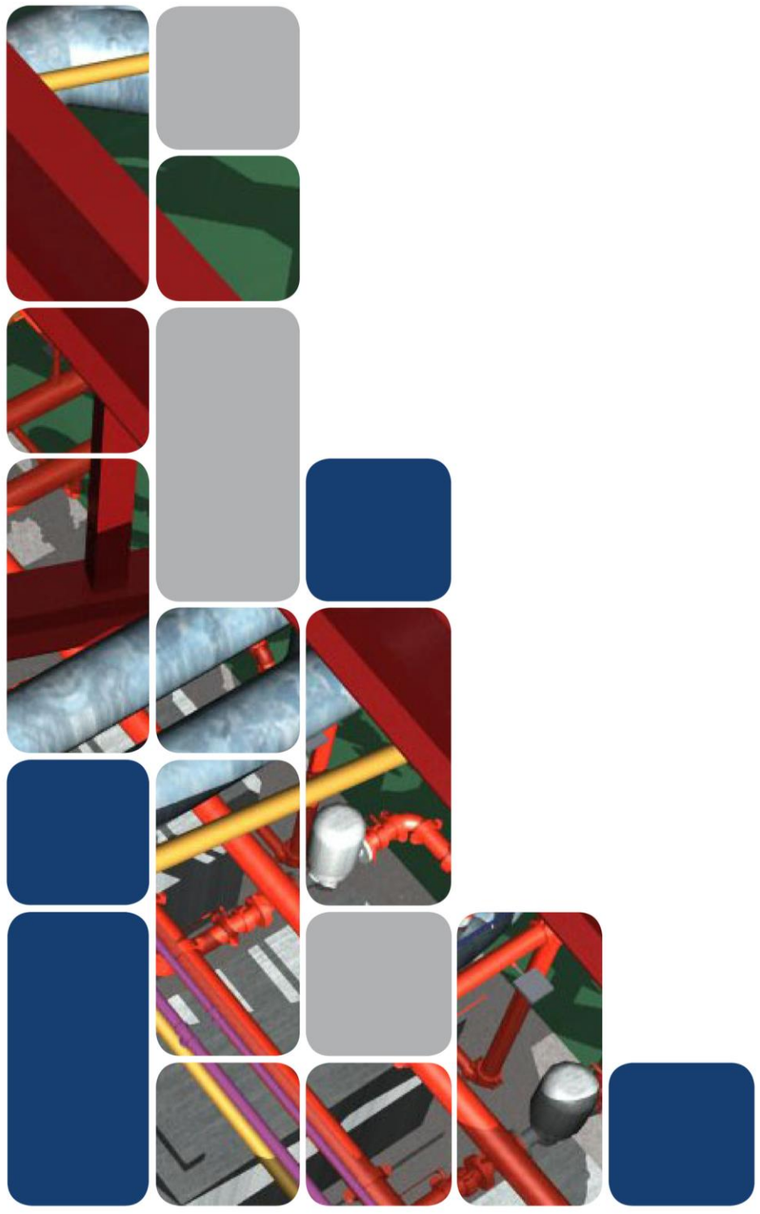


23 New Mount Street

Manchester

Sustainability & Energy Strategy Report

Report for:

HOMEZZZ Ltd

19rd July 2018

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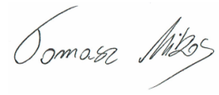
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Hydrock Consultants Limited has prepared this report in accordance with the instructions of the above named client for their sole and specific use. Any third parties who may use the information contained herein do so at their own risk.

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1.0 Introduction and Background

Hydrock have been appointed on behalf of Homezzz Limited to prepare a report in order to support the planning application to Manchester City Council in respect of the proposed development of the Grade II Listed former Co-operative Printing Society, New Mount Street, Manchester.

With consideration to the Heritage Report produced by Stephen Levrant Heritage Architecture Ltd and the Building Survey report commissioned by CBRE outlining that the property is in a poor condition overall, though structurally sound, substantial remedial and replacement works are required to the external fabric elements of the property.

Axis Architecture have prepared a set of general arrangement drawings which allowed us to address and incorporate the proposed layouts and associated aspects of the buildings energy use and sustainable development in order to demonstrate compliance with the relevant Planning Policy.

1.1 Description of Development

The site comprises three purpose-built ex printing works and one former domestic dwelling. The three former printing buildings are currently used as incubator office space which are interconnected and date from the 1870's to 1906, 1920 and the former domestic dwelling, now derelict, dating from circa 1850.

The subject site is bounded by Naples Street to the north, School Street to the east and New Mount Street to the south, and Ludgate Street to the west.

The subject site is Grade II Listed and it is understood to be not located within a conservation area.

1.2 Project Vision

Implementation of the scheme will see the redevelopment of the buildings from their current office use to residential use delivering 66 residential units with a central light-well / atrium. After a predicted 15-month construction period.

A planning application will be submitted supported by this Sustainability and Energy Report.



Figure 1: New Mount Street Site

	FLOOR	1 BED	2 BED	1 BED DUPLEX	2 BED T/H	3 BED T/H
	B		10	3	1	1
	G	4	8			
	1	4	8			
	2	4	8			
	3	7	2			
	4	4	2			
Total		23	38	3	1	1
Total Number of Units			66			

Table 1 details the accommodation schedule for the subject site:

Table 1: New Mount Street Proposed Site Accommodation Schedule

1.3 Scope of the Report

It is our understanding that the application will be assessed against the Manchester's Local Development Framework (LDF) Core Strategy Development Plan Document. This report considers the relevant energy and sustainability sections namely EN3, EN4 and EN6 which are discussed in detail in section 1.6.2. The following sections contained within the LDF are outside of the scope of this report:

- Assessment to Code for Sustainable Homes not required.
- BREEAM assessment not required

- FRA and SUDS assessments are out of scope.
- Water Management and Weather Resilience
- Waste Management
- Construction Management
- Biodiversity
- Waterways

1.4 Building Regulations

1.4.1 Approved Document Building Regulations, Part L1 2013:

Part L - Conservation of Fuel and Power sets the energy efficiency standards required by Building Regulations and controls the insulation values of building elements, the allowable area of windows, doors and other openings, air permeability of the structure, the heating efficiency of boilers and the insulation and controls for heating appliances and systems together with hot water storage and lighting efficiency.

1.5 Standard Assessment Procedure

The Standard Assessment Procedure (SAP) is the methodology used by the Government to assess and compare the energy and environmental performance of dwellings. Its purpose is to provide accurate and reliable assessments of dwelling energy performances that are needed to underpin energy and environmental policy initiatives. SAP calculations are a requirement of the Building Regulations, and are required for all newly built dwellings in the UK.

1.6 Planning Policy Context

This section summarises the key national and local policies and regulations that have been considered as part of this report production and that must be addressed in order to demonstrate compliance with the requirements of the Local Planning Authority (LPA).

1.6.1 The National Planning Policy Framework

Published on 27 March 2012 this document sets out the Government's planning policies for England and how these are expected to be applied.

The Local Plan is produced to implement national policies relevant to the local area. Illustrated in Figure 2 is the Government's energy hierarchy which has been adopted to implement a fabric first approach. This will ensure that pragmatic and less expensive options are incorporated.

The approach adopted is as follows:

- Minimise energy demand by improving the building envelope in terms of insulation and air tightness
- Implement passive design measures
- Manage demands through specification of controls and energy efficient plant for heating, ventilation and lighting.
- Consideration of low and zero carbon, renewable or decentralised technologies to address climate change resilience

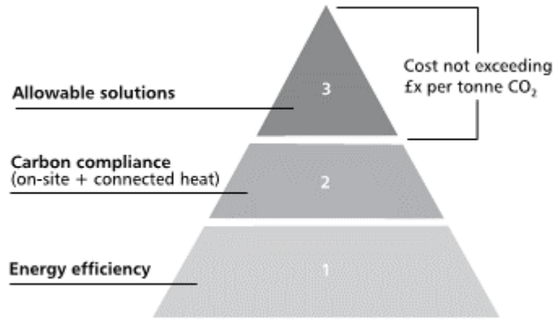


Figure 2: The Government's preferred energy hierarchy. Source: CIBSE Guide F

1.6.2 Manchester's Local Development Framework. Core Strategy Development Plan Document.

The Core Strategy was adopted on the 11th July 2012. It sets out the following policies for developments:

EN3 – Heritage

- The Council will encourage development that complements and takes advantage of the distinct historic and heritage features of its districts and neighbourhoods, including those of the City Centre.
- New developments must be designed so as to support the Council in preserving or, where possible, enhancing the historic environment, the character, setting and accessibility of areas and buildings of acknowledged importance,

EN4 – Reducing CO_2 Emissions by Enabling Low and Zero Carbon Development

All development must follow the principle of the Energy Hierarchy, being designed:

- To reduce the need for energy through design features that provide passive heating, natural lighting and cooling,
- To reduce the need for energy through energy efficient features such as improved insulation and glazing,
- To meet residual energy requirements through the use of low or zero carbon energy generating technologies,
- Wherever possible new development and retrofit projects, including energy generation plant, must be located and designed in a manner that allows advantage to be taken of opportunities for low and zero carbon energy supplies,
- Where possible new development and retrofit projects will be used as a mechanism to help improve energy efficiency and provide low and zero carbon energy supplies to existing buildings,
- Where appropriate new development and retrofit projects will be required to connect to and/or make contributions to low or zero carbon energy schemes and/or to incorporate provision to enable future connection to any existing/potential decentralised energy schemes,
- The use of building materials with low embodied carbon in new development and refurbishment schemes.

EN6 – Target Framework for CO_2 Reductions from Low or Zero Carbon Energy Supplies

- Applications for residential development of 10 or more units and all other development over 1,000sqm will be expected as a minimum to meet the target shown in Table 12.1 (reproduced below in Table 2), unless this can be shown not to be viable. This should be demonstrated through an energy statement, submitted as part of the Design and Access Statement. Such a statement will be expected to set out the projected regulated energy demand and associated CO_2 emissions for all phases of the development.
- Developments smaller than the above threshold, but involving the erection of a building or substantial improvement to an existing building will also be expected to meet the minimum target, where viable, but will not be expected to submit an energy statement.

The target framework relates to three broad development locations and their potential for low and zero carbon, decentralised energy. The areas are defined as follows:

Target1: Network development areas: Locations where the proximity of new and existing buildings, the mix of uses and density of development provide the right conditions to support district heating (and cooling).

Target 2: Electricity intense areas: Locations where the predominant building type has an all electric fit-out such as retail units and leisure complexes.

Target 3: Micro-generation areas: Locations where lower densities and a fragmented mix of uses tend to mean that only building scale solutions are practical.

Target	% Minimum requirement
Target 1: Network development area	CHP/district heating anchor or connection or where not feasible a 15% increase on Part L 2010
Target 2: Electricity intense buildings	+15% increase on Part L 2010
Target 3: Micro generation area	+15%increase on Part L 2010

Table 2: Domestic CO_2 emissions reduction targets (LDF Table 12.1)

1.6.3 Supplementary Planning Guidance and the Manchester Unitary Development Plan

The Guide to Development in Manchester - Supplementary Planning Document and Planning Guidance (SPD) was adopted in April 2007. It sets out policies for developments in accordance with Government Circular 1/2006 for the submission of a design and access statement to accompany all planning applications for major development. Manchester City Council MCC produced the SDP as a means of guiding those involved in the development process in the preparation of these statements. The document sets out the City Council's stance on a wide range of issues, demonstrating, where applicable, their links to the Manchester Unitary Development Plan (UDP).

Section 4.4 of the SPD requires Developers to submit a statement on how their proposal will achieve the environmental standards set out in Chapter 4. The Environmental Standards Statement is required for all planning applications, both outline and full, with the exception of changes of use where no operational work is required, house extensions and mining or engineering work. Whilst this development falls into the category of a change of use there will be a requirement for material changes to the building hence an E&S statement will be required.

Energy Efficiency

Policy E1.5 of The UDP encourages high standards of energy efficiency in new development. In the Environmental Standards Statement, developers should show how they have considered the steps necessary

to reduce energy demand at the earliest stages of design. Developers should aim to reduce CO_2 emissions by at least 25% more than the requirements of Approved Document L (2006) – 'Conservation of Fuel and Power.' This was superseded by Approved Document L (2010) which calls for a 15% improvement as shown in Table 2 below and demonstrated in the Energy Section of this report.

The design principles will assist developers in:

- Achieving energy efficiency targets,
- Minimise reliance on energy-using equipment for heating, cooling, lighting and natural ventilation,
- Position trees and soft landscaping on and around the development and within buildings to provide natural shading, insulation and air conditioning,
- Integrate energy efficient micro-generation and community heating schemes, such as combined heat and power (CHP),
- Site layout and building design principle should maximise the capture and use of daylight and passive solar energy, whilst avoiding excessive solar gain in summer,
- Specify energy and water efficient appliances and systems.

Renewable Energy

Policy E1.5 of The UDP requires a reduction in energy demand which should aim for at least 20% of final site energy demand to be met by on-site renewable energy technologies.

Against the baseline of improvements over and above Approved Document Part L 2010 a developer is asked to consider renewable and decentralised energy technologies which will reduce the predicted carbon emissions in line with the relevant carbon reduction target. This is subject to commercial viability.

1.7 Targets for Development

- A 15% improvement in CO_2 emissions from Part L (2010) in line with Policy EN6 and exceeds the requirements of the 2007 SPD.
- The Government Energy Hierarchy responds to Policy EN 4 of the Manchester Core Strategy by maximising energy efficiency and reducing CO_2 emissions. The policy requires the application of the energy hierarchy to ensure that passive measures, energy efficiencies and low and zero carbon generation options are considered.

The output of this report follows the Energy Statement Methodology described in the Policy Approach EN6:

1. Set out the baseline information,
2. Calculate the total energy demand of the completed development,
3. Calculate the equivalent annual carbon emissions from the completed development,
4. Apply the appropriate carbon emissions reduction target,
5. Apply the energy hierarchy,
6. Consider all appropriate low carbon, renewable and/or decentralised energy technologies,
7. Assessment of least cost technology option.

2.0 Energy Demands

2.1 Building Energy Modelling

With reference to Policy EN4, a comparison of the building element thermal properties from existing to recommended will show how implementing energy efficient features such as improved insulation and glazing can increase energy efficiency in line with Approved Document Part L1B.

Further mitigation of CO_2 under Policy EN6 will help to identify any appropriate renewable technologies that could be used.

An evaluation of the building design and associated services was carried out utilising the Standard Assessment Procedure (SAP) analysis tool. Modelling was based around assumed building loads and improvements recommended to demonstrate how the scheme could achieve the requirements of the Local Planning Authority (LPA) in conjunction with the requirements of the National and Local Planning Guidance.

The software models are used for the following:

- Building energy demand and consumption,
- Thermal comfort analysis.

The analysis tools will highlight the building's energy consumption in kWhr/annum / tonnes of CO_2.

A Target Emission Rate (TER) is established by the SAP software to calculate the CO_2 emission rate from a notional building of the same size and shape as the actual building but with specified properties. The TER is set equal to the CO_2 emissions from this notional building with no further adjustments being made. This Target Emission rate can then be used as the Baseline for any improvements to CO_2.

The SAP software can also be used to establish the CO_2 emission rate for existing buildings.

Calculations have been undertaken in Stroma FSAP 2012 Version 1.0.1.21, an advanced SAP software tool that is certified for carrying out SAP calculations.

2.2 Baseline Site Energy Demands and CO_2 Emissions

In order to calculate the regulated baseline energy demand of the development and the equivalent annual carbon emissions from the completed development, SAP calculations have been carried out using a worst-case apartment (top floor) and typical apartment (mid floor).

Using the SAP methodology, Table 3 shows the calculated energy demand of the proposed apartments and new build town houses.

The figures are based upon the assumption that the existing thermal elements will be upgraded to meet the requirements set out in Approved Document Part L1B, and the new build town houses will pass Part L1A.

An average has been taken using the worst case apartment and a typical apartment and used to estimate a total residual regulated energy demand and emissions total for the whole development shown in Table 4.

Baseline energy demands and reduction targets have then been set which can be seen in Table 5.

	Residual Regulated Energy Demand (kWh/m²/year)		
	Worst Case Apartment	**Typical Apartment**	**New Build (Town houses)**
Space + water heating	137.8	102	58.57
Electricity used for Heat Distribution	3.32	2.5	6.09
Electricity used for equipment	27	25.5	
Electricity for Lighting	19.5	22.4	12
Total	**187.6**	**152.4**	**76.66**
	Residual Regulated Emissions (kgCO₂/m²/year)		
	32.82	**26.65**	**13.42**

Table 3: Estimated residual regulated energy demand and regulated emissions

	Total Residual Regulated Energy Demand Total (kWh/year)		
	Existing Building	**New Build Town Houses**	**Existing + New Proposal**
Space + water Heating	687,238	18,390	705,628
Electricity used for Heat Distribution	16,346	1,912	18,258
Electricity used for equipment	61,899		61,899
Electricity for Lighting	84,345	3,768	88,113
Total	**849,828**	**24,070**	**873,898**
	Residual Regulated Emissions Total (kgCO₂/year)		
New Build Residential	**149,244**	**4,213**	**153,457**

Table 4: Total estimated residual regulated energy demand and regulated emissions

Baseline Energy Demands and Reduction targets				
	Energy Demand (kWh/year)	Energy Reduction Achieved (%)	Regulated CO_2 emissions ($kgCO_2$/year)	CO_2 reduction achieved (%)
Building Regulations Part L1B Baseline energy demand and Emissions (all upgraded elements)	**873,898**		**153,457**	
Energy reduction target	**742,813**	**15%**	**130,438**	**15%**

Table 5: Baseline energy demands and reduction targets

3.0 Energy Efficiency

Following the Energy Statement Methodology described in the Policy Approach EN6 and in line with the energy hierarchy the following statements apply:

- To reduce the need for energy through energy efficient features such as improved insulation and glazing
- Wherever possible new development and retrofit projects, including energy generation plant, must be located and designed in a manner that allows advantage to be taken of opportunities for low and zero carbon energy supplies,

3.1 Insulation Standards

In terms of fabric it is assumed the "new build" elements shall use modern construction technologies, methods and materials. Following initial SAP calculations for the new build elements, the following fabric standards have been established to comply with the Part L requirements.

The following table demonstrates the building elements used within the SAP calculations for the new build town houses.

Building Element Thermal Properties			
U-Values			**Notes**
External Walls	0.16	W/m^2.K	Approx. 140mm insulation
External Floor	0.11	W/m^2.K	Approx. 200mm insulation
Roof	0.11	W/m^2.K	Approx. 200mm insulation

Table 6: Building element thermal properties

It should be noted that these values are not the absolute minimum values required for Building Regulations compliance. They are improvements on these minimum values in order to generally achieve compliance in emission and energy efficiency.

Where an existing thermal element is part of a building subject to "change of use", under Part L1B reasonable provision would be to upgrade those thermal elements whose U-value is worse than the threshold values given, provided it is technically and economically feasible. Table 7 shows the estimated U-values of the existing thermal elements based on information given in the CBRE Building Survey report (dated March 2016) and site survey information, threshold U values and the improved U-value for cost effectiveness.

Building Element Thermal Properties			
Element	Existing U values (estimated)	Threshold U value	Improved U value (cost effective L1B)
Wall	1.34 W/m^2.K	0.70 W/m^2.K	0.30 W/m^2.K
Roof	0.81 W/m^2.K	0.35 W/m^2.K	0.16 W/m^2.K

Table 7: Upgrading retained thermal elements

3.2 Walls

The majority of exterior elevations are of high historic significance. To improve the U-value of the building element a cost effective option would be to dry-line the inner face of wall, insulating between the studs fixed to wall.

Energy Strategy – Wall Insulation				
	Energy Demand (kWh/year)	Energy Reduction Achieved (%)	Regulated CO_2 emissions ($kgCO_2$/year)	CO_2 reduction achieved (%)
Existing Building (Using estimated U values for thermal elements)	**1371,109**		**241,545**	
Improved Wall Insulation	**1227,145**	10.5% (from existing)	**216,183**	10.5%(from existing)

Table 8: Improved wall insulation – illustrating an energy reduction

3.3 Roof

The original timber roof structure is also of high significance. There is a possibility that the roof void may be removed removing any of the insulation currently at ceiling level. A suggested option would be to insulate between rafters to improve the u-value of this building element.

Energy Strategy- Roof Insulation				
	Energy Demand (kWh/year)	Energy Reduction Achieved (%)	Regulated CO_2 emissions ($kgCO_2$/year)	CO_2 reduction achieved (%)
Existing Building (Using estimated U values for thermal elements)	**1371,109**		**241,545**	
Upgraded Roof Insulation	**1223,029**	10.8% (from existing)	**215,458**	10.8%(from existing)

Table 9: Improved roof insulation – illustrating an energy reduction

3.4 Glazing

Glazing New build Town Houses			
U-Values			**Notes**
Glazing	1.4	$W/m^2.K$	Advanced Double Glazing. Based on 25% external wall being glazed.
Glazing	0.60	G-Value	

Table 10: Glazing thermal properties (new build)

Glazing Existing			
Element	Existing U values (estimated)	Threshold U value	Improved U value (Possible with secondary Glazing)
Glazing	4.8 $W/m^2.K$	3.3 $W/m^2.K$	2.4$W/m^2.K$

Table 11: Glazing thermal properties (existing)

3.5 Windows

The Heritage appraisal states that windows should be retained and refurbished and not replaced. Secondary glazing units could be installed to the inside face of the windows to improve the U-value of this building element.

Energy Strategy- Secondary Glazing				
	Energy Demand (kWh/year)	Energy Reduction Achieved (%)	Regulated CO_2 emissions ($kgCO_2$/year)	CO_2 reduction achieved (%)
Existing Building (Using estimated U values for thermal elements)	**1371,109**		**241,545**	
Upgraded Roof Insulation	**1169,556**	14.7% (from existing)	**206,038**	14.7% (from existing)

Table 12: Secondary glazing - illustrating an energy reduction

3.6 Heating Systems

For the purpose of this report and energy modelling, the buildings shall be mechanically heated from a central gas boiler plant (Community Heating) with a LTHW distribution network throughout the development serving Heat Interface Units (HIUs) in each apartment, this allows advantage to be taken of opportunities for low and zero carbon energy supplies that can connect into this central system.

Any central boiler plant fuel shall be mains gas and will have an efficiency of 95%.

3.7 Ventilation

Ventilation from wet rooms and kitchens within the existing and new building will be provided via mechanical extract ventilation (MEV) to a central extract system exhaust to atmosphere.

An air permeability of 3m³/hr.m² at 50 pa has been used for the "new build" town houses

The proposal for the new building is to have background ventilators as part of the windows (town houses). However, Approved Document F suggests that if the existing buildings are expected to have an air permeability leakier than 5m³/hr.m² at 50 pa background ventilators are not necessary. We have assumed that this is the case.

3.8 Lighting

The following tables outline electrical design assumptions;

Space	Lighting Power Density (W/m²)	Small Power Density (W/m²)
Dwelling	3	2
Communal Space/Corridor	2	1

Table 13: Electrical Power Density

Space	Occupancy Sensing	Daylight Linking
Circulation, Stairwell	Presence Detection (AUTO-ON-OFF)	None
Dwellings	None	None

Table 14: Lighting Control Strategy

3.9 ICT

The development shall include high speed broadband access and enable the next generation of broadband to be available to dwellings. The development shall include smart metering and sub-metering to enable good energy management and make residents aware of the energy they are consuming.

4.0 Decentralised Energy

4.1 Existing CHP/CCHP Networks

We have reviewed the potential for any de-centralised energy networks that are found local to the development and looked at the feasibility of connection.

The Co-op head-quarters located at One Angel Square is an office building completed in February 2013 that is in close proximity to the development. It uses waste heat from two 400kW combined heat and power (CHP) units.

Various factors would need to be considered and agreements entered into, however, we feel that this should not be discounted as this could be a viable option if this energy was made available by the Co-op to external developments.

4.2 Installation of CHP

By implementing an on-site Micro CHP the energy demand and CO_2 emissions can be improved to meet the criteria set out in Policy EN6 demonstrating a 15% improvement over the baseline.

	LZC and Renewable Technologies						
Technology	Categories rated from 1 (very poor) to 5 (very good)				Capital Cost £	Cost per kg of CO_2 saved	Overall rating
	Capital Cost	Payback Period	Maintenance Requirement	Carbon Savings			
Micro CHP	5	5	1	5	£50,000	£2.17 kgCO_2	4

Table 15: Micro CHP feasibility

The full quota of waste heat is unlikely to be utilised. There is limited plant space available to install generators buffer vessels and flue. This makes this technology difficult to implement, therefore it has been discounted as an option to pursue.

5.0 Low and Zero Carbon (LZC) Energy Generation

This section assesses the feasibility for each LZC technologies, the capital cost associated with the installation and the cost per kg of CO_2 saved to achieve the 15% reduction in CO_2 emissions from Part L (2010). In line with Policy EN6, the tables also rate the technology in terms of payback and maintenance requirements

5.1 Biomass

	LZC and Renewable Technologies						
Technology	Categories rated from 1 (very poor) to 5 (very good)				Capital Cost £	Cost per kg of CO_2 saved	Overall rating
	Capital Cost	Payback Period	Maintenance Requirement	Carbon Savings			
Biomass	3	4	2	3	£95,000	£4.13kgCO_2	3

Table 16: Biomass feasibility

There is limited plant space available for fuel storage. The availability of biomass fuel, and the difficulty of delivery of fuel mean Biomass has been discounted as an option to pursue.

5.2 Photovoltaics

	LZC and Renewable Technologies						
Technology	Categories rated from 1 (very poor) to 5 (very good)				Capital Cost £	Cost per kg of CO_2 saved	Overall rating
	Capital Cost	Payback Period	Maintenance Requirement	Carbon Savings			
PV	4	4	5	4	£66,000	£2.88 kgCO_2	5

Table 17: Photovoltaics feasibility

Due to the external elevations being of high historic significance a PV installation on the roof has been discounted as an option to pursue.

5.3 Solar Water Heating

	LZC and Renewable Technologies						
Technology	Categories rated from 1 (very poor) to 5 (very good)				Capital Cost £	Cost per kg of CO_2 saved	Overall rating
	Capital Cost	Payback Period	Maintenance Requirement	Carbon Savings			
Solar Water heating	1	4	3	2	£184,000	£8.01 kgCO_2	3

Table 18: Solar water heating feasibility

The hot water demand is likely to be insufficient to warrant the size of system required to meet the CO_2 reduction and due to the external elevations being of high historic significance a solar heating installation on the roof has been discounted as an option to pursue.

5.4 Heat Pumps

	LZC and Renewable Technologies						
Technology	Categories rated from 1 (very poor) to 5 (very good)				Capital Cost £	Cost per kg of CO_2 saved	Overall rating
	Capital Cost	Payback Period	Maintenance Requirement	Carbon Savings			
ASHP	3	3	3	2	£130,000	£5.68 kgCO_2	2

Table 19: Heat pumps feasibility

The size of Heat pump required to meet the CO_2 reduction requirement and lack of available plant space for heat pumps discounts this as an option to pursue.

5.5 Wind Turbines

	LZC and Renewable Technologies						
Technology	Categories rated from 1 (very poor) to 5 (very good)				Capital Cost £	Cost per kg of CO_2 saved	Overall rating
	Capital Cost	Payback Period	Maintenance Requirement	Carbon Savings			
Wind	1	3	3	3	£140,000	£6.18 kgCO_2	3

Table 20: Wind turbines feasibility

Planning issues such as noise, shadow flicker, visual impact mean wind turbines have been discounted as an option to pursue.

6.0 Summary of Results

Following the Energy Statement methodology set in EN6, the baseline information has been set and a proposed heating strategy utilising a community heating scheme with central boiler scheme initially selected. The feasibility of central plant will need to be assessed during subsequent design stages.

An assessment has been carried out to identify the most feasible provisions for upgrading thermal elements to the existing structure. Existing U-values have been estimated and target U-values proposed for the building for assessment against Policy EN6.

This fabric first approach estimation could achieve a 36% reduction in carbon.

Table 21 shows the available LZC technologies and a rating on their viability for the project in which they could be utilised. CHP was the most viable and cost effective solution but was discounted due to limited plant space and building constraints. In order to make CHP cost effective as per Table 21 then the full quota of waste heat must be utilised and this is not possible in a residential project where the loads are not constant and are unpredictable.

LZC and Renewable Technologies						
Technology	Categories rated from 1 (very poor) to 5 (very good)				Cost per kg of CO_2 saved	Overall rating
	Capital Cost	Payback Period	Maintenance Requirement	Carbon Savings		
Solar Thermal	1	4	3	2	£8.01 $kgCO_2$	3
ASHP	3	3	3	2	£5.68 $kgCO_2$	2
Biomass	2	4	2	3	£4.13 $kgCO_2$	3
Wind	1	3	3	3	£6.18 $kgCO_2$	3
PV	5	5	5	5	£2.88 $kgCO_2$	5
CHP	5	5	5	5	£2.17 $kgCO_2$	5

Table 21: Summary table of available LZC technologies & their viability

Table 22 compares the existing buildings' energy demand without any improvements to the thermal elements against upgraded elements resulting in a potential 36% reduction in energy demand and CO_2 emissions which satisfies the Part L1B requirement and the fabric first approach to complying with EN4.

Energy Strategy Summary Table				
	Energy Demand (kWh/year)	Energy Reduction Achieved (%)	Regulated CO_2 emissions ($kgCO_2$/year)	CO_2 reduction achieved (%)
Existing Building (Using estimated U values for thermal elements)	**1371,109**		**241,545**	
Building Regulations Part L1B Baseline energy demand and Emissions (all upgraded elements)	**873,898**	36% (from existing)	**153,457**	36%(from existing)

Table 22: Energy strategy summary

7.0 Proposed Design – A Fabric First Solution

Given the historic significance of the building and the difficulties of incorporating renewables into buildings of this type, the proposed design solution should adopt the "fabric first" approach.

1. By adopting a passive design ethos significant improvement can be realised. This includes aspects such as improved insulation standards, use of natural ventilation, better area to volume ratio, and low air permeability (leakage). The fabric improvements and the addition of secondary glazing are predicted to deliver an emissions reduction of 36% compared to if the building fabric and glazing were not upgraded and remained. New build town houses will require highly insulated and air better air tightness exceeding the requirements of Part L1A 2013.

2. The provision of efficient building services and A+ rated appliances and fixtures and fittings, such as white goods, high efficiency lighting, demand controlled ventilation and heating strategies.

3. Supply energy from low or zero carbon technologies. This should only be considered as a final measure and may be not viable due to capital cost of implementation and insufficient area available.

4. It should be noted that Low or zero carbon (LZC) and renewable technologies have been considered in terms of practical, technical, functional and economic viability within the report and have been discounted at this stage.