



ENERGY STRATEGY

PROJECT:

136-137 Friar Street, Reading

PROJECT NUMBER:

P2636

DOCUMENT REF:

P2636-ENE-02

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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

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1.0 EXECUTIVE SUMMARY

QuinnRoss Energy was commissioned to develop an energy assessment for the proposed *136-137 Friar Street, Reading* development that would demonstrate how it will provide heating and power and meet the energy and carbon emission targets set by national, regional, and local policy.

The site is located on *136-137 Friar Street*, in the *Borough of Reading*. The development will involve the demolition of the rear part of the building, retention of front façade and roof plane; and construction of a five-storey rear extension and dormer windows to retained front roof plane; to accommodate a Class C1 hotel use and ground floor Class E commercial, business, and service use.

This development will be subject to the following requirements:

Requirement	Description / Summary
Building Regulations Part L2 2021	New non-domestic buildings must have a Building's Emission Rate (BER) equal to or less than the calculated Target Emissions Rate (TER). Additionally, the Dwelling Primary Energy Rating (DPER) must be equal to or less than a calculated Target Primary Energy Rating (TPER).
Reading Borough Local Plan 2019	Policy CC2 in the Local Plan states that minor non-residential developments are required to achieve a BREEAM rating of 'Very Good.' Aside from this stipulation, the Local Plan does not specify any specific energy or CO ₂ targets, other than development is encouraged to minimise energy, water, and materials consumption.

Table 01: Summary of energy and sustainability targets

The design team followed the two assessment criteria below as the most effective way to improve the energy efficiency of the property.

Method	Description / Summary
Energy Efficiency Measures	
Building form	The building form will be optimised to help limit any unnecessary energy use.
High performing building thermal envelope	The construction U-values will perform above the current building regulations.
Low infiltration	Air tightness will be no higher than 3.0 m ³ /m ² h.
Daylight strategy	Daylight penetration in rooms will be maximised to reduce lighting demand significantly.
Highly efficient lighting with controls	LED lighting will be installed throughout.
Highly efficient HVAC systems	Highly efficient heat pumps for heating & cooling.

Highly efficient hot water generation	The hot water demand will be provided by the same heat pump used for heating. Hot water cylinders will be highly insulated to minimise losses.
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 where possible.
Renewable Measures	
Air source heat pumps	Highly efficient heat pump system for space heating, cooling & hot water will be installed.

Table 02: Summary of energy efficiency & renewable methods

Thermal and Energy Modelling Results

The whole development has been analysed for its energy use using current 2021 Building Regulations, Part L2 2021, in approved energy modelling software. The predicted and saved tonnes of CO₂ is shown below:

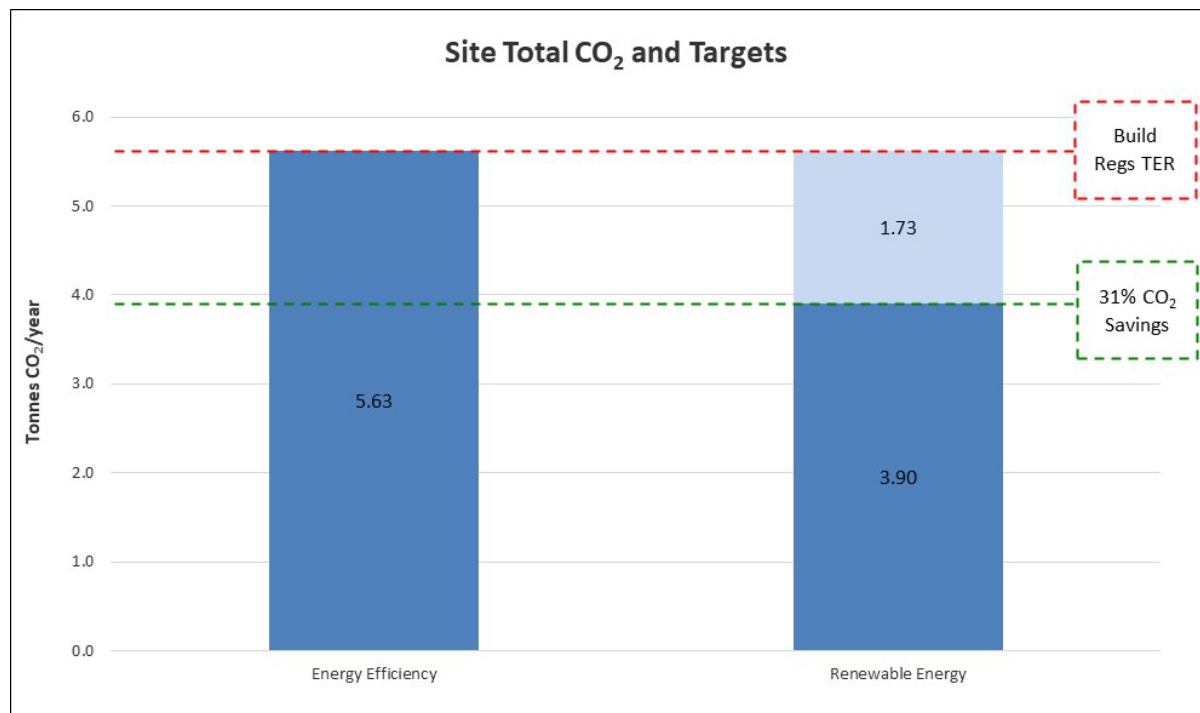


Table 03: Summary of carbon reductions

2.0 INTRODUCTION

QuinnRoss Energy was commissioned to develop an energy assessment for the proposed *136-137 Friar Street, Reading* development that would demonstrate how it will provide heating and power and meet the energy and carbon emission targets set by national, regional, and local policy.

The site is located on *136-137 Friar Street*, in the *Borough of Reading*. The development will involve the demolition of the rear part of the building, retention of front façade and roof plane; and construction of a five-storey rear extension and dormer windows to retained front roof plane; to accommodate a Class C1 hotel use and ground floor Class E commercial, business, and service use.

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 L2 2021, new buildings other than dwellings.
- Reading Borough Local Plan 2019.

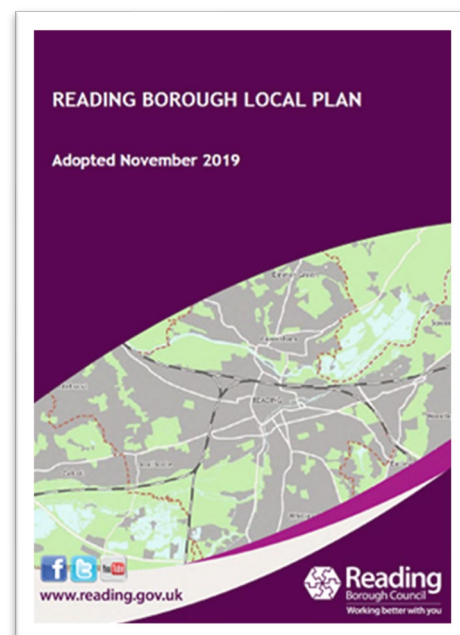
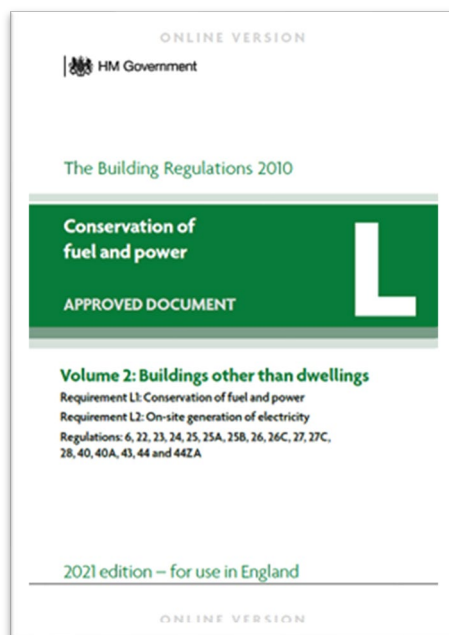


Figure 01: Document front cover images of applicable policies

3.01 Building Regulations Part L2

The development will be subject to the Approved Document Part L2 2021, for new non-domestic buildings. Each individual space will be subject to the Dynamic Simulation Model (DSM) calculation which will determine a Target CO₂ Emissions Rate (TER) and a Target Primary Energy Target (TPER). This effectively requires a minimum level of CO₂ emissions and energy consumption when compared to a target building which is determined by the approved energy modelling software.

The targets are 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 tenant's behaviour, such as computers, lifts, or escalators.

3.02 Reading Borough Local Plan 2019

The Reading Borough Local Plan 2019 does not outline any specific energy or CO₂ targets other than starting development should seek to reduce energy, materials, and water consumption as much as possible.

4.0 ENERGY ASSESSMENT

4.01 Energy Efficiency Measures

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:

- Suitable floor to ceiling heights to help optimise daylight penetration into spaces.

4.01.02 Building Envelope Thermal Performance

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 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/m ² .K	
	Commercial Min Build Regs Req	Proposed Development
Wall	0.26	0.18
Roof	0.18	0.12
Floor	0.18	0.15
Glazing	1.60	1.20

Table 04: Proposed U-values

4.01.03 Air Infiltration

Uncontrolled air infiltration in a building can contribute to a sizeable proportion of heat losses particularly in well insulated modern buildings. An air permeability of no greater than 3.0 m³/m²h is proposed.

4.01.04 Daylight strategy

The provision of artificial lighting accounts for a considerable 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:

- Suitable floor to ceiling heights
- Dual aspect glazing in areas where possible.

4.01.05 Energy efficient services

Several energy efficient HVAC and lighting strategies are proposed for the development:

- Lighting – LED lighting will be installed throughout and be chosen to minimise over-illumination.
- Energy meters – energy meters will be installed for all major energy uses including water.
- User controls – Efficient and user-friendly controls will be specified throughout.
- Heating – The development will be highly insulated for low space heating requirements. All spaces will also use heat pump heating with a high level of seasonal efficiency.
- Hot water – All hot water will be provided by the same high efficiency heat pumps used for heating, with highly insulated storage tanks.
- Mechanical ventilation – All mechanical / fresh air ventilation units will use highly efficient heat recovery systems.
- Cooling – Efficient mechanical equipment (lighting, fans etc) will be specified to minimise internal gains. Solar control glazing with a 0.40 g-value will also be installed to reduce solar gains.
- Air conditioning – All spaces will be cooled by a heat pump system with a high level of efficiency.

4.01.06 Insulated pipework

All internal heating pipework, particularly those located in internal 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.

4.01.07 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 where possible to encourage energy consumption reduction.

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 Renewable Energy Measures

The final part of the hierarchy is to minimise carbon dioxide emissions using renewable / Low or Zero Carbon (LZC) technologies. An initial LZC tech feasibility study has been conducted, shown in appendix A, and the most appropriate product available is heat pumps.

4.02.01 Air source heat pumps

Several energy studies were performed to establish the most CO₂ neutral system available and using a highly efficient heat pump system for space heating, cooling and hot water uses the least amount of

energy. The proposed system will have a heating seasonal efficiency of around 450% and a cooling seasonal efficiency of around 600%.

5.0 THERMAL & ENERGY MODELLING, & BREEAM RESULTS

5.01 Part ADL2 Software Used

All Part L2 calculations will use the Dynamic Simulation Modelling (DSM) method. The software used is the *Integrated Environmental Suite (IES)* software *Virtual Environment (VE) Version 2021.1.0.0*. IESVE is one of the world leaders in developing DSM software and is used internationally for all manner of dynamic simulation calculations, including Part L2 and ASHRAE 90.1 calculations. IESVE is approved by the Department of Community and Local Government (DCLG) for performing Part L2 2021 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 CO₂ emissions analysis using the relevant weather file for the location.

<https://www.iesve.com/>

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

5.02 Results Using Current Building Regulations 2021

The Part ADL2 results under current Building Regulations 2021 (current) are shown below:

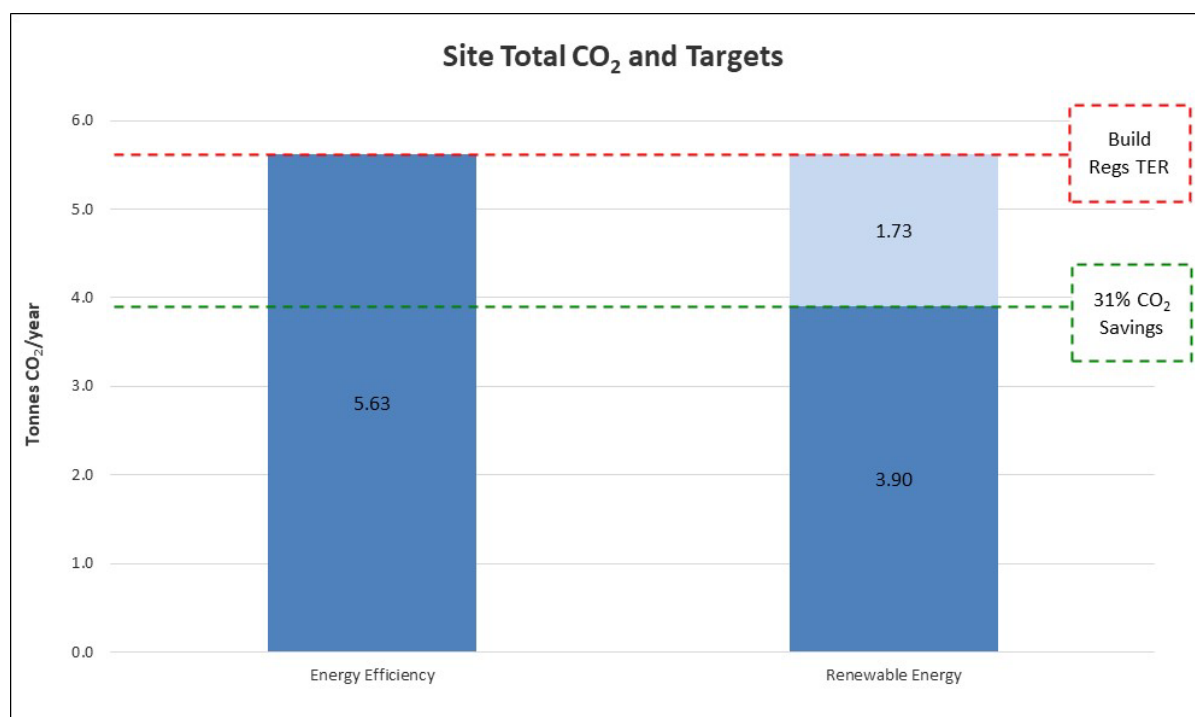


Figure 02: Part L2A results

Using the input data outlined in this report the proposed building will exceed Part ADL2 2021 compliance by 31%.

6.0 SUMMARY & CONCLUSION

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

Requirement	Description / Summary
Building Regulations Part L2 2021	Using the inputs outlined in this strategy all areas of the development will be compliant with Part L2.
Reading Borough Local Plan 2019	All energy and water consumption has been minimised as far as feasibly possible.

Table 05: Summary of energy and sustainability targets

To achieve the above emissions, the following energy reduction methods will be implemented:

Energy Efficiency

- **Building Form** – The building form must be optimised to help limit any unnecessary energy use. This includes 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 above the current building regulations. The following construction U-values will be used.

Envelope Element	U-Value W/m².K	
	Commercial Min Build Regs Req	Proposed Commercial
Wall	0.26	0.18
Roof	0.18	0.12
Floor	0.18	0.15
Glazing	1.60	1.20

Table 06: Proposed U-values

- **Low Infiltration** – Air tightness no higher than 3.0 m³/m²h.
- **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 sensors where possible.
- **Highly efficient lighting with controls** – LED lighting installed throughout.
- **Highly efficient HVAC systems** – Only specifying a high efficiency heat pump system.
- **Highly efficient hot water generator** - The hot water demand will be provided by the same heat pump used for space heating with highly insulated hot water storage tanks.

- **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 where possible.

Renewable Energy

- **Air Source Heat Pumps** – Highly efficient heat pump for space heating, cooling and hot water will be installed.

Energy Modelling Results

The whole development has been analysed for its energy use using approved energy modelling software. The predicted tonnes of CO₂ are shown below:

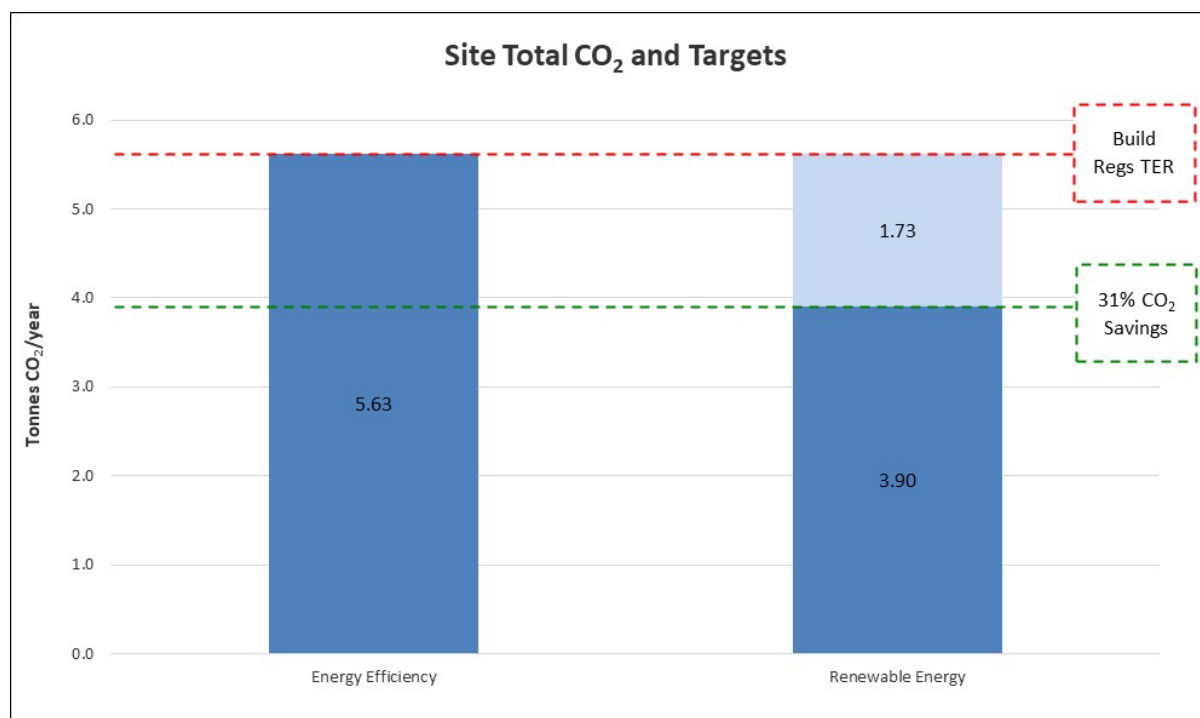
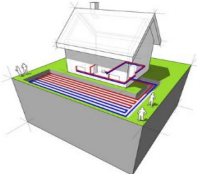
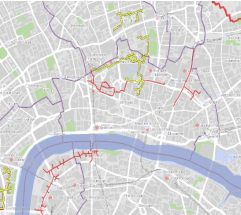


Figure 03: Summary of CO₂ emissions and savings

As the results above show, when including all the previously mentioned energy efficiency methods, the building will achieve an 31% improvement over current Building Regulations.

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 has minimal roof space, which would be more effectively used to accommodate the heat pumps. 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. Although PV's are suitable for this development the building footprint is actually quite small and thus roof area is not extensive. The roof will have space for the outdoor heatpump units and amenity space for the residents, which also has a set requirements. The resultant remaining space would have little impact if used for PV's.	Medium
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 CO ₂ 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 suburban 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 making it feasible for this development. Although CHP is feasible, it would not offer significantly better savings over the proposed heat pumps. It must also be noted that future Building Regs are widely predicted to be moving away from CHP and natural resource consumption, therefore CHP is not considered.	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.	Low

7.02 Appendix B – Input data used for Part ADL2 calculations.

Constructions U-values	
Floor	0.18 W/m ² .K
Roof	0.12 W/m ² .K
Wall	0.18 W/m ² .K
Door	2.20 W/m ² .K
Glazing	
Overall U-value (including frame)	1.20 W/m ² .K
g-value	0.40
Air Permeability	
Air permeability	3.0 m ³ /m ² .h
HVAC Systems	
Main system	
System description	VRF heat pump heating & cooling with MVHR
NCM system type	Variable refrigerant flow
Heat source	Heat pump (electric): air source
Heating fuel type	Electricity
Heating generator seasonal efficiency	4.50
Cooling system	Heat pump (electric): air source
Cooling fuel type	Electricity
Cooling seasonal energy efficiency rating (SEER)	4.00
Cooling nominal energy efficiency rating (EER)	6.00
AHU Specific fan power (SFP)	-
AHU Pump type	-
Heat recovery efficiency	-
DHW	
System description	Same as space heating
Heating fuel type	Electricity
Delivery efficiency	100%
Storage volume (l)	300
Storage insulation (mm)	50
Lighting	
Lighting power densities	lm/W
All areas	140
Power & Lighting controls	
Electric Power Factor	<0.9
PIR's	No
Daylight sensors	No
Metering / Monitoring	Lighting systems have provision for metering
Lighting control parasitic power	0.10 W/m ²



7.03 Appendix C – Hotel BRUKL

Project name

Hotel**As built****Date:** Tue May 23 08:48:40 2023

Administrative information

Building Details

Address: 136 Friar Street, READING, RG1 1EX

Certifier details

Name: Christopher Armstrong**Telephone number:** 01795 841 035**Address:** Unit 3, Grove Dairy Farm Business Centre,
Bobbing Hill, Bobbing, SITTINGBOURNE, ME9
8NY

Certification tool

Calculation engine: Apache**Calculation engine version:** 7.0.19**Interface to calculation engine:** IES Virtual Environment**Interface to calculation engine version:** 7.0.19**BRUKL compliance module version:** v6.1.e.0**Foundation area [m²]:** 137.95The CO₂ emission and primary energy rates of the building must not exceed the targets

Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	14.08
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	9.6
Target primary energy rate (TPER), kWh _{PE} /m ² .annum	152.64
Building primary energy rate (BPER), kWh _{PE} /m ² .annum	104.61
Do the building's emission and primary energy rates exceed the targets?	BER =< TER BPER =< TPER

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

Fabric element	U _{a-Limit}	U _{a-Calc}	U _{i-Calc}	First surface with maximum value
Walls*	0.26	0.18	0.18	FR000007:Surf[1]
Floors	0.18	-	-	UNKNOWN
Pitched roofs	0.16	0.12	0.12	RF000000:Surf[2]
Flat roofs	0.18	0.12	0.12	FR00000B:Surf[0]
Windows** and roof windows	1.6	1.18	1.18	FR000007:Surf[0]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	-	-	No personnel doors in building
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

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

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

** Display windows and similar glazing are excluded from the U-value check. *** Values for rooflights refer to the horizontal position.

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

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

Air permeability	Limiting standard	This building
m ³ /(h.m ²) at 50 Pa	8	3

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

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

1- HEAT PUMP SYSTEM

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.5	4	0	-	-
Standard value	2.5*	5	N/A	N/A	N/A
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.					

"No HWS in project, or hot water is provided by HVAC system"

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

General lighting and display lighting		General luminaire	Display light source	
Zone name		Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
	Standard value	95	80	0.3
First: Room Lobby		140	-	-
First: Lounge		140	-	-
First: Room Lobby		140	-	-
Second: Room Lobby		140	-	-
Second: Room Lobby		140	-	-
Second: Store		140	-	-
Second: Store		140	-	-
Second: Room 1 WC		140	-	-
Second: Room 1		140	-	-
Second: Room 2		140	-	-
Second: Room 2 WC		140	-	-
Second: Room 4 WC		140	-	-
Second: Room 4		140	-	-
Second: Room 3		140	-	-
Second: Room 3 WC		140	-	-
Second: Circulation		140	-	-
First: Staircase		140	-	-
First: Concierge		140	15	9
First: Room 3		140	-	-
First: Room 3 WC		140	-	-
First: Room 2		140	-	-
First: Room 2 WC		140	-	-
First: Room 1 WC		140	-	-
First: Room 1		140	-	-

The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
First: Room Lobby	N/A	N/A
First: Lounge	NO (-54.6%)	NO
First: Room Lobby	N/A	N/A
Second: Room Lobby	N/A	N/A
Second: Room Lobby	N/A	N/A
Second: Store	N/A	N/A
Second: Store	N/A	N/A
Second: Room 1 WC	N/A	N/A
Second: Room 1	NO (-83.2%)	NO
Second: Room 2	NO (-57.3%)	NO
Second: Room 2 WC	N/A	N/A
Second: Room 4 WC	N/A	N/A
Second: Room 4	NO (-57.6%)	NO
Second: Room 3	NO (-82.1%)	NO
Second: Room 3 WC	N/A	N/A
Second: Circulation	N/A	N/A
First: Staircase	N/A	N/A
First: Concierge	N/A	N/A
First: Room 3	NO (-65.7%)	NO
First: Room 3 WC	N/A	N/A
First: Room 2	NO (-57.3%)	NO
First: Room 2 WC	N/A	N/A
First: Room 1 WC	N/A	N/A
First: Room 1	NO (-56.1%)	NO

Regulation 25A: Consideration of high efficiency 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
Floor area [m ²]	275.9	275.9
External area [m ²]	322.6	322.6
Weather	LON	LON
Infiltration [m ³ /hm ² @ 50Pa]	3	3
Average conductance [W/K]	70.56	115.66
Average U-value [W/m ² K]	0.22	0.36
Alpha value* [%]	28.84	10

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

Building Use

% Area Building Type

Retail/Financial and Professional Services
 Restaurants and Cafes/Drinking Establishments/Takeaways
 Offices and Workshop Businesses
 General Industrial and Special Industrial Groups
 Storage or Distribution

100 Hotels

Residential Institutions: Hospitals and Care Homes
 Residential Institutions: Residential Schools
 Residential Institutions: Universities and Colleges
 Secure Residential Institutions
 Residential Spaces
 Non-residential Institutions: Community/Day Centre
 Non-residential Institutions: Libraries, Museums, and Galleries
 Non-residential Institutions: Education
 Non-residential Institutions: Primary Health Care Building
 Non-residential Institutions: Crown and County Courts
 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	5.51	10.44
Cooling	3.94	2.72
Auxiliary	0	3.41
Lighting	14.36	14.81
Hot water	45.3	71.78
Equipment*	15.24	15.24
TOTAL **	69.11	103.16

* 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
Displaced electricity	0	0

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	123.38	149.8
Primary energy [kWh _{PE} /m ²]	104.62	152.64
Total emissions [kg/m ²]	9.6	14.08

HVAC Systems Performance

System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEFF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] ASHP, [HFT] Electricity, [CFT] Electricity									
Actual	83.1	40.2	5.5	3.9	0	4.19	2.84	4.5	4
Notional	104.4	45.4	10.4	2.7	0	2.78	4.63	----	----
[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



7.04 Appendix D – Ground Retail BRUKL

Project name

Ground Retail**As built****Date:** Tue May 23 08:36:54 2023**Administrative information****Building Details****Address:** 136 Friar Street, READING, RG1 1EX**Certifier details****Name:** Christopher Armstrong**Telephone number:** 01795 841 035**Address:** Unit 3, Grove Dairy Farm Business Centre,
Bobbing Hill, Bobbing, SITTINGBOURNE, ME9
8NY**Certification tool****Calculation engine:** Apache**Calculation engine version:** 7.0.19**Interface to calculation engine:** IES Virtual Environment**Interface to calculation engine version:** 7.0.19**BRUKL compliance module version:** v6.1.e.0**Foundation area [m²]:** 174.82**The CO₂ emission and primary energy rates of the building must not exceed the targets**

Target CO ₂ emission rate (TER), kgCO ₂ /m ² annum	4.06
Building CO ₂ emission rate (BER), kgCO ₂ /m ² annum	3.89
Target primary energy rate (TPER), kWh _{PE} /m ² annum	43.95
Building primary energy rate (BPER), kWh _{PE} /m ² annum	42.45
Do the building's emission and primary energy rates exceed the targets?	BER ≤ TER BPER ≤ TPER

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

Fabric element	U _{a-Limit}	U _{a-Calc}	U _{i-Calc}	First surface with maximum value
Walls*	0.26	0.18	0.18	GR000002:Surf[2]
Floors	0.18	0.17	0.17	GR000000:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	0.12	0.12	GR000001:Surf[1]
Windows** and roof windows	1.6	1.24	1.24	GR000005:Surf[1]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	2.2	2.2	GR000002:Surf[1]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

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

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

** Display windows and similar glazing are excluded from the U-value check. *** Values for rooflights refer to the horizontal position.

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

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

Air permeability	Limiting standard	This building
m ³ /(h.m ²) at 50 Pa	8	3

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

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

1- HEAT PUMP SYSTEM

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.5	4	0	-	-
Standard value	2.5*	5	N/A	N/A	N/A
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.					

"No HWS in project, or hot water is provided by HVAC system"

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

General lighting and display lighting		General luminaire		Display light source	
Zone name		Efficacy [lm/W]		Efficacy [lm/W]	Power density [W/m²]
	Standard value	95		80	0.3
Ground: Storage		140		80	1.875
Ground: Circulation		140		80	1.875
Ground: Staircase		140		80	1.875
Ground: Retail Zone 1		140		80	1.875
Ground: Retail Zone 7		140		80	1.875
Ground: Retail Zone 6		140		80	1.875
Ground: Retail Zone 5		140		80	1.875
Ground: Retail Zone 4		140		80	1.875
Ground: Retail Zone 2		140		80	1.875
Ground: Retail Zone 3		140		80	1.875

The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Ground: Storage	N/A	N/A
Ground: Circulation	N/A	N/A
Ground: Staircase	N/A	N/A
Ground: Retail Zone 1	NO (-28.5%)	NO
Ground: Retail Zone 7	N/A	N/A
Ground: Retail Zone 6	NO (-100%)	NO
Ground: Retail Zone 5	NO (-99.5%)	NO
Ground: Retail Zone 4	NO (-97.9%)	NO
Ground: Retail Zone 2	NO (-57%)	NO
Ground: Retail Zone 3	NO (-86.6%)	NO

Regulation 25A: Consideration of high efficiency 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
Floor area [m ²]	174.8	174.8
External area [m ²]	255	255
Weather	LON	LON
Infiltration [m ³ /hm ² @ 50Pa]	3	3
Average conductance [W/K]	58.21	60.14
Average U-value [W/m ² K]	0.23	0.24
Alpha value* [%]	25.09	10

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

Building Use

% Area Building Type

100	Retail/Financial and Professional Services
	Restaurants and Cafes/Drinking Establishments/Takeaways
	Offices and Workshop Businesses
	General Industrial and Special Industrial Groups
	Storage or Distribution
	Hotels
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential Schools
	Residential Institutions: Universities and Colleges
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
	Non-residential Institutions: Libraries, Museums, and Galleries
	Non-residential Institutions: Education
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
	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	4.91	5.78
Cooling	4.22	3
Auxiliary	0	0
Lighting	16.45	20.33
Hot water	2.49	0.56
Equipment*	20.26	20.26
TOTAL **	28.07	29.68

* 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
Displaced electricity	0	0

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	117.31	107.91
Primary energy [kWh _{PE} /m ²]	42.45	43.95
Total emissions [kg/m ²]	3.89	4.06

HVAC Systems Performance

System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEFF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] ASHP, [HFT] Electricity, [CFT] Electricity									
Actual	74.2	43.2	4.9	4.2	0	4.19	2.84	4.5	4
Notional	57.9	50	5.8	3	0	2.78	4.63	----	----
[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
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