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PHASE 2 & 3, 59-75 QUEEN'S ROAD, ROYAL
HEIGHTS, READING, RG1 4BN

Sustainability and Energy Report

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Prepared by:

London Office

QuinnRoss Consultants Ltd
One Bridge Wharf
156 Caledonian Road
London
N1 9UU

Kent Office

QuinnRoss Consultants Ltd
Unit 3 - Grove Dairy Farm Business Centre
Bobbing Hill, Bobbing, Sittingbourne
Kent ME9 8NY
Tel 01795 841035

Phase 2 & 3, 59-75 Queens Road,
Royal Heights,
READING, RG1 4BN

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1.0 EXECUTIVE SUMMARY

This report assesses the design of the proposals for a residential development, based in Reading, under the Building Regulations Part L1A 2013 and Reading Borough Council's Core Strategy local policy. The proposed premises are mostly a multi-storey new-build residential building with some social housing integrating to the building but accessed separately.

The scheme is also Phase 2 & 3 of this development, with Phase 1 being a consented PD development in progress. Phase 1 energy calculations are outlined in a separate Quinn Ross report *Part L1A & L1B 2013 Building Regulations Standard Assessment Procedure (SAP) Compliance Report*, issued 16/01/2018. **This report will analyse Phase 2 & 3 only.**

Part L1A is concerned with the conservation of fuel and power in new dwellings and *Reading Borough Council* have their *Core Strategy* which outlines its own more stringent requirements for larger developments. Both set out requirements for limiting carbon emissions from buildings and approved calculations must be carried out to show compliance is achieved.

The Building Regulation and Reading Borough Council requirements are summarised as follows:

Regulation	Description
Part L1A – New Dwellings	The apartments will come under the Building Regulations Part L1A and each individual dwelling will subject to a CO ₂ TER, TFEE, limits to design flexibility and heat gains criteria. All dwellings must conform to all criteria to comply.
Reading Borough Council Core Strategy	Local policy requires all new developments must maximise their energy efficiency and energy conservation measures in their design, plus off-set at least 20% of predicted carbon dioxide emissions through on-site energy generation (including CHP).

To achieve the above targets, the following energy reduction methods will be implemented. Although the building is not based in London, the widely adopted London Plan's Energy Hierarchy is used so all elements of energy efficiency are considered:

Energy Efficiency (EE) measure	Description / Summary
Be Lean	
Building form	The building form must be optimised to help limit any unnecessary energy use.
High performing building thermal envelope	Construction U-values performing substantially above the current building regulations.
High performing thermal bridges	All thermal bridges will be K1 approved
Low thermal mass	The building will incorporate a low thermal mass in its structure and constructions.
Low infiltration	Air tightness no higher than 5.0 m ³ /m ² h.
Daylight strategy	The maximisation of daylight within a building can reduce lighting demand significantly.
Natural ventilation for residential spaces	Use opening windows and ventilation louvers/grilles for out of hours and night time purging.
Highly efficient lighting with controls	Low Energy LED lighting installed throughout.
Highly efficient HVAC systems	Only specifying highly efficient heating systems, and mech vent units with low SFP's and heat recovery.
Insulated pipe work	All Internal heating pipework will be insulated to a standard beyond building regulation requirements.

Unregulated Energy Use	Efforts will be made to reduce the unregulated emissions by providing “best in class” (“A” rated or equivalent) white goods and energy display devices that show electricity use to encourage residents to save energy.
Be Clean	
District Heating (DH) Networks	Reading Borough Council is in the process of developing infrastructure for DH sites that aims to have schemes available “within the next 10 years”. However as of today there are no schemes available for this site therefore DH is not considered.
Combined Heat and Power (CHP)	A highly efficient SAV SYSTEMS XRGI 20 engine is proposed for all heating and hot water.
Be Green	
Low or Zero Carbon (LZC) Technology	Considering the scheme’s urban environment Photovoltaic (PV) solar panels would be the only feasible option, however considering there is relatively little roof space and the energy and CO ₂ reductions offered by the CHP unit will far exceed the National and local policies PV’s are not considered.

Using the input data outlined in this report, the following conclusions can be found:

Issue	Conclusion
Criterion 01 – TER and TFEE	All dwellings will be compliant with Criterion 01, the TER and TFEE, of the Building Regulations Part L1A 2013.
Criterion 02 – Limits to Design Complexity	All dwellings will be compliant with Criterion 02, limits to design flexibility.
Criterion 03 – Heat Gain Limitation	All dwellings will be compliant with Criterion 03, limits to heat gains.
SAP Rating	All dwellings will have SAP ratings between 82-83, which is a very low energy consuming design.
Env Rating	All dwellings will have Env ratings between 92-94, indicating they will produce very little CO ₂ .
Energy Performance Certificate (EPC)	All dwellings will achieve residential EPC band B ratings.

Total site-wide CO₂ emissions are shown below:



With the CHP applied, the building will have a 58% reduction of CO₂ emissions over a conventional gas boiler system, significantly more than the 20% requirement by local policy.

2.0 INTRODUCTION

This report assesses the design of the proposals for a residential development, based in Reading, under the Building Regulations Part L1A and local planning policy. Part L1A is concerned with the conservation of fuel and power in new dwellings and *Reading Borough Council* have their *Core Strategy* which outlines its own more stringent requirements for larger developments. Both set out requirements for limiting carbon emissions from buildings and approved calculations must be carried out to show compliance is achieved.

The proposed premises are mostly a multi-storey new-build residential building with some additional social housing integrating to the building but accessed separately.

The scheme is also Phase 2 & 3 of this development, with Phase 1 being a consented PD development in progress. Phase 1 energy calculations are outlined in a separate Quinn Ross report *Part L1A & L1B 2013 Building Regulations Standard Assessment Procedure (SAP) Compliance Report*, issued 16/01/2018.



Figure 1: IES model image showing all 3 phases of the scheme

This report will analyse Phase 2 & 3 only.

3.0 PLANNING POLICY AND LEGISLATION

There are several national and local policies applicable to this development, which are outlined in this section.

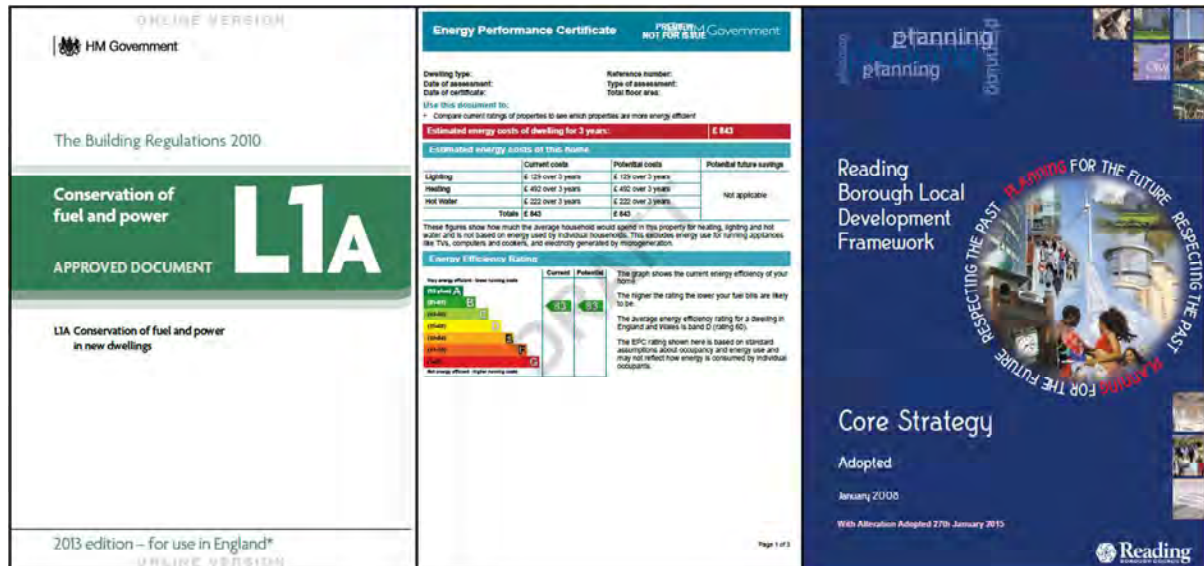


Figure 2: Images of National and Local Policy applicable documents

3.0.1 Part L1A – New dwellings

All apartments will come under the Building Regulations Conservation of Fuel and Power in new dwellings Part L1A and each individual dwelling will subject to the Standard Assessment Procedure (SAP) calculation. 3 criteria are applicable at this stage:

- Criterion 01: Achieving the TER and TFEE rate.
- Criterion 02: Limits to design flexibility.
- Criterion 03: Limiting the effects of heat gains in summer.

There are two further criteria (04 & 05) applicable at completion stage, which are not analysed in this study.

The Target Emission Rate (TER): this is a limit of kg CO₂ per m² based on regulated loads of the building. Regulated loads refer to heating, cooling, auxiliary, lighting and DHW energy consumption, end uses related to the quality of the building construction and design. Unregulated loads are energy consuming end uses related to occupant's behaviour, such as computers, lifts or escalators.

Target Fabric Energy Efficiency (TFEE) value: this effectively requires a minimum level of building fabric and energy performance when compared to a TER which is determined by the approved SAP software (kg/CO₂/m²/yr).

Limits to design flexibility: this ensures the building fabric and HVAC systems have a minimum specified performance, e.g. U-value of walls to be no higher than 0.28 W/m².K.

Limiting heat gain in summer: this refers to limiting internal temperatures due to excessive heat gains. This shall be achieved by an appropriate combination of window size and orientation, solar protection by shading or other solar control measures, ventilation (day and night) and high thermal capacity.

SAP Rating: The SAP rating is expressed on a scale of 1-100. A rating of 1 represents very high running costs per square metre, while an SAP of 100 represents zero energy cost.

Environmental (Env) Rating: the Env rating is based on the Carbon Dioxide (CO₂) emissions associated with space heating, water heating, ventilation and lighting, having regard to the emissions saved by energy generation technologies. As with the SAP rating above, the EIR is also expressed on a scale of 1 to 100, the higher the number the lower the emissions.

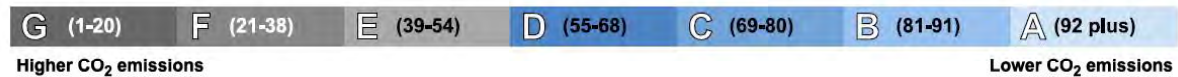


Figure 3: SAP, Env & EPC rating scale

3.0.2 Energy Performance Certificate (EPC)

It is a legal requirement for all new and existing buildings that are built, sold or rented to undergo predicted energy consumption calculations and have the results displayed in the form of an EPC. Buildings are assessed on a band A to G scale where A is extremely efficient with low CO₂ emissions and G is poor performance.

There is no specific requirement or target for EPC's, other than an EPC calculation must be carried out and it must be performed by an experienced engineer accredited with a well-established professional body.

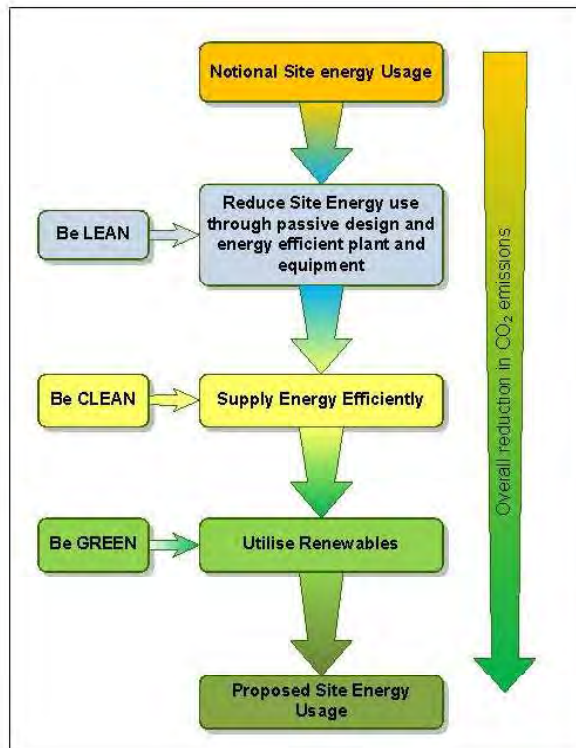
3.0.3 Local Policy

Reading Borough Council has issued a *Core Strategy* which outlines several policies regarding development in their borough. Policy CS1: Sustainable Construction and Design outlines several requirements for new larger developments regarding BREEAM and water-use reduction methods, however the most applicable policies to energy are as follows:

- All new developments must maximise their energy efficiency and energy conservation measures in their design.
- Larger developments must off-set at least 20% of predicted carbon dioxide emissions through on-site energy generation (including chp).
- The use of de-centralised energy production, such as CHP, is encouraged.

5.0 APPROACH – THE ENERGY HIERARCHY

As part of our aims to provide a sustainable development we will be following the widely adopted energy hierarchy originally outlined in the London Plan policy. Although the building is of course not in London, the London Plan is widely regarded as one of the biggest drivers in low energy consumption and low carbon design and adopting its approach will enhance this development's energy reducing credentials. The hierarchy shown below guides our approach to minimising the energy use within the building and to create a comfortable internal environment. This consists of three best practice criteria: Be Lean, Be Clean and Be Green to achieve Low energy and carbon design.



Be Lean – Passive Measures:

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

Be Clean – Decentralised Energy:

consideration given to the potential to connect to any local decentralised heating networks.

Be Green – Renewable Energy:

the use of appropriate on-site renewable/low carbon technologies.

Figure 4: London Plan's energy hierarchy

6.0 INPUT DATA USING THE ENERGY HIERACHY

As the building design is still developing several inputs will be subject to change. However, all technical inputs known at this stage are outlined in this section and applied to the calculation software.

The geometry of the building was taken from EAA architects' drawings issued 04/05/2018. The image below shows a 3D model of the development:



Figure 5: 3D model image of proposed scheme.

6.01 Be Lean

6.01.01 Building Form

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

- Natural ventilation openings in the residential areas to avoid the use of mechanical ventilation or cooling systems.
- Generous floor to ceiling heights to help optimise daylight penetration into spaces.
- Dual aspect glazing or rooflights were available to optimise daylight and uniformity, which limits the need for artificial lighting.

6.01.02 Building Envelope Thermal Performance

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

substantially above the current minimum requirement of the building regulations. As a result, the following construction U-values ($\text{W/m}^2\cdot\text{K}$) are proposed:

Envelope Element	U-Value $\text{W/m}^2\cdot\text{K}$	
	Building Regulations	This building
Wall	0.30	0.15
Roof	0.20	0.10
Floor	0.25	0.10
Glazing	2.00	1.40

Table 1: Proposed U-values for domestic and non-domestic

Please note further reduction in U-values is feasible however it will likely gain little to no energy reduction and cause issues for overheating or require cooling.

6.01.03 Thermal Mass

The building aims to have little thermal mass using a lightweight structure that will reduce the absorption of environmental heat gains by the building materials, thus reducing HVAC demands. The building will aim to have a Thermal Mass Parameter (TMP) no greater than 250 ("medium").

6.01.04 Thermal Bridging

Reducing heat losses through bridging of constructions is as essential as high levels of insulation. Therefore this building will aim to have all thermal bridges to be K1 approved, the highest level of Y-value available.

6.01.05 Air Infiltration

Uncontrolled air infiltration in a building can contribute to a significant proportion of heat losses particularly in well insulated modern buildings. An air permeability of no greater than $5.0 \text{ m}^3/\text{m}^2\text{h}$ is proposed.

6.01.06 Daylight strategy

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

- Generous floor to ceiling heights
- Dual aspect glazing in areas where possible
- Daylight dimmable sensors on all lighting where possible

6.01.07 Natural ventilation

Although the building will be supplied with mechanical ventilation units it is an aim for the building to use natural ventilation where possible using the following methods:

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

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

6.01.08 Energy efficient services

A number of 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.
- Central controls – a building management systems (BMS) will enable the heating, cooling and DHW systems to respond to the demand dynamically and run more efficiently.
- User controls – Efficient and user-friendly controls will be specified throughout all buildings.
- Heating – The building will be highly insulated for low space heating requirements. Heating and hot water demand will be provided by a high efficiency combined heat and power (CHP) unit.
- Mechanical ventilation – All mechanical ventilation heat recovery (MVHR) units will utilise highly efficient heat recovery systems and low specific fan powers (SFP's).
- Ventilation – All ventilation will be provided by MVHR units. The scheme aims to avoid air conditioning entirely, thus reducing its overall energy consumption and CO₂ footprint.

6.01.09 Insulated pipework

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

6.01.10 Unregulated energy use

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

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

6.01.11 Energy Centre

It is proposed the plant for the whole site will be contained within an on-site energy centre containing the following plant:

- Central cold-water tank with booster pumps (with sprinkler storage if required)
- Communal heating gas CHP, modular boilers and control/BEMS panels
- Pressurisation unit, dosing pot, air and dirt separator and side stream filtration
- Back up emergency life safety second power source.
- Plate Heat Exchanger areas
- Thermal store.

The CHP engine strategy will be outlined in the next sub-section.

6.02 Be Clean

6.02.01 District Heating (DH) Networks

The next stage of the London Plan hierarchy is to look at the availability of decentralised heat networks within the vicinity of the development. Consideration should be given to connecting to these networks should there be one close to the development, or if a network is proposed for the local area.

Reading Borough Council outlines a need to develop centralised heat networks in a number of its planning documents and has taken steps to employ engineering teams to highlight best positions for DH sites. Schemes will be feasible “*within the next 10 years*” however as of today there are no schemes available for this site therefore DH is not considered.

6.02.02 Combined Heat and Power (CHP)

As part of the energy centre, it is proposed to install a *SAV Systems XRG1 20* Natural Gas CHP unit of around 50 kWe capacity with a 63% thermal efficiency and 33% electrical efficiency. All heating and hot water will be provided by this unit.

6.03 Be Green

The final part of the hierarchy is to minimise carbon dioxide emissions through the use of renewable / Low or Zero Carbon (LZC) technologies.

A full LZC technology analysis is outlined in appendix A.

Considering the scheme’s urban environment Photovoltaic (PV) solar panels would be the only feasible option, however considering there is relatively little roof space and the energy and CO₂ reductions offered by the CHP unit will far exceed the National and local policies PV’s are not considered.

A simplified and full list of all the building’s input data outlined in this section can be found in appendix B.

7.0 APPROVED SOFTWARE

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

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

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