Bolton College

Renewable and Sustainability Planning Report

October 2023

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Quality Assurance – Approval Status

This document has been prepared and checked in accordance with
Waterman Group's IMS (BS EN ISO 9001:2015, BS EN ISO 14001:2015 and ISO 45001:2018)

Issue	Date	Prepared by	Checked by	Approved by
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1	16/10/23	Tim Davies Director	Nuala Maguire Technical Director	Tim Davies Director

[redacted]

Comments

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Content

1. Introduction

This report outlines the renewable and sustainable energy design proposals for the new build building at the existing Bolton College campus site. The report sets out the approach that has been taken with the design to meet the Local Planning Application requirements, minimising the energy use of the building through passive and active measures and incorporating renewable technologies to further reduce the carbon emissions from the building. The report also addressed the design steps taken to allow the building to adapt to climate change in future years.

1.1 Bolton Council Core Planning Policies

The building has been assessed against the following Bolton Council Core Strategy Policy CG2.2, and the following report outlines how each has been met, summarised below and in the following document text.

1. Prior to commencement of development a scheme, including a timetable for implementation, shall be submitted to and approved in writing by the local planning authority demonstrating a minimum reduction of 10% of carbon emissions (to be calculated by reference to a baseline for the predicted carbon emissions of the development as defined in the Building Regulations Part L standards current at the time of commencement of development) through the use of decentralised, fabric first, renewable and/or low carbon technologies. Development shall be carried out and maintained thereafter in accordance with the approved scheme.

   Reason

   In the interests of tackling climate change and in order to comply with Bolton's Core Strategy policy CG2.2.

   Reason for pre-commencement condition

   The details of the low carbon technologies is required to be agreed with the Local Planning Authority prior to commencement in order to ensure that it is adopted in full throughout the construction period in order to achieve a minimum reduction of 10% carbon emissions.

Design Response:

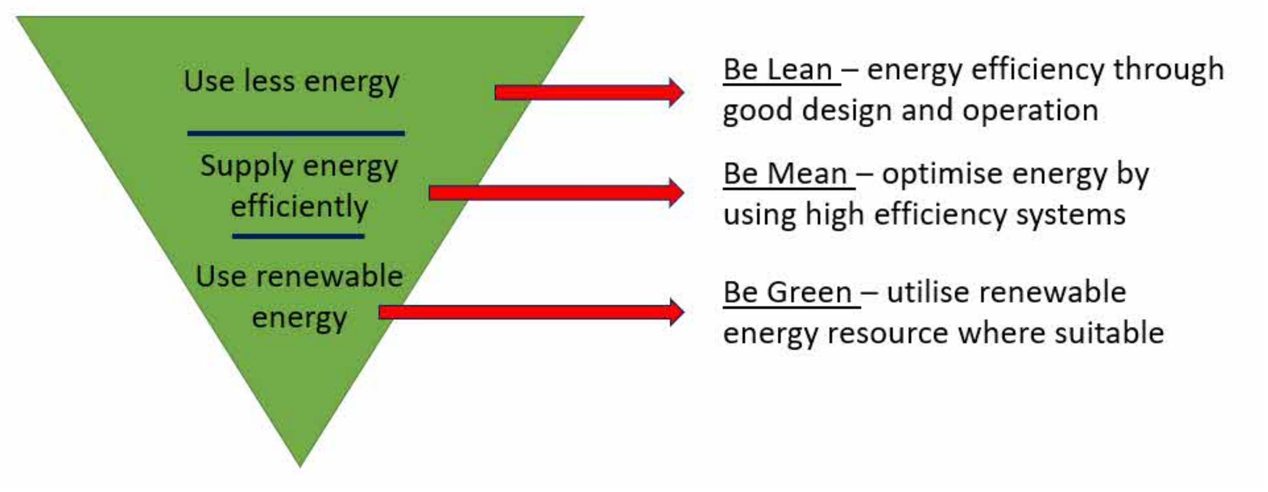
The following report demonstrates how the building has been developed to address the required elements of Policy CG2.2, outlining the passive design measures such as solar shading, natural ventilation measures, free cooling and daylight, fabric and material choices. The report also addresses how the building can be modified simply in the future to maintain a comfortable environment, by adapting to changes in the external climate.

2. The Approach to Sustainability

This section outlines the project's approach to sustainable design and presents the design proposals for achieving an energy efficient building.

2.1 The Energy Hierarchy

The Energy Strategy for the proposed development has been progressed on the well-founded approach that is often referred to as a the "lean, mean, green" approach. The lean, mean, green strategy applies throughout the development and the specific solutions have been analysed and are summarised in the sections below.



2.2 Energy Conservation Measures to be Taken

The energy conservation measures ("Lean" Solutions) proposed for the building, include the following

Improving thermal insulation. Wall, roof, floor & glazing provide 'U' values, significantly better than Building Regulation standards.

Proposed U-values:-
External wall - 0.17 W/m²k
Roof – 0.12 W/m²k
Floor – 0.12 W/m²k
Window – 1.1 W/m²k
Door – 1.13 W/m²k

Improving airtightness. Air tightness standards are significantly better than Building Regulations and will provide large energy savings to heating and cooling.

Proposed Air Permeability 3m³/hm²@50Pa

Optimising daylighting. Providing generous glazing to the function spaces to enhance daylighting

Low water demand appliances. Careful specification of the sanitaryware is required to minimise water demand and hot water heating energy.

Improving services thermal insulation.

Control of solar gains using high efficiency glazing

Proposed Glazing G-Value – 0.39

Passive natural ventilation systems, coupled with night cooling and thermal mass

2.3 Energy Measures to be Taken

The energy efficiency measures ("Mean" Solutions) for the building will include

Lighting. Use of high efficacy LED lighting in all areas.

Daylight dimming. Rooms with high daylight factors will be provided with automatic dimmable luminaires under photocell control.

Lighting Control. Use of automatic lighting control provided where possible and in line with room use to ensure lights are on only when demand dictates – including presence detection and absence detection

Heating, Ventilation System Controls. To ensure that the plant runs efficiently, and rooms are only conditioned when occupancy dictates.

Heat recovery on ventilation plant to recover energy from exhaust air paths.

Metering. Provision of meters to aid the energy management of energy including power, lighting and heating.

Building Management System. Automatic controls that allow the energy in spaces, to be controlled and switched off when the room is not occupied, plant operation to be monitored and plant failure to be quick identified.

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3. Proposals for LZC Technologies

A number of low and zero carbon technologies have been considered. A summary of technologies considered are included within Appendix ‘A’. To maximise the betterment on Part L and comply with the planning sensitivities of the listed building, the following LZC technologies are proposed:

Air Source Heat Pumps (ASHP) for heating for the building.

3.1 Air Source Heat Pumps

An ASHP system shall be utilised to provide heating within the new building. It is proposed that the air source heat pump condensers shall be located within an external plant compound adjacent to the building, below the external escape stairs. Whilst the exact requirement will be set by the final design, it is anticipated that two heat pump units will be installed to serve the buildings heating requirements for the radiator heating system to the common areas and two further VFR heat pumps for the teaching area heating requirements.

4. CO2 Emissions

The scheme has been modelled and the energy demand and carbon dioxide emission assessments have been carried out using the National Calculation Method outlined in the building regulations Part L2A 2021 BRUKL assessment.

The design of the building has achieved the required compliance of the BRUKL carbon emission and this is demonstrated within tables and by the initial planning stage BRUKL document for the scheme shown below.

Building	**Target Emission Rate ($kgCO_2/m^2$.annum)**	**Building Emission Rate ($kgCO_2/m^2$.annum)**	**Part - L Improvement (%)**
Bolton College	5.33	4.67	12.38

BRUKL Document

The following extract shows the as designed BRUKL document output.

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BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Bolton College - 2021 improved roof slab glazing walls air perm

As designed

Date: Thu Aug 24 08:57:12 2023

Administrative information

Building Details

Address: Deane Road Campus,, Bolton, BL3 5BG

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.22

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.22

BRUKL compliance module version: v6.1.e.1

Certifier details

Name: Waterman Group

Telephone number: Phone

Address: Street Address, City, Postcode

Foundation area [m²]: 346.86

The CO_2 emission and primary energy rates of the building must not exceed the targets

Target CO_2 emission rate (TER), $kgCO_2/m^2annum$	5.33	
Building CO_2 emission rate (BER), $kgCO_2/m^2annum$	4.67	
Target primary energy rate (TPER), kWh_{PE}/m^2annum	57.24	
Building primary energy rate (BPER), kWh_{PE}/m^2annum	50.07	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	0.17	0.17	SP00000B:Surf[1]
Floors	0.18	0.12	0.12	SP00000B:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	0.12	0.12	SP00002C:Surf[1]
Windows** and roof windows	1.6	1.1	1.1	SP000002:Surf[1]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	1.13	1.13	SP00002C:Surf[3]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

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

* 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.

*** Values for rooflights refer to the horizontal position.

^ For fire doors, limiting U-value is 1.8 W/m²K

NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
m³/(h.m²) at 50 Pa	8	3

5. Adaption to Climate Change

The building has been developed to address the required elements of future climate chnage. This has been provided by a series of staged measures that have been applied to all elements of the building design, including such passive design measures such as solar shading, natural ventilation measures, free cooling and daylight, fabric material choices and green walls, all of which are outlined below. The design has also addresses how the building can be modified simply in the future to maintain a comfortable environment, by adapting to changes in the external climate.

The main principals of passive design that have been applied to this proposed building, in order to provide good indoor environmental comfort (temperature, air quality, etc), as well meet the appropriate construction standards are set out below.

Temperature / Air Strategy:

- The building has been developed to maximise, where possible, the daylight potential to the spaces to maximise the ability to harness light and reduce the electrical energy consumption of the artificial lighting systems.
- The specification of the glazing system has been carefully appraised and selected to ensure that the benefit gained from the high levels of glazing is not lost due to a high solar load. This is particularly the case with the entrance atrium glazed façade. The requirements for solar control to meet the building energy targets, occupant comfort and Part L2A solar overheating requirements has been ensured by the selection of a glazing system that achieved a high light transmission rate whilst also achieving a low g-value and solar gain rate.
- The concept design stage has been developed and centred around the proposal that the building shall be ventilated wherever possible by hybrid natural ventilation with some areas of fully mechanical ventilation where the situation dictated, such as toilet areas.
- With the provision of hybrid natural ventilation to the building, the potential use of night cooling to pre-cool the building overnight can be implemented. This is best achieved by motorised ventilators providing a controlled ingress of cool night air into the building.
- The winter draught free ventilation provision is catered for by the proposed use of hybrid natural / mechanical ventilation heat recovery units (MVHR) to blend the incoming cold air with the warmer air at high level in the classroom, improving occupant comfort, making full use of the free heating and reducing overall heating loads.

Building fabric / form strategy:

- The building form is simple and has a low exposed surface area proportion to volume (has a good 'form factor'); this prevents excess heat loss.
- Building fabric insulation is appropriately specified and exceeds the current government standards.
- Good practice standards of design will be utilised to reduce thermal bridging and improve air tightness rating where possible.
- Building fabric apertures (windows / doors) will be deliberately set back from the outside face of the façade to the insulation 'thermal line' (reduced cold bridging in these key heat-loss risk areas)

Future Adaptability of the Building:

The current predictions for future climate change indicate that, due to the effects of global warning already instigated by the previous years of uncontrolled greenhouse gas emissions, the global climate will increase in temperature by several degrees during this century, and the current experienced temperatures are recorded as currently already having risen by 1ºC on average.

The impact this will have on the global climate, the local microclimate and therefore the proposed building itself cannot be definitively advised, however the general climate models all show that the local environment in which the building will reside will be warmer throughout the summer and the winter months and be liable to higher levels of intensive rainfall and storms.

Obviously, the predicted warmer winter conditions will benefit the building energy consumption by reducing the amount of energy required during peak period to warm the building. However, the warmer summer periods will mean that in order to maintain the current desired summertime maximum temperature levels, the building will potentially need to be modified in the future to maintain pace with the external climate.

It is envisaged that across the building lifetime, there are a number of areas where the building can be modified to achieve the desired adaption to ensure that the building can continue to be used and does not become obsolete. The below list of options is based on the current technology and system available on the market today, however it is envisaged that, as the climate changes and technology advances, newer systems, fabrics, construction techniques and live technologies such as nano-tech systems will be developed that will then provide further options for future development of the building. The important factor is for the buildings to be built today with the ability to incorporate the technology of tomorrow.

System	How can the system be incorporated into the building?	Can be included within the building (yes/no)
Relaxation of the current internal temperatures	As the external temperatures rise it is expected that the internal design temperatures will also rise as occupants become acclimatised to working within a warmer environment, therefore the building could be fully operational in a warmer environment without any further modifications due to natural changes in the occupant's comfort criteria.	Yes
Improvement of the façade performance	The existing building is a proposed as a steel framed construction therefore the façade can be removed and replaced in future years with a newer and more technologically advanced, higher performing façade to provide sufficient extra benefit to offset the changes in climate	Yes
Improved ventilation	Along with the modifications to the external façade, the openable natural ventilation areas can be increased at the same time to improve the level of natural ventilation provision to the rooms and building to offset the changes in the climate.	Yes

Phase change materials	Additional thermal mass can be retrofitted into the building to improve the performance of the night cooling. Simple phase change material sheets or blocks can be installed around the building and rooms to increase the level of stored energy coolth that can then be released throughout the next day.	Yes
Limiting gains from lighting and equipment	Both installed lighting systems and equipment have both a limited lifespan and a continued development to reduce the energy consumed by their use. These developments will continue such that when these systems are due to be replaced in 15 to 20 years' time, the new installations will be more energy efficient and therefore will naturally aid in the efforts to combat the effects of the climate change.	Yes
Mixed mode ventilation	The effectiveness of the natural ventilation systems will decrease as the external temperatures rise, however there is the ability to start to introduce at this stage boost extract fans to assist the natural ventilation strategies as local systems in each room.	Yes

6. Conclusions

Preliminary calculations of the energy demand and carbon dioxide emissions have been carried out using the National Calculation Method outlined in the building regulations Part L2A 2021 BRUKL calculation software.

Energy efficient design techniques have been adopted to ensure that passive design measures are maximised in the first instance as follows

- Low U-values
- Low air permeability
- Passive measures including natural ventilation

Low energy lighting, energy efficient controls and high efficiency plant selection have been incorporated to reduce carbon dioxide emissions of the proposed development.

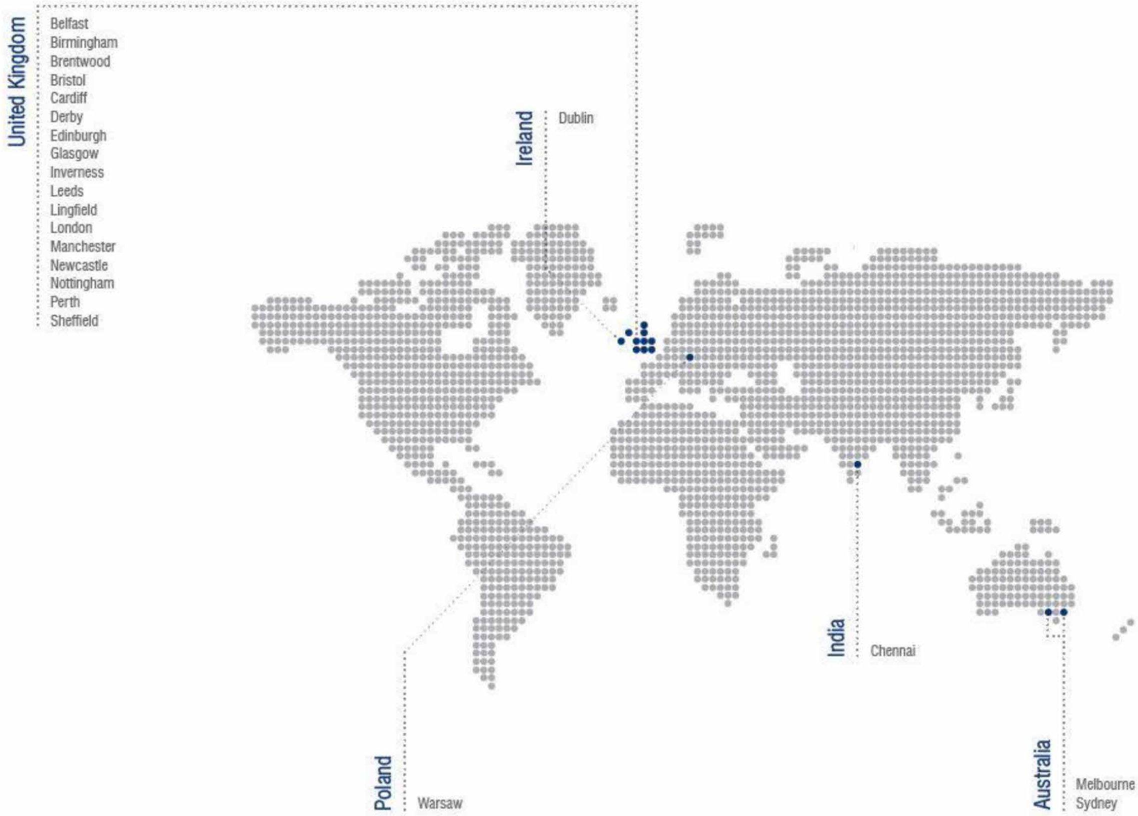
The use of low and zero carbon technologies also supplement the scheme with the proposed use of air source heat pumps. The review looked at the possibilities for including further LZC technologies but these were discounted.

The result of this combined approach is that the design has been shown to achieve a 12.38% betterment of the Building Regulation emissions, exceeding the requirements of Core Policy CG2.2.

Appendix A - Renewable Technologies Considered

The following table summarises the LZC technologies considered for this project.

Sustainable Design Option	Suitability for site	Reason for acceptance or rejection of option	Export of energy feasible?	Cost for Carbon Emission Reduction
Biomass boiler	No	Site location (close to housing) and logistics (e.g. fuel stores and flue emissions) preclude this option	No	High
Ground source heat pumps	Yes	Made up ground conditions anticipated as being restrictive to operational efficiencies	No	High
Air source heat pumps	Yes	Suitable for site logistics and application	No	Medium
Bio-diesel Generator	No	Site location (close to housing) and logistics (e.g. fuel stores and flue emissions) preclude this option	No	High
Solar water heating	No	Insufficient hot water demand within the building	No	Medium
Photovoltaic cells	Yes	PV cells can be incorporated but were not necessary to meet target emissions	Yes – can be linked to grid electricity	Medium
Combined heat and power plant	No	Insufficient base heat demand	No	Medium
Hydro-power	No	No local water courses	No	High



*Project Office