PRIESTS BRIDGE, EAST SHEEN RICHMOND

ENERGY STRATEGY

PROJECT NUMBER: P1591

DOCUMENT REF: P1591-ENE-03

Revision	Date	Details	Authored	Checked
R1	30/01/2019	Issued for planning	C Armstrong	S Quinlan
R2	19/11/2019	Revised after design addendum	C Armstrong	S Quinlan
R3	17/06/2022	Revised to suit design changes	A Jones	C Armstrong

OFFICES

KENT (HQ) – Unit 3 Grove Dairy Farm Business Centre, Bobbing Hill, Bobbing, Sittingbourne, Kent ME9 8NY

LONDON – One Bridge Wharf, 56 Caledonian Road, London, N1 9UU

CONTENTS

1.0 EXECUTIVE SUMMARY

QuinnRoss Consultants was commissioned by Wimshurst Pelleriti to develop an Energy Strategy for the proposed 26-28 Priests Bridge development that would demonstrate how it will provide heating and power and meet the energy and carbon emission targets set by national and local policy. This energy strategy concerns the planning policies and regulations that apply to the proposed development and the sustainability strategies employed at the site. The relevant targets are noted, and we will outline the best methods to allow compliance with them.

The new development is expected to comprise 9 no. residential units, mainly one and two-bedroom apartments, a flexible commercial space at ground floor level beneath 7 no. of the residential units and a larger flexible commercial unit at the rear with 2 no. residential units at first floor level.

This development will be subject to the following requirements:

Requirement	Description / Summary
Building Regulations Part L1A	Each individual dwelling must have better building fabric and energy performance when compared to a Target Emission Rate (TER)
Building Regulations Part L2A	The commercial areas must have a Building's Emission Rate (BER) equal to or less than the calculated Target Emissions Rate (TER)
EPC	An EPC calculation must be carried out upon completion by an experienced engineer accredited with a well-established professional body
Richmond Borough Local Plan LP22	All new residential dwellings must have CO_2 emissions 35% better than the current 2013 Building Regulations
Richmond Borough Local Plan LP22	All new commercial buildings must have CO_2 emissions 35% better than the current 2013 Building Regulations
Richmond Borough Core Strategy CP22	All new developments must have a 20% reduction of CO_2 via renewable technology
BREEAM Excellent	All new commercial developments must aim for BREEAM "Excellent", which is a BREEAM score of at least 70%

Table 1: Summary of energy and sustainability targets

To achieve the above targets, the following energy reduction methods will be required, using the London Plan's Energy Hierarchy:

Method	Description / Summary
Be Lean	
Building form	The building form must be optimised to help limit any unnecessary energy use.
High performing building thermal envelope	Construction U-values performing substantially above the current building regulations.
Low infiltration	Air tightness no higher than 5.0 m^3/m^2h.
Daylight strategy	The maximisation of daylight within a building can reduce lighting demand significantly.
Natural ventilation	All residential areas will be naturally ventilated and use opening windows and night time purging.
Highly efficient lighting with controls	LEL lighting, such as LED lighting, installed throughout with daylight and PIR sensors where possible.
Highly efficient HVAC systems	Only specifying highly efficient heat pumps in the residential and commercial spaces with high heating CoP and cooling SEER's.
Insulated pipe work	All Internal heating pipework will be insulated to a standard beyond building regulation requirements.

Unregulated Energy Use	Efforts will be made to reduce the unregulated emissions by providing "best in class" ("A" rated or equivalent) white goods and energy display devices that show electricity use to encourage residents to save energy.
Be Clean	
District Heating	The nearest existing and potential DH networks are 3-6 km from the site which is an unfeasible distance and pipe lines would have to cross the River Thames and several major road and rail lines. DH is therefore not considered.
Combined Heat and Power (CHP) for residential spaces	Although it is not unfeasible to install a CHP engine for this development it must be noted that the development is relatively small, and a smaller / micro CHP would be the only feasible option. Smaller CHP engines are much less efficient than larger ones, having a worse heat to power ratio. This means that they do not enable as large a CO_2 reduction as they would for a larger development. CHP is therefore not considered.
Be Green	
Solar photovoltaic (PV) panels for commercial spaces	27 m^2 of PV panels will be located at roof level. The SunForte PM096B00 product is used. This currently has a highly efficient modular panel efficiency of 19.6% and, although more expensive than less efficient cheaper models, they offer greater output for less panel area when compared to less efficient models. The PV's will be laid horizontal/flat and evenly distributed among the apartments based on panel area/floor area.
Air source heat pumps	Both residential and commercial spaces will heat pumps. The residential areas will use air to water heat pumps for heating & hot water and commercial spaces will use air source heat pumps for heating & cooling.

Table 2: Summary of energy hierarchy Lean, Clean & Green methods

Thermal and Energy Modelling Results

All commercial and residential apartments have been analysed for their energy use using approved energy modelling software. The domestic predicted and saved tonnes of CO_2 are shown below:

Domestic	
Scenario	Regulated t/CO_2 year
Baseline: Part L 2013 of the Building Regulations Compliant Development	17.8
After Energy Demand Reduction	15.1
After Heat Network / CHP	15.1
After Renewable Energy	11.0

Scenario	Regulated Domestic Carbon Dioxide Savings	
	Regulated t/CO_2 year	%
Savings From Energy Demand Reduction	2.7	15%
Savings From Heat Network / CHP	0	0%
Savings From Renewable Energy	4.2	23%
Cumulative On-Site Savings	6.8	38%

Domestic	Annual Shortfall (t/CO_2 year)	Cumulative Shortfall (t/CO_2 year)
Total Target Savings	6.2	-
Shortfall	-0.6	-18.1

Table 3: Summary of domestic CO_2 emissions and savings

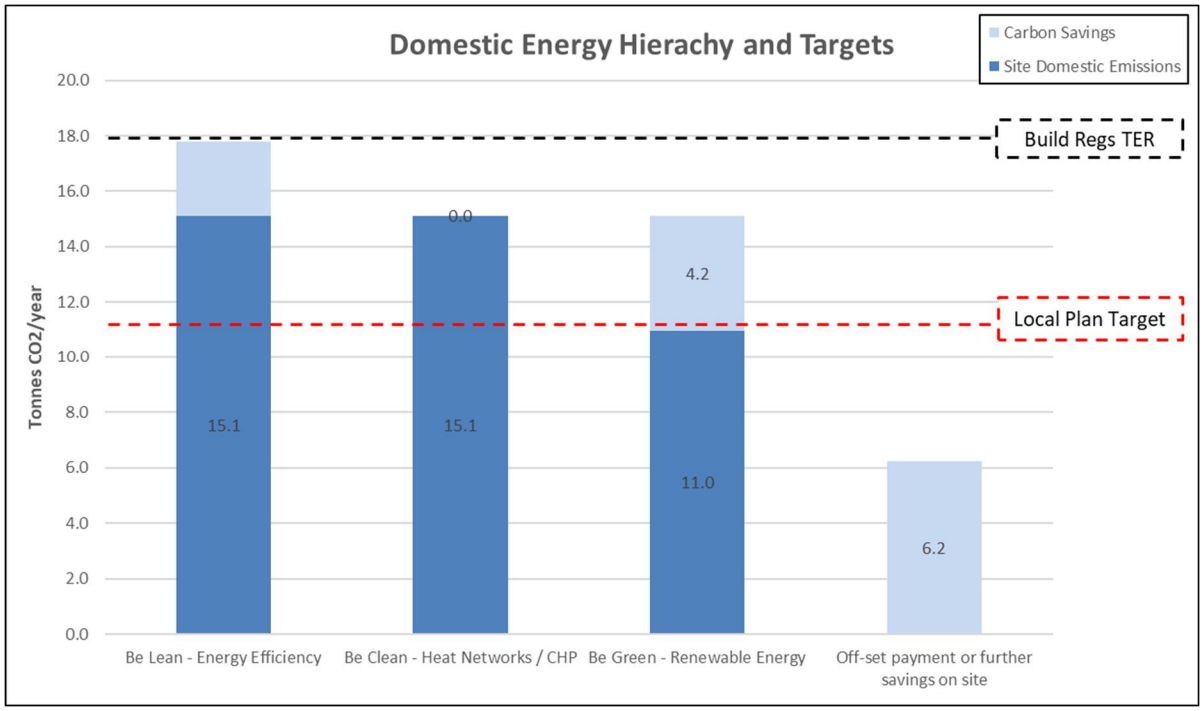


Figure 1: Summary of domestic CO_2 emissions and savings

As the results above show, when including all available Lean and Green technologies and methods, the domestic areas of the building will achieve a 38% improvement over current Building Regulations.

The non-domestic predicted and saved tonnes of CO_2 are shown below. Please note this is for all commercial units combined:

Non-Domestic	
Scenario	**Regulated t/CO_2 year**
Baseline: Part L 2013 of the Building Regulations Compliant Development	16.3
After Energy Demand Reduction	14.7
After Heat Network / CHP	14.7
After Renewable Energy	12.3

Scenario	Regulated Non-Domestic Carbon Dioxide Savings	
	Regulated t/CO_2 year	**%**
Savings From Energy Demand Reduction	1.6	10%
Savings From Heat Network / CHP	0	0%
Savings From Renewable Energy	2	15%
Cumulative On-Site Savings	4.0	24%

Non-Domestic	Annual Shortfall (t/CO_2 year)	Cumulative Shortfall (t/CO_2 year)
Total Target Savings	5.7	-
Shortfall	1.7	51.5

Table 4: Summary of non-domestic CO_2 emissions and savings

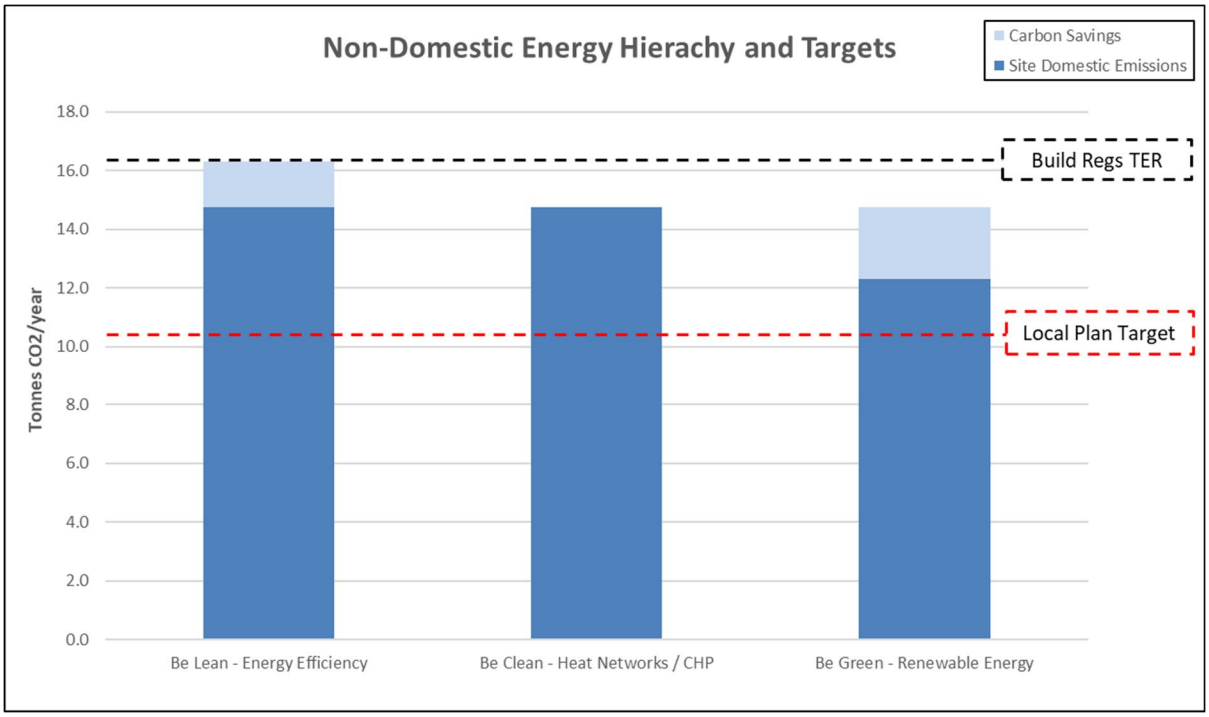


Figure 2: Summary of non-domestic CO_2 emissions and savings

As the results above show, when including all available Lean technologies and methods, the commercial areas of the building will achieve a 24% improvement over current Building Regulations.

The Site-Total predicted and saved tonnes of CO_2 are shown below:

Site Total			
Scenario	**Total Regulated Emissions (t/CO_2 yr)**	**CO2 Savings (t/CO2/yr)**	**Percentage Saving (%)**
Part L 2013 Baseline	34	-	-
Be Lean	30	4	12%
Be Clean	30	0	0%
Be Green	23	7	19.3%
CO2 Savings Off-set (t/CO2/yr)	33		

Table 5: Summary of site total CO_2 emissions and savings

All inputs, L1A SAP outputs and L2A BRUKL documents can be found in the appendices.

BREEAM

QuinnRoss has issued a BREEAM New Construction 2018 pre-assessments, document reference no: *P1567-BREEAM-01* issued 31/01/19. This report states the building will potentially achieve a BREEAM score of 72% which is an "*Excellent*" rating.

Improvements Over Previous Scheme

QuinnRoss has issued a previous energy strategy for this scheme, *P1591-ENE-01* issued 30 January 2019, which used a more conventional boiler system in the residential apartments and the scheme as a whole reduced t/CO_2 by 12% over Building Regulations. This new addendum with its proposed heat pump system will reduce CO2 further, a 21% reduction over Building Regulations, nearly double the previous scheme's savings. The figure below shows this saving:

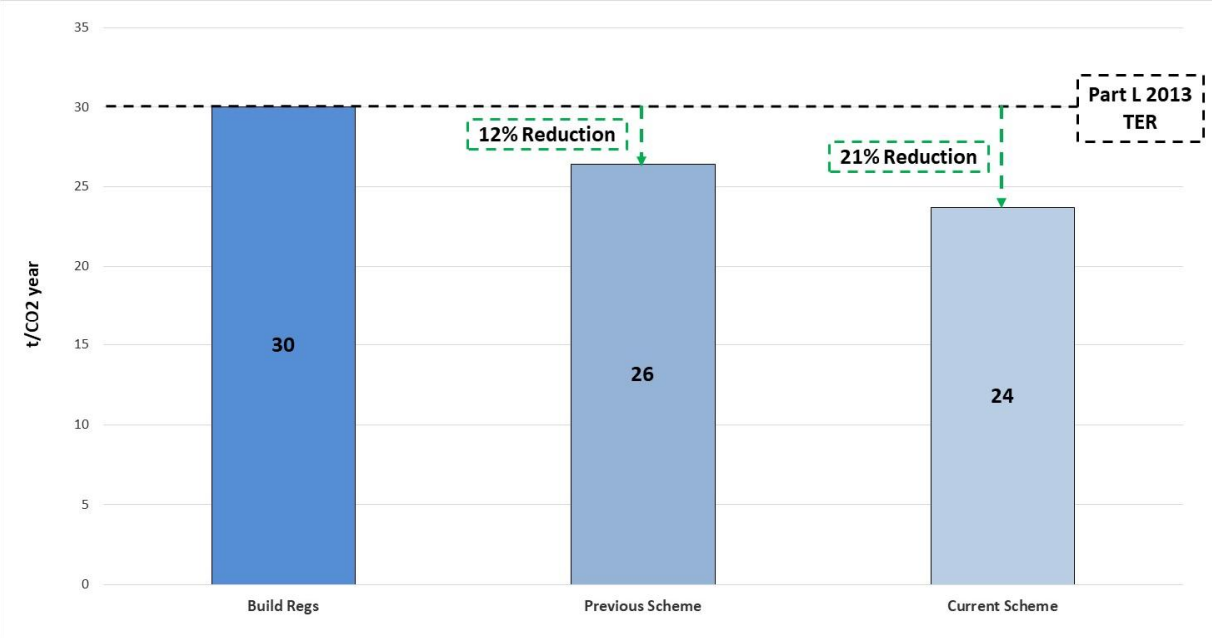


Figure 3: Comparison of current and previous scheme

2.0 INTRODUCTION

QuinnRoss Consultants was commissioned by Wimshurst Pelleriti to develop an energy assessment for the proposed Priests Bridge development that would demonstrate how it will provide heating, power and meet the energy and carbon emission targets set by national and local policy.

The site is located on 26-28 Priests Bridge, East Sheen, in the London Borough of Richmond. See site image below:

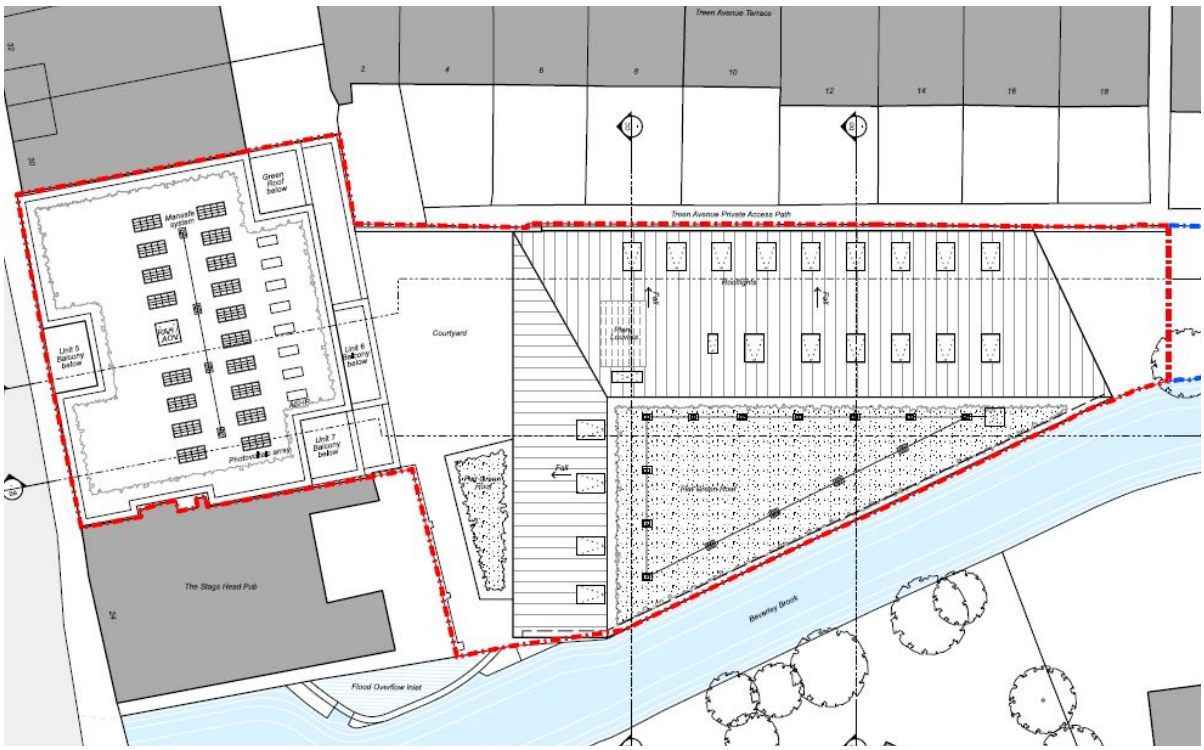


Figure 4: Site plan of site

The new development is expected to comprise 9 no. residential units, mainly one and two-bedroom apartments, a flexible commercial space at ground floor level beneath 7 no. of the residential units and a larger flexible commercial unit at the rear with 2 no. residential units at first floor level.

3.0 PLANNING POLICY AND LEGISLATION

This section describes the planning policies and regulations that will affect the proposed development. These are outlined below:

- Building Regulations Part L2A 2013, new buildings other than dwellings.
- Building Regulations Part L1A 2016, new dwellings.
- Energy Performance Certificate (EPC).
- London Borough of Richmond Core Strategy.
- London Borough of Richmond Development Management Plan.
- London Borough of Richmond Local Plan.
- The London Plan 2016.
- BREEAM UK New Construction 2018.

Figure 5: Document front cover images of applicable policies

3.01 Building Regulations Part L1A

The residential areas of the development will be subject to the Building Regulations Conservation of Fuel and Power in new dwellings Part L1A (ADL1A). Each individual dwelling will subject to the Standard Assessment Procedure (SAP) calculation which will determine energy consumption, therefore CO_2 emissions, in kWh/m^2/yr and a Target Fabric Energy Efficiency (TFEE) value. This effectively requires a minimum level of building fabric and energy performance when compared to a Target Emission Rate (TER) which is determined by the approved SAP software (kg/CO_2/m^2/yr).

The Target Emissions Rate is a limit of kg CO_2 per m^2 based on regulated loads of the building. Regulated loads refer to heating, cooling, auxiliary, lighting and DHW energy consumption, end uses related to the quality of the building construction and design. Unregulated loads are energy consuming end uses related to occupant's behaviour, such as computers, lifts or escalators.

3.02 Building Regulations Part L2A

The commercial areas of the development will be subject to the Approved Document Part L2A 2013 (ADL2A), for new non-domestic buildings. It sets out requirements for limiting carbon emissions from buildings. It is a mandatory requirement that calculations must be carried out to show the Building's Emission Rate (BER) is equal to or less than the calculated Target Emissions Rate (TER). These calculations must be undertaken by a Dynamic Simulation Modelling (DSM) software approved for such calculations. Part L2A defines five methodology and criteria, the first three can be tested at this design stage. These are described below:

- **Criterion 1 –** Carbon Emissions Target: Part L 2013 requires that the building's CO_2 Emission Rate (BER) is equal to or lower than a Target CO_2 Emission Rate (TER). The two calculations must be performed in a prescribed way using the same approved modelling software.
- **Criterion 2 –** Limit to design flexibility: This criterion ensures the building fabric and HVAC systems have a minimum specified performance, e.g. U-value of walls to be no higher than 0.35 W/m^2.K.
- **Criterion 3 –** Limits to Solar Gains: Any zone in the actual building that is an occupied space will be subject to a solar gain limit.

There are two further criteria for compliance, which must be determined at the completion of the building.

3.03 Energy Performance Certificate (EPC)

It is a requirement for all new non-dwellings over 500m² frequently visited by the public and all new dwellings marketed for sale to undergo predicted energy consumption calculations and have the results displayed in the form of an EPC.

The only target for the EPC calculation is that defined by the Minimum Energy Efficiency Standards (MEES). MEES makes it illegal to rent, sell or lease a residential unit that achieves an EPC band F or worse. This regulation is more focussed on existing dwellings however and a new development is unlikely to encounter such low EPC scoring.

3.04 Richmond Borough Council Policies

The proposed building falls within the administrative area of the London Borough of Richmond who have a set of requirements for new developments outlined in several policy documents:

- Core Strategy
- Development Management Plan
- Richmond Local Plan

The documents above outline a number of topics related to development, such as flood risks, biodiversity and town planning, however this report is focused on the energy related requirements which are summarised in this section.

3.04.01 Core Strategy

- CP1 – All new commercial buildings must achieve BREEAM “Excellent”.
- CP2 – All new development must outline how they will minimise energy consumption.
- CP2 – All new developments must evaluate decentralised energy where appropriate.
- CP2 – All new developments must have a 20% reduction of CO_2 via renewable technology.

3.04.02 Development Management Plan

- DM SD1 – All new development must achieve 'zero carbon' standards from 2016.
- DM SD2 – Some form of low carbon renewable and/or de-centralised energy will be expected in some form.
- DM SD2 – New development must conform to the London Plan 2016’s Energy Hierarchy approach to design: 1) minimise energy used on site, then 2) use low carbon technologies, finally 3) include renewable sources.
- DM SD2 – New development will be expected to connect to existing or planned decentralised energy networks.
- DM SD 9 – New developments must achieve at least 2 credits under BREEAM New Construction 2018 Wat 01 Water Consumption.

3.04.03 Local Plan

- LP20 – New developments should look to minimise energy consumption through the London Plan 2016’s cooling hierarchy.
- LP22 – New residential developments must achieve water consumption of no more than 110 l/pers/day.

- LP22 – All new commercial buildings must achieve BREEAM "Excellent".
- LP22 – All new residential developments, under 10 units, must achieve CO_2 emissions 35% better than Building Regulations 2013.
- LP22 – All new commercial developments must achieve CO_2 emissions 35% better than Building Regulations 2013.
- LP22 – All New development must conform to the London Plan 2016's Energy Hierarchy approach (see DM SD2 above).
- LP22 – New development will be expected to connect to existing or planned decentralised energy networks.

Please note policy DM SD 1 and LP22 contradict each other as they require different CO_2 reduction targets, one requiring zero carbon and one requiring 35% reduction of CO_2 emissions, as this development is less than 10 units.

It is assumed that Local Plan policy LP22 is the overriding requirement and the development's residential areas will aim for a 35% reduction in CO_2 over Building Regulations 2013.

3.05 London Plan 2016

All local policies refer to the requirements of *The London Plan 2016*.

The London Plan 2016 outlines a number of policies to underpin London's response to climate change. These policies cover adaptation, waste, aggregates, contaminated land, hazardous substances and most applicable to this development climate change mitigation. The key policies within the London Plan relating to energy consumption and CO_2 emissions include the following policies:

- 5.2 Minimising Carbon Dioxide Emissions
- 5.3 Sustainable Design and Construction
- 5.5 Decentralised Energy Networks
- 5.6 Decentralised Energy in Development Proposals
- 5.7 Renewable Energy
- 5.9 Overheating and Cooling

3.06 BREEAM 2018

The Building Research Establishment Environmental Assessment Method (BREEAM) seeks to minimise the adverse effects of buildings (new build and refurbishment) on the environment. It also aims to enable developments to be recognised according to their environmental benefits; provide a credible, environmental label for buildings; and to stimulate demand for environmentally sustainable buildings.

Buildings assessed under BREEAM are distributed points based on the total number of BREEAM criteria met and their respective environmental weightings. Although BREEAM targets vary between dwelling and non-dwelling buildings the categories are generally as follows:

- Management
- Health and wellbeing
- Energy
- Transport
- Water
- Materials
- Waste
- Land use and ecology

- Pollution
- Innovation

BREEAM compliance requirements will be building dependent and cannot be specified in detail at this stage. However, for information purposes the BREEAM rating benchmarks for new construction projects assessed under *BREEAM UK New Construction, Non-domestic Buildings, 2018* are as follows:

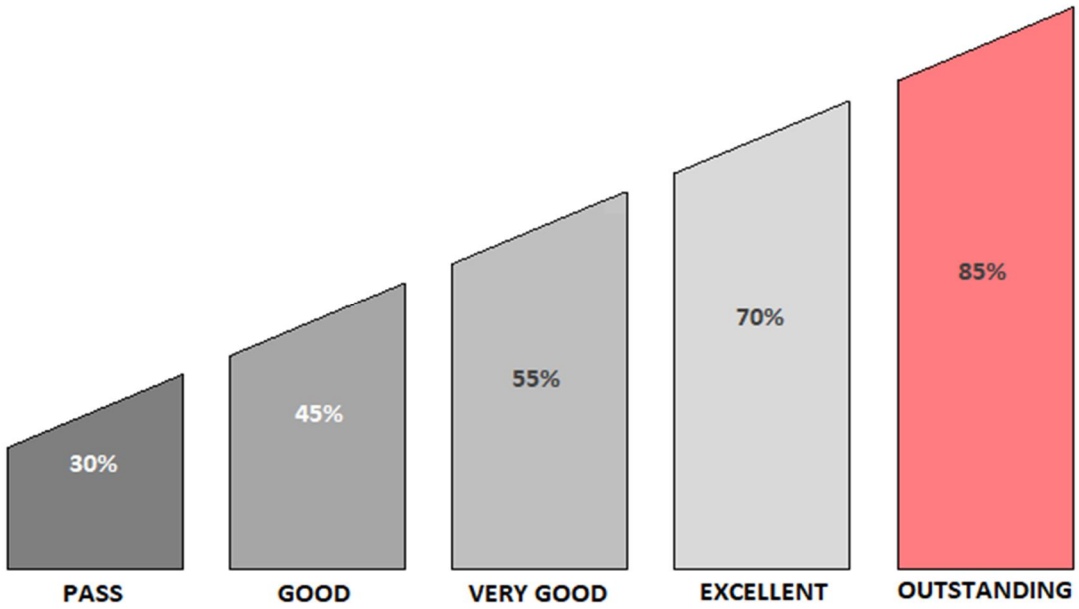
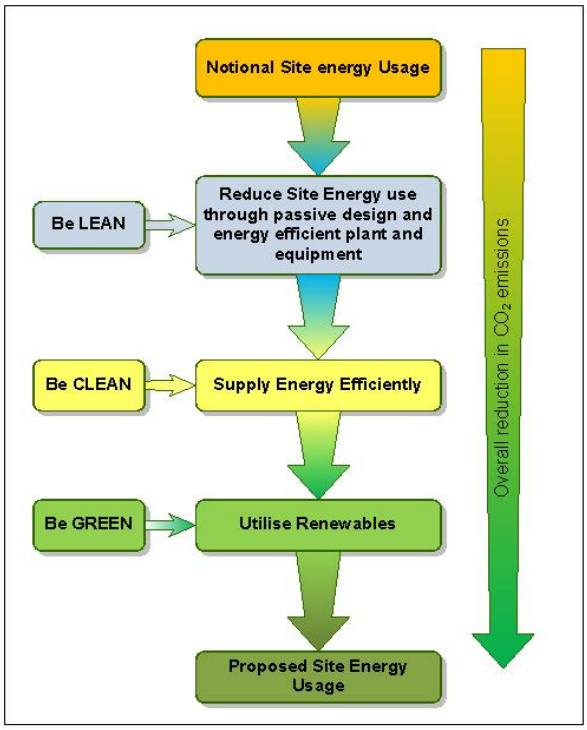


Figure 6: BREEAM score ratings based on BREEAM UK New Construction, Non-domestic Buildings, 2018

Please note as mentioned above, local policy requires this development to achieve *BREEAM "Excellent"*, for all commercial spaces. There is currently no BREEAM applicable for residential spaces, therefore no targets for these spaces.

4.0 ENERGY HIERACHY

As part of our aims to provide a sustainable development we will be following the widely adopted energy hierarchy originally outlined in the *London Plan* policy. The hierarchy shown below guides our approach to minimising the energy use within the building and to create a comfortable internal environment. This consists of three best practice criteria: Be Lean, Be Clean and Be Green to achieve Low energy and carbon design.



Be Lean – Passive Measures: reducing energy use through consideration of building form and construction in order to minimise the need for mechanical and electrical systems. Minimise plant energy use by selecting the most appropriate engineering systems and optimising system performance.

Be Clean – Decentralised Energy: consideration given to the potential to connect to any local decentralised heating networks.

Be Green – Renewable Energy: the use of appropriate on-site renewable/low carbon technologies.

Figure 7: London Plan's energy hierarchy

The design team has taken the above criteria and applied the most feasible measures to the building.

4.01 Be Lean

4.01.01 Building Form

The first thing to consider under passive design measures is how the building form can be best optimised and influenced to help limit any unnecessary energy use. The building form design includes the following to reduce energy use:

- Natural ventilation openings in the residential areas to avoid the use of mechanical ventilation or cooling systems.
- Generous floor to ceiling heights to help optimise daylight penetration into spaces.
- Dual aspect glazing or rooflights were available to optimise daylight and uniformity, which limits the need for artificial lighting.
- External shading / Bris soleil used for the large commercial space to reduce solar gains.

4.01.02 Building Envelope Thermal Performance

As there is no cooling for occupants for the residential the highest energy emitting end use will be heating. The most effective way of keeping heating energy consumption to a minimum is to ensure the building uses high performing fabric properties. It is proposed the building is well insulated and uses high performing

constructions substantially above the current minimum requirement of the building regulations. As a result, the following construction U-values (W/m².K) are proposed:

Envelope Element	U-Value W/m².K	
	Domestic	Non-Domestic
Wall	0.18	0.22
Roof	0.13	0.18
Floor	0.13	0.18
Glazing	1.40	1.60

Table 6: Proposed U-values for domestic and non-domestic

Please note further reduction in U-values is feasible for the commercial spaces, however these spaces are likely to have a retail or office use with a high glazing ratio where heating is a smaller energy using end use. Further reduction in U-values will likely gain little to no energy reduction and cause issues for overheating or increase cooling demand.

4.01.03 Air Infiltration

Uncontrolled air infiltration in a building can contribute to a significant proportion of heat losses particularly in well insulated modern buildings. An air permeability of no greater than 5.0 m³/m²h is proposed.

4.01.04 Daylight strategy

The provision of artificial lighting accounts for a significant proportion of most building's primary energy consumption. The maximisation of daylight within a building can reduce this demand significantly. The below items will be considered during the design development period throughout the contract:

- Generous floor to ceiling heights.
- Dual aspect glazing in areas where possible.
- Daylight dimmable and occupancy sensors where possible.

4.01.05 Natural ventilation

Natural ventilation to be used in all commercial and residential areas where possible using the following methods:

- Opening windows and balcony doors.
- Exposed soffits to utilise thermal mass cooling effect. Please note, an unexposed soffit would be a ceiling covered with a fixed structure, such as ceiling tiles for example.
- Night purging/ventilation.

Please note having exposed soffits will only be effective when used in conjunction with night purging/ventilation. It will also have effects on the acoustics of the room.

4.01.06 Energy efficient services

A number of energy efficient HVAC and lighting strategies are proposed for the development:

- Lighting – Low Energy Lighting (LEL), such as LED's, will be installed throughout and be chosen to minimise over-illumination.
- User controls – Efficient and user-friendly controls will be specified throughout all buildings.
- Residential Heating – The residential areas will be highly insulated for low space heating requirements. Heating and hot water demand will be provided by high efficiency heat pumps (outlined in section 4.03).

- Commercial Cooling – Efficient mechanical equipment (lighting, fans etc) will be specified to minimise internal gains. Solar control glazing will be used to reduce solar gain. Openable windows will be provided to allow for natural ventilation.
- Air conditioning – The commercial units will be comfort cooled and a heat pump cooling system will be used with a cooling Seasonal Energy Efficiency Rating (SEER) of at least 4.0 is proposed.

4.01.07 Insulated pipework

All Internal heating pipework, particularly those located in internal public corridors, will be insulated to a standard beyond building regulation requirements. This will minimise issues of internal heat gain and avoid the need for any additional ventilation or cooling.

4.01.08 Unregulated energy use

In addition, efforts are being made to reduce the unregulated emissions by providing "best in class" ("A" rated or equivalent) white goods and energy display devices that show electricity use to encourage residents to save energy.

Please note the benefits of high efficiency appliances cannot be included in any results shown in this report. These measures interact to some degree (e.g. more low energy lighting reduces the ancillary heat gains from lighting, so increases the space heating demand) so comparisons of individual results can produce apparent anomalies and are not provided as a result.

4.02 Be Clean

4.02.01 District Heating (DH) Networks

The next stage of the London Plan hierarchy is to look at the availability of decentralised heat networks within the vicinity of the development. Consideration should be given to connecting to these networks should there be one close to the development, or if a network is proposed for the local area. The image below shows the location of the site on the current London Heat Map (https://maps.london.gov.uk/webmaps/heatmap/):

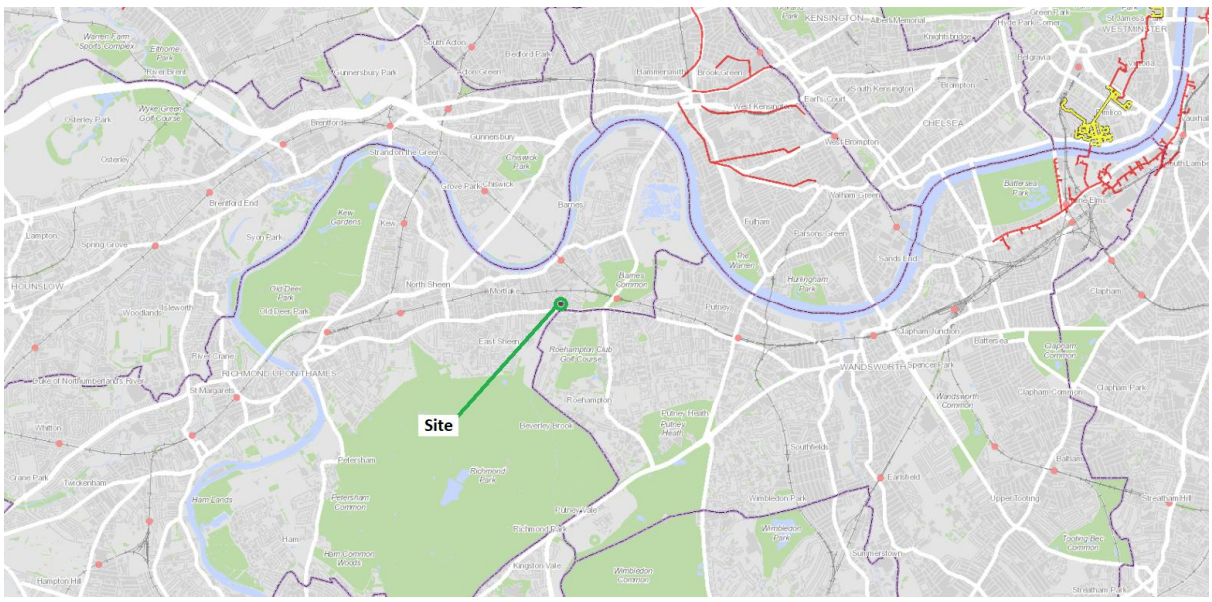


Figure 8: London heat map image showing site

The nearest existing DH network is located 6 km away in Pimlico. This is too far to allow for a feasible connection.

The nearest proposed network is the proposed Hammersmith & Fulham network, around 3 km from the site. This distance is also too far for a feasible connection and such a connection would have to cross the River Thames and several mainline network railways and main roads.

DH is therefore unfeasible and not considered.

4.02.02 Combined Heat and Power (CHP)

Although it is not unfeasible to install a CHP engine for this development it must be noted that the development is relatively small, and a smaller / micro CHP would be the only feasible option. Smaller CHP engines are much less efficient than larger ones, having a worse heat to power ratio. This means that they do not enable as large a CO_2 reduction as they would for a larger development. Furthermore, the GLA published guidance in April 2015 stating that it is not expected for smaller sites (less than 500 dwellings) to carry out a full feasibility analysis for the use of CHP. CHP is therefore not considered.

4.03 Be Green

The final part of the hierarchy is to minimise carbon dioxide emissions using renewable / Low or Zero Carbon (LZC) technologies. The implementation of renewables will almost certainly be required to meet the zero carbon targets of the residential elements. An initial LZC tech feasibility study has been carried out, shown in appendix A, and the most appropriate product available is solar photovoltaic (PV) panels.

4.03.01 Solar PV Panels

PV's are well suited for use as the renewable energy solution for the proposed development. The electricity that is generated by them can be used for a wide range of applications on site and can also be exported to the National Grid.

27 m^2 of PV panels will be located at roof level. The SunForte PM096B00 product is used. This currently has a highly efficient modular panel efficiency of 19.6% and, although more expensive than less efficient cheaper models, they offer greater output for less panel area when compared to less efficient models. The PV's will be laid horizontal/flat and evenly distributed among the residential areas based on panel/floor area.

Please note it is not intended for the commercial units to be connected to the PV panels. The uncertain nature of these units makes it difficult to predict the effectiveness of any renewable technology on these units.

Product information for the proposed PV units can be found in appendix E.

A proposed roof layout showing the location of the PV panels is shown in appendix F.

4.03.02 Air Source Heat Pumps

Considering future revisions to Building Regulations energy and CO_2 calculations the most CO_2 neutral heating system available is a highly efficient heat pump systems for space heating and hot water. The proposed heat pump system for this development is a Mitsubishi Ecodan system with a 290% heating efficiency.

Product information for the proposed heat pump system can be found in appendix G.

The commercial units will also use a commercial VRF heat pump system for heating and cooling. A manufacturer has not been selected yet, however the heating and cooling efficiencies used for this strategy are very typical for developments of this type.

5.0 THERMAL & ENERGY MODELLING, & BREEAM RESULTS

5.01 Software Used

5.01.01 Part L2A for Commercial Areas

All Part L2A calculations will use the Dynamic Simulation Modelling (DSM) method. The software used is the *Integrated Environmental Suite (IES)* software *Virtual Environment (VE) Version 2018.0.1.0.* IESVE is one of the world leaders in developing DSM software and is used internationally for all manner of dynamic simulation calculations, including Part L2A and ASHRAE 90.1 calculations. IESVE is approved by the Department of Community and Local Government (DCLG) for performing Part L2A 2013 and EPC calculations and for fills the requirements of CIBSE AM11 as a Building Energy and Environmental Modelling (BEEM) software. The software was used to create a 3-D model based on information provided by the design team as defined in the following section. Hourly simulations for a year were then run as part of the CO_2 emissions analysis using the relevant weather file for the location.

https://www.iesve.com/

The calculations were also carried out by an approved CIBSE Low Carbon Energy Assessor (LCEA) who is a fully accredited Level, 3, 4 and 5 user of IESVE.

An IES model image of the development is shown below:

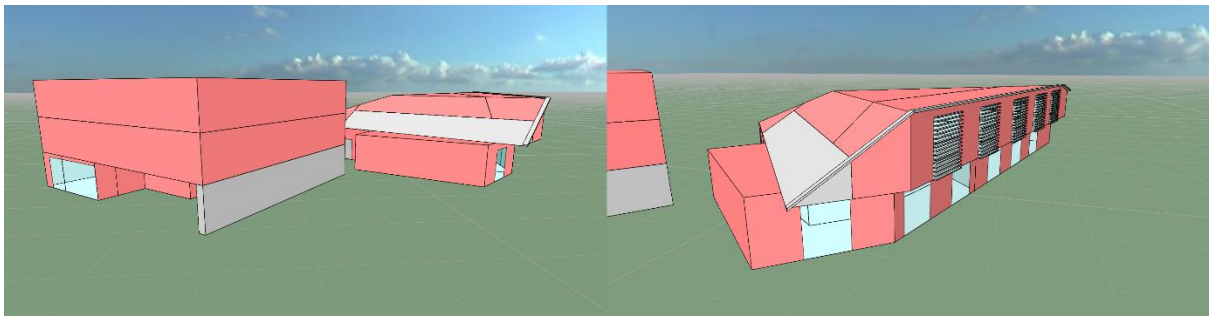


Figure 9: IES model image of proposed scheme

5.01.02 Part L1A for Residential Areas

All residential dwellings will be calculated using the Standard Assessment Procedure (SAP). The software used will be *Elmhurst Energy*'s (formerly NHER) *Design SAP 2012* which is widely used for building energy calculations throughout the On-Construction industry. All versions of *Elmhurst's Design SAP* software are fully BRE tested and Government approved; they calculate the necessary building regulations/standards for England (Part L), Wales (Part L), Northern Ireland (Part F) and Scotland (Section 6).

http://www.elmhurstenergy.co.uk/

The calculations were also carried out by an approved *Elmhurst Energy* On-Construction Domestic Energy Assessor (OCDEA).

5.02 Part L2A for Commercial Areas

5.02.01 Commercial Unit Front

The current design for the front unit was analysed under Part L2A. All inputs have to be assumed at this stage based on best practice guidance and experience with other similar units. These can be found in appendix C. The Part L2A results are shown below:

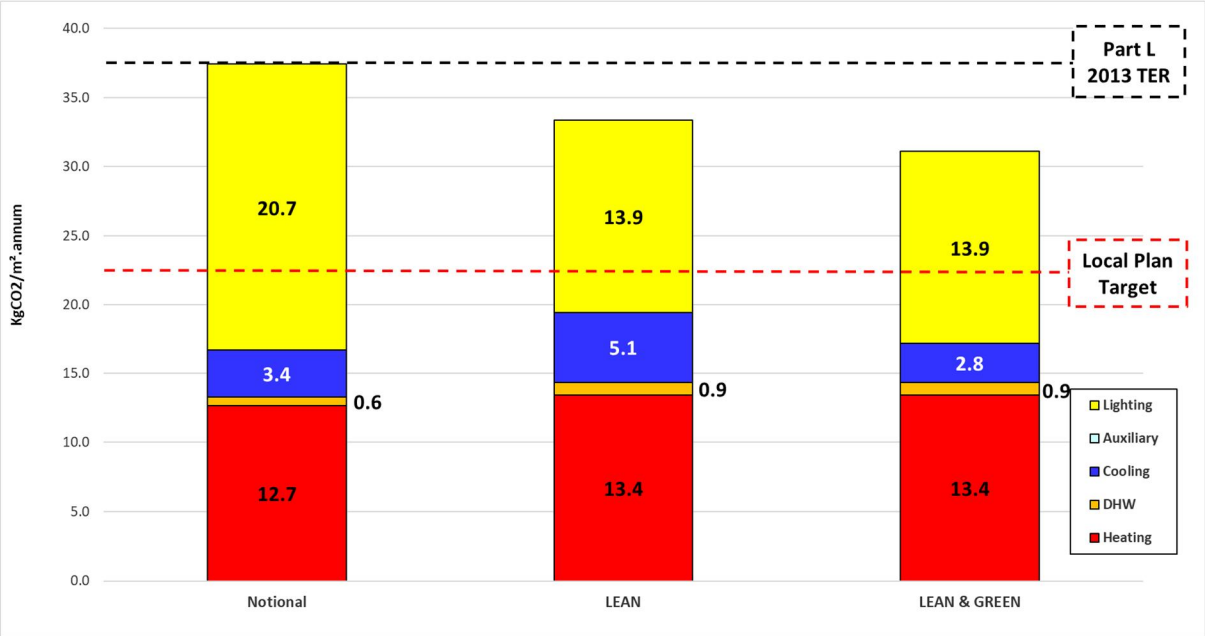


Figure 10: Part L2A results for 94 sqm unit

Using the input data in this report the unit will exceed Part L2A compliance by 16%.

The BRUKL documents proving the above calculations can be found in appendix J for the LEAN and K for the GREEN scenario.

5.02.02 Commercial Unit Rear

The current design for the rear unit was analysed under Part L2A. All inputs have to be assumed at this stage based on best practice guidance and experience with other similar units. These can be found in appendix D. The Part L2A results are shown below:

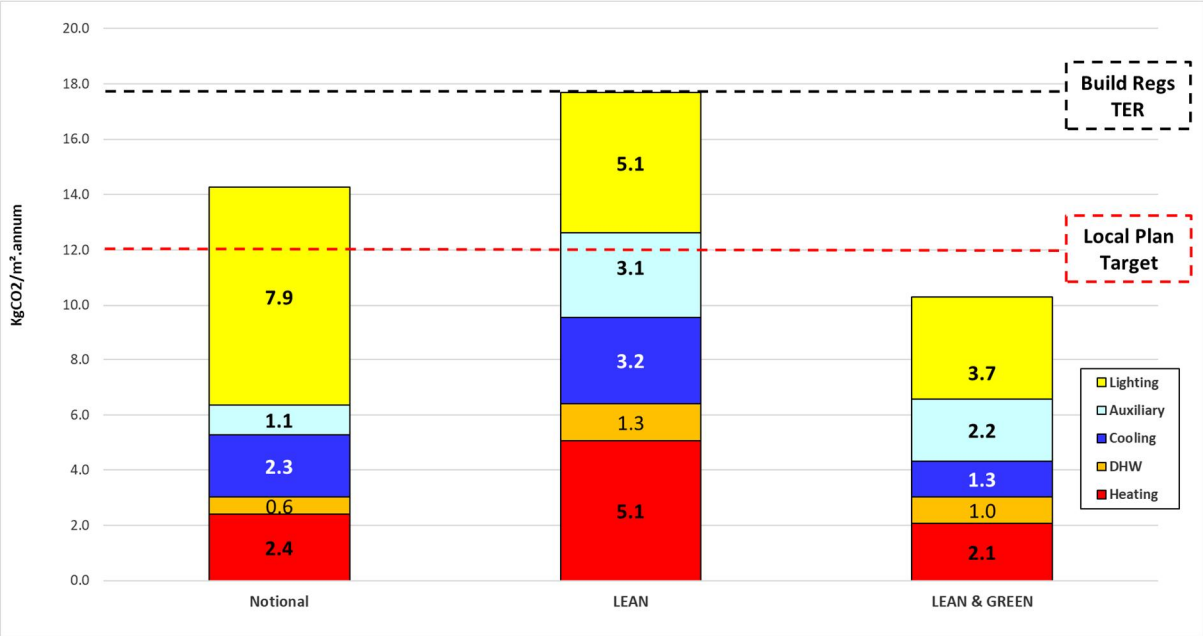


Figure 11: Part L2A results for 649 sqm unit

Using the input data outlined in this report this unit will exceed Part L2A compliance by 27%.

The BRUKL documents proving the above calculations can be found in appendix L for the LEAN and M for the GREEN scenario.

5.03 Part L1A for Residential Apartments

5.03.01 LEAN Scenario

The current design for the residential apartments were analysed under Part L1A. The results for the LEAN scenario are shown below:

Apartment	Location	Carbon Emissions (Kg CO2/m².yr)			Energy Consumption (kWh/m².yr)			Cri 03
		DER	TER	% DER<TER	DFEE	TFEE	% DFEE<TFEE	
UNIT 01	1st	29.45	32.77	10.13%	51.91	60.88	14.73%	PASS
UNIT 02	1st	29.90	33.97	11.98%	57.30	66.54	13.89%	PASS
UNIT 03	1st	26.33	31.06	15.23%	52.41	61.34	14.56%	PASS
UNIT 04	2nd	28.09	32.59	13.81%	53.11	61.94	14.26%	PASS
UNIT 05	2nd	27.24	33.01	17.48%	61.82	68.14	9.28%	PASS
UNIT 06	2nd	25.11	29.93	16.10%	56.72	60.50	6.25%	PASS
UNIT 07	2nd	28.69	34.11	15.89%	63.55	70.57	9.95%	PASS
UNIT 08	1st	22.05	27.65	20.25%	49.26	55.89	11.86%	PASS
UNIT 09	1st	21.30	24.43	12.81%	40.64	43.89	7.40%	PASS

Table 7: Part L1A results for LEAN scenario

A selection of SAP outputs as proof of the above calculations can be found in appendix H.

5.03.02 LEAN & GREEN Scenario

The results for the LEAN & GREEN scenario are shown below:

Apartment	Location	Carbon Emissions (Kg CO2/m².yr)			Energy Consumption (kWh/m².yr)			Cri 03
		DER	TER	% DER<TER	DFEE	TFEE	% DFEE<TFEE	
UNIT 01	1st	21.79	32.77	33.51%	51.91	60.88	14.73%	PASS
UNIT 02	1st	22.20	33.97	34.65%	57.30	66.54	13.89%	PASS
UNIT 03	1st	18.64	31.06	39.99%	52.41	61.34	14.56%	PASS
UNIT 04	2nd	20.37	32.59	37.50%	53.11	61.94	14.26%	PASS
UNIT 05	2nd	19.52	33.01	40.87%	61.82	68.14	9.28%	PASS
UNIT 06	2nd	17.42	29.93	41.80%	56.72	60.50	6.25%	PASS
UNIT 07	2nd	20.98	34.11	38.49%	63.55	70.57	9.95%	PASS
UNIT 08	1st	16.39	27.65	40.72%	49.26	55.89	11.86%	PASS
UNIT 09	1st	15.61	24.43	36.10%	40.64	43.89	7.40%	PASS

Table 8: Part L1A results for LEAN and GREEN scenario

A selection of SAP outputs as proof of the above calculations can be found in appendix I.

Using the input data and PV's outlined in this report the residential apartments will exceed Part L1A compliance by 38% on average.

5.05 BREEAM

QuinnRoss has issued a BREEAM New Construction 2018 pre-assessments, document reference no: *P1567-BREEAM-01* issued 31/01/19. This report states the building will potentially achieve a BREEAM score of 72% which is an "*Excellent*" rating.

6.0 SUMMARY & CONCLUSION

The proposed development will have to achieve the following energy & sustainability targets:

Requirement	Description / Summary
Building Regulations Part L1A	Each individual dwelling must have better building fabric and energy performance when compared to a Target Emission Rate (TER)
Building Regulations Part L2A	The commercial areas must have a Building's Emission Rate (BER) equal to or less than the calculated Target Emissions Rate (TER).
EPC	An EPC calculation must be carried out upon completion by an experienced engineer accredited with a well-established professional body.
Richmond Borough Local Plan LP22	All new residential dwellings must have CO_2 emissions 35% better than the current 2013 Building Regulations.
Richmond Borough Local Plan LP22	All new commercial buildings must have CO_2 emissions 35% better than the current 2013 Building Regulations.
Richmond Borough Core Strategy CP22	All new developments must have a 20% reduction of CO_2 via renewable technology
BREEAM Excellent	All new commercial buildings must aim for BREEAM "Excellent", which is a BREEAM score of at least 70%.

Table 9: Summary of energy and sustainability targets

To achieve the above targets, the following energy reduction methods will be required, using the London Plan's Energy Hierarchy:

Be Lean

- **Building Form –** The building form must be optimised to help limit any unnecessary energy use. This includes natural ventilation openings, limiting solar gains on south facing facades and large floor to ceiling heights to help optimise daylight penetration.

- **High performing building thermal envelope –** Construction U-values performing substantially above the current building regulations. The following construction U-values are recommended:

Envelope Element	U-Value W/m².K	
	Domestic	Non-Domestic
Wall	0.18	0.22
Roof	0.13	0.18
Floor	0.13	0.18
Glazing	1.40	1.60

Table 10: Proposed U-values for domestic and non-domestic

- **Low Infiltration –** Air tightness no higher than 5.0 m^3/m^2h.

- **Daylight Strategy –** The maximisation of daylight within a building can reduce lighting demand significantly by using generous floor to ceiling heights, dual aspect glazing and daylight dimmable and occupancy sensors where possible.

- **Natural Ventilation –** Natural ventilation to be used in all areas where possible, with opening windows during occupied hours and night time cooling.

- **Highly efficient lighting with controls –** LEL, such as LED lighting, installed throughout with daylight and PIR sensors where possible.

- **Highly efficient HVAC systems –** Only specifying highly efficient heat pumps in the residential and commercial spaces with high heating CoP and cooling SEER's.

- **Insulated pipe work -** All Internal heating pipework will be insulated to a standard beyond building regulation requirements.

- **Unregulated Energy Use -** In addition, efforts are being made to reduce the unregulated emissions by providing "best in class" ("A" rated or equivalent) white goods and energy display devices that show electricity use to encourage residents to save energy.

Be Clean

- **District Heating (DH) –** The nearest existing and potential DH networks are 3-6 km from the site which is an unfeasible distance and pipe lines would have to cross the River Thames and several major road and rail lines. DH is therefore not considered.

- **Combined Heat and Power (CHP) –** Although it is not unfeasible to install a CHP engine for this development it must be noted that the development is relatively small, and a smaller / micro CHP would be the only feasible option. Smaller CHP engines are much less efficient than larger ones, having a worse heat to power ratio. This means that they do not enable as large a CO_2 reduction as they would for a larger development. Furthermore, the GLA published guidance in April 2015 stating that it is not expected for smaller sites (less than 500 dwellings) to carry out a full feasibility analysis for the use of CHP. CHP is therefore not considered.

Be Green

- **Solar Photovoltaic (PV) Panels –** 27 m^2 of PV panels will be located at roof level. The SunForte PM096B00 product is used. This currently has a highly efficient modular panel efficiency of 19.6% and, although more expensive than less efficient cheaper models, they offer greater output for less panel area when compared to less efficient models. The PV's will be laid horizontal/flat and evenly distributed among the apartments based on panel area/floor area.

- **Air source heat pumps -** The most CO_2 neutral heating system available for residential units is a heat pump system for space heating and hot water. The proposed heat pump system for this development is a Mitsubishi Ecodan system with a 290% heating efficiency. The commercial units will also use a commercial VRF heat pump system for heating and cooling. A manufacturer has not been selected yet, however the heating and cooling efficiencies used for this strategy are very typical for developments of this type.

Thermal and Energy Modelling Results

All commercial and a selection of residential apartments have been analysed for their energy use using approved energy modelling software.

The domestic predicted tonnes of CO_2 are shown below:

Domestic	
Scenario	Regulated t/CO_2 year
Baseline: Part L 2013 of the Building Regulations Compliant Development	17.8
After Energy Demand Reduction	15.1
After Heat Network / CHP	15.1
After Renewable Energy	11.0

Scenario	Regulated Domestic Carbon Dioxide Savings	
	Regulated t/CO_2 year	%
Savings From Energy Demand Reduction	2.7	15%
Savings From Heat Network / CHP	0	0%
Savings From Renewable Energy	4.2	23%
Cumulative On-Site Savings	6.8	38%

Non-Domestic	Annual Shortfall (t/CO_2 year)	Cumulative Shortfall (t/CO_2 year)
Total Target Savings	6.2	-
Shortfall	-0.6	-18.1

Table 11: Summary of domestic CO_2 emissions and savings

As the results above show, when including all available Lean and Green technologies and methods, the domestic areas of the building will achieve a 38% improvement over current Building Regulations.

The non-domestic predicted tonnes of CO_2 are shown below:

Non-Domestic	
Scenario	Regulated t/CO_2 year
Baseline: Part L 2013 of the Building Regulations Compliant Development	16.3
After Energy Demand Reduction	14.7
After Heat Network / CHP	14.7
After Renewable Energy	12.3

Scenario	Regulated Non-Domestic Carbon Dioxide Savings	
	Regulated t/CO_2 year	%
Savings From Energy Demand Reduction	1.6	10%
Savings From Heat Network / CHP	0	0%
Savings From Renewable Energy	2	15%
Cumulative On-Site Savings	4.0	24%

Non-Domestic	Annual Shortfall (t/CO_2 year)	Cumulative Shortfall (t/CO_2 year)
Total Target Savings	5.7	-
Shortfall	1.7	51.5

Table 12: Summary of non-domestic CO_2 emissions and savings

As the results above show, when including all available Lean technologies and methods, the commercial areas of the building will achieve a 24% improvement over Building Regulations.

The Site-Total predicted and saved tonnes of CO_2 are shown below:

Site Total			
Scenario	**Total Regulated Emissions (t/CO_2 yr)**	**CO2 Savings (t/CO2/yr)**	**Percentage Saving (%)**
Part L 2013 Baseline	34	-	-
Be Lean	30	4	12%
Be Clean	30	0	0%
Be Green	23	7	19.3%
CO2 Savings Off-set (t/CO2/yr)	33		

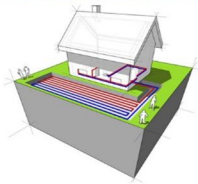
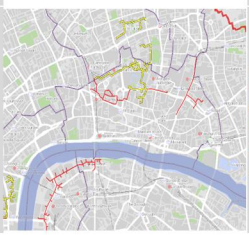
Table 13: Summary of site total CO_2 emissions and savings

BREEAM

QuinnRoss has issued a BREEAM New Construction 2018 pre-assessments, document reference no: *P1567-BREEAM-01* issued 31/01/19. This report states the building will potentially achieve a BREEAM score of 72% which is an "*Excellent*" rating.

7.0 APPENDICES

7.01 Appendix A – LZC Technology Feasibility Analysis

Technology		Feasibility	
Photovoltaic (PV) Panels		PV's use semiconductor technology to convert incident solar radiation into electrical power. The building is well suited for solar collection with a large flat roofs located several storeys above ground level. Any electricity that is generated and used on site is preferable as every kWh used is one that the development doesn't have to purchase. Any surplus electricity generated can be exported to the national grid, receiving a further export tariff in addition to the generation tariff.	High
Solar Thermal Panels		Solar thermal panels are a method of harvesting the sun's energy, commonly to provide a source of preheated water. As mentioned above, the building has a large area of roof providing an ideal location for solar thermal collection. The optimum size of a solar thermal array is to provide approximately a third of the daily stored demand, which would benefit the residential areas however it would be at the cost of PV panel area. Electricity demand reduction, from PV's, has a greater impact on CO2 savings than the gas demand used for hot water heating, especially when including CHP making this tech feasible but less effective than other options.	Medium
Ground Source Heat Pump (GSHP)		A GSHP takes low-grade heat from the ground and uses electricity to convert it to useful heat (at approximately 40°C) that can be used to heat a building. The ground can also be used as a heat sink to provide cooling. The bore holes and length of pipework into the ground required for this tech make this option difficult to justify considering the developments central London location.	Low
Air Source Heat Pump (ASHP)		Similar to the GSHP, ASHP utilises the external environment as a heat source. A heat pump uses electricity or gas to run a refrigerant cycle, extracting heat from external air to convert it to useful heat for space heating. ASHPs offer high efficiencies and are suited to institutional and commercial properties. Although these systems are typically noisy, must be located externally and require an area of flat roof, their high efficiencies are too beneficial to rule out.	High
Wind Turbines		Wind energy can be converted to electricity by using wind turbines. This renewable technology is suited to exposed areas free from obstructions where the average wind speeds are high. On the site there are plenty of obstructions which would lead to the wind having a turbulent nature resulting in poor output for turbines, plus they have significant visual and noise impacts on neighbouring areas. Hence they are unsuitable for this development.	Low
Biomass		Biomass fuel is usually wood chips or wood pellets, and as it comes from plants it is considered a low-carbon source of high-grade heat that can be used for space heating, domestic hot water and, with absorption chillers, cooling (this last option is very rarely implemented due to high capital cost). A biomass boiler needs to operate under a reasonably constant load being a solid fuel boiler; it is unable to respond to load fluctuations as quickly as a gas or oil boiler. This limits the boilers to being suitable to operate for the provision of the base load. This could still be suitable for this development for its likely large base load however biomass also has the potential to have a significantly detrimental effect on air quality in the local vicinity, frequent fuel deliveries are required which could be disruptive to residents and there are significant maintenance costs. Unless a free source of wood can be found, such as waste from a factory or forestry management operation, the biomass fuel is often the same price or more expensive than gas. This means that the additional capital outlay on top of the increased fuel, maintenance costs, air quality, running costs and maintenance issues make biomass less viable than other tech available.	Low
Combined Heat and Power		CHP is the simultaneous generation of usable heat and power (usually electricity) in a single process, the heat being distributed in surrounding buildings instead of being wasted. CHP is best suited to buildings with large heating and DHW demands and although feasable for this building they are less efficient the smaller they are. As this development is relatively small it is likely a small or micro CHP would not offer significant savings in CO2 taking into account the energy used to run the unit.	Medium
District Heating		DH tends to be large CHP units run by commercial energy firms supplying energy to local buildings through underground pipework. Though they offer the same benefits as an on site CHP, without maintenance costs (provided by the supplier), the limitations are the proposed site needs to be within reasonable distance of a network. There are no existing DH networks near this site and the closest potential network would require 3 km of pipework and have to cross the Thames. Therefore DH is not plausable.	Low

7.02 Appendix B – Input data used for domestic/residential areas

Constructions U-values	
Floor	0.13 W/m².K
Wall	0.18 W/m².K
Party wall	0.00 W/m².K (please note this figure represents no heat loss through party walls, not a target U-value)
Roof	0.13 W/m².K
Door	1.80 W/m².K

Glazing	
Overall U-value (including frame)	1.40 W/m²K
g-value	0.60

Thermal Bridging Y-values	
Unit 01	0.070
Unit 02	0.055
Unit 03	0.082
Unit 04	0.070
Unit 05	0.140
Unit 06	0.150
Unit 07	0.140

Air Permeability	
Air permeability	5.0 m^3/m^2h

HVAC Systems	
Main Heating 1	
Heat source	Heat pump
Heating use	Space and water
Main Heating Code	Electricity PET Heat pump air-to-water
Fuel type	Electricity
Heating efficiency	291%
Flue type	-
Heat emitter	Radiators
Heating controls	CHC Programmer and room thermostat

Domestic Hot Water	
Water Heating	
Water heating	Same as main heating
Flue gas heat recovery system	None
Waste water heat recovery	None
Solar thermal	None
Water use < 125 litres/person/day	No
Showers in property	Non-electric only
Hot water cylinder	Yes

Hot Water Cylinder	
Independent time control	Yes
Cylinder stat	Yes
Cylinder in heated space	Yes
Cylinder volume litres	210
Cylinder losses Kwh/day	2.20
Pipework insulation	Fully insulated
Thermal store	None

Ventilation	
Natural ventilation - Air change rate	
Windows open during hot weather	Windows fully open
Cross ventilation possible	No
Night ventilation	Yes
ACH	4.00

Mechanical ventilation	
Constant mech vent/extract system	None
Intermittent fans	Yes - WC/Bathroom/Kitchen extract
No. of fans	2.00

Lighting

Lighting power densities	
% of Low Energy Lighting (L.E.L) used	100%
Electricity tariff	Standard
External lights fitted	None

New Technologies

Photovoltaic Unit	
PV area available m²	27.3
PV product	SunForte PM096B00
Cell efficiency	19.6%
kWp per panel	0.32
No.of panels	26
PV array KW peak for whole building	8.32
Orientation	Horizontal
Elevation	-
Overshadowing	None or little

7.03 Appendix C – Input Data Commercial Unit Front

Constructions U-values	
Floor	0.22 W/m².K
Wall	0.26 W/m².K
Roof	0.18 W/m².K
Door	2.20 W/m².K

Glazing	
Overall U-value (including frame)	1.60 W/m²K
g-value	0.60

Air Permeability	
Air permeability	5.0 m^3/m^2h
Resulting ach rate (CIBSE TM23 method)	0.091

HVAC Systems	
Shop floor system	
System description	Electric heating with AC & nat vent
NCM system type	Split or multi-split system
Heat source	Direct or storage eletric heater
Heating fuel type	Electrcity
Heating generator seasonal efficiency	1.00
Cooling system	Heat pump (electric)
Cooling fuel type	Electricity
Cooling seasonal energy efficiency rating (SEER)	4.00
AHU Specific fan power (SFP)	-
AHU Pump type	-
Mech vent SFP (per unit) W/l/s	-
Heat recovery efficiency	-
Ventilation controls	-

DHW	
System description	Instantaneous hot water only
Heating fuel type	Electrcity
Delivery efficiency	95%
Storage volume (l)	-
Storage tank insulation thickness (mm)	-

Ventilation	
Vent system	Natural ventilation via opening windows

Lighting	
Lighting power densities	**Lm/W**
General lighting	120
Display lighting	60.00

Power & Lighting controls	
Electric Power Factor	0.90 - 0.95
PIR's	Yes
Daylight sensors	Yes
Metering / Monitoring	Lighting systems have provision for metering
Lighting control parasitic power	0.10 W/m²

7.04 Appendix D – Input Data Commercial Unit Rear

Constructions U-values	
Floor	0.18 W/m².K
Wall	0.22 W/m².K
Roof	0.18 W/m².K
Door	2.20 W/m².K

Glazing	
Overall U-value (including frame)	1.60 W/m²K
g-value	0.40
Light transmittance	60%

Air Permeability	
Air permeability	5.0 m^3/m^2h
Resulting ach rate (CIBSE TM23 method)	0.091

HVAC Systems	
VRF with mech vent	
System description	VRF AC with mech vent
NCM system type	Split or multi-split system
Heat source	Heat pump (electric): air source
Heating fuel type	Electrcity
Heating generator seasonal efficiency	4.50
Cooling system	Heat pump (electric)
Cooling fuel type	Electrcity
Cooling seasonal energy efficiency rating (SEER)	4.00
AHU Specific fan power (SFP)	0.90
AHU Pump type	-
Mech vent SFP (per unit) W/l/s	-
Heat recovery efficiency	65%
Ventilation controls	-

DHW	
System description	Instantaneous hot water only
Heating fuel type	Electrcity
Delivery efficiency	95%
Storage volume (l)	-
Storage tank insulation thickness (mm)	-

Ventilation	
WC extract	
SFP (W/l/s)	0.5
Flow rate (ach)	10.0
Scope of extract system	Centralised: fan remote from zone

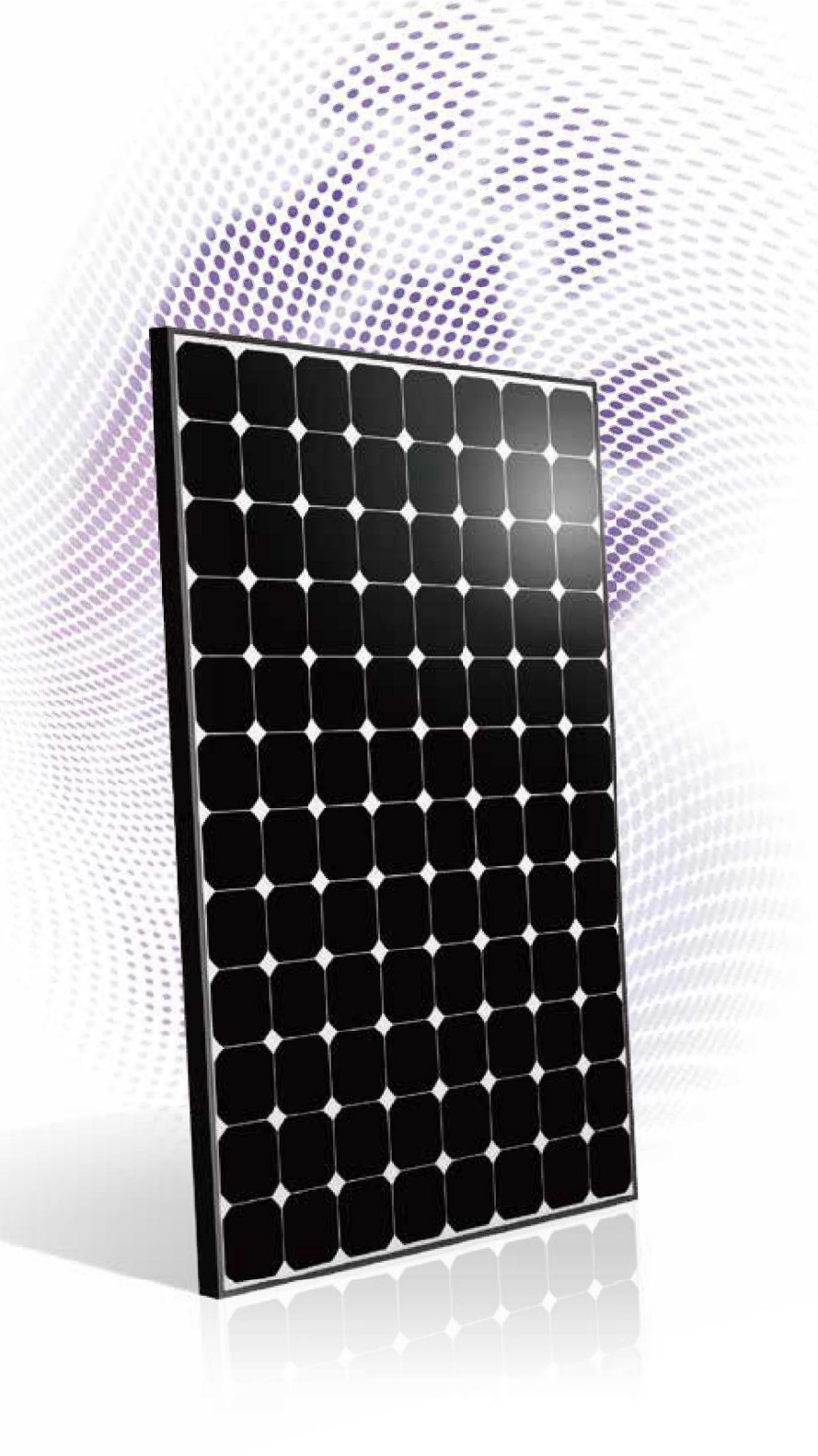
Lighting	
Lighting power densities	**Lm/W**
General lighting	120
Display lighting (reception)	60.00

Power & Lighting controls	
Electric Power Factor	0.90 - 0.95
PIR's	Yes
Daylight sensors	Yes
Metering / Monitoring	Lighting systems have provision for metering
Lighting control parasitic power	0.10 W/m²

7.06 Appendix E – PV Product Information

SunForte
PM096B00

Mono-Crystalline Photovoltaic Module



20+% EFF.

320W ~ 335W

Power Range
320 ~ 335 Wp

Highly Strengthened Design
Module complies with advanced loading tests to meet 5400 Pa loading requirements

Resistance to Salt Corrosion and Humidity
Module complies with IEC 61701: Salt Mist Corrosion Testing

All-Back Contact

Back Contact Cells
No string in the front side enhances light conversion space

IP 67

IP-67 Rated Junction Box
Advanced water and dust proof level

Transformer less
Validates the compatibility with transformer-less inverters at high system voltage.

PID RESISTANCE

PID-Resistance
Certified High PID resistance. Diamond Level

Superior Performance at High Temperatures
Less power loss in hot weather conditions due to the low temperature coefficient

ASSEMBLED IN TAIWAN

BenQ Solar

SunForte PM096B00 (320 ~ 335 Wp)

Electrical Data

Typ. Nominal Power P_N	320W	325W	327W	330W	333W	335W
Typ. Module Efficiency	19.6%	19.9%	20.1%	20.3%	20.4%	20.6%
Typ. Nominal Voltage V_{mp} (V)	54.7	54.7	54.7	54.7	54.7	54.7
Typ. Nominal Current I_{mp} (A)	5.86	5.94	5.98	6.04	6.09	6.13
Typ. Open Circuit Voltage V_{OC} (V)	64.8	64.9	64.9	64.9	64.9	64.9
Typ. Short Circuit Current I_{SC} (A)	6.27	6.39	6.46	6.52	6.58	6.62
Maximum Tolerance of P_N	0 / +3%					

• Above data are the effective measurement at Standard Test Conditions (STC)
• STC: irradiance 1000 W/m², spectral distribution AM 1.5, temperature 25 ± 2 °C, in accordance with EN 60904-3

Temperature Coefficient

NOCT	45 ± 2 °C
Typ. Temperature Coefficient of P_N	-0.33 % / K
Typ. Temperature Coefficient of V_{OC}	-0.26 % / K
Temperature Coefficient of I_{SC}	0.05 % / K

• NOCT: Normal Operation Cell Temperature, measuring conditions: irradiance 800 W/m², AM 1.5, air temperature 20 °C, wind speed 1 m/s

Mechanical Characteristics

Dimensions (L x W x H)	1559 x 1046 x 46 mm (61.38 x 41.18 x 1.81 in)
Weight	18.6 kg (41.0 lbs)
Front Glass	High transmission tempered glass with AR-Tech, 3.2 mm (0.13 in)
Cell	96 high efficiency back contact cells
Back Sheet	Composite film
Frame	Anodized aluminum frame
Junction Box	IP-67 rated with 3 bypass diodes
Connector Type & Cables	TE Connectivity PV4: 1 x 4 mm² (0.04 x 0.16 in²), Length: each1.0 m (39.37 in)

Operating Conditions

Operating Temperature	-40 ~ +80 °C
Ambient Temperature Range	-40 ~ +45 °C
Max. System Voltage IEC/UL	1000V / 1000V
Serial Fuse Rating	20A
Maximum Surface Load Capacity	Tested up to 5400 Pa according to IEC 61215 (advanced test)

Warranties and Certifications

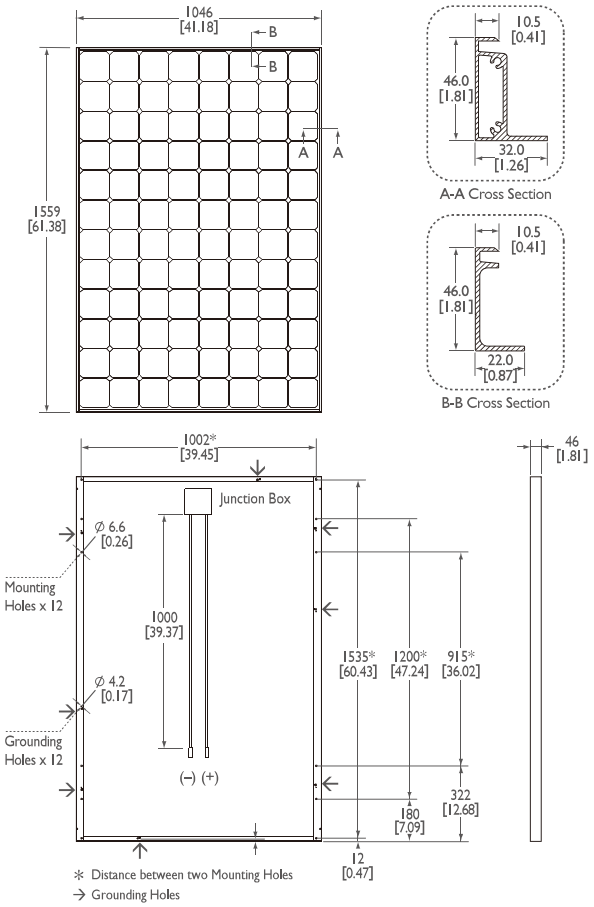
Product Warranty	Maximum 15 years for material and workmanship
Performance Guarantee	Guaranteed output of 95% for 5 years and linear degradation to 87% for 25 years
Certifications	According to IEC/EN 61215 , IEC/EN 61730 and UL 1703 guidelines *

* Please confirm other certifications with official dealers

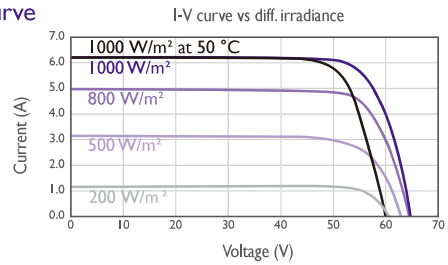
Packing Configuration

Container	20' GP	40' GP	40' HQ
Pieces per pallet	22	22	22
Pallets per container	6	14	28
Pieces per container	132	308	616

Dimensions mm [inch]



I-V Curve



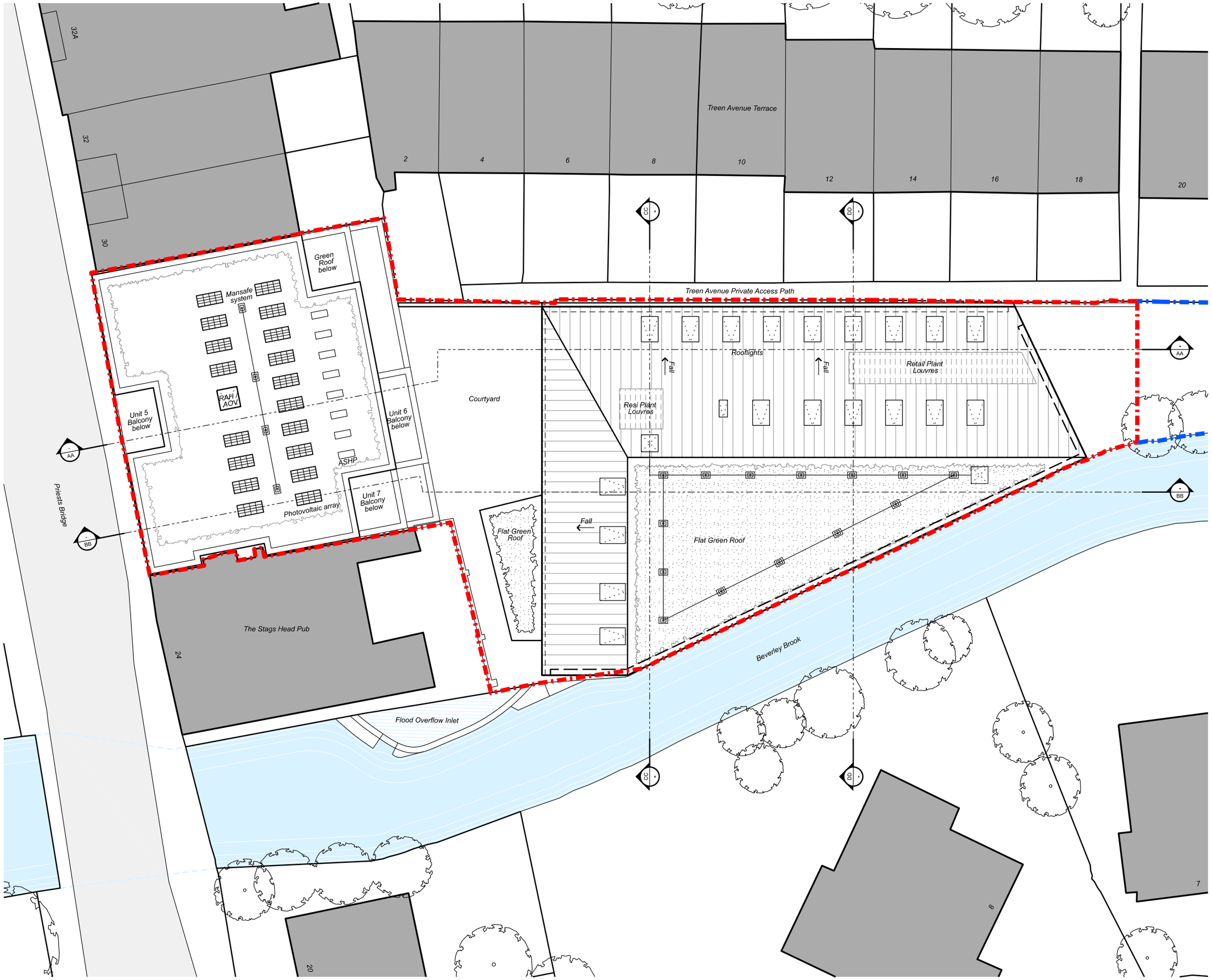
Current/voltage characteristics with dependence on irradiance and module temperature.

Dealer Stamp

AU Optronics Corporation
No. 1, Li-Hsin Rd. 2, Hsinchu Science Park, Hsinchu 30078, Taiwan
Tel: +886-3-500-8899 www.BenQSolar.com

BenQ Solar

7.07 Appendix F – Roof Layout Showing PV Panels



0 1m 5m

N

Revision	Date	Description
P1	24.06.2022	Planning Application

project
j0663 - 22-28 Priests Bridge

drawing title
Roof Plan
Proposed

drawing number	revision
WP-0663-A-0106-P-RF	P1
scale @ A1 / A3	date
1:100 / 1:200	June 2022

drawing purpose

WIMSHURST PELLERITI

The Mews,
6 Putney Common, SW15 1HL

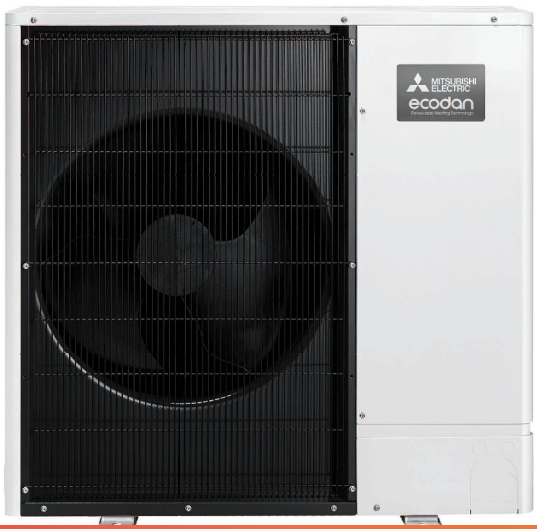
0208 780 2206
info@wp.uk.com
wimshurst-pelleriti.com

7.08 Appendix G – Residential heat pumps product information

PUHZ-W-VAA

Product Information

Ultra Quiet Ecodan



3 Times Quieter than previous equivalent models, virtually eliminating planning restrictions

MITSUBISHI ELECTRIC

ecodan®
Renewable Heating Technology

PUHZ-W-VAA Product Information

58 dB(A)
Sound Power Level

45 dB(A)
Sound Pressure Level at 1m

Our market leading Ecodan air source heat pumps are designed to provide a home with reliable, trouble free renewable heating and hot water.

The New Ultra Quiet Ecodan takes air source heat pumps to the next level

These new models offer superb style, market leading energy efficiency and sound levels. Designed especially for residential applications the 8.5kW and 11.2kW units are **3 times quieter than previous models**, **virtually eliminating planning restrictions.**

8 dB(A) drop in sound power output

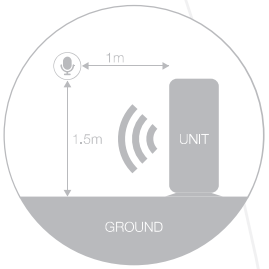
Typical sound pressure levels:

120dB(A) **80**dB(A) **60**dB(A) **40**dB(A)

This means the Ultra Quiet Ecodan has a sound pressure level similar to a **Library.**

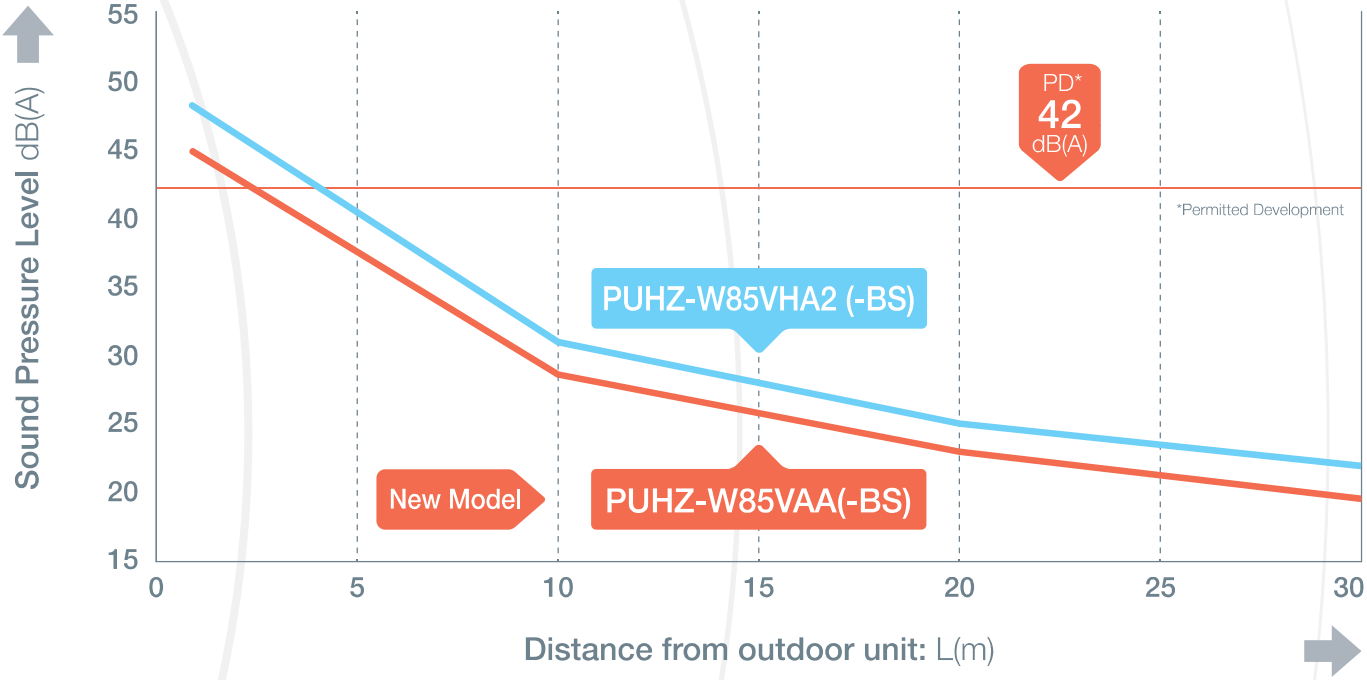
Estimated Noise Levels

Based on the distance from the outdoor unit



Annotation and Measurement Condition

1. Sound data was measured once unit operation was stable.
2. Sound reflection from ground and surrounding walls is not considered.

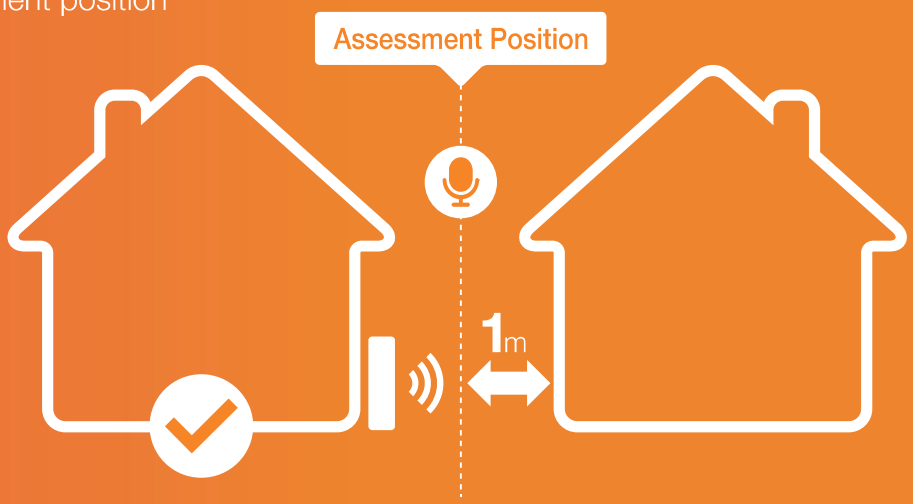


Low Sound = **Heat Pump Placement Flexibility**

One of the regulations under **Permitted Development**, is that the sound pressure level of an air source heat pump must not exceed 42dB(A) 1m from the neighbours nearest room (Assessment Position).

With class leading **sound power levels of just 58dB(A)**, the Ultra Quiet Ecodan air source heat pump can be located much closer to the assessment position and **pass planning**.

This ultra quiet performance means you can now choose the most convenient location for your Ecodan, causing no disturbance to neighbours.



ultraquietecodan.co.uk

ErP A++

PUHZ-W-VAA Product Information

APPROVED PRODUCT

PUHZ-W85VAA: MCS Ref: HP0002/45
PUHZ-W85VAA-BS: MCS Ref: HP0002/46
PUHZ-W112VAA: MCS Ref: HP0002/47
PUHZ-W112VAA-BS: MCS Ref: HP0002/48

QUIET MARK

Manufactured in the UK

R410A

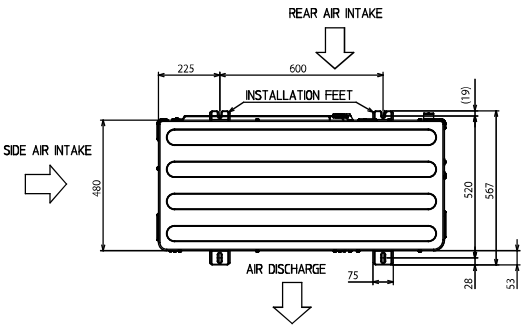
OUTDOOR UNIT		PUHZ-W85VAA(-BS)	PUHZ-W112VAA(-BS)
HEAT PUMP SPACE HEATER - 55°C	ErP Rating	A++	A++
	η_s	137%	133%
	SCOP	3.50	3.40
HEAT PUMP SPACE HEATER - 35°C	ErP Rating	A++	A++
	η_s	171%	170%
	SCOP	4.35	4.34
HEAT PUMP COMBINATION HEATER - Large Profile*1	ErP Rating	A	A
	η_{wh}	104%	100%
HEATING*2 (A-3/W35)	Capacity (kW)	8.3	11.0
	Power Input (kW)	2.86	3.73
	COP	2.90	2.95
OPERATING AMBIENT TEMPERATURE (°C DB)		-20 ~ +35°C	-20 ~ +35°C
SOUND DATA*3	Pressure Level at 1m (dBA)	45	47
	Power Level (dBA)*4	58	60
WATER DATA	Pipework Size (mm)	28	28
	Flow Rate (l/min)	25.8	32.1
	Water Pressure Drop (kPa)	16.1	24.4
DIMENSIONS (mm)*7	Width	1050	1050
	Depth	480	480
	Height	1020	1020
WEIGHT (kg)		97	118
ELECTRICAL DATA	Electrical Supply	220-240v, 50Hz	220-240v, 50Hz
	Phase	Single	Single
	Nominal Running Current [MAX] (A)	9.1 [22.0]	10.9 [28.0]
	Fuse Rating - MCB Sizes (A)*6	25	32
REFRIGERANT CHARGE (kg) / CO_2 EQUIVALENT (t)	R410A (GWP 2088)	2.4/5.01	3.3/6.89

*1 Combination with EHPT20X-MHCW Cylinder. *2 Under normal heating conditions at outdoor temp: -3°CDB / -4°CWB, outlet water temp 35°C, inlet water temp 30°C.
*3 Under normal heating conditions at outdoor temp: 7°CDB / 6°CWB, outlet water temp 55°C, inlet water temp 47°C as tested to BS EN14511. *4 Sound power level tested to BS EN12102. *5 MCB Sizes BS EN60898-2 & BS EN60947-2.
*6 Flow Temperature Controller (FTC) for standalone systems PAC-IF062B-E Dimensions WxDxH (mm) - 520x150x450

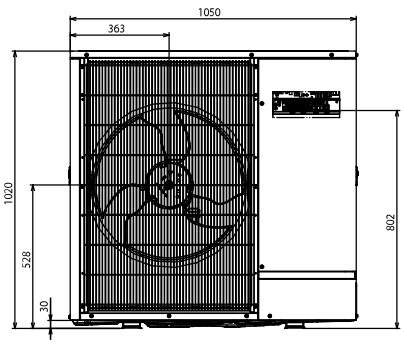
η_s is the seasonal space heating energy efficiency (SSHEE) η_{wh} is the water heating energy efficiency

Product Dimensions PUHZ-W85 / 112VAA(-BS)

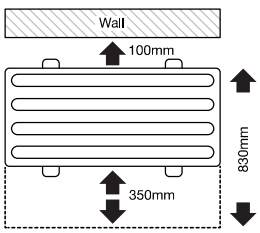
Upper View



Front View



Required Space



The space required in front of the unit is 350mm.

MITSUBISHI ELECTRIC
Changes for the Better

Telephone: 01707 278666
email: heating@meuk.mee.com
web: heating.mitsubishielectric.co.uk

UNITED KINGDOM Mitsubishi Electric Europe Living Environment Systems Division
Travellers Lane, Hatfield, Hertfordshire, AL10 8XB, England General Enquiries Telephone: 01707 282880 Fax: 01707 278881
IRELAND Mitsubishi Electric Europe Westgate Business Park, Ballymount, Dublin 24, Ireland
Telephone: Dublin (01) 419 8800 Fax: Dublin (01) 419 8890 International code: (003531)

Green Gateway
www.greengateway.mitsubishielectric.co.uk
Mitsubishi Electric UK's commitment to the environment

Follow us @meuk_les
Follow us @green_gateway
Mitsubishi Electric Living Environmental Systems UK
mitsubishielectric2
thehub.mitsubishielectric.co.uk

Note: The fuse rating is for guidance only. Please refer to the relevant databook for detailed specification. It is the responsibility of a qualified electrician/electrical engineer to select the correct cable size and fuse rating based on current regulation and site specific conditions. Mitsubishi Electric's air conditioning equipment and heat pump systems contain a fluorinated greenhouse gas, R410A (GWP:2088), R32 (GWP:675), R407C (GWP:1774) or R134a (GWP:1430). *These GWP values are based on Regulation (EU) No 517/2014 from IPCC 4th edition. In case of Regulation (EU) No.626/2011 from IPCC 3rd edition, these are as follows. R410A (GWP:1975), R32 (GWP: 550), R407C (GWP:1650) or R134a (GWP:1300).

Effective as of April 2018 SAP No. 338239

7.09 Appendix H – SAP Summary LEAN

SUMMARY FOR INPUT DATA
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	Unit 08-09 Priests Bridge	**Issued on Date**	17/06/2022
Assessment Reference	Unit 08 Be Lean	**Prop Type Ref**	Be Lean & Green
Property			

SAP Rating	81 B	**DER**	22.05	**TER**	27.65
Environmental	83 B	**% DER<TER**	20.24		
CO_2 Emissions (t/year)	1.41	**DFEE**	49.26	**TFEE**	55.89
General Requirements Compliance	Pass	**% DFEE<TFEE**	11.87		

Assessor Details	Mr. Andrew Jones, Andrew Jones, Tel: 01795 841 035, ajones@quinnross.com	**Assessor ID**	N955-0001
Client			

SUMMARY FOR INPUT DATA FOR: New Build (As Designed)

Orientation	North West	
Property Tenure	Unknown	
Transaction Type	New dwelling	
Terrain Type	Urban	
1.0 Property Type	Flat, End-Terrace	
2.0 Number of Storeys	1	
3.0 Date Built	2022	
4.0 Sheltered Sides	2	
5.0 Sunlight/Shade	Average or unknown	

6.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Ground Floor:	32.12 m	76.70 m²	2.90 m

7.0 Living Area	31.62	m²
8.0 Thermal Mass Parameter	Simple calculation - Medium	
Thermal Mass	250.00	kJ/m²K

9.0 External Walls

Description	Type	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
External Wall 1	System Build	0.18	75.98	64.98
Wall to Unhtd	Cavity Wall	0.18	17.17	15.07

9.1 Party Walls

Description	Type	Construction	U-Value (W/m²K)	Area (m²)
Party Wall 1	Solid Wall		0.00	24.13

10.0 External Roofs

Description	Type	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
External Roof 1	External Flat Roof	0.13	76.70	70.70

12.0 Opening Types

Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	G-value	Frame Type	Frame Factor	U Value (W/m²K)
Glazing	Manufacturer	Window	Double Low-E Soft 0.05			0.60		0.70	1.40
Front Door	SAP table	Door to Corridor							1.40
Roof Light	Manufacturer	Roof Window	Double Low-E Soft 0.05			0.60		0.70	1.40

SUMMARY FOR INPUT DATA
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width (m)	Height (m)	Count	Area (m²)	Curtain Closed
SE Win 01	Window	[1] External Wall 1	South East	None	0.00					8.25	
N Win 01	Window	[1] External Wall 1	North	None	0.00					2.75	
SW Roof Light	Roof Window	[1] External Roof 1	South West	None						6.00	
Front Door	Door to Corridor	[2] Wall to Unhtd	North West							2.10	

14.0 Conservatory	None	
15.0 Draught Proofing	100	%
16.0 Draught Lobby	No	
17.0 Thermal Bridging	Calculate Bridges	

17.1 List of Bridges

Source Type	Bridge Type	Length	Psi	Imported
Table K1 - Approved	E2 Other lintels (including other steel lintels)	4.40	0.300	Yes
Table K1 - Approved	E3 Sill	4.40	0.040	Yes
Table K1 - Approved	E4 Jamb	15.00	0.050	Yes
Table K1 - Approved	E7 Party floor between dwellings (in blocks of flats)	32.12	0.070	Yes
Table K1 - Default	E14 Flat roof	32.12	0.080	Yes
Table K1 - Approved	E16 Corner (normal)	5.80	0.090	Yes
Table K1 - Approved	E18 Party wall between dwellings	5.80	0.060	Yes
Table K1 - Default	R1 Head of roof window	6.00	0.080	Yes
Table K1 - Default	R2 Sill of roof window	6.00	0.060	Yes
Table K1 - Default	R3 Jamb of roof window	8.00	0.080	Yes

Y-value	0.055	W/m²K
18.0 Pressure Testing	Yes	
Designed AP_{50}	5.00	m³/(h.m²) @ 50 Pa
Property Tested ?		
As Built AP_{50}		m³/(h.m²) @ 50 Pa

19.0 Mechanical Ventilation

Summer Overheating

Windows open in hot weather	Windows fully open
Cross ventilation possible	No
Night Ventilation	Yes
Air change rate	4.00

Mechanical Ventilation

Mechanical Ventilation System Present	No

20.0 Fans, Open Fireplaces, Flues

	MHS	SHS	Other	Total
Number of Chimneys	0		0	0
Number of open flues	0		0	0
Number of intermittent fans				3
Number of passive vents				0
Number of flueless gas fires				0

21.0 Fixed Cooling System	No	

22.0 Lighting

Internal

Total number of light fittings	20
Total number of L.E.L. fittings	20

Percentage of L.E.L. fittings	100.00	%
External		
External lights fitted	No	
23.0 Electricity Tariff	Standard	
24.0 Main Heating 1	Database	
Percentage of Heat	100	%
Database Ref. No.	103151	
Fuel Type	Electricity	
Main Heating	PET	
SAP Code	224	
In Winter	208.9	
In Summer	296.5	
Controls	CHC Programmer and room thermostat	
PCDF Controls	0	
Sap Code	2204	
Is MHS Pumped	Pump in heated space	
Heat Emitter	Radiators	
Flow Temperature	36° - 45°C	
25.0 Main Heating 2	None	
Community Heating	None	
28.0 Water Heating	HWP From main heating 1	
Water Heating	Main Heating 1	
Flue Gas Heat Recovery System	No	
Waste Water Heat Recovery Instantaneous System 1	No	
Waste Water Heat Recovery Instantaneous System 2	No	
Waste Water Heat Recovery Storage System	No	
Solar Panel	No	
Water use <= 125 litres/person/day	No	
SAP Code	901	
Immersion Only Heating Hot Water	No	
29.0 Hot Water Cylinder	Hot Water Cylinder	
Cylinder Stat	Yes	
Cylinder In Heated Space	Yes	
Independent Time Control	Yes	
Insulation Type	Measured Loss	
Cylinder Volume	210.00	L
Loss	2.20	kWh/day
Pipes insulation	Fully insulated primary pipework	
31.0 Thermal Store	None	

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

None

SUMMARY FOR INPUT DATA
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	Unit 08-09 Priests Bridge	**Issued on Date**	17/06/2022
Assessment Reference	Unit 09 Be Lean	**Prop Type Ref**	Be Lean & Green
Property			

SAP Rating	82 B	**DER**	21.30	**TER**	24.43
Environmental	84 B	**% DER<TER**	12.80		
CO_2 Emissions (t/year)	1.33	**DFEE**	40.64	**TFEE**	43.89
General Requirements Compliance	Pass	**% DFEE<TFEE**	7.40		

Assessor Details	Mr. Andrew Jones, Andrew Jones, Tel: 01795 841 035, ajones@quinnross.com	**Assessor ID**	N955-0001
Client			

SUMMARY FOR INPUT DATA FOR: New Build (As Designed)

Orientation	South West	
Property Tenure	Unknown	
Transaction Type	New dwelling	
Terrain Type	Urban	
1.0 Property Type	Flat, End-Terrace	
2.0 Number of Storeys	1	
3.0 Date Built	2022	
4.0 Sheltered Sides	2	
5.0 Sunlight/Shade	Average or unknown	

6.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Ground Floor:	14.55 m	77.00 m²	2.90 m

7.0 Living Area	27.91	m²
8.0 Thermal Mass Parameter	Simple calculation - Medium	
Thermal Mass	250.00	kJ/m²K

9.0 External Walls

Description	Type	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
External Wall 1	System Build	0.18	31.18	17.18
Wall to Unhtd	Cavity Wall	0.18	11.02	8.92

9.1 Party Walls

Description	Type	Construction	U-Value (W/m²K)	Area (m²)
Party Wall 1	Solid Wall		0.00	73.60

10.0 External Roofs

Description	Type	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
External Roof 1	External Flat Roof	0.13	77.00	77.00

12.0 Opening Types

Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	G-value	Frame Type	Frame Factor	U Value (W/m²K)
Glazing	Manufacturer	Window	Double Low-E Soft 0.05			0.60		0.70	1.40
Front Door	SAP table	Door to Corridor							1.40
Roof Light	Manufacturer	Window	Double Low-E Soft 0.05			0.60		0.70	1.40

SUMMARY FOR INPUT DATA
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width (m)	Height (m)	Count	Area (m^2)	Curtain Closed
SE Win 01	Window	[1] External Wall 1	South East	None	0.00					12.00	
NW Roof Light	Window	[1] External Wall 1	North West	None	0.00					2.00	
Front Door	Door to Corridor	[2] Wall to Unhtd	South West							2.10	

14.0 Conservatory	None	
15.0 Draught Proofing	100	%
16.0 Draught Lobby	No	
17.0 Thermal Bridging	Calculate Bridges	

17.1 List of Bridges

Source Type	Bridge Type	Length	Psi	Imported
Table K1 - Approved	E2 Other lintels (including other steel lintels)	8.30	0.300	Yes
Table K1 - Approved	E3 Sill	7.30	0.040	Yes
Table K1 - Approved	E4 Jamb	22.20	0.050	Yes
Table K1 - Approved	E7 Party floor between dwellings (in blocks of flats)	14.55	0.070	Yes
Table K1 - Default	E14 Flat roof	14.55	0.080	Yes
Table K1 - Approved	E16 Corner (normal)	5.80	0.090	Yes
Table K1 - Approved	E18 Party wall between dwellings	5.80	0.060	Yes

Y-value	0.058	W/m²K
18.0 Pressure Testing	Yes	
Designed AP_{50}	5.00	$m^3/(h.m^2)$ @ 50 Pa
Property Tested ?		
As Built AP_{50}		$m^3/(h.m^2)$ @ 50 Pa

19.0 Mechanical Ventilation

Summer Overheating

Windows open in hot weather	Windows fully open
Cross ventilation possible	Yes
Night Ventilation	Yes
Air change rate	6.00

Mechanical Ventilation

Mechanical Ventilation System Present	No

20.0 Fans, Open Fireplaces, Flues

	MHS	SHS	Other	Total
Number of Chimneys	0		0	0
Number of open flues	0		0	0
Number of intermittent fans				3
Number of passive vents				0
Number of flueless gas fires				0

21.0 Fixed Cooling System	No	

22.0 Lighting

Internal

Total number of light fittings	20	
Total number of L.E.L. fittings	20	
Percentage of L.E.L. fittings	100.00	%

External

External lights fitted	No

SUMMARY FOR INPUT DATA
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

23.0 Electricity Tariff	Standard	
24.0 Main Heating 1	Database	
Percentage of Heat	100	%
Database Ref. No.	103151	
Fuel Type	Electricity	
Main Heating	PET	
SAP Code	224	
In Winter	182.6	
In Summer	296.5	
Controls	CHC Programmer and room thermostat	
PCDF Controls	0	
Sap Code	2204	
Is MHS Pumped	Pump in heated space	
Heat Emitter	Radiators	
Flow Temperature	36° - 45°C	
25.0 Main Heating 2	None	
Community Heating	None	
28.0 Water Heating	HWP From main heating 1	
Water Heating	Main Heating 1	
Flue Gas Heat Recovery System	No	
Waste Water Heat Recovery Instantaneous System 1	No	
Waste Water Heat Recovery Instantaneous System 2	No	
Waste Water Heat Recovery Storage System	No	
Solar Panel	No	
Water use <= 125 litres/person/day	No	
SAP Code	901	
Immersion Only Heating Hot Water	No	
29.0 Hot Water Cylinder	Hot Water Cylinder	
Cylinder Stat	Yes	
Cylinder In Heated Space	Yes	
Independent Time Control	Yes	
Insulation Type	Measured Loss	
Cylinder Volume	210.00	L
Loss	2.20	kWh/day
Pipes insulation	Fully insulated primary pipework	
31.0 Thermal Store	None	

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

None

7.10 Appendix I – SAP Summary LEAN & GREEN

SUMMARY FOR INPUT DATA
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	Unit 08-09 Priests Bridge	**Issued on Date**	17/06/2022
Assessment Reference	Unit 08 Be Green	**Prop Type Ref**	Be Lean & Green
Property			

SAP Rating	87 B	**DER**	16.39	**TER**	27.65
Environmental	88 B	**% DER<TER**	40.71		
CO_2 Emissions (t/year)	0.95	**DFEE**	49.26	**TFEE**	55.89
General Requirements Compliance	Pass	**% DFEE<TFEE**	11.87		

Assessor Details	Mr. Andrew Jones, Andrew Jones, Tel: 01795 841 035, ajones@quinnross.com	**Assessor ID**	N955-0001
Client			

SUMMARY FOR INPUT DATA FOR: New Build (As Designed)

Orientation	North West
Property Tenure	Unknown
Transaction Type	New dwelling
Terrain Type	Urban
1.0 Property Type	Flat, End-Terrace
2.0 Number of Storeys	1
3.0 Date Built	2022
4.0 Sheltered Sides	2
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Ground Floor:	32.12 m	76.70 m²	2.90 m

7.0 Living Area	31.62	m²
8.0 Thermal Mass Parameter	Simple calculation - Medium	
Thermal Mass	250.00	kJ/m²K

9.0 External Walls

Description	Type	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
External Wall 1	System Build	0.18	75.98	64.98
Wall to Unhtd	Cavity Wall	0.18	17.17	15.07

9.1 Party Walls

Description	Type	Construction	U-Value (W/m²K)	Area (m²)
Party Wall 1	Solid Wall		0.00	24.13

10.0 External Roofs

Description	Type	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
External Roof 1	External Flat Roof	0.13	76.70	70.70

12.0 Opening Types

Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	G-value	Frame Type	Frame Factor	U Value (W/m²K)
Glazing	Manufacturer	Window	Double Low-E Soft 0.05			0.60		0.70	1.40
Front Door	SAP table	Door to Corridor							1.40
Roof Light	Manufacturer	Roof Window	Double Low-E Soft 0.05			0.60		0.70	1.40

SUMMARY FOR INPUT DATA
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width (m)	Height (m)	Count	Area (m²)	Curtain Closed
SE Win 01	Window	[1] External Wall 1	South East	None	0.00					8.25	
N Win 01	Window	[1] External Wall 1	North	None	0.00					2.75	
SW Roof Light	Roof Window	[1] External Roof 1	South West	None						6.00	
Front Door	Door to Corridor	[2] Wall to Unhtd	North West							2.10	

14.0 Conservatory	None	
15.0 Draught Proofing	100	%
16.0 Draught Lobby	No	
17.0 Thermal Bridging	Calculate Bridges	

17.1 List of Bridges

Source Type	Bridge Type	Length	Psi	Imported
Table K1 - Approved	E2 Other lintels (including other steel lintels)	4.40	0.300	Yes
Table K1 - Approved	E3 Sill	4.40	0.040	Yes
Table K1 - Approved	E4 Jamb	15.00	0.050	Yes
Table K1 - Approved	E7 Party floor between dwellings (in blocks of flats)	32.12	0.070	Yes
Table K1 - Default	E14 Flat roof	32.12	0.080	Yes
Table K1 - Approved	E16 Corner (normal)	5.80	0.090	Yes
Table K1 - Approved	E18 Party wall between dwellings	5.80	0.060	Yes
Table K1 - Default	R1 Head of roof window	6.00	0.080	Yes
Table K1 - Default	R2 Sill of roof window	6.00	0.060	Yes
Table K1 - Default	R3 Jamb of roof window	8.00	0.080	Yes

Y-value	0.055	W/m²K
18.0 Pressure Testing	Yes	
Designed AP_{50}	5.00	m³/(h.m²) @ 50 Pa
Property Tested ?		
As Built AP_{50}		m³/(h.m²) @ 50 Pa

19.0 Mechanical Ventilation

Summer Overheating

Windows open in hot weather	Windows fully open
Cross ventilation possible	No
Night Ventilation	Yes
Air change rate	4.00

Mechanical Ventilation

Mechanical Ventilation System Present	No

20.0 Fans, Open Fireplaces, Flues

	MHS	SHS	Other	Total
Number of Chimneys	0		0	0
Number of open flues	0		0	0
Number of intermittent fans				3
Number of passive vents				0
Number of flueless gas fires				0

21.0 Fixed Cooling System	No	

22.0 Lighting

Internal

Total number of light fittings	20
Total number of L.E.L. fittings	20

Percentage of L.E.L. fittings	100.00	%
External		
External lights fitted	No	
23.0 Electricity Tariff	Standard	
24.0 Main Heating 1	Database	
Percentage of Heat	100	%
Database Ref. No.	103151	
Fuel Type	Electricity	
Main Heating	PET	
SAP Code	224	
In Winter	208.9	
In Summer	296.5	
Controls	CHC Programmer and room thermostat	
PCDF Controls	0	
Sap Code	2204	
Is MHS Pumped	Pump in heated space	
Heat Emitter	Radiators	
Flow Temperature	36° - 45°C	
25.0 Main Heating 2	None	
Community Heating	None	
28.0 Water Heating	HWP From main heating 1	
Water Heating	Main Heating 1	
Flue Gas Heat Recovery System	No	
Waste Water Heat Recovery Instantaneous System 1	No	
Waste Water Heat Recovery Instantaneous System 2	No	
Waste Water Heat Recovery Storage System	No	
Solar Panel	No	
Water use <= 125 litres/person/day	No	
SAP Code	901	
Immersion Only Heating Hot Water	No	
29.0 Hot Water Cylinder	Hot Water Cylinder	
Cylinder Stat	Yes	
Cylinder In Heated Space	Yes	
Independent Time Control	Yes	
Insulation Type	Measured Loss	
Cylinder Volume	210.00	L
Loss	2.20	kWh/day
Pipes insulation	Fully insulated primary pipework	
31.0 Thermal Store	None	
32.0 Photovoltaic Unit	One Dwelling	

SUMMARY FOR INPUT DATA
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

PV Cells kWp	Orientation	Elevation	Overshading	Connected to Dwelling
1.10	South	Horizontal	None Or Little	Yes

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

None

SUMMARY FOR INPUT DATA
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	Unit 08-09 Priests Bridge	**Issued on Date**	17/06/2022
Assessment Reference	Unit 09 Be Green	**Prop Type Ref**	Be Lean & Green
Property			

SAP Rating	88 B	**DER**	15.61	**TER**	24.43
Environmental	89 B	**% DER<TER**	36.10		
CO_2 Emissions (t/year)	0.87	**DFEE**	40.64	**TFEE**	43.89
General Requirements Compliance	Pass	**% DFEE<TFEE**	7.40		

Assessor Details	Mr. Andrew Jones, Andrew Jones, Tel: 01795 841 035, ajones@quinnross.com	**Assessor ID**	N955-0001
Client			

SUMMARY FOR INPUT DATA FOR: New Build (As Designed)

Orientation	South West
Property Tenure	Unknown
Transaction Type	New dwelling
Terrain Type	Urban
1.0 Property Type	Flat, End-Terrace
2.0 Number of Storeys	1
3.0 Date Built	2022
4.0 Sheltered Sides	2
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Ground Floor:	14.55 m	77.00 m²	2.90 m

7.0 Living Area	27.91	m²
8.0 Thermal Mass Parameter	Simple calculation - Medium	
Thermal Mass	250.00	kJ/m²K

9.0 External Walls

Description	Type	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
External Wall 1	System Build	0.18	31.18	17.18
Wall to Unhtd	Cavity Wall	0.18	11.02	8.92

9.1 Party Walls

Description	Type	Construction	U-Value (W/m²K)	Area (m²)
Party Wall 1	Solid Wall		0.00	73.60

10.0 External Roofs

Description	Type	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
External Roof 1	External Flat Roof	0.13	77.00	77.00

12.0 Opening Types

Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	G-value	Frame Type	Frame Factor	U Value (W/m²K)
Glazing	Manufacturer	Window	Double Low-E Soft 0.05			0.60		0.70	1.40
Front Door	SAP table	Door to Corridor							1.40
Roof Light	Manufacturer	Window	Double Low-E Soft 0.05			0.60		0.70	1.40

SUMMARY FOR INPUT DATA
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width (m)	Height (m)	Count	Area (m²)	Curtain Closed
SE Win 01	Window	[1] External Wall 1	South East	None	0.00					12.00	
NW Roof Light	Window	[1] External Wall 1	North West	None	0.00					2.00	
Front Door	Door to Corridor	[2] Wall to Unhtd	South West							2.10	

14.0 Conservatory	None	
15.0 Draught Proofing	100	%
16.0 Draught Lobby	No	
17.0 Thermal Bridging	Calculate Bridges	

17.1 List of Bridges

Source Type	Bridge Type	Length	Psi	Imported
Table K1 - Approved	E2 Other lintels (including other steel lintels)	8.30	0.300	Yes
Table K1 - Approved	E3 Sill	7.30	0.040	Yes
Table K1 - Approved	E4 Jamb	22.20	0.050	Yes
Table K1 - Approved	E7 Party floor between dwellings (in blocks of flats)	14.55	0.070	Yes
Table K1 - Default	E14 Flat roof	14.55	0.080	Yes
Table K1 - Approved	E16 Corner (normal)	5.80	0.090	Yes
Table K1 - Approved	E18 Party wall between dwellings	5.80	0.060	Yes

Y-value	0.058	W/m²K
18.0 Pressure Testing	Yes	
Designed AP_{50}	5.00	m³/(h.m²) @ 50 Pa
Property Tested ?		
As Built AP_{50}		m³/(h.m²) @ 50 Pa

19.0 Mechanical Ventilation

Summer Overheating

Windows open in hot weather	Windows fully open
Cross ventilation possible	Yes
Night Ventilation	Yes
Air change rate	6.00

Mechanical Ventilation

Mechanical Ventilation System Present	No

20.0 Fans, Open Fireplaces, Flues

	MHS	SHS	Other	Total
Number of Chimneys	0		0	0
Number of open flues	0		0	0
Number of intermittent fans				3
Number of passive vents				0
Number of flueless gas fires				0

21.0 Fixed Cooling System	No	

22.0 Lighting

Internal

Total number of light fittings	20	
Total number of L.E.L. fittings	20	
Percentage of L.E.L. fittings	100.00	%

External

External lights fitted	No

SUMMARY FOR INPUT DATA
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

23.0 Electricity Tariff	Standard	
24.0 Main Heating 1	Database	
Percentage of Heat	100	%
Database Ref. No.	103151	
Fuel Type	Electricity	
Main Heating	PET	
SAP Code	224	
In Winter	182.6	
In Summer	296.5	
Controls	CHC Programmer and room thermostat	
PCDF Controls	0	
Sap Code	2204	
Is MHS Pumped	Pump in heated space	
Heat Emitter	Radiators	
Flow Temperature	36° - 45°C	
25.0 Main Heating 2	None	
Community Heating	None	
28.0 Water Heating	HWP From main heating 1	
Water Heating	Main Heating 1	
Flue Gas Heat Recovery System	No	
Waste Water Heat Recovery Instantaneous System 1	No	
Waste Water Heat Recovery Instantaneous System 2	No	
Waste Water Heat Recovery Storage System	No	
Solar Panel	No	
Water use <= 125 litres/person/day	No	
SAP Code	901	
Immersion Only Heating Hot Water	No	
29.0 Hot Water Cylinder	Hot Water Cylinder	
Cylinder Stat	Yes	
Cylinder In Heated Space	Yes	
Independent Time Control	Yes	
Insulation Type	Measured Loss	
Cylinder Volume	210.00	L
Loss	2.20	kWh/day
Pipes insulation	Fully insulated primary pipework	
31.0 Thermal Store	None	
32.0 Photovoltaic Unit	One Dwelling	

PV Cells kWp	Orientation	Elevation	Overshading	Connected to Dwelling
1.11	Horizontal	Horizontal	None Or Little	Yes

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

None

7.11 Appendix J – Front Commercial Unit BRUKL LEAN

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Commercial Unit Front - LEAN

As designed

Date: Fri Jun 17 09:17:47 2022

Administrative information

Building Details

Address: LONDON, SW14

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: Christopher Armstrong

Telephone number: 01795 841035

Address: Unit 3, Grove Dairy Farm Business Centre, Bobbing Hill, Bobbing, Sittingbourne, ME9 8NY

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	37.4
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	37.4
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	33.4
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and 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	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.22	0.22	GR000001:Surf[2]
Floor	0.25	0.18	0.18	GR000001:Surf[0]
Roof	0.25	-	-	UNKNOWN
Windows***, roof windows, and rooflights	2.2	1.6	1.6	GR000001:Surf[1]
Personnel doors	2.2	2.2	2.2	GR000000:Surf[2]
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

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]

$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

* There might be more than one surface where the maximum U-value occurs.

** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

*** Display windows and similar glazing are excluded from the U-value check.

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

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	5

Building services

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

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	0.9 to 0.95

1- Retail

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	2.5	0	0	-
Standard value	N/A	2.6	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

1- Retail DHW

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

"No zones in project where local mechanical ventilation, exhaust, or terminal unit is applicable"

General lighting and display lighting	**Luminous efficacy [lm/W]**			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Ground: Retail zone 02	-	120	60	222
Ground: Retail zone 01	-	120	60	644
Ground: Stairs	-	120	60	181

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?
Ground: Retail zone 02	NO (-51.6%)	NO
Ground: Retail zone 01	NO (-95.8%)	NO
Ground: Stairs	N/A	N/A

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	133.1	133.1
External area [m²]	294.3	294.3
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	5	5
Average conductance [W/K]	84.94	158.73
Average U-value [W/m²K]	0.29	0.54
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	26.11	39.7
Cooling	9.92	6.76
Auxiliary	0	0
Lighting	27.12	40.95
Hot water	1.79	1.86
Equipment*	20.26	20.26
TOTAL**	**64.94**	**89.28**

* 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 & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	150.98	215.5
Primary energy* [kWh/m²]	197.37	188.55
Total emissions [kg/m²]	33.4	37.4

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	87.6	63.4	26.1	9.9	0	0.93	1.78	1	2.5
	Notional	123.2	92.3	39.7	6.8	0	0.86	3.79	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

Key to terms

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

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.22	GR000001:Surf[2]
Floor	0.2	0.18	GR000001:Surf[0]
Roof	0.15	-	UNKNOWN
Windows, roof windows, and rooflights	1.5	1.6	GR000001:Surf[3]
Personnel doors	1.5	2.2	GR000000:Surf[2]
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

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

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

7.12 Appendix K – Front Commercial Unit BRUKL LEAN & GREEN

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Commercial Unit Front - GREEN

As designed

Date: Fri Jun 17 09:21:14 2022

Administrative information

Building Details

Address: LONDON, SW14

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: Christopher Armstrong

Telephone number: 01795 841035

Address: Unit 3, Grove Dairy Farm Business Centre, Bobbing Hill, Bobbing, Sittingbourne, ME9 8NY

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	37.4
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	37.4
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	31.1
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and 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	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.22	0.22	GR000001:Surf[2]
Floor	0.25	0.18	0.18	GR000001:Surf[0]
Roof	0.25	-	-	UNKNOWN
Windows***, roof windows, and rooflights	2.2	1.6	1.6	GR000001:Surf[1]
Personnel doors	2.2	2.2	2.2	GR000000:Surf[2]
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

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]

$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

* There might be more than one surface where the maximum U-value occurs.

** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

*** Display windows and similar glazing are excluded from the U-value check.

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

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	5

Building services

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

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	0.9 to 0.95

1- Retail

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	4.5	0	0	-
Standard value	N/A	2.6	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

1- Retail DHW

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

"No zones in project where local mechanical ventilation, exhaust, or terminal unit is applicable"

General lighting and display lighting	**Luminous efficacy [lm/W]**			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Ground: Retail zone 02	-	120	60	222
Ground: Retail zone 01	-	120	60	644
Ground: Stairs	-	120	60	181

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?
Ground: Retail zone 02	NO (-51.6%)	NO
Ground: Retail zone 01	NO (-95.8%)	NO
Ground: Stairs	N/A	N/A

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	133.1	133.1
External area [m²]	294.3	294.3
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	5	5
Average conductance [W/K]	84.94	158.73
Average U-value [W/m²K]	0.29	0.54
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	26.11	39.7
Cooling	5.51	6.76
Auxiliary	0	0
Lighting	27.12	40.95
Hot water	1.79	1.86
Equipment*	20.26	20.26
TOTAL**	**60.53**	**89.28**

* 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 & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	150.98	215.5
Primary energy* [kWh/m²]	183.96	188.55
Total emissions [kg/m²]	31.1	37.4

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	87.6	63.4	26.1	5.5	0	0.93	3.2	1	4.5
	Notional	123.2	92.3	39.7	6.8	0	0.86	3.79	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

Key to terms

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

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.22	GR000001:Surf[2]
Floor	0.2	0.18	GR000001:Surf[0]
Roof	0.15	-	UNKNOWN
Windows, roof windows, and rooflights	1.5	1.6	GR000001:Surf[3]
Personnel doors	1.5	2.2	GR000000:Surf[2]
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

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

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

7.13 Appendix L – Rear Commercial Unit BRUKL LEAN

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Commercial Unit Rear - LEAN

As designed

Date: Fri Jun 17 08:33:56 2022

Administrative information

Building Details

Address: LONDON, SW14

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: Christopher Armstrong

Telephone number: 01795 841035

Address: Unit 3, Grove Dairy Farm Business Centre, Bobbing Hill, Bobbing, Sittingbourne, ME9 8NY

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	19.4
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	19.4
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	17.7
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	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.22	0.22	FF000001:Surf[1]
Floor	0.25	0.18	0.18	FF000001:Surf[0]
Roof	0.25	0.18	0.18	GR000003:Surf[6]
Windows***, roof windows, and rooflights	2.2	1.66	2	1S000003:Surf[1]
Personnel doors	2.2	2.2	2.2	FF000002:Surf[1]
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

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]

$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

* There might be more than one surface where the maximum U-value occurs.

** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

*** Display windows and similar glazing are excluded from the U-value check.

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

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	5

Building services

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

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	0.9 to 0.95

1- Office

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.5	2.5	0	0	0.65
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- Office DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	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		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
Ground: WC	-	-	0.5	-	-	-	-	-	-	-	N/A
Ground: Stairs	-	-	-	0.9	-	-	-	-	-	-	N/A
Ground: Lobby	-	-	-	0.9	-	-	-	-	-	-	N/A
Ground: Reception	-	-	-	1.6	-	-	-	-	-	-	N/A
Ground: Office zone 03	-	-	-	1.4	-	-	-	-	-	-	N/A
Ground: Office zone 04	-	-	-	1.4	-	-	-	-	-	-	N/A
Ground: Office zone 05	-	-	-	1.4	-	-	-	-	-	-	N/A
Ground: Office zone 02	-	-	-	1.4	-	-	-	-	-	-	N/A
Ground: Office zone 01	-	-	-	1.4	-	-	-	-	-	-	N/A
1st: OFFICE	-	-	-	1.4	-	-	-	-	-	-	N/A
1st: OFFICE perimeter zone	-	-	-	1.4	-	-	-	-	-	-	N/A

General lighting and display lighting

	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Ground: WC	-	120	-	84

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Ground: Stairs	-	120	-	28
Ground: Lobby	-	120	-	23
Ground: Reception	-	120	60	85
Ground: Office zone 03	120	-	-	182
Ground: Office zone 04	120	-	-	287
Ground: Office zone 05	120	-	-	584
Ground: Office zone 02	120	-	-	351
Ground: Office zone 01	120	-	-	663
1st: OFFICE	120	-	-	162
1st: OFFICE perimeter zone	120	-	-	259

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?
Ground: WC	N/A	N/A
Ground: Stairs	NO (-96.5%)	NO
Ground: Lobby	NO (-87.4%)	NO
Ground: Reception	NO (-89.4%)	NO
Ground: Office zone 03	NO (-53.6%)	NO
Ground: Office zone 04	NO (-79.1%)	NO
Ground: Office zone 05	NO (-48.1%)	NO
Ground: Office zone 02	NO (-67.8%)	NO
Ground: Office zone 01	NO (-67.2%)	NO
1st: OFFICE	NO (-40.9%)	NO
1st: OFFICE perimeter zone	NO (-69.4%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	582.4	582.4
External area [m²]	1332.3	1332.3
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	5	3
Average conductance [W/K]	409.45	500.48
Average U-value [W/m²K]	0.31	0.38
Alpha value* [%]	10.29	10

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

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
100	**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	9.87	6.45
Cooling	6.16	6.07
Auxiliary	5.95	2.91
Lighting	9.88	21.27
Hot water	2.57	2.68
Equipment*	37.2	37.2
TOTAL**	**34.42**	**39.38**

* 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 & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	122.12	142.27
Primary energy* [kWh/m²]	104.61	112.81
Total emissions [kg/m²]	17.7	19.4

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	82.8	39.3	9.9	6.2	5.9	2.33	1.78	2.5	2.5
	Notional	59.4	82.9	6.5	6.1	2.9	2.56	3.79	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

Key to terms

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

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.22	FF000001:Surf[1]
Floor	0.2	0.18	FF000001:Surf[0]
Roof	0.15	0.18	GR000003:Surf[6]
Windows, roof windows, and rooflights	1.5	1.6	1S000002:Surf[1]
Personnel doors	1.5	2.2	FF000002:Surf[1]
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

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

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

7.14 Appendix M – Rear Commercial Unit BRUKL LEAN & GREEN

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Commercial Unit Rear - GREEN

As designed

Date: Fri Jun 17 12:48:58 2022

Administrative information

Building Details

Address: LONDON, SW14

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: Christopher Armstrong

Telephone number: 01795 841035

Address: Unit 3, Grove Dairy Farm Business Centre, Bobbing Hill, Bobbing, Sittingbourne, ME9 8NY

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	19.4
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	19.4
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	14
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	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.22	0.22	FF000001:Surf[1]
Floor	0.25	0.18	0.18	FF000001:Surf[0]
Roof	0.25	0.18	0.18	GR000003:Surf[6]
Windows***, roof windows, and rooflights	2.2	1.66	2	1S000003:Surf[1]
Personnel doors	2.2	2.2	2.2	FF000002:Surf[1]
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

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]

$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

* There might be more than one surface where the maximum U-value occurs.

** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

*** Display windows and similar glazing are excluded from the U-value check.

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

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	5

Building services

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

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	0.9 to 0.95

1- Office

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.5	4.5	0	0	0.65
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- Office DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	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		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
Ground: WC	-	-	0.5	-	-	-	-	-	-	-	N/A
Ground: Stairs	-	-	-	0.9	-	-	-	-	-	-	N/A
Ground: Lobby	-	-	-	0.9	-	-	-	-	-	-	N/A
Ground: Reception	-	-	-	1.6	-	-	-	-	-	-	N/A
Ground: Office zone 03	-	-	-	1.4	-	-	-	-	-	-	N/A
Ground: Office zone 04	-	-	-	1.4	-	-	-	-	-	-	N/A
Ground: Office zone 05	-	-	-	1.4	-	-	-	-	-	-	N/A
Ground: Office zone 02	-	-	-	1.4	-	-	-	-	-	-	N/A
Ground: Office zone 01	-	-	-	1.4	-	-	-	-	-	-	N/A
1st: OFFICE	-	-	-	1.4	-	-	-	-	-	-	N/A
1st: OFFICE perimeter zone	-	-	-	1.4	-	-	-	-	-	-	N/A

General lighting and display lighting

	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Ground: WC	-	120	-	84

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Ground: Stairs	-	120	-	28
Ground: Lobby	-	120	-	23
Ground: Reception	-	120	60	85
Ground: Office zone 03	120	-	-	182
Ground: Office zone 04	120	-	-	287
Ground: Office zone 05	120	-	-	584
Ground: Office zone 02	120	-	-	351
Ground: Office zone 01	120	-	-	663
1st: OFFICE	120	-	-	162
1st: OFFICE perimeter zone	120	-	-	259

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?
Ground: WC	N/A	N/A
Ground: Stairs	NO (-96.5%)	NO
Ground: Lobby	NO (-87.4%)	NO
Ground: Reception	NO (-89.4%)	NO
Ground: Office zone 03	NO (-53.6%)	NO
Ground: Office zone 04	NO (-79.1%)	NO
Ground: Office zone 05	NO (-48.1%)	NO
Ground: Office zone 02	NO (-67.8%)	NO
Ground: Office zone 01	NO (-67.2%)	NO
1st: OFFICE	NO (-40.9%)	NO
1st: OFFICE perimeter zone	NO (-69.4%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	582.4	582.4
External area [m²]	1332.3	1332.3
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	5	3
Average conductance [W/K]	409.45	500.48
Average U-value [W/m²K]	0.31	0.38
Alpha value* [%]	10.29	10

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

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
100	**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	5.48	6.45
Cooling	3.42	6.07
Auxiliary	5.95	2.91
Lighting	9.88	21.27
Hot water	2.57	2.68
Equipment*	37.2	37.2
TOTAL**	**27.29**	**39.38**

* 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 & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	122.12	142.27
Primary energy* [kWh/m²]	82.95	112.81
Total emissions [kg/m²]	14	19.4

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	82.8	39.3	5.5	3.4	5.9	4.19	3.2	4.5	4.5
	Notional	59.4	82.9	6.5	6.1	2.9	2.56	3.79	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

Key to terms

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

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.22	FF000001:Surf[1]
Floor	0.2	0.18	FF000001:Surf[0]
Roof	0.15	0.18	GR000003:Surf[6]
Windows, roof windows, and rooflights	1.5	1.6	1S000002:Surf[1]
Personnel doors	1.5	2.2	FF000002:Surf[1]
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

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

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