 2	-	-	-	1.1	-	-	-	-	-	-	N/A	
2nd Office 3	-	-	-	1.1	-	-	-	-	-	-	N/A	
2nd Office 4	-	-	-	1.1	-	-	-	-	-	-	N/A	
2nd Office 5	-	-	-	1.1	-	-	-	-	-	-	N/A	
2nd Office 6	-	-	-	1.1	-	-	-	-	-	-	N/A	
2nd Office 7	-	-	-	1.1	-	-	-	-	-	-	N/A	
2nd Office 8	-	-	-	1.1	-	-	-	-	-	-	N/A	
2nd toilet 1	-	-	0.3	-	-	-	-	-	-	-	N/A	
2nd toilet 2	-	-	0.3	-	-	-	-	-	-	-	N/A	
2nd toilet 3	-	-	0.3	-	-	-	-	-	-	-	N/A	
2nd toilet 4	-	-	0.3	-	-	-	-	-	-	-	N/A	
2nd toilet 5	-	-	0.3	-	-	-	-	-	-	-	N/A	
2nd WC circulation	-	-	0.3	-	-	-	-	-	-	-	N/A	
3rd Office 1	-	-	-	1.1	-	-	-	-	-	-	N/A	
3rd Office 2	-	-	-	1.1	-	-	-	-	-	-	N/A	
3rd Office 3	-	-	-	1.1	-	-	-	-	-	-	N/A	
3rd Office 4	-	-	-	1.1	-	-	-	-	-	-	N/A	
3rd Office 5	-	-	-	1.1	-	-	-	-	-	-	N/A	
3rd Office 6	-	-	-	1.1	-	-	-	-	-	-	N/A	
3rd Office 7	-	-	-	1.1	-	-	-	-	-	-	N/A	
3rd Office 8	-	-	-	1.1	-	-	-	-	-	-	N/A	
3rd toilet 1	-	-	0.3	-	-	-	-	-	-	-	N/A	
3rd toilet 2	-	-	0.3	-	-	-	-	-	-	-	N/A	
3rd toilet 3	-	-	0.3	-	-	-	-	-	-	-	N/A	
3rd toilet 4	-	-	0.3	-	-	-	-	-	-	-	N/A	
3rd toilet 5	-	-	0.3	-	-	-	-	-	-	-	N/A	
3rd WC circulation	-	-	0.3	-	-	-	-	-	-	-	N/A	
LG Changing 2	-	-	0.3	-	-	-	-	-	-	-	N/A	

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
LG Changing Corridor	-	-	0.3	-	-	-	-	-	-	-	N/A
Gr Office reception	-	-	-	1.1	-	-	-	-	-	-	N/A
Gr WC 1	-	-	0.3	-	-	-	-	-	-	-	N/A
Gr WC 2	-	-	0.3	-	-	-	-	-	-	-	N/A
Gr WC 3	-	-	0.3	-	-	-	-	-	-	-	N/A
Gr WC 4	-	-	0.3	-	-	-	-	-	-	-	N/A
Gr WC 5	-	-	0.3	-	-	-	-	-	-	-	N/A
Gr WC 6	-	-	0.3	-	-	-	-	-	-	-	N/A
Gr WC circulation	-	-	0.3	-	-	-	-	-	-	-	N/A
LG Changing 3	-	-	0.3	-	-	-	-	-	-	-	N/A
LG Changing 4	-	-	0.3	-	-	-	-	-	-	-	N/A

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
LG WC 1		-	80	-	20
LG Store 1		80	-	-	68
LG lift		-	80	-	35
LG Circulation 1		-	80	-	41
LG Circulation 2		-	80	-	56
LG Bin Store		80	-	-	28
LG Stairs 3		-	80	-	35
LG Bike Store		80	-	-	28
LG Changing 1		-	80	-	18
LG Circulation 3		-	80	-	34
LG Store 2		80	-	-	14
1st Office 1		80	-	-	651
1st Office 2		80	-	-	353
1st Office 3		80	-	-	544
1st Office 4		80	-	-	1954
1st Office 5		80	-	-	639
1st Office 6		80	-	-	2667
1st Office 7		80	-	-	315
1st Office 8		80	-	-	1193
1st Stairs 1		-	80	-	34
1st Stairs 2		-	80	-	42
1st lifts		-	80	-	29
1st lift lobby		-	80	-	48
1st WC circulation		-	80	-	43
1st toilet 1		-	80	-	29
1st toilet 2		-	80	-	30
1st toilet 3		-	80	-	32
1st toilet 4		-	80	-	31

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
1st toilet 5		-	80	-	30
2nd Office 1		80	-	-	651
2nd Office 2		80	-	-	414
2nd Office 3		80	-	-	544
2nd Office 4		80	-	-	1954
2nd Office 5		80	-	-	639
2nd Office 6		80	-	-	2663
2nd Office 7		80	-	-	322
2nd Office 8		80	-	-	1190
2nd toilet 1		-	80	-	30
2nd toilet 2		-	80	-	30
2nd toilet 3		-	80	-	30
2nd toilet 4		-	80	-	31
2nd toilet 5		-	80	-	32
2nd Stairs 1		-	80	-	34
2nd lift lobby		-	80	-	48
2nd WC circulation		-	80	-	43
2nd lifts		-	80	-	29
2nd Stairs 2		-	80	-	42
3rd Office 1		80	-	-	651
3rd Office 2		80	-	-	416
3rd Office 3		80	-	-	543
3rd Office 4		80	-	-	1954
3rd Office 5		80	-	-	639
3rd Office 6		80	-	-	2663
3rd Office 7		80	-	-	322
3rd Office 8		80	-	-	1190
3rd toilet 1		-	80	-	63
3rd toilet 2		-	80	-	30
3rd toilet 3		-	80	-	30
3rd toilet 4		-	80	-	31
3rd toilet 5		-	80	-	32
3rd Stairs 1		-	80	-	34
3rd Stairs 2		-	80	-	42
3rd lift lobby		-	80	-	48
3rd WC circulation		-	80	-	43
3rd lifts		-	80	-	29
LG Plant		80	-	-	125
LG Changing 2		-	80	-	29
LG Changing Corridor		-	80	-	98
1st store		80	-	-	8
3rd store		80	-	-	8
Gr Refuse Store		80	-	-	83

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
Gr Lift Lobby		-	80	-	92
Gr stairs 1		-	80	-	42
Gr lifts		-	80	-	35
Gr Office reception		-	80	22	323
Gr Office Entrance		-	80	22	62
Gr WC 1		-	80	-	67
Gr WC 2		-	80	-	34
Gr WC 3		-	80	-	38
Gr circulation 2		-	80	-	35
Gr stairs 2		-	80	-	37
Gr WC 4		-	80	-	35
Gr WC 5		-	80	-	31
Gr WC 6		-	80	-	53
Gr circulation 3		-	80	-	77
Gr circulation 4		-	80	-	32
Gr WC circulation		-	80	-	34
LG Changing 3		-	80	-	39
LG Changing 4		-	80	-	29

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?
1st Office 1	NO (-61%)	NO
1st Office 2	NO (-31%)	NO
1st Office 3	NO (-55%)	NO
1st Office 4	NO (-56%)	NO
1st Office 5	NO (-47%)	NO
1st Office 6	NO (-4%)	NO
1st Office 7	NO (-66%)	NO
1st Office 8	NO (-52%)	NO
2nd Office 1	NO (-57%)	NO
2nd Office 2	NO (-31%)	NO
2nd Office 3	NO (-49%)	NO
2nd Office 4	NO (-48%)	NO
2nd Office 5	NO (-42%)	NO
2nd Office 6	NO (-14%)	NO
2nd Office 7	NO (-66%)	NO
2nd Office 8	NO (-50%)	NO
3rd Office 1	NO (-57%)	NO
3rd Office 2	NO (-33%)	NO
3rd Office 3	NO (-66%)	NO
3rd Office 4	NO (-49%)	NO
3rd Office 5	NO (-42%)	NO
3rd Office 6	NO (-11%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
3rd Office 7	NO (-66%)	NO
3rd Office 8	NO (-50%)	NO
Gr Office reception	NO (-98%)	NO
Gr Office Entrance	NO (-27%)	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 [m ²]	4224	4224
External area [m ²]	5043	5043
Weather	LON	LON
Infiltration [m ³ /hm ² @ 50Pa]	5	3
Average conductance [W/K]	2258	2082
Average U-value [W/m ² K]	0.45	0.41
Alpha value* [%]	18.04	18.04

* 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
7	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
93	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	5.26	5.91
Cooling	6.05	9.14
Auxiliary	3.45	2.95
Lighting	19.53	21.42
Hot water	10.81	11.29
Equipment*	37.52	37.52
TOTAL**	45.1	50.7

* 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	0.28	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	110.92	143.03
Primary energy* [kWh/m ²]	114.74	120.79
Total emissions [kg/m ²]	19.4	21.1

* 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 SSEFF	Cool SSEER	Heat gen SEFF	Cool gen SEER	
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	8.3	111.2	2.6	7.7	4.3	0.9	4	0.95	4
	Notional	7.4	151.2	2.5	11.7	3.7	0.82	3.6	----	----
[ST] No Heating or Cooling										
	Actual	54.3	0	15.1	0	1.5	1	0	1	0
	Notional	49.7	0	16.9	0	2	0.82	0	----	----
[ST] No Heating or Cooling										
	Actual	76	0	21.1	0	0	1	0	1	0
	Notional	77.2	0	26.2	0	0	0.82	0	----	----

Key to terms

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

Key Features

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

Building fabric

Element	U _{i-Typ}	U _{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.12	External Wall
Floor	0.2	0.14	Basement Floor
Roof	0.15	0.11	Roof
Windows, roof windows, and rooflights	1.5	1.25	Ground Window
Personnel doors	1.5	1.26	Internal Door 0.79
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-Typ} = Typical individual element U-values [W/(m²K)] U _{i-Min} = Minimum individual element U-values [W/(m²K)] * There might be more than one surface where the minimum U-value occurs.			

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

Project name

**Friar Street New development A1/A2 Use
5Pvs**

As designed

Date: Mon Feb 19 09:53:46 2018

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.4.1"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.4.1

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

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name:

Telephone number:

Address: , ,

Criterion 1: The calculated CO₂ emission rate for the building should not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	43.2
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	43.2
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	41
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	0.12	0.13	Basement Wall
Floor	0.25	0.14	0.14	Ground Floor
Roof	0.25	-	-	No roofs in project
Windows***, roof windows, and rooflights	2.2	1.25	1.26	Glazing W0.7
Personnel doors	2.2	1.73	1.82	Internal Door 0.89
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-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

Building services

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

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

1- Gas Boiler heating (12 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	4	-	1.1	0.8
Standard value	0.91*	2.6	N/A	1.1^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					
^ Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.					

2- Natural ventilation

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	-	-	-
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

1- New HWS Circuit

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.95	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	Zone	Standard
	Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1		
LG Unit 1		-	-	-	1.1	-	-	-	-	-	-	N/A
LG Unit 2		-	-	-	1.1	-	-	-	-	-	-	N/A
Gr Retail 2		-	-	-	1.1	-	-	-	-	-	-	N/A
Gr Retail 3		-	-	-	1.1	-	-	-	-	-	-	N/A
Gr Retail 4		-	-	-	1.1	-	-	-	-	-	-	N/A
Gr Retail 1-1		-	-	-	1.1	-	-	-	-	-	-	N/A
Gr Retail 2-1		-	-	-	1.1	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]										HR efficiency	
	ID of system type	A	B	C	D	E	F	G	H	I		
	Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
Gr Retail 1-2		-	-	-	1.1	-	-	-	-	-	-	N/A
Gr Retail 4-1		-	-	-	1.1	-	-	-	-	-	-	N/A
Gr Retail 1-3		-	-	-	1.1	-	-	-	-	-	-	N/A
Gr Retail 5		-	-	-	1.1	-	-	-	-	-	-	N/A
Gr Retail 1-4		-	-	-	1.1	-	-	-	-	-	-	N/A

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
LG Stairs 1		-	80	-	18
LG Unit 1		-	80	22	433
LG Unit 2		-	80	22	480
LG Stairs 2		-	80	-	16
Gr Retail 2		-	80	22	304
Gr Retail 3		-	80	22	204
Gr Retail 4		-	80	22	161
Gr Refuse Store		80	-	-	83
Gr Retail 1-1		-	80	22	127
Gr Retail 2-1		-	80	22	89
Gr Retail 1-2		-	80	22	313
Gr Retail 4-1		-	80	22	444
Gr Retail 1-3		-	80	22	119
Gr Retail 5		-	80	22	220
Gr Retail 1-4		-	80	22	267

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?
LG Unit 1	N/A	N/A
LG Unit 2	N/A	N/A
Gr Retail 2	NO (-31%)	NO
Gr Retail 3	NO (-11%)	NO
Gr Retail 4	NO (-23%)	NO
Gr Retail 1-1	NO (-55%)	NO
Gr Retail 2-1	NO (-45%)	NO
Gr Retail 1-2	NO (-93%)	NO
Gr Retail 4-1	NO (-94%)	NO
Gr Retail 1-3	NO (-38%)	NO
Gr Retail 5	NO (-22%)	NO
Gr Retail 1-4	NO (-91%)	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 [m ²]	1177	1177
External area [m ²]	5047	5047
Weather	LON	LON
Infiltration [m ³ /hm ² @ 50Pa]	5	3
Average conductance [W/K]	2263	1601
Average U-value [W/m ² K]	0.45	0.32
Alpha value* [%]	18.04	18.04

* 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	6.68	10.67
Cooling	3.84	5.18
Auxiliary	6.94	5.87
Lighting	13.2	14.32
Hot water	122.93	128.33
Equipment*	56.66	56.66
TOTAL**	153.6	164.38

* 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	0.84	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	82.26	103.75
Primary energy* [kWh/m ²]	237.54	245.14
Total emissions [kg/m ²]	41	43.2

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

HVAC Systems Performance										
System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER	
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	13.2	63.5	4.1	4.4	8	0.9	4	0.95	4
	Notional	25.2	77	8.5	5.9	6.7	0.82	3.6	----	----
[ST] No Heating or Cooling										
	Actual	143.6	0	39.9	0	0	1	0	1	0
	Notional	122	0	41.4	0	0	0.82	0	----	----

Key to terms

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

Key Features

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

Building fabric

Element	U _{i-Typ}	U _{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.12	External Wall
Floor	0.2	0.14	Basement Floor
Roof	0.15	-	No roofs in project
Windows, roof windows, and rooflights	1.5	1.25	Ground Window
Personnel doors	1.5	1.26	Internal Door 0.79
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-Typ} = Typical individual element U-values [W/(m²K)] U _{i-Min} = Minimum individual element U-values [W/(m²K)] * There might be more than one surface where the minimum U-value occurs.			

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

Project name

27-32 Market Place Proposed

As designed

Date: Mon Feb 12 10:00:40 2018

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.4.1"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.4.1

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

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name:

Telephone number:

Address: , ,

Criterion 1: The calculated CO₂ 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	36.2
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	36.2
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	39.1
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	0.37	0.46	Basement Wall
Floor	0.25	0.23	0.24	Ground Floor
Roof	0.25	0.19	0.19	Roof
Windows***, roof windows, and rooflights	2.2	1.72	1.8	Arcade Fixed Glazing 0.2
Personnel doors	2.2	1.91	1.91	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-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	10

Building services

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

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

1- Extract (4 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

2- Extract for Kitchen (LG Kitchen)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

3- Retail (15 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	4	-	1.1	0.8
Standard value	0.91*	2.6	N/A	1.1^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					
^ Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.					

4- Retail (LG Storage & Plant)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0	-	-	1.1	0.8
Standard value	N/A	N/A	N/A	1.1^	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.					

1- New HWS Circuit

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.95	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 WC 1		-	-	0.3	-	-	-	-	-	-	-	N/A
LG WC 2		-	-	0.3	-	-	-	-	-	-	-	N/A
LG Kitchen		-	-	-	-	-	-	-	-	0.3	-	N/A
LG Storage & Plant		-	-	-	-	1.1	-	-	-	-	-	N/A
Gr Retail 7 Pub 1		-	-	-	-	1.1	-	-	-	-	-	N/A
Gr Retail 8		-	-	-	-	1.1	-	-	-	-	-	N/A
Gr Retail 6-1		-	-	-	-	1.1	-	-	-	-	-	N/A
Gr Bike store retail unit 6		-	-	-	-	1.1	-	-	-	-	-	N/A
LG Retail 6 Pub		-	-	-	-	1.1	-	-	-	-	-	N/A
LG Retail unit 3		-	-	-	-	1.1	-	-	-	-	-	N/A
LG WC 3		-	-	0.3	-	-	-	-	-	-	-	N/A
LG WC 4		-	-	0.3	-	-	-	-	-	-	-	N/A
Gr Bike store retail unit 8		-	-	-	-	1.1	-	-	-	-	-	N/A
LG Pub Storage		-	-	-	-	1.1	-	-	-	-	-	N/A
LG Corridor		-	-	-	-	1.1	-	-	-	-	-	N/A
Gr Corridor 1		-	-	-	-	1.1	-	-	-	-	-	N/A
Gr Retail 7 Pub 2		-	-	-	-	1.1	-	-	-	-	-	N/A
Gr Retail 7 Pub 3		-	-	-	-	1.1	-	-	-	-	-	N/A
Gr Corridor 2		-	-	-	-	1.1	-	-	-	-	-	N/A
Gr Pub Entrance		-	-	-	-	1.1	-	-	-	-	-	N/A
Gr Retail 6-2		-	-	-	-	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	
LG WC 1	-	80	-	95
LG WC 2	-	80	-	89
LG Kitchen	-	80	-	394
LG Storage & Plant	80	-	-	83
Gr Retail 7 Pub 1	-	80	22	161

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
Gr Retail 8		-	80	22	668
Gr Retail 6-1		-	80	22	304
Gr Bike store retail unit 6		80	-	-	4
LG Retail 6 Pub		-	80	22	57
LG Retail unit 3		-	80	22	266
LG WC 3		-	80	-	53
LG WC 4		-	80	-	50
Gr Bike store retail unit 8		80	-	-	5
LG Pub Storage		80	-	-	38
LG Corridor		-	80	-	41
Gr Corridor 1		-	80	-	37
Gr Retail 7 Pub 2		-	80	22	149
Gr Retail 7 Pub 3		-	80	22	76
Gr Corridor 2		-	80	-	35
Gr Pub Entrance		-	80	-	22
Gr Retail 6-2		-	80	22	697

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?
Gr Retail 7 Pub 1	YES (+34%)	NO
Gr Retail 8	YES (+78%)	NO
Gr Retail 6-1	NO (-7%)	NO
Gr Bike store retail unit 6	N/A	N/A
LG Retail 6 Pub	N/A	N/A
LG Retail unit 3	N/A	N/A
Gr Bike store retail unit 8	N/A	N/A
LG Pub Storage	N/A	N/A
LG Corridor	N/A	N/A
Gr Corridor 1	YES (+98%)	NO
Gr Retail 7 Pub 2	YES (+78%)	NO
Gr Retail 7 Pub 3	NO (-4%)	NO
Gr Corridor 2	NO (-46%)	NO
Gr Pub Entrance	YES (+155%)	NO
Gr Retail 6-2	NO (-43%)	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 [m ²]	401	401
External area [m ²]	916	916
Weather	LON	LON
Infiltration [m ³ /hm ² @ 50Pa]	10	3
Average conductance [W/K]	462	455
Average U-value [W/m ² K]	0.5	0.5
Alpha value* [%]	18.48	18.48

* 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	18.15	12.69
Cooling	8.04	10.74
Auxiliary	5.08	4.47
Lighting	32.3	29.55
Hot water	44.47	46.42
Equipment*	42.9	42.9
TOTAL**	108.04	103.86

* 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 & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	186.44	185.83
Primary energy* [kWh/m ²]	228.01	205.14
Total emissions [kg/m ²]	39.1	36.2

* 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 SSEFF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] No Heating or Cooling									
Actual	186.3	0	51.7	0	1.6	1	0	1	0
Notional	160.8	0	54.5	0	2.2	0.82	0	----	----
[ST] No Heating or Cooling									
Actual	79.6	0	22.1	0	2.7	1	0	1	0
Notional	102.6	0	34.8	0	3.6	0.82	0	----	----
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	48.2	148.4	14.8	10.3	6.1	0.9	4	0.95	4
Notional	18.2	178.3	6.2	13.8	5.1	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-Typ}	U _{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.22	External Wall
Floor	0.2	0.2	Exposed Floor
Roof	0.15	0.19	Roof
Windows, roof windows, and rooflights	1.5	1.69	Arcade Glazing Entrance 0.8
Personnel doors	1.5	1.91	Internal 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-Typ} = Typical individual element U-values [W/(m²K)] U _{i-Min} = Minimum individual element U-values [W/(m²K)] * There might be more than one surface where the minimum U-value occurs.			

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