Energy Report_

Client: The Boathouse, Twickenham Ltd

Project Name: The Boathouse, Ranelagh Drive, Twickenham, TW1 1QZ

Revision	Date	Description	Prepared By	Checked By
N1	28-09-2022	Draft Issue for Planning	Walter De Intinis	Maria Papantoni
N2	29-09-2022	Issue for Planning	Walter De Intinis	Maria Papantoni
N3	14-04-2023	Revised to included updated plans	Andrew Chambi	Maria Papantoni
N4	16-06/2023	Revised to include updated scheme	Lee Pasifull	Maria Papantoni

Contents

Introduction

GDM Partnership Building Services Consultants Limited were requested by The Boathouse, Twickenham Ltd to undertake an Energy Statement to support the planning application to the London Borough of Richmond upon Thames (LBRuT) Council.

This report assesses how the proposed scheme and services meet the planning requirements of LBRuT and analyses the London Plan 2021 requirements appropriate for the proposed scheme. This Energy assessment has been carried out following the Greater London Authority (GLA) Guidance on Preparing Energy Assessments (June 2022). Accordingly, the SAP10.2 carbon factors are used for all calculations associated on this assessment.

The description of development is currently "demolition of existing building and outbuildings to provide three residential buildings including associated landscaping works, provision of parking and works to the public realm."

The Development is located within the Richmond Borough Council. The Boathouse site is located at the junction between Ranelagh Drive and the Thames footpath to the west of Richmond lock. The Boathouse is close to Richmond Train Station. The site address is The Boathouse, Ranelagh Drive, Twickenham, TW1 1QZ.

The National Planning Policy Framework (NPPF) was revised on 20 July 2021 and sets out the Government's planning policies for England and how these should be applied. Approved Document Part L 2021 of the Building Regulations of national building regulations took effect on 15 June 2022.

In March 2021, the Mayor released a new London Plan. In relation to energy and sustainability the Plan looks to further push the requirements on referable developments. The new London Plan 2021, and the GLA's Guidance on Preparing Energy Assessments (June 2022), is the benchmark for London planning regulation. A minimum on-site reduction of at least 35 per cent beyond Building Regulations is required for all residential development. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, in agreement with the borough, either through a cash in lieu contribution to the borough's carbon offset fund, or off-site provided that an alternative proposal is identified, and delivery is certain.

Specific consideration is given to the London Plan 2021 Policy SI 2: Minimising Greenhouse Gas Emissions that requires that all development to be net zero-carbon. This means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the 'Energy Hierarchy' as set forth by the GLA.

- Baseline: Part L 2021 of the Building Regulations compliant development.
- Energy Demand Reduction – Be Lean: The energy demand of the development is minimised through prioritisation of passive design.
- Heat Networks/ Combined Heat Power (CHP) – Be Clean: The use of a decentralised heating network utilising a combined heat and power to reduce emissions.
- Low & Zero Carbon Technologies – Be Green: On site renewable energy generation should be prioritised and where this is not possible, off-site renewable energy should be procured.
- Be Seen: Monitor, verify and report on energy performance of the development.
- Offsetting carbon: Any remaining carbon emissions balance is offset.

Executive Summary

This Energy Statement has been prepared by GDM Partnership on behalf of The Boathouse, Twickenham Ltd to provide a commentary on the sustainability and energy performance of the proposed development at the Boathouse.

The proposed energy efficiency measures for the development include highly efficient heating, cooling and ventilation systems, including the use of highly efficient building fabric, high performance solar controlled glazing and LED lighting.

Part L 2021 of national building regulations took effect on 15 June 2022. To calculate carbon emissions and reductions, the design was assessed under 'Part L 2021: Conservation of Fuel and Power' of the UK Building Regulations, using the National Calculation Methodology (NCM).

A detailed energy model was created using Government approved software Elmhurst Energy Systems LTD Design SAP 10. This program is tested by BRE for use in connection with building regulations and Energy Performance Certificates for new dwellings.

In accordance with the GLA's Energy Assessments Guidance on preparing energy assessments (June 2022), for the carbon emissions and reductions calculations the SAP 10.2 emission factors have been used to present the results. The energy strategy has been developed by following the GLA energy hierarchy:

- Baseline: This is the performance of the notional building.
- Be Lean: Energy demand will be reduced by achieving a well-insulated envelope which is both airtight and thermal bridge free. High performance glazing provides a positive energy balance whilst mechanical ventilation with heat recovery maintains good air quality with minimal heat loss. Energy efficient building systems such as LED lighting and low-power fans and pumps will further drive down regulated energy use. Robust quality control, commissioning and handover procedures on site will further drive down energy use.
- Be Clean: Combined heat & power was considered however this has been discounted due to poor base load and desire to avoid on-site combustion of fossil fuels. Connection to the district heating scheme was also considered however there are no existing or proposed district heating networks (DEN) within 500m of the site, therefore connection to an existing network is not feasible.
- Be Green: The remaining energy demand will be met through low and zero carbon energy sources. The development's heating, cooling and hot water needs will be provided through efficient air-source heat pumps, which whilst not supporting a future District Energy Network (DEN), reduces carbon emissions from the development from day one. In 15-20 years, when the heating system is due for replacement it would be appropriate to re-evaluate and install an alternative system if there is a DEN available to connect to.
- Be Seen: The energy performance of the development will be monitored, verified and reported in line with the 'be seen' policy and relevant guidance document.
- Any remaining carbon balance will be offset.

The following tables indicate the results of the Boathouse energy assessment, firstly based on the Full SAP Calculations document outputs, and then secondly with the adjusted figures based on SAP 10.2 – where the Grid electricity fuel carbon factor is 0.136 (kgCO2/kWh).

Carbon Reduction

The results indicate that the proposed development is achieving a 68% improvement over the Building Regulations Part L 2021 Target Emission Rate (TER). Therefore, the development achieves the 35% target complying with Policy SI 2 of the new London Plan and the 35% target complying with the London Borough of Richmond upon Thames (LBRuT) Council requirements.

Table 1 Carbon Dioxide Emissions after each stage of the Energy Hierarchy for the development

Part L 2021 Building Regulations	Carbon Dioxide Emissions for domestic buildings (Tonnes CO2 per annum)	
	Regulated	Non Regulated
Baseline: Part L 2021 of the Building Regulations Compliant	9.5	8.0
After energy demand reduction	8.4	8.0
After heat network / CHP	8.4	8.0
After renewable energy	3.0	8.0

Table 2 Regulated Carbon Dioxide Emissions from each stage of the Energy Hierarchy for the development

Part L 2021 Building Regulations	Regulated domestic carbon dioxide savings	
	(Tonnes CO2 per annum)	(%)
Savings from energy demand reduction	1.2	12%
Savings from heat network / CHP	0.0	0%
Savings form renewable energy	5.4	56%
Total cumulative savings	**6.5**	**68%**
	(Tonnes CO2)	
Cumulative saving for off-set payment	**91**	
Cash in-lue contribution (£)	**8,620**	

Based on The London Plan's carbon off-set price of £95 per tonne, the required total contribution to off-set carbon is £8,620.00 over a 30-year period. This will be met through cash in lie contribution to the LBRuT's Emissions Fund secured by legal agreement.

West Entrance of The Boathouse

Background

This Energy Statement sets out the energy efficiency and carbon reduction measures that will be incorporated into The Boathouse development.

Description of Development

The development at The Boathouse consists of a four-storey building with ground floor and a basement which houses a home office, plant room and a utility room. Winter heating will be served by an underfloor heating system and cooling is proposed in all communal areas and master bedrooms. There is car parking and a cycle store on the premises. The site has its own jetty which is not utilised and needs refurbishment.

The development sits within a Conservation Area, but it doesn't comprise any listed buildings.

Drawings used for the assessment were published on 02.09.2022, drawing numbers PL-050 – PL053.

The proposed external gross Site Area is: 1,145.8 m^2 – 12,333.3 sq ft approx.

The Gross External Building area is: 1,097.2 m^2 – 11,810.2 sq ft (this includes lower ground floor and does not include the ground floor amenity space by the river path).

The Gross Internal Building area is: 852.80m^2 – 10,535.8 sq ft

South view of The Boathouse

Planning Policy

National Planning Policy Framework

The National Planning Policy Framework (NPPF) was revised on 20 July 2021 and sets out the Government's planning policies for England and how these should be applied.

The NPPF supports the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change. It should help to shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure.

The NPPF, Section 14 outlines its energy and climate change policies. New developments should be planned for in ways that:

avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaption measures, including through the planning of green infrastructure; and

can help to reduce greenhouse gas emissions, such as through its location, orientation and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards.

To help increase the use and supply of renewable and low carbon energy and heat, plans should:

provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts);

consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and

identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co-locating potential heat customers and suppliers.

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

comply with any development 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.

The key focus of the NPPF is to support local and regional planning authorities.

Regional Policy – London Plan

In March 2021, the Mayor released a new London Plan. In relation to energy and sustainability the Plan looks to further push the requirements on referable developments. The policies considered in the preparation of the statement are mainly under Chapter 9: Sustainable Infrastructure.

The Greater London Authority (GLA) new London Plan 2021 and the GLA's Guidance on Preparing Energy Assessments June 2022 document are the benchmark for London planning regulation. Together they provide a useful tool to undertake energy and sustainability assessments.

The GLA Energy Assessment Guidance looks to standardise how energy assessments for developments within London are presented and reported. As part of this process referable developments are encouraged to use the updated SAP 10.2 emissions factors while continuing to use the current Building Regulation methodology.

Policy SI 2: Minimising Greenhouse Gas Emissions requires that new development should be net zero-carbon. This means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the following energy hierarchy:

- Be lean: use less energy and manage demand during operation
- Be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly
- Be green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site
- Be seen: monitor, verify and report on energy performance

The development proposals should include a detailed energy strategy to demonstrate how the zero-carbon target will be met within the framework of the energy hierarchy.

A minimum on-site reduction of at least 35 per cent beyond Building Regulations is required for all developments as well as the energy efficiency measures alone will be reduced for residential uses by 10 per cent below regulated CO_2 emissions of a development compliant with Part L 2021 of the Building Regulations. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, in agreement with the borough, either through a cash in lieu contribution to the borough's carbon offset fund, or off-site provided that an alternative proposal is identified, and delivery is certain.

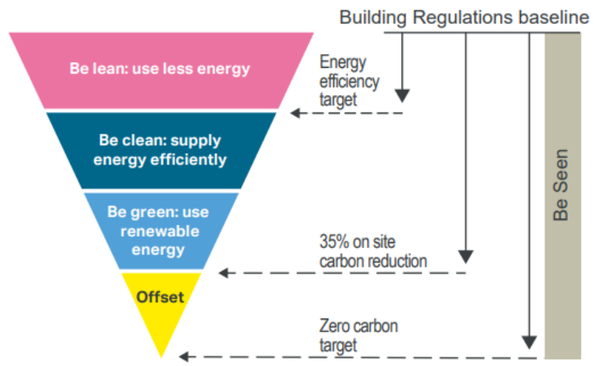
Boroughs must establish and administer a carbon offset fund. Offset fund payments must be ring-fenced to implement projects that deliver carbon reductions. The operation of offset funds should be monitored and reported on annually.

The development proposals should calculate and minimise carbon emissions from any other part of the development, including plant or equipment, that are not covered by Building Regulations, i.e. unregulated emissions.

Local Policy – Richmond Borough Planning

The London Borough of Richmond Local Plan LP 20 (Climate Change Adaptation) requires carbon offsetting against operational emissions. Where it is clearly demonstrated that it is not financially or technically viable to achieve zero-carbon on-site, any shortfall in carbon reduction targets should be addressed via off-site measures or through the provision of a carbon offset payment secured by legal agreement. Policy PL 22 states that all new residential development or extensions creating 1-9 dwelling units should achieve a 35% reduction.

New developments, in their layout, design, construction, materials, landscaping and operation, should minimise the effects of overheating as well as minimise energy consumption in accordance with the following hierarchy:



Source: Greater London Authority

Figure 1- Hierarchy of the GLA's energy monitoring system

The "be seen" step of the GLA's energy hierarchy is referenced, to encourage monitoring and measuring of actual performance. To demonstrate this, an energy monitoring system shall be installed with MID approved energy apportioning meters, enabling the building management team to report back actual energy usage in operation.

Structure of the Energy Assessment

The SAP model of The Boathouse was created in using Government approved software Elmhurst Energy Systems LTD Design SAP 10 to analyse the proposed case energy performance against Part L1 2021 notional building criteria.

The software is validated by the Building Research Establishment (BRE) which provides a framework for calculating the energy consumption of dwellings.

The energy assessment has been carried out following the GLA's Guidance on Preparing Energy Assessments (June 2020). Accordingly, the SAP 10.2 carbon factors are used for all calculations in this report. It includes:

- Baseline: Part L 2021 of the Building Regulations compliant development.
- Be Lean: A review of the passive, active design measures and energy efficient features incorporated into the design.
- Be Clean: An assessment of the feasibility of connecting to a district heating network or incorporating a combined heat and power system.
- Be Green: A review of renewable energy technologies and their application for this development.
- Be Seen: A commentary on Energy Metering and reporting

Baseline

Before energy efficiency measures are investigated, it is necessary to establish the baseline energy consumption of the scheme, for comparison and evaluation of the proposed carbon reduction measures.

To determine the CO2 emissions baseline, the Target Emission Rate (TER) has been used. As per the Government's Standard Assessment Procedure (SAP) for Energy Rating of Dwellings, the main heating fuel (space and water) has been provided by gas for the notional building.

Fabric Characteristics

The table below identifies fabric characteristics for the notional building.

Table 3 – Fabric characteristics of Notional Building within Part L 2021

Element/ Characteristic	Notional Building (W/m²K)
Floor (W/m²K)	0.13
Roof/ terrace (W/m²K)	0.10
External wall (W/m²K)	0.15
External window (including frame) (W/m²K)	1.4
Roof Lights (W/m²K)	1.4
Glazing Specifications	
Solar transmittance (G-value) (%)	0.76
Visible Light Transmittance (%)	0.60
Air Permeability @ 50 Pascals ($m^3/hr.m^2$)	3.0
Thermal Bridging	
Thermal bridging Y-value (W/mK)	0.033

A Target Emissions Rate (TER) of 11.3 kg/m²/year has been identified as the baseline figure.

Reference should be made to **Appendix A** for the TER figure.

Be Lean - Demand Reduction

This section outlines how energy demand and consumption will be reduced through the implication of lean design measures to the proposed scheme.

Under Policy SI 2 of the new London Plan (March 2021) certain levels of emissions savings should be achieved at the Be Lean stage of the energy hierarchy. This is represented as a reduction in emissions from the Part L 2021 Notional Building Target Emissions Rate (TER) to the development's design represented by the Dwelling Emissions Rate (DER).

The reductions targeted are as follows:

- Residential developments should achieve a 10% saving over the TER.

Passive Design Measures

Passive solar design involves adapting building massing, layout and glazing to best respond to the local climate and annual sun path, with the aim of reducing energy demands and improving occupant comfort through limiting solar gain.

Orientation and Site Layout

The orientation of the building is firmly fixed due to the size of the site, roads, pedestrian paths and adjacent river surrounding the site.

Lighting

The amount of glazing within external facades are optimized to get good levels of natural daylight throughout the occupied space. The proposed glazing will have high light transmission value thereby daylighting will be fully utilised.

All light fittings are assumed to be efficient LED and it's assumed that one light bulb is installed per room.

The following lighting efficacies have been allowed within the SAP model:

- Living Room and Bedrooms – 100 lm/cw
- Circulation, toilets, stores – 100 lm/cw

Solar Shading

All elevations will gain a small amount of shading due to a neighbouring building and surrounding trees being of the same height.

All new glazing in the dwelling will be with high visible light transmission (VLT) to achieve effective daylighting of occupied spaces.

Fabric Characteristics

The building fabric U-values of the building have been significantly improved when compared against the 'Limiting' Part L1 2021 values.

Table 4 – Fabric Characteristics for Be Lean Proposed Scheme

Element/ Characteristic (W/m²K)	Limiting Part L1 2021	Proposed Scheme
Floor (W/m²K)	0.18	0.13
Roof/ terrace (W/m²K)	0.16	0.10
External wall (W/m²K)	0.26	0.15
Party Wall Thermal Line - Adjacent Buildings	0.20	0
External window (including frame) (W/m²K)	1.60	1.4
Rooflight (W/m²K)	1.60	1.4
Glazing Specifications		
Solar transmittance (G-value) (%)	-	-
Air Permeability @ 50 Pascals ($m^3/hr.m^2$)	8.0	3.0
Thermal Bridging		
Thermal bridging Y-value (W/mK)	0.05	0.033

Thermal Bridging

Linear thermal bridge Psi values have been carefully considered and are included in the U-value calculations. Should there be any other elements of the building envelope that lead to potential thermal bridging, these will be considered and designed to a high standard, according to enhanced construction details.

Refer to **Appendix C** for details on Accredited Construction Details.

Air Permeability

An air leakage rate of $3m^3/hr/m^2$ at 50Pa should be targeted for all aspects of the development. This is in comparison with $8m^3/hr/m^2$ at 50Pa maximum under the Building Regulation minimum standards. Good air tightness can be achieved by prefabrication of several key building components under factory conditions, robust detailing of junctions and good building practices on site.

Active Design Measures -Ventilation

Occupied spaces with windows or other external openings could be naturally ventilated, however, the proposal is to use mechanical extract ventilation within toilets, bathrooms and kitchen.

Therefore, the building has intermittent extract ventilation and is designed to operate with high efficiency fans and a recommended minimum energy specific fan power of 0.5 W/l/s according to the domestic building services compliance guide.

Fixed Building Services

All equipment and plant will exceed the minimum requirements of the Approved Document Part L1 2021 of the Building Regulations for conventional space heating/ cooling systems, hot water systems and ventilation systems.

The heating and cooling systems shall be appropriately zoned, with local time and temperature controls EPC 5 Stars.

For the purposes of demonstrating CO_2 emission improvements in the 'be lean' stage of the energy hierarchy, the dwelling utilises gas for heating and domestic hot water, and seasonal energy efficiency ratio 3.3 (SEER) for cooling which is provided by a separate mini VRF system. In this way CO_2 emission improvements from the proposed space heating and hot water demand reduction measures can be compared against the Part L 2021 baseline, for example through improvements in performance of building fabric, heat recovery or water efficient fittings.

A summary of the fixed building services inputs can be found in **Appendix B.**

Unregulated Energy

Unregulated energy is those uses that fall outside the typical scope of building regulations. This can include energy used through cooking, computers, external lighting and other 'plug loads' which are typically under the control of the occupant. Addressing these loads, which often form a significant portion of a building's overall energy consumption, is key to reducing energy consumption. This will be achieved through the specification of energy efficient white goods, lifts as well as other appliances where possible.

Energy Demand

The development's fabric energy efficiency has been calculated and presented in the following table. The estimated improvement is calculated to be 12% via passive design measures.

Table 5 – Site Wide Fabric Energy Efficiency Improvement.

	Target Fabric Energy Efficiency (kWh/m²)	Dwelling Fabric Energy Efficiency (kWh/m²)	Improvement (%)
Development total	43.80	41.60	5%

Cooling

The cooling hierarchy in London Plan Policy SI 4: Managing heat risk has been applied to the development.

- Minimising internal heat generation through energy efficient design. E.g. minimised heat distribution infrastructure within the buildings.
- Reducing the amount of heat entering the building in summer. E.g. use of carefully designed shading measures.
- Use of thermal mass and high ceilings to manage the heat within the building.
- Passive ventilation e.g. opening windows, passive stack.
- Provide mechanical ventilation.
- Provide active cooling systems.

Natural ventilation is feasible and will be implemented on this development in all communal areas. Mechanical vent/cooling is required to prevent overheating and to provide adequate fresh air into the spaces in winter months when it is unlikely windows will be opened due to cold draughts.

Mini VRF technology is found to be suitable to provide cooling for the living room and master bedrooms of this development. Through a refrigeration cycle, external ambient air can be used as a heating or cooling medium. Air source heat pumps recover or reject heat from outside air and can deliver heating or cooling, or both to an occupied space.

Therefore, a gas combi boiler providing heating and a mini-VRF for cooling are proposed for the 'be lean' stage of the development.

Predicted Cooling and Heating Demand

This new section explains how London Plan policies apply now that Part L 2021 has taken effect. It introduces a percentage improvement benchmark for residential developments and the requirement to report the Energy Use Intensity (EUI) and space heating demand of the development. Energy Use Intensity (EUI) is a measure of the total energy consumed in a building annually. It includes both regulated (fixed systems for lighting, heating, hot water, air conditioning and mechanical ventilation) and unregulated (cooking and all electrical appliances, and other small power) energy. It does not include energy use from electric vehicle charging or any reduction in EUI due to renewable energy generation on-site.

Table 6 – EUI & space heating demand (predicted energy use)

Building type	EUI (kWh/m2/year) (excluding renewable energy)	Space heating demand (kWh/m2/year) (excluding renewable energy)	EUI value from Table 4 of the guidance (kWh/m2/year) (excluding renewable energy)	Space heating demand from Table 4 of the guidance(kWh/m2/year) (excluding renewable energy)	Methodology used
Residential	36.51	38.11	35	15	Part L1 - SAP 10.2

Be Lean Results

The 'Be Lean' measures alone provide a 12.00% carbon saving when compared against a baseline L2A 2021 compliant building.

Table 7 – Carbon Dioxide Emissions after Be Lean stage for the development

Part L 2021 Building Regulations	Carbon Dioxide Emissions for domestic buildings (Tonnes CO2 per annum)	
	Regulated	Non Regulated
Baseline: The Boathouse	9.5	8.0
After energy demand reduction	8.4	8.0

Table 8 Regulated Carbon Dioxide savings from Be Lean stage for the development

Part L 2021 Building Regulations	Regulated domestic carbon dioxide savings	
	(Tonnes CO2 per annum)	(%)
Savings from energy demand reduction	1.20	12%

The total regulated carbon saving go beyond Part L 2021 Building Regulations through the combination of energy efficient design and renewable technologies is 0.00%. The heat pump is considered a Green Technology and as such, the benefit results are listed in the 'Be Green' section.

Reference should be made to section Appendix A for the Be Lean stage SAP Calculation document output.

Be Clean – Supply Energy Efficiently

The next step in the Energy Hierarchy is the 'Be Clean' strategy of supplying the required energy as efficiently as possible.

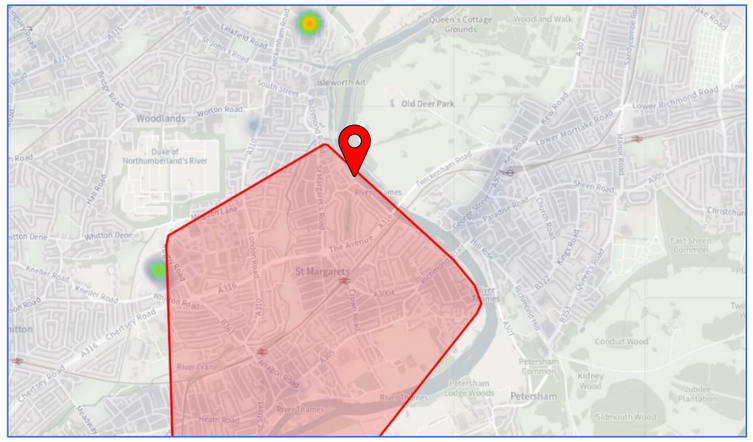
Potential approaches include connecting the scheme to existing low carbon or CHP-led district energy networks, or if no existing schemes exist, investigating whether such networks are planned in the area and designing systems with the flexibility to connect to these in the future.

With or without a district energy system, the feasibility of CHP (combined heat and power). For larger developments, the use of a site wide communal heating system should be provided if considered viable.

District Energy Networks (DEN)

Investigations have been undertaken to determine if the development can connect into an existing or proposed distribution network. There are no existing or proposed district heating networks near the development site.

Figure 2 London Heat Map showing the heat density of the area surrounding Boathouse.



Therefore, it is proposed to install a VRF (Variable Refrigerant Flow) system for cooling and a gas combi boiler for heating, which whilst not supporting a future DEN, reduces carbon emissions from the development from day one. In 15-20 years when the heating system is due for replacement it would be appropriate to re-evaluate and install an alternative system at this point in time if there is a DEN available to connect to.

CHP

Combined heat and power engines are not viable for the development as they generate harmful NOx and SOx emissions which can be detrimental to human health more directly than CO2 emissions. This negative contribution to the local air would directly conflict with the London Plan.

Be Clean Results

Since there are no changes proposed, clean measures have not been adopted as part of proposals with this proposed scheme. The carbon emissions, at the end of 'be clean' stage, are identical to those at the end of the 'be lean' stage.

Be Green – Renewable Technology

The third and final stage of the energy hierarchy - 'Be Green' is to review the potential of a range of renewable energy systems to serve the energy requirements of the site and thereby offset CO2 emissions.

Solar Water Heating

Solar thermal domestic hot water consumption is technically viable for this development. However, there is limited available space at roof level to install solar thermal collectors, therefore, this technology is being excluded from the design proposals.

Wind Power

It is recognised that wind generators are often associated with unacceptable visual and noise implications. Wind technology as a renewable energy source is not considered appropriate for this site as the wind turbines would not be visually appropriate for this development and this technology being excluded from the final design proposals.

Photovoltaics

Photovoltaic collectors are compatible with the proposed building services solution; however, there is insufficient space at roof level to provide a meaningful amount of PV's and this technology has been excluded from the design proposals.

Air Source Heat Pump (ASHP)-Heating

Through a refrigeration cycle, external ambient air can be used as a heating or cooling medium. Air source heat pumps recover or reject heat from outside air and can deliver heating or cooling, or both to an occupied space.

The heating for the houses, and DHW services for the toilets/showers are proposed to be provided by air source heat pumps.

Table 9 - 1 ASHPs Seasonal Efficiency for Be Green development

Heating Circuit - Dwelling	
Fuel Source	Air Source Heat Pumps (ASHPs)
SCOP %	3.34
Cooling Circuit - Dwelling	
Fuel Source	Variable Refrigerant Flow System (VRF)
SEER	3.3 (House 1 & 3); 3.65 (House 2)
DHW Circuit	
Fuel Source	Air Source Heat Pumps (ASHPs)
Efficiency %	3.34

Be Green Results

Air source heat pumps have been incorporated into the 'Be Green' design proposal.
With the inclusion of air source heat pumps, a carbon reduction of 56% on regulated emissions has been calculated.

Table 10 Carbon Dioxide Emissions after each stage of the Energy Hierarchy for the development

Part L 2021 Building Regulations	**Carbon Dioxide Emissions for domestic buildings (Tonnes CO2 per annum)**	
	Regulated	**Non Regulated**
Baseline: Part L 2021 of the Building Regulations Compliant Development	9.5	8.0
After energy demand reduction (be lean)	8.4	8.0
After heat network / CHP (be clean)	8.4	8.0
After renewable energy (be green)	3.0	8.0

Table 11 Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for the development

Part L 2021 Building Regulations	**Regulated domestic carbon dioxide savings**	
	(Tonnes CO2 per annum)	**(%)**
Be lean: savings from energy demand reduction	1.2	12%
Be clean: savings from heat network	0.0	0%
Be green: savings from renewable energy	5.4	56%
Total Cumulative Savings	**6.5**	**68%**

The 'Be Green' SAP Calculation document's front page can be found in **Appendix A**.

Conclusion

The results show a site wide carbon reduction of **68%** when compared against a compliant baseline case. Therefore, the development achieves the 35% target complying with Policy SI 2 of the new London Plan and the 35% target complying with the London Borough of Richmond upon Thames (LBRuT) Council requirements.

Table 12 – Carbon emissions summary

	Total regulated emissions (Tonnes CO2 / year)	**CO2 savings (Tonnes CO2 / year)**	**Percentage savings (%)**
Part L 2021 baseline	9.5		
Be lean	8.4	1.2	12%
Be clean	8.4	0.0	0%
Be green	3.0	5.4	56%
Total Savings	-	**6.5**	**68%**

Based on The London Plan's carbon off-set price of £95 per tonne, the required total contribution to off-set carbon is ££8,630.00 over a 30-year period. This will be met through cash in lie contribution to the LBRuT's Emissions Fund secured by legal agreement.

The total carbon offset will be 91 tonnes CO2/year, requiring a cash in-lieu contribution of **£8,620** based on GLA recommended price of £95 per tonne CO2.

Appendix A – Full SAP Calculation Reports

House 01 - Be Lean

Property Reference	House 01	Issued on Date	15/06/2023
Assessment Reference	01- Be Lean - LP	Prop Type Ref	House 01
Property	House 01, 01, Ranelagh Drive, Twickenham, Richmond, TW1 1QZ		

SAP Rating	82 B	DER	11.06	TER	11.18
Environmental	87 B	% DER < TER			1.07
CO_2 Emissions (t/year)	2.97	DFEE	40.08	TFEE	46.08
Compliance Check	See BREL	% DFEE < TFEE			13.01
% DPER < TPER	-12.10	DPER	66.47	TPER	59.29

Assessor Details	Mr. Lee Pasifull	Assessor ID	Y856-0001
Client			

SUMMARY FOR INPUT DATA FOR: New Build (As Designed)

Orientation	Southwest
Property Tenture	1
Transaction Type	6
Terrain Type	Urban
1.0 Property Type	House, End-Terrace
Which Floor	0
2.0 Number of Storeys	4
3.0 Date Built	2022
4.0 Sheltered Sides	1
5.0 Sunlight/Shade	Average or unknown
6.0 Thermal Mass Parameter	Precise calculation
Thermal Mass	N/A kJ/m²K
7.0 Electricity Tariff	Standard
Smart electricity meter fitted	No
Smart gas meter fitted	No

7.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Basement:	24.10 m	55.19 m²	2.40 m
Ground floor:	35.51 m	144.79 m²	3.36 m
1st Storey:	21.69 m	55.87 m²	2.75 m
2nd Storey:	21.69 m	56.01 m²	2.96 m
3rd Storey:	0.00 m	0.00 m²	0.00 m
4th Storey:	0.00 m	0.00 m²	0.00 m
5th Storey:	0.00 m	0.00 m²	0.00 m
6th Storey:	0.00 m	0.00 m²	0.00 m
7th Storey:	0.00 m	0.00 m²	0.00 m

8.0 Living Area 100.06 m²

9.0 External Walls

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Gross Area(m²)	Nett Area (m²)	Shelter Rec	Shelter	Openings	Area Calculation Type
External Wall Lower Ground	Cavity Wall	Cavity wall : dense plaster, dense block, filled cavity, any outside structure	0.15	190.00	74.88	74.88	0.00	None	0.00	Enter Gross Area
External Wall Masonry	Cavity Wall	Cavity wall : dense plaster, dense block, filled cavity, any outside structure	0.15	190.00	161.05	137.29	0.00	None	23.77	Enter Gross Area
External Wall Cladding	Cavity Wall	Cavity wall : dense plaster, dense block, filled cavity, any outside structure	0.15	190.00	50.83	45.03	0.00	None	5.80	Enter Gross Area
External Wall Zinc	Cavity Wall	Cavity wall : dense plaster, dense block, filled cavity, any outside structure	0.15	190.00	13.84	13.84	0.00	None	0.00	Enter Gross Area

9.1 Party Walls

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Area (m²)	Shelter Res	Shelter
Party Wall	Solid Wall	Dense plaster both sides, dense blocks, cavity or cavity fill	0.00	180.00	116.40	0.00	None

10.0 External Roofs

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Gross Area(m²)	Nett Area (m²)	Shelter Code	Shelter Factor	Calculation Type	Openings

House 01 - Be Green

Property Reference	House 01	Issued on Date	15/06/2023
Assessment Reference	01 - Be Green	Prop Type Ref	House 01
Property	House 01, 01, Ranelagh Drive, Twickenham, Richmond, TW1 1QZ		

SAP Rating	80 C	DER	3.53	TER	11.10
Environmental	96 A	% DER < TER			68.20
CO_2 Emissions (t/year)	1.03	DFEE	40.08	TFEE	46.08
Compliance Check	See BREL	% DFEE < TFEE			13.01
% DPER < TPER	36.61	DPER	37.29	TPER	58.83

Assessor Details	Mr. Lee Pasifull	Assessor ID	Y856-0001
Client			

SUMMARY FOR INPUT DATA FOR: New Build (As Designed)

Orientation	Southwest
Property Tenture	1
Transaction Type	6
Terrain Type	Urban
1.0 Property Type	House, End-Terrace
Which Floor	0
2.0 Number of Storeys	4
3.0 Date Built	2022
4.0 Sheltered Sides	1
5.0 Sunlight/Shade	Average or unknown
6.0 Thermal Mass Parameter	Precise calculation
Thermal Mass	N/A kJ/m²K
7.0 Electricity Tariff	Standard
Smart electricity meter fitted	No
Smart gas meter fitted	No

7.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Basement:	24.10 m	55.19 m²	2.40 m
Ground floor:	35.51 m	144.79 m²	3.36 m
1st Storey:	21.69 m	55.87 m²	2.75 m
2nd Storey:	21.69 m	56.01 m²	2.96 m
3rd Storey:	0.00 m	0.00 m²	0.00 m
4th Storey:	0.00 m	0.00 m²	0.00 m
5th Storey:	0.00 m	0.00 m²	0.00 m
6th Storey:	0.00 m	0.00 m²	0.00 m
7th Storey:	0.00 m	0.00 m²	0.00 m

8.0 Living Area 100.06 m²

9.0 External Walls

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Gross Area(m²)	Nett Area (m²)	Shelter Rec	Shelter	Openings	Area Calculation Type
External Wall Lower Ground	Cavity Wall	Cavity wall : dense plaster, dense block, filled cavity, any outside structure	0.15	190.00	74.88	74.88	0.00	None	0.00	Enter Gross Area
External Wall Masonry	Cavity Wall	Cavity wall : dense plaster, dense block, filled cavity, any outside structure	0.15	190.00	161.05	137.29	0.00	None	23.77	Enter Gross Area
External Wall Cladding	Cavity Wall	Cavity wall : dense plaster, dense block, filled cavity, any outside structure	0.15	190.00	50.83	45.03	0.00	None	5.80	Enter Gross Area
External Wall Zinc	Cavity Wall	Cavity wall : dense plaster, dense block, filled cavity, any outside structure	0.15	190.00	13.84	13.84	0.00	None	0.00	Enter Gross Area

9.1 Party Walls

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Area (m²)	Shelter Res	Shelter
Party Wall	Solid Wall	Dense plaster both sides, dense blocks, cavity or cavity fill	0.00	180.00	116.40	0.00	None

10.0 External Roofs

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Gross Area(m²)	Nett Area (m²)	Shelter Code	Shelter Factor	Calculation Type	Openings

House 02 - Be Lean

Property Reference	House 02	Issued on Date	15/06/2023
Assessment Reference	02 - Be Lean LP	Prop Type Ref	House 02
Property	House 02, 02, Ranelagh Drive, Twickenham, Richmond, TW1 1QZ		

SAP Rating	91 B	DER	10.81	TER	11.26
Environmental	88 B	% DER < TER			4.00
CO_2 Emissions (t/year)	2.55	DFEE	37.99	TFEE	44.12
Compliance Check	See BREL	% DFEE < TFEE			13.89
% DPER < TPER	-11.55	DPER	66.81	TPER	59.89

Assessor Details	Mr. Lee Pasifull	Assessor ID	Y856-0001
Client			

SUMMARY FOR INPUT DATA FOR: New Build (As Designed)

Orientation	Southwest	
Property Tenture	1	
Transaction Type	6	
Terrain Type	Urban	
1.0 Property Type	House, Mid-Terrace	
Which Floor	0	
2.0 Number of Storeys	4	
3.0 Date Built	2022	
4.0 Sheltered Sides	2	
5.0 Sunlight/Shade	Average or unknown	
6.0 Thermal Mass Parameter	Precise calculation	
Thermal Mass	N/A	kJ/m²K
7.0 Electricity Tariff	Standard	
Smart electricity meter fitted	No	
Smart gas meter fitted	No	

7.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Basement:	11.20 m	41.44 m²	2.40 m
Ground floor:	11.20 m	120.44 m²	3.36 m
1st Storey:	11.20 m	55.24 m²	2.75 m
2nd Storey:	11.20 m	55.38 m²	2.96 m
3rd Storey:	0.00 m	0.00 m²	0.00 m
4th Storey:	0.00 m	0.00 m²	0.00 m
5th Storey:	0.00 m	0.00 m²	0.00 m
6th Storey:	0.00 m	0.00 m²	0.00 m
7th Storey:	0.00 m	0.00 m²	0.00 m

8.0 Living Area: 85.89 m²

9.0 External Walls

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Gross Area(m²)	Nett Area (m²)	Shelter Res	Shelter	Openings	Area Calculation Type
External Wall Basement	Solid Wall	Solid wall : dense plaster, 200 mm dense block, insulated externally	0.15	190.00	55.19	55.19	0.00	None	0.00	Enter Gross Area
External Wall Ext Masonry	Solid Wall	Solid wall : dense plaster, 200 mm dense block, insulated externally	0.15	190.00	59.24	45.27	0.00	None	13.97	Enter Gross Area
External Wall Cladding	Solid Wall	Solid wall : dense plaster, 200 mm dense block, insulated externally	0.15	190.00	50.83	45.91	0.00	None	4.92	Enter Gross Area
External Wall Second Floor	Solid Wall	Solid wall : dense plaster, 200 mm dense block, insulated externally	0.15	190.00	32.48	32.48	0.00	None	0.00	Enter Gross Area

9.1 Party Walls

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Area (m²)	Shelter Res	Shelter
Party Wall 1	Filled Cavity with Edge Sealing	Dense plaster both sides, dense blocks, cavity or cavity fill	0.00	180.00	270.40	0.00	None

10.0 External Roofs

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Gross Area(m²)	Nett Area (m²)	Shelter Code	Shelter Factor	Calculation Type	Openings

House 02 - Be Green

Property Reference	House 02	Issued on Date	15/06/2023
Assessment Reference	02 - Be Green	Prop Type Ref	House 02
Property	House 02, 02, Ranelagh Drive, Twickenham, Richmond, TW1 1QZ		

SAP Rating	80 C	DER	3.62	TER	11.15
Environmental	96 A	% DER < TER			67.53
CO_2 Emissions (t/year)	0.92	DFEE	37.99	TFEE	44.12
Compliance Check	See BREL	% DFEE < TFEE			13.89
% DPER < TPER	35.46	DPER	38.27	TPER	59.30

Assessor Details	Mr. Lee Pasifull	Assessor ID	Y856-0001
Client			

SUMMARY FOR INPUT DATA FOR: New Build (As Designed)

Orientation	Southwest	
Property Tenture	1	
Transaction Type	6	
Terrain Type	Urban	
1.0 Property Type	House, Mid-Terrace	
Which Floor	0	
2.0 Number of Storeys	4	
3.0 Date Built	2022	
4.0 Sheltered Sides	2	
5.0 Sunlight/Shade	Average or unknown	
6.0 Thermal Mass Parameter	Precise calculation	
Thermal Mass	N/A	kJ/m²K
7.0 Electricity Tariff	Standard	
Smart electricity meter fitted	No	
Smart gas meter fitted	No	

7.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Basement:	11.20 m	41.44 m²	2.40 m
Ground floor:	11.20 m	120.44 m²	3.36 m
1st Storey:	11.20 m	55.24 m²	2.75 m
2nd Storey:	11.20 m	55.38 m²	2.96 m
3rd Storey:	0.00 m	0.00 m²	0.00 m
4th Storey:	0.00 m	0.00 m²	0.00 m
5th Storey:	0.00 m	0.00 m²	0.00 m
6th Storey:	0.00 m	0.00 m²	0.00 m
7th Storey:	0.00 m	0.00 m²	0.00 m

8.0 Living Area: 85.89 m²

9.0 External Walls

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Gross Area(m²)	Nett Area (m²)	Shelter Res	Shelter	Openings	Area Calculation Type
External Wall Basement	Solid Wall	Solid wall : dense plaster, 200 mm dense block, insulated externally	0.15	190.00	55.19	55.19	0.00	None	0.00	Enter Gross Area
External Wall Ext Masonry	Solid Wall	Solid wall : dense plaster, 200 mm dense block, insulated externally	0.15	190.00	59.24	45.27	0.00	None	13.97	Enter Gross Area
External Wall Cladding	Solid Wall	Solid wall : dense plaster, 200 mm dense block, insulated externally	0.15	190.00	50.83	45.91	0.00	None	4.92	Enter Gross Area
External Wall Second Floor	Solid Wall	Solid wall : dense plaster, 200 mm dense block, insulated externally	0.15	190.00	32.48	32.48	0.00	None	0.00	Enter Gross Area

9.1 Party Walls

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Area (m²)	Shelter Res	Shelter
Party Wall 1	Filled Cavity with Edge Sealing	Dense plaster both sides, dense blocks, cavity or cavity fill	0.00	180.00	270.40	0.00	None

10.0 External Roofs

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Gross Area(m²)	Nett Area (m²)	Shelter Code	Shelter Factor	Calculation Type	Openings

House 03 - Be Lean

Property Reference	House 03	Issued on Date	15/06/2023
Assessment Reference	03 - Be Lean	Prop Type Ref	House 03
Property	House 03, 03, Ranelagh Drive, Twickenham, Richmond, TW1 1QZ		

SAP Rating	82 B	DER	11.29	TER	11.65
Environmental	87 B	% DER < TER			3.09
CO_2 Emissions (t/year)	3	DFEE	40.71	TFEE	47.23
Compliance Check	See BREL	% DFEE < TFEE			13.81
% DPER < TPER	-9.40	DPER	67.75	TPER	61.93

Assessor Details	Mr. Lee Pasifull	Assessor ID	Y856-0001
Client			

SUMMARY FOR INPUT DATA FOR: New Build (As Designed)

Orientation	Southwest	
Property Tenture	1	
Transaction Type	6	
Terrain Type	Urban	
1.0 Property Type	House, End-Terrace	
Which Floor	0	
2.0 Number of Storeys	4	
3.0 Date Built	2022	
4.0 Sheltered Sides	1	
5.0 Sunlight/Shade	Average or unknown	
6.0 Thermal Mass Parameter	Precise calculation	
Thermal Mass	N/A	kJ/m²K
7.0 Electricity Tariff	7 Hour Off Peak	
Smart electricity meter fitted	No	
Smart gas meter fitted	No	

7.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Basement:	24.60 m	47.77 m²	2.40 m
Ground floor:	37.92 m	154.83 m²	3.36 m
1st Storey:	21.17 m	53.06 m²	2.75 m
2nd Storey:	21.18 m	53.17 m²	2.98 m
3rd Storey:	0.00 m	0.00 m²	0.00 m
4th Storey:	0.00 m	0.00 m²	0.00 m
5th Storey:	0.00 m	0.00 m²	0.00 m
6th Storey:	0.00 m	0.00 m²	0.00 m
7th Storey:	0.00 m	0.00 m²	0.00 m

8.0 Living Area	98.20	m²

9.0 External Walls

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Gross Area(m²)	Nett Area (m²)	Shelter Rec	Shelter	Openings	Area Calculation Type
External Wall Lower Ground	Cavity Wall	Cavity wall : dense plaster, dense block, filled cavity, any outside structure	0.15	190.00	59.04	59.04	0.00	None	0.00	Enter Gross Area
External Wall Masonry	Cavity Wall	Cavity wall : dense plaster, dense block, filled cavity, any outside structure	0.15	190.00	206.75	182.98	0.00	None	23.77	Enter Gross Area
External Wall Cladding	Cavity Wall	Cavity wall : dense plaster, dense block, filled cavity, any outside structure	0.15	190.00	37.53	31.73	0.00	None	5.80	Enter Gross Area
External Wall Zinc	Cavity Wall	Cavity wall : dense plaster, dense block, filled cavity, any outside structure	0.15	190.00	6.24	6.24	0.00	None	0.00	Enter Gross Area

9.1 Party Walls

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Area (m²)	Shelter Res	Shelter
Party Wall	Solid Wall	Dense plaster both sides, dense blocks, cavity or cavity fill	0.00	180.00	139.67	0.00	None

10.0 External Roofs

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Gross Area(m²)	Nett Area (m²)	Shelter Code	Shelter Factor	Calculation Type	Openings

House 03 - Be Green

Property Reference	House 03	Issued on Date	15/06/2023
Assessment Reference	03 - Be Green	Prop Type Ref	House 03
Property	House 03, 03, Ranelagh Drive, Twickenham, Richmond, TW1 1QZ		

SAP Rating	79 C	DER	3.61	TER	11.56
Environmental	96 A	% DER < TER			68.77
CO_2 Emissions (t/year)	1.04	DFEE	40.71	TFEE	47.23
Compliance Check	See BREL	% DFEE < TFEE			13.81
% DPER < TPER	38.26	DPER	37.93	TPER	61.44

Assessor Details	Mr. Lee Pasifull	Assessor ID	Y856-0001
Client			

SUMMARY FOR INPUT DATA FOR: New Build (As Designed)

Orientation	Southwest	
Property Tenture	1	
Transaction Type	6	
Terrain Type	Urban	
1.0 Property Type	House, End-Terrace	
Which Floor	0	
2.0 Number of Storeys	4	
3.0 Date Built	2022	
4.0 Sheltered Sides	1	
5.0 Sunlight/Shade	Average or unknown	
6.0 Thermal Mass Parameter	Precise calculation	
Thermal Mass	N/A	kJ/m²K
7.0 Electricity Tariff	7 Hour Off Peak	
Smart electricity meter fitted	No	
Smart gas meter fitted	No	

7.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Basement:	24.60 m	47.77 m²	2.40 m
Ground floor:	37.92 m	154.83 m²	3.36 m
1st Storey:	21.17 m	53.06 m²	2.75 m
2nd Storey:	21.18 m	53.17 m²	2.98 m
3rd Storey:	0.00 m	0.00 m²	0.00 m
4th Storey:	0.00 m	0.00 m²	0.00 m
5th Storey:	0.00 m	0.00 m²	0.00 m
6th Storey:	0.00 m	0.00 m²	0.00 m
7th Storey:	0.00 m	0.00 m²	0.00 m

8.0 Living Area	98.20	m²

9.0 External Walls

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Gross Area(m²)	Nett Area (m²)	Shelter Rec	Shelter	Openings	Area Calculation Type
External Wall Lower Ground	Cavity Wall	Cavity wall : dense plaster, dense block, filled cavity, any outside structure	0.15	190.00	59.04	59.04	0.00	None	0.00	Enter Gross Area
External Wall Masonry	Cavity Wall	Cavity wall : dense plaster, dense block, filled cavity, any outside structure	0.15	190.00	206.75	182.98	0.00	None	23.77	Enter Gross Area
External Wall Cladding	Cavity Wall	Cavity wall : dense plaster, dense block, filled cavity, any outside structure	0.15	190.00	37.53	31.73	0.00	None	5.80	Enter Gross Area
External Wall Zinc	Cavity Wall	Cavity wall : dense plaster, dense block, filled cavity, any outside structure	0.15	190.00	6.24	6.24	0.00	None	0.00	Enter Gross Area

9.1 Party Walls

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Area (m²)	Shelter Res	Shelter
Party Wall	Solid Wall	Dense plaster both sides, dense blocks, cavity or cavity fill	0.00	180.00	139.67	0.00	None

10.0 External Roofs

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Gross Area(m²)	Nett Area (m²)	Shelter Code	Shelter Factor	Calculation Type	Openings

Appendix B – Services Input

System Detail	Be Lean	Be Green
VRF Fan Coil Units with Mech Vent – Living Room/ Bedrooms		
Ventilation Type	Natural Ventilation	Natural Ventilation
HVAC Type	VRF System	VRF System
Other Local Room heater with Mech Vent - Shower & WC		
Ventilation Type	Extract in Toilets	Extract in Toilets
HVAC Type	Underfloor Direct heating gas	Underfloor Direct heating electric
Shower Flow Rate l/s/m²	8	8
Toilet SFP W/l/s	0.5	0.5
Fan Type	Fan remote from zone	Fan remote from zone
Electric panel heater with Nat Vent - Circulation		
Ventilation Type	Natural Ventilation	Natural Ventilation
Heat Source Type	Mains Gas	Electricity
HVAC Type	Underfloor Heater	Underfloor Direct Electric Heaters
Heating Circuit - Apartment		
Fuel Source	Mains Gas	Grid Supplied Electricity
Heat Pump?	No	Yes
SCOP %	89.5	3.3
Heating Circuit - Toilet, Shower		
Fuel Source	Mains Gas	Grid Supplied Electricity
Heat Pump?	No	Yes
SCOP %	89.5	3.3
Cooling Circuit - Apartment,		
Fuel Source	Grid Supplied Electricity	Grid Supplied Electricity
Cooling Source Type	VRF FCU	VRF FCU
SEER	3.3	3.3
DHW Circuit - Toilet		
Fuel Source	Mains Gas	Electricity
Heat Pump?	No	No
Efficiency %	89.5	3.3
Lighting		
Auto Presence Detection	Manual	Manual
Daylight control	no Dimming in Dwelling	No Dimming in Apartments
Luminaire Lumens/ Circuit Watt	Apartment = 100 lm/cw	Apartment = 100 lm/cw
Other		
Pump speed	No pump	Pump in unheated space

Appendix C – Accredited Construction Details

The following table shows the Reference values of psi for junctions. These have been used in the design in order to meet the required overall equivalent Y-value of no greater than 0.05W/m²K, which must be proven through calculation once the construction details are further developed.

SAP version 10.2 (03-02-2022)

Table R2: Reference values of psi for junctions

	Ref	Junction detail	Ψ (W/m.K)
Junctions with an external wall	E1	Steel lintel with perforated steel base plate	0.05
	E2	Other lintels (including other steel lintels)	0.05
	E3	Sill	0.05
	E4	Jamb	0.05
	E5	Ground floor (normal)	0.16
	E19	Ground floor (inverted)	0.07
	E20	Exposed floor (normal)	0.32
	E21	Exposed floor (inverted)	0.32
	E22	Basement floor	0.07
	E6	Intermediate floor within a dwelling	0
	E7	Party floor between dwellings (in blocks of flats) [a]	0.07
	E8	Balcony within a dwelling, wall insulation continuous [b]	0
	E9	Balcony between dwellings, wall insulation continuous [b] [c]	0.02
	E23	Balcony within or between dwellings, balcony support penetrates wall insulation	0.02
	E10	Eaves (insulation at ceiling level)	0.06
	E24	Eaves (insulation at ceiling level - inverted)	0.24
	E11	Eaves (insulation at rafter level)	0.04
	E12	Gable (insulation at ceiling level)	0.06
	E13	Gable (insulation at rafter level)	0.08
	E14	Flat roof	0.08
	E15	Flat roof with parapet	0.56
	E16	Corner (normal)	0.09
	E17	Corner (inverted – internal area greater than external area)	-0.09
	E18	Party wall between dwellings [c]	0.06
	E25	Staggered party wall between dwellings [c]	0.06
Junctions with a party wall [c]	P1	Ground floor	0.08
	P6	Ground floor (inverted)	0.07
	P2	Intermediate floor within a dwelling	0
	P3	Intermediate floor between dwellings (in blocks of flats)	0
	P7	Exposed floor (normal)	0.16
	P8	Exposed floor (inverted)	0.24
	P4	Roof (insulation at ceiling level)	0.12
	P5	Roof (insulation at rafter level)	0.08
Junctions within a roof or with a room-in-roof	R1	Head of roof window	0.08
	R2	Sill of roof window	0.06
	R3	Jamb of roof window	0.08
	R4	Ridge (vaulted ceiling)	0.08
	R5	Ridge (inverted)	0.04
	R6	Flat ceiling	0.06
	R7	Flat ceiling(inverted)	0.04
	R8	Roof to wall (rafter)	0.06
	R9	Roof to wall (flat ceiling)	0.04
	R10	All other room-in-roof junctions	0.08
	R11	Upstands or kerbs of rooflight	0.08

[a] Value of Ψ is applied to both sides of the party floor
[b] This is an externally supported balcony (the balcony slab is not a continuation of the floor slab) where the wall insulation is continuous and not bridged by the balcony slab or its supports
[c] Value of Ψ is applied to each dwelling

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GDM