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Energy & Sustainability Statement
15/16 York Street, Brunswick Square, Bristol

For

Noma Architecture

25th February 2021

A connected approach to sustainable building solutions

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This document contains the following information:

- Energy Statement
- Sustainability Strategy

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1. Executive Summary

1.1 Overview

The Energy Statement provides a clear assessment of the proposed redevelopment's energy requirements and subsequent CO_2 emissions.

In formulating designed energy and carbon emissions IES 2017 has been used to calculate the estimated CO_2 reductions.

The Sustainability Strategy provides information on proposed energy efficiency measures and other carbon reductions. It considers how the redevelopment maintains a balance of environmental, economic and social issues.

A summary low and zero carbon feasibility (section 6.0) investigates the viability of integrating a host of LZC technologies within the proposed redevelopment.

1.2 Key findings

The Energy Statement concludes an overall reduction of 56.37% in regulated CO_2 for the proposed building compared to the existing building. An additional reduction of 3.52% in residual emissions after improved energy efficiency can be provided from 4 kWp of solar PV.

The proposed redevelopment is to remain passively ventilated.

Energy demand from artificial lighting has been reduced though maximising natural daylighting and providing LED lighting throughout.

The proposed development lends itself to connection to a future district heating system.

Whilst the specific requirements of BCS14 are not met for new development i.e. a 20% saving in CO_2 the report justifies the amount of appropriate renewable technology feasible and applying this to an existing building alongside improved fabric performance has significantly reduced the energy demand and subsequent overall CO_2 emissions.

2. Introduction

2.1 Background

This report has been prepared by Melin Consultants considering national policy planning requirements and the requirements of *Bristol City Council Core Strategies BCS 13-16*. It follows, where appropriate, guidance of the *Climate Change and Sustainability – Practice Note (Dec 2012)*.

It is intended to provide a clear and straightforward assessment of the proposed redevelopment's energy requirements and subsequent CO_2 emissions using IES 2017 software as a measure of the proposed building's benchmark.

It is supplemented by a summary of the proposed thermal performance upgrades of the fabric building materials and how the redevelopment engages with issues around sustainable design in a wider context.

It has been proposed to redevelop the existing building to provide a mix of open plan and smaller unit offices and meeting spaces. There is provision for a reception lobby and on-site cycle storage.

2.1.1 Bristol City Council Climate Change & Sustainability – Practice Note

The practice note offers advice on the implementation of the *Bristol Development Framework Core Strategy*. Collectively they form a suite of planning policies relating to climate change and sustainability.

BCS13 Climate Change – requires development to both mitigate and adapt to climate change.

BCS14 Sustainable Energy – provides criteria for assessing new renewable energy scheme, with a presumption in favour of large-scale renewable energy installations. It requires new development to minimise its energy requirements and then incorporate an element of renewable energy to reduce it CO_2 emissions by a further 20%. It also supports the delivery of a district heating network for Bristol.

Applications for planning permissions must now be accompanied the following additional information:

Policy	Required Information	Scale of development
BCS13	Sustainability Statement including:	All
BCS14	Energy strategy	All

The proposed redevelopment site presents some unique challenges in in terms of sustainability issues and the potential impact on conservation and features that have historical and heritage importance.

The redevelopment seeks to provide a balanced approach and looks to take on board the ethos of sustainable design, energy demands and CO_2 reduction whilst acknowledging the history of the building.

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3. Site analysis

3.1 Location

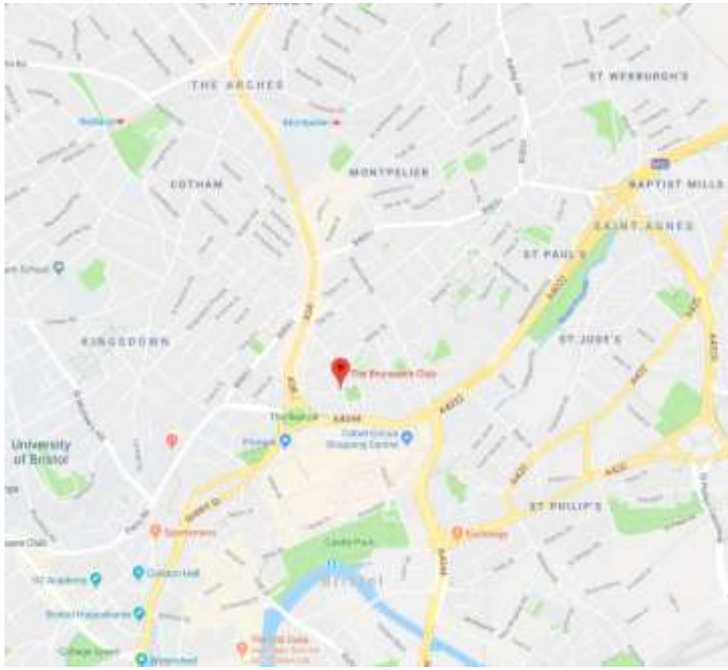
The redevelopment building is 15-16 York Street, Brunswick Square in central Bristol from its current use as a private member's club to offices.

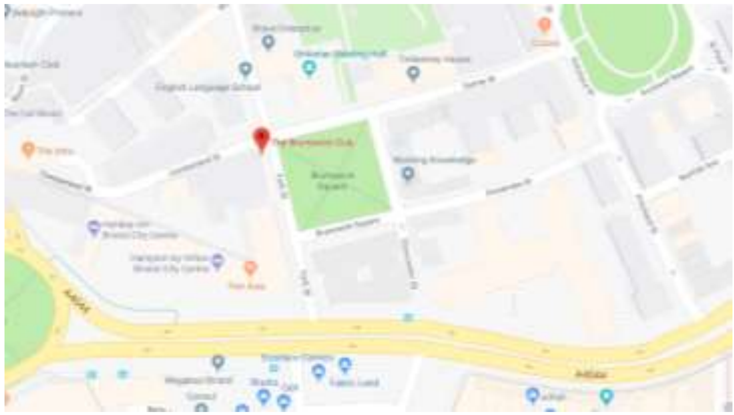
Cabot Circus and the principal shopping district are to the south, with a mix of commercial and residential properties to the north, east and west.

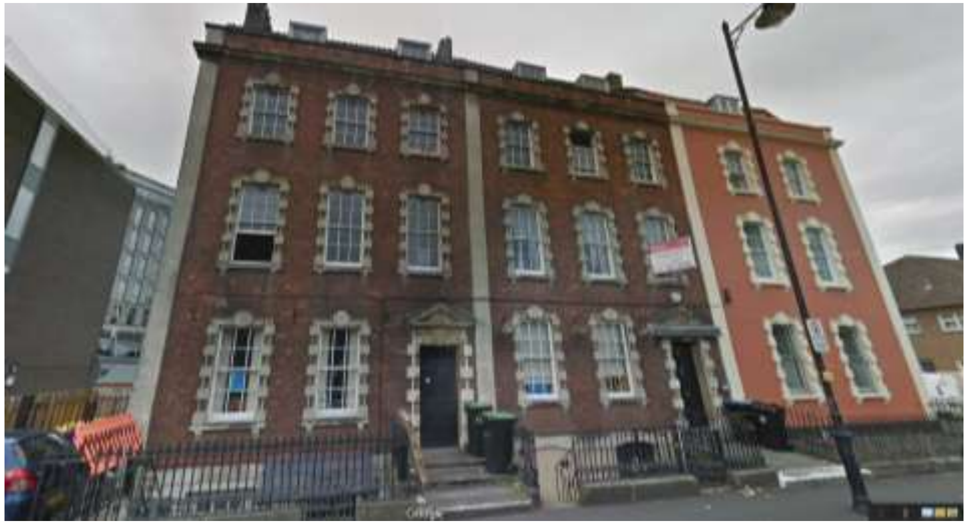
The site lies within the suburb area of St. Pauls.

The building comprises 2no. five storey Georgian houses along with a 20th century extension that extends over the whole of the rear of the plot at lower ground and ground floor level.

The redeveloped site will provide general office accommodation with a mix of open plan offices, meeting rooms, smaller cell offices, tea making facilities, central reception area and on-site cycle storage with a total GIFA of approx.. 1162m^2.







The proposed redevelopment is situated just off the A4044. The A4044 provides access to the city centre from the M32 and southern arterial routes to the south west and south east of England. The M5 and M4 motorways are approximately 8km to the north west and north east of the site respectively.

The central location provides excellent access to local amenities.

Within 500m safe walking route building users have access to the following amenities:

- Food outlets
- Cash machine
- Outdoor open space
- Postal facility
- Community facility
- Pharmacy

Parking is currently via paid meters surrounding the edge of Brunswick Square or numerous multi storey car parks within 500m safe walking route.

4. Energy efficient & sustainable design measures

4.1 Approach to sustainability

To supplement the Bristol City Council core requirements for sustainable construction the design team have considered the three issues that contribute to the proposed redevelopments overall sustainability. These are environmental, economic and social.

4.2 BREEAM

The proposed redevelopment is not required to achieve BREEAM Refurbishment and Fit-out. However, the principles have been adopted and form the theme for sustainability within the proposal.

4.3 Daylighting

The proposed redevelopment is limited in the opportunity to enhance the existing glazing. The internal room configuration does however makes effective use of the existing glazing by minimizing room depths and keeping non occupied spaces (tea making areas, toilets and circulation spaces) to areas that do not feature glazing. It is proposed to include a significant new glazed roof area to the first floor of the rear of the building providing natural daylight to the ground and lower ground floors. Currently only the ground floor benefit from a smaller number of roof lights.

To maximise the daylight factor room wall, floor and ceiling colours should be kept light and the glazing should be regularly cleaned.

It is anticipated that the front and rear elevations will be at risk from glare. User controlled blinds with low transmittance values are recommended for these windows.

4.4 Ventilation

The redevelopment will incorporate a natural/passive ventilation design strategy. This will be facilitated by openable windows and shallow room depths with an opportunity for single sided ventilation. Mechanical extraction will be fitted to tea making and toilet areas in line with Part F of the Building Regulations.

4.5 Lighting

Any new and existing external light fittings for the building, access ways and pathways will have a luminous efficacy of at least 70 lamp lumens/circuit Watt. All external light fittings will be controlled through a time switch, or daylight sensor, to prevent operation during daylight hours.

Internal lighting will be designed to provide Lux levels appropriate to room activity. Typically, 300-500 lux for general office activity. Low energy LED fittings will be used throughout, for modelling purposes lamps with 75 lumens per circuit watt have been used throughout.

Current lighting provision is a mix of fluorescent, halogen and incandescent lamps.

4.6 Energy monitoring

Energy metering via pulsed output meters will be installed to all energy consuming systems (lighting, heating, hot water, small power, ventilation) and linked to an appropriate energy monitoring and building management system (BMS). Appropriate sub-metering will be provided for individual letting units.

This will provide future tenants with the opportunity to monitor and target energy demand.

There is no current building management system.

4.7 Fabric performance

Detail design has not yet been undertaken however it is intended that high-performance insulation is installed to the warm side of the lower ground floor external walls, rear ground floor external walls and 3rd floor mansard external walls.

High performance insulation to the ceiling soffits in the unheated areas of the lower ground floor will avoid a thermal bridge to the occupied space above. The ceiling soffit of the rear ground floor will be thermal lined with high performance insulation along with the ceiling soffit to the 3rd floor mansard roof (refer to architectural drawings 2139-2200-01 & 2139-2202-01).

Several windows the west elevation 1st, 2nd and 3rd floors are non-original and are intended to be replaced (refer to architectural drawing 2139-2200-01 & 2139-2202-01). The windows are to be replaced with like for like windows due to building conservation restrictions.

The detailed design will take thermal bridging into consideration and where possible continuity of thermal insulation will occur at junction between walls and roof.

The improved walls U-value will achieve a minimum 0.25W/m^{2}K against a regulatory minimum of 0.30W/m^{2}K (Part L2B)

The improved ceiling soffits U-value is required to be minimum 0.18/m^{2}K against a regulatory minimum of 0.18W/m^{2}K.

A maximum air leakage of 10m^3/hr/m^2@50Pa will be allowed for with a requirement for third party testing on completion of refurbishment works.

4.8 Water

Toilets are to have dual control 4/2.5ltr flush. Taps to all areas will have flows restricted to 4.5ltr/min. The lower ground floor shower will be restricted to 6ltr/min.

A minimum 40% reduction in the estimated overall potable water usage against a notional building compliant with Building Regulations will be targeted

A pulsed output water meter will be installed on the buildings mains water supplies.

Flow control devices will be installed to each WC area/ facility to regulate the supply of water.

There is no proposed increase in impermeable areas.

4.9 Materials

Major construction materials will be purchased from suppliers that can demonstrate a sustainable environmental management policy such as ISO14001 and BES6001. The environmental policy and sustainability policy for each manufacturer shall be considered prior to purchase orders being placed.

All timber used within the redevelopment will be required to demonstrate it has been purchased from a sustainable source through robust schemes such as the Forest Stewardship Council (FSC) certification scheme.

4.10 Heating & DHW strategy

There is not currently a proposal to change the existing heating plant. It is estimated that the current boiler was installed after 1998, has a seasonal efficiency of 81% and is in good working order.

Following the appointment of an appropriate qualified engineer to develop a services strategy consideration will be given to the potential replacement of the existing heating system based on the principle of 'consequential improvement' with Part L2B i.e. demonstrate a less than 10-year pack and embodied energy cost do not offset in use efficiency savings. This work will be undertaken at RIBA stages 3-4 and prior to any construction works commence. It will also include for a detailed analysis of micro-CHP (see section 6.11)

4.11 District heating

There are currently no connection opportunities to a district heating scheme. By utilising a distribution of heat through water enables the scheme to become part of a future district heating scheme. The location of the redevelopment is within an area of high density and estimated high heat demands.

The existing heating distribution is by pipework from a central plant to radiators.

4.12 Waste management

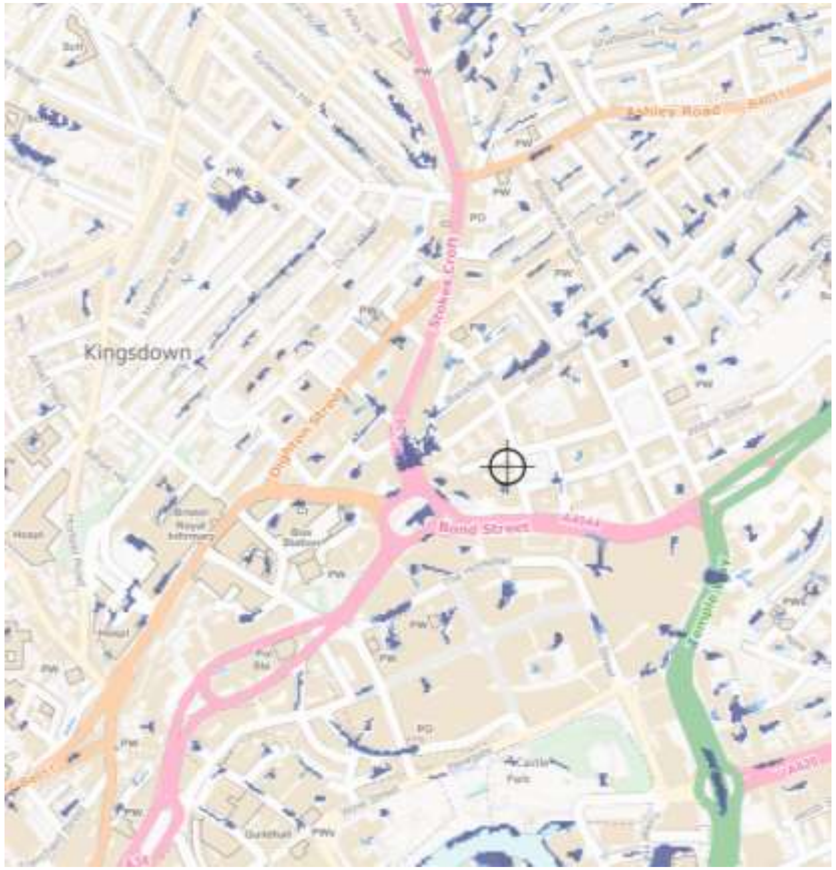
Dedicated waste storage facilities are in accessible areas for all building users on the lower ground floor. They are adequately sized to accommodate both recycled and general waste.

The appointed main contractor will be required to adopt a robust site waste management scheme and incorporate a site waste management plan that will minimise waste destined for landfill. In addition to this nonhazardous construction site waste will be measured and is required to be less than 6.5 tonnes per 100m^2 of gross internal floor area.

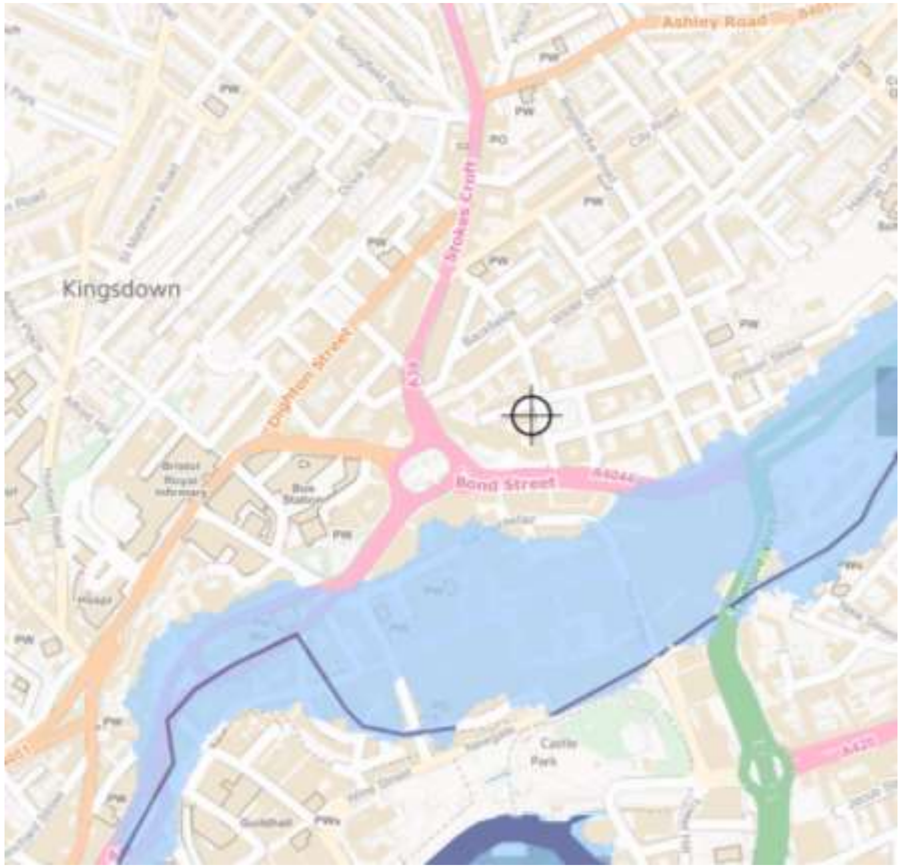
A pre-demolition audit will be undertaken prior to any demolition and removal works on the existing building.

4.13 Flood risk

A formal Flood Risk Assessment is not available. Environment Agency risk of flood from rivers and surface water indicates that the proposed site is outside of risk and extreme risk areas.



Risk of surface water flooding



Risk of flooding from rivers

4.14 Future adaptation

Spatially the opportunity for extending the building is limited and is not being considered.

Using a piped hot water distribution system lends itself for future connection to a district heating system.

Internal lightweight partition walls will allow for future adaptation and changing accommodation requirements.

Standardised heights across floors allows for repetitive and standardised materials assemblies within the main structure.

4.15 Biodiversity

There is limited opportunity to enhance biodiversity. A suitably qualified ecologist will be consulted prior to construction works to ensure that all current legislation is complied with and any opportunities to enhance ecology within or near the building is considered.

4.16 Transport

The site has an excellent provision of transport nodes with public transport services available.

The closest train station to the site is Montpelier 1.2km to the north. Bristol Temple Meads main train station is 1.6km to the south, providing links to the main rail network.

Multiple bus stops are within a 500m safe walking route. The nearest of which is Cabot Circus on the A4044.

The redeveloped site will provide a minimum of 14 secure indoor cycle storage spaces, showering and changing facilities.

5. Site constraints

Prior to the investigation into the suitability of potential low and renewable energy sources a scoping exercise has been undertaken to identify any key constraints which may affect the performance or viability of introducing any LZC technologies to the site.

5.1 Planning constraints

Brunswick Square is within a conservation area.

5.2 Air Quality Management Area

The proposed redevelopment is within Bristol City Council Air Quality Management Area.

5.3 Geological constraints

No geological constraints are known onsite.

5.4 Archaeological and historic values

An Historic Building Assessment (Cotswold Archaeology) has been undertaken for the site which concludes that there are unlikely to be buried remains of archaeological significance.

5.5 Solar resources

Solar energy resource is available onsite with minimal obstructions to the east elevation by surrounding trees and buildings. The rear and west of the building is directly flanked on the east and north elevation by two storey higher buildings. The south and west rear elevations are partially flanked by taller buildings

5.6 Visual constraints

There are no visual constraints as far as site layout is concerned.

6. Low & zero carbon feasibility

6.1 Funding

The Feed-in Tariff (FIT) scheme In July 2009 the 'UK Renewable Energy Strategy' was published and set out the Governments aspirations to comply with the EU 2009 Renewable Energy Directive. This directive committed the UK to sourcing 15% of our energy from renewable sources (in effect cutting out CO_2 emissions), and gave a clearer indication to the Governments support of micro-generation to assist in the reduction of CO_2.

The directive also provides the vehicle for delivery of two initiatives to make a carbon reduction through the installation of micro-generation projects.

6.2 Feed-in Tariff

The FiT scheme was a government programme designed to promote the uptake of renewable and low-carbon electricity generation technologies.

The Feed in Tariff was removed from service in April 2019 and has not yet been replaced.

6.3 Renewable Heat Incentive

The Renewable Heat Incentive (RHI), which is the first of its kind in the world, encourages the installation of renewable heat equipment such as solar thermal technologies, biomass boilers and ground, air and water source heat pumps. Like a FIT it is a government environmental programme that provides financial incentives to increase the uptake of renewable heat by businesses, the public sector and non-profit organisations.

Broadly speaking it provides a subsidy, payable for 20 years, to eligible, non-domestic renewable heat generators.

The payments will be made quarterly over a 20-year period to the owner of the heat installation.

You will not be eligible for the RHI if you have received a 'grant from public funds' for the costs of purchasing or installing your renewable heat installation.

It is important to note that any available incentive is taken into account when estimating payback periods but examples with and without the incentive have been provided to give the reader an informed level benchmark when considering all technologies.

6.4 Considered technologies

The following technologies have been considered:

- Solar PV
- Heat Pumps – Aerothermal
- Solar Thermal
- Hydro
- Wind
- Biomass (solid)
- CHP (gas)
- Heat Pumps – Geothermal

6.5 Photovoltaic (PV)

6.5.1 Background Information

Solar energy involves the use of the sun's energy (solar radiation) to provide electricity through using photovoltaic panels (PV). Solar PV converts the energy from the sun into electricity through semi-conductor cells connected together and mounted into modules. These modules are then connected to an inverter that converts direct current (DC) into alternating current (AC) so that it can be connected to the building main electricity distribution board. PV panels require only daylight and not direct sunlight to generate electricity, however shading and obstructions can significantly affect the overall performance levels.

The PV system can provide electricity to a building when it's generated or when building demand in insufficient surplus electricity can be exported to the national grid and generate an income.

They can be installed to the roofs or facades of individual buildings in the form of separate panel units or as solar slates which have a lower visual impact. There is an increasing trend to mount larger arrays on the ground when roof space is restrictive. The most effective orientation and angle is south facing inclined at between 30-35° to the horizontal, however yield only falls off slowly as the inclination reduces or faces to the south east or south west.

The additional weight of solar PV needs to be considered when undertaking structural calculations but typically does not increase loading by a significant amount.

PV installations have no moving parts and require minimal maintenance. However, they need to be kept clean for optimum performance and regular cleaning to remove dust accumulation may be needed. Systems can be designed and located so that they can 'self-clean' when it is raining.

It is recommended that the design team seek independent specialist advice, using accurate weather data, to identify the full extent of solar potential.

6.5.2 Land Use

There are no issues regarding land use other than the area of roof required to accommodate the quantity of PV to meet the energy demand for the building.

6.5.3 Local Planning Requirements

Consideration needs to be given to the location of the building within a conservation area. Clarification should be sought prior to any detailed design work.

6.5.4 Noise

There are no noise issues with this technology.

6.5.5 Feasibility of Exporting

There is potential to export electricity back into the national grid during times of low electricity use.

6.5.6 Available Funding

Following removal of the Feed in Tariff in 2019, there are currently no available funding sources.

6.5.7 Technology Suitability

Solar PV technology would be suitable for this however there may be issues with the building being in a conservation area. The available south facing roof space is limited.

6.6 Aerothermal (Air Source)

6.6.1 Background Information

An air source heat pump (ASHP) extracts heat from the outside air in the same way that a fridge extracts heat from its inside. It can extract heat from the air even when the outside temperature is below freezing. Although heat pumps require electricity to operate they are considered a low carbon technology.

The measure of efficiency of a heat pump is given by the Coefficient of Performance (CoP), which is defined as the ratio of heat output, divided by the quantity of electrical energy put in. The CoP depends on the temperature difference between internal and external conditions. Unlike the ground external air is much less stable therefore lower CoP's are achieved during the heating season. On a mild day when external air temperatures are around 20°C typical CoP can be greater than 4. However in winter as temperatures drop to below 0°C the CoP will drop to nearer 1.

Additionally, when external temperatures drop for longer periods below 0°C moisture in the air may condense and form ice on the heat exchanger. This affects the heat transfer coefficient and must be melted periodically using a 'defrost cycle' which uses energy to warm the exchanger but providing no useful heat gain within the building.

When used as space heating devices ASHP's achieve the best CoP when operating on low flow and return temperatures (40/30°C) such as under floor heating.

6.6.2 Land Use

Air Source Heat Pumps can be wall, floor or roof mounted depending on size, however, consideration needs to be given to the positioning of air intakes/oeuvre and external space will generally be required for the heat exchanger. There do not appear to be any constraints to site this type of technology.

6.6.3 Local Planning Requirements

At present this would need to be part of the planning application and it will need to be demonstrated that noise will not be a problem. The building is situated within a conservation area and unlikely to be granted permission of externally sited condensers.

6.6.4 Noise

Typical operating noise levels of a compressor are 50-55dBA at 1m.

6.6.5 Feasibility of Exporting

This system is designed to generate heat locally for the building occupants and therefore the feasibility of exporting heat from this system is not applicable.

6.6.6 Available Funding

Non-domestic installations that qualify under the Micro-generation Certification Scheme (MCS) will be measured under the Renewable Heat Incentive.

6.6.7 Technology Suitability

ASHP's are usually sited in areas where a heating and cooling demand is present or heated areas with low temperature flow and return (such as UFH). If the proposed refurbishment works were to utilise a system of underfloor heating then the technology is suitable, however additional guidance would need to be sought to investigate the viability of the technology in terms of the conservation status.

6.7 Solar Thermal

6.7.1 Background Information

Solar water heating systems use energy from the sun to heat water and is arguably the most recognised and tested renewable source in the world with technology now well developed and a large range of equipment to suit many different applications.

6.7.2 Technology Suitability

Domestic hot water requirements are deemed to be low with a single shower and several wash hand basins therefore solar thermal panels will not provide an environmental or economic benefit.

6.8 Hydro

6.8.1 Background Information

Water power can be harnessed in many ways; tidal flows can be utilised to produce power by building a barrage across an estuary and releasing water in a controlled manner through a turbine; large dams hold water which can be used to provide large quantities of electricity; wave power is also harnessed in various ways. It is a technology that has been utilised throughout the world, by a diverse range of societies and cultures, for many centuries.

6.8.2 Technology Suitability

There are no available water sources to enable hydropower technologies to be considered as a viable option.

6.9 Wind

6.9.1 Background Information

40% of all the wind energy in Europe blows over the UK making it the windiest country in Europe. In 2007 wind energy overtook hydropower to become the largest renewable generation source and currently contributes over 10% of the UK's electricity supply, with onshore wind comprising the bulk of this.

A wind turbine suitability checklist includes the following:

- The area needs to be windy enough i.e. at least 4.5m/s for building mounted and at least 5m/s for free standing turbines and not be disrupted by surrounding tall trees or buildings or other features that will create turbulence.
- There should be an unobstructed roof aspect for roof mounted turbines to be fixed to i.e. a gable end, edge of building or flat roof, if a free-standing turbine is not considered appropriate.

Reference to the NOABL wind speed database predicts that the annual average wind speed for the redevelopment site is between 4.00 m/s.

6.9.2 Technology Suitability

There would likely be potential problems in obtaining planning permission for a building mounted turbine due to the building being within a conservation area.

The predicted wind speeds are below the minimum level required and may also be disrupted by surrounding structures causing turbulent air flow and significantly reducing performance.

6.10 Biomass

6.10.1 Background Information

The term ‘biomass’ covers solids, bio-gas and bio-liquids but generally refers to an energy resource derived from organic matter, including wood from forests, waste wood source, farmed coppices and approved farmed energy crops or farm and factory waste. It doesn’t include fossil fuels.

Benefits of a biomass system include zero net contribution of CO_2 to the atmosphere, diversity of fuel supply, plus the benefit of using a fuel source that is predicted to fall in price whilst conventional energy sources such as natural gas and electricity are set to rise.

Biomass is generally regarded as carbon neutral. The CO_2 released during the generation of energy from biomass should be balanced by the CO_2 absorbed during the fuel’s production. However unlike most other renewable energy sources biomass fuel isn’t abundant or free.

There are several key considerations when designing a biomass system. Most of these surround the supply and storage of the fuel. It is essential that an established supplier can provide assurance of security of supply to the site.

As with all delivered fuels, potential issues surrounding delivery need to be considered. The main vehicle access to the site is via York Street. Although this road does not have any weight restrictions it is busy and unsuitable for direct parking or delayed off-loading.

Once on site the biomass would need to be housed within an adequately sized fuel store providing a dry secure environment.

The current plans show a suitably sized plant room for a biomass system however consideration would need to be given to the storage of the fuel in a nearby location.

6.10.2 Land Use

Biomass boilers are not usually that much larger than the equivalent fossil fuel boilers. Consideration is needed though as to the storage and access requirements for fuel.

6.10.3 Local Planning Requirements

The building is within an Air Quality Management Area (AQMA) however biomass appliances are generally exempt from a smoke control area.

A biomass heating system, due to level of NO_x and SO_x (nitrogen and sulphur oxides) emissions produced, is required to incorporate a flue above the roofline of the building.

6.10.4 Noise

The only issues with regards to noise with this type of LZC relate to the impact of noise from lorries delivering the biomass fuel and the noise of the pellets/wood chips being deposited into the storage area. Otherwise, the running noise from the system is comparable to that of a conventional gas system.

6.10.5 Feasibility of Exporting

This system is designed to generate heat locally for the use on the redevelopment and therefore the feasibility of exporting heat/electricity from this system is not applicable.

6.10.6 Available Funding

Non-domestic installations that qualify under the Micro-generation Certification Scheme (MCS) will be measured under the Renewable Heat Incentive.

6.10.7 Technology Suitability

To be a viable option the technology needs to be suitable for use with the preferred heating distribution method (i.e. the existing heat distribution) however additional studies would need to be undertaken to determine more accurate heat loads. Overall the technology is considered suitable, providing that suitable storage spaces can be found for the fuel, a suitable local network supply can be found and access/delivery to the site is adequate.

6.11 Combined Heat and Power (CHP)

6.11.1 Background Information

Combined Heat and Power (CHP) or co-generation is the production of electricity and useful heat in a single process. In CHP plants the heat produced during the generation of electricity can be put to good use at source, rather than being wasted or benefitting other activities as is the case for centralised power generation.

The plant when operated on natural gas is approx. three times cheaper per kWh than power generated from the grid. Significant carbon savings are achieved as power generated at source does not suffer grid power transmission losses.

Micro CHP can operate in either heat or power lead modes. In most cases though units are operated in power lead mode and are controlled to modulate electrical power generation to match site demand.

The systems can be used with a variety of fuels including natural gas and biomass.

6.11.2 Technology Suitability

There is unlikely to be sufficient heat demand to make this technology suitable for the proposed redevelopment. It is recommended that further analysis is undertaken by a specialist to establish base heat loads and anticipated occupation levels.

6.12 Ground & Water Source

6.12.1 Background Information

Ground and water source systems use the relatively constant year-round temperature of the ground or water to provide heating (they can also be used for cooling).

6.12.2 Technology Suitability

There are no options to feasibly run sufficient amounts of underground pipework. Therefore, technology is not considered suitable.

6.13 Summary

Technology	Suitable	Requires further investigation	Unsuitable	Summary
Solar PV	☺			Can provide a reasonable payback period. Conservation area may not allow the use of solar PV roof elevation.
Aerothermal		😐		Could provide significant CO_2 reductions. Would be best suited to an UFH system. Could be issue with externally mounted condensers. Existing heating system may not suit replacement.
Solar Thermal			☹	Low hot water demand.
Hydro			☹	No available resource.
Wind			☹	No sufficient local wind speeds. Urban location would create wind turbulence.
Biomass		😐		Opportunity to reduce CO_2 emissions. Potential access, storage and air quality issues. Existing heating system may not suit replacement.
Combined Heat & Power		😐		Unlikely to be sufficient heat demand. Further investigation required.
Ground & Water Source Heat Pump			☹	No opportunity to run sufficient underground pipework.

7. Energy demand and CO_2 emissions

7.1 Energy benchmarks

To demonstrate how the redevelopment will reduce carbon emissions by a prescribed amount, technical calculations provide estimated primary energy usage and CO_2 emissions for a *baseline* or existing building. Additional calculations provide primary energy usage and CO_2 emissions for an *improved energy efficiency* building based on proposed refurbishment. A final set of calculation provide primary energy usage and CO_2 emissions for an *improved energy efficiency and renewable offset* building.

This report provides a potential strategy to provide a reduction in CO_2 over a *baseline* building by 56.37% including an additional 3.52% CO_2 reduction in the residual emission after *improved energy efficiency*, from photovoltaic panels (see section 8).

This calculation methodology differs from that detailed in BCC Climate Change and Sustainability Practice Note (Dec 2012) to provide a more relative baseline building based on the existing fabric.

It is not technical feasible to improve the thermal performance and services strategy beyond the Part L2A Target Emission Rate of a new build construction.

The improved building fabric goes beyond current Part L2B requirements.

Unimproved fabric is in line with Part L2B guidance in terms of listed building status whereby Regulation 21 of Building Regulations grants an exemption from compliance with the energy efficiency requirements to certain classes of building:

- Listed in accordance with section 1 of the Planning (Listed Buildings and Conservation Areas) Act 1990
- In a conservation area designated in accordance with section 69 of the Planning (Listed Buildings and Conservation Areas) Act 1990
- Included in the schedule of monuments maintained under section 1 of the Ancient Monuments and Archaeological Areas Act 1979

It is estimated for calculation purposes that a maximum of 35-40^2 of solar PV panels can be orientated sufficiently to avoid a visual constraint. This figure can be adjusted as necessary.

7.2 Baseline building

For the purposes of the modelling exercise the following has been estimated:

- Air leakage 25m^3/hr/m^2 @ 50Pa (standard default for all existing buildings prior to 2006)
- The average floor U-value is set at 0.29 W/m^{2}K (uninsulated)
- The average wall U-value is set at 1.43 W/m^{2}K (solid masonry)
- The average roof U-value is set at 3.38 W/m^{2}K (uninsulated)
- The average window U-value is set at 4.23 W/m^{2}K (single glazed)
- Natural ventilation

7.3 Improved energy efficiency

Additional to the baseline Part L2a compliance the proposed redevelopment will incorporate the following improvements (suggested):

- Improved air leakage to 10m^3/hr/m^2 @ 50Pa
- The improved wall U-value is set at 0.25 W/m^{2}K
- The improved roof U-value is set at 0.18 W/m^{2}K

7.4 Renewable offset

To demonstrate a residual reduction in CO_2 emissions additional to the improved energy efficient building the proposed redevelopment will incorporate (suggested):

- 4 kWp photovoltaic panels

7.5 Drawing issue

In formulating this report and the relevant calculations, the following drawings have been used:

2139-2100-01
2139-2101-01
2139-2102-01
2139-2103-01
2139-2105-01
2139-2200-01
2139-2202-01

8. Calculation results (proposed strategy)

Energy and CO_2 reduction						
Plot type	*Baseline buildings*		*Improved energy efficiency*		*Renewable offset*	
TER	14.6 kg/m^2		17.0 kg/m^2		15.6 kg/m^2	
BER	62.8 kg/m^2		28.4 kg/m^2		29.8 kg/m^2	
	kWh/m^2	CO_2 kg/m^2	kWh/m^2	Kg CO_2/m^2	kWh/m^2	Kg CO_2/m^2
Heating & Cooling	116.50		40.75		40.75	
Hot Water	3.63		24.29		24.29	
Auxiliary electric	2.05		1.93		1.93	
Lighting	69.03		31.6		31.6	
Total	191.21	62.8	92.65	28.4	92.65	27.4
PV contribution					1.86	
CO_2 reduction	n/a		54.78%		56.37%	
Residual contribution from renewable technology					3.52%	

For the purposes of this report the results have been calculated for the entire site in one calculation, these are outlined below:

	Energy demand (kWh/m^2 pa)	Energy saving achieved (%)	Regulated CO_2 emissions (kg/m^2 pa)	Saving achieved on residual CO_2 emissions (%)
("Baseline" energy demand & emissions)	191.21		62.8	
Improved efficiency measures	92.65	51.55%	28.4	54.78%
Proposed scheme after on-site renewables	90.79	2.01%	27.4	3.52%
Total savings on baseline emissions				56.37%

Baseline buildings

Baseline energy demand (kWh/m^2) pa	191.21
Regulated emissions (kg/m^2) pa	62.8

Improved energy efficiency

Energy savings from energy efficiency measures (KWh pa)	51.55%
Emissions savings from energy efficiency measures (kg pa)	54.78%
Total regulated emissions after energy efficiency measures (kg/m^2 pa)	28.4

9. SBEM outputs