



**Boddingtons -
Manchester**

Energy Statement

DN0107-WW-ZZ-ZZ-RP-CS-00002

November 2021



LATIMER
by Clarion Housing Group

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Appendix A - SBEM & SAP

Issue / Revision Record

Issue	Date	By	Checked	Comment
1	23.11.21	MG	FTC	Draft
2	24.11.21	MG	FTC	For Planning
3	03.12.21	FTC	SOH	Additional Comments Incorporated.

Executive Summary

The Energy Statement has been prepared by Wallace Whittle on behalf of Clarion Housing Group to support a full detailed planning application for a phased development comprising:

- Erection of two buildings to create a mixed-use development comprising residential uses (Use Class C3) with commercial uses (Use Class E) provided at the ground floor level, together with a new courtyard pocket park, landscaping, cycle parking, accessible parking spaces, highways work, access arrangements, and other associated works.

This Energy Statement has been prepared to support the planning application. Development quantum (refer to accommodation schedule for further details):

- 461 total apartments
- 938 sqm (GIA) of ground floor commercial and community floorspace

This Statement is based on the client approved strategy submitted at RIBA Design Stage 3. And demonstrates how the proposals will comply with the objectives of Manchester City Council Local Plan: Core Strategy in terms of energy and Carbon emissions reduction targets. These are set out in section 2 below.

The calculations supporting the Energy Statement were undertaken to assess the site's carbon dioxide (CO₂) emissions and to identify the most appropriate energy efficient solutions and appropriate low and zero carbon technologies.

Based on these calculations, the Energy Statement has been written in compliance with Manchester City Council Local Plan: Core Strategy. The Energy Hierarchy stages of 'Be Lean', 'Be Clean' and 'Be Green' (illustrated in the figure below) are set to maximise the reduction of Carbon Dioxide (CO₂) emissions of the proposed scheme. 'Be Lean', incorporates passive design measures and assesses energy efficient equipment for 'unregulated' emissions. 'Be Clean', incorporates the efficient supply of energy within a development and 'Be Green' incorporates the use of low and zero carbon generating technologies into a development.



Image 1 – Energy Hierarchy

The Energy Statement demonstrates that the proposed scheme is compliant with the local energy policy requirements through the combination of the 'Be Lean', 'Be Clean' and 'Be Green' measures.

The 'Be Lean' design measures include; U-values, glazing g-values, and air permeability rates which are performing better than the notional model under Part L1A 2013 (as amended 2016). Furthermore, the incorporation of A+ rated white goods will reduce 'unregulated' emissions. Further Part L1A 'Be Lean' SAP calculations are appended in this report to demonstrate compliance with Part L1A 2013 (as amended 2016).

'Be Clean' technologies include exploring a connection to an existing or new district heat network. This has been reviewed but has been deemed unfeasible because the site is not located within close proximity of any district heating networks.

'Be Green' technologies include exploring the integration of various renewable technologies into the proposed scheme's design. It has been identified that currently the most practical technology is Solar Photovoltaics (PV) and Low Carbon Air Source Heat Pumps (ASHP) for hot water. PV provision has been maximised to allocate approximately 36kWp (175m² array) to serve the Domestic elements of the development.

The application of the PV array and ASHP hot water in combination with the 'Be Lean/Be Clean' design measures, would result for a total estimated Carbon Dioxide reduction of 40.10% against a Part L 2013 baseline compliant building when assessed through passive and energy saving technologies.

Table 1 presents the predicted CO₂ savings for the combined site 'domestic & non-domestic' wide assessment (regulated SAP and SBEM emissions):

Energy Hierarchy	Total Regulated CO2 Emissions (Tonnes CO2/Yr)		
	Domestic	Non-domestic	Site Wide
A - Baseline Emissions of Development (pre-improvement)	637	30	667
B - Be Lean	642	28	670
C - Be Clean	642	28	670
D - Be Green	377	25	402
E - Total Reduction in Carbon (KgCO ₂ /yr) from Baseline	260	5	265
F - Percentage Improvement in Carbon Emissions (above Building Regs ADL1A 2013)	40.83%	17.10%	39.77%
C-D - Percentage Contribution from LZC Technologies.	41.29%	13.00%	40.10%

Table 1 – Summary of CO₂ emissions reductions (as calculated with SAP and SBEM)

1.0 Introduction

Wallace Whittle have been appointed to develop the energy strategy; mechanical, electrical, and public health services strategies; utilities assessments and vertical transportation appraisals for the new Domestic led mixed-use scheme at Former Boddingtons site, Manchester.

This Energy Statement has been prepared by Wallace Whittle on behalf of Clarion Housing Group. to support a full planning application for a phased development comprising:

- Erection of two buildings to create a mixed-use development comprising residential uses (Use Class C3) with commercial uses (Use Class E) provided at the ground floor level, together with a new courtyard pocket park, landscaping, cycle parking, accessible parking spaces, highways work, access arrangements, and other associated works.

The illustrative masterplan is shown below:



Image 2 – Site Plan

The purpose of this report is to summarise the approach to energy conservation and the adoption of the low and zero carbon energy sources (LZC) for the development in response to the planning objectives of Manchester City Council Local Plan: Core Strategy in terms of energy CO₂ reduction targets. In particular, the following policies apply:

- Core Strategy Policy EN4 - Reducing CO₂ Emissions by Enabling Low and Zero Carbon Development.
- Core Strategy Policy EN5: Strategic Areas for low and zero carbon decentralised energy infrastructure
- Core Strategy Policy EN6 – Target Framework for CO₂ Reductions from Low and Zero Carbon Energy Supplies.
- Core Strategy Policy EN7 – Promote use of Energy infrastructure opportunities
- Core Strategy Policy EN8 – Adaptation to Climate Change.

This statement provides a summary of the mechanical, electrical and public health (MEP) systems and requirements to provide a fully serviced scheme across both phases of the site in line with the requirements of Manchester City Council Core Strategy. The proposed scheme layout, engineering systems and the provision of energy services have been designed for each dwelling with low carbon and passive measures approach being adopted.

A range of energy low and zero carbon generating technologies have been appraised as potential on-site energy regeneration in relation to the proposed development. These comprise:

- Solar Hot Water
- Solar Photovoltaics
- Biomass heating
- Ground Source Heat Pumps
- Air Source Heat Pumps
- Fuel cells
- Wind turbines
- Combined Heat and Power (CHP)

1.1 Site and Surroundings

The proposed development is located on a former industrial brownfield site formerly the Boddington brewery site. Most of the site has been cleared with existing buildings surrounding the site occupied and in situ. Great Ducie Street, a main arterial route out of Manchester, is located to the west of the site. The site is within walking distance of Manchester City Centre.

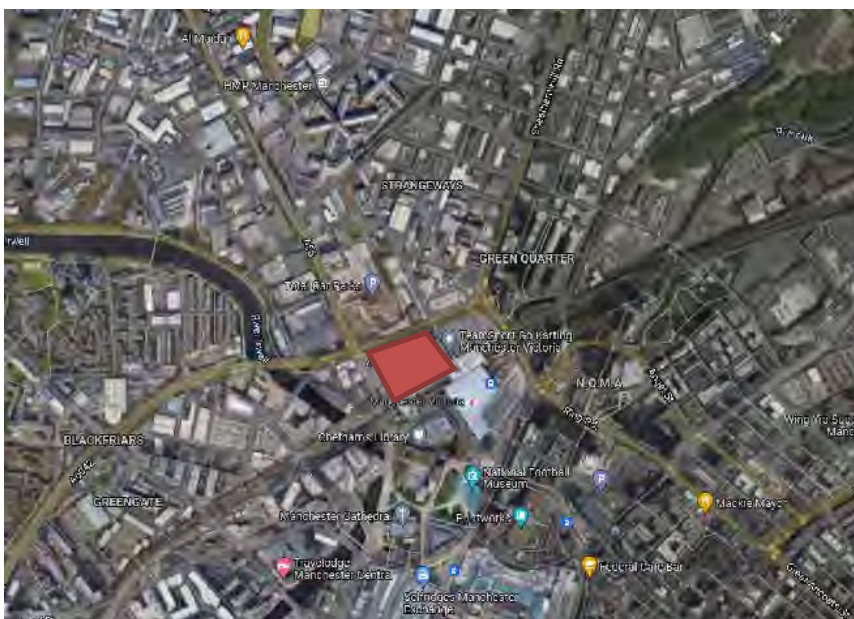


Image 3 - Site Plan

1.2 Development Description

This Energy Statement has been prepared to support the Full Planning Application (the application) comprising of:

Development quantum (refer to accommodation schedule for further details):

- 461 total apartments.
- 938 sqm (GIA) of ground floor commercial and community floorspace.

1.3 Objectives

The objective of this statement is to demonstrate how the proposed design for the development complies with the Manchester Local Plan: Core Strategy, promotes sustainable development, energy and CO₂ savings as detailed in Section 2.0 of this report and follows the agreed energy strategy for the Former Boddington site development “The Development”.

1.4 Limitations

This report has been prepared based on the current knowledge of the proposed scheme. Whilst the information used is taken from the planning drawings, the final performance will be dependent on the final commissioning results and actual operation of the building.

The Domestic and non-Domestic areas use a Notional and Actual Building calculation methodology as set out in the Government’s Standard Assessment Procedure (SAP2012) and Simple Building Evaluation Method (SBEM) operational parameters as required by Building Regulations - Part L1A/2A 2013. This allows a ‘like for like’ analysis under the Building Regulations. The results presented in this report are therefore not valid for ‘Real’ building operation.

An overheating assessment has been completed for Block A and B using Dynamic Simulation Modelling (DSM) software. Dynamic thermal simulation is a sophisticated form of building energy modelling. IES DSM software has been used, which is government approved Part L simulation software.

2.0 Policy and Legislative Compliance

This statement provides a response to the Manchester City Council Core Strategy Development Plan 2012 and Building Regulations relating to reduction of CO₂ emissions and energy use. This section presents the targets set out by the local planning and regulatory frameworks.

2.2 Planning Policy Core Strategy Policy EN 4

Reducing CO₂ Emissions by Enabling Low and Zero Carbon Development: This policy targets the reducing of CO₂ emissions through following of the Energy Hierarchy framework; firstly, reducing the need for energy through efficient design measures, followed by clean energy and lastly, the application of renewable or LZC technologies.

Core Strategy Policy EN 5

Strategic Areas for low and zero carbon decentralised energy infrastructure: This policy encourages applicable developments, should give detailed consideration to the role of low and zero carbon infrastructure and decentralized energy networks, where feasible.

Core Strategy Policy EN 6

Target Framework for CO₂ reductions from low or zero carbon energy supplies: This Policy requires electricity intense residential development of 10 or more units to meet, as a minimum, a 15% reduction in CO₂ emissions over Part L Building Regulations.

Core Strategy Policy EN 7

Energy infrastructure opportunities: This policy encourages mayor developments to use low and zero carbon decentralised energy schemes.

Core Strategy Policy EN 8

Adaptation to Climate Change: All new developments to be adaptable to climate change in terms of its design, layout, siting, and function of both building associated external spaces.

2.2 Building Regulations Targets

The proposed development will be required to comply with the UK Building Regulations Part L: Conservation of Fuel and Power; In new dwellings Part L1A applies and Part L2A for all non-domestic areas.

This report covers Building Regulations compliance for the domestic and non-domestic elements of the proposed development. All CO₂ emissions calculations and results presented in this document were obtained through UK Building Regulations approved calculations methodologies.

3.0 Calculation Methodology

The following section describes the methodology and software used to assess the regulated energy performance of the development in line with Manchester Local Plan: Core Strategy.

3.1 Methodology for Dwellings (SAP) & Non-Dwellings (SBEM)

The Standard Assessment Procedure (SAP) and Simple Building Evaluation Method (SBEM) is an analysis process used to accurately estimate the environmental impact and energy consumption of a dwelling/ non-dwelling so it can be assessed and compared with other dwellings/buildings. And it is used to demonstrate compliance with the UK Building Regulations Part L Conservation of Fuel and Power. SAP and SBEM calculates the Target Emissions Rate (TER) and Dwelling/Building Emissions Rate (DER/BER) and then assesses the dwelling/building performance based on these calculations. Building Regulations state that each building must have a (DER/BER) that equals or is lower than the (TER).

SAP/SBEM quantifies a dwelling or building performance in terms of: energy use per unit floor area, a fuel cost based energy efficiency rating (the SAP rating) and CO₂ emissions. It takes into account the energy needed to provide space heating, lighting, domestic hot water and cooling systems as well as estimating the heat loss through construction materials. The reports generated by SAP/SBEM will provide engineers and architects with information to ensure that dwellings/buildings are built to the required efficiency standards. Importantly the calculations done at these early stages can be taken forward into full building regulations if the planning application is successful.

SAP 2012/ SBEM software has been used for calculations within this assessment for Part L1A/2A 2013 compliance. New SAP10 and SBEM carbon factors will be introduced in 2022 however this new methodology will only be used once the Building Regulations Approved Document L is next updated (Scheduled for June 2022 with a 1-year transition period). For this reason, SAP 2012 and SBEM, as above mentioned, has been used as it is the Government's Standard Assessment Procedure used for Building Regulation compliance purposes.

3.2 SAP/SBEM Weather Data

Following the Energy Performance Certificate conventions for conducting energy assessments, due to the location of the development the SAP weather profile 'North West Region' has been selected for the dwellings within the SAP 2012 /SBEM software.

3.3 Dynamic Simulation Modelling (DSM)

The non-domestic element of the proposed development compliance with Part L2A has been completed using the Dynamic Simulation Model (DSM). IES Version 2021 DSM software has been used to complete this assessment, it must be noted that this software is an approved National Calculation Method (NCM) simulation software.

This methodology can base its performance calculations upon incremental time steps as low as 1 minute. This allows realistic variations in fabric thermal storage (thermal mass effects), weather conditions, occupancy, internal and solar gains to be taken into account and their implications upon building/plant operation to be modelled effectively.

DSM uses zone specific operational profiles (occupancy, lighting, ventilation and domestic hot water (DHW) demand) and heating, ventilation and air conditioning (HVAC) plant performance data to effectively model and predict the energy performance of a building.

The 3D geometry and building construction materials were modelled based on the architectural plans and elevations. The 3D model describes the building:

- Orientation
- Geometry of building form and all associated exposure of surfaces
- Material constructions

- Windows and glazing
- The 3D geometry has been subdivided into generic zone types as per the National Calculation Method (NCM) requirements.



Image 4 - Model snapshot (artist impression)

This comprehensive approach is considered best practice for assessing building non-domestic energy performance.

3.4 Dynamic Weather Data

To accurately model the dynamic nature of the buildings' thermal response, hourly recorded weather data is used in dynamic thermal simulations. Such weather data contains records of radiation, temperature, humidity, sunshine duration and additionally wind speed and direction.

A CIBSE weather file Test Reference Year (TRY) for Manchester was used for the Part L2A compliance analysis as per the National Calculation Method requirements.

CIBSE weather files DSY 1, 2 & 3 weather files for Manchester have been used for this overheating analysis as per the TM49, TM52 and TM59 Calculation Method requirements.

3.5 Overheating

In response to Core Strategy Policy EN 8: Adaptation to Climate Change. A dynamic overheating analysis has been conducted on the proposed Block A and B. Proposed schemes are required to adopt measures that reduce the demand for artificial cooling as follows:

- Minimising internal heat generation through energy efficient design.
- Reducing the amount of heat entering the building during the summer.
- Use passive ventilation.
- Use mechanical ventilation.

Wallace Whittle's Dynamic Overheating Assessment details the methodologies used in assessing the overheating potential of the scheme and identifies possible overheating risk areas and design strategies for overheating reduction. All recommendations from the Dynamic Overheating Assessment have been adopted by the design team to mitigate any overheating risk to the proposed scheme.

Domestic overheating has not always been a problem in the UK but climate change, increased urbanisation, construction of high-rise apartment blocks and winter energy efficiency measures have all contributed in the amplification of high internal temperatures.

A CIBSE weather file DSY 1 (2020) for Manchester has been used for this analysis. DSY2 and DSY3 weather files have also been used.

The overheating performance for the development has been assessed at a high level against CIBSE TM49, TM52 and TM59 Design methodology for overheating in homes which contains three criteria for overheating in Domestic developments:

- a) *For living rooms, kitchens and bedrooms:* the number of hours during which ΔT is greater than or equal to one degree (K) during the period May to September inclusive shall not be more than 3% of occupied hours.
- b) *For bedrooms only: the guaranteed comfort during the sleeping hours the operative temperature in the bedroom from 10pm to 7am shall not exceed 26°C for more the 1% of annual hours.*
- c) For homes predominantly mechanically ventilated. All occupied rooms should not exceed an operative temperature of 26°C for more than 3% of the annual occupied hours (CIBSE Guide A 2015a).

The results indicate that the dwellings will typically comply with the parameters above and any short periods of exceedance are within tolerance. Refer to DN0107-WWL-XX-XX-RP-CS-006 for full details on the overheating assessment carried out for the proposed site.

4.0 Energy Consumption and CO₂ Emissions

The 'Baseline' energy consumption and CO₂ emissions are based on the entire site emissions of the proposed development scheme. The planning policy context advocates the following Energy Hierarchy to ensure that carbon requirements are met in the most efficient manner when assessed against Part L of Building Regulations 2013.



Image 5 - Calculation of energy/carbon dioxide savings

The images above show the amount of CO₂ that can be saved through adopting each stage of the energy hierarchy when assessed against Part L 2013 of the Building Regulations.

4.1 Calculating the Baseline Scenario

The 'Baseline' energy consumption and CO₂ emissions are based on the site emissions of the proposed development. The baseline is the Target Emission Rate (TER) as defined by prescribed Government approved software SAP and SBEM.

The CO₂ emissions were calculated using Government approved software to generate the 'target' emissions for the Domestic elements as dictated by the Building Regulations Part L1A 2013. Non-Domestic elements are dictated by Part L2A 2013 of the Building Regulations. The combined results were used to form the baseline for the entire site against which savings are to be calculated.

Table 6 below shows the SAP 2012 performance of a range of dwelling types across the development. The baseline Domestic figures have been taken from these results.

Our Ref	Plot No.	No of Type	Area/ plot m ²	TER kgCO ₂ /m ² /yr	2012 CO ₂ Emissions kgCO ₂ /pa
Z42502	Type 1.1	1	52.01	28.78	1,498
Z47503	Type 1.2	5	50.43	27.82	7,010
Z47504	Type 2.2	2	65.16	23.23	3,023
Z47505	Type 2.4	2	62.22	25.64	3,186
Z47506	Type 2.6	1	64.95	25.89	1,682
Z47507	Type 3.1	1	88.41	23.58	2,086
Z47508	Type 2.8	2	72.38	22.89	3,315
Z47509	Type 2.8	2	71.96	26.15	3,771
Z47510	Type 1.1 -Mid	8	52.01	24.11	10,028
Z47511	Type 1.2 -Mid	50	50.43	23.22	58,499
Z47512	Type 2.2 -Mid	28	65.16	19.23	35,030
Z47513	Type 2.4 -Mid	18	62.22	21.33	23,855
Z47514	Type 2.6 -Mid	28	64.95	21.49	39,100
Z47515	Type 3.1 -Mid	14	88.41	18.88	23,393
Z47516	Type 2.8 -Mid	48	72.38	18.73	64,968
Z47517	Type 2.8 -Mid	38	71.96	21.69	59,338
Z47518	Type 1.1 -Top	1	52.01	29.90	1,555
Z47519	Type 1.2 -Top	8	50.43	28.09	11,337
Z47520	Type 2.2 -Top	6	65.16	23.53	9,188
Z47521	Type 2.4 -Top	4	62.22	26.63	6,620
Z47522	Type 2.6 -Top	2	64.95	26.38	3,429
Z47523	Type 3.1 -Top	1	88.41	24.57	2,175
Z47524	Type 2.8 -Top	4	72.38	23.21	6,717
Z47525	Type 2.8 -Top	6	71.96	27.11	11,701
Z42526	Type 2.1	4	63.14	28.55	7,223
Z42527	Type 1.2	3	50.95	25.45	3,898
Z42528	Type 1.3	6	49.53	28.05	8,351
Z42529	Type 2.5	2	66.46	25.36	3,376
Z42530	Type 2.9	1	63.42	26.62	1,687
Z42531	Type 2.10	1	79.74	22.97	1,834
Z42532	Type 2.1 -Mid	20	63.14	24.04	30,307
Z42533	Type 1.2 -Mid	20	50.95	21.33	21,705
Z42534	Type 1.3 -Mid	43	49.53	23.33	49,624
Z42535	Type 2.5 -Mid	36	66.46	20.90	50,005
Z42536	Type 2.9 -Mid	16	63.42	21.97	22,324
Z42537	Type 2.10 -Mid	18	79.74	18.60	26,697
Z42538	Type 2.1 -Top	2	63.14	29.54	3,725
Z42539	Type 1.2 -Top	3	50.95	25.70	3,928
Z42540	Type 1.3 -Top	2	49.53	28.34	2,803
Z42541	Type 2.5 -Top	2	66.46	25.73	3,416
Z42542	Type 2.9 -Top	1	63.42	27.25	1,731
Z42543	Type 2.10 -Top	1	79.74	39.66	1,882
Total					637,020

Table 5 - Calculation of baseline CO₂ emissions for the domestic development

Table 7 below shows the SBEM performance of a range of building types across the development.

The baseline figures have been taken from these results.

Baseline	Floor Area m ²	Total CO ₂ kg/m ² /yr	Regulated Total CO ₂ kg/yr
Commercial	164	31.6	5,182
Commercial	334	31.6	10,554
Commercial	254	31.6	8,026
Resi Entrance/ Co working	186	31.6	5,878
TOTAL	938		29,641

Table 6 - Calculation of baseline CO₂ emissions for the non-domestic development

Based on these modelling calculations the following Target Baseline emissions have been established for the proposed scheme as Table 8 below:

Energy Hierarchy	Total Regulated CO ₂ Emissions
	(KgCO ₂ /Yr)
A – Domestic Baseline Emissions of Development (pre-improvement)	637,020
G - Commercial Baseline Emissions of Development (pre-improvement)	29,641
M (A+G) – Total Baseline Emissions of Development (pre-improvement)	666,661

Table 7 - Calculation of total baseline CO₂ emissions for the domestic and non-domestic development

4.2 'Be Lean' Energy Efficiency Measures

The 'Be Lean' measures proposed will reduce the energy consumption and CO₂ emissions for the proposed scheme so that the proposed dwellings achieve a substantial reduction beyond Part L 2013 without the reliance on 'Be Clean and Be Green' measures. The proposed scheme has focused on 'lean' design measures by maximising the opportunities available in energy efficient design.

The 'Be Lean' measures include:

- Improved U-values beyond minimum Part L 2013 compliance
- Improved glazing g-values beyond minimum Part L 2013 compliance.
- Significant reduction in Part L 2013 Air Permeability levels
- Introduction of an air source heat pump on the domestic hot water system
- Lean design measures were applied to the baseline design to reduce the overall energy demands.

The following sections outline the proposed thermal fabric performance requirements to ensure compliance with both minimum Fabric Energy Efficiency (FEE) requirements of Part L1A 2013 and the 'Be Lean' requirements of the Energy Hierarchy and Core Strategy EN4 and 6 policies.

4.2.1 Proposed Fabric & Thermal Performance

The tables below present the proposed specific thermal and fabric performance requirements for all Domestic and non-Domestic units across all the plots to achieve Part L1A/2A 2013 compliance and to meet Manchester Core Strategy Policy EN4 and EN6:

Domestic Design Parameters

Element	Performance
Ground floor	0.10 W/m ² K
Upper heat loss floors to unheated spaces	0.15 W/m ² K
External wall	0.17 W/m ² K
Curtain Walling (where present)	1.0 W/m ² K
Exposed walls to risers	0.17 W/m ² K
Roofs	0.10 W/m ² K
Terrace Roofs	0.13 W/m ² K
Party Walls (Dwellings, Corridors and staircases)	Fully filled and appropriately sealed to qualify for 0.00 W/m ² K (heated circulation areas)
Windows (including frame)	1.50 W/m ² K, g-value 0.34 on all elevations
Mechanical Ventilation	MVHR Sentinel Kinetic on every plot. SFP<0.6, Heat Recovery>90%
Air permeability	3 m ³ /h.m ² @50Pa

Table 8 - Fabric Thermal Performance all Domestic Blocks

Non- Domestic Design Parameters

Element	Performance
Ground floor	0.10 W/m ² K
External walls	0.17 W/m ² K
Exposed walls to risers and unheated areas	0.17 W/m ² K
Main Roofs & Soffits	0.10 W/m ² K
glazing (including frame)	1.50 W/m ² K, g-value 0.34 on all elevations
Air permeability	3 m ³ /h.m ² @50Pa

Table 9 - Fabric Thermal Performance Non-Domestic blocks

The materials construction within the thermal models are all compliant with and exceed the notional U-values stipulated in the Building Regulations Part L 2013.

4.2.2 Part L1A 2013 – Fabric Energy Efficiency (FEE) rate

Specific attention should be given to compliance with Criterion 2 (Regulation 26A) of Part L1A 2013. This criterion concerns the average Fabric Energy Efficiency Rate (FEE) of each Domestic dwelling within the scheme and is assessed using SAP2012.

This regulation has been introduced into Part L1A 2013 to appropriately limit heat gains and losses through the building's structure by calculating the total CO₂ emissions arising from fabric performance. Similarly, to Criterion 1; the calculated Dwelling Fabric Energy Efficiency Rating (DFEE) rate must not be greater than the Target Fabric Energy Efficiency (TFEE).

The proposed fabric parameters confirm the Target Fabric Energy Efficiency Rating (TFEE) is achieved when assessed on an area weighted block average basis.

4.2.3 Domestic Party Wall Definition

The SAP conventions extract below outlines criteria that categorises the u-value of party walls between dwellings and other heated spaces based on their construction type.

#	Limitations	Topic	Conventions	Issue date
5.03		Party wall U-values	In the context of U-values, 'party wall' includes any wall between the dwelling and another heated space which can be: - another dwelling - commercial premises - a heated corridor or stairwell in a block of flats - a heated common area Note: A heated corridor is one with controlled fixed heaters. Heat from distribution pipes is to be disregarded. The only U-values at present for party walls are 0, 0.2 and 0.5. This applies to both flats and houses regardless of construction type (masonry, timber frame etc). U = 0.5 should be used for party walls unless documentary evidence is provided, in which case: A solid party wall has U = 0. To qualify for U = 0.2 (effective edge sealing): - the sealing must prevent air going in or out of any cavity - the sealing is required top and bottom and vertically. To qualify for U = 0: - any cavity must be sealed as above, and - any cavity must be fully filled Framed systems (timber or metal) may have more than one cavity.	Sept 2010 amended March 2011 amended October 2015

Table 10 - SAP Conventions

Our calculations have determined the party walls in the Domestic component of the development design must qualify for the 0.00 W/m²K U-value to demonstrate compliance with the criteria of Building Regulations Part L1A 2013 and with respect to the 'Be Lean' stage of the Energy Hierarchy. This is based on heated corridors and stair-cores.

4.2.4 Air Permeability

When entering the air permeability result into SAP for the Domestic dwellings 'As Built' Part L1A Building Regulations there are three options:

- Where the dwelling has been pressure tested, the assessed air permeability is the measured air permeability.
- Where the dwelling has not been tested, the assessed air permeability is the average test obtained from other dwellings of the same type on the development increased by margin of +2 m³/h/m²@50Pa*
- Where the builder has opted to avoid testing, the assessed air permeability will be a value of 15m³/h/m²@50Pa.

(* Direct from page 19 paragraph 5.18 of Approved Document L1A – On each development, an air pressure test should be carried out on three units of each dwelling type of 50% of all instances of that dwelling type, whichever is less. The majority of larger developments will include many dwelling types – and multiple units of each type should be tested to confirm the robustness of the designs and the construction procedures).

Air permeability rates of $3\text{m}^3/\text{h.m}^2$ @ 50Pa have been set for the entire development on the Domestic and non-Domestic buildings. To ensure this value is achieved, early advice should be undertaken to ensure that air barrier continuity is maintained across each dwelling and building. All dwellings must be tested to avoid adopting the average value $+2\text{ m}^3/\text{h.m}^2$ at 50Pa as required in Building Regulations for any untested dwellings.

4.2.5 Thermal Bridging

The design team is working to minimise thermal bridging to prevent the loss of heat and the development of cold spots which can lead to mould by considering accredited construction standards. Unitised curtain walling could enhance thermal bridging in all apartments within the main towers. The current scheme assumes that Accredited Construction details and its associated thermal bridging values will be achieved for this development as a minimum standard. The final construction details will be developed to ensure insulation continuity enhancing thermal bridging.

4.2.6 Ventilation

Windows are considered on the models to be openable and designed to be secured and rain protected. Domestic dwellings will utilise mechanical ventilation incorporating heat recovery (MVHR). The MVHR systems have been included within the calculations to operate a Specific Fan Power of <0.6 / (W/litre/sec) and Heat Exchanger Efficiency of 90+%.

This approach is an efficient method of reducing energy consumption within the dwellings whilst contributing to the mitigation of any overheating issues by increasing air change rates.

4.2.7 Cooling

The hierarchy to minimize the need for artificial cooling is summarised as:

- Minimise internal heat generation (i.e. reduce the demand for cooling)
- Reduce the heat entering the building in summer
- Manage heat within the building Passive ventilation
- Mechanical ventilation
- Active cooling systems (Include use of FCU's / Comfort cooling)

The design for the development benefits from passive design solutions including reduction of single aspect apartments, balconies providing shading to Domestic dwellings, windows glazing, g-values and other measures. The glazing has been specified with low g-values limiting the amount of heat entering dwellings as per Section 4.2.1.

When feasible, corridors will benefit from natural ventilation. However, when natural ventilation is not feasible, they will have environmental control systems, extracting internal air from corridors through the smoke extract system dispelling excess heat maintaining constant comfortable temperatures to avoid the risk of overheating as per Criterion C of CISBE TM59 guidance. These measures will limit the amount of active cooling required across the scheme.

The overheating results indicate that the dwellings will typically comply with the parameters above and any short periods of exceedance are within tolerance.

4.2.8 Heat Generation and Distribution

The proposed scheme will be provided with high efficiency electric panel heaters for space heating and heat pumps to generate domestic hot water (DHW).

The space heating will be controlled by the resident via suitable energy programmers and appliance thermostats. The DHW will have a cylinder thermostat and controls for the heat pump operation.

4.2.9 Lighting

It is recommended that all light fittings are specified as dedicated energy efficient lights (LED). For the Domestic elements the efficacy of all fittings should be >60lumens/circuit Watt. For the non-Domestic elements the efficacy of all fittings should be >100lumens/circuit Watt. Appropriate controls such as PIR/ movement and daylight controls should be fitted where practicable.

4.2.10 Solar Control Glazing

Solar controlled glazing with low g-values will limit the amount of solar gain transmittance into a dwelling. For compliance with Criterion 3 of Part L Building Regulations a g-value 0.34 for all elevations has been used for the overheating calculation for the dwellings.

The g-value also limits the impact of overheating within the dwelling and contributes to Fabric Energy Efficiency (FEE) compliance by reducing heat demand through the capitalisation of solar heat gains. The scheme has incorporated design features that would limit overheating as the majority of dwellings are dual aspect and will benefit from cross ventilation for rapid heat mitigation.

4.2.11 'Unregulated Emissions'

'Unregulated Emissions', i.e. those not covered by the Building Regulations assessments, are uncontrolled and are occupant led energy consumptions. The energy consumption and associated carbon dioxide emissions from corridor lighting, external lighting, small power and equipment within dwellings are considered insignificant for the purposes of this assessment.

4.2.12 'Be Lean' Results

The results in Table 12 below show a significant reduction through the incorporation of 'Be Lean' design measures on the Domestic element of the development.

Our Ref	Plot No.	No of Type	Area/ plot m ²	DER kgCO ₂ /m ²	2012 CO ₂ Emissions kgCO ₂ /pa
Z42502	Type 1.1	1	52.01	32.42	1,685
Z47503	Type 1.2	5	50.43	29.25	7,388
Z47504	Type 2.2	2	65.16	25.29	3,297
Z47505	Type 2.4	2	62.22	29.65	3,696
Z47506	Type 2.6	1	64.95	29.01	1,884
Z47507	Type 3.1	1	88.41	26.91	2,378
Z47508	Type 2.8	2	72.38	24.49	3,547
Z47509	Type 2.8	2	71.96	30.13	4,332
Z47510	Type 1.1 -Mid	8	52.01	24.53	10,194
Z47511	Type 1.2 -Mid	50	50.43	21.89	55,221
Z47512	Type 2.2 -Mid	28	65.16	18.90	34,483
Z47513	Type 2.4 -Mid	18	62.22	22.31	24,975
Z47514	Type 2.6 -Mid	28	64.95	21.66	39,464
Z47515	Type 3.1 -Mid	14	88.41	19.07	23,641
Z47516	Type 2.8 -Mid	48	72.38	17.99	62,536
Z47517	Type 2.8 -Mid	38	71.96	22.59	61,799
Z47518	Type 1.1 -Top	1	52.01	33.71	1,753
Z47519	Type 1.2 -Top	8	50.43	29.75	12,023
Z47520	Type 2.2 -Top	6	65.16	25.59	10,009

Our Ref	Plot No.	No of Type	Area/ plot m ²	DER kgCO ₂ /m ²	2012 CO ₂ Emissions kgCO ₂ /pa
Z47521	Type 2.4 -Top	4	62.22	30.65	7,641
Z47522	Type 2.6 -Top	2	64.95	29.52	3,832
Z47523	Type 3.1 -Top	1	88.41	28.01	2,475
Z47524	Type 2.8 -Top	4	72.38	24.75	7,180
Z47525	Type 2.8 -Top	6	71.96	30.98	13,385
Z42526	Type 2.1	4	63.14	33.30	8,410
Z42527	Type 1.2	3	50.95	26.87	4,112
Z42528	Type 1.3	6	49.53	29.41	8,737
Z42529	Type 2.5	2	66.46	27.34	3,629
Z42530	Type 2.9	1	63.42	29.14	1,846
Z42531	Type 2.10	1	79.74	24.92	1,986
Z42532	Type 2.1 -Mid	20	63.14	25.61	32,328
Z42533	Type 1.2 -Mid	20	50.95	20.51	20,890
Z42534	Type 1.3 -Mid	43	49.53	21.93	46,642
Z42535	Type 2.5 -Mid	36	66.46	20.07	48,090
Z42536	Type 2.9 -Mid	16	63.42	21.47	21,816
Z42537	Type 2.10 -Mid	18	79.74	17.93	25,692
Z42538	Type 2.1 -Top	2	63.14	34.25	4,331
Z42539	Type 1.2 -Top	3	50.95	27.32	4,173
Z42540	Type 1.3 -Top	2	49.53	29.96	2,972
Z42541	Type 2.5 -Top	2	66.46	27.68	3,682
Z42542	Type 2.9 -Top	1	63.42	29.78	1,890
Z42543	Type 2.10 -Top	1	79.74	25.41	2,025
Total					642,066
%age improvement					-0.79%

Table 11 - 'Be Lean' Energy Efficiency reduction and CO₂ emission savings from a SAP compliant dwelling

Table 11 demonstrates that through the energy efficiency measures described in Section 4.2 "Be Lean Energy Efficiency Measures", a -0.79% reduction on site CO₂ emissions is predicted to be achieved from the Baseline scheme. (Please note that the baseline and Be Lean domestic model was developed with an all-electric heating and DHW strategy (electric panel heaters and direct electric DHW system). Please refer to appendix a below for the sample SAP calculation for a number of flats.

The results in Table 13 below show a significant reduction through the incorporation of 'Be Lean' design measures on the non-Domestic element of the development. Please refer to appendix a for the Be lean BRUKL for the commercial units assessed.

'Be Lean' Non-Domestic Calculations			
	Floor Area m ²	Total CO ₂ (kg/m2/yr)	Regulated Total CO ₂ (kg/yr)
Commercial	164	30.1	4,936
Commercial	334	30.1	10,053
Commercial	254	30.1	7,645
Resi Entrance/ Co working	186	30.1	5,599
TOTAL	938		28,234

Table 12 - 'Be Lean' Energy Efficiency reduction and CO₂ emissions from an SBEM compliant building

Based on these modelling calculations the following Be Lean emissions have been established for the proposed scheme as Table 13 below:

Energy Hierarchy	Total Regulated CO ₂ Emissions
	(kgCO ₂ /Yr)
B – Domestic Be Lean Emissions of Development	642,066
H - Commercial Be Lean Emissions of Development	28,234
N (B+H) – Total Be Lean Emissions of Development	670,300

Table 13 - Calculation of total 'Be Lean' CO₂ emissions for the Domestic and non-Domestic development

Table 13 demonstrates that through the energy efficiency measures described in Section 4.2 "Be Lean Energy Efficiency Measures", a -0.55% reduction on site CO₂ emissions is predicted to be achieved from the Baseline scheme (666,661 kgCO₂/yr).

4.3 'Be Clean' Energy Efficiency Measures

The 'Be Clean' measures will not include connection to an existing or new district heating system. District heating works by the supply of hot water distributed from a central source, typically a CHP / Boiler set within a large-scale energy distribution centre. There are no existing DHN's in close proximity to this development. Please refer to Section 5.0 for further details.

4.3.1 'Be Clean' Results

For the reasons set out in section 5 below the 'Be Clean' results are the 'Be Lean' results. There is therefore no change.

4.4 'Be Green' Renewables

A range of technologies have been studied to identify the most adequate renewable energy generation system for the proposed scheme. These include:

- Site mounted wind turbines
- Roof mounted wind turbines
- Solar Photovoltaics (PV)
- Solar Hot Water
- Ground Source Heat Pumps
- Biomass
- Direct Air Source Heat Pumps
- Fuel cells

A renewable energy options assessment has been undertaken to evaluate which of these technologies would be feasible in terms of economic, political, environmental and practical considerations. The study provides a clear understanding of the constraints and opportunities associated with a variety of different renewable energy technologies.

The choice of technology will be dependent upon a range of factors including orientation, height, window size, surrounding buildings and environment, site size and layout, geology, conservation and biodiversity.

The general feasibility of the technologies which were discounted are shown in Table 14.

Renewable Technology	Unfeasible due to
Solar Thermal	- The roof space has been given over to PV panels, as they offer the more significant savings. - The Development's large domestic hot water is better served by a central DHN system. Or a dedicate low carbon technology as the proposed heat pumps.
Biomass Heating	- High risk of air pollution issues associated with a biomass flue emissions. - Risk and reliability of fuel supply. - Impact on local air quality of RGB. - Large area for fuel storage and frequent deliveries. - Specialist maintenance knowledge. - High noise impact from deliveries.
Fuel Cells	- Viability of equipment. - Unavailable reliable source of non-fossil fuel hydrogen for the site. - Significant safety concern due to the volatile properties of the fuel.
Wind Turbines	Impact within an urban environment: - Size and appearance. - Noise. - Appropriate positioning. - Unpredictable and varying wind speeds. - Cost. - Maintenance.
Ground Source Heat Pumps (GSHP)	The application of this technology was discounted due to the size of the development and its associated heat loads. The size of ground collectors and other technical consideration relating to the unknown quality of the ground on site deemed this technology financially and technically unfeasible.
Façade Solar Photovoltaics	- Low efficiency compared to traditional PV. - Large areas of arrays required to generate the same electricity. - Technology mainly applied to commercial buildings.

Table 14 - Discounted Renewable Technologies

4.4.1 Renewable Technologies

A desktop study has considered the following technologies for this project:

4.4.1.1 Solar Thermal Hot Water

Solar hot water uses a heat collector, usually as panels on the roof, in which liquid is heated by the sun. In a typical system, a heat transfer medium (generally a water/antifreeze mixture) travels through a series of heat conducting tubes known as a heat collector.



Image 6 - Solar Hot Water

During its circulation through the tubes, the fluid picks up heat from the sun which is then transferred to the domestic hot water supply as it passes through a coil in an appropriate storage cylinder.

These systems do not generally provide space heating and are often described as 'solar thermal' systems. They are among the most cost-effective renewable energy systems that can be installed to developments in urban environments.

A basic solar thermal collector comprises of a translucent cover, an absorption plate, and the heat transfer system. In the UK, there are two main types of collectors, known as evacuated tube and flat-plate.

The proposed scheme's relatively large DHW demand can be achieved more efficiently via connection to a heat pump integral within each Hot Water cylinder. Routing of solar thermal pipework through to each flat would cause significant problems. Therefore, the specification of a solar system is deemed inappropriate for this scheme.

4.4.1.2 Biomass

Biomass is a feasible 'green' technology. Biomass systems differ from other renewable sources because they emit carbon dioxide when the fuel is burnt. However, the amount is equal to the carbon absorbed when the biomass material was growing, leading them to be classified as carbon neutral. For large scale projects there are three types of wood fuel that are generally used: wood pellets, wood chips and biodiesel.



Image 7 - Biomass Boiler

The success of such a system is dependent on securing a reliable, preferably local source of fuel. The biomass boiler would generally be used in conjunction with a gas CHP. Operating under this strategy, the system should have the potential to further reduce site wide carbon emissions but by a limited amount as the space heat demand has been significantly reduced through best practice passive measures.

To achieve a meaningful carbon emission reduction, the biomass system would have to be used instead of a gas CHP and would provide a similar overall site carbon emission reduction. However, there are several issues associated with biomass district heating that led to this being discounted for the site:

- High risk of air pollution issues associated with the flue emissions
- Risk and reliability of fuel supply
- Manchester City Council is a smoke-controlled area
- Large area for fuel storage or frequent deliveries
- Specialist maintenance knowledge

- Convenient access for delivery vehicles – either walking floor or covered bulk heavy goods vehicles, typically require a 26m turning circle
- Noise from deliveries – deliveries could be up to 10 times per month
- A district heat network is not proposed for this site, as an all-electric solution with heat pumps is proposed.

Due to the reasons stated above, biomass is deemed inappropriate for this scheme.

4.4.1.3 Fuel Cells

Fuel cells deliver electricity via hydrogen. Current research indicates that although the technology is developing commercially, the viability of equipment and reliable sources of non-fossil fuel hydrogen are not yet available on a commercial scale that would suit the demands of the proposed scheme.



Image 8 - Fuel Cells

Large storage tanks with hydrogen would also have to be located within the site. This is considered a significant safety concern due to the flammability properties of hydrogen gas, which is the main constituent in the fuel cells. Additionally, there is limited protocol on the suitable method of thermally modelling this technology within DSM analysis and SAP. It is not proposed for this scheme due to all reasons mentioned above.

4.4.1.4 Site Mounted Large Wind Turbines

Due to the proximity to existing and future Domestic developments and associated poor wind speeds in urban environments, this technology is deemed unsuitable in this instance.

The noise associated with large scale wind turbines could have a potential impact with adjacent Domestic developments. A 300 – 500 kW turbine could potentially reach a sound level of 100 dB at 8 m/s wind speed.



Image 8 – Wind Turbines

4.4.1.5 Roof Mounted Wind Turbines

The feasibility of the roof mounted wind turbines has been studied in terms of:

- Size and visual impact on the building
- Power output
- Noise generation

Wind turbines extract energy from the wind using a rotor which usually comprises of two or three blades similar in profile to the wing of an airplane. Most small wind turbines generate direct current (DC) electricity. Systems that are not connected to the national grid require battery storage and an inverter to convert DC electricity to AC.



Image 9 - Roof-mounted small-scale wind turbine

Wind systems can also be connected to the national grids. A special inverter and controller converts DC electricity to AC at a quality and standard acceptable to the grid, hence no expensive battery storage is required. Any unused or excess electricity may be able to be exported to the grid and sold to the local electricity supply company.

The average on site wind speed is 4.6 m/s at 10m as shown in image 09 below. For a turbine to be feasible a wind speed of at least 6m/s is required to produce a satisfactory energy output.

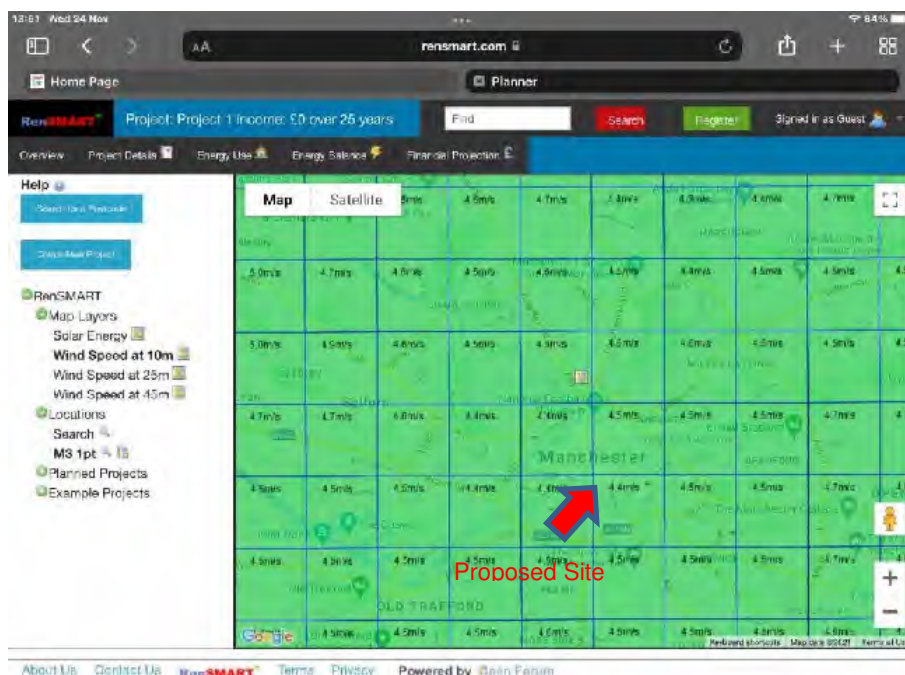


Image 10 - On site Average Wind Speed

Based on 10 No. 6 kW turbines it has been estimated that the scheme could potentially save 31tCO₂. However, due to low wind speeds, aesthetic impact and potential detrimental impact on wildlife, roof mounted wind turbines are not considered suitable for this application.

4.4.1.6 Ground Source Heat Pump (GSHP)

GSHPs provide extracted heat from the ground or water during the winter months via a heat pump and circulate hot water into a building to provide space-heating and pre-heated domestic hot water. In the summer months the process can be reversed to provide cooling.



Image 11 - GSHP

GSHPs are not considered an appropriate technology for this scheme for the following reasons:

- Extraction licences would need to be applied for from the Environment Agency and local water-way management body to use any source of water required for the heating process
- High risk to contaminate underground water sources
- A substantial amount of land, either via slinky or bore holes would be required resulting in the technology becoming cost prohibited.
- High cost of centralised heating / cooling generation and distribution systems.
- Dependant on the suitability of the ground conditions and the usable area available.
- High maintenance and running cost.

4.4.1.7 Air Source Heat Pump (ASHP)

This assessment has identified that full Air Source Heat Pumps (ASHPs) would only be viable with a district heat network solution to produce heating and domestic hot water (DHW). ASHPs utilise low grade heat in the air, as similar in the refrigeration process, enabling them to produce hot water, typically at around 45°C.

Heat pumps for the hot water systems only are considered a viable option and are proposed for use on this development.



Image 12- ASHP Unit

Individual heat pumps will be installed on the apartment hot water systems (DHW) to assist with low carbon technology and reducing CO₂ emissions.

4.4.1.8 Façade Solar Photovoltaics (FPV)

Façade Solar Photovoltaics uses thin-film PV technology to manufacture ss. The material is ideal for building integrated solutions, enabling to produce transparent or opaque solar PV panels, ideal for façades, canopies, skylights or curtain walls. Designed specifically for Building Integrated (BI) applications, thin-film technology offers performance advantages through:

FPV can operate at non-optimal angles therefore offering greater potential for installation locations such as the vertical side of a building.

FPV has a small annual yield generation, ideally large installations are required for best benefits. This technology operates down to 10% of sunlight, extending the number of hours over the year in which to produce electricity providing a more consistent energy yield. Additionally, FPV alignment makes panels less affected by shading.



Image 13 - Façade Solar Photovoltaics

FPV has low efficiency compared with traditional PV applications, therefore feasible application requires large façade areas connected centrally. FPV technology mainly applies to commercial buildings. Due to the proposed Domestically led scheme and technology constraints to allocate generation to individual dwellings, this technology is deemed inadequate for the proposed scheme.

4.4.1.9 Solar Photovoltaics (PV)

PV uses energy from light to create electricity for the running of appliances and lighting. The PV cell consists of one of the two layers of a semi conducting material, usually silicon (normally Monocrystalline, Polycrystalline and Amorphous silicon).

When light shines on the cell it creates an electric field across the layers causing electricity to flow. The greater the light intensity, the greater the flow of electricity.

Individually PV cells only provide a small amount of electricity and they are generally grouped together into a module for convenience and higher output.

PV is most suitable where electricity is generated at the point of use and the energy loss and costs with transmission and distribution are avoided.

A key advantage of PV in the urban environment is their potential to be integrated into the fabric of the building. No extra land space is required, and they can either blend into the building and surrounding environment making them either very discreet or giving a clear indication of 'green' credentials.



Image 14 - Solar Photovoltaics (PV)

For the Domestic areas it has been calculated that the Solar PV array would be circa 36kWp (Panel area approx. 175m²) for the Domestic elements of the project. This amount of PV would be orientated to face South and pitched at 30°.

The Solar PV is proposed to be situated on the roof of Block B as they have no overshadowing from adjacent towers.

4.4.2 'Be Green' Results

This assessment has identified that Solar Photovoltaics is the most suitable technology for the proposed scheme.

The arrays will be incorporated into the roof design where they will operate at their maximum potential and not restrict other plant space or roof access.

Air source heat pumps are also included in the design proposal to provide the Domestic Hot Water (DHW) within each apartment.

The Solar Photovoltaics and DHW Heat Pump will meet the Manchester City Council's EN4 & EN4 policy, requiring all developments to provide a reduction of CO₂ emissions through on-site renewable energy generation.

The results in Table 15 below show a significant reduction through the incorporation of 'Be Green' design measures on the domestic element of the development.

Our Ref	Plot No.	No of Type	Area/ plot m ²	SAP	DER kgCO ₂ /m ² /yr	2012 CO ₂ Emissions kgCO ₂ /pa
Z42502	Type 1.1	1	52.01	86	22.5	1,170
Z47503	Type 1.2	5	50.43	89	19.2	4,841
Z47504	Type 2.2	2	65.16	89	16.5	2,150
Z47505	Type 2.4	2	62.22	87	20.6	2,563
Z47506	Type 2.6	1	64.95	87	20.3	1,318
Z47507	Type 3.1	1	88.41	85	19.8	1,751
Z47508	Type 2.8	2	72.38	89	16.3	2,360
Z47509	Type 2.8	2	71.96	85	21.9	3,152
Z47510	Type 1.1 -Mid	8	52.01	92	14.3	5,950
Z47511	Type 1.2 -Mid	50	50.43	93	11.4	28,745
Z47512	Type 2.2 -Mid	28	65.16	93	9.7	17,697
Z47513	Type 2.4 -Mid	18	62.22	92	13.0	14,559
Z47514	Type 2.6 -Mid	28	64.95	92	12.7	23,096
Z47515	Type 3.1 -Mid	14	88.41	92	11.7	14,482
Z47516	Type 2.8 -Mid	48	72.38	93	9.4	32,658
Z47517	Type 2.8 -Mid	38	71.96	91	14.2	38,830
Z47518	Type 1.1 -Top	1	52.01	85	23.8	1,238
Z47519	Type 1.2 -Top	8	50.43	88	19.7	7,948
Z47520	Type 2.2 -Top	6	65.16	89	16.8	6,568
Z47521	Type 2.4 -Top	4	62.22	86	21.7	5,401
Z47522	Type 2.6 -Top	2	64.95	86	20.8	2,702
Z47523	Type 3.1 -Top	1	88.41	85	20.9	1,848
Z47524	Type 2.8 -Top	4	72.38	89	16.5	4,777
Z47525	Type 2.8 -Top	6	71.96	84	22.8	9,844
Z42526	Type 2.1	4	63.14	83	24.5	6,188
Z42527	Type 1.2	3	50.95	90	16.7	2,553
Z42528	Type 1.3	6	49.53	89	19.2	5,706
Z42529	Type 2.5	2	66.46	87	18.8	2,499
Z42530	Type 2.9	1	63.42	86	20.4	1,294
Z42531	Type 2.10	1	79.74	87	17.2	1,372
Z42532	Type 2.1 -Mid	20	63.14	89	16.7	21,089
Z42533	Type 1.2 -Mid	20	50.95	93	9.7	9,884
Z42534	Type 1.3 -Mid	43	49.53	93	11.3	24,067
Z42535	Type 2.5 -Mid	36	66.46	93	11.2	26,797
Z42536	Type 2.9 -Mid	16	63.42	92	12.4	12,583
Z42537	Type 2.10 -Mid	18	79.74	93	9.9	14,210
Z42538	Type 2.1 -Top	2	63.14	82	25.4	3,208
Z42539	Type 1.2 -Top	3	50.95	89	17.1	2,614
Z42540	Type 1.3 -Top	2	49.53	88	19.8	1,961
Z42541	Type 2.5 -Top	2	66.46	87	19.1	2,539
Z42542	Type 2.9 -Top	1	63.42	86	21.0	1,332
Z42543	Type 2.10 -Top	1	79.74	87	17.7	1,411
Total						376,952
%age Improvement above Baseline						40.83%

 Table 15 - Be Green Renewable CO₂ saving contribution

Table 15 shows that through the energy efficiency measures described in Section 4.2 “Be Green Energy Efficiency Measures”, 376,952 kgCO₂ savings are predicted which equates to 40.83% reduction on site CO₂ emissions from the “Be Green” scheme. (please refer to appendix a below for the sample SAP Calculations for the dwellings)

The results in Table 16 below show a significant reduction through the incorporation of ‘Be Green’ design measures on the non-domestic element of the development.

'Be Green' Non-domestic Calculations			
	Floor Area m²	Total CO₂ (kg/m²/yr)	Regulated Total CO₂ (kg/yr)
Commercial	164	26.2	4,297
Commercial	334	26.2	8,751
Commercial	254	26.2	6,655
Resi Entrance/ Co working	186	26.2	4,873
TOTAL	938		24,576

 Table 16 - 'Be Green' Energy Efficiency reduction and CO₂ emissions from an SBEM compliant building

Based on these modelling calculations the following Be Green emissions have been established for the proposed scheme as Table 17 below (please refer to appendix a below for the Be Green commercial BRUKL document).

Energy Hierarchy	Total Regulated CO₂ Emissions
	(KgCO₂/Yr)
C – Domestic Be Green Emissions of Development	376,952
I – Non-Domestic Be Green Emissions of Development	24,576
O (C+I) – Total Be Green Emissions of Development	401,528

 Table 17 - Calculation of total 'Be Green' CO₂ emissions for the Domestic and non-Domestic development

Energy Hierarchy	Total Regulated CO₂ Emissions (Tonnes CO₂/Yr)		
	Domestic	Non-domestic	Site Wide
A - Baseline Emissions of Development (pre-improvement)	637	30	667
B - Be Lean	642	28	670
C - Be Clean	642	28	670
D - Be Green	377	25	402
E - Total Reduction in Carbon (KgCO ₂ /yr) from Baseline	260	5	265
F - Percentage Improvement in Carbon Emissions (above Building Regs ADL1A 2013)	40.83%	17.10%	39.77%
C-D - Percentage Contribution from LZC Technologies#	41.29%	13.00%	40.10%

 Table 18 – Site Wide CO₂ Reduction Summary.

Table 18 presents the savings estimated through the energy hierarchy and energy efficiency measures described this report. The "Be Green Energy Efficiency Measures" suggest, a 39.77% reduction on site CO₂ emissions with an estimated site CO₂ reduction contribution of 40.1% through LZC technologies.

5.0 District Heating Networks

In response to the Core Strategy Policy EN5 and EN7 this section outlines how consideration of energy supplied efficiently from a district heating network can be provided to the development in line with the energy hierarchy.

Decentralised Heating Networks

The energy policy EN4 reaffirms the view that energy generated by centralised power stations and transmitted through the national grid is highly inefficient and wasteful.

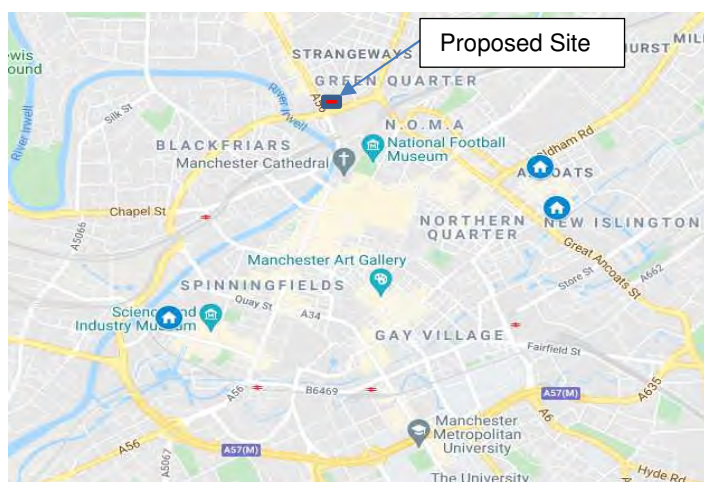
One of priorities for reducing CO₂ emissions is to reduce reliance on centralised power stations. This means increasing the use of local, low-carbon energy supplies through de-centralised energy systems.

Decentralised plant generally means any heating and hot water and/or electricity generation provided on a district wide (DHN) or site wide (CHN) basis. DHN and CHN can typically include combined heat and power equipment (CHP). CHP is an engine which, when running, generates electricity and heats water which can then be distributed around a development.

Benefits of district heating networks can include:

- Provision of low carbon / lower cost heat to domestic and commercial customers
- Diversification of the energy mix
- Reductions in region-wide carbon emissions
- Targeting and reduction of fuel poverty
- Potential long-term revenue streams for local authorities
- Alignment with regeneration programmes
- Driving the growth of the low carbon services sector

However, there are currently no existing district heating networks near to the site. An extract from the ADE District Heating Installation Map¹ has been highlighted in Image 15 indicating the nearest networks at Manchester Victoria Square and Royal Mills which are around 500m from the proposed development site.



District Heating Network Locations around Manchester

Image 15 – Location of site in relation to existing and proposed heat networks

¹ <https://www.theade.co.uk/resources/publications/district-heating-installation-map>

6.0 Sustainability

This statement considers many aspects of sustainable design and construction of the development. Sustainable developments arise as a result of user interaction (or management operation) with the environment, buildings and their associated building services.

Achieving sustainable development requires action on four main fronts:

1. Promotion and encouragement of sustainable lifestyles.
2. Design and construction of quality buildings and building services and its surroundings.
3. Use, operation and maintenance of buildings, building services and its surroundings.
4. Selection and use of other sustainable equipment and surroundings incl. adoption of lifestyle changes, new methods and embracing the challenges ahead.

In addition, by adopting the philosophies below the development can be developed sustainably:

- Designing buildings and surrounding environments that are easy to operate and maintain.
- Pre-installing sustainable and energy efficient equipment and/or advising on such.
- Providing guidance on the efficient and sustainable use of the buildings and surroundings.

6.1 Sustainable Design & Construction

The design currently includes a number of components that gives the scheme a head start in relation to the sustainability. The list below is not exhaustive:

Energy

- The development will be designed and constructed to achieve low energy and carbon dioxide emissions, improving upon current Building Regulations Part L 2013 using the Be Lean, Be Clean, Be Green energy hierarchy. Manchester policy is a 15% uplift in Building Regs.
- Sub-metering of all major energy consuming systems will be provided to differentiate between energy loads for heating and hot water, lighting and small power consumption.
- Dedicated energy efficient lighting will be installed internally and externally. Movement and daylight controlled lighting will be introduced, where practicable. The efficacy and colour rendering index ratings will be considered.

Water

- Internal water consumption will be reduced using low flush/ flow appliances. This will include appliances such as aerated/ flow regulated taps, low-flow showers, low-flush WC's, low-flush urinals, PIR control on main water supply to all toilet areas, etc. and where practicable.
- Where areas use more than 10% of the buildings predicted total water usage, sub-metered pulsed output meters will be considered.
- Flow control devices will be installed to sanitary fittings, where practicable.

Materials

- All building and construction materials used on the schemes will aim to be sought from environmentally managed accreditation schemes, (such as EMAS/ ISO 14001 accreditation). All timber will be sourced from a certified chain of custody. Overall, at least 80% of all material sourced on this project will be responsibly sourced, and where practical.
- The building will incorporate suitable durability and protection measures or designed features/solutions to prevent damage to vulnerable parts of the internal and external building and landscaping elements
- Insulation will have low environmental impact in use and during manufacture. This is measured via the insulation index rating.

Pollution

- The units will be provided with electrical heating (and cooling) systems only to ensure NOx emissions are eliminated.
- Reduction of night-time light pollution using ILE compliant light fittings will be installed, where practicable.

Waste

- Dedicated colour coded bins will be provided for recycling of paper/ card, metal, plastic and cans, food waste, etc. External bin storage space will meet the requirements of the Local authority.
- The aim will be to divert as much waste from landfill as possible by reducing construction waste and re-use or recycling waste, wherever possible.

Health and Wellbeing

- Daylight and view of sky will be optimised reducing the requirement to consume energy from electric lighting. Based on the layout and extent of the glazing, these credits are certainly achievable, subject to detailed design.
- Landscaping and usable garden/ leisure space will be maximised to provide occupants with an aesthetic external environment, where practicable.
- Safety issues will incorporate recommendations from a CPDA or ALO input, wherever practicable.

Management

- A comprehensive Building User Guide (BUG) will be issued for the tenants and facilities managers.
- The contractor will manage and monitor environmental issues during construction process. This will include monitoring and management of energy and water consumption of site activities, separation, streaming and recycling of waste, the reduction of air, dust and ground pollution.

Ecology and Land-use

- The contractor will enlist the help of a suitably qualified person to recommend appropriate ecological features that will positively enhance the ecology of the site, where practical.
- Protection and mitigation measures will be introduced, where practicable, to reduce the impact of the development on the existing site and to enhance the development.
- Ecological improvement will be undertaken to enhance the ecological value of the site once the development is built, wherever practicable.
- Where possible provision of trees may provide carbon dioxide sequestration opportunities.

6.2 Sustainability Conclusion

The scheme will ensure that a quality sustainable new development is created. This will offer building occupiers, and the whole community added benefits in terms of quality of living standards and life, lower energy and water bills and enhanced/improved surroundings and facilities.

A holistic approach to sustainable design and construction has been provided from the outset of this development, which has helped to influence and develop the proposals. The proposals may change as the design progresses and changes could affect the financial viability of the proposed development, but by considering the findings of this report the contractor (once appointed) can endeavour to adopt the principles, wherever practicable. *For the detailed Sustainability Strategy please refer to Atkins Sustainability Statement.*

7.0 Conclusions

This Energy Statement has outlined the measures to reduce the carbon emissions for the proposed development and resulting savings at each stage of the Energy Hierarchy.

Through the integration of the measures outlined in this strategy, the CO₂ emissions arising from the building energy consumption can be reduced by a total of 40.10% beyond a compliant Part L 2013 Baseline.

A number of passive measures including improved U-Values and air permeability, low g-value, energy efficient lighting, a mixed mode ventilation strategy combining natural ventilation and MVHR, connection to efficient electric heating and all DHW heat requirements to be provided by integrated heat pumps, coupled with 36kWp solar PV array (175m² array) for the Domestic blocks provide a means to reduce energy consumption and onsite CO₂ emissions.

The Table 19 below summarises the energy consumption and CO₂ emissions for the scheme for a compliant 'Be Lean', 'Be Clean', 'Be Green' approach.

Energy Hierarchy	Total Regulated CO ₂ Emissions (Tonnes CO ₂ /Yr)		
	Domestic	Non-domestic	Site Wide
A - Baseline Emissions of Development (pre-improvement)	637	30	667
B - Be Lean	642	28	670
C - Be Clean	642	28	670
D - Be Green	377	25	402
E - Total Reduction in Carbon (KgCO ₂ /yr) from Baseline	260	5	265
F - Percentage Improvement in Carbon Emissions (above Building Regs ADL1A 2013)	40.83%	17.10%	39.77%
C-D - Percentage Contribution from LZG Technologies #	41.29%	13.00%	40.10%

Table 19 - Summary of CO₂ emissions reductions (as calculated with SAP 2012 and SBEM)

Please note that the Domestic contribution from LZCT includes the improvement from the heat pump on the Domestic Hot Water side (DHWHP). With this factored in the renewables and LZCT contribution significantly exceeds Manchester Core Strategy EN6 15% CO₂ reduction requirement.

This Energy Statement for the proposed development shows that the combined measures proposed will reduce the CO₂ emissions of the scheme by at least 39% from the combined 'Be Lean', 'Be Clean' and "Be Green" when compared against a Baseline emissions case.

The contribution from LZCT is provided from HW heat pumps and Photovoltaic panels. The PV panels and the HW heat pump on every Domestic unit is providing a 41.29% CO₂ reduction.

Recommendations proposed to overcome any issues with overheating were considered at an early design stage and implementation of these recommendations have been effective, as demonstrated in this study.

8.0 Glossary of Terms

Reference	Meaning
CHP	Combined heat and power
HVAC	Heating, ventilation, and air conditioning (HVAC)
DHW	Domestic Hot Water
TER	Target CO ₂ Emission Rate expressed as kgCO ₂ /(m ² year)
BER	Building CO ₂ Emission Rate expressed as kgCO ₂ /(m ² year)
DER	Dwelling CO ₂ Emission Rate expressed as kgCO ₂ /(m ² year)
TFEE	Target fabric energy efficiency rate expressed as kWh/(m ² year)
DFEE	Dwelling fabric energy efficiency rate expressed as kWh/(m ² year)
FEE	Fabric Energy Efficiency
FEES	Fabric Energy Efficiency Standard
PV	Solar Photovoltaics
CO₂	Carbon Dioxide
BCB	Building Control Body – a local authority or an approved inspector
BRUKL	Building Regulations UK Part L
SAP	Standard Assessment Procedure
U-value	Measurement of heat loss through building element in W/m ² K
g-value	Measurement of solar energy transmittance of ss
Psi-value	Measurement of heat loss across a thermal bridge W/m ² K
Building Regulations	Part L1A 2013 and Part L2A 2013
Party Walls Zero Heat Loss	To qualify for the proposed zero heat loss u-value of 0.00 W/m ² .K the party walls must either be solid with no cavity or cavities must be fully filled with insulation
Air Permeability	The physical property used to measure airtightness of the building fabric. It is defined as air leakage rate per hour per square metre of envelope area at the test reference pressure differential of 50 Pascals (50 N/m ²)

Reference	Meaning
Air Permeability	The envelope area, or measured part of the building, is the total area of all floors, walls and ceilings bordering the internal volume that is the subject of the pressure test. This includes wall as and floors below external ground level Overall internal dimensions are used to calculate this envelope area and no subtractions are made for the area of the junctions of internal walls, floors and ceilings with exterior walls, floors and ceilings. Air permeability is measured in $\text{m}^3/\text{m}^2/\text{hr}$

Appendices

Appendix A – SAP & SBEM

A selection of typical SAP calculations are detailed below:

1B 2P dwellings Be Lean :

BASIC COMPLIANCE REPORT					
Calculation Type: New Build (As Designed)					
Property Reference	121752		Issued on Date	25/11/2021	
Assessment Reference	242502	Prop Type Ref	Type 1.1 Mid		
Property	A1 -Mid, Former Boddingtons Site				
SAP Rating	82 B	DER	24.53	TER	24.11
Environmental	85 B	% DER<TER	-1.75		
CO ₂ Emissions (t/year)	1.05	DFEE	31.65	TFEE	32.70
General Requirements Compliance	Fail	% DFEE<TFEE	3.23		
Assessor Details	Mr. Paul Ahern, Paul Ahern, Tel: 01617621055, paul.ahern@energycouncil.co.uk			Assessor ID	T237-0001
Client					
SUMMARY FOR INPUT DATA FOR New Build (As Designed)					
Criterion 1 – Achieving the TER and TFEE rate					
1a TER and DER					
Fuel for main heating	Electricity				
Fuel factor	1.55 (electricity)				
Target Carbon Dioxide Emission Rate (TER)	24.11	kgCO ₂ /m ²			
Dwelling Carbon Dioxide Emission Rate (DER)	24.53	kgCO ₂ /m ²			
Excess emissions	0.42 (1.7%)	kgCO ₂ /m ² Fail			
1b TFEE and DFEE					
Target Fabric Energy Efficiency (TFEE)	32.70	kWh/m ² /yr			
Dwelling Fabric Energy Efficiency (DFEE)	31.65	kWh/m ² /yr			
	-1.1 (-3.4%)	kWh/m ² /yr Pass			
Criterion 2 – Limits on design flexibility					
Limiting Fabric Standards					
2 Fabric U-values					
Element	Average	Highest			
External wall	0.17 (max. 0.30)	0.17 (max. 0.70)			Pass
Party wall	0.00 (max. 0.20)	-			Pass
Openings	1.50 (max. 2.00)	1.50 (max. 3.30)			Pass
2a Thermal bridging					
Thermal bridging calculated from linear thermal transmittances for each junction					
3 Air permeability					
Air permeability at 50 pascals	3.00 (design value)				
Maximum	10.0 Pass				
Limiting System Efficiencies					
4 Heating efficiency					
Main heating system	Room heaters - Electric Panel, convector or radiant heaters				
Secondary heating system	None				
5 Cylinder insulation					

BASIC COMPLIANCE REPORT

Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Hot water storage	Nominal cylinder loss: 1.74 kWh/day Permitted by DBSCG 2.24	Pass
Primary pipework insulated	No primary pipework	
6 Controls		
Space heating controls	Programmer and appliance thermostats	Pass
Hot water controls	Cylinderstat	Pass
7 Low energy lights		
Percentage of fixed lights with low-energy fittings	100 %	
Minimum	75 %	Pass
8 Mechanical ventilation		
Continuous supply and extract system		
Specific fan power	0.59	
Maximum	1.5	Pass
MVHR efficiency	94 %	
Minimum	70 %	Pass

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (Thames Valley)	Slight	Pass
Based on:		
Overshading	Average	
Windows facing South West	5.09 m ² , No overhang	
Windows facing North West	5.13 m ² , No overhang	
Air change rate	4.00 ach	
Blinds/curtains	None	

Criterion 4 – Building performance consistent with DER and DFEE rate

Party Walls

Type	U-value	
Filled Cavity with Edge Sealing	0.00	W/m ² K Pass

Air permeability and pressure testing

3 Air permeability

Air permeability at 50 pascals	3.00 (design value)	
Maximum	10.0	Pass

10 Key features

Party wall U-value	0.00	W/m ² K
Air permeability	3.0	m ³ /m ² h
Photovoltaic array	0.08	kW

This report has not been submitted through the Elmhurst Energy members' portal, therefore results are subject to change when the dwelling is completed.

1B 2P dwellings Be Clean

BASIC COMPLIANCE REPORT				
Calculation Type: New Build (As Designed)				
Property Reference	121752	Issued on Date	25/11/2021	
Assessment Reference	242502	Prop Type Ref	Type 1.1 Mid	
Property	A1 -Mid, Former Boddingtons Site			
SAP Rating	82 B	DER	24.53	TER
Environmental	85 B	% DER<TER	-1.75	
CO ₂ Emissions (t/year)	1.05	DFEE	31.65	TFEE
General Requirements Compliance	Fail	% DFEE<TFEE	3.23	
Assessor Details	Mr. Paul Ahern, Paul Ahern, Tel: 01617621055, paul.ahern@energycouncil.co.uk		Assessor ID	T237-0001
Client				
SUMMARY FOR INPUT DATA FOR New Build (As Designed)				
Criterion 1 – Achieving the TER and TFEE rate				
1a TER and DER				
Fuel for main heating	Electricity			
Fuel factor	1.55 (electricity)			
Target Carbon Dioxide Emission Rate (TER)	24.11	kgCO ₂ /m ²		
Dwelling Carbon Dioxide Emission Rate (DER)	24.53	kgCO ₂ /m ²		
Excess emissions	0.42 (1.7%)	kgCO ₂ /m ²	Fail	
1b TFEE and DFEE				
Target Fabric Energy Efficiency (TFEE)	32.70	kWh/m ² /yr		
Dwelling Fabric Energy Efficiency (DFEE)	31.65	kWh/m ² /yr		
	-1.1 (-3.4%)	kWh/m ² /yr	Pass	
Criterion 2 – Limits on design flexibility				
Limiting Fabric Standards				
2 Fabric U-values				
Element	Average	Highest		
External wall	0.17 (max. 0.30)	0.17 (max. 0.70)	Pass	
Party wall	0.00 (max. 0.20)	-	Pass	
Openings	1.50 (max. 2.00)	1.50 (max. 3.30)	Pass	
2a Thermal bridging				
Thermal bridging calculated from linear thermal transmittances for each junction				
3 Air permeability				
Air permeability at 50 pascals	3.00 (design value)			
Maximum	10.0			
Limiting System Efficiencies				
4 Heating efficiency				
Main heating system	Room heaters - Electric Panel, convector or radiant heaters			
Secondary heating system	None			
5 Cylinder insulation				

BASIC COMPLIANCE REPORT		
Calculation Type: New Build (As Designed)		
Hot water storage	Nominal cylinder loss: 1.74 kWh/day Permitted by DBSCG 2.24	Pass
Primary pipework insulated	No primary pipework	
6 Controls		
Space heating controls	Programmer and appliance thermostats	Pass
Hot water controls	Cylinderstat	Pass
7 Low energy lights		
Percentage of fixed lights with low-energy fittings	100	%
Minimum	75	%
8 Mechanical ventilation		
Continuous supply and extract system		
Specific fan power	0.59	
Maximum	1.5	Pass
MVHR efficiency	94	%
Minimum	70	%
Criterion 3 – Limiting the effects of heat gains in summer		
9 Summertime temperature		
Overheating risk (Thames Valley)	Slight	Pass
Based on:		
Overshading	Average	
Windows facing South West	5.09 m ² , No overhang	
Windows facing North West	5.13 m ² , No overhang	
Air change rate	4.00 ach	
Blinds/curtains	None	
Criterion 4 – Building performance consistent with DER and DFEE rate		
Party Walls		
Type	U-value	
Filled Cavity with Edge Sealing	0.00	W/m ² K
Air permeability and pressure testing		
3 Air permeability		
Air permeability at 50 pascals	3.00 (design value)	
Maximum	10.0	
10 Key features		
Party wall U-value	0.00	W/m ² K
Air permeability	3.0	m ³ /m ² h
Photovoltaic array	0.08	kW

This report has not been submitted through the Elmhurst Energy members' portal, therefore results are subject to change when the dwelling is completed.



2B 4P dwelling Be Lean:

BASIC COMPLIANCE REPORT					
Calculation Type: New Build (As Designed)					
Property Reference		Z42525-Op2		Issued on Date 25/11/2021	
Assessment Reference		Z42525		Prop Type Ref Type 2 & Top	
Property B2 4 -Top, Former Boddingtons Site					
SAP Rating	83 B	DER	22.79	TER	26.90
Environmental	85 B	% DER<TER	15.29		
CO ₂ Emissions (t/year)	1.13	DFEE	49.44	TFEE	51.56
General Requirements Compliance		Pass	% DFEE<TFEE	4.12	
Assessor Details		Mr. Paul Ahern, Paul Ahern, Tel: 01617621055, paul.ahern@energycouncil.co.uk		Assessor ID T237-0001	
Client					
SUMMARY FOR INPUT DATA FOR New Build (As Designed)					
Criterion 1 – Achieving the TER and TFEE rate					
1a TER and DER					
Fuel for main heating	Electricity				
Fuel factor	1.55 (electricity)				
Target Carbon Dioxide Emission Rate (TER)	26.90	kgCO ₂ /m ²			
Dwelling Carbon Dioxide Emission Rate (DER)	22.79	kgCO ₂ /m ²	Pass		
	-4.11 (-15.3%)	kgCO ₂ /m ²			
1b TFEE and DFEE					
Target Fabric Energy Efficiency (TFEE)	51.56	kWh/m ² /yr			
Dwelling Fabric Energy Efficiency (DFEE)	49.44	kWh/m ² /yr			
	-2.2 (-4.3%)	kWh/m ² /yr	Pass		
Criterion 2 – Limits on design flexibility					
Limiting Fabric Standards					
2 Fabric U-values					
Element	Average	Highest			
External wall	0.17 (max. 0.30)	0.17 (max. 0.70)	Pass		
Party wall	0.00 (max. 0.20)	-	Pass		
Roof	0.10 (max. 0.20)	0.10 (max. 0.35)	Pass		
Openings	1.50 (max. 2.00)	1.50 (max. 3.30)	Pass		
2a Thermal bridging					
Thermal bridging calculated from linear thermal transmittances for each junction					
3 Air permeability					
Air permeability at 50 pascals	3.00 (design value)				
Maximum	10.0				
Pass					
Limiting System Efficiencies					
4 Heating efficiency					
Main heating system 1	Room heaters - Electric Panel, convector or radiant heaters				
Main heating system 2	Heat pump with warm air distribution - Electric Dimplex EDL200UK-630				

2B 4P dwelling Be Green:

BASIC COMPLIANCE REPORT		
Calculation Type: New Build (As Designed)		
Secondary heating system	None	
5 Cylinder insulation	No cylinder	
Hot water storage	No cylinder	
6 Controls		
Space heating controls 1	Programmer and appliance thermostats	
Hot water controls	No cylinder	
7 Low energy lights		
Percentage of fixed lights with low-energy fittings	100	%
Minimum	75	%
8 Mechanical ventilation		
Continuous supply and extract system		
Specific fan power	0.59	
Maximum	1.5	Pass
MVHR efficiency	94	%
Minimum	70	%
Pass		
Criterion 3 – Limiting the effects of heat gains in summer		
9 Summertime temperature		
Overheating risk (Thames Valley)	Slight	
Based on:		
Overshading	Average	
Windows facing North East	7.66 m ² , No overhang	
Windows facing South East	7.70 m ² , No overhang	
Air change rate	4.00 ach	
Blinds/curtains	None	
Criterion 4 – Building performance consistent with DER and DFEE rate		
Party Walls		
Type	U-value	
Filled Cavity with Edge Sealing	0.00	W/m ² K
Pass		
Air permeability and pressure testing		
3 Air permeability		
Air permeability at 50 pascals	3.00 (design value)	
Maximum	10.0	
Pass		
10 Key features		
Party wall U-value	0.00	W/m ² K
Roof U-value	0.10	W/m ² K
Air permeability	3.0	m ³ /m ² h
Photovoltaic array	0.08	kW

This report has not been submitted through the Elmhurst Energy members' portal, therefore results are subject to change when the dwelling is completed.

3B dwellings Be Lean

BASIC COMPLIANCE REPORT					
Calculation Type: New Build (As Designed)					
Property Reference	121765		Issued on Date	25/11/2021	
Assessment Reference	242523		Prop Type Ref	Type 3.1 Top	
Property	81 6 -Top, Former Boddingtons Site				
SAP Rating	76 C	DER	28.01	TER	24.57
Environmental	79 C	% DER<TER	-13.99		
CO ₂ Emissions (t/year)	1.91	DFEE	45.52	TFEE	47.24
General Requirements Compliance	Fail	% DFEE<TFEE	3.64		
Assessor Details	Mr. Paul Ahern, Paul Ahern, Tel: 01617621055, paul.ahern@energycouncil.co.uk			Assessor ID	T237-0001
Client					
SUMMARY FOR INPUT DATA FOR New Build (As Designed)					
Criterion 1 – Achieving the TER and TFEE rate					
1a TER and DER					
Fuel for main heating	Electricity				
Fuel factor	1.55 (electricity)				
Target Carbon Dioxide Emission Rate (TER)	24.57	kgCO ₂ /m ²			
Dwelling Carbon Dioxide Emission Rate (DER)	28.01	kgCO ₂ /m ²			
Excess emissions	3.44 (14.0%)	kgCO ₂ /m ²	Fail		
1b TFEE and DFEE					
Target Fabric Energy Efficiency (TFEE)	47.24	kWh/m ² /yr			
Dwelling Fabric Energy Efficiency (DFEE)	45.52	kWh/m ² /yr			
	-1.7 (-3.6%)	kWh/m ² /yr	Pass		
Criterion 2 – Limits on design flexibility					
Limiting Fabric Standards					
2 Fabric U-values					
Element	Average	Highest			
External wall	0.17 (max. 0.30)	0.17 (max. 0.70)	Pass		
Party wall	0.00 (max. 0.20)	-	Pass		
Roof	0.10 (max. 0.20)	0.10 (max. 0.35)	Pass		
Openings	1.50 (max. 2.00)	1.50 (max. 3.30)	Pass		
2a Thermal bridging					
Thermal bridging calculated from linear thermal transmittances for each junction					
3 Air permeability					
Air permeability at 50 pascals	3.00 (design value)				
Maximum	10.0				
Pass					
Limiting System Efficiencies					
4 Heating efficiency					
Main heating system	Room heaters - Electric				
	Panel, convector or radiant heaters				
Secondary heating system	None				
5 Cylinder insulation					

BASIC COMPLIANCE REPORT		
Calculation Type: New Build (As Designed)		
Hot water storage	Nominal cylinder loss: 1.74 kWh/day Permitted by DBSCG 2.24	Pass
Primary pipework insulated	No primary pipework	
6 Controls		
Space heating controls	Programmer and appliance thermostats	Pass
Hot water controls	Cylinderstat	Pass
7 Low energy lights		
Percentage of fixed lights with low-energy fittings	100	%
Minimum	75	%
Pass		
8 Mechanical ventilation		
Continuous supply and extract system		
Specific fan power	0.59	
Maximum	1.5	
MVHR efficiency	94	%
Minimum	70	%
Pass		
Criterion 3 – Limiting the effects of heat gains in summer		
9 Summertime temperature		
Overheating risk (Thames Valley)	Slight	Pass
Based on:		
Overshading	Average	
Windows facing South East	7.70 m ² , No overhang	
Windows facing South West	5.09 m ² , No overhang	
Air change rate	4.00 ach	
Blinds/curtains	None	
Criterion 4 – Building performance consistent with DER and DFEE rate		
Party Walls		
Type	U-value	
Filled Cavity with Edge Sealing	0.00	W/m ² K
Pass		
Air permeability and pressure testing		
3 Air permeability		
Air permeability at 50 pascals	3.00 (design value)	
Maximum	10.0	
Pass		
10 Key features		
Party wall U-value	0.00	W/m ² K
Roof U-value	0.10	W/m ² K
Air permeability	3.0	m ³ /m ² h
Photovoltaic array	0.08	kW
This report has not been submitted through the Elmhurst Energy members' portal, therefore results are subject to change when the dwelling is completed.		

3B dwellings Be Clean

BASIC COMPLIANCE REPORT					
Calculation Type: New Build (As Designed)					
Property Reference	Z42523-Op2		Issued on Date	25/11/2021	
Assessment Reference	Z42523	Prop Type Ref	Type 3.1 Top		
Property	B1.6 -Top, Former Boddingtons Site				
SAP Rating	B3 B	DER	20.88	TER	24.41
Environmental	B3 B	% DER<TER	14.46		
CO ₂ Emissions (t/year)	1.25	DFEE	45.52	TFEE	47.24
General Requirements Compliance	Pass	% DFEE<TFEE	3.64		
Assessor Details	Mr. Paul Ahern, Paul Ahern, Tel: 01617621055, paul.ahern@energycouncil.co.uk			Assessor ID	T237-0001
Client					
SUMMARY FOR INPUT DATA FOR New Build (As Designed)					
Criterion 1 – Achieving the TER and TFEE rate					
1a TER and DER					
Fuel for main heating	Electricity				
Fuel factor	1.55 (electricity)				
Target Carbon Dioxide Emission Rate (TER)	24.41	kgCO ₂ /m ²			
Dwelling Carbon Dioxide Emission Rate (DER)	20.88	kgCO ₂ /m ²	Pass		
	-3.53 (-14.5%)	kgCO ₂ /m ²			
1b TFEE and DFEE					
Target Fabric Energy Efficiency (TFEE)	47.24	kWh/m ² /yr			
Dwelling Fabric Energy Efficiency (DFEE)	45.52	kWh/m ² /yr			
	-1.7 (-3.6%)	kWh/m ² /yr	Pass		
Criterion 2 – Limits on design flexibility					
Limiting Fabric Standards					
2 Fabric U-values					
Element	Average	Highest			
External wall	0.17 (max. 0.30)	0.17 (max. 0.70)	Pass		
Party wall	0.00 (max. 0.20)	-	Pass		
Roof	0.10 (max. 0.20)	0.10 (max. 0.35)	Pass		
Openings	1.50 (max. 2.00)	1.50 (max. 3.30)	Pass		
2a Thermal bridging					
Thermal bridging calculated from linear thermal transmittances for each junction					
3 Air permeability					
Air permeability at 50 pascals	3.00 (design value)				
Maximum	10.0				
Pass					
Limiting System Efficiencies					
4 Heating efficiency					
Main heating system 1	Room heaters - Electric Panel, convector or radiant heaters				
Main heating system 2	Heat pump with warm air distribution - Electric Dimplex EDL200UK-630				



BASIC COMPLIANCE REPORT		
Calculation Type: New Build (As Designed)		
Secondary heating system	None	
5 Cylinder insulation		
Hot water storage	No cylinder	
6 Controls		
Space heating controls 1	Programmer and appliance thermostats	
Hot water controls	No cylinder	
7 Low energy lights		
Percentage of fixed lights with low-energy fittings	100	%
Minimum	75	%
Pass		
8 Mechanical ventilation		
Continuous supply and extract system		
Specific fan power	0.59	
Maximum	1.5	
MVHR efficiency	94	%
Minimum	70	%
Pass		
Criterion 3 – Limiting the effects of heat gains in summer		
9 Summertime temperature		
Overheating risk (Thames Valley)	Not significant	
Pass		
Based on:		
Overshading	Average	
Windows facing South East	7.70 m ² , No overhang	
Windows facing South West	5.09 m ² , No overhang	
Air change rate	4.00 ach	
Blinds/curtains	None	
Criterion 4 – Building performance consistent with DER and DFEE rate		
Party Walls		
Type	U-value	
Filled Cavity with Edge Sealing	0.00	W/m ² K
Pass		
Air permeability and pressure testing		
3 Air permeability		
Air permeability at 50 pascals	3.00 (design value)	
Maximum	10.0	
Pass		
10 Key features		
Party wall U-value	0.00	W/m ² K
Roof U-value	0.10	W/m ² K
Air permeability	3.0	m ³ /m ² h
Photovoltaic array	0.08	kW

This report has not been submitted through the Elmhurst Energy members' portal, therefore results are subject to change when the dwelling is completed.



Be Lean Typical Commercial Unit –

BRUKL Output Document

HM Government
Compliance with England Building Regulations Part L 2013

Project name **Shell and Core**

Commercial Space - Be Lean As designed

Date: Thu Nov 25 09:25:30 2021

Administrative information

Building Details

Address: Boddingtons, Manchester,

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.13

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.13

BRUKL compliance check version: v5.6.b.0

Certifier details

Name: Matthew Adams

Telephone number: 0161 762 1055

Address: Energy Council, Viridor House, 3 Bolholt Terrace,
Bury, BL8 1PP

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

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	31.3
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	31.3
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	29.9
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 fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the 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	0.21	0.24	FF000008:Surf[10]
Floor	0.25	0.12	0.12	GF000007:Surf[0]
Roof	0.25	-	-	UNKNOWN
Windows***, roof windows, and rooflights	2.2	1.6	1.6	FF000008:Surf[0]
Personnel doors	2.2	-	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building
U _a -Limit = Limiting area-weighted average U-values [W/(m ² K)] U _a -Calc = Calculated area-weighted average U-values [W/(m ² K)] U _i -Calc = Calculated maximum individual element U-values [W/(m ² K)] * 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	8

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- VRF + Mech Vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.5	6	0	0	0.8
Standard value	2.5*	2.6	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

1- Elec HW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	0.1
Standard value	1	N/A

Local mechanical ventilation, exhaust, and terminal units

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

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

Shell and core configuration

Zone	Assumed shell?
FF Unit 1	NO
GF Unit 1	NO

General lighting and display lighting	Luminous efficacy [lm/W]			General lighting [W]
Zone name	Luminaire	Lamp	Display lamp	
Standard value	60	60	22	
FF Unit 1	-	85	60	4642
GF Unit 1	-	85	60	4303

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?
FF Unit 1	NO (-74.7%)	NO
GF Unit 1	NO (-57.2%)	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?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m ²]	860.2	860.2
External area [m ²]	862	862
Weather	MAN	MAN
Infiltration [m ³ /hm ² @ 50Pa]	8	3
Average conductance [W/K]	220.99	448.42
Average U-value [W/m ² K]	0.26	0.52
Alpha value* [%]	10	10

* 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 Institutions: Hospitals and Care Homes C2 Residential Institutions: Residential schools C2 Residential Institutions: Universities and colleges C2A Secure Residential Institutions Residential spaces D1 Non-residential Institutions: Community/Day Centre D1 Non-residential Institutions: Libraries, Museums, and Galleries D1 Non-residential Institutions: Education D1 Non-residential Institutions: Primary Health Care Building D1 Non-residential Institutions: 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	0.37	1.34
Cooling	6.32	8.74
Auxiliary	4.69	3.06
Lighting	42.37	47.61
Hot water	3.91	1.86
Equipment*	20.26	20.26
TOTAL**	57.66	62.62

* Energy used by equipment does not count towards the total for consumption or 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]	102.51	131.59
Primary energy* [kWh/m ²]	177.03	183.89
Total emissions [kg/m ²]	29.9	31.3

* 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] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity									
Actual	5.5	97	0.4	6.3	4.7	4.19	4.26	4.5	6
Notional	12.4	119.2	1.3	8.7	3.1	2.56	3.79	---	---

Key to terms

Heat dem	= Heating energy demand
Cool dem	= 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 Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	U _{i-Typ}	U _{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.18	GF000007:Surf[1]
Floor	0.2	0.12	GF000007:Surf[0]
Roof	0.15	-	UNKNOWN
Windows, roof windows, and rooflights	1.5	1.6	FF000008:Surf[0]
Personnel doors	1.5	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building
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	8

Be Cean Typical Commercial Unit

BRUKL Output Document

HM Government
Compliance with England Building Regulations Part L 2013

Project name **Shell and Core**

Commercial Space - Be Green As designed

Date: Thu Nov 25 09:29:00 2021

Administrative information

Building Details

Address: Boddingtons, Manchester,

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.13

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.13

BRUKL compliance check version: v5.6.b.0

Certifier details

Name: Matthew Adams

Telephone number: 0161 762 1055

Address: Energy Council, Viridor House, 3 Bolholt Terrace,
Bury, BL8 1PP

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

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	31.3
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	31.3
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	25.9
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 fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the 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	0.21	0.24	FF000008:Surf[10]
Floor	0.25	0.12	0.12	GF000007:Surf[0]
Roof	0.25	-	-	UNKNOWN
Windows***, roof windows, and rooflights	2.2	1.6	1.6	FF000008:Surf[0]
Personnel doors	2.2	-	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

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	8

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- VRF + Mech Vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.5	6	0	0	0.8
Standard value	2.5*	2.6	N/A	N/A	0.5

Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system NO

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.

1- Elec HW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	0.1
Standard value	1	N/A

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
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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	-	N/A
FF Unit 1	-	-	-	1	-	-	-	-	-	-	N/A
GF Unit 1	-	-	-	1	-	-	-	-	-	-	N/A

Shell and core configuration

Zone	Assumed shell?
FF Unit 1	NO
GF Unit 1	NO

General lighting and display lighting

Zone name	Luminous efficacy [lm/W]			General lighting [W]
	Luminaire	Lamp	Display lamp	
Standard value	60	60	22	
FF Unit 1	-	85	60	4642
GF Unit 1	-	85	60	4303

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?
FF Unit 1	NO (-74.7%)	NO
GF Unit 1	NO (-57.2%)	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?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters			Building Use	
	Actual	Notional	% Area	Building Type
Area [m ²]	880.2	880.2	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 Institutions: Hospitals and Care Homes C2 Residential Institutions: Residential schools C2 Residential Institutions: Universities and colleges C2A Secure Residential Institutions Residential spaces D1 Non-residential Institutions: Community/Day Centre D1 Non-residential Institutions: Libraries, Museums, and Galleries D1 Non-residential Institutions: Education D1 Non-residential Institutions: Primary Health Care Building D1 Non-residential Institutions: Crown and County Courts D2 General Assembly and Leisure, Night Clubs, and Theatres Others: Passenger terminals Others: Emergency services Others: Miscellaneous 24hrs activities Others: Car Parks 24 hrs Others: Stand alone utility block
External area [m ²]	882	882		
Weather	MAN	MAN		
Infiltration [m ³ /hm ² @ 50Pa]	8	3		
Average conductance [W/K]	220.99	448.42		
Average U-value [W/m ² K]	0.26	0.52		
Alpha value* [%]	10	10		

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

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	0.37	1.34
Cooling	6.32	8.74
Auxiliary	4.69	3.06
Lighting	42.37	47.61
Hot water	3.91	1.86
Equipment*	20.26	20.26
TOTAL**	57.66	62.62

* Energy used by equipment does not count towards the total for consumption or 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	7.8	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]	102.51	131.59
Primary energy* [kWh/m ²]	177.03	183.89
Total emissions [kg/m ²]	25.9	31.3

* 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 SSEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity									
Actual	5.5	97	0.4	6.3	4.7	4.19	4.26	4.5	8
Notional	12.4	119.2	1.3	8.7	3.1	2.56	3.79	----	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
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Roof	0.15	-	UNKNOWN
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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	8



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