



Land at Queens
Road, Lower
Caversham, RG4
8DN

Energy Strategy Report

April 2024

Ref: 23-10684



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Revision	Initial	Rev A	Rev B	Rev C
Date	11/04/2024			
Prepared by	I. Bhatnagar			
Checked by	A.Gonzales			
Authorised by	M. Standen			

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Abbreviations

ASHP:	Air Source Heat Pump
BER:	Building Emission Rate
CO ₂ :	Carbon Dioxide
CHP:	Combined Heat and Power
CSH:	Code for Sustainable Homes
DHW:	Domestic Hot Water
ESR:	Energy Strategy Report
GHG:	Green House Gas
GSHP:	Ground Source Heat Pump
GLA:	Great London Authority
HVAC:	Heating, Ventilation, and Air Conditioning
IES VE:	Integrated Environmental Solutions Virtual Environment
KWp:	Kilo Watt Power
KWh:	Kilo Watt Hour
LZC:	Low Zero Carbon
MVHR:	Mechanical Ventilation Heat Recovery
MCS:	Microgeneration Certification Scheme
NPPF:	National Planning Policy Framework
NCM:	National Calculation Methodology
OSM:	Open Street Map
PV:	Photovoltaic
SBEM:	Simplified Building Energy Modelling
SFP:	Specific Fan Power
TER:	Target Emission Rate

1. Executive Summary

This Energy Strategy Report demonstrates the predicted energy performance and carbon emissions of the proposed development located at **Queens Road, Lower Caversham, RG4 8DN**. The presented figures in this study are based on the most updated information provided by the design team. The development will comprise of **2 new-build dwellings, including associated amenities like parking, private gardens etc.** The overall analysis took into consideration the national building regulations (i.e. **Part L 2021**) and the local policy requirements (i.e. **Reading Borough Local Plan**). Based on the study assumptions, the project shall comply with the council local policies and buildings regulations.

1.1 Buildings Policy Requirements

The national building regulations require buildings to comply with the energy efficiency requirements. This shall be accomplished through capping the project carbon emissions below the regulated target. In addition to the above, **Reading Borough Council** requires new developments to incorporate sustainable design and construction measures. The table below summarises the best practice building regulations and local policy requirements the assessment adopted for the development.

Table 1: National and Local Policy Requirements

Policy:	Requirement	Compliance Check
Part L 2021	The dwelling primary energy rate (DPER), dwelling emission rate (DER) and dwelling fabric energy efficiency (DFEE) must not exceed the target primary energy rate (TPER), target emission rate (TER) and target fabric energy efficiency (TFEE) respectively.	The new-build residential development achieved all criteria by the proposed implementation of measures within this energy strategy i.e. improved fabric thermal performance, efficient building services and renewable technologies.
Reading Borough Local Plan	All new-build minor housing will achieve at a minimum a 19% improvement in the dwelling emission rate over the target emission rate.	The project has maximized carbon reductions, resulting in 79% reduction over Part L 2021 for each dwelling.
	Buildings in Reading should be built to high standards of energy efficiency incorporating on-site renewable energy where possible.	Solar PV has been incorporated within the project as part of the proposed energy strategy.

1.2 Assessment Methodology and Strategies

The adopted methodology to mitigate the project's CO₂ emissions is in alignment with the London Plan's Energy Hierarchy Guidance. Compliance with the energy hierarchy suggestions (i.e. >35% reduction over Part L baseline) automatically demonstrates Part L compliance. Models and simulation assumptions have been carried out using **SAP** calculation methods which comply with the National Calculation Methodologies (NCM).

Table 2 below explains the Energy Hierarchy stages and the suggested strategies to help the proposed development achieve the required carbon targets.

Table 2: Energy Hierarchy stages to achieve >35% reductions over Part L requirement.

Stages	Strategies
BE LEAN Carbon Efficient Design (Minimising energy demand)	- Improved fabric U-values beyond Part L requirements. - Enhanced thermal bridging performance. - Energy efficient lighting fittings (i.e., LED). Further information can be found in the Be Lean Section.
BE CLEAN (Availability of CHP and communal heating systems)	Feasibility for local CHPs and communal heating systems has been assessed. Further information can be found in the Be Clean Section.
BE GREEN On-site renewable technologies (i.e. ASHP, PVs, etc)	Provision of efficient building services using ASHP and solar PV. Further information will be presented in the Be Green section below.
BE SEEN In-use monitoring	Installation of Smart Meters is recommended to monitor the actual operational energy use, manage it effectively and mitigate the performance gap.

Table 3: Analysis stages (as per energy hierarchy) and their corresponding carbon emissions

Analysis Stage	Plot 1 Dwelling Emission Rate (DER) (KgCO ₂ /m ² .annum)	Plot 2 Dwelling Emission Rate (DER) (KgCO ₂ /m ² .annum)
Notional TER	11.65	12.15
Baseline	6.50	6.64
Be-Lean	3.90	4.07
Be-Clean	3.90	4.07
Be-Green	2.34	2.51

The table above enlists the carbon emissions for each stage of the energy hierarchy for the 2 blocks, following the implementation of various environmental strategies relevant to each stage.

1.3 Assessment Results

The residential development has been simulated under four conditions to analyse the improvements hierarchy. The first simulation assesses the building under the notional building specifications defined by Part L 2021. The function of this first simulation is to generate the regulated carbon target (TER) and the actual Building Emission Rate (BER). The second calculation analyses the carbon reductions achieved after improving the building fabric thermal performance by adopting improved thermal U-values and airtightness (i.e. Be Lean). The third stage of simulation assesses the feasibility of adopting local low-carbon energy sources like CHPs (i.e. Be Clean stage). The fourth simulation analyses the carbon reductions after considering renewable technologies as a strategy to achieve the recommended reductions beyond **Part L** requirements (i.e. Be Green).

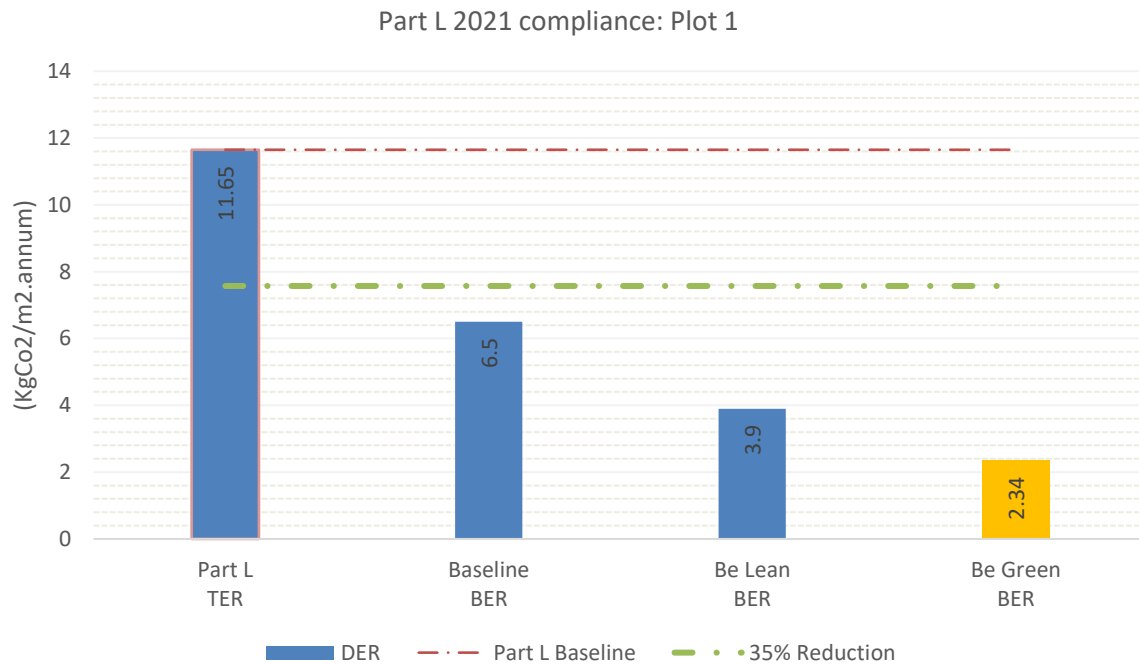


Figure 1a: Impact on Dwelling Emission Rate (DER) of the building after every stage of the proposed strategy

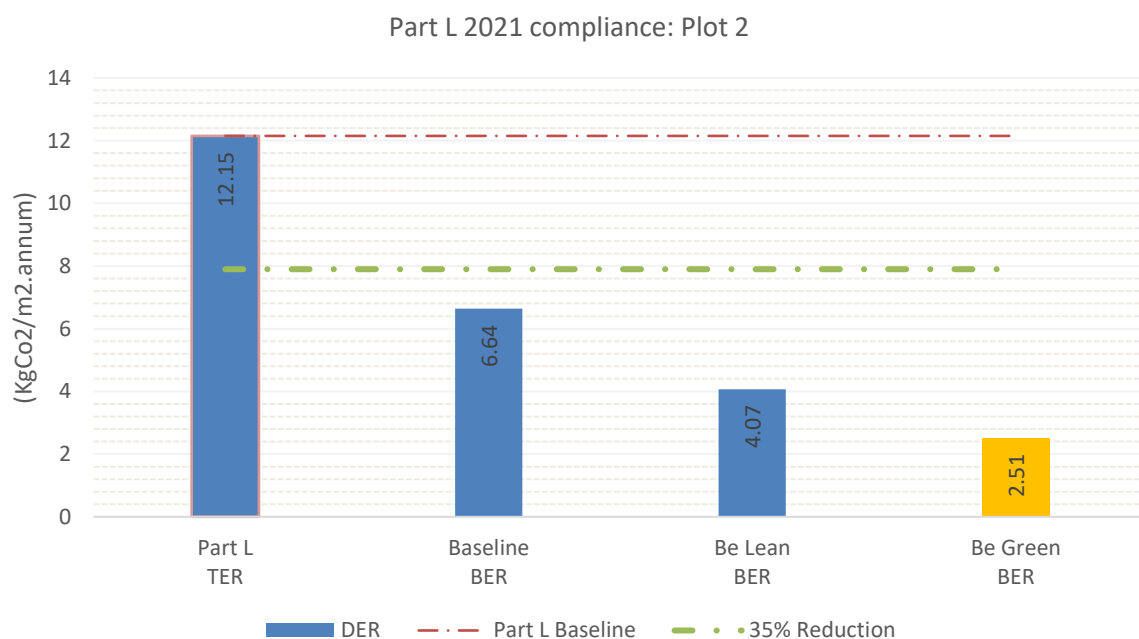


Figure 1b: Impact on Building Emission Rate (BER) of the building after every stage of the proposed strategy

Results of the simulations show that the overall development is able to meet the all the criteria of the national and local policies i.e. >19% reduction over TER from all measures combined.

It is also worth noting here that the dwellings fall below the threshold of a major development since the combined floor area is less than 1000 m². However, the Local Plan for Reading requires non-major residential developments to also demonstrate >19% reduction over Part L 2013 TER. Since the Building Regulations have now been superseded with Part L 2021, the dwellings have been assessed according to the latest, more stringent compliance criteria.

In line with the Reading Borough Council's expectation from all developments to make carbon savings, a carbon shortfall calculation has been carried out in *Table 4* below, as an indication of the carbon output that may result from the development of the dwellings.

Table 4: Carbon shortfall calculation

Energy Hierarchy Analysis Stage	Plot 1		Plot 2	
	Total Carbon (tCO ₂ /annum)	% Reduction (against TER)	Total Carbon (tCO ₂ /annum)	% Reduction (against TER)
Notional TER	1.19	-	1.24	-
Baseline	0.66	44.21	0.68	45.35
Be-Lean	0.40	66.52	0.41	66.50
Be-Clean	0.40	66.52	0.41	66.50
Be-Green	0.24	79.91	0.26	79.34

Please note that non-major developments are only expected to make carbon offset contributions where >19% carbon emissions reductions are not being achieved on site.

Please refer to appendix A for further SAP calculations.

2. Introduction

This Energy Strategy Report (ESR) focuses on the energy strategies explored for the proposed scheme in order to make it comply with national and local policy requirements. The report presents how the annual energy consumption and related carbon emissions will be minimised to meet the regulated targeted carbon emissions (**i.e. Part L TER**). Furthermore, the report explains how to reach the required energy targets to achieve **>19%** carbon reductions for the development.

The assessed development is located in the Lower Caversham area of **Reading Borough** in the South of England. The development proposal has a total built up area of **204 m²** (*please see calculation reports in Appendix A*) with **2 dwellings located at Queens Road, Lower Caversham, RG4 8DN**.



Figure 2: Site Location (marked in Orange).

The domestic and non-domestic sectors play an important role in the UK economy, both as employer and generator of output and in providing other sectors – such as retail, finance and business – with a critical factor of production, the physical location from which to do business. This ESR report analyses the residential project using research and policies guidance to make sure this development is built up to achieve positive economic, social and environmental impacts.

The Wandsworth Council aims to ensure that the growth of the borough is sustainably delivered, both through a robust approach to the protection and effective management of the borough's environment and natural resources and by identifying opportunities for growth to support the development of more sustainable buildings and neighbourhoods. It facilitates the development of built environment designed to minimise its contribution to, and to mitigate the effects of, climate change – thereby contributing to an overall improvement in the quality of life of the borough's residents.

To reach these ambitious targets, the Council has developed a detailed roadmap outlining actions that it will take:

1. Policy CC2: Sustainable Design and Construction:

Proposals for new development, including the construction of new buildings and the redevelopment and refurbishment of existing building stock, will be acceptable where the design of buildings and site layouts use energy, water, minerals, materials and other natural resources appropriately, efficiently and with care and take account of the effects of climate change.

To meet these requirements:

- All major non-residential developments or conversions to residential are required to meet the most up-to-date BREEAM 'Excellent' standards, where possible;
- All minor non-residential developments or conversions to residential are required to meet the most up-to-date BREEAM 'Very Good' standard as a minimum;
- All non-residential development or conversions to residential should incorporate water conservation measures so that predicted per capita consumption does not exceed the appropriate levels set out in the applicable BREEAM standard. Both residential and non-residential development should include recycling greywater and rainwater harvesting where systems are energy and cost effective.

2. Policy H5: Standard for New Housing

New build housing should be built to the following standards, unless it can be clearly demonstrated that this would render a development unviable:

- All new build housing outside the Central Area as defined on the Proposals Map will comply with the nationally-described space standard.
- All new build housing will be built to the higher water efficiency standard under Regulation 36(3) of the Building Regulations.
- All major new-build residential development should be designed to achieve zero carbon homes.
- All other new build housing will achieve at a minimum a 19% improvement in the dwelling emission rate over the target emission rate, as defined in the 2013 Building Regulations.
- All new build housing will be accessible and adaptable in line with M4(2) of the Building Regulations, unless it is built in line with M4(3).
- On developments of 20 or more new build dwellings, at least 5% of dwellings will be wheelchair user dwellings in line with M4(3) of the Building Regulations. Any market homes provided to meet this requirement will be 'wheelchair adaptable' as defined in part M, whilst homes where the Council is responsible for allocating or nominating an individual may be 'wheelchair accessible'.

4. Assessment Methodology

4.1 The Energy Hierarchy

The energy hierarchy is a classification of different methods to improve energy performance in a parallel sequence. This includes primarily a focus on reducing energy use by avoiding unnecessary consumption, to then improving the efficiency of energy systems to minimise loss. This is followed by exploiting renewable energy sources and low carbon energy solutions for energy needs. Finally, any remaining demand can be catered for by conventional fuel sources and carbon offsetting solutions.

The Energy Strategy adopts a set of principles to guide design development and decisions regarding energy, balanced with the need to optimise environmental and economic benefits. The following hierarchy should be used to assess applications:

- **BE LEAN** – By using less energy and considering the further energy efficiency measure in comparison to the baseline building.
- **BE CLEAN** – By supplying energy efficiently. Clean energy use looks at further carbon dioxide emission savings over the lean building by taking into consideration the use of decentralise energy (e.g. CHP, District Heat Networks).
- **BE GREEN** – By integrating renewable energy into the scheme which can further reduce the carbon dioxide emission rate.
- **BE SEEN** – By monitoring, verifying, and reporting on energy performance to use energy mode effectively.

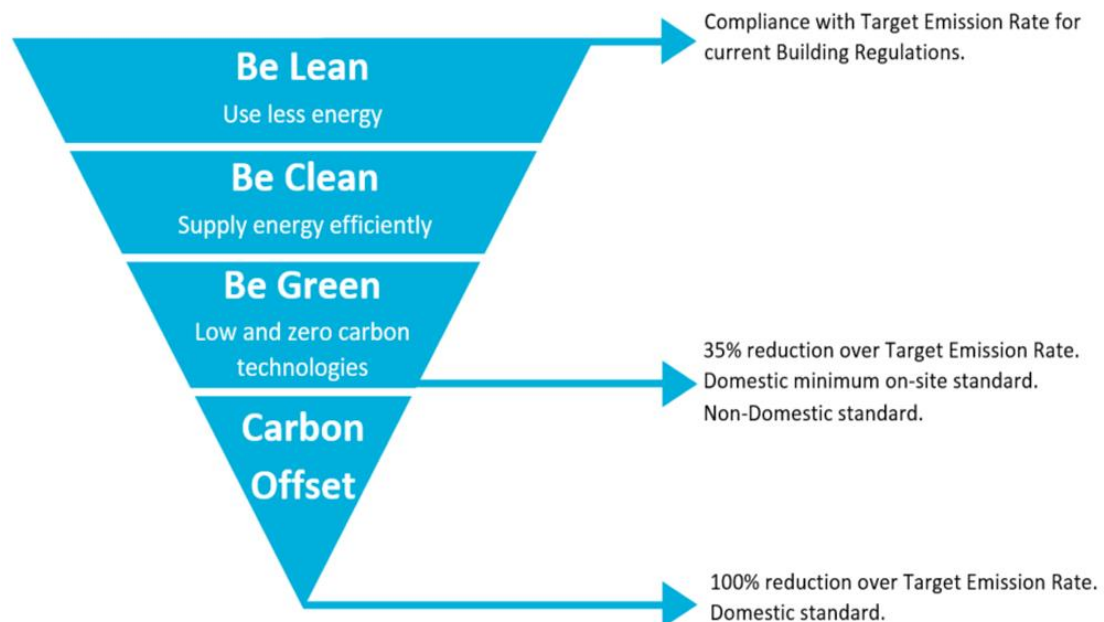


Figure 4: GLA Energy Hierarchy

It should be noted here that while the Energy Hierarchy is derived from the London Plan, the project lies outside the jurisdiction of the Greater London Authority. However, the methodology provides an appropriate framework for energy assessments and has therefore been appointed within this report as a step-by-step approach to ensuring compliance.

4.2 Modelling strategy.

The Government approved software; **SAP 10** have been utilised to carry out the project compliance simulations according to the National Calculation Methodology (NCM). Simulated Models are built to assess the Dwelling Emission Rate (DER) against the notional building Target Emission Rate (TER). The notional building used to determine emission targets is the same size and shape as the actual building, constructed to concurrent regulated specifications (i.e. **Part L 2021**).

The proposed dwellings have been modelled entirely to the notional building specifications in order to meet the carbon targets and the limiting fabric and buildings services parameters. However, for differences in fabric design and glazing areas, actual buildings sometimes are expected to exceed the notional TER. Therefore, further improvements to the actual building parameters (e.g. fabric, HVAC, lightings, renewables) are made to meet the required compliance targets. The approved document (i.e. **Part L 2021**) however, encourages developers to vary the specification provided the same overall level of carbon dioxide emissions is achieved or bettered. It is important to note that SAP is not intended to be used as a building design tool but to inform the designers' design decisions.

Information received from the project team has been used to undertake the energy assessments and supporting the modelling assumptions. The document references are listed in the table below.

Table 5: Reference documents list, as used for energy analysis.

No.	Document Name	Format	Received Date
1	Queens Rd Planning 2024.03.14	.dwg	14-03-2024

5. BASELINE - Target Emission Rate (TER) & Dwelling Emission Rate (DER)

The notional target (known as Target Emission Rate), as calculated in line with the Building Regulation 2021, is the maximum amount of carbon dioxide a development is allowed to emit. The Target Emission Rate (TER) includes carbon dioxide emissions which are covered by Part L1 of the Building Regulations, known as regulated emissions (space and water heating, ventilation, lighting, pumps, fans & controls). The baseline energy uses, and resultant CO₂ emissions rates of the development have been assessed using government-approved software (**SAP 10**).

This first run of simulation assesses the models under the notional building specifications defined under Part L to limit the fabric thermal heat losses. The assessment results in the regulated target values for energy consumption and carbon emissions i.e. the TER and TPER, by using the Government approved methodology (SAP).

The baseline regulated CO₂ emissions for the development are presented in the tables below:

Plot 1:

Table 6a: Regulated Energy Use and Carbon Emissions TER at Baseline

Energy Hierarchy Stage	DER (kgCO ₂ /m ² . year)	DPER (KWh _{PE} /m ² . year)	DFEE (kWh/m ² . year)
Notional	11.65	60.9	42.95
Baseline	6.5	67.1	72.3

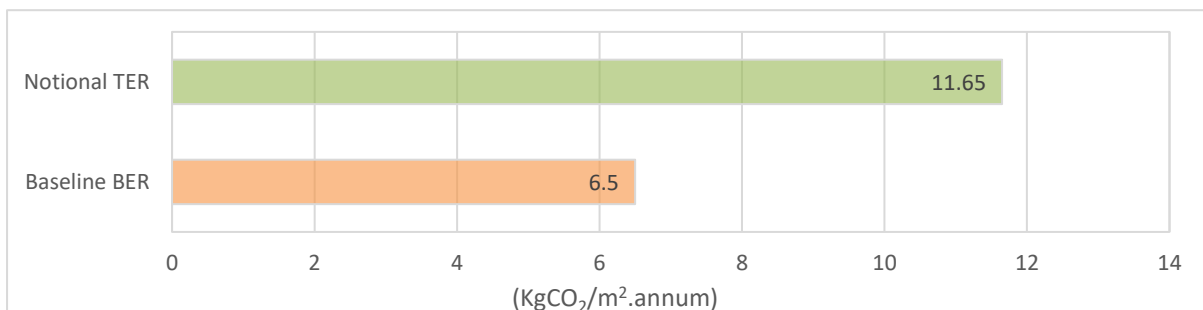


Figure 5a: Notional Building TER and Baseline DER for the proposed scheme.

Plot 2:

Table 6b: Regulated Energy Use and Carbon Emissions TER at Baseline

Energy Hierarchy Stage	DER (kgCO ₂ /m ² . year)	DPER (KWh _{PE} /m ² . year)	DFEE (kWh/m ² . year)
Notional	12.15	63.66	44.95
Baseline	6.64	68.63	74.0

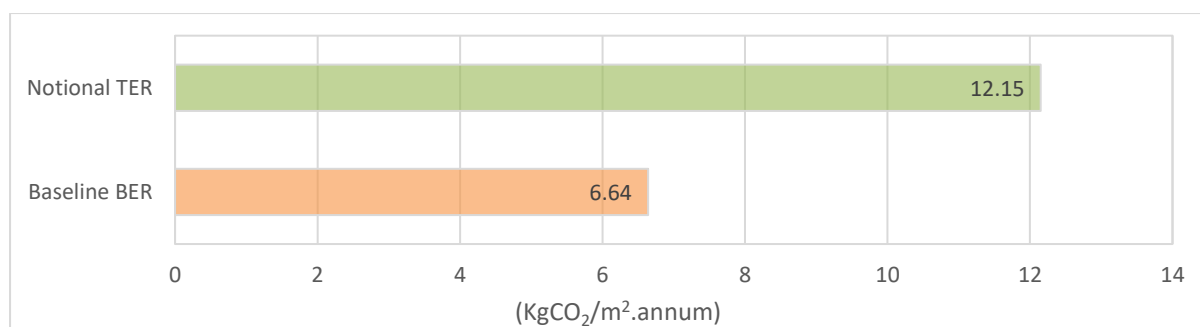


Figure 5b: Notional Building TER and Baseline DER for the proposed scheme.

The results of the first run show that the Baseline DER for the new-build residences are lower than the regulated target emissions rate (TER). However, the DPER and DFEE criteria are failing at this stage. Further improvements to the model are carried out in the following sections (i.e. Be Lean and Be Green) to try and achieve compliance for all criteria.

6. BE LEAN - Energy Efficient Design

This section outlines the project location, orientation and climatic conditions taken into account to determine the most feasible energy efficient measures taken in order to minimise the building's energy demand. The analysis helps reduce the energy use and CO₂ emissions beyond the Baseline benchmark on the path to achieving compliance (**Building Regulations Part L 2021**).

6.1 Site location



Figure 6: Urban view of the site surroundings (source: Google Earth)

The proposed project site is located at **Queens Road, Lower Caversham, RG4 8DN** in the borough of Reading. The immediate surrounding areas are largely low-rise residential with a large park towards the south of the site. The location is in close proximity to the Thames River.

6.2 Site weather and Microclimate

The local weather and microclimate usually influence a building's energy performance. Urban design has a significant impact on microclimate and outdoor thermal comfort. Several studies in different climate regions have concluded that ventilation and shade are crucial to improve urban thermal comfort. Often the thermal conditions are improved as a consequence of good urban design including exist of proper shade and sufficient ventilation. This in turn leads to decreased occurrence of heat stress and heat-related diseases as well as grown performance of both mental and physical tasks.

London weather data has been used for thermal and energy simulations. Figure represents the annual dry bulb temperature in London City. Maximum temperatures can reach up to 34.9°C in late Jun, and minimum temperatures can reach down to -2.1°C in late Feb. The buildings in this location are generally low rise, and the site is not expected to suffer from the Urban Heat Island effects.

The site's landscape also affects the energy demand of a building. Vegetation, landform, and any existing buildings can provide shade to a new development. For instance, if located to the south of

the building, deciduous trees can be advantageous, providing shade in the summer but allowing sunshine through in the winter when they lose their leaves. However, in this case, the context is largely urban and while a large park is located to the South of the site, no dense vegetation exists in the immediate vicinity.

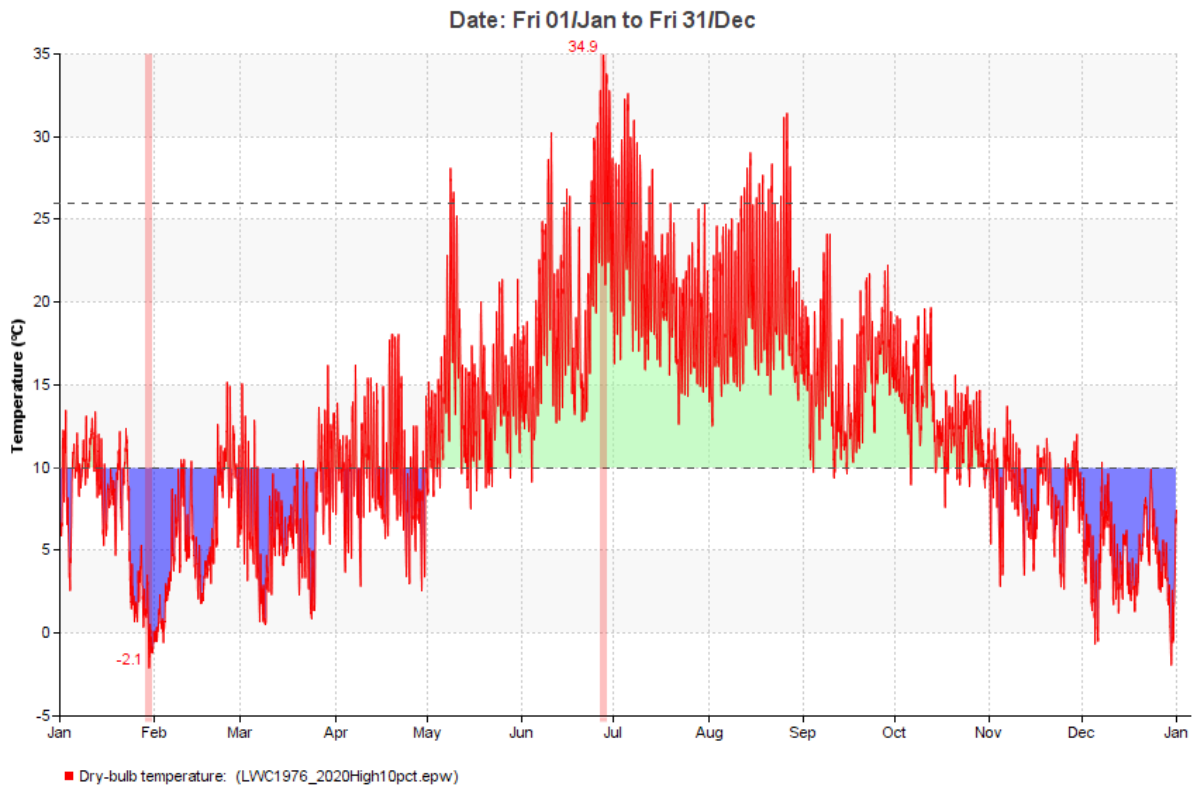


Figure 7: IES Annual Dry Bulb Temperature according to London weather file TRY05.fwt

6.3 Building Orientation, layout, and form

Building layout, orientation and form can influence many key features of the development. The design should provide for an effective use of space and appealing layout, with opportunities to benefit from natural daylight balanced with achieving solar gain without overheating. In general, a higher thermal performance can be achieved by limiting the surface area to volume ratio as this minimises heat loss through the wall area.

It should be noted that where the building footprint is extremely tight, for example in a city centre location, then the building form and orientation may have to be dictated by the available space and not by implementation of best practice measures. Invariably, planning constraints and/or the functional relationships of specific areas will result in some measure of deep planning, thus reducing the opportunity for natural ventilation and/or daylight.

In the current scenario, both the dwellings have been designed such that each regularly occupied space (i.e. living rooms, bedrooms, kitchen etc.) has ample openings to allow daylight and sunlight in. The primary axes run **East to West**, with the majority of the windows at the front and back i.e. facing East or West.

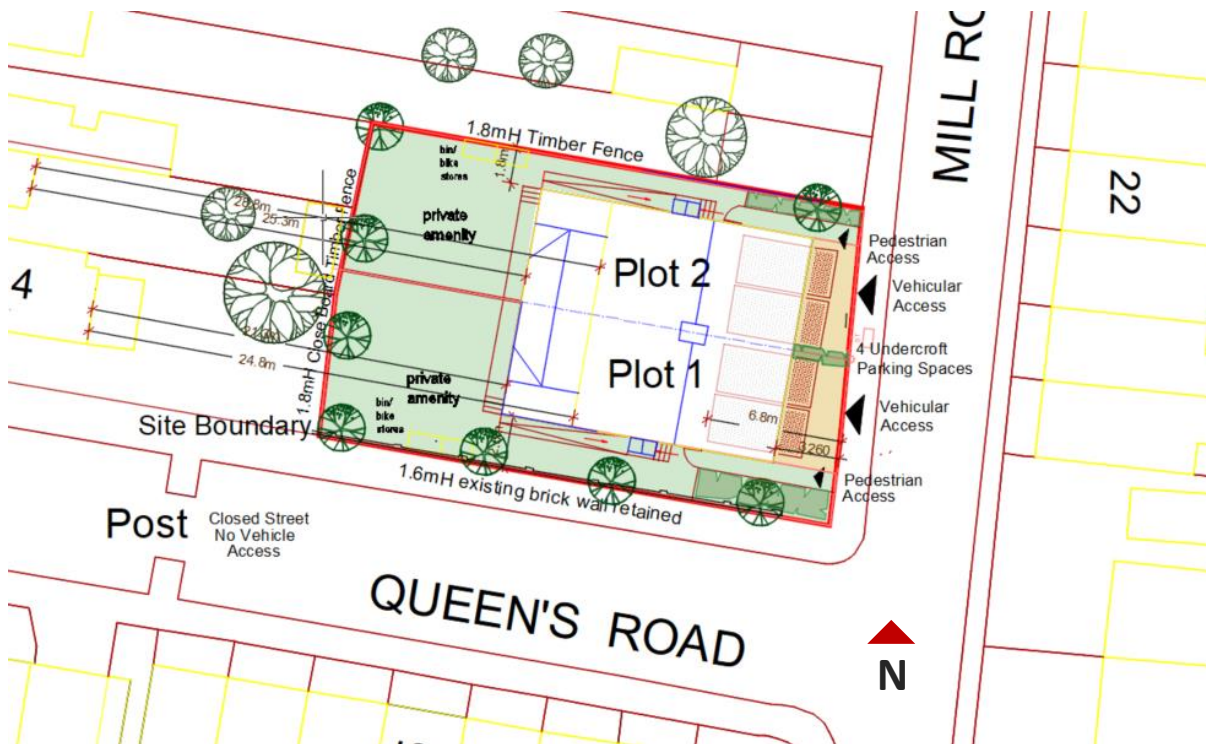


Figure 8: Proposed site plan

6.4 Building Design – Energy Efficiency Design Measures

At the 'BE LEAN' stage of the energy hierarchy, energy efficient building elements have been incorporated into the model. The heat loss of different building element is dependent upon their U-value, air permeability, and thermal bridging Y-values. Therefore, better U-values and air permeability figures than the minimum values set in **Part L1 2021** have been suggested in this stage of assessment process.

Table 7 below presents the improved U-values used for the dwellings against the **Part L1 2021** figures as used for the Baseline. The Be Lean stage U-values promote a thermally efficient building fabric in order to reduce energy consumption through passive measures. The overall figures mentioned in the table below are the assumptions for the second run of simulation.

Table 7: Proposed thermal performance for construction material.

Residential			
Category Specification		Part L 2021 Notional	Be Lean Proposed
U-value (W/m ² K)	Wall	0.26	0.15
	Floor	0.18	0.11
	Roof	0.16	0.11
	Windows	1.6	1.0
	Doors	1.6	1.2
Thermal Bridging (W/mK)	Lintels (E2)	1	0.02
	Sill (E3)	0.1	0.02

	Jamb (E4)	0.1	0.02
	Junction b/w ground floor and external walls (E5)	0.32	0.05
	Junction b/w intermediate floor and external walls (E6)	0.14	0.005
Air Permeability (m ³ /h.m ² at 50 Pa)		8.00	2.50

The new-build residential development will be adopting the following measures for enhanced fabric thermal performance:

- Enhanced envelope U-values - to reduce the building's heat losses and demand.
- Providing a well-sealed envelope to minimize the infiltration of cold winter air and warm air in summer.
- Minimizing thermal bridging by using accredited construction details to avoid heat losses.
- Adopting a window to wall ratio that prioritizes daylight but controls solar gain and glare – to reduce electric lighting energy consumption while mitigating overheating.
- Providing exposed thermal mass to provide passive cooling – suppresses summertime overheating to acceptable levels without the need for high energy consuming mechanical cooling systems.

With the introduction of stricter benchmarks under Part L 2021, thermal bridging has become crucial for compliance, particularly for the Dwelling Fabric Energy Efficiency (DFEE) criterion. As such, the building construction elements resulting in the maximum heat loss associated with thermal bridging were targeted. It has been proposed that heat loss through joints around openings (i.e. lintels, sills and jambs) as well as joints between external walls floor slabs (including ground floor and intermediate floor) be reduced through the use of more efficient insulation and joint assembly.

6.5 Building occupancy type

The building occupancy type is dependent on the NCM building type. **C3 Residential** building type has been identified for the building. The occupancy and internal gains have been input accordingly.

6.6 Daylighting and Solar Shading Strategy

The glazing specification has been carefully selected to ensure the internal environment is pleasant on all orientations. The spaces are recommended to make use of blinds to limit excess solar gains, particularly for the spaces facing West. This will help reduce the overheating risk, and subsequently the cooling demand.

The glazing specifications assumed for the energy model are summarized in the table below:

Table 8: Glazing specifications

	U-value (Including frame)	G-value	VT
Residential	1.0	0.63	0.7

6.7 Ventilation strategy

Natural Ventilation + Heat Recovery Ventilation

All spaces will utilise Mechanical Ventilation Heat Recovery units to provide background and boost ventilation. These units utilise the warm exhausted air to pre-heat the fresh incoming supply air. This helps to significantly reduce the heat loss of the building by retaining heat within the thermal envelope.

6.8. Cooling Hierarchy

The building regulations outline a hierarchy of measures which should be followed in order to reduce the demand for cooling within the development. Multiple strategies have been considered for this development to reduce the cooling demand and the overheating risks, as described below:

- ✓ **Reducing Solar Gains** – Minimal glazing with low G-Values have been targeted in order to minimise solar gains.
- ✓ **Minimising Internal Heat Gains** – Heat distribution infrastructure within buildings is to be designed to minimise pipe lengths and adopt pipe configurations which minimise heat loss (e.g., twin pipes). All hot water pipes are to be insulated to reduce heat escaping into occupied spaces.
- ✓ **Thermal Mass** – Increasing the amount of exposed thermal mass can help to absorb excess heat within the building. Further investigation needs to be undertaken to try to capitalise on the thermal massing wherever possible, so as to help regulate the internal temperature.
- ✓ **Optimised ventilation** – Mechanical extraction strategies will be adopted with extract fans in wet rooms (e.g., toilets) to remove the hot, humid air. MVHR has been recommended with automatic summer bypass to reduce the peak summertime temperatures.

Be Lean – Active Design Measures

The table below shows the applied ‘Be Lean’ active design measures incorporated within the design to demonstrate the energy strategy approach.

Table 9: Active Design Measures adopted at Be Lean Stage

No.	Measure	Explanation
1	Heat recovery ventilation	Heat recovery has been used as part of a ventilation strategy to maximise energy efficiency. The following specifications are suggested for the MVHR system - Specific Fan Power (SFP): 0.75 Efficiency: 85% Duct Installation Specification: Level 1 Duct Type: Rigid It is crucial to ensure that the system is installed inside the heating envelope to ensure optimum efficiency levels.
2	On-demand control	The room by room heating and lighting controls ensure that energy efficiency is maximised in almost all spaces where the amount of air delivered is variable to suit the space.

3	Low Temperature Hot Water (LTHW) system	Heating for the building is provided by a system which features reduced flow and return temperatures, reducing thermal losses and space heat gain as compared to a traditional system. Due to the nature of the LTHW system, should a community heat network connection become available to the site in the future, the proposed system is compatible for connection.
4	Variable speed pumping	Variable speed pumping on all secondary circuits reduces energy consumption associated with distribution significantly.
5	Lighting Efficiency	The proposed light fittings shall be 100% energy efficient fittings i.e., LED lighting. These have been found to be a cost-effective measure to reduce electrical energy use associated with artificial lighting.

The impact of the measures implemented at the Be Lean stage is summarized below:

Plot 1:

Table 11a: Regulated Carbon Emissions (BER) at Be Lean Stage

Energy Hierarchy Stage	DER (kgCO ₂ /m ² . year)	DPER (KWh _{PE} /m ² . year)	DFEE (kWh/m ² . year)
Notional	11.65	60.9	42.95
Be Lean	3.9	40.72	41.7

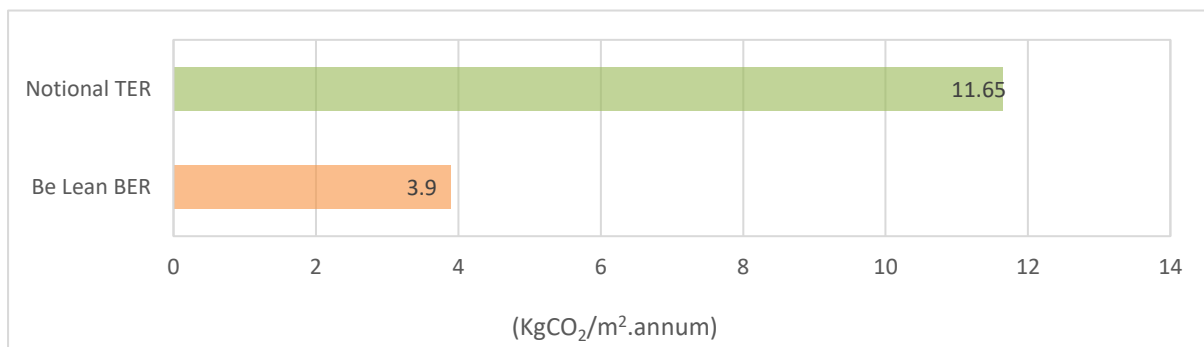


Figure 9a: Notional Building TER and Be Lean DER for the proposed scheme.

Plot 2:

Table 11b: Regulated Carbon Emissions (BER) at Be Lean Stage

Energy Hierarchy Stage	DER (kgCO ₂ /m ² . year)	DPER (KWh _{PE} /m ² . year)	DFEE (kWh/m ² . year)
Notional	12.15	63.66	44.95
Be Lean	4.07	42.51	44.00

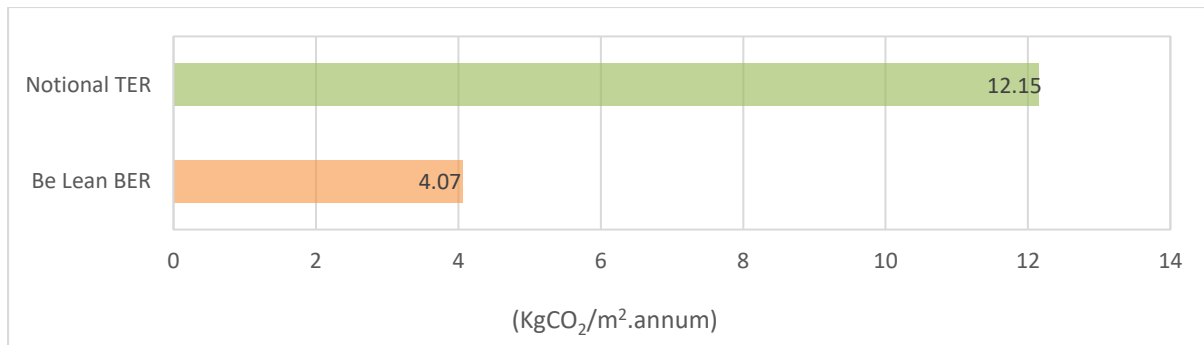


Figure 9b: Notional Building TER and Be Lean BER for the proposed scheme.

At the 'Be Lean' stage of the energy hierarchy, high performance construction material and energy efficient building systems have been incorporated into the model, as summarized in Table 7 and Table 9 above. The output from the energy assessment confirms that upgrading the building fabric will result in the significant reductions in the carbon output of the domestic units and also lead to compliance in under all criteria as per Part L 2021.

Further improvements to the Be Lean stage model are proposed within the next (i.e. Be Green) stage, namely the implementation of renewable technologies.

7. BE CLEAN – CHP & Decentralised Energy Networks

The Energy Hierarchy encourages the use of local CHP system and connection to District Heating systems to reduce CO₂ emissions further.

7.1 Decentralised Energy Network

District and community heating systems are favoured because they offer:

- Potential economies of scale in respect of efficiency and therefore reduced carbon emissions.
- Greater potential for future replacement with Low or Zero Carbon (LZC) technologies.

The feasibility of connecting into an existing heating network or providing the building with its own combined heat and power plant has been assessed alongside the **London Heat Map** (refer Figure 10 below) as part of this assessment. The map identifies that the site is not located near any existing or proposed district heat networks. This has been demonstrated from the London Heat Map (<http://www.londonheatmap.org.uk>).

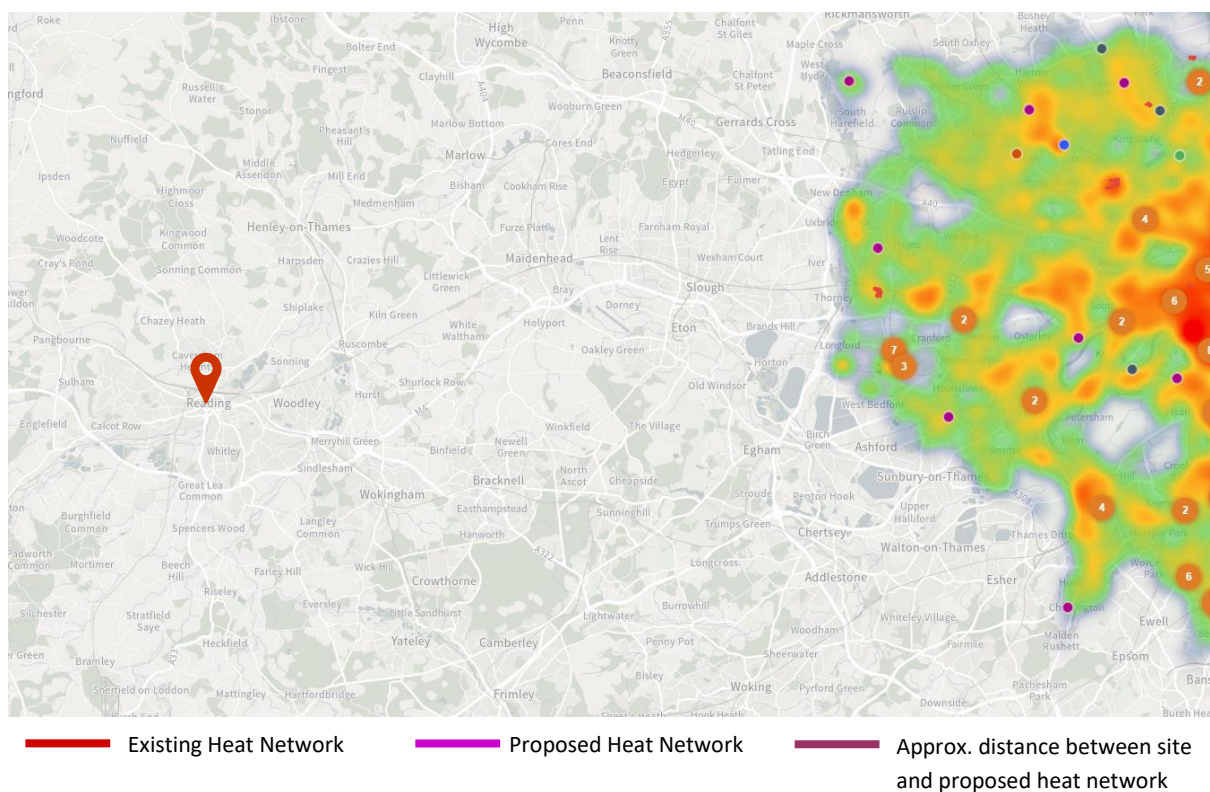


Figure 10: London Heat Map near the site

For the current analysis, it is proposed for this development to utilise air source heat pump installation which enables a low temperature heating network to be set up within the building for heating and hot water systems. This makes the proposed system compatible for future connectivity with any heat networks, should the opportunity present itself.

7.2 Combined Heat and Power (CHP)

The Energy Hierarchy identifies the combined heat and power (CHP) as a method of producing heat and electricity with much lower emissions than separate heat and power. Also, it encourages the creation of district heating systems supplied by CHP. The implementation of a CHP strategy should

be decided according to good practice design. Key factors for the efficient implementation of the CHP system are:

- Development with high heating load for most of the year.
- CHP operation based on maximum heat load for minimum 10 hours per day.
- CHP operation at maximum capacity of 90% of its operating period.

To ensure that CHP is financially viable it is essential that the unit is selected to meet the base heat load and that this load is maintained over a large proportion of the day (a figure of 14 – 17 hours per day is often quoted subject to the load profiles and gas and electricity prices) to ensure that the additional costs (maintenance) associated with running a CHP unit can be recovered. This needs to run the CHP plant, as far as possible continuously makes the building load profile of prime importance when reviewing the viability of such solutions and in particular the summertime heat load profile. To enable the CHP plant to run continuously when it is operating, a thermal store is often used so that excess CHP capacity can be used.

Generally, developments consist of at least 50 residential units would obtain the benefits of the micro-CHP system. As such, **the implementation of a CHP has not been considered for this development.** In case the design team considers installing this technology, further information regarding the local system storage space will be needed. Additionally, further information is required on the CHP located near the site in order to gauge its feasibility.

Plot 1:

Table 12a: Regulated Carbon Emissions (BER) at Be Lean Stage

Energy Hierarchy Stage	DER (kgCO ₂ /m ² . year)	DPER (KWh _{PE} /m ² . year)	DFEE (kWh/m ² . year)
Notional	11.65	60.9	42.95
Be Clean	3.9	40.72	41.7

Plot 2:

Table 12b: Regulated Carbon Emissions (BER) at Be Lean Stage

Energy Hierarchy Stage	DER (kgCO ₂ /m ² . year)	DPER (KWh _{PE} /m ² . year)	DFEE (kWh/m ² . year)
Notional	12.15	63.66	44.95
Be Clean	4.07	42.51	44.00

8. BE GREEN – Renewable Energy Appraisal

In this section the viable renewable energy technologies that could reduce the development's CO₂ emissions are examined. In accordance with Policy SI 2 of the London Plan, the technical feasibility and economic viability of installing each LZC technology at the development have been assessed, so as to discount any unsuitable options at an early stage.

In determining the appropriate renewable technology for the site, the following factors are considered.

- Renewable energy resources or fuel availability of the LZC technology on the site.
- Implementation with regards the overall M&E design strategy for building type.
- Capital, operating and maintenance cost available for the project.
- Planning Permission from the local council.
- Available Grants.

The table below summarises the various low zero carbon technologies considered for the projects, and **Air Source Heat Pumps (ASHP) and Photovoltaics (PV)** have been identified as the most appropriate option for this development.

Table 13: Feasibility Study of LZC Technologies

Technology Name:	Carbon Payback	Feasibility
Photovoltaic (PV)	High	HIGH
Air Source Heat Pumps (ASHP)	High	HIGH
Biomass	High	LOW
Wind Power	Low	LOW
Hydro Power	None	LOW
Solar Thermal	Low	MEDIUM
Ground Source Heat Pumps (GSHP)	High	LOW

8.1 Non-feasible Technology

- **Ground Source Heat Pumps (GSHP)**

A ground source heat pump would be a feasible option to meet the space heating requirements. However, it requires ground space for bore holes to extract the ground heat to be utilized for space heating requirements. In this case there is no available ground space for a borehole or trench system, the ground source loop would have to be incorporated within the foundation piles of the structure, which would result in additional cost. Hence, this option is not suitable for this development.

- **Solar Thermal**

The use of solar thermal for this development would be limited to domestic hot water only. The use of solar thermal for space heating would not be practical as it is not required when solar thermal is at its most effective during the summer months. Moreover, according to the scheme scale the expected carbon offset from the system is generally lower compared to other LZC technologies.

- **Hydro power**

The project site is close to the Thames River. However, the costs involved in extending a network up to the river will far outweigh the benefits to be drawn from a small-scale hydro-electric system. Hence this will not be studied any further because of the location and the spatial limitations of the development.

- **Biomass**

A biomass system designed for this development would be fueled by wood pellets which have a high energy content. However, a biomass system would not be an appropriate technology for the site for the following reasons:

- The burning of wood pellets releases substantially more NOx emissions when compared to similar gas boilers. As the development is situated within an urban area, the installation of a biomass boiler would further impact on the air quality in this area.
- Pellets would need to be transported from local pellet suppliers, which causes carbon emissions to the air.
- Site doesn't have an adequate storage space impacting layout and logistics arrangements.

However, if a biomass system is considered at further detailed design stage, local suppliers can be found near the site as shown in the map below (<http://biomass-suppliers-list.service.gov.uk>).

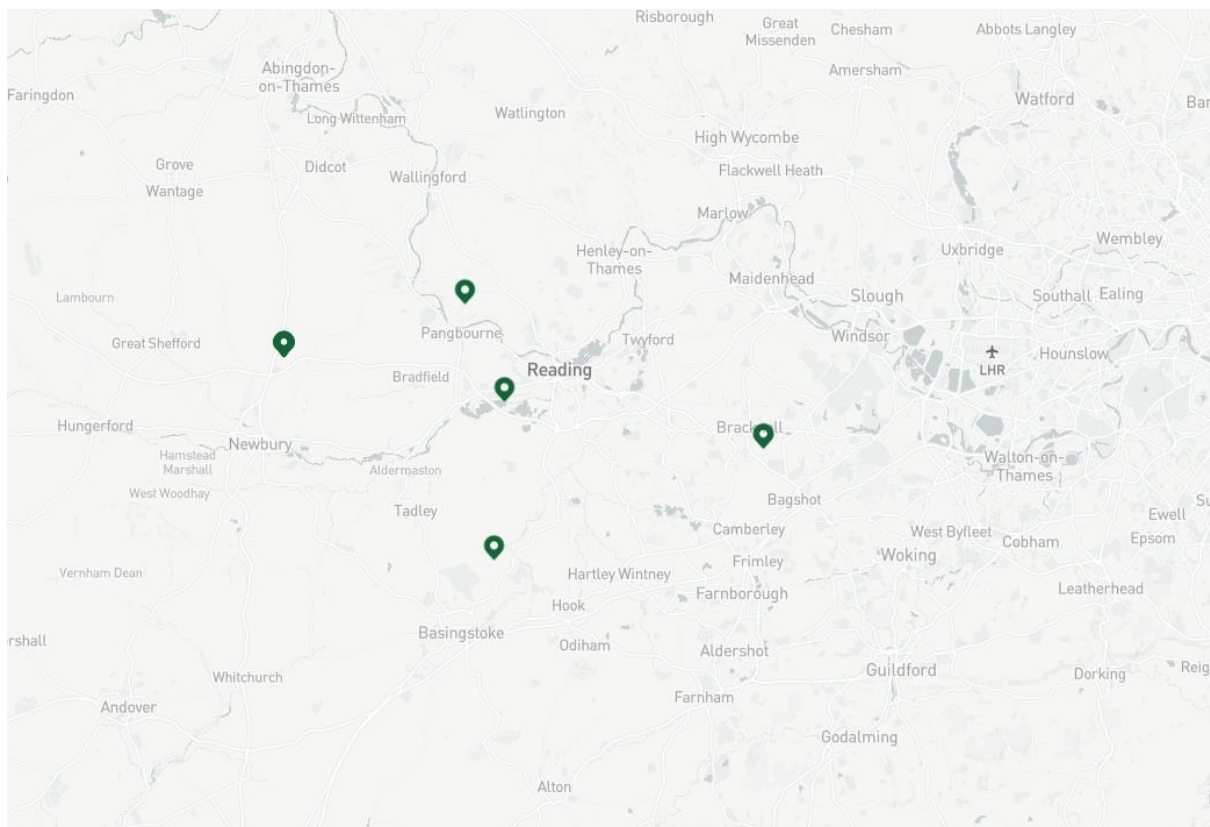


Figure 11: Biomass suppliers locations proximity to the project location.

- **Wind Power**

Wind turbines need extensive planning requirements, and they are only feasible at consistent wind speed. Moreover, since the development is located in an urban area, the site does not have sufficient wind speed to operate wind turbine at the height of 10 meters as shown below (*source: <https://www.rensmart.com/Maps#NOABL>*). Hence this option has been discounted.

Location

- Latitude: 51.46384702792485
- Longitude: -0.9625775585790496
- Height above sea level: 193 m

Wind Speeds

estimates from NOABL data

- At 10m above ground level 4.6 m/s
- At 25m above ground level 5.4 m/s
- At 45m above ground level 5.9 m/s

Solar

falling on a optimally oriented panel

- Annual Energy per m² 1141 kWh
- Daily Energy per m² 3126 Wh

Please note that the NOABL windspeed dataset is a model of windspeeds across the country, assuming completely flat terrain. It isn't a database of measured windspeeds. Other factors such as hills, houses, trees and other obstructions in the vicinity of the site need to be considered as well, as they can have a significant effect. In case you're installing a wind turbine is being considered, measurements using an anemometer need to be carried out to determine what the actual figures are.

8.2 Proposed Technology

• Air Source Heat Pumps

An ASHP can meet the space heating demands on site more efficiently in comparison to gas boilers. Although this low carbon technology consumes electricity to operate, the heat output is much greater due to higher efficiency. Therefore, it has been suggested for the space heating and hot water for this project.

Another advantage to the use of ASHP technology is that it has no impact on the Air Quality credentials i.e. NO_x, Particulate Matter etc. Emissions associated with building operations, specifically those resulting from space conditioning of the building are minimized.

The design stage specifications used for energy calculations are in the table below. However, the ASHP was proposed only for simulation, detailed ASHP specifications should be provided by a mechanical engineer during the design development. The system must be certified under the Microgeneration Certification Scheme (MCS) and ideally, the Enhanced Capital Allowances criteria.

Table 14: ASHP system specs, as assumed for energy modelling.

Systems	General Specification	Control
Heating and Cooling	Air Source Heat Pumps	- Winter Efficiency: 219% - Summer Efficiency: 190% - Heat emitter: Radiators - Flow Temperature: 45 °C - Control: Time and temperature zone control
Hot Water	100% demand being met by ASHP	Water use <= 125 l/person/day

• Photovoltaic (PV)

Solar PV could be one of the suitable renewable technologies for the project due to the following reasons:

- The installation of PV is much simpler when compared to other renewable technologies.
- There is sufficient roof space available to install enough PV modules to have a significant impact on carbon emissions of the development.
- PV panels sited on the roof within an urban area are less visually intrusive when compared to wind turbines.

Table 15: Suggested solar PV specifications.

Solar PV property	Specification (as input for energy assessment)
Orientation	South-East
Inclination	30° (as per roof pitch)
Plant size	1.5 kWp per dwelling

Power output	250 W per panel
Number of panels	6
PV area (sq.m.)	approx. 10 m ² (assuming 1.7 m ² per panel)
Overshading	None or little

In summary, 6 high efficiency 250 W PV panels can be installed for each dwelling at 30° inclination facing South-East. These provide a further reduction of carbon emissions through on-site renewable energy generation, as encouraged by Reading Council. The proposed PV panels are subject to further consideration at detailed design stages. In order to qualify both the installer and the equipment, the system must be certified under the Microgeneration Certification Scheme (MCS).

Given the proposed LZC technologies on the site (i.e., **ASHP and PV**), the overall CO₂ reduction at Be Green stage can be calculated as shown below:

Plot 1:

Table 16a: Regulated Carbon Reduction at Be-Green Stage

Energy Hierarchy Stage	DER (kgCO ₂ /m ² . year)	DPER (KWh _{PE} /m ² . year)	DFEE (kWh/m ² . year)
Notional	11.65	60.9	42.95
Be Green	2.34	28.1	41.7

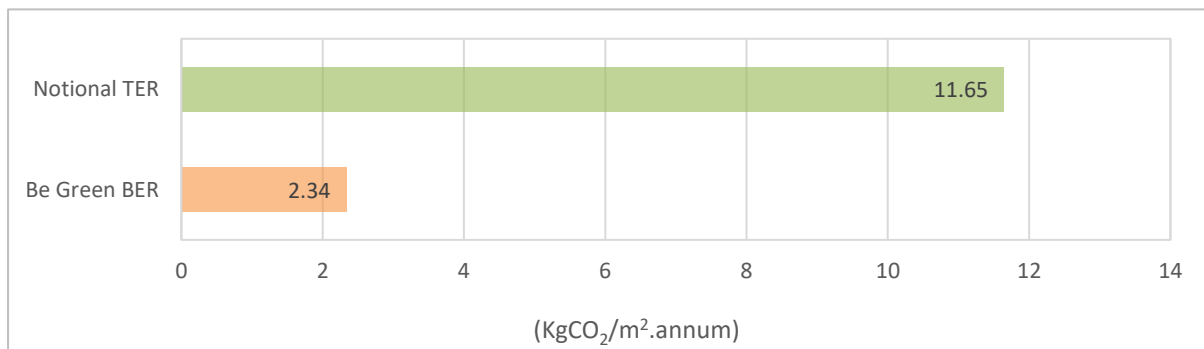


Figure 12a: Notional Building TER and Be Green DER for the proposed scheme.

Plot 2:

Table 16b: Regulated Carbon Reduction at Be-Green Stage

Energy Hierarchy Stage	DER (kgCO ₂ /m ² . year)	DPER (KWh _{PE} /m ² . year)	DFEE (kWh/m ² . year)
Notional	12.15	63.66	44.95

Be Green	2.51	29.86	44.00
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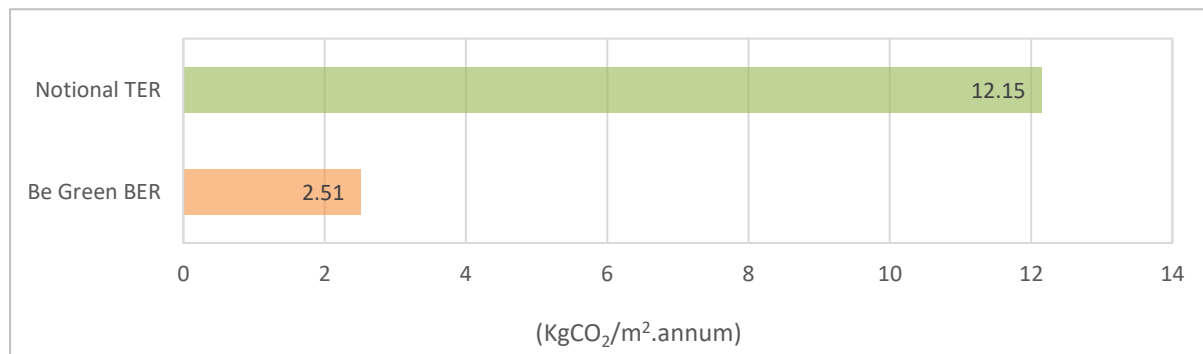


Figure 12b: Notional Building TER and Be Green BER for the proposed scheme.

9. Conclusion

This report assesses the predicted energy performance and carbon dioxide emissions of the proposed development at **Land at Queens Road, Lower Caversham, Reading RG4 8DN**.

Based on the information provided by the design team, the study has been done on the provision of **2 new-build dwellings**. The study results show that **efficient building fabric and heating systems** proposed for the new-build dwellings are keys to achieve building regulations compliance. Moreover, reduced thermal bridging at major junctions proved to be an important measure to achieve reductions beyond Part L requirements. The combined carbon savings from each stage are shown in the charts below. Given the total cumulative carbon savings, the proposed development shall meet the planning requirements.

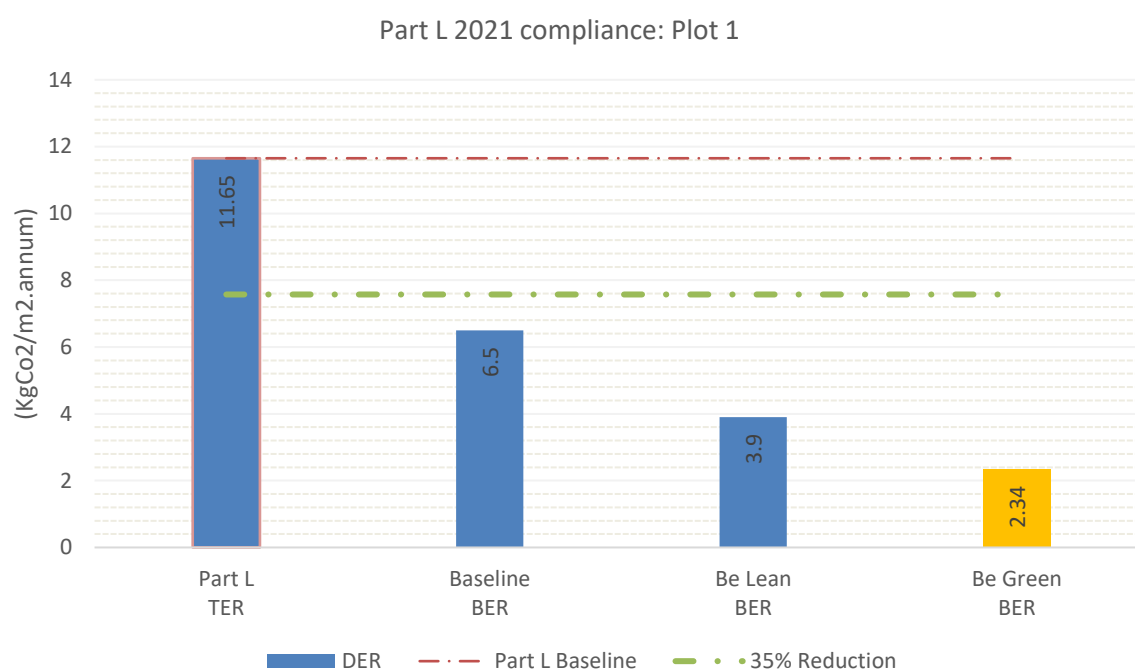


Figure 13: Total Carbon Emissions Reductions after each stage of the Energy Hierarchy

Table 16a: Overall Regulated Carbon Reduction

Plot 1			
Analysis Stage	Dwelling Emission Rate (KgCO ₂ /m ² .annum)	Total Carbon (Tonnes CO ₂ /annum)	% Reductions (against Notional)
Notional	11.65	1.19	-
Baseline	6.50	0.66	44.21
Be Lean	3.90	0.40	66.52
Be Clean	3.90	0.40	66.52
Be Green	2.34	0.24	79.91

Part L 2021 compliance: Plot 2

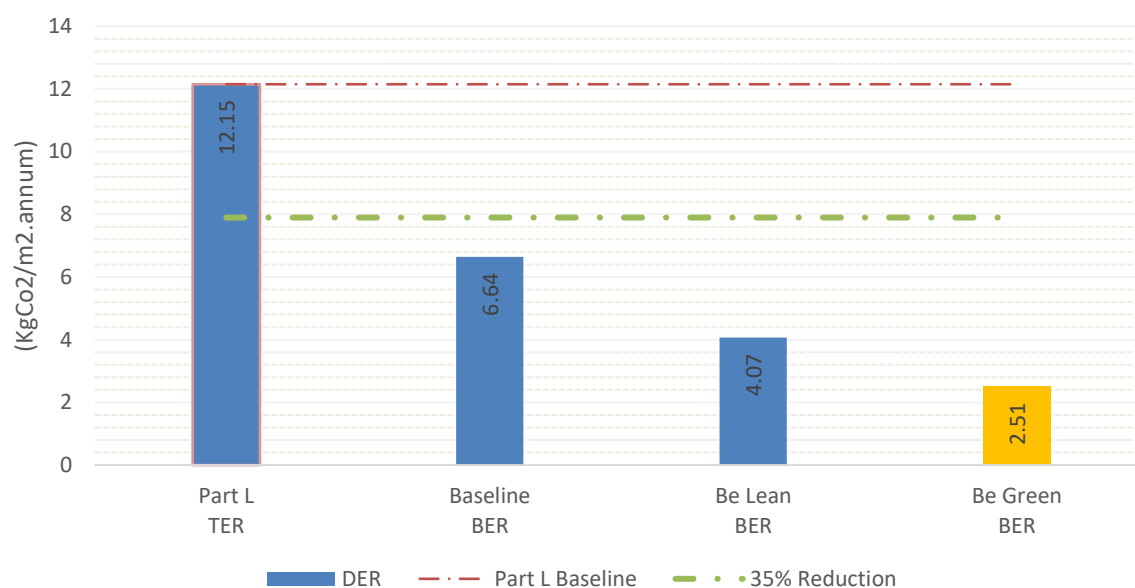


Figure 13b: Total Carbon Emissions Reductions after each stage of the Energy Hierarchy

Table 16b: Overall Regulated Carbon Reduction

Plot 2			
Analysis Stage	Dwelling Emission Rate (KgCO ₂ /m ² .annum)	Total Carbon (Tonnes CO ₂ /annum)	% Reductions (against Notional)
Notional	12.15	1.24	-
Baseline	6.64	0.68	45.35
Be Lean	4.07	0.41	66.50
Be Clean	4.07	0.41	66.50
Be Green	2.51	0.26	79.34

10. Appendix – SAP Reports

Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Array SAP 10 program, Array

Date: Thu 11 Apr 2024 11:28:50

Project Information			
Assessed By	Ishita Bhatnagar	Building Type	House, Semi-detached
OCDEA Registration	EES/030550	Assessment Date	2024-04-11

Dwelling Details			
Assessment Type	As designed	Total Floor Area	102 m ²
Site Reference	Baseline	Plot Reference	Plot 1
Address	Plot 1 Land at Queens Road Queens Road, Reading, RG4 8DN		

Client Details	
Name	Client
Company	Company
Address	Address, Town, AA11 1AA

This report covers items included within the SAP calculations. It is not a complete report of regulations compliance.

1a Target emission rate and dwelling emission rate			
Fuel for main heating system	Electricity		
Target carbon dioxide emission rate	11.65 kgCO ₂ /m ²		
Dwelling carbon dioxide emission rate	6.5 kgCO ₂ /m ²		OK
1b Target primary energy rate and dwelling primary energy			
Target primary energy	60.9 kWh _{PE} /m ²		
Dwelling primary energy	67.1 kWh _{PE} /m ²		FAIL
1c Target fabric energy efficiency and dwelling fabric energy efficiency			
Target fabric energy efficiency	42.9 kWh/m ²		
Dwelling fabric energy efficiency	72.3 kWh/m ²		FAIL

2a Fabric U-values				
Element	Maximum permitted average U-Value [W/m ² K]	Dwelling average U-Value [W/m ² K]	Element with highest individual U-Value	
External walls	0.26	0.26	Walls (1) (0.26)	OK
Party walls	0.2	0	Party Wall (1) (0)	N/A
Curtain walls	1.6	0	N/A	N/A
Floors	0.18	0.18	Heatloss Floor 1 (0.18)	OK
Roofs	0.16	0.16	Roof (1) (0.16)	OK
Windows, doors, and roof windows	1.6	1.6	Opening (1.6)	OK
Rooflights	2.2	N/A	N/A	N/A

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	Net area [m ²]	U-Value [W/m ² K]
Exposed wall: Walls (1)	78.2849	0.26
Party wall: Party Wall (1)	47.6	0 (!)
Ground floor: Heatloss Floor 1, Heatloss Floor 1	51.24	0.18
Upper floor: Heatloss Floor 2, Heatloss Floor 2	19.43	0.18
Exposed roof: Roof (1)	70.66	0.16

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	Area [m ²]	Orientation	Frame factor	U-Value [W/m ² K]
Opening, Window	1.978	West	0.7	1.6
Opening, Window	3.8915	West	0.7	1.6
Opening, Window	2.0272	West	0.7	1.6
Opening, Window	0.56	West	0.7	1.6
Opening, Window	1.15	South	0.7	1.6
Opening, Window	0.5264	South	0.7	1.6
Opening, Window	1.38	South	0.7	1.6
Opening, Window	1.38	South	0.7	1.6
Opening, Window	1.38	South	0.7	1.6
Opening, Door	1.932	South	N/A	1.6
Opening, Window	1.15	East	0.7	1.6
Opening, Window	1.15	East	0.7	1.6

Name	Area [m ²]	Orientation	Frame factor	U-Value [W/m ² K]
Opening, Window	1.38	East	0.7	1.6
Opening, Window	1.38	East	0.7	1.6

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))

Building part 1 - Main Dwelling: Thermal bridging calculated from linear thermal transmittances for each junction

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E2: Other lintels (including other steel lintels)	SAP table default	1	
External wall	E3: Sill	SAP table default	0.1	
External wall	E4: Jamb	SAP table default	0.1	
External wall	E5: Ground floor (normal)	SAP table default	0.32	
External wall	E6: Intermediate floor within a dwelling	SAP table default	0.14	
External wall	E16: Corner (normal)	SAP table default	0.18	
External wall	E18: Party wall between dwellings	SAP table default	0.24	
External wall	E10: Eaves (insulation at ceiling level)	SAP table default	0.12	
External wall	E12: Gable (insulation at ceiling level)	SAP table default	0.25	
External wall	E20: Exposed floor (normal)	SAP table default	0.32	
External wall	E21: Exposed floor (inverted)	SAP table default	0.32	
External wall	E24: Eaves (insulation at ceiling level - inverted)	SAP table default	0.15	
Party wall	P1: Ground floor	SAP table default	0.32	
Party wall	P2: Intermediate floor within a dwelling	SAP table default	0 (!)	
Party wall	P4: Roof (insulation at ceiling level)	SAP table default	0.48	
Roof	R4: Ridge (vaulted ceiling)	SAP table default	0.12	
Roof	R5: Ridge (inverted)	SAP table default	0.12	

3 Air permeability (better than typically expected values are flagged with a subsequent (!))

Maximum permitted air permeability at 50Pa	8 m ³ /hm ²	
Dwelling air permeability at 50Pa	8 m ³ /hm ² , Design value	OK
Air permeability test certificate reference		

4 Space heating

Main heating system 1: Heat pump with radiators or underfloor heating - Electricity

Efficiency	219.3%
Emitter type	Radiators
Flow temperature	45°C
System type	Air source heat pump
Manufacturer	
Model	
Commissioning	

Secondary heating system: N/A

Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water

Cylinder/store - type: N/A

Capacity	N/A
Declared heat loss	N/A
Primary pipework insulated	N/A
Manufacturer	
Model	
Commissioning	

Waste water heat recovery system 1 - type: N/A

Efficiency	
Manufacturer	
Model	

6 Controls		
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services		
Function		
Ecodesign class		
Manufacturer		
Model		
Water heating - type: N/A		
Manufacturer		
Model		
7 Lighting		
Minimum permitted light source efficacy	75 lm/W	
Lowest light source efficacy	80 lm/W	OK
External lights control	N/A	
8 Mechanical ventilation		
System type: N/A		
Maximum permitted specific fan power	N/A	
Specific fan power	N/A	N/A
Minimum permitted heat recovery efficiency	N/A	
Heat recovery efficiency	N/A	N/A
Manufacturer/Model		
Commissioning		
9 Local generation		
N/A		
10 Heat networks		
N/A		
11 Supporting documentary evidence		
N/A		
12 Declarations		
a. Assessor Declaration		
This declaration by the assessor is confirmation that the contents of this BREL Compliance Report are a true and accurate reflection based upon the design information submitted for this dwelling for the purpose of carrying out the "As designed" assessment, and that the supporting documentary evidence (SAP Conventions, Appendix 1 (documentary evidence) schedules the minimum documentary evidence required) has been reviewed in the course of preparing this BREL Compliance Report.		
Signed:	Assessor ID:	
Name:		
	Date:	
b. Client Declaration		
N/A		

Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Array SAP 10 program, Array

Date: Thu 11 Apr 2024 11:30:01

Project Information			
Assessed By	Ishita Bhatnagar	Building Type	House, Semi-detached
OCDEA Registration	EES/030550	Assessment Date	2024-04-11

Dwelling Details			
Assessment Type	As designed	Total Floor Area	102 m ²
Site Reference	Be Lean	Plot Reference	Plot 1
Address	Plot 1 Land at Queens Road Queens Road, Reading, RG4 8DN		

Client Details	
Name	Client
Company	Company
Address	Address, Town, AA11 1AA

This report covers items included within the SAP calculations. It is not a complete report of regulations compliance.

1a Target emission rate and dwelling emission rate			
Fuel for main heating system	Electricity		
Target carbon dioxide emission rate	11.65 kgCO ₂ /m ²		
Dwelling carbon dioxide emission rate	3.9 kgCO ₂ /m ²		OK
1b Target primary energy rate and dwelling primary energy			
Target primary energy	60.9 kWh _{PE} /m ²		
Dwelling primary energy	40.72 kWh _{PE} /m ²		OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency			
Target fabric energy efficiency	42.9 kWh/m ²		
Dwelling fabric energy efficiency	41.7 kWh/m ²		OK

2a Fabric U-values				
Element	Maximum permitted average U-Value [W/m ² K]	Dwelling average U-Value [W/m ² K]	Element with highest individual U-Value	
External walls	0.26	0.15	Walls (1) (0.15)	OK
Party walls	0.2	0	Party Wall (1) (0)	N/A
Curtain walls	1.6	0	N/A	N/A
Floors	0.18	0.11	Heatloss Floor 1 (0.11)	OK
Roofs	0.16	0.11	Roof (1) (0.11)	OK
Windows, doors, and roof windows	1.6	1.02	Opening (1.2)	OK
Rooflights	2.2	N/A	N/A	N/A

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	Net area [m ²]	U-Value [W/m ² K]
Exposed wall: Walls (1)	78.2849	0.15
Party wall: Party Wall (1)	47.6	0 (!)
Ground floor: Heatloss Floor 1, Heatloss Floor 1	51.24	0.11
Upper floor: Heatloss Floor 2, Heatloss Floor 2	19.43	0.11
Exposed roof: Roof (1)	70.66	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	Area [m ²]	Orientation	Frame factor	U-Value [W/m ² K]
Opening, Window	1.978	West	0.7	1 (!)
Opening, Window	3.8915	West	0.7	1 (!)
Opening, Window	2.0272	West	0.7	1 (!)
Opening, Window	0.56	West	0.7	1 (!)
Opening, Window	1.15	South	0.7	1 (!)
Opening, Window	0.5264	South	0.7	1 (!)
Opening, Window	1.38	South	0.7	1 (!)
Opening, Window	1.38	South	0.7	1 (!)
Opening, Window	1.38	South	0.7	1 (!)
Opening, Door	1.932	South	N/A	1.2
Opening, Window	1.15	East	0.7	1 (!)
Opening, Window	1.15	East	0.7	1 (!)

Name	Area [m ²]	Orientation	Frame factor	U-Value [W/m ² K]
Opening, Window	1.38	East	0.7	1 (!)
Opening, Window	1.38	East	0.7	1 (!)

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))

Building part 1 - Main Dwelling: Thermal bridging calculated from linear thermal transmittances for each junction

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E1: Steel lintel with perforated steel base plate	Calculated by person with suitable expertise	0.02 (!)	
External wall	E3: Sill	Calculated by person with suitable expertise	0.02 (!)	
External wall	E4: Jamb	Calculated by person with suitable expertise	0.02 (!)	
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.05	
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0.005 (!)	
External wall	E16: Corner (normal)	SAP table default	0.18	
External wall	E18: Party wall between dwellings	SAP table default	0.24	
External wall	E10: Eaves (insulation at ceiling level)	SAP table default	0.12	
External wall	E12: Gable (insulation at ceiling level)	SAP table default	0.25	
External wall	E20: Exposed floor (normal)	SAP table default	0.32	
External wall	E21: Exposed floor (inverted)	SAP table default	0.32	
External wall	E24: Eaves (insulation at ceiling level - inverted)	SAP table default	0.15	
Party wall	P1: Ground floor	SAP table default	0.32	
Party wall	P2: Intermediate floor within a dwelling	SAP table default	0 (!)	
Party wall	P4: Roof (insulation at ceiling level)	SAP table default	0.48	
Roof	R4: Ridge (vaulted ceiling)	SAP table default	0.12	
Roof	R5: Ridge (inverted)	SAP table default	0.12	

3 Air permeability (better than typically expected values are flagged with a subsequent (!))

Maximum permitted air permeability at 50Pa	8 m ³ /hm ²	
Dwelling air permeability at 50Pa	2.5 m ³ /hm ² , Design value (!)	OK
Air permeability test certificate reference		

4 Space heating

Main heating system 1: Heat pump with radiators or underfloor heating - Electricity	
Efficiency	219.3%
Emitter type	Radiators
Flow temperature	45°C
System type	Air source heat pump
Manufacturer	
Model	
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water

Cylinder/store - type: N/A	
Capacity	N/A
Declared heat loss	N/A
Primary pipework insulated	N/A
Manufacturer	
Model	
Commissioning	

Waste water heat recovery system 1 - type: N/A		
Efficiency		
Manufacturer		
Model		
6 Controls		
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services		
Function		
Ecodesign class		
Manufacturer		
Model		
Water heating - type: N/A		
Manufacturer		
Model		
7 Lighting		
Minimum permitted light source efficacy	75 lm/W	
Lowest light source efficacy	79.8 lm/W	OK
External lights control	N/A	
8 Mechanical ventilation		
System type: Balanced whole-house mechanical ventilation with heat recovery		
Maximum permitted specific fan power	1.5 W/(l/s)	
Specific fan power	0.75 W/(l/s)	OK
Minimum permitted heat recovery efficiency	73%	
Heat recovery efficiency	85%	OK
Manufacturer/Model	xy	
Commissioning		
9 Local generation		
N/A		
10 Heat networks		
N/A		
11 Supporting documentary evidence		
N/A		
12 Declarations		
a. Assessor Declaration		
This declaration by the assessor is confirmation that the contents of this BREL Compliance Report are a true and accurate reflection based upon the design information submitted for this dwelling for the purpose of carrying out the "As designed" assessment, and that the supporting documentary evidence (SAP Conventions, Appendix 1 (documentary evidence) schedules the minimum documentary evidence required) has been reviewed in the course of preparing this BREL Compliance Report.		
Signed:	Assessor ID:	
Name:	Date:	
b. Client Declaration		
N/A		

Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Array SAP 10 program, Array

Date: Thu 11 Apr 2024 15:40:25

Project Information			
Assessed By	Ishita Bhatnagar	Building Type	House, Semi-detached
OCDEA Registration	EES/030550	Assessment Date	2024-04-11

Dwelling Details			
Assessment Type	As designed	Total Floor Area	102 m ²
Site Reference	Be Green	Plot Reference	Plot 1
Address	Plot 1 Land at Queens Road Queens Road, Reading, RG4 8DN		

Client Details	
Name	Client
Company	Company
Address	Address, Town, AA11 1AA

This report covers items included within the SAP calculations. It is not a complete report of regulations compliance.

1a Target emission rate and dwelling emission rate			
Fuel for main heating system	Electricity		
Target carbon dioxide emission rate	11.65 kgCO ₂ /m ²		
Dwelling carbon dioxide emission rate	2.34 kgCO ₂ /m ²		OK
1b Target primary energy rate and dwelling primary energy			
Target primary energy	60.9 kWh _{PE} /m ²		
Dwelling primary energy	28.1 kWh _{PE} /m ²		OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency			
Target fabric energy efficiency	42.9 kWh/m ²		
Dwelling fabric energy efficiency	41.7 kWh/m ²		OK

2a Fabric U-values				
Element	Maximum permitted average U-Value [W/m ² K]	Dwelling average U-Value [W/m ² K]	Element with highest individual U-Value	
External walls	0.26	0.15	Walls (1) (0.15)	OK
Party walls	0.2	0	Party Wall (1) (0)	N/A
Curtain walls	1.6	0	N/A	N/A
Floors	0.18	0.11	Heatloss Floor 1 (0.11)	OK
Roofs	0.16	0.11	Roof (1) (0.11)	OK
Windows, doors, and roof windows	1.6	1.02	Opening (1.2)	OK
Rooflights	2.2	N/A	N/A	N/A

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	Net area [m ²]	U-Value [W/m ² K]
Exposed wall: Walls (1)	78.2849	0.15
Party wall: Party Wall (1)	47.6	0 (!)
Ground floor: Heatloss Floor 1, Heatloss Floor 1	51.24	0.11
Upper floor: Heatloss Floor 2, Heatloss Floor 2	19.43	0.11
Exposed roof: Roof (1)	70.66	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	Area [m ²]	Orientation	Frame factor	U-Value [W/m ² K]
Opening, Window	1.978	West	0.7	1 (!)
Opening, Window	3.8915	West	0.7	1 (!)
Opening, Window	2.0272	West	0.7	1 (!)
Opening, Window	0.56	West	0.7	1 (!)
Opening, Window	1.15	South	0.7	1 (!)
Opening, Window	0.5264	South	0.7	1 (!)
Opening, Window	1.38	South	0.7	1 (!)
Opening, Window	1.38	South	0.7	1 (!)
Opening, Window	1.38	South	0.7	1 (!)
Opening, Door	1.932	South	N/A	1.2
Opening, Window	1.15	East	0.7	1 (!)
Opening, Window	1.15	East	0.7	1 (!)

Name	Area [m ²]	Orientation	Frame factor	U-Value [W/m ² K]
Opening, Window	1.38	East	0.7	1 (!)
Opening, Window	1.38	East	0.7	1 (!)

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))

Building part 1 - Main Dwelling: Thermal bridging calculated from linear thermal transmittances for each junction

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E1: Steel lintel with perforated steel base plate	Calculated by person with suitable expertise	0.02 (!)	
External wall	E3: Sill	Calculated by person with suitable expertise	0.02 (!)	
External wall	E4: Jamb	Calculated by person with suitable expertise	0.02 (!)	
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.05	
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0.005 (!)	
External wall	E16: Corner (normal)	SAP table default	0.18	
External wall	E18: Party wall between dwellings	SAP table default	0.24	
External wall	E10: Eaves (insulation at ceiling level)	SAP table default	0.12	
External wall	E12: Gable (insulation at ceiling level)	SAP table default	0.25	
External wall	E20: Exposed floor (normal)	SAP table default	0.32	
External wall	E21: Exposed floor (inverted)	SAP table default	0.32	
External wall	E24: Eaves (insulation at ceiling level - inverted)	SAP table default	0.15	
Party wall	P1: Ground floor	SAP table default	0.32	
Party wall	P2: Intermediate floor within a dwelling	SAP table default	0 (!)	
Party wall	P4: Roof (insulation at ceiling level)	SAP table default	0.48	
Roof	R4: Ridge (vaulted ceiling)	SAP table default	0.12	
Roof	R5: Ridge (inverted)	SAP table default	0.12	

3 Air permeability (better than typically expected values are flagged with a subsequent (!))

Maximum permitted air permeability at 50Pa	8 m ³ /hm ²	
Dwelling air permeability at 50Pa	2.5 m ³ /hm ² , Design value (!)	OK
Air permeability test certificate reference		

4 Space heating

Main heating system 1: Heat pump with radiators or underfloor heating - Electricity	
Efficiency	219.3%
Emitter type	Radiators
Flow temperature	45°C
System type	Air source heat pump
Manufacturer	
Model	
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water

Cylinder/store - type: N/A	
Capacity	N/A
Declared heat loss	N/A
Primary pipework insulated	N/A
Manufacturer	
Model	
Commissioning	

Waste water heat recovery system 1 - type: N/A		
Efficiency		
Manufacturer		
Model		
6 Controls		
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services		
Function		
Ecodesign class		
Manufacturer		
Model		
Water heating - type: N/A		
Manufacturer		
Model		
7 Lighting		
Minimum permitted light source efficacy	75 lm/W	
Lowest light source efficacy	79.8 lm/W	OK
External lights control	N/A	
8 Mechanical ventilation		
System type: Balanced whole-house mechanical ventilation with heat recovery		
Maximum permitted specific fan power	1.5 W/(l/s)	
Specific fan power	0.75 W/(l/s)	OK
Minimum permitted heat recovery efficiency	73%	
Heat recovery efficiency	85%	OK
Manufacturer/Model	xy	
Commissioning		
9 Local generation		
Technology type: Photovoltaic system (1)		
Peak power	1.5 kWp	
Orientation	South East	
Pitch	30°	
Overshading	1 (overshading factor calculated according to MCS)	
Manufacturer		
MCS certificate		
10 Heat networks		
N/A		
11 Supporting documentary evidence		
N/A		
12 Declarations		
a. Assessor Declaration		
This declaration by the assessor is confirmation that the contents of this BREL Compliance Report are a true and accurate reflection based upon the design information submitted for this dwelling for the purpose of carrying out the "As designed" assessment, and that the supporting documentary evidence (SAP Conventions, Appendix 1 (documentary evidence) schedules the minimum documentary evidence required) has been reviewed in the course of preparing this BREL Compliance Report.		
Signed:	Assessor ID:	
Name:	Date:	
b. Client Declaration		
N/A		

Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Array SAP 10 program, Array

Date: Thu 11 Apr 2024 11:45:11

Project Information			
Assessed By	Ishita Bhatnagar	Building Type	House, Semi-detached
OCDEA Registration	EES/030550	Assessment Date	2024-04-11

Dwelling Details			
Assessment Type	As designed	Total Floor Area	102 m ²
Site Reference	Baseline_2	Plot Reference	Plot 2
Address	Plot 1 Land at Queens Road Queens Road, Reading, RG4 8DN		

Client Details	
Name	Client
Company	Company
Address	Address, Town, AA11 1AA

This report covers items included within the SAP calculations. It is not a complete report of regulations compliance.

1a Target emission rate and dwelling emission rate			
Fuel for main heating system	Electricity		
Target carbon dioxide emission rate	12.15 kgCO ₂ /m ²		
Dwelling carbon dioxide emission rate	6.64 kgCO ₂ /m ²		OK

1b Target primary energy rate and dwelling primary energy			
Target primary energy	63.66 kWh _{PE} /m ²		
Dwelling primary energy	68.63 kWh _{PE} /m ²		FAIL

1c Target fabric energy efficiency and dwelling fabric energy efficiency			
Target fabric energy efficiency	44.9 kWh/m ²		
Dwelling fabric energy efficiency	74.0 kWh/m ²		FAIL

2a Fabric U-values				
Element	Maximum permitted average U-Value [W/m ² K]	Dwelling average U-Value [W/m ² K]	Element with highest individual U-Value	
External walls	0.26	0.26	Walls (1) (0.26)	OK
Party walls	0.2	0	Party Wall (1) (0)	N/A
Curtain walls	1.6	0	N/A	N/A
Floors	0.18	0.18	Heatloss Floor 1 (0.18)	OK
Roofs	0.16	0.16	Roof (1) (0.16)	OK
Windows, doors, and roof windows	1.6	1.6	Opening (1.6)	OK
Rooflights	2.2	N/A	N/A	N/A

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	Net area [m ²]	U-Value [W/m ² K]
Exposed wall: Walls (1)	81.0449	0.26
Party wall: Party Wall (1)	47.6	0 (!)
Ground floor: Heatloss Floor 1, Heatloss Floor 1	51.24	0.18
Upper floor: Heatloss Floor 2, Heatloss Floor 2	19.43	0.18
Exposed roof: Roof (1)	70.66	0.16

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	Area [m ²]	Orientation	Frame factor	U-Value [W/m ² K]
Opening, Window	1.978	West	0.7	1.6
Opening, Window	3.8915	West	0.7	1.6
Opening, Window	2.0272	West	0.7	1.6
Opening, Window	0.56	West	0.7	1.6
Opening, Window	1.15	North	0.7	1.6
Opening, Window	0.5264	North	0.7	1.6
Opening, Window	1.38	North	0.7	1.6
Opening, Door	1.932	North	N/A	1.6
Opening, Window	1.15	East	0.7	1.6
Opening, Window	1.15	East	0.7	1.6
Opening, Window	1.38	East	0.7	1.6
Opening, Window	1.38	East	0.7	1.6

Name	Area [m ²]	Orientation	Frame factor	U-Value [W/m ² K]
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2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part 1 - Main Dwelling : Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E2: Other lintels (including other steel lintels)	SAP table default	1	
External wall	E3: Sill	SAP table default	0.1	
External wall	E4: Jamb	SAP table default	0.1	
External wall	E5: Ground floor (normal)	SAP table default	0.32	
External wall	E6: Intermediate floor within a dwelling	SAP table default	0.14	
External wall	E16: Corner (normal)	SAP table default	0.18	
External wall	E18: Party wall between dwellings	SAP table default	0.24	
External wall	E10: Eaves (insulation at ceiling level)	SAP table default	0.12	
External wall	E12: Gable (insulation at ceiling level)	SAP table default	0.25	
External wall	E20: Exposed floor (normal)	SAP table default	0.32	
External wall	E21: Exposed floor (inverted)	SAP table default	0.32	
External wall	E24: Eaves (insulation at ceiling level - inverted)	SAP table default	0.15	
Party wall	P1: Ground floor	SAP table default	0.32	
Party wall	P2: Intermediate floor within a dwelling	SAP table default	0 (!)	
Party wall	P4: Roof (insulation at ceiling level)	SAP table default	0.48	
Roof	R4: Ridge (vaulted ceiling)	SAP table default	0.12	
Roof	R5: Ridge (inverted)	SAP table default	0.12	

3 Air permeability (better than typically expected values are flagged with a subsequent (!))				
Maximum permitted air permeability at 50Pa		8 m ³ /hm ²		
Dwelling air permeability at 50Pa		8 m ³ /hm ² , Design value		OK
Air permeability test certificate reference				

4 Space heating	
Main heating system 1 : Heat pump with radiators or underfloor heating - Electricity	
Efficiency	219.3%
Emitter type	Radiators
Flow temperature	45°C
System type	Air source heat pump
Manufacturer	
Model	
Commissioning	
Secondary heating system : N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: N/A	
Capacity	N/A
Declared heat loss	N/A
Primary pipework insulated	N/A
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls		
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services		
Function		
Ecodesign class		
Manufacturer		
Model		
Water heating - type: N/A		
Manufacturer		
Model		
7 Lighting		
Minimum permitted light source efficacy	75 lm/W	
Lowest light source efficacy	80 lm/W	OK
External lights control	N/A	
8 Mechanical ventilation		
System type: N/A		
Maximum permitted specific fan power	N/A	
Specific fan power	N/A	N/A
Minimum permitted heat recovery efficiency	N/A	
Heat recovery efficiency	N/A	N/A
Manufacturer/Model		
Commissioning		
9 Local generation		
N/A		
10 Heat networks		
N/A		
11 Supporting documentary evidence		
N/A		
12 Declarations		
a. Assessor Declaration		
This declaration by the assessor is confirmation that the contents of this BREL Compliance Report are a true and accurate reflection based upon the design information submitted for this dwelling for the purpose of carrying out the "As designed" assessment, and that the supporting documentary evidence (SAP Conventions, Appendix 1 (documentary evidence) schedules the minimum documentary evidence required) has been reviewed in the course of preparing this BREL Compliance Report.		
Signed:	Assessor ID:	
Name:	Date:	
b. Client Declaration		
N/A		

Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Array SAP 10 program, Array

Date: Thu 11 Apr 2024 11:45:44

Project Information			
Assessed By	Ishita Bhatnagar	Building Type	House, Semi-detached
OCDEA Registration	EES/030550	Assessment Date	2024-04-11

Dwelling Details			
Assessment Type	As designed	Total Floor Area	102 m ²
Site Reference	Be Lean	Plot Reference	Plot 2
Address	Plot 1 Land at Queens Road Queens Road, Reading, RG4 8DN		

Client Details	
Name	Client
Company	Company
Address	Address, Town, AA11 1AA

This report covers items included within the SAP calculations. It is not a complete report of regulations compliance.

1a Target emission rate and dwelling emission rate			
Fuel for main heating system	Electricity		
Target carbon dioxide emission rate	12.15 kgCO ₂ /m ²		
Dwelling carbon dioxide emission rate	4.07 kgCO ₂ /m ²		OK
1b Target primary energy rate and dwelling primary energy			
Target primary energy	63.66 kWh _{PE} /m ²		
Dwelling primary energy	42.51 kWh _{PE} /m ²		OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency			
Target fabric energy efficiency	44.9 kWh/m ²		
Dwelling fabric energy efficiency	44.0 kWh/m ²		OK

2a Fabric U-values				
Element	Maximum permitted average U-Value [W/m ² K]	Dwelling average U-Value [W/m ² K]	Element with highest individual U-Value	
External walls	0.26	0.15	Walls (1) (0.15)	OK
Party walls	0.2	0	Party Wall (1) (0)	N/A
Curtain walls	1.6	0	N/A	N/A
Floors	0.18	0.11	Heatloss Floor 1 (0.11)	OK
Roofs	0.16	0.11	Roof (1) (0.11)	OK
Windows, doors, and roof windows	1.6	1.02	Opening (1.2)	OK
Rooflights	2.2	N/A	N/A	N/A

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	Net area [m ²]	U-Value [W/m ² K]
Exposed wall: Walls (1)	81.0449	0.15
Party wall: Party Wall (1)	47.6	0 (!)
Ground floor: Heatloss Floor 1, Heatloss Floor 1	51.24	0.11
Upper floor: Heatloss Floor 2, Heatloss Floor 2	19.43	0.11
Exposed roof: Roof (1)	70.66	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	Area [m ²]	Orientation	Frame factor	U-Value [W/m ² K]
Opening, Window	1.978	West	0.7	1 (!)
Opening, Window	3.8915	West	0.7	1 (!)
Opening, Window	2.0272	West	0.7	1 (!)
Opening, Window	0.56	West	0.7	1 (!)
Opening, Window	1.15	North	0.7	1 (!)
Opening, Window	0.5264	North	0.7	1 (!)
Opening, Window	1.38	North	0.7	1 (!)
Opening, Door	1.932	North	N/A	1.2
Opening, Window	1.15	East	0.7	1 (!)
Opening, Window	1.15	East	0.7	1 (!)
Opening, Window	1.38	East	0.7	1 (!)
Opening, Window	1.38	East	0.7	1 (!)

Name	Area [m ²]	Orientation	Frame factor	U-Value [W/m ² K]
2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part 1 - Main Dwelling: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E2: Other lintels (including other steel lintels)	Calculated by person with suitable expertise	0.02 (!)	
External wall	E3: Sill	Calculated by person with suitable expertise	0.02 (!)	
External wall	E4: Jamb	Calculated by person with suitable expertise	0.02 (!)	
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.05	
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0.005 (!)	
External wall	E16: Corner (normal)	SAP table default	0.18	
External wall	E18: Party wall between dwellings	SAP table default	0.24	
External wall	E10: Eaves (insulation at ceiling level)	SAP table default	0.12	
External wall	E12: Gable (insulation at ceiling level)	SAP table default	0.25	
External wall	E20: Exposed floor (normal)	SAP table default	0.32	
External wall	E21: Exposed floor (inverted)	SAP table default	0.32	
External wall	E24: Eaves (insulation at ceiling level - inverted)	SAP table default	0.15	
Party wall	P1: Ground floor	SAP table default	0.32	
Party wall	P2: Intermediate floor within a dwelling	SAP table default	0 (!)	
Party wall	P4: Roof (insulation at ceiling level)	SAP table default	0.48	
Roof	R4: Ridge (vaulted ceiling)	SAP table default	0.12	
Roof	R5: Ridge (inverted)	SAP table default	0.12	
3 Air permeability (better than typically expected values are flagged with a subsequent (!))				
Maximum permitted air permeability at 50Pa		8 m³/hm²		
Dwelling air permeability at 50Pa		2.5 m³/hm², Design value (!)		OK
Air permeability test certificate reference				
4 Space heating				
Main heating system 1: Heat pump with radiators or underfloor heating - Electricity				
Efficiency	219.3%			
Emitter type	Radiators			
Flow temperature	45°C			
System type	Air source heat pump			
Manufacturer				
Model				
Commissioning				
Secondary heating system: N/A				
Fuel	N/A			
Efficiency	N/A			
Commissioning				
5 Hot water				
Cylinder/store - type: N/A				
Capacity	N/A			
Declared heat loss	N/A			
Primary pipework insulated	N/A			
Manufacturer				
Model				
Commissioning				
Waste water heat recovery system 1 - type: N/A				
Efficiency				
Manufacturer				
Model				

6 Controls		
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services		
Function		
Ecodesign class		
Manufacturer		
Model		
Water heating - type: N/A		
Manufacturer		
Model		
7 Lighting		
Minimum permitted light source efficacy	75 lm/W	
Lowest light source efficacy	80 lm/W	OK
External lights control	N/A	
8 Mechanical ventilation		
System type: Balanced whole-house mechanical ventilation with heat recovery		
Maximum permitted specific fan power	1.5 W/(l/s)	
Specific fan power	0.75 W/(l/s)	OK
Minimum permitted heat recovery efficiency	73%	
Heat recovery efficiency	85%	OK
Manufacturer/Model	xy	
Commissioning		
9 Local generation		
N/A		
10 Heat networks		
N/A		
11 Supporting documentary evidence		
N/A		
12 Declarations		
a. Assessor Declaration		
This declaration by the assessor is confirmation that the contents of this BREL Compliance Report are a true and accurate reflection based upon the design information submitted for this dwelling for the purpose of carrying out the "As designed" assessment, and that the supporting documentary evidence (SAP Conventions, Appendix 1 (documentary evidence) schedules the minimum documentary evidence required) has been reviewed in the course of preparing this BREL Compliance Report.		
Signed:	Assessor ID:	
Name:	Date:	
b. Client Declaration		
N/A		

Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Array SAP 10 program, Array

Date: Thu 11 Apr 2024 11:46:09

Project Information			
Assessed By	Ishita Bhatnagar	Building Type	House, Semi-detached
OCDEA Registration	EES/030550	Assessment Date	2024-04-11

Dwelling Details			
Assessment Type	As designed	Total Floor Area	102 m ²
Site Reference	Be Green	Plot Reference	Plot 2
Address	Plot 1 Land at Queens Road Queens Road, Reading, RG4 8DN		

Client Details	
Name	Client
Company	Company
Address	Address, Town, AA11 1AA

This report covers items included within the SAP calculations. It is not a complete report of regulations compliance.

1a Target emission rate and dwelling emission rate			
Fuel for main heating system	Electricity		
Target carbon dioxide emission rate	12.15 kgCO ₂ /m ²		
Dwelling carbon dioxide emission rate	2.51 kgCO ₂ /m ²		OK
1b Target primary energy rate and dwelling primary energy			
Target primary energy	63.66 kWh _{PE} /m ²		
Dwelling primary energy	29.86 kWh _{PE} /m ²		OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency			
Target fabric energy efficiency	44.9 kWh/m ²		
Dwelling fabric energy efficiency	44.0 kWh/m ²		OK

2a Fabric U-values				
Element	Maximum permitted average U-Value [W/m ² K]	Dwelling average U-Value [W/m ² K]	Element with highest individual U-Value	
External walls	0.26	0.15	Walls (1) (0.15)	OK
Party walls	0.2	0	Party Wall (1) (0)	N/A
Curtain walls	1.6	0	N/A	N/A
Floors	0.18	0.11	Heatloss Floor 1 (0.11)	OK
Roofs	0.16	0.11	Roof (1) (0.11)	OK
Windows, doors, and roof windows	1.6	1.02	Opening (1.2)	OK
Rooflights	2.2	N/A	N/A	N/A

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	Net area [m ²]	U-Value [W/m ² K]
Exposed wall: Walls (1)	81.0449	0.15
Party wall: Party Wall (1)	47.6	0 (!)
Ground floor: Heatloss Floor 1, Heatloss Floor 1	51.24	0.11
Upper floor: Heatloss Floor 2, Heatloss Floor 2	19.43	0.11
Exposed roof: Roof (1)	70.66	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	Area [m ²]	Orientation	Frame factor	U-Value [W/m ² K]
Opening, Window	1.978	West	0.7	1 (!)
Opening, Window	3.8915	West	0.7	1 (!)
Opening, Window	2.0272	West	0.7	1 (!)
Opening, Window	0.56	West	0.7	1 (!)
Opening, Window	1.15	North	0.7	1 (!)
Opening, Window	0.5264	North	0.7	1 (!)
Opening, Window	1.38	North	0.7	1 (!)
Opening, Door	1.932	North	N/A	1.2
Opening, Window	1.15	East	0.7	1 (!)
Opening, Window	1.15	East	0.7	1 (!)
Opening, Window	1.38	East	0.7	1 (!)
Opening, Window	1.38	East	0.7	1 (!)

Name	Area [m ²]	Orientation	Frame factor	U-Value [W/m ² K]
2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part 1 - Main Dwelling: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E2: Other lintels (including other steel lintels)	Calculated by person with suitable expertise	0.02 (!)	
External wall	E3: Sill	Calculated by person with suitable expertise	0.02 (!)	
External wall	E4: Jamb	Calculated by person with suitable expertise	0.02 (!)	
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.05	
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0.005 (!)	
External wall	E16: Corner (normal)	SAP table default	0.18	
External wall	E18: Party wall between dwellings	SAP table default	0.24	
External wall	E10: Eaves (insulation at ceiling level)	SAP table default	0.12	
External wall	E12: Gable (insulation at ceiling level)	SAP table default	0.25	
External wall	E20: Exposed floor (normal)	SAP table default	0.32	
External wall	E21: Exposed floor (inverted)	SAP table default	0.32	
External wall	E24: Eaves (insulation at ceiling level - inverted)	SAP table default	0.15	
Party wall	P1: Ground floor	SAP table default	0.32	
Party wall	P2: Intermediate floor within a dwelling	SAP table default	0 (!)	
Party wall	P4: Roof (insulation at ceiling level)	SAP table default	0.48	
Roof	R4: Ridge (vaulted ceiling)	SAP table default	0.12	
Roof	R5: Ridge (inverted)	SAP table default	0.12	
3 Air permeability (better than typically expected values are flagged with a subsequent (!))				
Maximum permitted air permeability at 50Pa		8 m³/hm²		
Dwelling air permeability at 50Pa		2.5 m³/hm², Design value (!)		OK
Air permeability test certificate reference				
4 Space heating				
Main heating system 1: Heat pump with radiators or underfloor heating - Electricity				
Efficiency	219.3%			
Emitter type	Radiators			
Flow temperature	45°C			
System type	Air source heat pump			
Manufacturer				
Model				
Commissioning				
Secondary heating system: N/A				
Fuel	N/A			
Efficiency	N/A			
Commissioning				
5 Hot water				
Cylinder/store - type: N/A				
Capacity	N/A			
Declared heat loss	N/A			
Primary pipework insulated	N/A			
Manufacturer				
Model				
Commissioning				
Waste water heat recovery system 1 - type: N/A				
Efficiency				
Manufacturer				
Model				

6 Controls		
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services		
Function		
Ecodesign class		
Manufacturer		
Model		
Water heating - type: N/A		
Manufacturer		
Model		
7 Lighting		
Minimum permitted light source efficacy	75 lm/W	
Lowest light source efficacy	80 lm/W	OK
External lights control	N/A	
8 Mechanical ventilation		
System type: Balanced whole-house mechanical ventilation with heat recovery		
Maximum permitted specific fan power	1.5 W/(l/s)	
Specific fan power	0.75 W/(l/s)	OK
Minimum permitted heat recovery efficiency	73%	
Heat recovery efficiency	85%	OK
Manufacturer/Model	xy	
Commissioning		
9 Local generation		
Technology type: Photovoltaic system (1)		
Peak power	1.5 kWp	
Orientation	South East	
Pitch	30°	
Overshading	1 (overshading factor calculated according to MCS)	
Manufacturer		
MCS certificate		
10 Heat networks		
N/A		
11 Supporting documentary evidence		
N/A		
12 Declarations		
a. Assessor Declaration		
This declaration by the assessor is confirmation that the contents of this BREL Compliance Report are a true and accurate reflection based upon the design information submitted for this dwelling for the purpose of carrying out the "As designed" assessment, and that the supporting documentary evidence (SAP Conventions, Appendix 1 (documentary evidence) schedules the minimum documentary evidence required) has been reviewed in the course of preparing this BREL Compliance Report.		
Signed:	Assessor ID:	
Name:	Date:	
b. Client Declaration		
N/A		