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Energy Statement

1.0 Executive Summary

CPW LLP has undertaken an initial Part L compliance assessment of the proposed Friar Street development. This is to demonstrate through the use of accredited thermal modelling software, how the scheme will incorporate energy efficiency measures and Low and Zero Carbon (LZC) technology solutions to reduce the predicted regulated CO₂ emissions of the development in accordance with Reading Borough Council energy planning conditions.

Initial SAP calculations have been made to demonstrate how the scheme will incorporate energy efficiency measures and Low and Zero Carbon (LZC) technology solutions to reduce the predicted regulated CO₂ emissions of the development by at least 35% (CO₂ reduction on 2013 building regulations) for new build residential developments. The calculations have been performed with SAP2012 methodology in accordance with The Sustainable Design and Construction SPD adopted 2019.

CPW have also conducted initial BRUKL analysis to show the carbon efficiency performance of the commercial spaces in their assumed operation. From this we have also calculated the sitewide cumulative savings on Part L Building Regulations 2013.

The building emission rate is compared to a Target Emission rate below to demonstrate the savings achieved.

	Regulated carbon dioxide savings			
	Target Emission Rate	Building Emission Rate	Reduction (Tonnes CO ₂ per annum)	(%) improvement
Non-Domestic Buildings	38.8	34.7	4.1	11%
Domestic Buildings	169.4	93.7	75.7	45%
Total Cumulative Savings		127.1	79.1	38.4%

Note 1. CO₂ emission factors of 0.216 for Gas and 0.519 for Electricity have been used to calculate the above and are taken from Building Regulations Approved Documents.

These results demonstrate compliance with the planning requirement of achieving 35% betterment on Part L 2013 for residential developments. The Dwelling Emission Rate has been calculated at a 45% improvement upon the Target Emission Rate from the notional building as per Part L of the Building Regulations.

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2.0 Introduction

CPW has undertaken an Energy Assessment for the proposed Friar Street Development in accordance with the Reading Borough Council planning requirements.

This document complies with the requirements at both national and local level, as set out in the National Planning Policy Framework (2021), The Reading Borough Local Plan (2019), The Reading Borough Council Sustainable Design and Construction SPD (2019).

This Energy assessment shall demonstrate how the scheme will incorporate energy efficiency measures, decentralised energy sources and Low and Zero Carbon (LZC) technology solutions to reduce the predicted regulated CO₂ emissions of the development in accordance Sustainable Design and Construction SPD strategy policy, specifically but not limited to:

- Policy CC2 Sustainable Design and Construction
- Policy CC3 Adaptation to Climate Change
- Policy CC4: Decentralised Energy

It should also be noted that the use of SAP2012 and SAP-10 Carbon Factors have been utilised for energy and carbon assessments.

The new-build mixed-use development has been benchmarked against Building Regulations Parts L1A and L2A of the Building Regulations in terms of baseline regulated energy demand and carbon. As a new-build development the residential element of the building is to be assessed under Part L1A. Similarly, as a non-domestic new-build development the commercial element of the development is to be assessed under Approved Document Part L2A.

In order to deliver an environmentally responsible development, an exemplar approach is being proposed based on low energy design principles. This approach involves energy demand minimisation through effective building form and orientation, good envelope design and proficient use of services before considering the use of off-site CHP-led district heating to decarbonise the energy supply – in line with a commonly used Energy Hierarchy utilised on GLA referable projects; Be Lean, Be Clean, Be Green, Be Seen.

The Energy and Sustainability Targets which were examined within the Energy assessment are the following:

- Compliance with Building regulations Part L 2013
 - Part L1A for Domestic buildings
 - Part L2A for non-Domestic buildings
- Local planning requirement to achieve 35% betterment on Part L 2013 targets for residential developments
- Achieve BREEAM rating of 'EXCELLENT' (applicable only to non-domestic buildings)
- Meet TM52 overheating criteria for all non-residential areas.
- Meet TM59 overheating criteria for all Residential accommodation.

The Energy and thermal modelling has been broken down into the following packages and analysed as follows:

- 3No. Retail units - BRUKL report generated using IES Virtual Environment 2021 software.
- Restaurant space - BRUKL report generated using IES Virtual Environment 2021 software.
- 103 Residential units – Simulated under SAP 2012 and SAP10 methodology

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3.0 Energy Benchmarking

3.1 BREEAM

BREEAM or Building Research Establishment's Environmental Assessment Method is a voluntary scheme that aims to quantify and reduce the environmental burdens of buildings by rewarding those designs that take positive steps to minimise their environmental impacts. Projects are assessed using a system of credits. The credits are grouped within the following categories:

- Management
- Health and Wellbeing
- Energy
- Transport
- Water
- Materials
- Waste
- Land Use and Ecology
- Pollution

The assessment process results in a report covering the issues assessed together with a formal certification giving a rating on a scale of UNCLASSIFIED, PASS, GOOD, VERY GOOD, EXCELLENT and OUTSTANDING.

The diagram and text below describes how BREEAM scores and rates an assessed building:

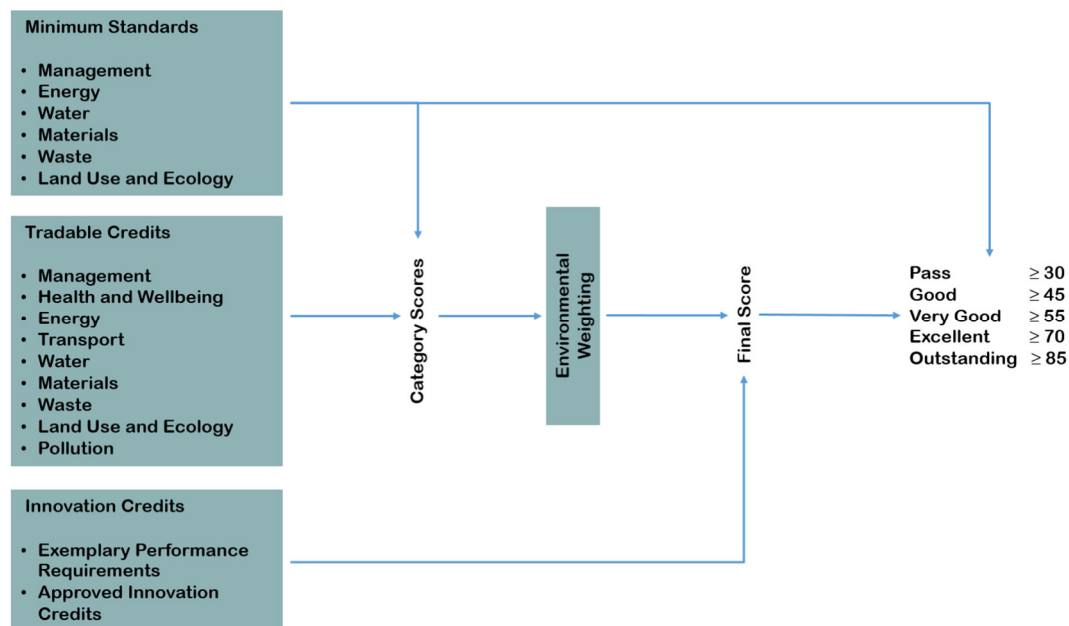


Figure 1 - Process for awarding a BREEAM rating

The BREEAM categories contain a number of environmental issues, which reflect the options available when designing, procuring and constructing a building.

Tradable Credits

Each environmental issue has a set number of 'credits' available and these credits are awarded where the building demonstrates that it complies with the requirements of that issue.

Minimum Standards

A number of issues within a category have set minimum standards, i.e. a minimum number of credits that must be achieved in order for a particular BREEAM rating level to be met.

Innovation Credits

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Innovation credits provide additional recognition for a building that innovates in the field of sustainable performance, above and beyond the level that is currently recognised and rewarded by standard BREEAM issues. Innovation credits are awarded for either complying with pre-defined BREEAM issue exemplary level requirements, or via application to BRE Global to have a particular building feature, system or process recognised as 'innovative'.

Within each of the BREEAM categories outlined above, there are a number of credit requirements that reflect the options available to designers and managers of buildings.

An environmental weighting is applied to the scores achieved under each category, as shown below, in order to calculate the final BREEAM score. The weighting factors have been derived from consensus-based research with various groups such as government, material suppliers and lobbyists. This research was carried out by BRE Global to establish the relative importance of each environmental issue.

The environmental weightings are as follows:

BREEAM Section	Weighting (%)	BREEAM Section	Weighting (%)
Management	12.0	Materials	12.5
Health and Wellbeing	15.0	Waste	7.5
Energy	19.0	Land Use and Ecology	10.0
Transport	8.0	Pollution	10.0
Water	6.0		

Figure 2 - BREEAM 2014 New Construction section weighting

The BREEAM rating bands are as follows:

BREEAM Rating	Score (%)
UNCLASSIFIED	<30
PASS	≥30
GOOD	≥45
VERY GOOD	≥55
EXCELLENT	≥70
OUTSTANDING	≥85

Table 1 - BREEAM rating bands

Although, at this stage, it is very difficult to predict exactly the number of BREEAM credits likely to be achieved by each LZC technology when applied to the current development, it is worth noting that these technologies have an influence over the following:

Ene 1 **Reduction of CO₂ Emissions** – Up to 12 (+5 Innovation) credits are available.

Ene 4 **Low Carbon Design** – One credit is available.

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Pol 2 **NO_x Emissions** – Up to 3 credits are available

BREEAM Pre-Assessment

A pre assessment meeting was held on the 15th of February with the project design team, where the BREEAM requirements were discussed to determine the possible score.

The assessment was produced using BREEAM 2018 Retail and based on a Shell Only basis as this was deemed to most appropriate based on the building to be delivered by the design team, and there are no services being installed in the building.

Incoming services will however be provided but be capped off in the building for future connection and the retail and restaurant MEP services will be installed as part of the tenant fit out.

The initial pre-assessment determined that a target score of 57.8% was achievable but a potential target of 58.6% was considered possible but additional work would need to be undertaken to determine whether these credits can be achieved and targeted.

The three incubator units of 59m², 50m² and 46m² have been excluded, due to the area is too small to assess, and they would need to be assessed separately. This would add additional cost to each unit development and the sustainable benefits would be negligible.

The BRE have stated that scale of the development (area or project budget: BREEAM does not lend itself to developments less than 1,000m² and with project budgets below £1,000,000 or EUR 1.2M as the scope for improvement in projects of this size is limited.

The cost of additional consultants, which may be required for a BREEAM rating alone, can often be disproportionate to the benefit of the development itself.

Despite the exclusion of the retail units, the commercial development area to be assess through BREEAM is still above the margin of 1000m² and therefore falls under a major non-residential development. Major non-residential developments require to meet a BREEAM score of 'Excellent' (70%) according Reading Borough Council Planning Policy adopted in 2019. This score is highly unlikely to be achieved given the restraints of the selected site.

However, the ground floor dining space of the commercial development area to be assess through BREEAM falls below the margin of 1000m² and therefore would fall under a minor non-residential development. Reading Borough Council Planning Policy states all minor non-residential developments or conversions to residential are required to meet the most up-to-date BREEAM 'Very Good' (score required 55%) standard as a minimum.

The BREEAM Pre-Assessment tracker shows that the Restaurant unit has the potential to achieve a BREEAM Rating of 'Very Good' and therefore should be considered for approval.

The BREEAM Pre-Assessment Tracker has been included within this report in Appendix C .

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3.2 Estimated Energy Demands and CO₂ Emissions

In order to benchmark the proposed new development, estimated energy demands and CO₂ emissions data have been calculated. These estimated energy consumptions are indicative only at this stage. They will, however, be used as a guideline to assess the percentage of the building's total energy consumption and CO₂ emissions that could be reduced or offset in accordance with the Energy Hierarchy.

In accordance with energy assessment guidance, it is prudent for this report to reflect the benchmark data derived from approved Dynamic Simulation Model (DSM) software which use government and industry agreed National Calculation Methodology (NCM) room templates containing standard operating conditions.

The modelling confirms the predicted notional regulated CO₂ emissions are as follows:

Building Regulations 2013 Part L Compliant Development	Notional Carbon Dioxide Emissions (Tonnes CO ₂ per annum)	
	Regulated	Unregulated*
Restaurant	32.9	61.61
Commercial / Retail units	5.87	60.78
Residential	117.6	-
Total	156.4	122.4

*unregulated load calculated using Part L software

Table 2 – Notional CO₂ Emissions

Note 1. CO₂ emission factors of 0.216 for Gas and 0.519 for Electricity have been used to calculate the above and are taken from Building Regulations Approved Documents.

It is CPWs recommendation that Reading Borough Council Planning Committee assess the proposed development based on updated SAP10 methodology, more commonly used and more inline with the updated Part L Building Regulations to be updated in June 2022. This ensures a more accurate carbon efficiency performance of the proposed development is reflected and the greater calculated carbon reductions can be fully acknowledged.

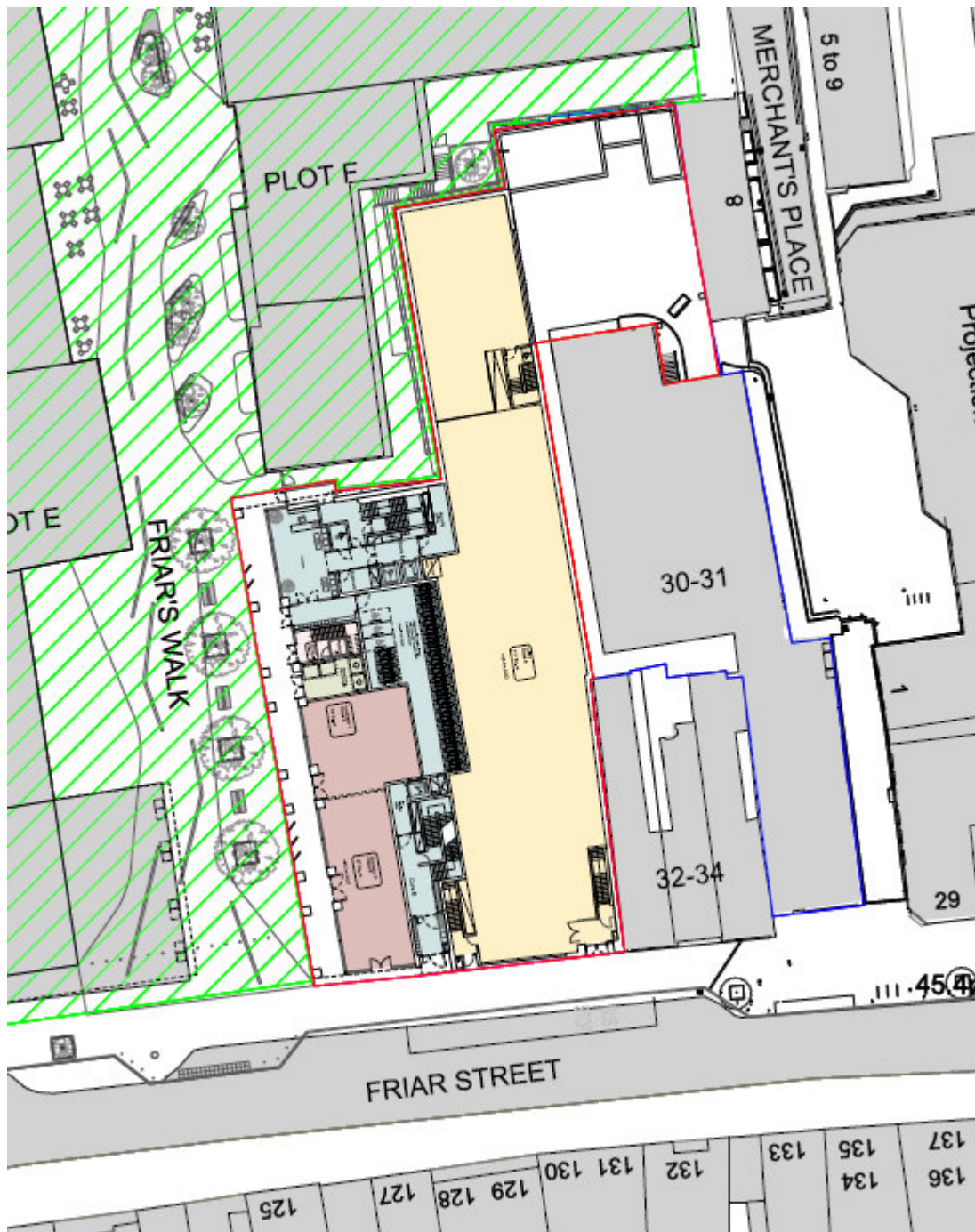
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4.0 Energy Efficiency – Be Lean

In order to deliver an environmentally responsible building, an exemplar approach is being proposed based on low energy design principles. In summary, this approach involves energy demand minimisation through effective building form and orientation, good envelope design and proficient use of services; such that the building itself is being used as the primary environmental modifier.

Long term energy benefits are best realised by reducing the inherent energy demand of the building in the first instance. These benefits are described and quantified in the following sections.

4.1 Site Location



The proposed site is located in the heart of Reading Town Centre, on Friar Street. A number of new developments building are currently being developed in the area. The majority of the surrounding buildings are generally quite low with the maximum height of the neighbouring properties to be around 10-12 storeys.

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4.2 Site weather and microclimate

The local weather and any microclimate will influence energy usage. A development on the coast may have a maritime climate, experiencing milder winters and cooler summers than those further inland, particularly on the west coast where they are subject to the jet stream influence. Inland buildings will have a continental climate, suffering more extremes in temperature and therefore more likely to require heating and cooling.

The climate in Reading Town centre is warm and temperate with annual average temperatures of approx. 10.0C. Reading lies 33m above sea level and there is significant rainfall throughout the year. Maximum temperatures can reach up to 22C in July and August, and minimum temperatures are unlikely to drop below 0-1C in the winter months. The buildings in this area generally low rise to one side, but being a city centre with high rise buildings to the North-East, the area might suffer from any Urban Heat Island effects, which could generate temperatures of up to 25C in the summer months. The most accurate weather station is in Swindon Brize Norton (approx. 40 miles away), and this will be used for any thermal simulations.

The site's landscape also affects the energy demand of a building. Vegetation, land form and any existing buildings can provide shade to a new development. For example, 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, any tree used for energy conservation should be considered as part of a much larger landscape.

As part of the regeneration and pedestrianisation of Friar's Walk, the landscape strategy aims to see the planting many trees and green spaces around this are, which are expected to have a positive effect on the site's environmental conditions; providing shade, and a cooler environment.

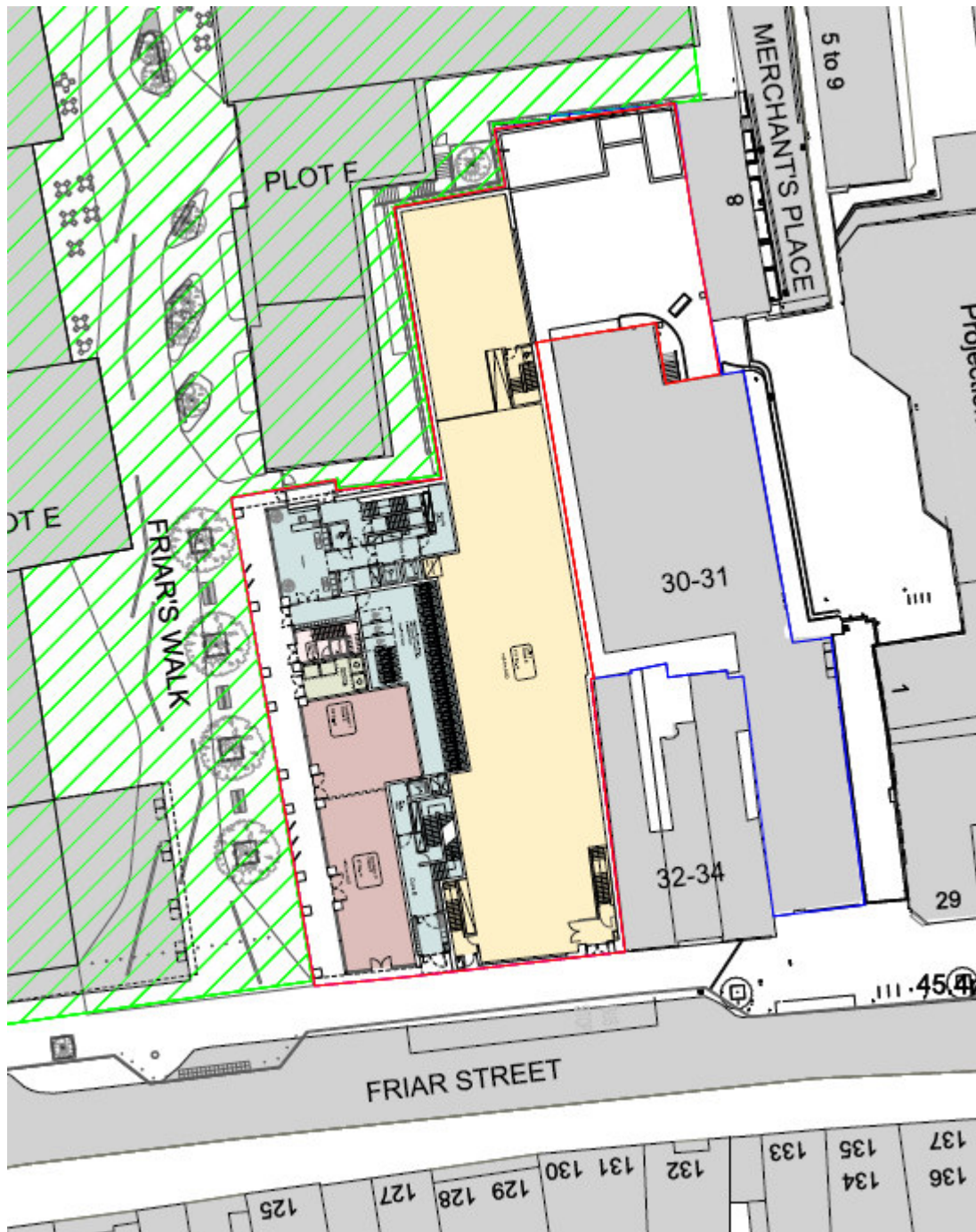
4.3 Building Orientation, Layout and Form

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.

By orientating the building, so that the long sides of the building face north and south, glare arising from the low early morning and evening sun is designed out. 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.

Solar heating or solar gain is often welcome in winter months, helping to heat up the building. However, careful design and attention to building orientation is essential to avoid summertime overheating, as on a clear day in summer an unshaded window in the UK can admit 3kWhr of energy per m² of glass. Overheating is likely to be more of a problem if the windows face the southern half of the sky (east or west facing windows can also be a problem in some types of building), there are horizontal or near-horizontal rooflights, the building has high internal heat gains or the building needs to be kept cooler than normal.

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Planning the internal layout of buildings and rooms to maximise the benefits of solar gain and minimise the disadvantages is essential. The majority of commercial spaces face South to South-West and are for the most part protected from the effects of extreme solar irradiation. All occupied spaces have access to the external envelope and hence access to a form of natural daylight and ventilation.

All retail accommodation is located on the ground floor of the development. The restaurant space is located on ground floor and basement level at the base of the residential accommodation. The tenant shared co-working space accommodation is located to the north-west section of the building, which should limit the ingress of solar gains to spaces where internal gains could be high, due to the taller buildings neighbouring the development.

The residential accommodation is contained within two cores from Levels 1 to Level 6 for core B, with core A climbing to level 10. Where balconies are provided recessed from the building facade, these provide solar shading to window openings into apartments. This is increasingly important in the case of the South and West facing apartments.

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The building form factor is approximately 0.2 which means that we have good floor area to heat loss surface area ratio. This assists the commercial building element in minimising heat losses and improving the likelihood of achieving a good air tightness.

4.4 Building Design – Energy Efficiency

The general construction design standards to be adopted must exceed the requirements of the current (2013 Edition) Part L Building Regulations.

To this end, the proposed design shall promote reduced CO₂ emissions from delivered energy consumption by minimising operational energy demand through passive and best-practice measures. The LZC technology energy options presented herein will potentially provide a further CO₂ reduction over and above the measures included as an integral part of the project design.

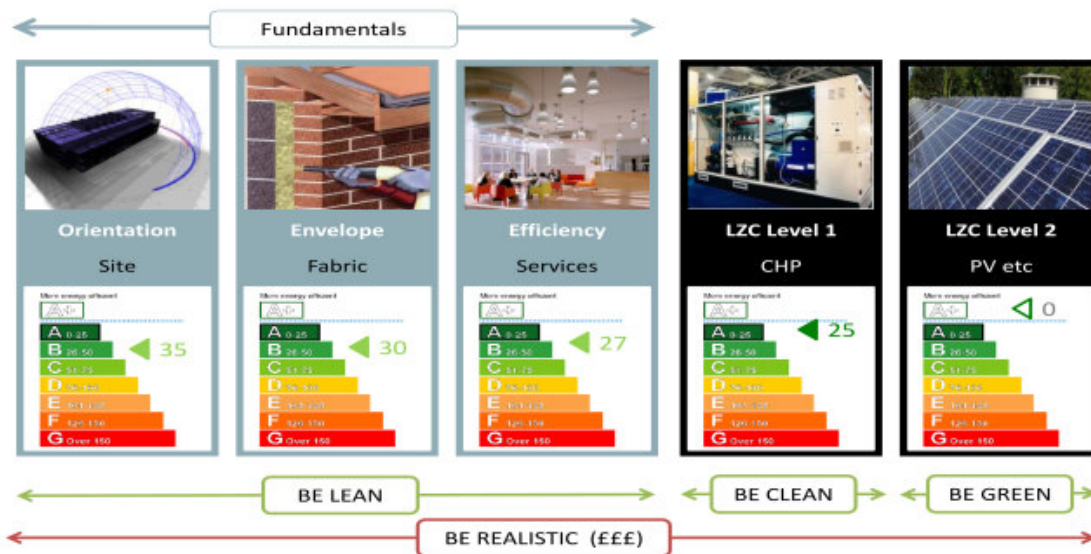
Be Lean – use less energy

Being lean is all about utilising passive, often simple measures to help reduce the energy consumption to a sensible minimum level. For this project we started with the thermal envelope. Using traditional construction methods, we have been able to engineer the building envelope to minimise heat loss in winter and minimise unwanted heat gain in summer. This has been achieved by:-

- Enhanced envelope U-values - to reduce the building's heating requirements;
- Providing a well-sealed envelope to minimise the infiltration of cold winter air - to reduce the building's heating requirement;
- Minimising thermal bridging by careful structural and architectural detailing - to reduce the building's heating requirement;
- Adopting a window design that optimises daylight but controls solar gain and glare – to reduce electric lighting energy consumption;
- Providing exposed thermal mass where possible to provide passive cooling – suppresses summertime overheating to acceptable levels without the need for high energy consuming and expensive to run and maintain mechanical cooling systems.
- Considering the layout and orientation of the building - to minimise summertime overheating and the need for high energy consuming and expensive to run and maintain mechanical cooling systems.

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The following diagram illustrates the approach we have adopted:



The application of exposed thermal mass to provide passive cooling is well understood and is an excellent method of suppressing the fluctuations of internal temperature without resorting to mechanical cooling systems, which are both expensive to install, consume significant amounts of energy in summer and have high maintenance costs. In occupied spaces and where possible, this passive cooling will be provided by exposing the concrete floor. The exposed thermal mass will absorb room heat gains during the day allowing the spaces to remain comfortable and compliant with the overheating criteria. Stored heat will be released at night by means of the mixed mode ventilation philosophy. This will regenerate the exposed concrete's ability to absorb heat the following day. The process is described in more detail later in the report.

Ceilings will be finished with a high reflective coating to optimise daylight, especially towards the back corners of the rooms. It will also improve the artificial light uniformity and improve its energy efficiency. The window design has been carefully considered to enable optimum daylight transmission while still affording natural ventilation with or without the blinds down. Importantly the structural engineering solution for the building allows the window head height to be maximised so they finish immediately below the soffit. This, together with the generous ceiling height has allowed us to meet and exceed the daylighting criteria.

The development's thermal envelope performance will be better than that required by the Building Regulations to minimise heat loss and therefore minimise the heating energy consumed. This will be achieved by improving the U-Values and by having a very tight thermal envelope to minimise the opportunity for heat to escape. We propose to design the building envelope to deliver an air leakage rate better than 3m³/hr/m² at 50 Pa, considerably better than the Building Regulation minimum of 10m³/hr/m² at 50 Pa.

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Fabric First Energy Strategy – Thermal Envelope

Aligned with our Energy Strategy we promote a thermally efficient building fabric specification in order to inherently reduce the energy consumption of the building. This strategy designs out the need for Renewables (LZC) solutions that are disproportionately expensive and ensures the construction budget is put into the building.

The table below shows the proposed building fabric thermal performance for the development:

Element	Criteria U-Value (W/m ² K)	Notes
General Glazing	U = 1.2	Glass to achieve a total light transmission of 0.71 G-Value of 0.4
Wall	U = 0.15	Thermal mass to inner leaf
Roof	U = 0.1	Light weight construction.
Ground/ Basement Floor	U = 0.12	-
Internal Glass Partitions	-	Glass to achieve a total light transmission of 0.69
Ceiling / Soffit	-	To achieve a minimum reflectance of 80%. Painted concrete and false ceilings.
Internal Wall	-	To achieve a minimum reflectance of 60%. Internal partitions and internal surfaces of external walls.
Floor	-	To achieve a minimum reflectance of 25 - 30%
Thermal Bridging Ψ value	0.01 w/mK or better	Thermal bridging elements will be either designed out completely or their specification will be carefully detailed to minimise heat transmission through the envelope.

The table below shows some of the 'Be Lean' active design measures incorporated within the design to demonstrate our approach.

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Item	Description
Heat recovery ventilation	As discussed, all ventilation systems utilise heat recovery ventilation as part of a mixed-mode ventilation strategy that is deployed to maximise energy efficiency.
On-demand control to communal spaces	Areas of the building that are intended to be intermittent use like retail units, and commercial spaces, have local demand controlled ventilation.
Zoned building services	The building energy systems will be zoned to ensure that energy is not lost when a certain area requires heat but another does not.
Automatic monitoring of all energy sub-metering	Out of range alarms shall be triggered when the energy consumption of the building exceeds the typical consumption levels to highlight to the facilities staff that excessive energy use has occurred.
Variable speed pumping	Variable speed pumping on all secondary circuits (see heating schematic) reduces energy consumption associated with distribution significantly.
Lighting Efficiency	LED's have been appraised for their suitability as part of the design development, and have been found to be a cost effective measure to reduce lighting electrical energy use.
On-demand control to communal spaces	The room by room ventilation, heating and lighting controls ensure that energy efficiency is maximised in every space where the amount of air delivered is variable to suit the space.

Solar Shading Strategy

The scheme benefits from the usage of solar performance glazing. The glazing specification is carefully selected to ensure the internal environment is pleasant on all orientations but varying the g-value. In addition, a number of locations contain internal blinds to limit daylight, reducing the effective g-value further still. The proposed G-value for the elevations of the development glazing shall be 0.4.

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5.0 Decentralised Energy – Be Clean

5.1 Existing Heat Networks

Opportunities to connect the planned development to existing or future decentralised heat distribution networks, including those featuring Combined Heat and Power (CHP) plant, have been investigated. Reading Borough Council policy encourages the design and implementation of decentralised heat networks.

Investigations have been carried out into the viability of connection into a local district heating network. It was found from conversations through the pre-app process that, currently, Reading Council have a proposed the implementation of a District Heating System that shall be created specifically to accommodate the central Reading district by supplying all required district heating requirements.

The District Heating Proposal is still at feasibility stage and not currently available for connection. The Friar Street development intends to provide the mechanical and spatial allowance for the proposed system to connect to a future District Heating system. This can be achieved by allowing for future connection to the base of the LTHW riser and space allowance for potential future plant within the basement residential bike store.

6.0 Appraisal of Renewable and Low Carbon Technology Energy Options – Be Green

In accordance with BREEAM requirements, 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.

A summary of the feasibility process is tabulated below and an overview of each viable technology is given subsequently.

Technology	Brief Description	Benefits	Issues/Limitations	Feasible for Site?
Solar Photovoltaic	Solar photovoltaic panels convert solar radiation into electrical energy through semiconductor cells. They are not to be confused with solar panels which use the sun's energy to heat water (or air) for water and space heating.	Low maintenance/no moving parts Easily integrated into building design No ongoing costs Income generated from Feed-in Tariff (FIT)	Any overshadowing reduces panel performance Panels ideally inclined at 30° to the horizontal facing a southerly direction	Yes, but limited to upper roof space
Solar Thermal	Solar thermal energy can be used to contribute towards space heating and hot water requirements. The two most common forms of collector are panel and evacuated tube.	Low maintenance Little/no ongoing costs Income generated from Renewable Heat Incentive (RHI) scheme	Must be sized for the building hot water requirements Panels ideally inclined at 30° to the horizontal facing a southerly direction	No, not suitable on this site. Limited available roof space to make this viable to serve full DHW demand
Ground Source Heat Pump (GSHP)	GSHP systems tap into the earth's considerable energy store to provide both heating and cooling to buildings. A number of installation methods are possible including horizontal trench, vertical boreholes, piled foundations (energy piles) or plates/pipe work submerged in a large body of water. The design, installation and operation of GSHPs is well established.	Minimal maintenance Unobtrusive technology Flexible installation options to meet available site footprint Income generated from Renewable Heat Incentive (RHI) scheme	Large area required for horizontal pipes Full ground survey required to determine geology More beneficial to the development if cooling is required Integration with piled foundations must be done at an early stage	No, see section 6.1

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Technology	Brief Description	Benefits	Issues/Limitations	Feasible for Site?
Air Source Heat Pump	Electric or gas driven air source heat pumps extract thermal energy from the surrounding air and transfer it to the working fluid (air or water).	Efficient use of fuel Relatively low capital costs	Specialist maintenance More beneficial to the development if cooling is required Requires defrost cycle in extreme conditions Some additional plant space required	Yes
Wind Turbine (Stand-alone column mounted)	Wind generation equipment operates on the basis of wind turning a propeller, which is used to drive an alternator to generate electricity. Small scale (1kW – 15kW) wind turbines can be pole or roof mounted.	Low maintenance/ongoing costs Minimum wind speed available (www.bwea.com) Excess electricity can be exported to the grid Income generated from Feed-in Tariff (FIT)	Planning issues Aesthetic impact and background noise Space limitations on site Wind survey to be undertaken to verify 'local' viability	No, not suitable on this site
Wind Turbine (Roof Mounted)	As above	Low maintenance/ongoing costs Minimum wind speed available (www.bwea.com) Excess electricity can be exported to the grid Income generated from Feed-in Tariff (FIT)	Planning issues Aesthetic impact and background noise Structural/vibration impact on building to be assessed Proximity of other buildings raises issues with downstream turbulence Wind survey to be undertaken to verify 'local' viability	No, not suitable on this site
Bio-Renewable Energy Sources (Automated feed – wood-fuel boiler plant)	Modern wood-fuel boilers are highly efficient, clean and almost carbon neutral (the tree growing process effectively absorbs the CO ₂ that is emitted during combustion). Automated systems require mechanical fuel handling and a large storage silo.	Stable long term running costs Potential good CO ₂ saving Income generated from Renewable Heat Incentive (RHI) scheme	Large area needed for fuel delivery and storage Reliable fuel supply chain required Regular maintenance required Significant plant space required	No, not suitable on this site
Fuel Cells and Fuel Cell Combined Heat and Power	Fuel cells convert the energy of a controlled chemical reaction, typically involving hydrogen and oxygen, into electricity, heat and water vapour. Fuel cell stacks operate in the temperature range 65°C – 800°C providing co-generation opportunities in the form of Combined Heat and Power (CHP) solutions.	Zero CO ₂ emissions if fired on pure hydrogen and low CO ₂ emissions if fired on other hydrocarbon fuels Virtually silent operation since no moving parts High electrical efficiency Excess electricity can be exported back to the grid Benefits from being part of an energy centre/district heating scheme	Expensive Pure hydrogen fuel supply and distribution infrastructure limited in the UK Sufficient base thermal and electrical demand required Some additional plant space required Reforming process, used to extract hydrogen from alternative fuels, requires energy; lowering overall system efficiency	No, expensive, emerging technology

Table 3- Summary of Renewable and Low Carbon Technology Energy Options

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6.1 Ground Source Heat Pumps (GSHP)

Ground-source heat pumps (GSHPs) take low-grade heat from solar energy stored in the earth and convert it to high-grade heat by using an electrically driven heat pump containing a heat exchanger. By harnessing this constant temperature, a GSHP system absorbs energy from the earth and transfers it to a building. In the winter, heat from the earth is compressed to a higher temperature and directed into a building. In summer, a GSHP system is reversed moving heat from inside the building into the cooler earth. A bonus is that a GSHP system can provide moderate to high temperature hot water at no cost for domestic use in the summer and substantial savings in the winter.

Ground source energy systems can, if designed correctly, produce significant carbon savings compared to conventional heating and cooling plant. COPs of 4-6 are generally achievable with ground source heat pumps. On the other hand, GSHPs do present the engineer with certain challenges, not least the importance of geology and hydrogeology.

Heating and cooling systems that rely on a degree of thermal storage in the ground will operate more efficiently if the ground is of low thermal conductivity, whereas heating only systems that rely on good heat transfer in the ground, will operate more efficiently if the ground is of high thermal conductivity.

Ground source heat pump systems may be heating only, but ideally there would be a cooling need to replenish the heat extracted during the winter to leave the ground in a state of balance. This arrangement helps reduce the number of boreholes needed.

Based on the size and form of the building we have estimated that the peak space heating load of the building is in the region of 2kW per apartment, and the peak hot water load is 35kW per apartment. The following tables demonstrate a comparison of the 2 proposed systems to satisfy the building's heating loads:

System	Air Source Heat Pump (ASHP)	Ground source heat pumps (GSHP)
Coefficient of Performance (COP)	c. 3	c. 5
System Size	2 x 250kW ASHP units 1500 Litre thermal store	12 x 40kW GSHP internal units 12,000 Litre thermal store 52 x 225m deep boreholes
Plant space requirements (based on high level calculations)	Internal plant space: 18m ² External plant space: 60m ²	Internal plant space: 25m ² External borehole area circa. 5200m ² External Dry air cooler may be required if summer cooling load not sufficient to replenish borehole heat storage.
Estimated Electrical consumption in kWh/annum (space heating only)*	83,000kWh/annum	50,000kWh/annum
Advantages	- Reduced CO₂ emissions - Reduced energy costs - Creation / fostering of a "green" image for the building / developer / client - Compliance with Part L of the Building Regulations - Decarbonisation towards Net Zero Carbon	- Reduced CO₂ emissions beyond ASHP - Reduced energy costs - High efficiencies compared to ASHP - Creation / fostering of a "green" image for the building / developer / client - Compliance with Part L of the Building Regulations - Decarbonisation towards Net Zero Carbon - Minimal maintenance
Disadvantages	- Low capital cost, but higher compared to traditional boilers - Noise impact on adjacencies must be analysed and mitigated where necessary - External unobstructed location required to locate heat pumps.	- Large capital cost investment required for boreholes - The success of a GSHP system is dependent on suitable ground conditions - Correct system sizing can rely on specialist contractors and subject to ground surveys

Energy Statement

	Defrost cycles must be considered when sizing systems	- The systems, by their nature, comprise large amount of buried pipework which is inaccessible for repair in the (unlikely) event of a leak - GSHPs involve a considerable amount of excavation and engineering work
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CPW have investigated the suitability of the development site for the implementation of a Ground Source Heat Pump system to meet the space heating and domestic hot water demands of the building.

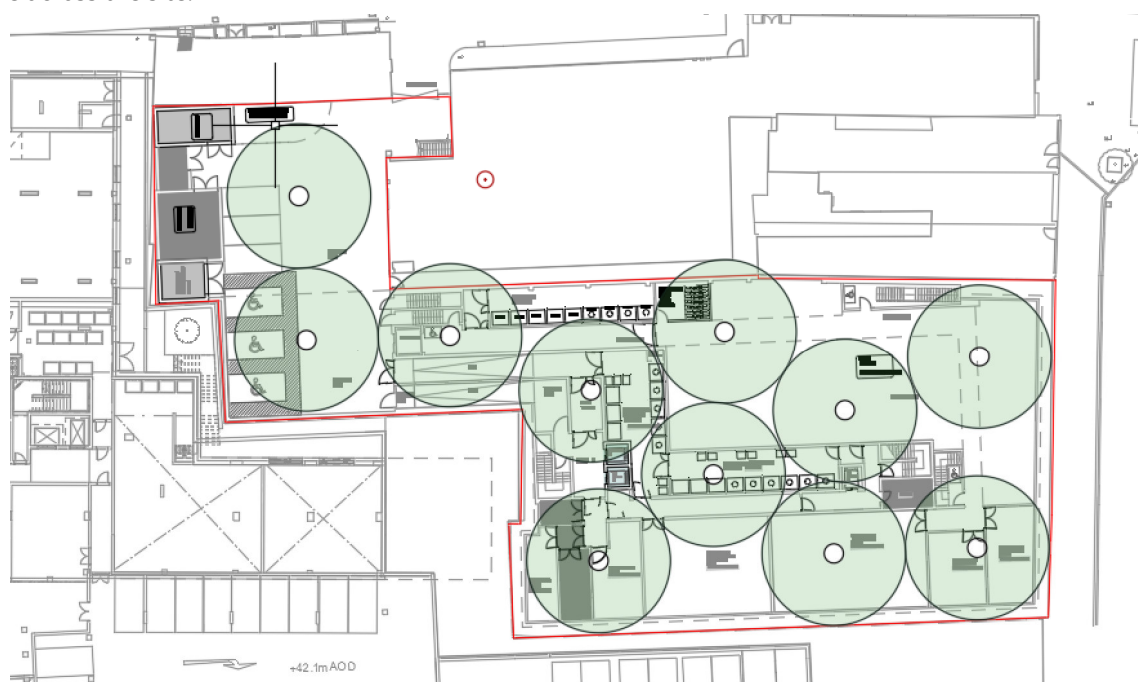
No of Dwellings	103
Peak Heating Load (kW)	165
Peak DHW load (kW)	309
Total GSHP load (kW)	474
Total number of Boreholes required	53

Calculations show from the total 474kW load of the Ground Source Heat Pump could be met by an estimated 53 boreholes in total.

Total GSHP Peak Load	Number of Boreholes	Average Borehole Depth (m)	Spacing Between Boreholes (m)
474	53	225	12

CPW have taken the size and spatial requirements of the borehole elements of the Ground Source Heat Pump installation from similar sized residential scheme proposals in order to investigate their arrangement across the proposed site at 35-39 Friar Street.

The graphic below shows an indicative borehole layout as an illustrative guide of the maximum number of boreholes available across the site.



Energy Statement

As shown in the graphic on page 20 the spatial constraints of the site boundary mean only 11 boreholes are able to be located within it. This is before detailed design investigations into the structural foundations of the building and its coordination with any borehole arrangements.

Given the spatial constraints of the site, the Ground Source Heat Pump driven plant would not be able to fulfil the energy demands of the 103 apartments, this alongside the large capital costs of the installation make the strategy of implementing Ground Source Heat Pumps unviable.

6.2 Air Source Heat Pump Technologies

Electric driven air source heat pumps extract thermal energy from the surrounding air and transfer it to the working fluid (air or water). ASHPs can provide both heating and cooling to buildings and have an associated Coefficient of Performance (COP), this is typically around 3 to 4 for heat pumps driven by compressors powered by electric motors and incorporating Variable Refrigerant Flow (VRF) technology. With VRF technology, there is an opportunity to heat and cool separate spaces and recover the heat between them. Care should be taken when mounting the units to avoid any acoustic problems associated with operating the fans. The outdoor units normally operate with sound levels typically in the range 55 - 60dB(A). A downside of electric driven air source heat pumps is that they require a defrost cycle in extreme conditions which impacts on the system efficiency. Heating capacity also falls off as the ambient temperature drops below 5°C but still maintains 80% capacity at -5°C.

Units are either roof or ground mounted and coupled to a thermal buffer store with additional back-up electric immersion heaters in the cylinder, to make up any shortfall. Alternative heat pump solutions can be supplied for internal installation within a plant room.



Figure 3 - Air Source Heat Pumps

6.3 Solar Photovoltaic (PV) Panels

Solar photovoltaic panels convert solar radiation into electrical energy through semiconductor cells. They are not to be confused with solar panels which use the sun's energy to heat water (or air) for water and space heating.



Figure 4 - CPW Photovoltaic Installations: Project Epic (BREEAM Excellent Office – above left) and Castle Wood (BREEAM Excellent School – above right)

Photovoltaic panels are available in a number of forms including mono-crystalline, polycrystalline, amorphous silicon (thin film) or hybrid panels (discussed later). They are fixed or integrated into a building's un-shaded south facing façade or pitched roof ideally at an incline of 30° to the horizontal for maximum energy yield.

Energy Statement

It is essential that the panels remain un-shaded, as even a small shadow can significantly reduce output. The individual modules are connected to an inverter to convert their direct current (DC) into alternating current (AC) which is usable in buildings.



Figure 5 - Solar PV Louvres on the South Facade

Although sloping rooftops provide an ideal site for fixing PV panels using traditional mounting frames, there are a number of alternative solutions whereby PV panels can be incorporated into the actual building fabric of the development.

Solar louvres use PV panels to provide solar shading on the south façade of buildings as part of the brise soleil (see above), and this can be a highly effective way of controlling overheating and help reduce glare.

Solar glazing uses a combination of solar PV and glass, where the PV cells are laminated between two panes of specialised glazing (see above). The resulting glass laminate serves the dual function of creating energy and shade at the same time, reducing the risk of overheating.



Figure 6 - CPW Solar Glazing Installation, University of Warwick - Materials and Analytical Sciences Building

Solar glazing can be used wherever conventional glass would be specified, especially in atria. Bespoke designs allow for varying light penetration by changing the spacing between individual cells. Typically, a combination of 50% PV and 50% translucent glazing is used.

Vertical solar facades can be used to directly replace conventional rain screen cladding materials providing a smooth, flat facade surface for the building. Where circumstances allow, the PV panels can be tilted towards the sun to maximize the energy yield.

As mentioned earlier, there are a number of types of PV cell:

Mono-crystalline Silicon Cells: These are made using cells saw-cut from a single cylindrical crystal of silicon. The principle advantage of mono-crystalline cells is their high efficiency, typically around 15 – 20%, although the manufacturing process required to produce mono-crystalline silicon is complicated, resulting in slightly higher costs than other competing technologies.

Polycrystalline Silicon Cells: These are made from cells cut from an ingot of melted and re-crystallised silicon. In the manufacturing process, molten silicon is cast into ingots of polycrystalline silicon. The ingots are then saw-cut into very thin wafers and assembled into complete cells giving a granular textured finish. Polycrystalline cells are cheaper

Energy Statement

to produce than mono-crystalline types, due to the simpler manufacturing process but tend to be slightly less efficient, with average efficiencies of circa 12 – 15%.

Thick-Film Silicon: This is another polycrystalline technology where the silicon is deposited in a continuous process onto a base material giving a fine grained, sparkling appearance. Like all crystalline PV, this is encapsulated in a transparent insulating polymer with a tempered glass cover and usually bound into a strong aluminium frame.

Thin-Film Amorphous Silicon: Amorphous silicon cells are composed of silicon atoms in a thin homogenous layer rather than a crystalline structure. Amorphous silicon absorbs light more effectively than crystalline silicon, so the cells can be thinner. For this reason, amorphous silicon is also known as a 'thin film' PV technology. Amorphous silicon can be deposited on a wide range of substrates, both rigid and flexible, which makes it ideal for curved surfaces and 'fold-away' modules. Amorphous cells are, however, less efficient than crystalline based cells, with typical efficiencies of around 6%, but they are easier and, therefore, cheaper to produce.

Other Thin Films: A number of other promising materials such as cadmium telluride (CdTe) and copper indium diselenide (CIS) are now being used for PV modules. The attraction of these technologies is that they can be manufactured by relatively inexpensive industrial processes, certainly in comparison to crystalline silicon technologies, yet they typically offer higher module efficiencies than amorphous silicon. New technologies based on the photosynthesis process are at early stages of commercialisation.

6.4 Energy production from LZC

6.4.1 Solar Photovoltaic Panels

The use of Photovoltaic Panels has been implemented into the Friar Street development proposal.

The roof space allocation has been estimated to accommodate 34 panels with the following estimated output and carbon savings under both SAP2012 and SAP10 methodology:

SAP2012 Methodology

ENERGY & CARBON

THE ANNUAL PREDICTED ENERGY OUTPUT IS AROUND

11,272 kWh

THE ANNUAL SITE-GENERATED ELECTRICITY SAVES

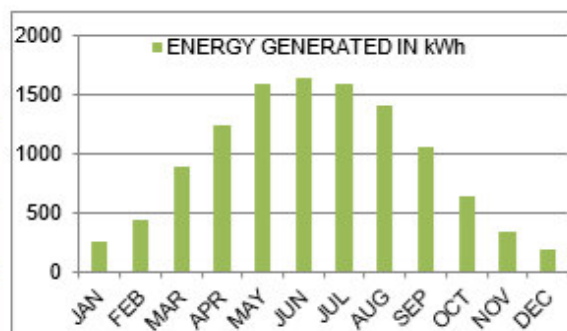
5,850 kg CO₂

THIS SAVING IS EQUAL TO DRIVING AN AVERAGE UK CAR AROUND

34,821 km

OR TAKING A RETURN FLIGHT FROM LONDON TO

HOUSTON
FOR 3 PERSON(S)



SAP10 methodology

ENERGY & CARBON

THE ANNUAL PREDICTED ENERGY OUTPUT IS AROUND

11,272 kWh

THE ANNUAL SITE-GENERATED ELECTRICITY SAVES

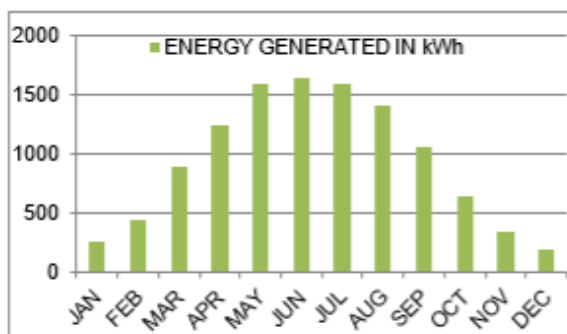
2,626 kg CO₂

THIS SAVING IS EQUAL TO DRIVING AN AVERAGE UK CAR AROUND

15,633 km

OR TAKING A RETURN FLIGHT FROM LONDON TO

HONOLULU
FOR 1 PERSON(S)



Energy Statement

6.4.2 Air Source Heat Pump

CPW's proposal is to provide the residential element of the development with Air Source Heat Pumps (ASHP). The network will run at approximately 55-35 degrees Celsius Flow and Return:

- Communal plant: The communal plants will comprise of a series of air source heat pumps, a 3-port valve arrangement and pipework circulation pumps that work to maintain the system temperature at approximately 55C.
- Space Heating and cooling: A Heat Interface Unit (HIU) will transfer heat from the communal system in order to serve the apartment heating system accordingly. Space heating will be provided via radiators to meet the thermal comfort requirements within each space of the apartments.
- Domestic Hot water: Hot water shall be transferred through the apartment Heat Interface Units from the communal heating system. This will minimise any DHWS network distribution losses.

ASHP's take full advantage of the improving carbon emission factors in the National Grid as they are powered by electricity, this technology has assisted the energy performance of the building and is required to comply with the Planning Policy set out by the Reading Borough Local Plan.

The ASHP's are expected to have a SCOP of 3 and an SEER of 4.

The noise levels associated with an ASHP installation should not be overlooked. Typically, acoustic buffer kits are employed to ensure noise levels don't exceed 65dBA when 1m from the unit.

The thermal buffer is important to allow the ASHP system to continue operating when heating/hot water load demand falls during the course of the day.



Air Source Heat Pump Unit

The following results demonstrate the output of the SAPs and GLA reporting spreadsheet values at the BE GREEN stage:

Energy Statement

Table 8: Regulated CO₂ Savings from Stage 3 – BE GREEN of the Energy Hierarchy for Domestic Buildings

7.0 Cooling and Overheating

7.1 The Cooling Hierarchy

CPW have proposed the current design strategies based on a good practice procedure, by implementing a cooling hierarchy to maximise the passive design measures prior to relying on the addition of comfort cooling and to minimise its use if implement. These have been included in the Friar Street development as follows:

1. Minimising Internal Heat Gains – DHW pipe work will be designed and insulated to minimise heat loss into the building. For residential accommodation, Danish standards DS439 have been used in order to provide a good level of diversification when sizing heating and hot water systems. In Commercial accommodation, kitchens and high heat spaces shall be situated away from areas of high solar gains.
2. Reducing Solar Gains – As stated in the Be Lean section, a low G-Value has been targeted in order to minimise solar gains. Solar shading will also be considered on the southern façade to combat overheating in certain rooms.
3. Thermal Mass – Thermal mass is being incorporated through the floor slabs and roof, which will comprise concrete planks. Suspended ceilings are likely to be required for acoustic reasons, however further investigation will be undertaken as to the design of these and the floor finishes to try to utilise and expose the thermal mass of the concrete floors wherever possible, so as to help regulate the internal temperature.
4. Passive Ventilation – Where natural ventilation is not applicable due to air quality and acoustic restrictions, mechanical ventilation will be carefully specified, to reduce energy demand to a minimum.
5. Mechanical Ventilation – Supply and extract systems will be specified with heat recovery to minimise energy use of the system.

Energy Statement

7.2 Overheating Analysis

A detailed analysis has been undertaken to determine whether or not rooms will overheat during the summer. The areas have been thermally modelled to comply with CIBSE TM52 (for non-residential spaces) and CIBSE TM59 (for residential accommodation) Overheating Criteria using CIBSE certified Level 5 approved Dynamic Simulation Modelling software.

The software conducts a Dynamic Thermal analysis of the space based upon a weather file derived from CIBSE calculations (Summer Design Year). The weather data files used by the modelling software are provided based on recorded data for the nearest geographical location, these provide details on temperature, solar irradiation, wind speed, wind direction etc. The data has been interpreted by the issuing authority such that it gives the anticipated maximum loads for a current design summer year. The results confirm the thermal comfort within a particular room throughout the summer months.

The TM52 Adaptive Comfort analysis tool within IES is capable of assessing overheating of buildings based on the criteria defined by BS EN15251 and BREEAM requirements.

Commercial accommodation: All commercial accommodation is proposed to be fully comfort cooled and hence is considered to be in compliance with all TM52 overheating limitations. This includes the following areas:

- Retail units
- Restaurant space

Residential accommodation

The residential spaces have been tested under TM59 for overheating compliance and the following critical assumptions have been made at this point in order to achieve the targets :

- The overheating strategy relies on mechanical ventilation within each room
- Windows are non-openable for mitigation of overheating
- Internal doors within apartments require to be opened at times to achieve overheating compliance.

The below weather files have been tested from the Swindon/Brize Norton weather station data:

Weather File: Swindon_Brize_Norton _DYS1_2020 (50th Percentile Range)

As a result of the acoustic consultant's report it has been determined that there are high levels of noise pollution being generated towards the Southern side of the site. The effect of this means that a number of apartments predominantly located towards the South elevations, are unable to rely on opening windows to deal with the effects of overheating. This is due to the duration of window opening required throughout the year, and the levels of noise experienced within the apartments.

Further detailed assessments by the acoustician will confirm the precise extent of this within the Environmental Noise Survey and Acoustic Design Statement.

Additionally, the Air Quality consultant has advised that due to NO₂ levels being close to the limit on the southern façade the opening of windows is not advised for dwellings that are south facing.

Therefore, the TM59 overheating analysis has been conducted without the ability to open windows to mitigate overheating and shall rely solely on the passive design measures of the building and the mechanical ventilation to be provided to each dwelling.

Energy Statement

Initial TM 59 Results displayed below:

Homes that are predominantly mechanically ventilated because they have either no opportunity or extremely limited opportunities for opening windows/lowers should be assessed for overheating using the fixed temperature method based on CIBSE Guide A (2015a).

Criteria for homes 'predominantly mechanically ventilated'

For homes with restricted window openings, the CIBSE fixed temperature test must be followed, i.e. all occupied rooms should not exceed an operative temperature of 26°C for more than 3% of annual occupied annual hours.

Criteria For Spaces Predominantly 'Mechanically Ventilated'

Room Name	Annual Occupied Hours	No. of Hours over 26°C p.a	% of hours over 26°C p.a	CIBSE criteria met?	Room Name	Annual Occupied Hours	No. of Hours over 26°C p.a	% of hours over 26°C p.a	CIBSE criteria met?
SECOND FLOOR BEDROOM					SECOND FLOOR LIVING/KITCHEN				
L02 : DOUBLE BEDROOM 1 APT 08	8760	443.00	5.06	FAIL	L02 : LIVING KITCHEN APT 08	4745	301.00	6.34	FAIL
L02 : DOUBLE BEDROOM 2 APT 07	8760	1130.00	12.90	FAIL	L02 : LIVING KITCHEN APT 07	4745	999.00	19.79	FAIL
L02 : DOUBLE BEDROOM 1 APT 07	8760	1067.00	12.18	FAIL					
L02 : DOUBLE BEDROOM 2 APT 06	8760	1036.00	11.83	FAIL	L02 : LIVING KITCHEN APT 06	4745	813.00	17.13	FAIL
L02 : DOUBLE BEDROOM 1 APT 06	8760	872.00	9.95	FAIL					
L02 : DOUBLE BEDROOM 2 APT 05	8760	1167.00	13.32	FAIL	L02 : LIVING KITCHEN APT 05	4745	906.00	19.09	FAIL
L02 : DOUBLE BEDROOM 1 APT 05	8760	881.00	10.06	FAIL					
L02 : DOUBLE BEDROOM 1 APT 04	8760	1241.00	14.17	FAIL	L02 : LIVING KITCHEN APT 04	4745	1245.00	26.24	FAIL
L02 : DOUBLE BEDROOM 2 APT 04	8760	1446.00	16.51	FAIL					
L02 : DOUBLE BEDROOM 1 APT 03	8760	1201.00	13.71	FAIL	L02 : LIVING KITCHEN APT 03	4745	903.00	19.03	FAIL
L02 : DOUBLE BEDROOM 2 APT 02	8760	1054.00	12.03	FAIL	L02 : LIVING KITCHEN APT 02	4745	769.00	16.21	FAIL
L02 : SINGLE BEDROOM 2 APT 01	8760	707.00	8.07	FAIL	L02 : LIVING KITCHEN APT 01	4745	648.00	13.66	FAIL
L02 : DOUBLE BEDROOM 1 APT 01	8760	720.00	8.22	FAIL					

Room Name	Annual Occupied Hours	No. of Hours over 26°C p.a	% of hours over 26°C p.a	CIBSE criteria met?	Room Name	Annual Occupied Hours	No. of Hours over 26°C p.a	% of hours over 26°C p.a	CIBSE criteria met?
SIXTH FLOOR BEDROOM					SIXTH FLOOR LIVING/KITCHEN				
L06 : DOUBLE BEDROOM 1 APT 07	8760	851.00	9.71	FAIL	L06 : LIVING KITCHEN APT 07	4745	638.00	13.45	FAIL
L06 : DOUBLE BEDROOM 2 APT 07	8760	726.00	8.29	FAIL					
L06 : SINGLE BEDROOM 3 APT 07	8760	595.00	6.79	FAIL					
L06 : DOUBLE BEDROOM 2 APT 06	8760	1120.00	12.79	FAIL	L06 : LIVING KITCHEN APT 06	4745	933.00	19.66	FAIL
L06 : DOUBLE BEDROOM 1 APT 06	8760	1019.00	11.63	FAIL					
L06 : DOUBLE BEDROOM 2 APT 05	8760	1032.00	11.78	FAIL	L06 : LIVING KITCHEN APT 05	4745	806.00	16.99	FAIL
L06 : DOUBLE BEDROOM 1 APT 05	8760	855.00	9.76	FAIL					
L06 : DOUBLE BEDROOM 2 APT 04	8760	1176.00	13.42	FAIL	L06 : LIVING KITCHEN APT 04	4745	911.00	19.20	FAIL
L06 : DOUBLE BEDROOM 1 APT 04	8760	862.00	9.84	FAIL					
L06 : DOUBLE BEDROOM 2 APT 03	8760	1692.00	19.32	FAIL	L06 : LIVING KITCHEN APT 03	4745	1435.00	30.24	FAIL
L06 : DOUBLE BEDROOM 1 APT 03	8760	1289.00	14.71	FAIL					
L06 : DOUBLE BEDROOM 1 APT 02	8760	1307.00	14.92	FAIL	L06 : LIVING KITCHEN APT 02	4745	1122.00	23.65	FAIL
L06 : DOUBLE BEDROOM 1 APT 01	8760	1200.00	13.70	FAIL	L06 : LIVING KITCHEN APT 01	4745	1145.00	24.13	FAIL

Room Name	Annual Occupied Hours	No. of Hours over 26°C p.a	% of hours over 26°C p.a	CIBSE criteria met?	Room Name	Annual Occupied Hours	No. of Hours over 26°C p.a	% of hours over 26°C p.a	CIBSE criteria met?
NINTH FLOOR BEDROOM					NINTH FLOOR LIVING/KITCHEN				
L09 : DOUBLE BEDROOM 2 APT 04	8760	1439.00	16.43	FAIL	L09 : LIVING KITCHEN APT 04	4745	1216.00	25.63	FAIL
L09 : DOUBLE BEDROOM 1 APT 04	8760	1184.00	13.52	FAIL					
L09 : DOUBLE BEDROOM 1 APT 03	8760	1265.00	14.44	FAIL	L09 : LIVING KITCHEN APT 03	4745	1593.00	33.57	FAIL
L09 : DOUBLE BEDROOM 2 APT 03	8760	1671.00	21.36	FAIL					
L09 : SINGLE BEDROOM 3 APT 03	8760	2433.00	27.77	FAIL					
L09 : SINGLE BEDROOM 2 APT 02	8760	1370.00	15.64	FAIL	L09 : LIVING KITCHEN APT 02	4745	1295.00	27.29	FAIL
L09 : DOUBLE BEDROOM 1 APT 02	8760	1271.00	14.51	FAIL					
L09 : SINGLE BEDROOM 3 APT 01	8760	1559.00	17.80	FAIL	L09 : LIVING KITCHEN APT 01	4745	1270.00	26.77	FAIL
L09 : DOUBLE BEDROOM 2 APT 01	8760	1291.00	14.74	FAIL					
L09 : DOUBLE BEDROOM 1 APT 01	8760	1450.00	16.55	FAIL					

As detailed in the Daylighting consultants Report, 65% of the 124 rooms assessed at first to fourth floor satisfy BRE daylighting requirements. Therefore, with the above results indicating apartments failing the overheating criteria set out in CIBSE TM59, and the reduction of glazing level maximised whilst limiting the shortfall on internal daylighting levels it has been determined that in this instance, the units shall be provided with active cooling systems to achieve overheating compliance.

For purposes of BREEAM dwellings were also assessed against **Weather File: Swindon_Brize_Norton_DYS1_2050 (50th Percentile Range)** to assess the buildings performance in reaction to the affects of global warming. As with the 2020 year weather file, all spaces identified as high risk spaces failed to meet the criteria set out in CIBSE TM59.

Energy Statement

Overheating Study

An Overheating Study has been completed to mitigate the risk of overheating within the dwellings via passive measures. The implementation of passive measures to minimise solar gains to the spaces and provide passive ventilation are energy efficient methods to mitigate the risk of overheating with little to no reliability on additional energy consumption.

The Overheating Study investigated 5 worse case apartments from various levels of the building, from the apartments assessed in the initial overheating assessment. The progressive passive measure options investigated are as follows;

- Option 1 – Solid Panels
- Option 2 – Brise Soleil
- Option 3 – Solid Panels + Brise Soleil
- Option 4 – Acoustic Ventilation + Brise Soleil + Triple Glazed
- Option 5 – Acoustic Ventilation Panels + Triple Glazed + Mesh Screens



Acoustic Ventilation



Panels Solid Panels



Brise Soleil

The results of the Overheating Study can be found in Appendix D of this report.

Energy Statement

Considering the results of the Overheating Study, Option 5 has been incorporated and shall be progressed with into the next stage of design. The Residential development's overheating strategy shall incorporate the following:

- South facing Apartments directly adjacent to Friar Street between levels 1 and 5 shall incorporate Acoustic Ventilation Panels within the glazing fitting and a triple glazed window build-up.
- South facing Apartments directly adjacent to Friar Street on level 6 shall incorporate Acoustic Ventilation Panels within the glazing fitting and a triple glazed window build-up and Mesh screens.
- South facing Apartments directly adjacent to Friar Street between levels 7 and 10 shall incorporate Mesh Screens, a triple glazed window build-up, and openable windows.

The Overheating Assessment results for Option 5 are shown below:

OPTION-5 WITH ACOUSTIC VENTILATION PANELS AND BRISE SOLEIL + TRIPLE GLAZING + MESH

LEVEL	APT	Room Name	Annual Occupied Hours	No. of Hours over 26°C p.a	% of hours over 26°C p.a	CIBSE criteria met?
LEVEL 02	APT 03	L02:APT03_1B2P_DOUBLE BEDROOM01	8760	59	0.67	PASS
		L02:APT03_1B2P_LIVING/KITCHEN	4745	63	1.33	PASS
	APT 04	L02:APT04_2B4P_DOUBLE BEDROOM01	8760	170	1.94	PASS
		L02:APT04_2B4P_DOUBLE BEDROOM02	8760	68	0.78	PASS
		L02:APT04_2B4P_LIVING/KITCHEN	4745	103	2.17	PASS

LEVEL	APT	Room Name	Annual Occupied Hours	No. of Hours over 26°C p.a	% of hours over 26°C p.a	CIBSE criteria met?
LEVEL 06	APT 02	L06:APT02_1B2P_DOUBLE BEDROOM01	8760	298	3.40	FAIL
		L06:APT02_1B2P_LIVING/KITCHEN	4745	364	7.67	FAIL
	APT 03	L06:APT03_2B4P_DOUBLE BEDROOM01	8760	398	4.54	FAIL
		L06:APT03_2B4P_DOUBLE BEDROOM02	8760	124	1.42	PASS
		L06:APT03_2B4P_LIVING/KITCHEN	4745	217	4.57	FAIL

Criteria For Spaces Predominantly 'Naturally Ventilated'									
LEVEL	APT	Room Name	Criteria 1	Criteria 2		TM59 Criteria met ?	Room Name	Criteria 1	TM59 Criteria met ?
LEVEL 09				No. of Hours	% of Hours				
		BEDROOM (DOUBLE OCCUPANCY)					LIVING ROOM AND KITCHEN		
	APT 03	L09 : DOUBLE BEDROOM 1 APT 03	0.4	7.00	0.21	PASS	L09:APT03_3B5P_LIVING/KITCHEN	0.7	PASS
		L09 : DOUBLE BEDROOM 2 APT 03	0.5	1.00	0.03	PASS			
		L09 : SINGLE BEDROOM 3 APT 03	0.9	1.00	0.03	PASS			

The implementation of this overheating strategy shall result in the vast majority of dwellings passing the overheating criteria set out in CIBSE TM59 guidance. Further enhancement of the passive measures would be detrimental to the daylighting levels which already do not meet BRE guidance.

Tempered air to high-risk apartments

Those dwellings that do not pass shall be fitted with cooling modules on the MVHR units within the utility cupboards. The cooling modules can provide the dwelling with tempered air when the external air temperature is insufficient to mitigate the risk of overheating. CPW ran an additional simulation to show the improvement in performance of each space. An air supply temperature of 16C was simulated within the thermal model as detailed in manufacturer literature for the cooling modules. In these high risk apartments an increase design flow rate was also implemented into the Living/Kitchen areas, an increase from Part F requirements to a set 20L/s.

Energy Statement



Where
buildings
come alive

FRIAR STREET OPTION 06 WITH SOLID PANELS WITH 41% OPENING (ADDED ON WEST FAÇADE TOO) WITH COOLING MODULE CIBSE TM59 Overheating Assessment

Weather File: Swindon_Brize_Norton_DSY1_2020High50_.epw

Homes that are predominantly mechanically ventilated because they have either no opportunity or extremely limited opportunities for opening windows/louvers should be assessed for overheating using the fixed temperature method based on CIBSE Guide A (2015a).

Criteria for homes 'predominantly mechanically ventilated'

For homes with restricted window openings, the CIBSE fixed temperature test must be followed, i.e. all occupied rooms should not exceed an operative temperature of 26°C for more than 3% of annual occupied annual hours.

Criteria For Spaces Predominantly 'Mechanically Ventilated'

LEVEL	APT	Room Name	Annual Occupied Hours	No. of Hours over 26°C p.a	% of hours over 26°C p.a	CIBSE criteria met?
LEVEL 02	APT 03	L02:APT03_1B2P_DOUBLE BEDROOM01	8760	11	0.13	PASS
		L02:APT03_1B2P_LIVING/KITCHEN	4745	12	0.25	PASS
	APT 04	L02:APT04_2B4P_DOUBLE BEDROOM01	8760	65	0.74	PASS
		L02:APT04_2B4P_DOUBLE BEDROOM02	8760	28	0.32	PASS
		L02:APT04_2B4P_LIVING/KITCHEN	4745	76	1.60	PASS
LEVEL	APT	Room Name	Annual Occupied Hours	No. of Hours over 26°C p.a	% of hours over 26°C p.a	CIBSE criteria met?
LEVEL 06	APT 02	L06:APT02_1B2P_DOUBLE BEDROOM01	8760	37	0.42	PASS
		L06:APT02_1B2P_LIVING/KITCHEN	4745	63	1.33	PASS
	APT 03	L06:APT03_2B4P_DOUBLE BEDROOM01	8760	190	2.17	PASS
		L06:APT03_2B4P_DOUBLE BEDROOM02	8760	88	1.00	PASS
		L06:APT03_2B4P_LIVING/KITCHEN	4745	142	2.99	PASS

As shown in the tables above the highest risk apartments on Level 06, that are unable to utilise openable windows to mitigate overheating, show further improvement upon the passive measure implemented in Option 5. All 3 bedrooms and 2 Living/Kitchen spaces simulated pass the criteria set out within TM59 for predominantly mechanically ventilated spaces.

Energy Statement

8.0 Carbon Emission Analysis Results

CPW LLP has undertaken an initial Part L compliance assessment of the proposed Friar Street development. This is to demonstrate through the use of accredited thermal modelling software, how the scheme will incorporate energy efficiency measures and Low and Zero Carbon (LZC) technology solutions to reduce the predicted regulated CO₂ emissions of the development in accordance with Reading Borough Council energy planning conditions.

Residential

Initial SAP calculations have been made to demonstrate how the scheme will incorporate energy efficiency measures and Low and Zero Carbon (LZC) technology solutions to reduce the predicted regulated CO₂ emissions of the development by at least 35% (CO₂ reduction on 2013 building regulations) for new build residential developments. The calculations have been performed with SAP2012 methodology in accordance with The Sustainable Design and Construction SPD adopted 2019.

SAP 2012 methodology:

	Total Regulated Emissions (Tonnes CO₂/year)	CO₂ Savings (Tonnes CO₂/year)	Percentage Savings (%)
Target Emission Rating	169.4	-	-
Dwelling Emission Rate	93.7	75.7	45
	Total Fabric Energy Efficiency (kWh/m²)	Energy Savings (kWh/m²)	Percentage Savings (%)
Target Fabric Energy Efficiency	48.1	-	-
Dwelling Fabric Energy Efficiency	40.0	8.1	17

These results demonstrate compliance with the planning requirement of achieving 35% betterment on Part L 2013 for residential developments. The Dwelling Emission Rate has been calculated at a 45% improvement upon the Target Emission Rate from the notional building as per Part L of the Building Regulations.

SAP2012 methodology is very dated with updated SAP10 methodology more commonly used and more inline with the updated Part L Building Regulations to be updated in June 2022. When assessed against SAP10 methodology the proposed development has the following calculated CO₂ emission savings:

Energy Statement

SAP10 methodology:

	Regulated domestic carbon dioxide savings	
	(Tonnes CO ₂ per annum)	(%)
Be lean: Savings from energy demand reduction	19.4	18%
Be clean: Savings from heat network	0.0	0%
Be green: Savings from renewable energy	42.5	41%
Cumulative on site savings	61.9	59%
Annual savings from off-set payment	37.4	-

The use of SAP10 methodology clearly shows the benefit of opting for an electrically driven heat generation plant such as Air Source Heat Pumps due to the more accurate Carbon Factors associated with the guidance.

We have shown the SAP10 methodology broken down into Be Lean, Be Clean and Be Green iterations as common with projects referable to the London Plan to indicate how the passive design measures of the building (Be Lean stage) are efficient in providing Carbon saving for the development against Part L of the Building Regulations at 18% savings.

SAP10 methodology calculates the Dwelling Emission Rate achieves a total 59% improvement upon the Target Emission Rate from the notional building as per Part L of the Building Regulations. Significantly above the 35% requirement set out by the Reading Borough Council Planning requirements.

Energy Statement

CPW have also conducted initial BRUKL analysis to show the carbon efficiency performance of the commercial spaces in their assumed operation. The BRUKLs show that the commercial spaces had the following improvements on Part L regulations, detailed in the table below. From this we have also calculated the sitewide cumulative savings on Part L Building Regulations 2013.

The building emission rate is compared to a Target Emission rate below to demonstrate the savings achieved.

	Regulated carbon dioxide savings			
	Target Emission Rate	Building Emission Rate	Reduction (Tonnes CO ₂ per annum)	(%) improvement
Non-Domestic Buildings	38.8	34.7	4.1	11%
Domestic Buildings	169.4	93.7	75.7	45%
Total Cumulative Savings		128.4	79.8	38.4%

Note 1. CO₂ emission factors of 0.216 for Gas and 0.519 for Electricity have been used to calculate the above and are taken from Building
These results demonstrate compliance with the planning requirement of achieving 35% betterment on Part L 2013 for residential developments. This narrow margin of compliance is due to outdated electricity carbon efficiency factors embedded within SAP2012 methodology.

It is CPWs recommendation that Reading Borough Council Planning Committee assess the proposed development based on updated SAP10 methodology, more commonly used and more inline with the updated Part L Building Regulations updated in June 2022. This ensures a more accurate carbon efficiency performance of the proposed development is reflected and the greater calculated carbon reductions can be fully acknowledged.

Energy Statement

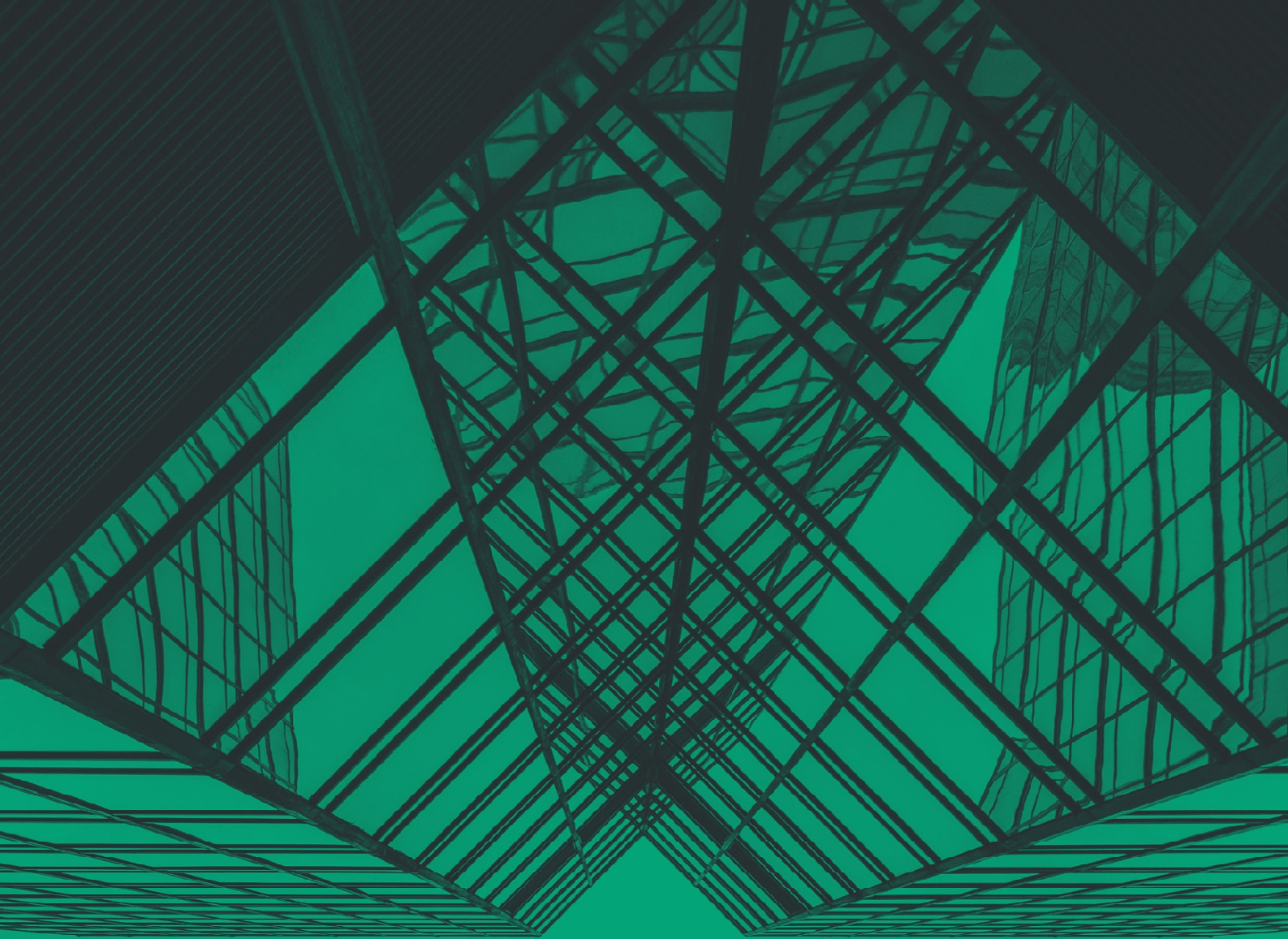
9.0 Appendices

9.1 Appendix A - BRUKL Documents

9.2 Appendix B – Sample SAP data sheets

9.3 Appendix C – BREEAM Pre-Assessment Tracker

9.4 Appendix D – Overheating Study



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