ATKINS

Member of the SNC-Lavalin Group

Thames Young Mariners

Energy Statement

October 2022

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Contents

Tables

Figures

Executive Summary

This report summarises the results of the energy analysis for the RIBA Stage 3 design for the Thames Young Mariners Development, located in Richmond, United Kingdom. Thames Young Mariners is an outdoor learning and development centre, which consists of a Main building, three residential blocks and a camping changing block, designed for a total occupancy of 240 people. The dynamic simulation model (DSM) of the development was analysed using IES VE 2022 simulation tool to arrive at the carbon savings by adopting the “Be Lean, Be Clean and Be Green” approach. The results of the analysis is summarised in the table below.

	Total regulated emissions (tCO_2)	CO_2 savings (tCO_2)	Percentage savings (%)
Part L 2013 baseline	23.3		
Be lean	15.0	8.3	36
Be clean	15.0	0	0
Be green	-6.2	21.3	91
Total Cumulative Savings		29.5	127

1. Introduction

1.1. Background

This Energy Statement has been prepared by Atkins and details the energy strategy for the proposed development at the Thames Young Mariners.

To support the planning application, this document identifies and describes the energy efficiency design and low carbon/renewable technology options that have been identified, and the preferred options for achieving a reduction in carbon emissions to satisfy policy.

In order to achieve the energy and sustainability objectives defined by national, regional and local policies, an assessment has been carried out to identify the most appropriate and viable strategies and technologies to achieve the carbon and renewable reductions. The energy options presented in this report have been considered at a strategic level.

1.2. Description of Development

Atkins Limited was commissioned by Surrey County Council (SCC) to complete a Stage 3 report to support the development of Thames Young Mariners. An extract of the proposed Architectural Site Plan is included below in Figure 1-1.

The proposed development consists of a Main building development, three Guest Residential blocks and Camping changing block.

1.2.1. Main Building

Lower Ground Plan The lower ground floor maintains the relationship to the water's edge via the slipway of the existing development, comprising changing and drying facilities for water-based activities. Changing facilities are designed to provide flexibility and diversity in use by a variety of user groups, integrating accessible facilities for independent or inclusive use. Existing storage located adjacent to the building is to be transferred to the proposed floating pontoons indicated on the plan. These combine access to the water with storage with boats and equipment to support the multiple water-based activities

First Floor Plan These proposals show the relocated staff residential accommodation at first floor level. The scale of provision has been reviewed with SOLD to optimise the amount of accommodation and include overnight surveillance of the site, which is an important security measure necessary due to the equipment stored within the site. Access to this accommodation is distinct from the general use at upper ground floor level. To achieve the energy efficiency targets for this scheme, a plantroom is included at this level for the primary energy generation plant that serves this building and the adjacent Guest Residential Blocks. Air source heat pumps (ASHPs) will be located here, with heat rejection equipment positioned externally on the flat roof above the kitchen and changing areas

1.2.2. Guest Residential Blocks

The three Guest Residential Blocks are additional to the existing development and represent an important part of the long-term viability. These will enable school groups to extend their stay on the site to multiple days and fully experience what is on offer. A standard design for each block is proposed to enable application of offsite modular construction. The layout is organised around a central corridor with four bed dormitories

sharing ensuite shower facilities. Additional guardian bedrooms are necessary for appropriate safeguarding of each group of children. The number of bedrooms is based on school group size. As for the changing facilities, our approach has been to integrate accessible sleeping provision alongside standard bedrooms so that groups can be fully inclusive. A small flexible room is included in each building for the school group to socialize and gather before and after activities.

1.2.3. Camping Changing Block

The proposed camping changing block is a new provision on site and will serve as a dedicated facility to camping guests throughout their stay at TYM. This accommodation is located adjacent to the camping area, providing improved access and provision and improving the overall operation of the site by providing discrete accommodation for different user groups.

The proposed site layout is shown in Figure 1-1 below.

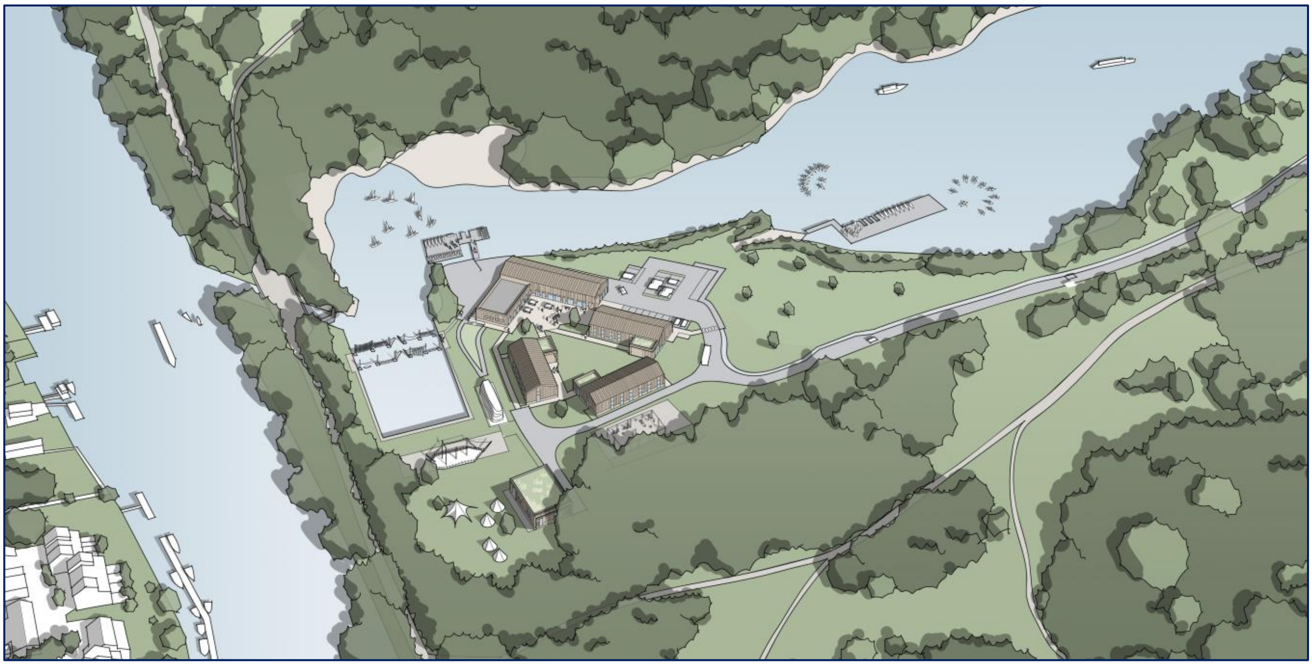

Figure 1-1 –Site Plan

2. Policy Requirements

2.1.1. National Planning Policy Framework

The National Planning Policy Framework (NPPF) document sets out the Government's planning policies for England and was updated July 2021.

The NPPF is designed to consolidate all policy statements, circulars and guidance documents into a singular document, called the National Planning Policy Framework. The framework's primary objective is the delivery of sustainable development, therefore focussing on the 3 pillars of sustainability. The framework is split into three sections; planning for prosperity (Economic), planning for people (Social) and planning for places (Environmental), each of which outlines guidance to tackle issues such as housing, transport infrastructure, climate change, business and economic development, etc.

In regard to climate change, the NPPF supports a reduction in greenhouse gas emissions and the delivery of renewable and low carbon energy. Climate change is covered in Section 14 '*Meeting the challenge of climate change, flooding and coastal change'*. To support the move to a low carbon future, local planning authorities should:

- plan for new developments in locations and ways which reduce greenhouse gas emissions.
- actively support energy efficiency improvements to existing buildings; and
- adopting nationally described standards when setting any local requirement for a building's sustainability.

In determining planning applications, local planning authority should expect a new development to:

- comply with adopted Local Plan policies on local requirements for decentralised energy supply, unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable; and
- take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption.

2.1.2. Surrey County Council

Introduction

SCC's Climate Change Strategy has been developed to face the impacts of climate change on a daily basis and to provide a joint framework for collaborative action on climate change across Surrey's local authorities and other partners. The strategic priorities relevant to energy strategies are listed below.

Organisation emissions

- Achieve net zero carbon local authorities that lead by example in promoting sustainable practices across their operations, estate, and vehicles.
- Strategic Priority 1 (SP1): Use net zero carbon energy across our council-owned buildings, and in the longer term, look to transition to net-zero carbon buildings, as defined by the UK Green Building Council (UKGBC) framework.

- Strategic Priority 2 (SP2): All council-owned vehicles, including SCC-owned bus fleet, to be zero carbon by 2030 or sooner.
- Strategic Priority 3 (SP3): Use our influence across our supply chain through procurement practices to drive significant carbon emission reductions in the operations of our staff, suppliers and partners.

Energy generation

To support the national decarbonisation ambition by leading renewable energy generation expansion and bringing low carbon heating into Surrey homes through smart, decentralised systems.

- Strategic Priority 1 (SP1): Expand renewable energy generation capacity across the county with a focus on solar PV installations as the greatest carbon reduction potential.
- Strategic Priority 2 (SP2): Develop localised smart energy systems that focus on providing low carbon energy to local businesses and residents, whilst reducing costs.

Buildings and infrastructure

To drive forward the transition to a zero-carbon built environment, through the pursuit of lower operational energy use, increased supply of renewable energy to Surrey's buildings and reduced embodied carbon – the GHG emissions associated with non-operational phases, e.g., construction.

- Strategic Priority 1 (SP1): Significantly improve the energy efficiency standards and practices of commercial buildings in Surrey to reduce energy consumption whilst reducing the cost for businesses.
- Strategic Priority 2 (SP2): Review and update planning policy to produce infrastructure that is better integrated, enabling the delivery of wider ambitions on local renewable energy generation and vehicle electrification.
- Strategic Priority 3 (SP3): Work with stakeholders to develop a systems-based approach to development and infrastructure that considers the whole-life cycle of construction, including water consumption, and promotes the integration of green infrastructure for climate change adaptation.

2.1.3. London Borough of Richmond Upon Thames Council

The Woking Borough Council Core strategy includes the following planning policies related to energy.

CS22: Sustainable construction

All new development should consider the integration of Combined Heat and Power (CHP) or other forms of low carbon district heating in the development. All new development in proximity of an existing or proposed CHP station or district heating network will be required to be connected to it unless it can be demonstrated that a better alternative for reducing carbon emissions from the development can be achieved.

CS23: Renewable and low carbon energy generation

Applicants should take appropriate steps to mitigate any adverse impacts of proposed development through careful consideration of location, scale, design and other measures. All reasonable steps to minimise noise impacts should be taken. Applicants should provide sound evidence of the availability of the resource which will be harnessed or the fuel to be used, including details of the adequacy of transport networks where applicable and detailed studies to assess potential adverse impacts such as noise nuisance, flood risk, shadow flicker and interference with telecommunications.

2.1.4. London Plan (2021)

The London Plan is a Spatial Development Strategy (SDS) published by the Mayor of London under the legislation of the Greater London Authority (GLA). It includes a range of policies that relate to sustainable design and construction. In developing the SDS, in accordance with the legislation and associated regulations, the Mayor has had regard to:

- The principle that there should be equality of opportunity for all people
- Reducing health inequality and promoting Londoners' health
- Achieving sustainable development in the United Kingdom
- Climate change and the consequences of climate change
- The desirability of promoting and encouraging the use of the Thames, particularly for passenger and freight transportation
- The resources available to implement the Mayor's strategies

Developments within Richmond are subject to the policy requirements of the London Plan 2021. The following policies of the London Plan (2021) have informed this strategy.

Policy SI2 Minimising greenhouse gas emissions
Policy SI3 Energy Infrastructure

2.1.5. Current Part L Building Regulations

Part L2A 2021

Approved Document Part L2A 21 incorporates several changes and additions compared to. Part L2A 2013 requires new non-domestic buildings to reduce their carbon emissions by a further 27% across the build mix, compared to Part L2A 2013.

Part L2A 2013 was based on comparing the actual building against a notional building. This approach remains the same for Part L2A 2021, however the notional building has been modified to have more energy efficient building fabric and reduced air permeability. Similar to Part L 2013, the notional building standards will change depending on the type of non-domestic building use.

There are also various changes on minimum standards for HVAC systems outlined in the second-tier document, *Non-domestic Services Compliance Guide 2013* Edition compared with previous Edition.

2.1.6. Disclaimer

Computer building simulation, including simulation undertaken to demonstrate compliance with energy regulation, provides an estimate of building performance. This estimate is based on a necessarily simplified and idealised version of the buildings that does not and cannot fully represent all the intricacies of the building once built. As a result, simulation results only represent an interpretation of the potential performance of the building. No guarantee or warrantee of building performance in practice can be based on simulation results alone.

3. Energy Strategy Approach

3.1.1. Methodology

The proposed energy strategy for the development will follow the London Plan 2021 Energy Hierarchy approach of Be Lean, Be Clean and Be Green to enable the maximum viable reductions in regulated and total CO_2 emissions over the baseline.

- be lean: use less energy and manage demand during operation through fabric and servicing improvements and the incorporation of flexibility measures
- be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly by connecting to district heating networks
- be green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site

The energy hierarchy is presented shown in Figure 3-1.

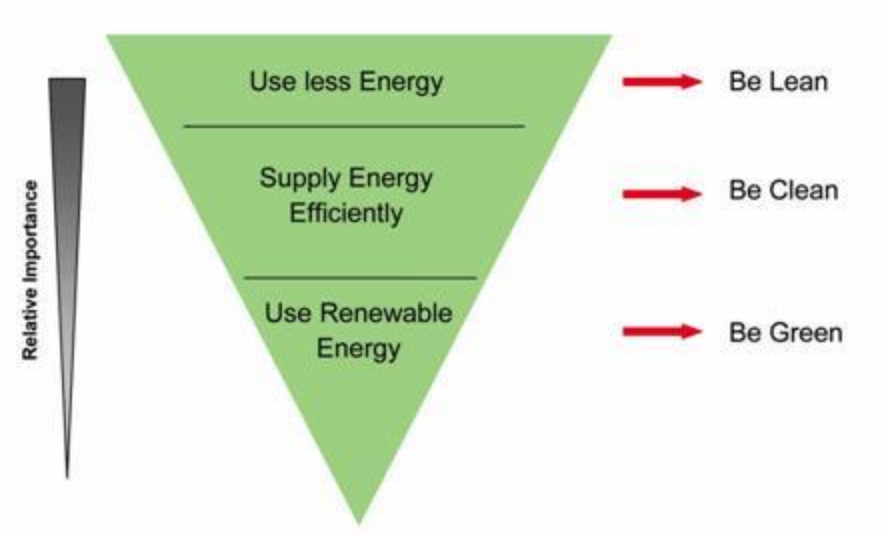

Figure 3-1 - Energy hierarchy

The proposed energy supply solutions aim to match energy profiles of the development ensuring effective use. The proposed solutions also take into consideration viability and flexibility of the scheme from a technical and economic point of view by identifying an optimal combination of energy efficiency measures as well as decentralised and renewable energy supply solutions. Applying these principles, the aim is to achieve the following objectives:

- Comply with the relevant regulatory requirements.
- Improve viability of the scheme by developing a technically robust and viable energy strategy.
- Improve feasibility, operation and management of the energy systems by promoting holistic design methods and solutions.

3.1.2. Carbon Factors

The energy and carbon assessments are carried out based on the current Part L 2021 building regulations using (SAP 10.2) carbon factors. The SAP10.2 carbon emission factors listed below:

- Natural gas: 0.210 kgCO2/kWh
- Grid electricity: 0.136 kgCO2/kWh

4. Establishing Baseline CO_2 Emissions

This section discusses the establishment of the Baseline CO_2 emissions against which the reduction in CO_2 emissions is assessed. The Baseline CO_2 emissions are defined by the Target Emissions Rate (TER) given by the notional building associated with the proposed building if:

- Heating is provided by gas boilers.
- Any active cooling is provided by electrically powered equipment.

4.1.1. Non-residential Baseline CO2 Emissions

An energy analysis model for the common rooms of the proposed developed to calculate CO_2 emission rates using the Part L 2021 of the building regulation methodology based on the National Calculation Methodology.

The 3D IES model snapshot for the model is provided below.

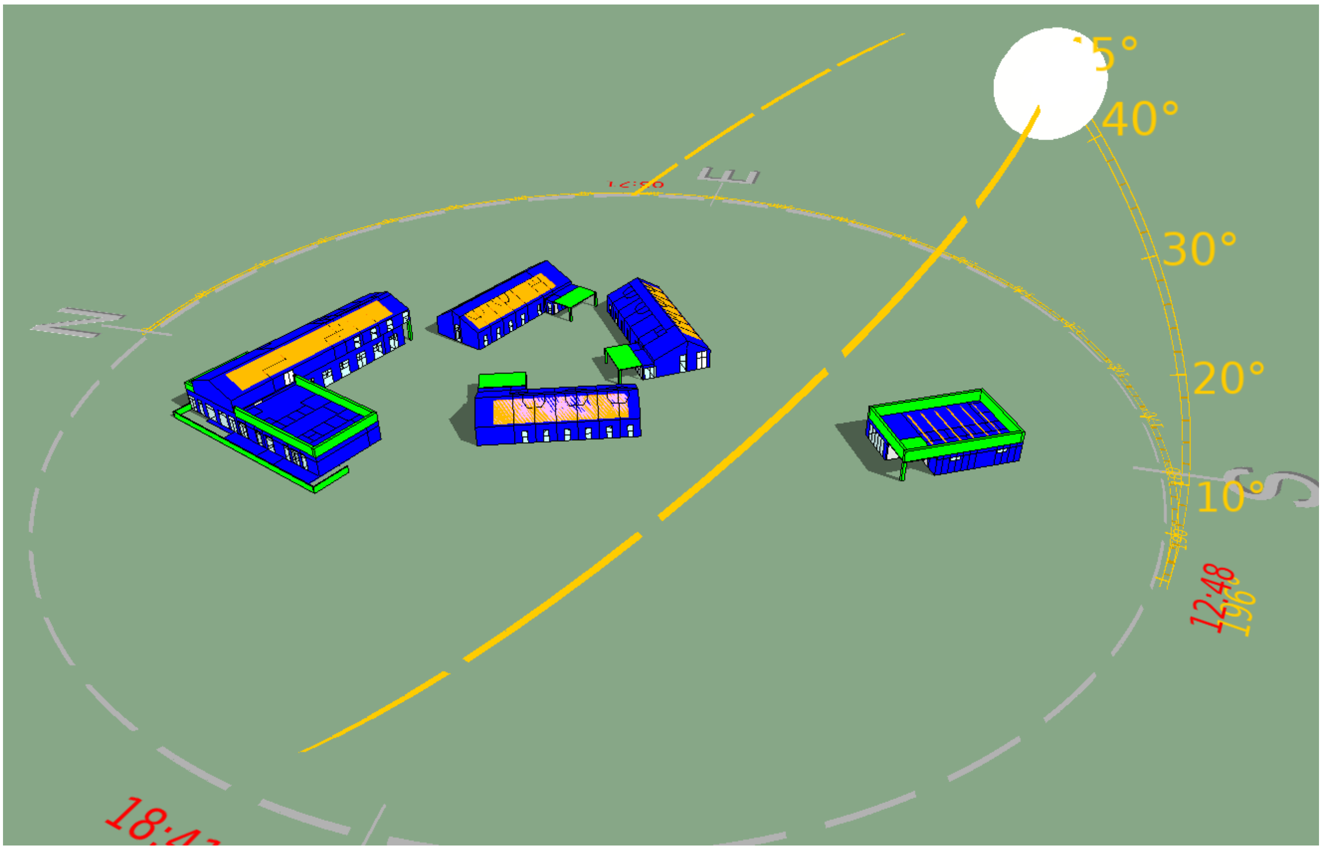

Figure 4-1 – IES 3D model – TYM Model

4.1.2. Unregulated CO2 Emissions

Non-building regulation emissions consists of emissions associated with energy consumption for elements that are not regulated, such as plug loads for equipment, laptop, screens, external lighting, lifts, etc.

The emissions associated with non-Building Regulation elements are calculated from the Equipment section of the Be Lean BRUKL. This can be found in the Appendix A.

The regulated, unregulated and total baseline CO_2 emissions for the commercial units are summarised in Table 4-3.

Table 4-3 – Non-residential Part L 2021 baseline CO_2 emissions

	CO_2 emissions (tCO_2/year)		
	Regulated	**Unregulated**	**Total**
Non-residential Part L 2021 Baseline	23.3	12.43	35.73

The TER results from the BRUKL report have been converted using the new SAP10.2 carbon emission factors to predict the non-residential regulated and unregulated CO_2 emissions baseline.

The TER results in the BRUKL report is provided in Appendix A.

5. Be Lean - Demand Reduction and Energy Efficiency

5.1.1. Passive Design

The proposed design incorporates optimal thermal characteristics of buildings to achieve and maintain good environmental conditions with minimum resources of material and fuel. The passive design aims to maximise use of natural heating, cooling and ventilation to create comfortable spaces inside the buildings.

An optimal site layout and buildings with efficient apartment layouts are shown through the design.

It is proposed to incorporate passive solar design measures across the development. The proposed glazed areas have been designed to maximise daylight and optimise solar gains. The final glazing specification will be selected to provide a balance of solar control and access to passive solar gain.

Openable windows are available to provide fresh air. In the community spaces, where the risk of overheating has been identified, cooling has been provided using VRV system.

5.1.2. Building Fabric

In order to achieve the Part L 2021 TER, good building fabric standards will be used. The minimum requirements for Part L2A 2021 and the proposed specification for individual building elements are presented in Table 5-1.

Table 5-1 - Proposed fabric specification

Element	**U-values (W/m^{2}K)**	
	Part L1A 2021 minimum fabric requirements	**Proposed specification for the development**
External walls	0.26	0.13
Roof	0.18	0.10
Ground floor	0.18	0.08
Windows [1]	1.60	1.0
External Doors	1.60	1.00
Airtightness	8 (m3/(hm2) at 50 Pa)	1 (m3/(hm2) at 50 Pa)

[1] Solar control glass with a g-value proposed to be 0.4. Glazing performance will need to be reviewed alongside acoustic performance as the design is developed.

The proposed specification should be viewed as guidance. Implementing these (or similar) building fabric standards will help to deliver substantial reductions in CO_2 emissions compared with the current building performance and regulations.

5.1.3. Thermal Bridging

Cold bridging will be minimised to prevent the loss of heat and to prevent the development of cold spots which can lead to mould. Suitable construction details will be developed to ensure insulation continuity and to meet the air tightness targets detailed below.

This assessment is based on accredited details for thermal bridges, where accredited details are available, enhanced detail for lintels, and default values for other thermal bridging. A dedicated façade engineer is engaged with a view of minimising and detailing the reduction of thermal bridging as the design develops.

5.1.4. Energy Efficient Systems

The overarching principle for the selection of the building fabric standards and energy efficient systems is to achieve compliance with Part L2A 2021 requirements through energy demand reduction measures alone.

5.1.5. Ventilation

Air tightness standards will significantly exceed Approved Document Part L minimum requirements. An improvement of the design air permeability rate together with the need to achieve the internal noise standards will require provision of mechanical ventilation. At this stage, it is proposed to provide Mechanical Ventilation with Heat Recovery (MVHR) to meet the fresh air supply requirement (unit dependant).

It is recommended to select MVHRs with low Specific Fan Powers (SFP). This can be achieved by using systems with high efficiency fan motors, radius bends and turning vanes in ductwork. MVHR systems should have a high heat recovery efficiency, summer bypass functionality and an automatic control which may take the form of sensors to modulate their performance.

Table 5-2 - Ventilation System Performance

Item	Value
Central AHU (W/l/s) - Main Block	1.8 (80% Heat Recovery)
Central AHU (W/l/s) - Changing Block	1.33 (80% Heat Recovery)
Toilet – Extract system Specific fan power (W/l/s)	0.4

5.1.6. Lighting

The fenestration levels aim to balance the need for maximising daylight and minimise the risk of excessive solar gains and limiting the need for artificial lighting during daylight hours. The electricity consumption associated with lighting will be further reduced by using Light Emitting Diodes (LEDs) within the building. Sensors will be used in communal areas to limit unnecessary use of lighting with no occupancy.

The spaces in the model are assigned a luminare efficacy of 110 lm/W. The control strategy is detailed in the table below.

Table 5-3 - Lighting Control Strategy

Space	Control Strategy
All Spaces	Auto-ON-OFF

5.1.7. Heating and Domestic Hot Water System

The project heating and domestic hot water requirements are met using a system comprising of an air source heat pump with water-source heat pump. This system is replaced with gas boiler system matching Part L notional values for boiler efficiency and controls for the Be Lean assessment. The contribution of the air source heat pumps is taken into account in the Be Green stage of the energy hierarchy.

5.1.8. Cooling

Cooling will be provided for amenity spaces and spaces with high thermal loads, which include the following:

- 005 General Office
- 010 Flexible Meeting
- 012 Office
- 016 Staff Room
- 017c Server Room
- 018 Main Hall
- RB1 002 Social & Learning
- RB2 002 Social & Learning
- RB3 002 Social & Learning

The VRF cooling system will be sized to meet the cooling demand and use the following characteristics:

Table 5-4 - Cooling System Efficiency

	Limiting Values	Proposed
VRF Unit	2.6	6.0

5.1.9. Demand Reduction (Be Lean) Summary and Outcome

The following table compares the Baseline and Be Lean energy consumption by end use reported in the BRUKL report.

The Be Lean non-domestic scenario achieves a reduction of 30% of regulated measured using SAP10.2 emissions factors. This reduction is primarily driven by reduction in heating, lighting, and hot water.

Table 5-5 – Non-Domestic: Baseline and Be Lean Comparison of Energy Consumption by End Use

	Be Lean	Baseline	
Heating (kWh/m^2)	21.49	40.03	
Cooling (kWh/m^2)	1.44	0.4	
Auxiliary (kWh/m^2)	3.8	2.74	
Lighting (kWh/m^2)	6.13	7.84	
Hot Water (kWh/m^2)	9.78	10.73	Carbon Savings (Be Lean) (%)
Total regulated emission (SAP10.2, tCO_2)	**15.0**	**23.3**	**36**

6. Be Clean – District Heat Networks

6.1.1. Connection to Existing or planned District Heating Networks

Given the lack of existing nearby district heating infrastructure to connect to at present and cost-effective connection options soon, it is proposed to provide an on-site energy supply option.

7. Cooling and Overheating

7.1.1. Cooling Hierarchy

The following measures have been incorporated in the development in alignment with the cooling hierarchy:

7.1.2. Minimising internal heat generation through energy efficient design

Internal heat generation is minimised by a combination of measures including the following:

- Minimising thermal bridging;
- Minimising heat loss from heating and hot water systems;
- No separate primary domestic hot water pipework distribution;
- No boilers in apartments;
- Low temperature hot water distribution;
- Low energy lighting.

7.1.3. Reducing the amount of heat entering the building in summer

The heat entering the building is reduced by a combination of measures including the following:

- Low glazing g-value;
- Improved fabric thermal conductivity;
- External shading through inset balconies and reveal.

7.1.4. Use of thermal mass and high ceilings to manage the heat within the building

The floor-to-floor height have been maximised within the design constraints of the development.

7.1.5. Passive ventilation

Most spaces will utilise openable windows, with some restrictions, to allow for cooling during the summer months.

7.1.6. Mechanical ventilation

Spaces are provided with mechanical ventilation with heat recovery to allow for background ventilation to be provided effectively throughout the year and minimise heating demand.

7.1.7. Criterion 3 Solar Gains Check

The spaces were assessed against Criterion 3 of the Part L2A of the building regulations. All spaces meet criteria 3.

7.1.8. Dynamic Overheating Analysis

A dynamic overheating simulation has been undertaken to further interrogate the cooling strategy and mitigate the risk of overheating.

The results are summarised in the table below.

Table 7-1 – TM52 Overheating Results

Pass	Fail
38	11

All dormitory spaces pass and those that fail are either single aspect or have limited opportunity of openable facades. Spaces that fail have now been assigned cooling. Details of this study can be found in the accompanying document; PR200-ATK-XX-RP-V-Overheating Report-00000.

7.1.9. Active cooling system

The following spaces are provided with active cooling system:

- 005 General Office
- 010 Flexible Meeting
- 012 Office
- 016 Staff Room
- 017c Server Room
- 018 Main Hall
- 018 Classroom Social
- 019 Kitchen Servery
- 008 First Aid
- RB1 002 Social & Learning
- RB2 002 Social & Learning
- RB3 002 Social & Learning

The following table reports on the cooling demand required for cooling of the non-domestic spaces provided with active cooling. The increased cooling demand is associated with the large amount of glazing serving these spaces, which result in higher solar gains in the actual model compared to the notional model. In addition the Actual building is far more highly insulated. However the cooling demand is a small fraction of the overall energy consumption of the building.

Table 7-2 - Cooling demand reporting (non-domestic)

	Area weighted average non-domestic cooling demand (MJ/m^2)	Total area weighted non-domestic cooling demand (MJ/year)
Actual	96.2	37,518
Notional	33.7	13,143

8. Be Green - Low Carbon and Renewable Energy Supply

8.1.1. On-Site Heat Supply

The provision of an on-site communal heating system for the development has been considered. The assessment showed that, due to the small size and the relatively low density of the development (and surrounding areas), it is not well suited for a communal heating system. A small communal heating system would unnecessarily complicate the design and significantly increase the capital and operating cost of the heating system. It would increase energy bills for the occupant which goes against the target to reduce fuel poverty. For these reasons, provision of a communal heating system is considered to be impractical and will not be taken forward.

It is therefore proposed to consider a heat supply system that uses low carbon and renewable energy technologies. The following low carbon and renewable energy technologies have been assessed for their suitability for the development with a view to achieve maximum regulated carbon savings:

- Air source heat pumps (heat supply)
- Solar Thermal Systems (Domestic Hot Water Supply)
- Photovoltaic (PV) systems (electricity supply)

The proposed energy strategy measures suggest that contribution from low carbon and renewable energy technologies are not required for compliance with the regulatory requirements. It is suggested to consider implementation of low carbon and renewable energy technologies if the detailed design identifies a shortfall in CO_2 emissions required for regulatory compliance.

8.1.2. Ground Source Heat Pumps

The ground can be used as both a source of heating and a source for cooling. Ground source heating involves heat pumps, drawing heat from underground, whereas ground source cooling can either use heat pumps or make use of low temperature groundwater directly. Ground Source Heat Pumps (GSHP) are a relatively mature technology and utilise the energy in the ground through a refrigeration cycle. Where GSHP are used for both heating and cooling, depending on the season, this can be a very efficient solution. GSHP can be open loop or closed loop.

Closed loop GSHP system comprises a sealed system of buried pipes normally containing brine or water/antifreeze solution. The solution is circulated continuously around a closed system.

Open Loop GSHP system uses groundwater which is taken from an aquifer to supply heating or cooling. The water is then returned to the ground (sometimes via a borehole or sometimes via storm water drainage). Open loop systems require abstraction and discharge licences from the Environment Agency (EA).

There should be sufficient site area within the development to accommodate a sufficient number of boreholes to meet the heating demand with a closed-loop system. However, the ground conditions are currently unknown and may not be suitable to use an open-loop system.

In a closed loop system, there is a network of pipes containing a working fluid of water and glycol, which is pumped around the pipes, transferring heat from the low-grade heat source to the working fluid. The heat pumps transfer the low-grade heat to a higher temperature, and often to a second working fluid which is then pumped around the building.

The network of pipes can be located in the energy piles, trenches, lakes and rivers.

A GSHP system is often used in mixed use developments where there is an even energy split between commercial areas requiring cooling and residential areas requiring heating. Sites with substantial simultaneous heat and cooling demands provide the greatest energy and emission saving.

It may be possible to utilise ground source energy loops on a site of this size however, the cost of the loops alone are between £1,500 and £3,000 per kW. This excludes the costs of the heat pumps themselves.

Ground source heat pumps are not recommended for this development because there is not a simultaneous heating and cooling requirement and therefore little advantage in using this expensive technology.

Because of the aforementioned issues, GSHPs are not practical or cost effective and therefore, they are not recommended for this development.

8.1.3. Air Source Heat Pumps

Air Source Heat pumps (ASHP) can be used as both a source of heating and a source for cooling. ASHP employs the use of air as the heat source. If designed and installed correctly, they can provide moderate CO_2 savings.

The downside is that the air temperature, and therefore efficiency of the heat pump, is reduced in cold weather when the heat is most needed. This means that one either needs to oversize ASHPs to take into account degradation in performance or, alternatively, provide an auxiliary electric heater. Provision of an auxiliary heater reduces capital cost but adds to running costs and reduces carbon savings.

Outdoor air systems are widely implemented in the form of split systems, with indoor and outdoor units linked by refrigerant pipes running through the wall. Packaged air systems where outdoor air is ducted to an indoor package are also available.

The outdoor units should be located outside of the building (e.g., on the roofs) and consider potential noise impacts from the external units.

The proposed design of the development an accommodate suitable outdoor and indoor plantroom space which makes use of individual ASHPs feasible.

The individual ASHPs can provide low carbon heating and hot water and space heating. The carbon benefits of ASHPs will increase with the decarbonisation of the electrical grid. Therefore, it is expected that the ASHPs will provide much higher savings with SAP10.2 carbon factors in comparison with the current carbon factors.

It is considered that use of energy efficient use of individual ASHPs for the development is feasible and recommended for the development.

Table 8-1 - Cooling System Efficiency

	Heating COP
ASHP (Main)	3.74
VRV Heating	3.34

8.1.4. Solar Thermal systems

Solar water heating systems use the energy from the sun to heat water, most commonly for domestic hot water needs. Solar heating systems use a heat collector that is usually mounted on a roof in which a fluid is heated by the sun.

In the proposed development, solar heat collectors are provided on the roofs of individual buildings to cater to the hot water demand of the respective building. ASHP will act as a backup supply to meet the excess demand.

8.1.5. Photovoltaics (PV)

The renewable energy assessment shows that PV systems can be provided to generate renewable power. This technology works well with all the other proposed technologies and can supply additional CO_2 reductions for the development.

PV panels use solar radiation and convert it into usable electricity through the application of semiconductor technology. Solar panel outputs vary depending upon orientation, inclination, solar radiation levels, cloud cover and temperature.

PV panels can be ground mounted, roof mounted or building Integrated (incorporated into the facade of a building). Due to the space limitations and costs, ground mounted and building integrated systems are not being considered for the site, whereas roof mounted systems are considered viable.

PV systems should ideally face south with an incline of 30º, although orientations within 45º of south and other angles can still generate outputs if panels are not over shaded. Optimum design of the PV installation is required to ensure maximum electrical output per kWp installed. There are a number of design considerations to be made to ensure the best use of the system. The key design considerations for designing and installing PV systems are:

- Design of PV installation to optimise inclination and orientation;
- Ensure that PV panels are not overshadowed;
- Ensure correct installation of PV arrays for good ventilation
- Ensure that the electrical wiring from PV arrays to inverters is kept to a minimum to reduce electrical losses;
- Provide sufficient space around PV installations for safe access and maintenance of the modules and other equipment installed on the roof.

The electricity generating potential of PV panels is not dependent on development demand but on suitable available roof space for installation.

PV technology is considered to be suitable for the development.

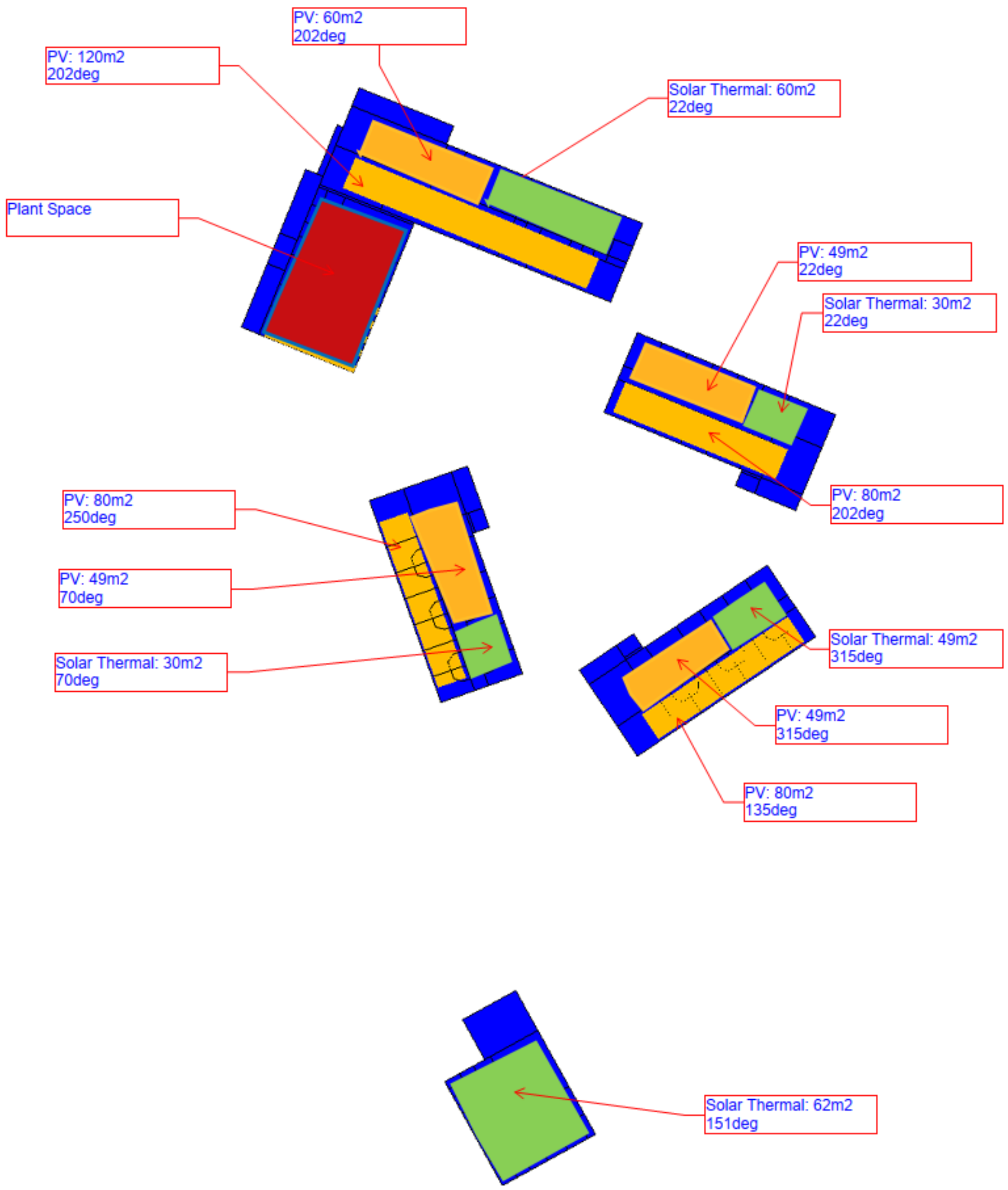

Figure 8-1 - Proposed Roof Mounted PV Area (in Orange)

Figure 8-1 highlights roof area that could be suitable for PV panels. The area highlighted in Figure 8-1 is approximately 567m^2 of PV for electricity generation which can generate 91,490 kWh/annum of energy, as well as an additional 214m^2 of PV earmarked for Solar Thermal.

When there is a sufficient electricity demand in the building, the electrical output of the PV system will be fully utilised on site with no export to the grid. If the electricity demand is lower than the electricity supplied by the PV unit, the surplus will be exported to the grid.

The electricity export contractual arrangements should be discussed and agreed during later stages of the project. Detailed electricity demand of the landlord areas will need to be carried out and confirmed during later stages of the project when more details about the M&E design of the development is available.

A management company will be responsible for operation and maintenance of the PV systems. The management company will carry out regular checks to ensure correct and efficient operation of the PV system.

8.1.6. Renewable Energy (Be Green) Summary and Outcome

Based on the proposed energy strategy, the total anticipated regulated CO_2 emissions have been calculated using the BER of the modelled the common rooms. The IES VE modelling results including the BER in the form of BRUKL report are provided in Appendix A.

The energy assessment shows that the proposed energy strategy which is based on LETI standards may result in circa 29.5 tCO_2 reduction of regulated CO_2 emissions per annum which equates to circa 127% reduction over the regulated Part L 2021 carbon baseline for the development.

Table 8-2 – Non-Domestic: Baseline and Be Lean Comparison of Energy Consumption by End Use

	Be Green	Be Clean	Be Lean	Baseline	
Heating (kWh/m^2)	6.44	21.49	21.49	39.56	
Cooling (kWh/m^2)	1.2	1.44	1.44	0.4	
Auxiliary (kWh/m^2)	3.97	3.8	3.8	2.74	
Lighting (kWh/m^2)	5.99	6.13	6.13	7.84	
Hot Water (kWh/m^2)	5.73	9.78	9.78	10.73	Carbon Savings (Be Green) (%)
Total regulated emission (SAP10, tCO_2)	**-6.2**	**15.0**	**15.0**	**23.2**	**127%**

The results above take into account the additional 235m^2 of PV that have been calculated to offset Unregulated carbon emissions to achieve Net Zero carbon emissions by 2050.

9. Carbon Offsetting

The following table reports on the site-wide carbon dioxide emission reduction calculated using SAP10.2 carbon emission factors and the GLA Carbon Emission Reporting Spreadsheet. The table reports a site-wide carbon emission saving offset amount of 29.5 tCO2.

Table 9-1 demonstrates that the carbon savings detailed in the previous sections more than meet the requirement to offset the emitted carbon. As such no carbon offset is required.

Table 9-1 - Site Wide Carbon Dioxide Emissions Reduction Performance

	Total regulated emissions (tCO_2/year)	CO_2 savings (tCO_2/year)	Percentage savings (%)
Part L 2013 baseline	23		
Be lean	15	8.3	36
Be clean	15	0	0
Be green	-6.2	21.3	91
Total Cumulative Savings		**29.5**	**127**

10. Be Seen – Monitoring

Energy monitoring can provide benefits to the end-user on a local level by providing insight to energy consumption and subsequent energy bills. On an aggregated level, monitoring can also benefit the developers by giving a better insight into building performance on a wide range of parameters.

Energy meters will be provided at the central plantroom. The following systems will be sub-metered for monitoring:

- Renewables for energy generation (if PV roof space is confirmed);
- Electric vehicle charging;
- Heating fuel (e.g. heat pump consumption).

A monitoring strategy will be devised in order to effectively collect information, and from correctly specified equipment. It is imperative that metering equipment can be easily accessible and identifiable to ensure monitoring and maintenance of these sensors/meters is unhindered. A dedicated data store will be specified so that information can be stored securely, and data can be easily retrieved. The design, commissioning and documentation for sub-metering will be suited to the size and use of the building. In addition to a building Log Book which will be prepared at handover, monitoring proforma sheets will also be provided to effectively monitor energy use.

Energy meters / smart meters will be provided to measure consumption, and the inclusion of data-loggers can be specified alongside smart meters to allow for data-sharing. Sensors may also be provided such that internal temperatures can be monitored. Monitoring by occupants is envisaged but has not yet been investigated.

11. Summary and Conclusions

The overarching objective of the proposed strategy is to use the LETI standards and achieve maximum realistic energy reduction and CO_2 savings using combination of energy demand reduction measures, energy efficiency and efficient energy supply technologies. The energy strategy measures are summarised and presented in Table 11-1.

Table 11-1 Summary of proposed energy strategy measures

Energy Hierarchy	Energy Strategy Measures
Energy Demand Reduction and Energy Supply	**Passive design** • Optimised design to enable controlled solar gain and improve direct and indirect natural lighting **Building Fabric** • Use of highly efficient building fabric standards based on LETI specification • Design with low air permeability rates based on LETI specification **Energy Efficiency** • Energy efficient lighting and appropriate controls
Low Carbon and Renewable Energy	**Low Carbon and Renewable Energy** • ASHPs for the development • Solar Thermal system for the development • PV provision of the development

The energy assessment shows that the proposed energy strategy may result in circa 29.5 tCO_2 reduction of regulated CO_2 emissions per annum which equates to circa 127% reduction over the regulated Part L 2021 carbon baseline for the entire development.

Table 11-2 – Total Part L 2021 CO_2 emissions

	CO_2 emissions (tCO_2/year)	
	Regulated	**Unregulated**
Total Part L 2021Baseline	23.3	12.4
Proposed energy strategy	-6.2	12.4

The Part L 2021 carbon assessment results have been converted using the new SAP 10.2 carbon emission factors to predict the total CO_2 emissions over the baseline. The regulated, unregulated and total emissions are summarised in Table 11-2.

In summary, the energy assessment shows the proposed energy strategy for the development:

- Complies with Part L 2021 Building Regulations
- Exceeds regulated operational Net Zero target against Part L 2021 and Part L (SAP10.2) baselines
- Exceeds regulated and unregulated operational Net Zero target against Part L 2021 and Part L (SAP10.2) baselines

Appendices

Appendix A. BRUKL

The Baseline and Lean BRUKL: 5210336-TYM-BE LEAN-121022-001_brukl

The Green BRUKL: 5210336-TYM-BE GREEN-121022-001_brukl

Both BRUKLs are provided alongside this document.

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