HOARE LEA

Avalon House.
London.
Barings Real Estate.

SUSTAINABILITY
ENERGY AND SUSTAINABILITY STATEMENT

REVISION 01 – 31 MAY 2024

Audit sheet.

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Executive Summary.

This report has been prepared by Hoare Lea on behalf of Barings Real Estate, (hereafter referred to as 'the applicant') in support of the planning application for the proposed development of Avalon House (hereafter referred to as the 'proposed development') located within the London Borough of Richmond Upon Thames.

The overall objective of the proposed development is to sustainably reconfigure and extend the existing building to meet current industry standards, and provide a high quality workplace environment.

This report should be read in conjunction with the full planning submission reports.

Description of Development.

Remove the existing roof and erection of a roof extension at fourth floor and rear extensions to floors ground — four to accommodate additional commercial floorspace (Class E), provision of rear and rooftop terraced amenity spaces, alterations to the ground floor entrance, recladding and remodelling of the facade, landscaping improvements to the rear car parking area, provision of end of journey and cycle parking facilities, associated building servicing and sustainability improvements, and other associated works.

Table 1: Area Schedule

Use	Existing sq. m (GIA)	Proposed sq. m (GIA)	Net Change sq. m (GIA)
Commercial (Class E)	3,076	4,068	+992
TOTAL	3,076	4,068	+992

Figure 1 – Proposed development (Source: Anomaly)

Planning Policy Requirements.

The proposed development has been informed by planning policy drivers outlined below. As a minor application these are not required to be adhered to for the scheme, however the proposed development has aspired to meeting and improving on these requirements where possible aligning with the applicant's aspiration for a sustainable office development.

National drivers; Approved Document Part L of the Building Regulations

Part L of the Building Regulations is the mechanism by which government is driving reductions in the regulated CO_2 emissions from buildings. The Proposed Development has been designed improve on the minimum performance parameters of the latest Part L (2021).

The assessment of the Proposed development against policy targets has been carried out using Building Regulations Part L (2021) referenced in the Draft Richmond Local Plan (2023). and Building Regulations Part L (2013) referenced in the Richmond Local Plan (2018).

Calculations demonstrating the energy requirements and associated CO_2 emissions for the development have been carried out using Building Regulations approved software IES VE.

Regional drivers; Greater London Authority (GLA) Policy

The energy strategy adopted for the proposed development follows the Mayor's energy hierarchy of 'Be Lean, Be Clean, Be Green, Be Seen' as detailed in the Greater London Authority (GLA) London Plan (2021) and referenced in the Richmond Local Plan (2018) and Draft Richmond Local Plan (2023).

Local drivers & Planning Policy Requirements; The London Borough of Richmond upon Thames (LBR)

The development's proposed energy and sustainability strategies are driven by the following Local Plan documents:

- Adopted Local Plan – July 2018
- Richmond Local Plan 'The best for our borough' Draft for consultation – June 2023

These documents set out the Council's current and proposed planning policies and provides guidance that helps create the conditions for harnessing the benefits of economic growth, reducing inequality and securing sustainable neighbourhoods.

The emerging Local Plan is not expected to be adopted until Winter 2024 at the earliest. The methodologies of the emerging Local Plan have been followed and its targets acknowledged.

Energy Strategy Summary.

The Energy Strategy has been developed using a 'fabric first' approach and follows the 'be lean', 'be clean', 'be green' and 'be seen' energy hierarchy.

Figure 2: Energy hierarchy results.

The scheme comprises non-domestic refurbishment and new build elements. These are assessed differently and therefore results are separated in this report. The London Borough of Richmond Upon Thames requires that results are provided for:

- New Build - Part L 2021 (2023 Draft Local Plan)
- Refurbishment – Part L 2021 with GLA Refurbishment Baseline (2023 Draft Local Plan)
- New Build – Part L 2013 (2018 Adopted Local Plan)

Be Lean – Passive Design and Energy Efficiency

The following passive design and energy efficiency measures have been incorporated into the design where possible:

- Highly insulated building fabric.
- Airtight construction (i.e. low air permeability) in the development.
- Highly efficient mechanical and electrical systems.

Be Clean – Supplying Energy Efficiently

The feasibility of connecting to any existing district heating networks has been reviewed, but no opportunities have been identified in the vicinity of the Proposed Development. Provision for a future connection will be made. On-site CHP is not proposed due to limited carbon reduction potential in light of recent grid decarbonisation and the adverse impact on air quality from flue emissions. Therefore, no additional carbon reductions are anticipated at the clean stage.

Be Green – Low and Zero (LZC) Technologies

The heating and cooling energy for the Proposed Development will be generated via an 'all electric / combustion-free' engineered solution utilising central Air Source Heat Pumps (ASHPs). In addition, the provision of solar photovoltaic (PV) panels will be maximised on available roof space.

Both heat pumps, VRF and PV are a form of low and zero carbon technology, therefore the output from these form part of the third stage of the energy hierarchy.

Energy Assessment Outcome

Energy results at each stage of the Energy Hierarchy for the Proposed Development are shown in the following graphs. An estimated total Carbon Offset Payment of £TBC will be required by the London Borough of Richmond Upon Thames based on the requirements of the Draft Local Plan 2023.

The estimated regulated CO_2 emissions reductions achieved at each stage of the energy hierarchy for the new build and refurbishment element of the proposed development against the criteria stated above are summarised in the sections below.

Table 2 - Regulated carbon dioxide emissions as each stage of the Energy Hierarchy – New Build – Part L 2021.

	Site-Wide Regulated Carbon Dioxide Emission Savings (tonnes CO_2/yr.)	
	Regulated	Unregulated
Baseline: Part L 2021	5.47	
After energy demand reduction (Be Lean)	5.05	
After heat network / CHP (Be Clean)	5.05	
After renewable energy (Be Green)	2.52	
	Site-Wide Regulated domestic carbon dioxide savings	
	(tonnes CO_2/yr.)	(%)
Savings from energy demand reduction	0.41	7.6%
Savings from heat network / CHP	0.00	0.0%
Savings from renewable energy	2.53	46.3%
Cumulative on-site savings	**2.95**	**53.9%**
Total target savings	5.47	100.0%
Shortfall	**2.52**	**46.1%**
Local carbon offset price (£/tCO_2)	£95	
Offset period (years)	30	
Total Offset Payment	**£7,183**	

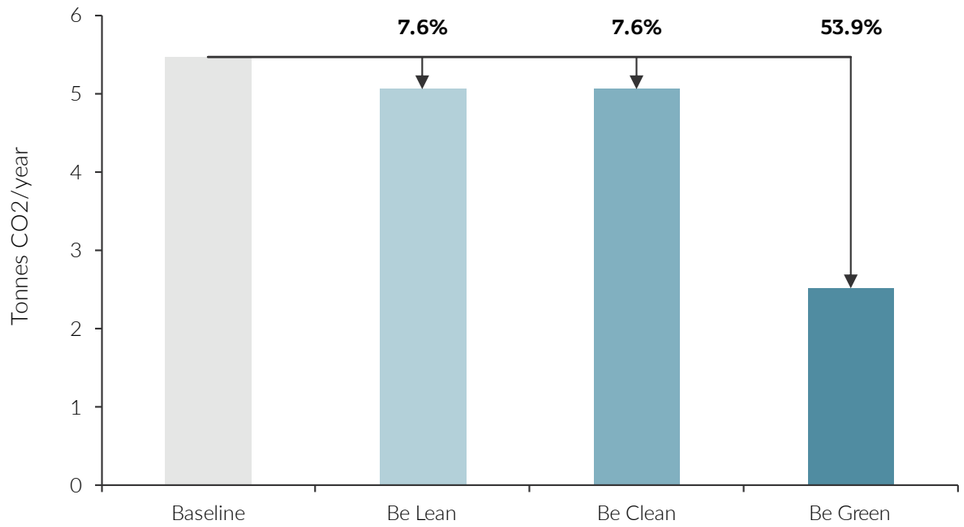


Figure 3 – Chart of regulated carbon dioxide emissions at each stage of the Energy Hierarchy –New Build – Part L 2021.

Table 3 - Regulated carbon dioxide emissions as each stage of the Energy Hierarchy – Refurbishment – Part L 2021 with GLA .Refurbishment Baseline

	Site-Wide Regulated Carbon Dioxide Emission Savings (tonnes CO_2/yr.)	
	Regulated	Unregulated
Baseline: Part L 2021 GLA Refurbishment Baseline	24.29	
After energy demand reduction (Be Lean)	13.00	
After heat network / CHP (Be Clean)	13.00	
After renewable energy (Be Green)	12.98	
	Site-Wide Regulated domestic carbon dioxide savings	
	(tonnes CO_2/yr.)	(%)
Savings from energy demand reduction	11.28	46.5%
Savings from heat network / CHP	0.00	0.0%
Savings from renewable energy	0.03	0.1%
Cumulative on-site savings	**11.31**	**46.6%**
Total target savings	24.29	100.0%
Shortfall	**12.98**	**53.4%**
Local carbon offset price (£/tCO_2)	£95	
Offset period (years)	30	
Total Offset Payment	**£36,983**	

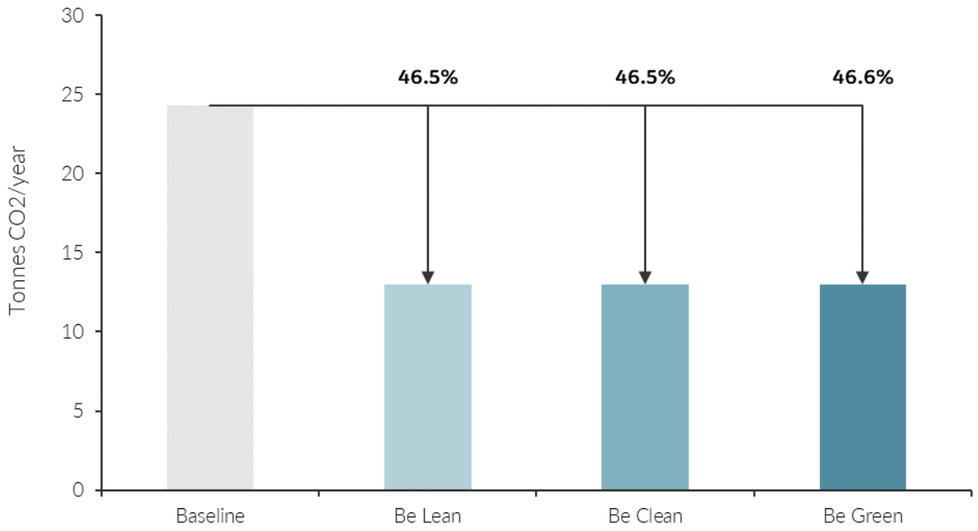


Figure 4 – Chart of regulated carbon dioxide emissions at each stage of the Energy Hierarchy – Refurbishment.

Table 4 - Regulated carbon dioxide emissions as each stage of the Energy Hierarchy – New Build – Part L 2013.

	Site-Wide Regulated Carbon Dioxide Emission Savings (tonnes CO_2/yr.)	
	Regulated	Unregulated
Baseline: Part L 2013 (SAP 10 carbon factors)	15.22	
After energy demand reduction (Be Lean)	9.81	
After heat network / CHP (Be Clean)	9.81	
After renewable energy (Be Green)	3.49	
	Site-Wide Regulated domestic carbon dioxide savings	
	(tonnes CO_2/yr.)	(%)
Savings from energy demand reduction	5.41	98.9%
Savings from heat network / CHP	0.00	0.0%
Savings from renewable energy	6.32	115.7%
Cumulative on-site savings	**11.73**	**77.1%**

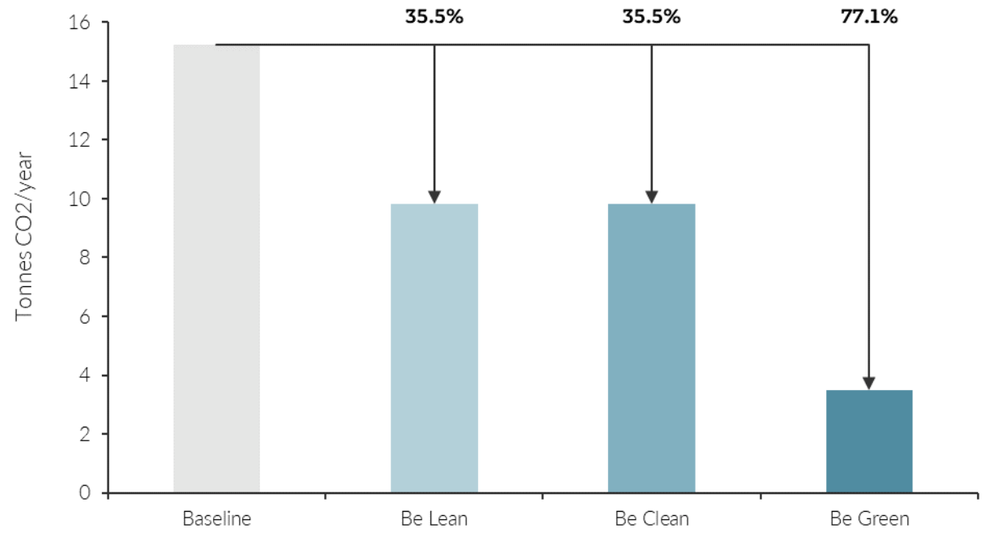


Figure 5 – Chart of regulated carbon dioxide emissions at each stage of the Energy Hierarchy – New Build Part L 2013.

Sustainability Strategy Summary

The Sustainability Strategy for Avalon House has been established in the context of current global challenges, and informed by both national and local policy requirements, Barings Real Estate's vision, and relevant sustainable design and development guidance and frameworks.

The project vision centres around the creation of a low carbon workplace building, with the user's health and wellbeing needs at the heart of design, delivered through significant re-use of the existing building and lowest embodied carbon cost.

The five key Sustainability outcomes for the project include the following:

1. An accessible and well-connected development that delivers social value to the wider community.
2. A positive and healthy place which enhances wellbeing and productivity.
3. A distinctive space integrating natural environments within an urban context, bridging between people & nature.
4. A low zero carbon, combustion free building, delivered at a low embodied carbon cost through circular economy principles.
5. Enabling sustainable growth through the creation of jobs and opportunities harnessing local talent.

Working with the project team we have actively engaged with the planning authority, local community groups and the general public throughout the planning process. Collaboration with the client and project team as well as key stakeholders has help to inform the innovative strategies for the proposed development.

Summary of the Key Sustainable Features.

The following list details the key sustainable features to be incorporated into the development which demonstrates the aspiration to go above and beyond planning policy:

- 100% retention of the existing substructure
- 100% retention of the existing superstructure
- Retention of façade on lower levels
- 95% of demolition waste materials diverted from landfill for reuse, recycling or recovery
- 95% of construction waste diverted from landfill for reuse, recycling or recovery
- Targeting >20% of new building elements to be comprised of recycled or reused content
- Targeting <560 $kgCO_2e/m^2_{GIA}$ Upfront Carbon (A1:A5),
- Target BREEAM 'Excellent' certification with an aspiration for 'Outstanding'.
- 53.9% improvement over Part L 2021 baseline for new areas
- 98.5m^2 PV array for onsite energy generation
- Target a biodiversity net gain

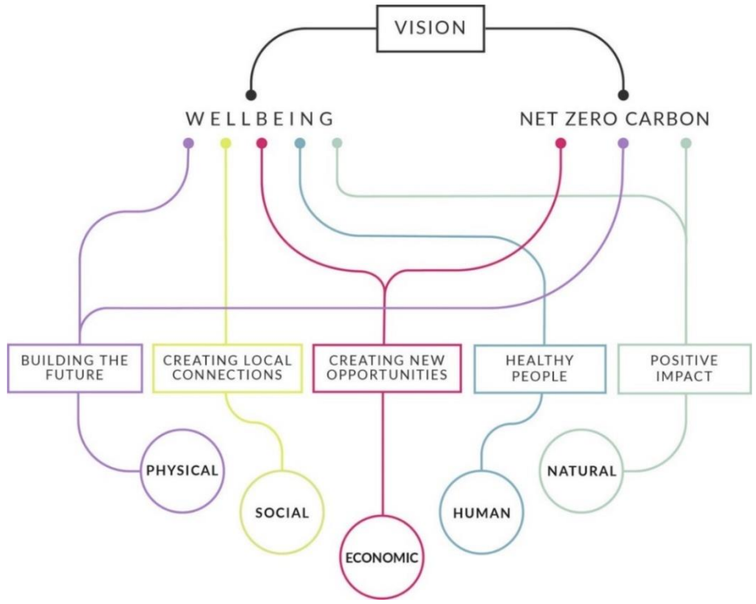


Figure 6 Sustainability vision for the development

1. Introduction.

This report has been prepared by Hoare Lea on behalf of Barings Real Estate, (hereafter referred to as 'the applicant') in support of the planning application for the proposed development of Avalon House (hereafter referred to as the 'proposed development') located within the London Borough of Richmond Upon Thames.

The overall objective of the proposed development is to sustainably reconfigure and extend the existing building to meet current industry standards, and provide a high quality workplace environment.

This report should be read in conjunction with the full planning submission reports. This Energy and Sustainability Statement has been prepared to demonstrate how the energy and sustainability related aspects of the Proposed Development meet the requirements of pertinent national and local planning policy.

1.1 Development Description.

"Remove the existing roof and erection of a roof extension at fourth floor and rear extensions to floors ground — four to accommodate additional commercial floorspace (Class E), provision of rear and rooftop terraced amenity spaces, alterations to the ground floor entrance, recladding and remodelling of the facade, landscaping improvements to the rear car parking area, provision of end of journey and cycle parking facilities, associated building servicing and sustainability improvements, and other associated works."

Figure 7 Proposed development (Source: Anomaly)

1.2 Site Context.

The Site is located in Richmond, bound by Lower Mortlake Road to the north and Tersha Street to the west, and commercial and residential buildings to the east and south. The existing building was completed in 2004.

2. Overview of policy drivers

Building Regulations: Approved Document Part L
Part L of the Building Regulations is the mechanism by which government is driving reductions in the regulated CO_2 emissions from buildings. The Proposed Development has been designed improve on the minimum performance parameters of the latest Part L (2021).

The assessment of the Proposed development against policy targets has been carried out using Building Regulations Part L (2021) referenced in the Draft Richmond Local Plan (2023). and Building Regulations Part L (2013) referenced in the Richmond Local Plan (2018).

Calculations demonstrating the energy requirements and associated CO_2 emissions for the development have been carried out using Building Regulations approved software IES VE.

Electricity grid decarbonisation
Recent progress in the energy sector has seen emissions associated with electricity consumption reduce drastically

The CO_2 factor for grid-supplied electricity in Building Regulations Part L (2013) was 0.519kgCO_2/kWh; as shown in Figure 8, this is a fair reflection of the performance of the grid at that time. However, in response to legally binding targets established in line with the Paris Agreement, significant progress has been made in decarbonising the electricity grid over the past 9 years.

The new ADL 2021 includes a significant reduction in the carbon factors for electricity, reducing from an annual average of 0.519 kgCO_2/kWh to 0.136kgCO_2/kWh (a 75% reduction). Previously, a constant carbon factor for electricity throughout the year was utilised. Due to fluctuations in the national electricity grid fuel mix throughout the year, the carbon emissions and primary energy factors in ADL 2021 vary on a monthly basis.

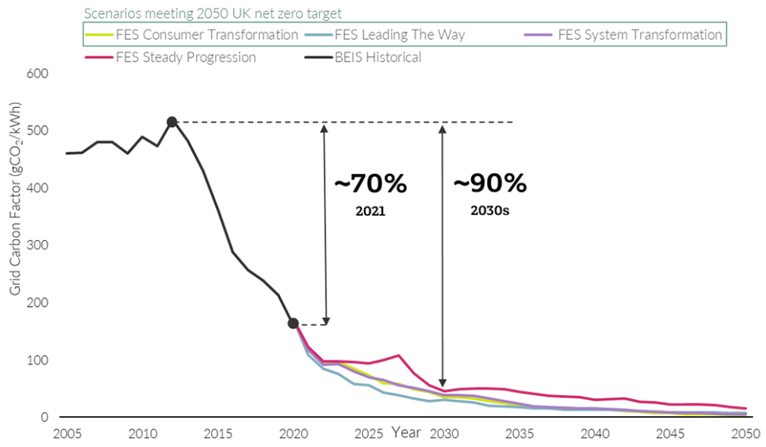


Figure 8: Historic and future projected carbon factor for the National Grid (8% transmission and distribution losses are included

2.1 Local Policy: London Borough of Richmond Upon Thames

The development's proposed energy and sustainability strategies are driven by the following Local Plan documents:

- Adopted Local Plan – July 2018
- Richmond Local Plan 'The best for our borough' Draft for consultation – June 2023

These documents set out the Council's current and proposed planning policies and provide guidance that helps create the conditions for harnessing the benefits of economic growth, reducing inequality and securing sustainable neighbourhoods.

The emerging Local Plan is not expected to be adopted until Winter 2024 at the earliest. The methodologies of the emerging Local Plan have been followed and its targets acknowledged.

Energy & Sustainability Policy Approach

The energy requirements of the Adopted Local Plan (2018) and the Draft Local Plan (2023) relevant to the Proposed Development have been summarised in Table 5. The development's response to each item has also been summarised.

Table 5: Local Plan Energy Planning Summary

Policy Area	Adopted Local Plan (2018) (Table 6.3.24)	Draft Local Plan (2023) (Table 16.3)	Development Response
Relevant Building Type	For new non-residential buildings, including extensions, over 100sqm floorspace:	For non-residential developments of 100sqm Gross Internal Area (GIA) or more (including new build, change of use and refurbishments):	
Sustainable Construction Checklist	Submit Sustainable Construction Checklist	Submit Sustainable Construction Checklist	Sustainable Construction Checklist submitted for the whole building (Refurbishment and New Build combined)
Part L Improvement and Carbon Offset Payment	35% reduction in CO2 emissions over Building Regulations (2013)	Net-zero with minimum 60% on-site reduction (Part L 2021); with a maximum of 40% to be offset at a rate of £300/t	Part L Improvements reported as follows: - New Build Improvement (Part L 2013) - New Build Improvement (Part L 2021). Offset payment has been calculated. - Refurbishment Improvement (Part L 2021 with GLA Baseline as per GLA Energy Assessment Guidance 2022). Offset payment has been calculated. A minimum 35% improvement will be targeted for each assessment.
London Plan Energy Hierarchy	Meet London Plan Energy Hierarchy	Meet London Plan Energy Hierarchy	London Plan Energy Hierarchy has been followed.
Energy Statement	Submit energy statement	Provide Energy Strategy in line with GLA Energy Assessment Guidance 2022	Energy Strategy in line with GLA Energy Assessment Guidance 2022 has been provided.
Energy Sources	N/A	No gas boilers after 2024	The development utilises an all-electric energy strategy
Overheating	N/A	Meet Part O, overheating mitigation requirements, and F, ventilation requirements, of Building Regulations.	The GLA Cooling check has been be carried out as per GLA Energy Assessment Guidance 2022
Renewables	N/A	Target of on-site renewable of 40% of building footprint	On-site renewables have been maximised
Development Energy Use Intensity	N/A	Disclose the anticipated Energy Use Intensity	Anticipated Energy Use Intensity has been calculated through a TM54 assessment and reported.
Fabric Energy Efficiency	N/A	Meet fabric efficiency targets as set out in Table 16.2 of the Local Plan (<15 kWh/m²/year space heating requirement)	Space heating requirement has been calculated and reported against the target.
Proposals above 500sqm (GIA) must also:			
Decentralised Energy Network Connection	Connect to existing or planned DE networks where feasible	Connect to existing Decentralised Energy Network (DEN) or one in the vicinity of the site.	Viability of a DHN connection has been assessed and connection made if viable.
Decentralised Energy Network Provision	N/A	Provide assessment of on-site DEN including microgeneration such as solar technologies	A single heating system serves the whole development, and provision has been made for future DHN connection.
BREEAM – New Build Elements	BREEAM 'Excellent'	BREEAM Non-domestic New Construction 'Outstanding', where applicable	A bespoke BREEAM assessment has been undertaken covering the New Build and Refurbishment areas of the development and an 'Excellent' rating targeted with an aspiration for 'Outstanding'.
BREEAM – Refurbished Elements	BREEAM 'Excellent'	BREEAM Non-domestic Refurbishment and Fit-out 'Outstanding', where applicable	A bespoke BREEAM assessment has been undertaken covering the New Build and Refurbishment areas of the development and an 'Excellent' rating targeted with an aspiration for 'Outstanding'.

3. Sustainability Strategy

This Sustainability Strategy for Avalon has been established in the context of current global challenges, and informed by both national and local policy requirements, the Applicant's vision, and relevant sustainable design and development guidance and frameworks.

The project approach to sustainability goes beyond minimising and managing impacts; it seeks to create value and generate a flow of real-term social, economic and environmental benefits to all stakeholders. This holistic approach captures the synergies and co-benefits between different areas of sustainability, enabling future-proof development that responds to the needs of people and planet.

To capture the multi-faceted sustainability benefits and values that Avalon House can bring to the site, local community, surrounding businesses, and future building users, five defined factors – the people, the building, the social network, the natural environment, and the economic aspects – inform our proposed sustainability framework.

The project vision centres around the creation of a zero carbon workplace building, with the user's health and wellbeing needs at the heart of design, delivered through significant re-use of the existing building and lowest embodied carbon cost.

The five key Sustainability outcomes for the project include the following:

1. An accessible and well-connected development that delivers social value to the wider community.
2. A positive and healthy place which enhances wellbeing and productivity.
3. A distinctive space integrating natural environments within an urban context, bridging between people & nature.
4. A net zero carbon, combustion free building, delivered at low embodied carbon cost through circular economy principles.
5. Enabling sustainable growth through the creation of jobs and opportunities harnessing local talent.

Working with the project team we have actively engaged with the planning authorities, local community groups and the general public throughout the planning process. Collaboration with the client and project team as well as key stakeholders has helped to inform the innovative strategies for the proposed development.

The Delivery Framework

Working with all key stakeholders, an overall vision for the development has been defined. Workshops have been held in collaboration with the client and project team to help create a charter including innovative initiatives and key objectives to be delivered as a result of the project. As illustrated in Figure 1 and 2 the strategy responds to the five elements of our defined framework; and is intended that the agreed objectives are tracked and monitored throughout project delivery and operational phases.

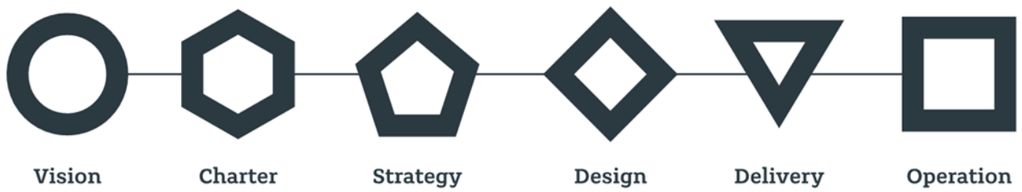


Figure 9 Sustainability strategy – Delivery phase (inception to completion)

3.1 BREEAM

In line with local policy drivers and the Applicant's sustainability aspirations, BREEAM will be targeted for the Proposed Development with an aspiration to achieve BREEAM 'Excellent' in line with the adopted local plan and an aspiration to achieve BREEAM Outstanding in line with the emerging local plan.

As the development comprises of both refurbishment and new build elements, it does not fall into the traditional BREEAM assessment schemes. Therefore, a bespoke set of criteria has been developed by the BRE to enable the building to be accurately assessed.

At this stage, all early action BREEAM credits have been achieved by the team to enable a BREEAM Excellent rating as a minimum with an aspiration for BREEAM 'Outstanding'. See Appendix A for a detailed pre-assessment.

The pre-assessment currently targets the following score / rating:

- BREEAM Score: 77.27%
- BREEAM Rating: 'Excellent'

The current pre-assessment targets all minimum standards for BREEAM 'Outstanding' in the Water, Materials and Pollution categories.

This represents the desire to exceed the minimum 70% required for BREEAM 'Excellent' by 7.27% A margin of 3-5% should be targeted over the required score at this stage in the design. As the design develops the project team will be actively aiming to increase the score and enable the aspirational target of BREEAM 'Outstanding' to be achieved.

Figure 10 BREEAM Scoring

Table 6 BREEAM Detailed Scoring

Category	Issue	Credits	
		Available	Targeted
Management	Man 01: Project Brief and design	4	4
	Man 02: Lifecycle Cost and Service Life Planning	4	4
	Man 03: Responsible Construction Practices **(M_e) (M_o)**	6	6
	Man 04: Commissioning and Handover **(M_e) (M_o)**	4	3
Health & Wellbeing	Hea 01: Visual Comfort	6	1
	Hea 02: Indoor Air Quality	3	1
	Hea 04: Thermal Comfort	3	2
	Hea 05: Acoustic Performance	2	2
	Hea 06: Safety and Security	1	1
Energy	Ene 01: Reduction of Energy Use & CO_2 Emissions **(M_e) (M_o)**	13.5	6
	Ene 02: Energy Monitoring **(M_v) (M_e) (M_o)**	2	2
	Ene 03: External Lighting	1	1
	Ene 04: Low Carbon Design	3	2
	Ene 06: Energy Efficient Transportation Systems	3	3
Transport	Tra 01: Public transport accessibility	3	3
	Tra 02: Proximity to Amenities	1	1
	Tra 03: Cyclist Facilities.	2	2
	Tra 05: Travel Plan	1	1
Water	Wat 01: Water consumption **(M_v) (M_e) (M_o)**	5	3
	Wat 02: Water Monitoring **(M_v) (M_e) (M_o)**	1	1
	Wat 03: Water Leak Detection and Prevention	2	2
	Wat 04: Water efficient equipment	1	1
Materials	Mat 01: Life Cycle Impacts	6	6
	Mat 03: Responsible Sourcing of Materials **(M_v) (M_e) (M_o)**	4	3
	Mat 04: Insulation	1	1
	Mat 05: Designing for Durability and Resilience	1	1
	Mat 06: Material Efficiency	1	1
Waste	Wst 01: Project Waste Management **(M_o)**	7	5
	Wst 02: Recycled Aggregates	1	0
	Wst 03: Operational Waste **(M_e) (M_o)**	1	1
	Wst 04: Speculative finishes	1	1
	Wst 05: Adaptation to Climate Change	1	1
	Wst 06: Functional Adaptability	1	1
Land Use and Ecology	LE 02: Protection of ecological features	1	1
	LE 04: Enhancing site ecology	1	1
	LE 05: Long term impact on biodiversity	2	2
Pollution	Pol 01: Impact of Refrigerants	3	1
	Pol 02: NOx Emissions	3	0
	Pol 03: Surface Water Run-off	5	3
	Pol 04: Reduction of Night Time Light Pollution	1	1
	Pol 05: Noise attenuation	1	1
Innovation	Inn 01: Exemplary Credits and Approved Innovations	3	2
	Targeted weighted score / rating:	77.27% 'Excellent'	

3.2 Climate change resilience

Overheating risk
Please see Section 5 for details of overheating strategy.

Flood risk and sustainable drainage
A Flood Risk Assessment and Sustainable Drainage Strategy has been produced by Elliot Wood in support of the application. This report demonstrates that the proposed development is at low risk of flooding from all potential sources, and that it can be occupied safely in the unlikely event of a peak flood event.

It is proposed to attenuate surface water run-off from the development area within the extent of works boundary to a peak discharge rate of 8.37l/s for all storm events up to an including the 1-in-100 years event plus 40% climate change. The peak discharge rate provides a greater than 63.7% reduction for all modelled storm events, including the 1-in1-year return period.

The development will achieve this by utilise permeable surfacing with a porous sub-base within the vehicular entrance road and car parking bays, with a below ground geo-cellular attenuation tank within the vehicular access area to the parking bays. The surface water flow rate from the geo-cellular attenuation tank is restricted via a vortex flow control device, and the permeable paving is restricted via an orifice plate. The vortex flow control device has a peak discharge flow rate at 4 l/s, and the orifice plate has a peak discharge flow rate at 4 l/s. The flow restrictors incorporated within the blue roofs restrict discharge flow rate to 0.37l/s for all blue roofed areas.

There are also several areas of proposed soft landscaping included within the scheme. It is anticipated that these areas of soft landscaping will not require positive drainage and will not require drainage connections for irrigation purposes. The proposed SuDS strategy draws on the CIRIA Four Pillars of SuDS by controlling and treating surface water runoff at source.

Further detail can be found in the Flood Risk Assessment and Sustainable Drainage Strategy.

3.3 Biodiversity

The landscaping design seeks to improve the existing site condition and introduce as much new greenery as possible, in order to soften the rear of the building and improve SUDs.

The hard and soft landscaping strategy takes into account user journeys and parking facilities, drainage, planting as well as sun paths and opportunities for green energy sources.

The design proposes for a shared landscape across the area and pockets of planting are introduced to further soften. The existing car park surface is to be replaced with permeable paving. The design intent is for greenery to be mixed into the paving to define the car parking spaces.

The roofing strategy consists of capturing and the opportunity to recycle rain water through the use of blue roofs. This is done in conjunction with the introduction of biodiverse and green roofs above the fire escape stairs, cycle stores, lift overrun, and main flat roof.

The scheme will provide integration of community space, bio-diverse planting, water harvesting and green roofs across the new roof space to create active space for both nature and the new building occupants.

Community space with shared meeting areas, communal and private terraces across the southern elevation of the building provide both indoor and outdoor meeting and event areas. The proposed window boxes allow for the integration of greenery into the south and west facades.

The proposals will include a species selection focused on creating year round interest, improvements to the site biodiversity and ecology, and variation in height, flower, seasonality and movement.

Full details of the planting strategy and species are to be further developed. For further information please refer to the Design and Access Statement.

3.4 Sustainable transport

A Transport Statement has been produce by Iceni in support of the planning application. The site is located close to numerous local facilities and public transport infrastructure with good access to active and sustainable travel networks. The Site has an excellent PTAL of 6a as a result of the proximity to several high frequency bus routes and Richmond railway station. It is shown throughout the Transport Statement that the proposed development accords with national, regional and local planning policy.

In summary, the uplift in trips, as a result of the additional Class E space is expected to be negligible and is not anticipated to result in any negative impacts. Overall, the provision of cycle parking and end of journey facilities combined with a reduction in car parking provides significant benefit compared to the current use in encouraging sustainable travel to the site.

Further details can be found in the Transport Statement.

3.5 Resource efficiency

Key Circular Economy principles will be implemented to ensure efficient use of natural resources. Measures include:

- A strategy to reduce, reuse and recycle materials minimising construction waste generation to 3.2 tonnes/100m^2 and achieving 95% diversion from landfill with at least 75% recycling rates. In addition the use of recycled aggregate will be considered for use throughout the development.
- On site environmental data during the construction phase will be collated, reviewed and verified to promote transparency and accountability. Upon project completion, the Applicant will disclose the waste arisings from the development via resource management plan.
- A minimum 10% of the total value of materials used in the construction will be derived from recycled and re-used content in the products and materials selected.
- A strict sustainable sourcing strategy aligned with industry best practice (e.g. ISO 20400 Sustainable procurement guidance) to be implemented to deliver sustainable outcomes through the whole value chain.
- The design of the new build elements will follow lean design principles to minimise the quantities of materials used. Specifically the design will maximise efficiencies achieved in off-site construction through the implementation of a standardised grid and pre-manufactured façade elements.
- The design will utilise assessment methods such as BREEAM ‘Excellent’ demonstrating excellence in sustainable design, construction and operation. This will address the efficient use of energy and water within the development through appropriate modelling and specification.

3.6 Pollution

Air quality

An Air Quality Assessment has been produced by Air Quality Consultants in support of the planning application. The Proposed Development will reduce the existing amount of car-parking provision by four spaces and therefore the amount of daily traffic associated with the Proposed Development will decrease.

Sustainable forms of transport to and from the Proposed Development will be encouraged through the adoption of a Travel Plan and Delivery and Servicing Plan, and all car parking spaces will include electric vehicle charging infrastructure.

The proposals involve the removal of the existing boilers and mechanical plant equipment, replacing them with Air Source Heat Pumps and installation of solar photovoltaic panels to ensure fully electric provision of energy and heating.

There will be no significant operational effects at any existing, sensitive receptor; a slight beneficial, but not significant, impact is anticipated.

During the construction works, a range of best practice mitigation measures will be implemented to reduce dust emissions and the overall effect will be ‘not significant’; appropriate measures have been set out in this report, to be included in the Dust Management Plan for the works.

Overall, the construction and operational air quality effects of the Proposed Development are judged to be ‘not significant’.

The Proposed Development has also been shown to meet the London Plan’s requirement that new developments are at least ‘air quality neutral’.

Further details can be found in the Air Quality Assessment.

Noise

A Noise Impact Assessment has been produced by Hoare Lea in support of the planning application. A noise impact assessment for the proposed redevelopment of Avalon House, Richmond, London has been carried out covering the operation of new building services plant, external terraces used for breakout purposes and the demolition and construction activities.

Operational noise limits for buildings services plant, background noise levels and initial building services plant selections have been identified and assessed with reference to nearest noise sensitive properties in Tersha Street, Cedar Terrace and West Sheen Vale.

Additional noise control mitigation for building services has been proposed. The results from incorporation of the mitigation indicate the proposed design criteria and hence London Borough of Richmond upon Thames requirements can feasibly be satisfied as the design progresses.

It is expected that the London Borough of Richmond upon Thames will apply standard conditions to secure the building services design criteria proposed, use of the external terraces and submission of a Noise and Vibration Demolition Method Statement (DMS) and a Construction Method Statement (CMS). On this basis, noise should not pose an obstacle to granting planning permission.

Further details can be found in the Noise Impact Assessment.

4. Energy strategy

4.1 The Energy Hierarchy

The energy strategy for the Proposed Development has adopted the energy hierarchy approach to reduce demand for energy prior to the consideration of integrating Low or Zero Carbon (LZC) technologies, since controlling demand is the most effective way of reducing energy requirements and CO_2 emissions.

Lean measures are adopted first, ensuring energy demand is minimised through good fabric performance, orientation, optimised glazing ratios and efficient services provision. Opportunities to connect to district heat network or community heating and cooling is then explored. Finally the feasibility of low or zero carbon technologies are investigated and appropriate technologies adopted for the Proposed Development.

Finally the 'Be seen' stage ensures that metering is in place to allow for monitoring of the energy consumption once the development is in operation. This is indicated diagrammatically in the figure below.

Figure 11: Energy Hierarchy Process

The following sections detail the passive design and energy efficiency measures that have been considered, and those that will be implemented at the Proposed Development. The effectiveness of the adopted measures have been assessed against a Building Regulations compliant baseline referred to as the notional dwelling or notional building. The percentage reduction for each stage is reported for regulated energy.

Currently, unregulated energy is not included within the Part L assessments but can form a significant part of overall energy consumption and CO_2 emissions from developments.

Definitions

The following definitions should be understood throughout this strategy:

- Energy demand – the 'room-side' amount of energy which must be input to a space to achieve comfortable conditions. In the context of space heating, this is the amount of heat which is emitted by a radiator, or other heat delivery mechanism.
- Energy consumption – the 'system-side' requirement for energy (fuel). In the context of a space heating system using a gas boiler, this is the amount of energy combusted (e.g. gas) to generate useful heat (i.e. the energy demand).
- Regulated CO_2 emissions – the CO_2 emissions emitted as a result of the combustion of fuel, or 'consumption' of electricity from the grid, associated with regulated sources (those controlled by Part L of the Building Regulations).
- Unregulated energy includes small power electricity use (computers, plug in devices) and catering energy consumption.

Disclaimer

The appraisals within this statement are based on Part L calculation methodology and should not be understood as a predictive assessment of likely future energy requirements or otherwise. Occupants may operate their systems differently, and / or the weather may be different from the assumptions made by Part L approved calculation methods, leading to differing energy consumption in practice.

4.2 Approach to Energy Assessment at the Proposed Development

Part L 2021

Energy assessment of the Proposed Development has been undertaken in line with the GLA's Energy Assessment Guidance (June 2022), as required by the London Borough of Richmond's Draft Local Plan (2023). This guidance outlines a variable assessment approach for new build and refurbishment which is summarised in Table 7.

The Proposed Development consists of both non-domestic refurbishment and new build elements. The energy model is divided into refurbishment and new build calculations. The areas assessed as new build comprise the extensions to the existing building.

Requirements for the Proposed Development are outlined in Table 7.

Table 7: GLA energy assessment methodology with Richmond Targets

Development type	Energy Hierarchy Stage	Target
New Build elements of the proposed development *GLA's Energy Assessment Guidance (June 2022) Section 6.1 – 6.14 & Section 7)*	All Major Developments	Zero Carbon for regulated emissions against Part L 2021 Baseline (i.e. 100% reduction in carbon emissions)
	Be Green	35% (GLA target) reduction in regulated emissions against Part L 2021 Baseline to be met on-site with remainder to be met via offset payments. Richmond 2023 Draft Plan targets 60% reduction.
	Be Lean	15% reduction in regulated emissions against the Part L 2021 Baseline from energy efficiency measures only (i.e. Be Lean stage reduction)
Refurbishment elements of the proposed development *GLA's Energy Assessment Guidance (June 2022) Section 6.15 – 6.25*	All Stages	Improvement against a GLA Refurbishment Baseline, based on Energy Assessment Guidance 2022 Appendix 3, at each stage of the energy hierarchy. No specific numerical target for improvement but "…every effort should be made to improve the energy performance of the building in line with London Plan carbon targets and to follow the energy hierarchy." (6.25) (GLA target). Richmond 2023 Draft Plan targets 60% reduction at Be Green.

To assess the development in line with GLA Energy Assessment Guidance (June 2022) requirements the modelling runs outlined in the table below have been carried out, and their results presented throughout this report.

Table 8: Part L 2021 Assessment Methodology

Energy Hierarchy Stage	New Build	Refurbishment
Baseline	Part L 2021 Baseline	GLA Energy Assessment Guidance June 2022 Appendix 3 Baseline
Be Lean	As per New Build Be Green, but with notional heating + hot water efficiencies. PV removed.	As per Refurbishment Be Green, but with notional heating + hot water efficiencies. PV removed.
Be Clean	Proposed New Build, including any CHP or Heat Network connection (not applicable for this development)	Proposed Refurbishment, including any CHP or Heat Network connection (not applicable for this development)
Be Green	Proposed New Build, including proposed heating + hot water efficiencies and PV	Proposed Refurbishment, including proposed heating + hot water efficiencies and PV

Part L 2013

The London Borough of Richmond's Adopted local Plan (2018) required the new build elements of the Proposed Development to achieve a 35% emissions reduction against Part L 2013, following the GLA Energy Hierarchy.

This will be assessed using the latest GLA Energy Assessment Guidance pertaining to Part L 2013, published in 2020. The process for this assessment is summarised in

Table 9: Part L 2013 Assessment Methodology

Energy Hierarchy Stage	New Build
Baseline	Part L 2013 Baseline
Be Lean	As per Be Green, but with 91% efficient boilers for heating and hot water. PV removed.
Be Clean	As per Be Lean, including any CHP or Heat Network connection (not applicable for this development)
Be Green	Proposed New Build, including proposed heating + hot water systems and PV

New Build and Refurbishment Split

The development has been split into new build and refurbishment areas for energy assessment purposes as set out in the previous sections. The demarcation has been determined by assessing the existing, building drawings, demolition drawings, and proposed building drawings. The split can be seen in Figure 12

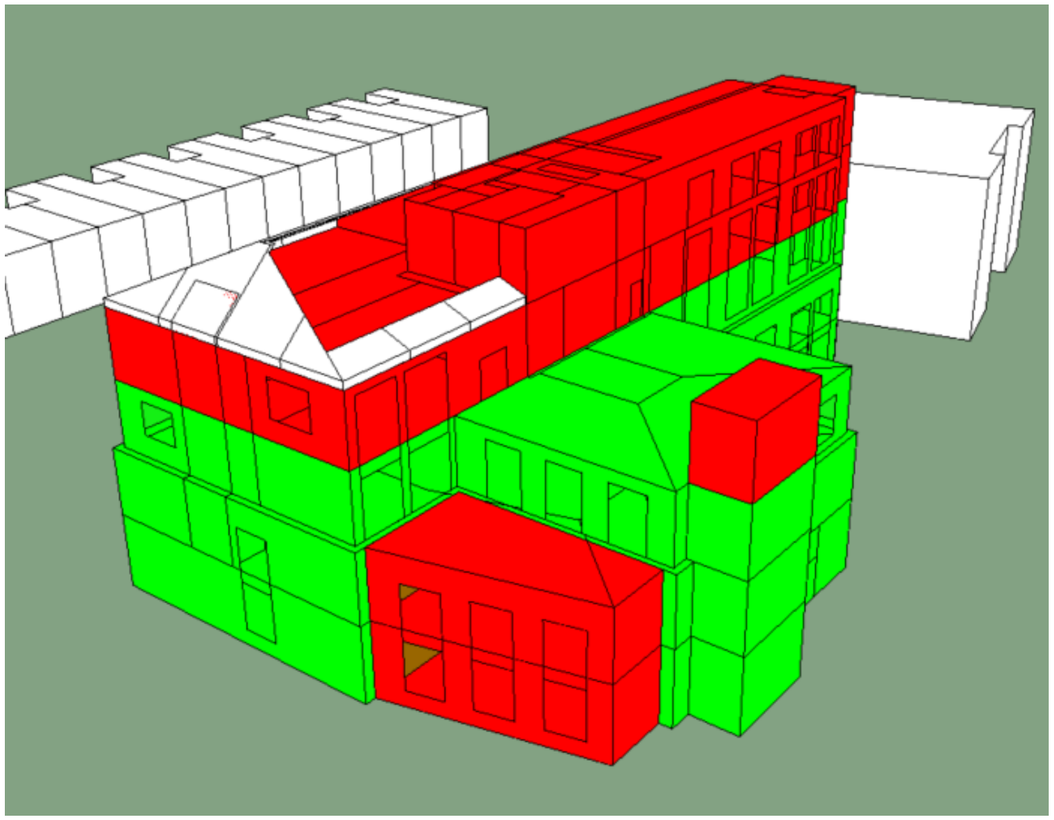


Figure 12: New Build (Red) and Refurbishment (Green) energy assessment split

5. Cooling and overheating

5.1 Cooling hierarchy

The 'cooling hierarchy' sets out prioritised measures for minimising overheating risk, illustrated in the figure below. The design response for the Proposed Development against each of the hierarchy items are summarised in table opposite.

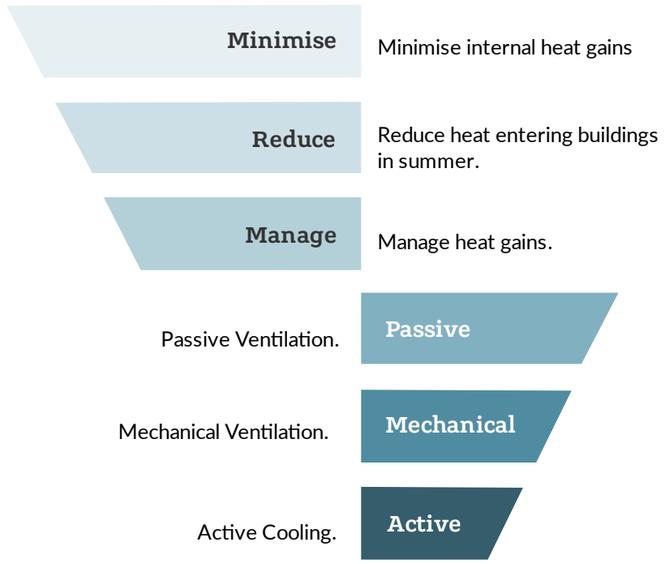


Figure 13: Cooling hierarchy.

5.2 Non-Domestic Cooling Demand Reduction

The table below compares the cooling energy demand of the whole building against a notional building built to Part L 2021 parameters, indicating a reduction of the cooling demand against the Part L 2021 notional building. This is required as set out in the GLA Energy Assessment Guidance 2022.

Table 10: Cooling Demand Reduction.

Space Use	Notional building	Actual building
Cooling demand (MJ/m^2)	267,850	139,563
Cooling demand (MJ/m^2/year)	65.98	34.38

Minimising internal heat gains

The following mitigation methods will be implemented to minimise the internal heat generation through energy efficient design at the Proposed development:

- Energy efficient lighting (i.e. LED) with low heat output.
- Insulation to heating and hot water pipework and minimisation of dead-legs to avoid standing heat loss.
- Energy efficient equipment with low heat output to reduce unnecessary heat gain.

Reducing the amount of heat entering the building in summer

The following mitigation methods will be implemented to reduce the amount of heat entering the building in summer within the proposed development:

- Facades have been developed with suitable glazing-to-solid ratios, with particular focus on south facing orientations.
- Suitable g-values will be specified to further control solar heat gains as required; and
- Buildings will have the capability for internal blinds to be installed to improve occupant comfort.

Passive ventilation

The potential for passive ventilation via opening facades to facilitate a mixed-mode ventilation strategy has been considered but is considered not feasible for the proposed development.

Mechanical ventilation

Mechanical ventilation is an important element of building services, to maintain good indoor air quality throughout the day by providing fresh air and extracting vitiated air.

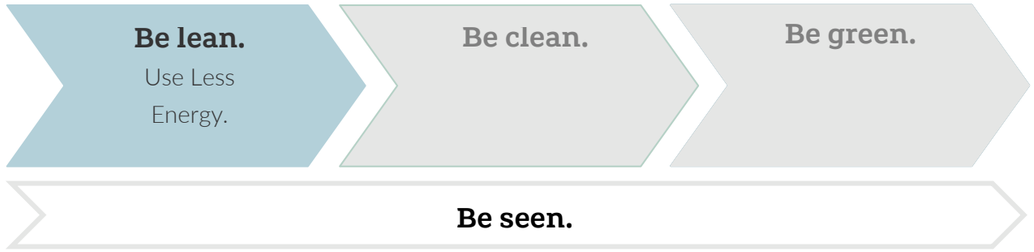
In line with BREEAM requirements, all air intake and discharge positions shall be separated by at least 10m to prevent the recirculation of vitiated air, and all air intakes will be at least 20m from any external sources of pollution. The design flow rates specified will aid the regulation of internal temperatures in summer months.

Active cooling

As the final step active cooling is specified, in order to keep internal temperatures within acceptable limits. The façade and building services have been designed with a fan coil unit cooling solution.

6. Be Lean.

Passive design and energy efficiency measures form the basis for the reduction in overall energy demand and carbon emissions for the proposed development. This energy strategy aims reduce the energy demand initially by optimising the envelope and building services within the proposed development.



6.1 Passive design and energy efficiency features.

Passive design measures are those which reduce the demand for energy within buildings, without consuming energy in the process.

These are the most robust and effective measures for reducing CO_2 emissions as the performance of the solutions, such as wall insulation, is unlikely to deteriorate significantly with time, or be subject to change by future property owners. In this sense, it is possible to have confidence that the benefits these measures will continue at a similar level for the duration of their installation.

Table 11 - Target and proposed fabric performance values

Building Element	Part L 2021 Limiting Values – New or replacement elements	Part L 2021 Notional Building Values	Development Performance
Air Permeability ($m^3/h.m^2$ at (50Pa))	8	3	3
External wall U-value ($W/m^2.K$)	0.26	0.18	0.12
Windows ($W/m^2.K$)	1.60	1.40	1.00
Façade Glazing Ratio	40%	40%	40%
Roof u-value (W/m^2K)	0.18 (flat)	0.15	0.10
Ground / Exposed Floor U-value (W/m^2K)	0.18	0.15	0.10
Internal Floor/Ceiling U-value (W/m^2K)		1.00	1.00
Rooflights (W/m^2K)	2.20	2.10	2.00
Pedestrian Doors (W/m^2K)	1.60	1.90	1.60
Glazing Performance			
Window g-value		0.29	0.28
Rooflight g-value		0.40	0.28
Window light transmittance		0.6	0.6
Rooflight light transmittance		0.71	0.71
Window Frame Factor		0.10	0.10
Rooflight Frame Factor		0.15	0.15

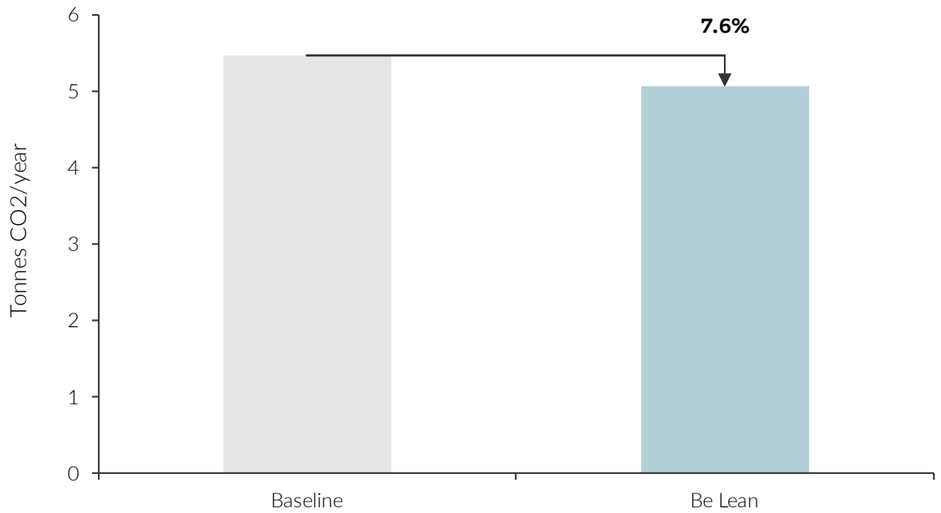
Table 12 – Be Lean target services performance values

Services Item	Unit	
Heat Pump Heating Efficiency		2.64 (GLA Be Lean value) ASHP heating proposed for the majority of the development
Direct Electric Heating Efficiency		1.34 (GLA Be Lean value for direct electric heating) Direct electric heating proposed for minor areas of the development
Heat Pump Cooling Efficiency		3.76
Comms Cooling DX Efficiency		6.00
Domestic Hot Water Heating Efficiency		1.00 (GLA Be Lean value for direct electric DHW)
Ventilation Specific Fan Power	W/l/s	1.60
Ventilation Heat Recovery	%	79.5
Fan Coil Unit Specific Fan Power	W/l/s	0.17
Trench Unit Specific Fan Power	W/l/s	0.15
Lighting - Office	$W/m^2/100lux$	1.1
Lighting - Other	lm/W	120
Lighting Controls		FOH Spaces: Auto-On-Dimmed BOH Spaces: None Offices: Perimeter daylight dimming

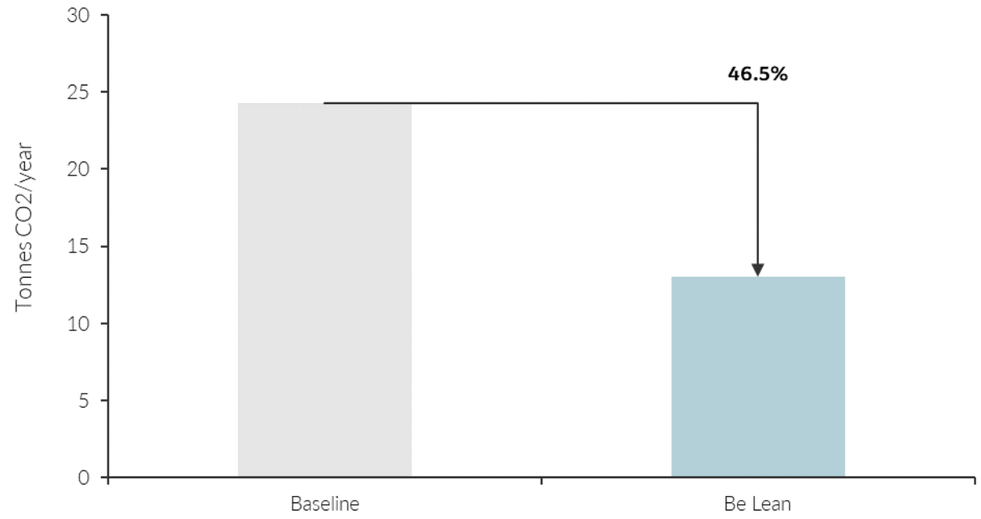
Be Lean summary.

New build Part L 2021 Target: 15% carbon reduction	7.8% reduction over baseline Appendix B details the target fabric and system performance parameters.
Refurbishment Target: improvement over baseline	46.5% reduction over baseline Appendix B details the target fabric and system performance parameters
New build Part L 2013 Target: N/A	41.9% reduction over baseline Appendix B details the target fabric and system performance parameters.

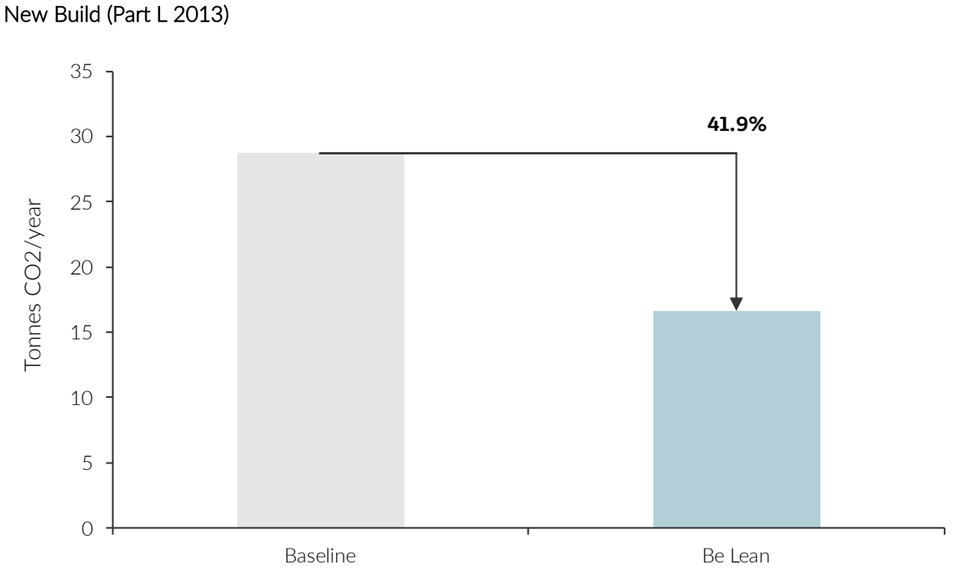
New Build (Part L 2021)



Refurbishment (GLA refurbishment baseline)

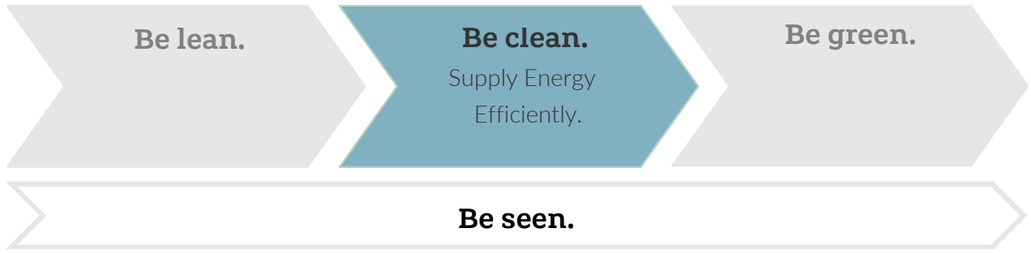


New Build (Part L 2013)



8. Be Clean.

This stage of the energy hierarchy includes consideration of connection to available district heat networks, or the use of on-site heat networks and decentralised energy production such as Combined Heat and Power (CHP) in order to provide energy and reducing consumption from the national grid and gas networks, through the generation of electricity, heating and cooling on-site.



8.1 Be clean: network and technologies.

The following sections detail considerations of the infrastructure and low-carbon energy supply measures that have been considered.

Combined heat and power (CHP)

Changes to the carbon factor of grid electricity have meant that previously favoured systems such as Combined Heat and Power (CHP) are becoming much less carbon efficient. In fact, CHP systems are now expected to lead to greater carbon emissions than conventional gas-fired boilers due to their lower efficiency.

Due to the decarbonisation of the electricity grid, alongside air quality concerns, CHP is not proposed.

Decentralised heat networks

Heat Network Priority Area (HNPA)

The majority of central London is identified as a Heat Network Priority Area, i.e., areas where heat density is sufficient for heat networks to provide a competitive solution for supplying heat to buildings and consumers.

The proposed development is located within an area of relatively low heat density[1]

Existing heat networks

The London Heat Map highlights the proposed Hounslow Borough Heat Network – Phase 1 DHN proposed by the Royal Borough of Hounslow, approximately 2 km from the Proposed Development, and the other side of the River Thames. This network does not therefore represent a viable connection opportunity at this stage for the project.

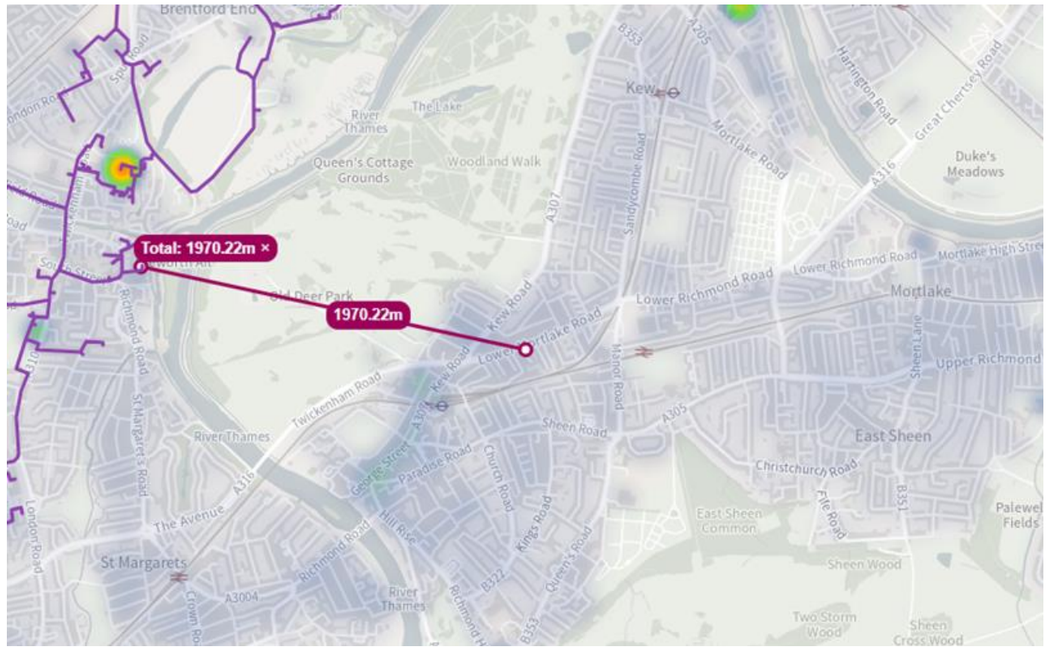


Figure 14: London Heat Map showing the Proposed Development and the closest proposed or existing DHN.

Plant space allowance will be made for a future heat network connection and pipework routes to the site boundary will be safeguarded, enabling a potential future connection to a DHN.

All spaces are proposed to be served by the central ASHP system. This maximises the utility of the central system and ensures that a single point of connection is provided to enable all areas to connect to a District Heating Network, should one become available in the future.

Decentralised heat networks summary

Table 13: Heat network summary

Development in a Heat Network Priority Area (HNPA)	Yes, high
District Heating Network connection	Not available
Borough energy officer and Heat Network Operator contacted	Yes, see Appendix D
Development future proofed for DHN connection	Yes, see Appendix D
Drawings of communal system provided	Yes. See Appendix D

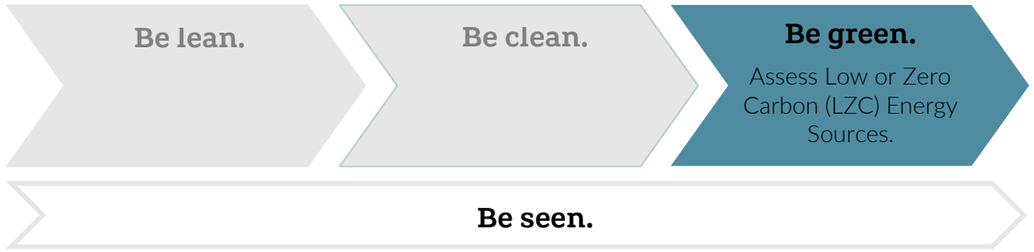
[1] London Heat Map (http://www.londonheatmap.org.uk)

Be Clean summary.

New build (Part L 2021) Target: DHN Connection	No further reduction over baseline There are no existing or planned district energy networks within feasible vicinity of the site that would enable a connection to the Proposed Development, nor are there currently any feasible future connections planned
Refurbishment Target: DHN Connection	No further reduction over baseline There are no existing or planned district energy networks within feasible vicinity of the site that would enable a connection to the Proposed Development, nor are there currently any feasible future connections planned
New build (Part L 2013) Target: DHN Connection	No further reduction over baseline There are no existing or planned district energy networks within feasible vicinity of the site that would enable a connection to the Proposed Development, nor are there currently any feasible future connections planned

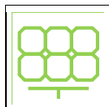
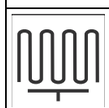
9. Be Green.

The final step of the energy hierarchy explores the feasibility of Low and Zero Carbon (LZC) technologies to allow for the production of renewable energy onsite in order to deliver further reduction in carbon emissions. Full Be Green Modelling inputs can be found in Appendix B.



9.1 Low and zero carbon (LZC) technology assessment.

Renewable or zero carbon technologies harness energy from the environment and convert this to a useful form. Many renewable technologies are available, however, not all of these are commercially viable or suitable.

	**Photovoltaics.** Photovoltaic (PV) panels harness energy from daylight and converts this into useful energy in the form of electricity. A PV system requires viable roof space in order for the array to be installed and function effectively. The Proposed Development will maximise space allocated to PV on the roof. 98.5m² of panel area is possible and is proposed. The proposed PV system is described in Table 14.
	**Solar thermal.** Solar Thermal Panels are similar to PV Panels in that they harness energy from solar irradiation. This technology however converts solar into thermal energy that can offset the demand on hot water generation systems. Solar thermal systems are not proposed for the Development as preference will be to assign available roof space to a photovoltaic array serving the Development.
	Heat pumps. Air Source Heat Pump (ASHP) and Ground Source Heat Pumps (GSHP) work to extract heat from the air or the ground. Generally, GSHPs are more efficient as the ground temperature is more stable over the course of the year relative to the air temperature, however overall output can be less. The proposed development is retaining the existing ground floor and foundations and therefore access to the ground for GSHP installation is prohibitive. Currently analysis to date suggests that a strategy led by air source heat pumps is the most appropriate option for the Proposed Development, and this solution is expected to reduce carbon emissions considerably in real terms. The use of heat pumps also enables a fossil fuel free development. For this reason, the technology has been included as the main heating and cooling source in the Proposed Development. The development will be served by an ASHP array with SCOP of 3.62. Some minor areas will be served by electric panel heaters.
	**Wind turbine.** Wind turbines provide high efficiency and capacity of electricity generation. However are not generally considered appropriate for town centre applications due to noise which may be a nuisance to neighbouring properties. Further. small wind turbines are known to provide only limited carbon reductions in reality, and this technology is best suited to large, stand-alone wind farm proposals. Considering the impacts described and the visual impact of wind turbines on the character and appearance of the area, the use of wind turbines will not be proposed for the development.
	**Biomass.** Biomass boilers burn wood fuel or other bio-fuel sources to generate heat. These boilers can operate at high efficiencies, comparable to condensing gas boilers. However, they require a large fuel store to maintain continuous operation during the winter months. As such, area take for such plant is high. Furthermore, security of fuel supply is an important consideration. As this technology would lead to in an increase of local NOx emissions from the Proposed Development, resulting in a reduction in the local air quality, together with compromising the all-electric scheme aspirations, the use of biomass boilers at the Proposed Development is considered to be unsuitable.

9.2 PV System Performance

The proposed PV system is described in Table 14.

Table 14 – PV Performance Summary

Services Item	Unit	Performance
Heat Pump Heating Efficiency		3.62
PV Area	m²	98.5
Orientation	° from North	160.2°
Tilt	° from horizontal	30°
Shading Factor		1 (no shading)
PV Type		Monocrystalline Silicon
Nominal Efficiency	%	20.1%
Nominal cell temperature	°C	42°C
Rated Power	(kWdc/m²)	0.2285
Degradation Factor		0.99
Electrical Conversion Factor		0.96

9.3 ASHP System Performance

Table 15: Target air source heat pump specification

	Air source heat pump
Capacity per ASHP (Cooling)	168.9kW
Capacity per ASHP (Heating)	133.3kW
No. ASHP	2
SCOP	3.62
SEER	3.67
Heating Flow / Return Temperature °C	45/40
Cooling Flow / Return Temperature °C	7/13
Manufactures Specification & Efficiencies	Mistubishi – NX-Q-G06-LN-EC-0804 See Appendix E

Heat Fraction

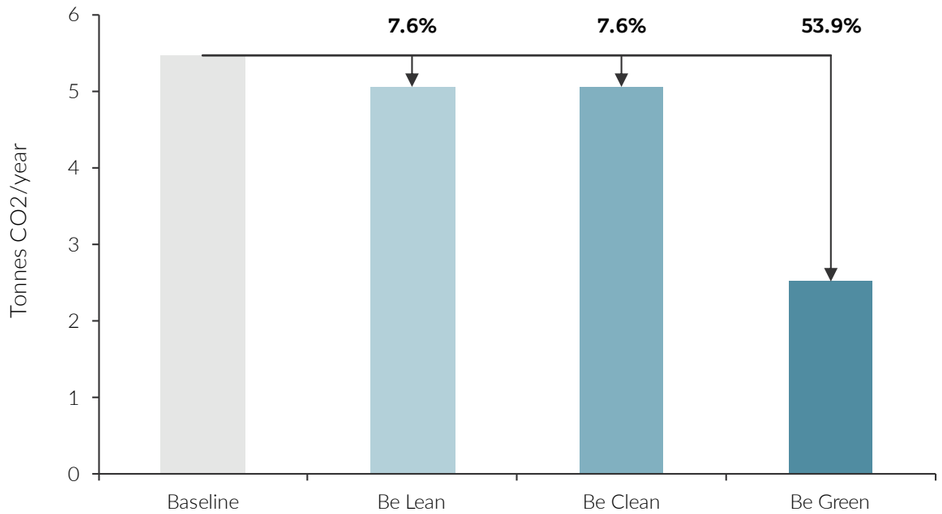
Table 16: Heat fraction

	% Heat fraction (space heating and DHW)
ASHP	44%
Direct electric / POU water heaters	56%
District heat network	0%
Gas boiler	0%
Other	0%

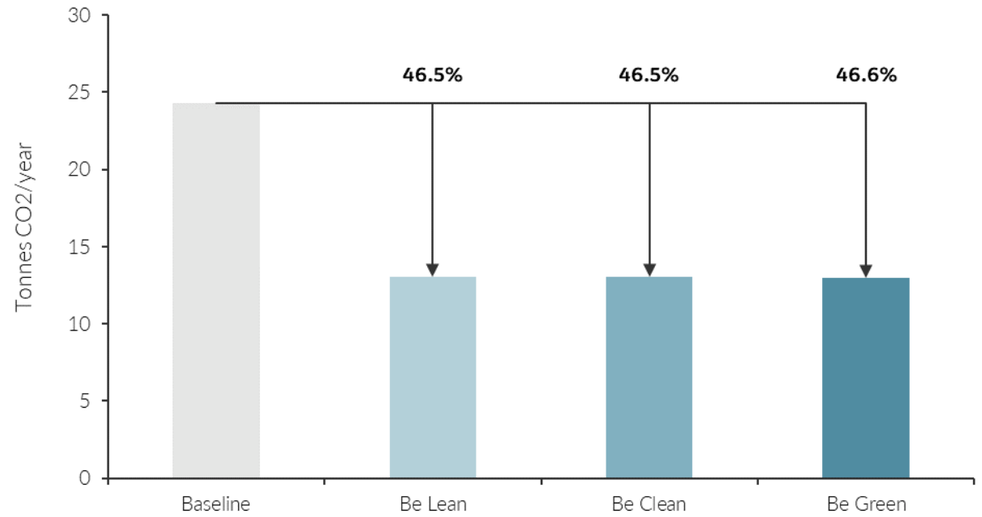
Be Green summary.

New Build (Part L 2021) GLA Target: 35% carbon reduction LBR 2023 Draft Local Plan Target: 60% carbon reduction	**53.9% reduction over baseline** Air source heat pumps, DX comms cooling and electric panel heaters will provide space heating, cooling, and hot water. 98.5m² of PV is proposed.
Refurbishment GLA Target: improvement over baseline LBR 2023 Draft Local Plan Target: 60% carbon reduction	**46.6% reduction over baseline** Air source heat pumps, DX comms cooling and electric panel heaters will provide space heating, cooling, and hot water.
New Build (Part L 2013) Target: 35% carbon reduction	**73.0% reduction over baseline** Air source heat pumps, DX comms cooling and electric panel heaters will provide space heating, cooling, and hot water. 98.5m² of PV is proposed.

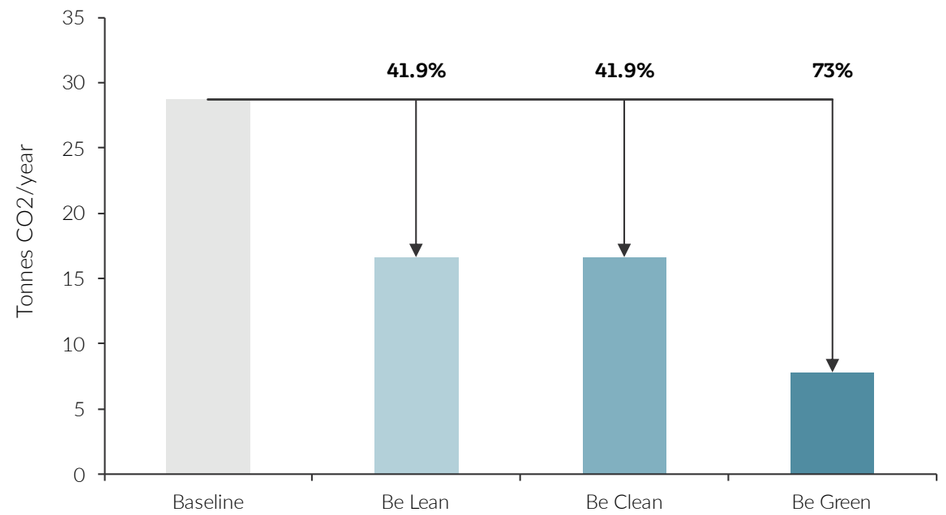
New Build (Part L 2021)



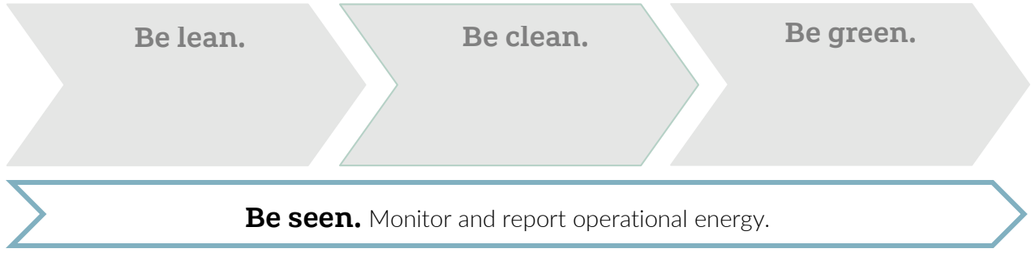
Refurbishment (GLA refurbishment baseline)



New Build (Part L 2013)



10. Be Seen.



10.1 Monitoring and Reporting.

Effective energy metering will be enabled by the provision of suitable infrastructure within the building's services systems.

Sustainability Monitoring and Reporting

The Applicant is committed to reporting sustainability performance, methodology and data every year in a transparent way, following the GRI guidelines. An annual Sustainability Report is published which contains agglomerated data concerning the Energy, Water, Waste and Greenhouse Gases reports of their portfolio.

Development Monitoring and Reporting Plan

The Proposed Development would therefore fall under the Applicant's corporate sustainability monitoring and reporting regime. The developed strategy will allow for an exhaustive metering of all the various energy usage in the facility. This will enable Energy Intensity and Carbon Emissions to be monitored, and the data included within the Annual Sustainability Reports.

Electrical meters will be provided on the main central Air Source Heat Pump(s), providing data on plant energy consumption throughout the year.

Each area of high energy load will be sub-metered in order to monitor energy consumption in greater granularity and facilitate reporting. All the main sub-systems (i.e. small power, lighting etc) will be separately monitored and their energy usage separately accounted. Energy intensity and carbon emissions will be monitored and reported annually.

The Applicant has also completed the planning stage of the GLA's be seen spreadsheet and at future stages will update the spreadsheet and follow the GLA's suggested be seen energy reporting protocols via the appropriate webs portals once these are available, at the appropriate stage.

10.2 Operational cost.

Operational costs for end users are an important consideration when appraising Energy Strategy options. Focussing solely on carbon emissions can lead to unintended consequences in the form of higher-than-expected occupant energy bills if capital and operational expenditure of the energy systems and networks are passed on to end users.

The new build element of the Proposed Development is anticipated to achieve a 7.6% reduction in CO_2 emissions beyond the Part L 2021 baseline, and the refurbishment a 46.5% reduction in CO_2 emissions beyond the GLA Refurbishment baseline, before the consideration of any Low or Zero Carbon (LZC) technologies, i.e. via passive design and energy efficiency measures. The savings achieved through the Be Lean stage demonstrate an energy demand reduction that will result in savings for future occupants.

Additionally, the following measures have been implemented or followed to protect occupants from rising energy costs:

- Followed quality standards to ensure optimum design such as CIBSE Code of Practice
- Inclusion of solar PV to reduce dependence in grid electricity.

Unregulated Energy

Unregulated energy includes small power electricity use (computers, plug in devices, washing machines, refrigeration) and catering energy consumption.

It is anticipated that the proportion of unregulated energy would gain in significance when compared to regulated energy as each revision of Building Regulations Part L comes into force and regulated energy is reduced.

It is therefore foreseeable that energy efficiency and the rising cost of energy would play an increasing role when future building users are deciding which appliances to purchase and the frequency of their use. However, it is not possible at present to quantify the extent of this potential reduction.

Given the uncertainty, measures to educate the future building users on how they can reduce their equipment energy use would be encouraged. This can be provided in the form of building user guides fit-out guides. The guidance measures detailed within these types of documents would consider:

- Use of A / A+ rated white goods
- Energy star rated computers and flat screen monitors, and voltage optimization and power factor correction.

11. Energy strategy summary

This strategy has shown that the Proposed Development will result in a highly efficient, low-carbon scheme.

New, high efficiency servicing equipment and efficient façades will minimise the energy usage of the building. Using the Mayor's energy hierarchy, the strategy has been developed to ensure that the Proposed development are efficient and economical.

This strategy has been prepared to demonstrate that at the planning stage, the Applicant and design team have given due consideration to the principles of energy and sustainability, and how these could be implemented for the Proposed Development.

The carbon emissions from regulated energy uses at the proposed development have been compared with the emissions targets of the London Borough of Richmond Adopted (2018) and Draft (2023) Local Plans.

The strategy has been developed using the 'be lean, clean and green' energy hierarchy which utilises a fabric first approach to maximise reduction in energy through passive design measures.

Be Lean.

New build Part L 2021 Target: 15% carbon reduction	7.6% reduction over baseline Appendix B details the target fabric and system performance parameters.
Refurbishment Target: improvement over baseline	46.5% reduction over baseline Appendix B details the target fabric and system performance parameters
New build Part L 2013 Target: N/A	41.9% reduction over baseline Appendix B details the target fabric and system performance parameters.

Be Clean.

New build (Part L 2021) Target: DHN Connection	No further reduction over baseline There are no existing or planned district energy networks within feasible vicinity of the site that would enable a connection to the Proposed Development, nor are there currently any feasible future connections planned
Refurbishment Target: DHN Connection	No further reduction over baseline There are no existing or planned district energy networks within feasible vicinity of the site that would enable a connection to the Proposed Development, nor are there currently any feasible future connections planned
New build (Part L 2013) Target: DHN Connection	No further reduction over baseline There are no existing or planned district energy networks within feasible vicinity of the site that would enable a connection to the Proposed Development, nor are there currently any feasible future connections planned

Be Green.

New Build (Part L 2021) GLA Target: 35% carbon reduction LBR 2023 Draft Local Plan Target: 60% carbon reduction	53.9% reduction over baseline Air source heat pumps, DX comms cooling and electric panel heaters will provide space heating, cooling, and hot water. 98.5m² of PV is proposed.
Refurbishment	46.6% reduction over baseline
GLA Target: improvement over baseline LBR 2023 Draft Local Plan Target: 60% carbon reduction	Air source heat pumps, DX comms cooling and electric panel heaters will provide space heating, cooling, and hot water.
New Build (Part L 2013) Target: 35% carbon reduction	73.0% reduction over baseline Air source heat pumps, DX comms cooling and electric panel heaters will provide space heating, cooling, and hot water. 98.5m² of PV is proposed.

Carbon offset payment.

New Build (Part L 2021) Target: 100% reduction of New Build calculated emissions.	Estimated payment: £7,183
Refurbishment Target: 100% reduction of New Build calculated emissions.	Estimated payment: £36,983
New Build (Part L 2013)	N/A

New Build (Part L 2021)

Table 17 - Regulated carbon dioxide emissions as each stage of the Energy Hierarchy – New Build – Part L 2021.

	Site-Wide Regulated Carbon Dioxide Emission Savings (tonnes CO_2/yr.)	
	Regulated	Unregulated
Baseline: Part L 2021	5.47	
After energy demand reduction (Be Lean)	5.05	
After heat network / CHP (Be Clean)	5.05	
After renewable energy (Be Green)	2.52	
	Site-Wide Regulated domestic carbon dioxide savings	
	(tonnes CO_2/yr.)	(%)
Savings from energy demand reduction	0.41	7.6%
Savings from heat network / CHP	0.00	0.0%
Savings from renewable energy	2.53	46.3%
Cumulative on-site savings	**2.95**	**53.9%**
Total target savings	5.47	100.0%
Shortfall	**2.52**	**46.1%**
Local carbon offset price (£/tCO_2)	£95	
Offset period (years)	30	
Total Offset Payment	£7,183	

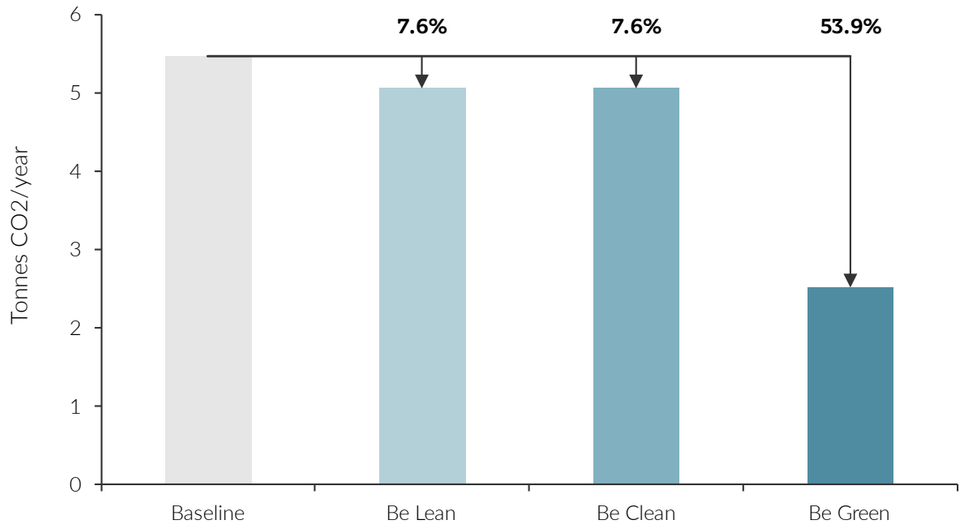


Figure 15 – Chart of regulated carbon dioxide emissions at each stage of the Energy Hierarchy – New Build – Part L 2021.

Refurbishment

Table 18 - Regulated carbon dioxide emissions as each stage of the Energy Hierarchy – Refurbishment – Part L 2021 with GLA .Refurbishment Baseline

	Site-Wide Regulated Carbon Dioxide Emission Savings (tonnes CO_2/yr.)	
	Regulated	Unregulated
Baseline: Part L 2021 GLA Refurbishment Baseline	24.29	
After energy demand reduction (Be Lean)	13.00	
After heat network / CHP (Be Clean)	13.00	
After renewable energy (Be Green)	12.98	
	Site-Wide Regulated domestic carbon dioxide savings	
	(tonnes CO_2/yr.)	(%)
Savings from energy demand reduction	11.28	46.5%
Savings from heat network / CHP	0.00	0.0%
Savings from renewable energy	0.03	0.1%
Cumulative on-site savings	**11.31**	**46.6%**
Total target savings	24.29	100.0%
Shortfall	**12.98**	**53.4%**
Local carbon offset price (£/tCO_2)	£95	
Offset period (years)	30	
Total Offset Payment	£36,983	

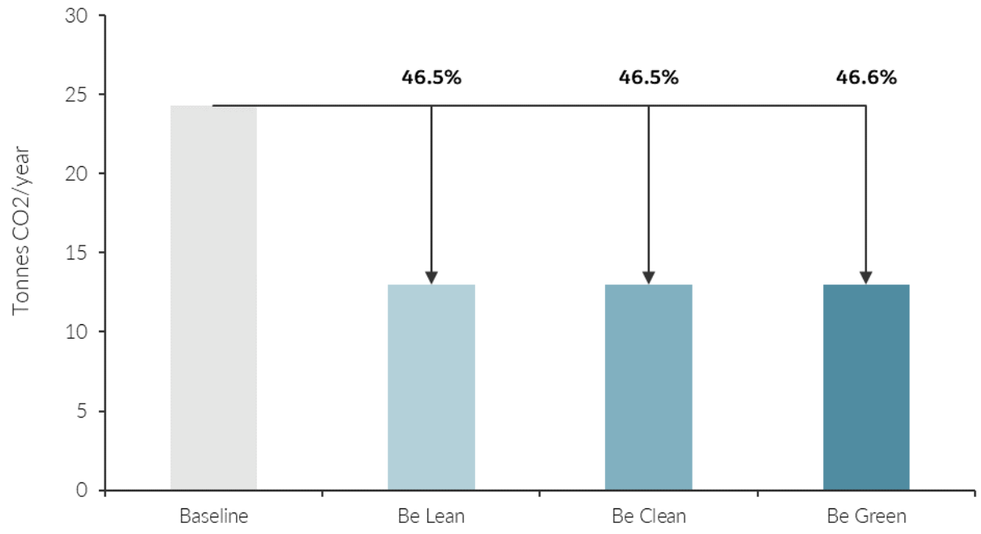


Figure 16 – Chart of regulated carbon dioxide emissions at each stage of the Energy Hierarchy – Refurbishment.

New Build (Part L 2013)

Table 19 - Regulated carbon dioxide emissions as each stage of the Energy Hierarchy – New Build – Part L 2013.

	Site-Wide Regulated Carbon Dioxide Emission Savings (tonnes CO_2/yr.)	
	Regulated	Unregulated
Baseline: Part L 2013 (SAP 10 carbon factors)	29	
After energy demand reduction (Be Lean)	17	
After heat network / CHP (Be Clean)	17	
After renewable energy (Be Green)	8	
	Site-Wide Regulated domestic carbon dioxide savings	
	(tonnes CO_2/yr.)	(%)
Savings from energy demand reduction	12	41.9%
Savings from heat network / CHP	0	0.0%
Savings from renewable energy	9	31.1%
Cumulative on-site savings	**21**	**73.0%**

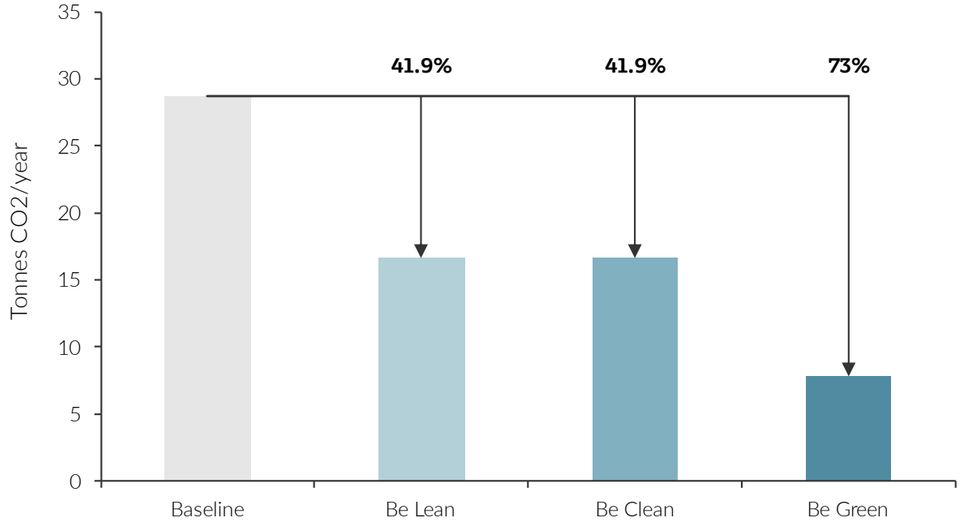


Figure 17 – Chart of regulated carbon dioxide emissions at each stage of the Energy Hierarchy – New Build – Part L 2013.

11.1 Energy use intensity and space heating demand.

Building type	Energy Use Intensity | EUI kWh/m^2_{GIA}/yr Excluding renewables	Space heating demand kWh/m^2_{GIA}/yr Excluding renewables	Methodology
Proposed Development	116	22.64	TM54

11.2 Flexibility and peak energy demand.

	Electrical*	Heat**	Comment
Estimate peak demand MW	225kW		
Available capacity MW	TBC		*Initial discussions still ongoing with UKPN*
Flexibility*** potential MW	25kW		*24 kW of PVs to be provided*
Revised peak demand MW	200kW		
Predicted flexibility %	Unknown		To be determined at the next stage.
Storage capacity kWh	None		None proposed at this stage.
*Including heat provided by electricity **From district heating, gas or other sources ***Demand side flexibility refers to the ability of a system to reduce or increase energy consumption for a period of time in response			

Flexibility	Included Y/N	Details
Renewable energy generation (load matching)	Y	PVs provided at roof level which will serve the landlord electrical systems.
Gateway to enable automated demand response	N	
Smart systems integration (e.g. smart charge points for EV, gateway etc.)	Y	Smart charge points provided for 4no. car park spaces.
Other initiative	N	

Appendix A: BREEAM Pre-Assessment

Issue	Credit Requirements	Credits	
		Available	Targeted
Man 01 Project Brief and Design	First Credit - Stakeholder consultation (project delivery): A clear sustainability brief is developed prior to Concept Design which sets out: Client requirements e.g. internal environmental conditions required, sustainability objectives and targets including target BREEAM rating, business objectives etc, Timescales and budget, List of consulters and professional appointments that may be required e.g. Suitably Qualified Acoustician etc, Constraints for the project (technical, legal, physical, environmental) Stage 2 Roles and Responsibilities a) End user requirements b) Aims of the design and design strategy c) Particular installation and construction requirements d) Design and construction risk assessments (e.g. CDM) e) Legislative requirements (Building control, heritage) f) Procurement and supply chain g) Identifying and measuring project success in line with project brief objectives h) Occupiers' budget and technical expertise i) Maintainability and adaptability of the proposals j) Requirements for end user documentation k) Requirements for commissioning and aftercare support The project team demonstrate how the project delivery stakeholder contributions and the outcomes of the consultation process have influenced or changed the Initial Project Brief, including if appropriate, the Project Execution Plan, Communication Strategy, and the Concept Design.	1	1
	2nd Credit - Stakeholder consultation (third party): Where evidence provided demonstrates that prior to the completion of the Concept Design stage, all relevant third-party stakeholders have been consulted by the design team and this covers the minimum consultation content (including but not limited to functionality, impacts on local community, inclusive and accessible design). The impact this consultation has had on the Project Brief and Concept Design must be demonstrated and consultation feedback has been given to all relevant parties.	1	1
	3rd Credit - Sustainability Champion (design): Where evidence provided demonstrates that a Sustainability Champion has been appointed to facilitate the setting and achievement of BREEAM performance target(s) for the project and evidence shows that the designed BREEAM performance target(s) has been contractually agreed and demonstrably achieved by project design.	1	1
	4th Credit - Sustainability Champion (monitoring progress): Where evidence provided demonstrates that the 3rd credit is achieved, and a Sustainability Champion is appointed to monitor progress against the agreed BREEAM performance target(s). This is done by attending key project/design team meetings during the Concept Design, Developed Design and Technical Design stages, reporting to the client during, and prior to, completion of each stage.	1	1
Man 02 Life Cycle Impacts	First and 2nd Credit - Elemental life cycle cost (LCC): Where evidence provided confirms that an outline, entire asset elemental life cycle cost (LCC) plan has been carried out at Process Stage 2 (equivalent to Concept Design - RIBA Stage 2) in line with 'Standardised method of life cycle costing for construction procurement' PD 156865:2008. The elemental LCC plan would need to: Be applicable to the life expectancy of the building, incorporating a range of options over 20, 30, 50+ years. Include the services component over a 15-year period	2	2

	Develop a fit-out strategy outlining options over a 10-year period. Demonstrate, using appropriate examples provided by the design team, how the elemental LCC plan has been used to influence building and systems design/specification to minimise life cycle costs and maximise critical value.		
	3rd Credit - Component level LCC option appraisal: Where evidence provided demonstrates that a component level LCC plan has been developed by end of Process Stage 4 (RIBA Stage 4) including the following component types: Services: e.g. heat source cooling source, and/or controls Finishes: e.g. walls, floors and/or ceilings External spaces Demonstrate using appropriate examples provided by the design team, how the component level LCC plan has been used to influence building and systems design/specification to minimise life cycle costs and maximise critical value.	1	1
	4th Credit - Capital cost reporting: Where evidence provided demonstrates reporting of the capital cost for the building in pounds per square metre (£/m^2) via the BREEAM Assessment Scoring and Reporting tool, Assessment Issue Scoring tab, Management section. Report capital cost for the scope of the refurbishment (differentiate between the extension scope + refurbishment works). Pro-rata capital cost for components which are linked. E.g. AHU's.	1	1
Man 03 (M) Responsible Construction Practices **Mandatory**: 1 credit (Considerate construction) for Excellent 2 credits (Considerate construction) for Outstanding	Pre-Requisite All timber and timber-based products used on the project is 'legally' harvested and traded timber First Credit - Environmental management: Evidence which demonstrates that the principle contractor operates an environmental management system (EMS) covering main operations e.g. third party certified to ISO 14001/EMAS or equivalent standard or have a structure that is in compliance with BS 8555-2003 and has reached stage 4 of implemented stage. Evidence that the principle contractor implements best practice pollution policies and procedures on-site in accordance with Pollution Prevention Guidelines.	1	1
	2nd Credit - Sustainability Champion (construction): Evidence which demonstrates that a Sustainability Champion is appointed to monitor the project to ensure ongoing compliance with relevant sustainability performance/process criteria. The defined BREEAM performance target forms a requirement of the principal contractor's contract and to achieve this credit in final post construction phase of assessment, the BREEAM-related performance target must be demonstrably achieved by the project.	1	1

	3rd and 4th Credit - Considerate construction: Where evidence provided demonstrates the contractor achieves 'compliance' with the criteria of a compliant considerate construction scheme (CCS score of at least 25). Where evidence provided demonstrates the contractor significantly exceeds 'compliance' with the criteria of the scheme (CCS score of at least 35). Exemplary Credit: With reference to the considerate construction criterion 7, in addition to meeting the criteria for two credits (i.e. where the contractor achieves 'compliance' with the criteria of a 'compliant' scheme), the contractor also achieves compliance with the criteria of the compliant scheme to an exemplary level of practice.	2	2 + 1 Exemplary
	5th and 6th Credit - Monitoring of refurbishment or fit-out-site impacts: Where evidence provided demonstrates the responsibility has been assigned to an individual for monitoring, recording and reporting energy use, water consumption and transport data resulting from all on-site refurbishment or fit-out processes (and dedicated off-site monitoring) throughout the refurbishment or fit-out programme. For data on transport movements; the delivery of major fit out materials and strip out waste is required to be included. This will include materials used for core services and interior fit out.	2	2
Man 04 Commissioning and Handover Mandatory: Criterion 9 (Building User Guide) for Excellent and Outstanding	First Credit - Commissioning and testing schedule and responsibilities: Where evidence provided demonstrates a schedule of commissioning and testing that identifies and includes a suitable timescale for commissioning and re-commissioning of all complex and non-complex building services and control systems and testing and inspecting building fabric, and that all commissioning is completed in accordance with current Building Regulations, BSRIA and CIBSE guidelines. BMS commissioning in compliance with BREEAM compliance note 3.2. An appropriate project team member(s) is appointed to monitor and programme pre-commissioning, testing, and where necessary, re-commissioning on behalf of the client The principal contractor accounts for the commissioning and testing programmes, responsibilities and criteria within their budget and main programme of works, allowing for sufficient time to complete commissioning and testing prior to handover.	1	1
	2nd Credit - Commissioning building services: The commissioning and testing schedule and responsibilities credit is achieved. For projects where work is being undertaken to upgrade, renovate or install new building services and systems. For complex building services and systems, a specialist commissioning manager is appointed during the design stage (by either client or contractor) with responsibility for: Undertaking design reviews and giving advice on suitability for ease of commissioning Providing commissioning management input to construction programming and during installation stages Management of commissioning, performance testing and handover/post-handover stages.	1	1
	Third credit - Testing and inspecting building fabric: Where credit 1 is achieved and evidence provided demonstrates that the integrity of the building fabric is quality assured through compliant post construction testing and inspection. Any defects identified in the thermographic survey or airtightness testing reports are rectified prior to building handover and close out.	1	0

<table>
<tr>
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<td>4th Credit - Handover:

Where evidence provided demonstrates that Building User Guides (BUG) are provided and are appropriate to all users of the building (general users including staff and if applicable residents, as well as the non-technical facilities management team/building manager) and that a training schedule is prepared for building occupiers/premises mangers, timed appropriately around handover and proposed occupation plans. The training schedule includes the following:

The design intent of refurbishment/fit-out works
The available aftercare provision and aftercare team main contact(s), including any scheduled seasonal commissioning and post occupancy evaluation
Introduction to, and demonstration of, installed systems and key features, particularly building management systems, controls and their interfaces, to ensure they are fully conversant with the detailed operation of the building
Introduction to the Building User Guide and other relevant building documentation, e.g. design data, technical guides, maintenance strategy, operations and maintenance (O&M) manual, commissioning records, log book etc.
Maintenance requirements, including any maintenance contracts and regimes in place.</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Hea 01

Visual Comfort</td>
<td>First Credit - Glare Control:

Where evidence provided demonstrates that the potential for disabling glare has been designed out of all relevant building areas either through building layout and/or building design.

In additional, a glare control strategy should be developed in tandem with the lighting strategy to ensure that glare is minimised whilst avoiding potential conflict with the lighting control systems, therefore avoiding higher than expected energy consumption.</td>
<td>N/A</td>
<td>N/A</td>
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<tr>
<td></td>
<td>2nd, 3rd + 4th Credits – Average daylighting:

Up to three credits are awarded on a sliding scale depending on the percentage of relevant building areas that comply with the following daylighting criteria, where yellow represents RFO requirements, and green represents NC Requirements.
<table>
<tr><th rowspan="2">Classification</th><th rowspan="2">Function</th><th rowspan="2">Average Daylight Factor</th><th colspan="3">Area of building to comply and credits scored</th><th rowspan="2">Uniformity requirement</th></tr>
<tr><th>1st</th><th>2nd</th><th>3rd</th></tr>
<tr><td rowspan="2">Office</td><td rowspan="2">All occupied spaces</td><td rowspan="2">2%</td><td>40%</td><td>60%</td><td>80%</td><td rowspan="2">a OR b+c</td></tr>
<tr><td>80%</td><td>80%</td><td>80%</td></tr>
</table>
The relevant building areas meet good practice daylight factor(s) (2% ADF for 80% of area for 3 credits): OR

A uniformity ratio of at least 0.3 or a minimum point daylight factor of at least 0.3 times the relevant average daylight factor value (2%). Spaces with glazed roofs, such as atria, must achieve a uniformity ratio of at least 0.7 or a minimum point daylight factor of at least 0.7 times the relevant average daylight factor value (2%); AND

At least 80% of the room has a view of sky from desk or table top height (0.85m in multi-residential buildings, 0.7m in other buildings) AND the room depth criterion d/w +d/HW < 2/(1-RB) is satisfied.

Where: d = room depth, w = room width, HW = window head height from floor level, RB = average reflectance of surfaces in the rear half of the room

<table>
<tr><th rowspan="2">Classification</th><th rowspan="2">Function</th><th rowspan="2">Average lux</th><th rowspan="2">Min lux</th><th rowspan="2">Hours per year</th><th colspan="3">Area of building to comply and credits scored</th></tr>
<tr><th>1st</th><th>2nd</th><th>3rd</th></tr>
<tr><td rowspan="2">Other functional areas</td><td rowspan="2">All occupied spaces</td><td>300</td><td>90</td><td>2000</td><td>40%</td><td>60%</td><td>80%</td></tr>
<tr><td>300</td><td>90</td><td>2000</td><td>80%</td><td>80%</td><td>80%</td></tr>
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<td>3</td>
<td>0</td>
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</table>

5th + 6th Credit - View Out

% floor area in each relevant building area compliant with view out criteria	% area compliant		Standard exclusions
	1st credit	2nd credit (if applicable)	
All RFO building types	80%	95%	Check relevant notes in manuals
All NC building types	95%		

Two credits 95% of the floor area / One credit 80% of RFO floor area AND 95% of NC floor area in relevant building areas are within 7m of a wall which has a window or permanent opening that provides an adequate view out. The window/opening must be ≥20% of the surrounding wall area.

Where the room depth is greater than 7m, compliance is only possible where the percentage of window/opening is the same as, or greater than, the values in Table 1.0 of BS 8206.

2 | 0

7th Credit - Internal and external lighting:

External lighting

For external areas, lighting provided is specified in accordance with BS 5489-1:2013 Lighting of roads and public amenity areas BS 5489-1:2013 Lighting of roads and public amenity areas, Code of Practice for the design of road lighting, BSI, 2013 and BS EN 12464-2:2014.

1 | 1

Exemplary Credit:

Where evidence is provided which demonstrates that the exemplary level requirements are achieved, as outlined below, where blue represents RFO and NC combined:

1 | 0

Exemplary Daylight factor Bespoke Criteria:

Classification	Function	Average Daylight Factor	Area of building to comply	Uniformity requirement
Office	All occupied spaces (multi-storey building)	3%	80%	Minimum point daylight factor of 1.2% OR 2.1% for spaces with glazed roofs

Exemplary Illuminance Bespoke Criteria:

Building Type	Space	Average lux	Min lux	Hours per year	Area of building to comply
All space types except for prison spaces and retail sales areas	Multi storey building	300	90	2650	80%

Hea 02 Indoor Air Quality	First Credit - Indoor air quality (IAQ) plan: Where evidence provided demonstrates that an IAQ plan has been produced with the objective of facilitating a process that leads to design, specification and installation decisions and actions that minimise indoor air pollution during occupation of the building. It must include Removal of contaminant sources Dilution and control of contaminant sources Procedures for pre-occupancy flush out Protection of Heating Ventilation and Air Conditioning (HVAC) systems from sources of pollution during refurbishment/fit-out works e.g. dust Procedures for protecting the indoor air quality of areas outside of the refurbishment or fit-out zone that may be affected by the refurbishment/fit-out works Procedures for identifying and implementing third party testing and analysis required to ascertain that the contaminant sources have been removed effectively before occupancy Commitments for maintaining indoor air quality in-use, e.g. maintenance and cleaning of the HVAC system, ductwork and filters.	1	1
	2nd Credit - Ventilation: For air-conditioned and mixed-mode buildings: the building's air intakes and exhausts are over 10m apart to minimise recirculation and intakes are over 20m from sources of external pollution or designed in accordance with BS EN 13779:2007 Annex A2. In addition, the building must be designed to provide fresh air and minimise internal pollutants (and ingress of external polluted air into the building) in accordance with the criteria of the relevant standard for ventilation. If naturally ventilated the openable windows/ventilators must be over 10m from sources of external pollution. Areas of the building subject to large and unpredictable or variable occupancy patterns have CO_2 or air quality sensors specified and: In mechanically ventilated spaces, the sensor(s) are linked to the mechanical ventilation system and provide demand-controlled ventilation to the space. In naturally ventilated spaces, the sensors either have the ability to alert the building owner/manager when CO_2 levels exceed the recommended set point, or are linked to controls with the ability to adjust the quantity of fresh air, i.e. automatic opening windows/roof vents.	1	0
	3rd Credit - Potential for natural ventilation: Where evidence provided demonstrates the building ventilation strategy is designed to be flexible and adaptable to potential building occupant needs and climatic scenarios through designs capable of providing fresh air entirely via a natural ventilation strategy, demonstrated via either of the following: The openable window area in each occupied space is equivalent to 5% of the gross internal floor area of that room/floor plate. OR The design demonstrates that the natural ventilation strategy provides adequate cross flow of air to maintain required thermal comfort conditions and ventilation rates. This is demonstrated using ventilation design tool types recommended by CIBSE AM10 For a strategy which does not rely on openable windows, or which has occupied spaces with a plan depth greater than 15m, the design must demonstrate that the ventilation strategy can provide adequate cross flow of air to maintain the required thermal comfort conditions and ventilation rates. The natural ventilation strategy must be capable of providing at least two levels of user-control on the supply of fresh air to the occupied space, as follows; Higher level: higher rates of ventilation achievable to remove short-term odours and/or prevent summertime overheating. Lower level: adequate levels of draught-free fresh air to meet the need for good indoor air quality throughout the year, sufficient for the occupancy load and the internal pollution loads of the space. Any opening mechanisms must be easily accessible and provide adequate user-control over air flow rates to avoid draughts.	1	0

Hea 04 Thermal Comfort	First Credit: Thermal Modelling Where evidence provided demonstrates that thermal modelling has been carried out using software in accordance with CIBSE AM11. The modelling demonstrates that the building design and services strategy can deliver thermal comfort levels in occupied spaces in accordance with the criteria set out in CIBSE Guide A Environmental Desi. In addition to the requirements above; Part 4 assessment: A competent person (e.g. chartered building services engineer) must assess the suitability of existing building services and controls to identify any changes that may be required as a result of fit-out works (e.g. as a result of changes to internal layout, occupant density, additional equipment that may increase cooling loads etc.).	1	1
	2nd Credit: Adaptability Where credit 1 is achieved and evidence provided outlines that the thermal modelling demonstrates that the building design and services strategy can deliver thermal comfort levels in occupied spaces in accordance with the criteria set out in CIBSE Guide A Environmental Design for a projected climate change environment. Where these levels are not met the project team demonstrates how the building has been adapted or designed to be easily adapted in future using passive design solutions. Additionally evidence is provided for air conditioned buildings, the PMV and PPD indices based on the modelling are reported via the BREEAM assessment scoring and reporting tool.	1	1
	3rd Credit: Thermal zoning and controls The thermal modelling analysis has informed the temperature control strategy for the building and its users. The strategy for proposed heating/cooling system(s) demonstrates that it has addressed the following: Zones within the building and how the building services could efficiently and appropriately heat or cool these areas. For example, consider the different requirements for the central core of a building compared with the external perimeter adjacent to the windows. The degree of occupant control required for these zones, based on discussions with the end user (or alternatively building type or use specific design guidance, case studies, feedback) considers: User knowledge of building services Occupancy type, patterns and room functions (and therefore appropriate level of control required) How the user is likely to operate or interact with the system(s), e.g. are they likely to open windows, access thermostatic radiator valves (TRV) on radiators, change air-conditioning settings etc. The user expectations (this may differ in the summer and winter) and degree of individual control (i.e. obtaining the balance between occupant preferences, for example some occupants like fresh air and others dislike draughts). How the proposed systems will interact with each other (where there is more than one system) and how this may affect the thermal comfort of the building occupants. The need or otherwise for an accessible building user actuated manual override for any automatic systems. In addition to the requirements above, the following applies:	1	0

	Where specified, any new local cooling or heating services (or changes to existing services) are designed to ensure they do not conflict with core services (e.g. conflicts between two separate cooling systems, conflicts between core heating and locally provided cooling systems).		
Hea 05 Acoustic Performance	Up to two credits: The building meets the appropriate acoustic performance standards and testing requirements defined in the checklists and tables section which defines criteria for the acoustic principles of: Sound insulation (1 credit): the sound insulation between acoustically sensitive rooms and other occupied areas complies with the performance criteria given in Section 7 of BS 8233:2014 Indoor ambient noise level (1 credit): achieve indoor ambient noise levels that comply with the design ranges given in Section 7 of BS 8233:2014	2	2
Hea 06 Safety and Security	1 Credit - Security of site and building: Where evidence provided demonstrates that a suitably qualified security specialist (SQSS) conducts an evidence-based Security Needs Assessment during or prior to Concept Design (RIBA Stage 2). The SQSS develops a set of recommendations or solutions during or prior to Concept Design (RIBA Stage 2 or equivalent). These recommendations or solutions aim to ensure that the design of buildings, public and private car parks and public or amenity space are planned, designed and specified to address the issues identified in the preceding SNA. The recommendations from the SQSS must be implemented into the design.	1	1
Ene 01 (M) Reduction of CO_2 emissions Mandatory: 6 credits for Excellent 10 credits for Outstanding	Up to 15 Credits – Energy performance Both Refurbishment and New Construction areas can be included in the same energy models and follow CN6 'Extensions to existing buildings and newly constructed thermal elements' as below: Where the refurbishment project also includes a newly constructed extension with new thermal elements (see Scope section to see where this is allowable under the scope of the scheme), the modelled performance of the baseline for new thermal elements (options 1 and 2) should be based upon compliance with the appropriate Building Regulations for new thermal elements (see Relevant definitions) as defined for the notional building. Where the new extension uses existing building services, the modelled baseline performance of the new extension and existing building should be based upon performance of the existing common building services plant. The baseline for any new building services plant servicing the extension only should be modelled based upon compliance with the appropriate Building Regulations (see Relevant definitions) as defined for the notional building and the Building Regulations Compliance Guide.	13.5	6
	Exemplary Credits Available – 5 credits The building achieves an EPR_{NC} ≥0.9 and zero net CO_2 emissions, and an equivalent percentage of the buildings modelled 'regulated' operational energy consumption, as stipulated in the table below, is generated by carbon neutral on-site, near-site or 'accredited external' sources and used to meet energy demand from 'unregulated' building systems or processes.	5	0

Innovation Credits	Equivalent % Criteria
1	10%
2	20%
3	50%
4	80%
5	>100%

Ene 02 (M) Energy monitoring **Mandatory**: 1 credit (First sub-metering credit) for Very Good and above	First Credit: Sub-metering of major energy consuming systems Where evidence provided demonstrates that the energy metering systems are installed that enable 90% of the estimated annual energy consumption of each fuel to be assigned to the various end-use categories of energy consuming systems. For buildings with a total useful floor area > 1000m^2 are metered using an appropriate energy monitoring and management system and systems in smaller buildings are metered either with an energy monitoring and management system or separate assessable energy sub-meters with pulsed or other open protocol communication outputs, to enable future connection to an energy monitoring and management system. The end energy consuming use is identifiable to the building user through labelling or data outputs. Systems that consume energy to perform the following functions within a building: a. Space heating b. Domestic hot water heating, c. Humidification*, d. Cooling*, e. Ventilation, i.e. fans (major)*, f. Pumps, g. Lighting h. Small power, i. Renewable or low carbon systems (separately), j. Controls, k. Other major energy consuming systems	1	1
	2nd Credit: Sub – metering of high energy load and tenancy areas Where evidence provided demonstrates that an accessible energy monitoring and management system or separate accessible energy sub-meters with pulsed or other open protocol communication outputs to enable future connection to an energy monitoring and management system are provided, covering **a significant majority*** of the energy supply to tenanted areas or, in the case of single occupancy buildings, relevant function areas or departments within the building/unit. **Lighting and small power** Due to traditional distribution methods, it can be difficult to separate lighting and small power cost effectively. It is acceptable, within a single floor, for lighting and small power to be combined for metering purposes, provided that sub-metering is provided for each floor plate. **Small function areas/departments** For a building consisting of a number of small function areas or departments (less than 200m^2), sub-metering the heating, hot water and combined electricity energy uses is sufficient to achieve this credit. Individual electricity energy uses within each unit do not need to be sub-metered. **Heating and hot water** Space heating and domestic hot water may be combined with a single heat or gas meter per tenanted area/function area/department, where it is impractical to sub-meter these items separately. ***Significant majority** A significant majority of the energy supply to the tenanted areas/function areas/departments covers most of the energy uses but does not have to include very small ones. As a guide, energy uses that cumulatively make up less than 10% of the energy supply for that area may be excluded.	1	1
Ene 03 External Lighting	One credit: Where evidence provided demonstrates that the external lighting has an average initial luminous efficacy of the external light fittings within the construction zone is not less than 70 luminaire lumens per circuit watt and that all external light fittings are automatically controlled for prevention of operation during daylight hours and presence detection in areas of intermittent pedestrian traffic.	1	1
Ene 04 Low Carbon Design	First Credit - Passive design analysis: Where the first credit of Hea 04 (Thermal comfort) is achieved and the project team carries out an analysis of the design to identify opportunities for the implementation of passive design solutions that reduce demands for energy consuming building services, and that these solutions are implemented meaningfully into the design. Full consideration must be given to passive design measures from the base build are maintained (BREEAM knowledge Base Ref. KBCN0859)	1	1
	Second credit - Free cooling: Where the first credit is achieved, the passive design analysis includes an analysis of free cooling and identifies opportunities for the implementation of free cooling solutions. Free cooling solutions might include night time cooling, ground coupled air cooling or surface water cooling; i.e. does not use active cooling.	1	0

<table>
<tr><td></td><td>Third credit - Low zero carbon feasibility study:
Where evidence provided demonstrates that a feasibility study has been carried out by the completion of the Concept Design stage (RIBA Stage 2) by an energy specialist to establish the most appropriate recognised local (on- or near-site) low or zero carbon energy source(s) for the development.

A local LZC technology/ies has been specified for the building in line with the recommendations of this feasibility study and this method of supply results in a meaningful reduction in regulated CO_2 emissions.</td><td>1</td><td>1</td></tr>
<tr><td rowspan="2">Ene 06
Energy efficient transportation systems</td><td>First credit - Energy consumption:
Where evidence provided demonstrates that where either lifts, escalators or moving walks are required:
An analysis of the transportation demand and usage patterns for the building has been carried out in accordance with BS EN ISO 25745 to determine the optimum number and size of lifts, (including counter-balancing ratio), escalators and/or moving walks.
The energy consumption has been estimated for different types and the lift/escalator/moving walk system/strategy with the lowest energy consumption has been specified.
Regenerative drives should be considered.
The transportation system with the lowest energy consumption is specified.</td><td>1</td><td>1</td></tr>
<tr><td>2nd and 3rd credit - Energy efficient features:
For each newly specified lift, the following three energy efficient features are specified and for existing lifts, at least two of the following energy efficient features are specified:
The lifts operate in a standby condition during off-peak periods. For example, the power side of the lift controller and other operating equipment such as lift car lighting, user displays and ventilation fans switch off when the lift has been idle for a prescribed length of time.
The lift car lighting and display lighting provides an average lamp efficacy, (across all fittings in the car) of > 55 lamp lumens/circuit Watt.
The lift uses a drive controller capable of variable speed, variable-voltage, and variable-frequency (VVVF) control of the drive motor.

Where the use of regenerative drives is demonstrated to save energy, they are specified.</td><td>2</td><td>2</td></tr>
<tr><td>Tra 01
Public transport accessibility</td><td>Three credits (building type specific)
Where evidence provided demonstrates the accessibility to the public transport network. This is summarised in the table below.
<table>
<tr><td>Accessibility Index</td><td>≥2</td><td>≥4</td><td>≥8</td></tr>
<tr><td>Building Type</td><td colspan="3">BREEAM Credits Available</td></tr>
<tr><td>Offices</td><td>1</td><td>2</td><td>3</td></tr>
</table>
The accessibility index for each building type is calculated based upon the following information:
The distance (m) from the main building entrance to each compliant public transport node
The public transport type(s) serving the compliant node e.g. bus or rail
The average number of services stopping per hour at each compliant node during the standard operating hours of the building for a typical day</td><td>3</td><td>3</td></tr>
<tr><td>Tra 02
Proximity to amenities</td><td>One Credit (building type specific)
Where evidence provided demonstrates that the building is located within the 500m distance via safe walking route of at least two of the following amenities:
Appropriate food outlet
Cash point
Leisure facility</td><td>1</td><td>1</td></tr>
</table>

<table>
<tr>
<td>Tra 03
Proximity to amenities</td>
<td>First credit - Cycle storage:
One credit is achieved where evidence provided demonstrates that the number of compliant cycle storage spaces provided are in accordance with the following:
1 per 10 staff
Second credit - Cyclist facilities:
The credit is achieved where at least two of the following compliant cyclist facilities are provided for all building users:
Showers
Changing facilities
Lockers
Drying spaces</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Tra 05
Travel Plan</td>
<td>One Credit:
Where evidence provided demonstrates that a travel plan has been developed as part of the feasibility and design stages which considers all types of travel relevant to the building type and users.
The travel plan must be structured to the needs of the particular site and takes into consideration the findings of a site-specific transport survey.
The travel plan must include a package of measures that have been used to steer the design of the development in order to meet the travel plan objectives and minimise car-based travel patterns.</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Wat 01 (M)
Water consumption

Mandatory:
One credit for Good and above.
Two credits for Outstanding.</td>
<td>Up to five credits:
Where evidence provided demonstrates that water consumption has been reduced to the following levels compared against the baseline building model:
<table>
<tr><th>% Improvement</th><th>No. of BREEAM Credits</th></tr>
<tr><td>12.5%</td><td>1</td></tr>
<tr><td>25%</td><td>2</td></tr>
<tr><td>40%</td><td>3</td></tr>
<tr><td>50%</td><td>4</td></tr>
<tr><td>55%</td><td>5</td></tr>
<tr><td>65%</td><td>Exemplary performance</td></tr>
</table>
</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Wat 02 (M)
Water monitoring

Mandatory:
Criterion 1 only for Good and above.</td>
<td>One credit:
Where evidence provided demonstrates that a water meter with a pulsed output will be installed on the mains supply to each building/unit.
Water-consuming plant or building areas, consuming 10% or more of the building's total water demand, need to be fitted with either sub meters or have water monitoring equipment integral to the plant or area. (Not applicable to Shell Only Assessments).
Each meter (main and sub) must have a pulsed output to enable connection to a Building Management System (BMS) for the monitoring of water consumption.
If the site on which the building is located has an existing BMS, managed by the same occupier/owner (as the new building), the pulsed water meter(s) for the new building must be connected to the existing BMS.</td>
<td>1</td>
<td>1</td>
</tr>
</table>

Wat 03 Water leak detection	First credit - Leak detection system: Where evidence provided demonstrates that a leak detection system which is capable of detecting a major water leak on the mains water supply within the building and between the building and the utilities water meter is provided.	1	1
	Second Credit - Flow control device to each sanitary area Flow control devices that regulate the supply of water to each WC area/facility according to demand are installed (and therefore minimise water leaks and wastage from sanitary fitting networks) Flow control systems may control combined WC areas, such as male and female toilets within a core; they are not required for each individual sanitary appliance. The criteria are set to encourage the isolation of the water supply to each WC block when it is not being used.	1	1
Wat 04 Water efficient equipment	First credit The design team has identified all unregulated water demands that could be realistically mitigated or reduced. System(s) or processes have been identified to reduce the unregulated water demand, and demonstrate, through either good practice design or specification, a meaningful reduction in the total water demand of the building.	1	1
Mat 01 Environmental Impact of Materials	Two options for assessment: The BREEAM RFO manual should be used for the refurbishment area and the BREEAM NC manual should be used for the new build. The tool will perform an area weighting to determine the number of credits achieved for the project. OR The whole project can be assessed under the BREEAM RFO criteria. Only Option 1: Project Lifecycle Assessment Study is available. Up to 6 Credits- Project lifecycle assessment study: The project uses a life cycle assessment (LCA) tool or undertakes a building information model life cycle assessment (BIM LCA) to measure the life cycle environmental impact of the refurbishment or fit-out works.	6	6 +1 Exemplary
Mat 03 (M) Responsible Sourcing Mandatory:	Pre-requisite All timber and timber-based products used on the project are ‘legally harvested and traded timber’ First Credit: Sustainable Procurement Plan Where evidence provided demonstrates that the principal contractor sources materials for the project in accordance with a documented sustainable procurement plan.	1	1

<table>
<tr>
<td>Criterion 1 sustainable timber sourcing for all ratings</td>
<td>Up to three Credits: Responsible Sourcing of Materials
Where evidence provided demonstrates the available responsible sourcing of materials (RSM) can be awarded where the applicable building materials are responsibility sourced in accordance with the BREEAM methodology.

<table>
<tr><th>RSM Credits</th><th>% of available RSM points achieved</th></tr>
<tr><td>3</td><td>≥ 54%</td></tr>
<tr><td>2</td><td>≥ 36%</td></tr>
<tr><td>1</td><td>≥ 18%</td></tr>
</table>
Exemplary Credit:
Where evidence provided demonstrates that at least 70% of the available RSM points are achieved</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Mat 04
Insulation</td>
<td>One Credit: Embodied Impact
Where evidence provided demonstrates that any new insulation specified for use within the following building elements must be assessed:
External walls
Ground floor
Roof
Building services
The Insulation Index for the building fabric and services insulation is the same as or greater than 2.5.</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Mat 05
Designing for Durability and Resilience</td>
<td>1 Credit: Designing for Durability and Resilience
PART A: Protecting vulnerable parts of the building from damage
Where evidence provided demonstrates that the building incorporates suitable durability and protection measures or designed features/solutions to prevent damage to vulnerable parts of the internal and external building and landscaping elements. This must include, but is not necessarily limited to:
Protection from the effects of high pedestrian traffic in main entrances, public areas and thoroughfares (corridors, lifts, stairs, doors etc.).
Protection against any internal vehicular/trolley movement within 1m of the internal building fabric in storage, delivery, corridor and kitchen areas.
Protection against, or prevention from, any potential vehicular collision where vehicular parking and manoeuvring occurs within 1m of the external building façade for all car parking areas and within 2m for all delivery areas.
PART B: Protecting exposed parts of the building from material degradation
Additionally, the relevant building elements incorporate appropriate design and specification measures to limit material degradation due to environmental factors.
Applicable building elements include foundation, retaining walls, external walls and doors, roof/balconies, glazing, cladding.
Environmental factors to consider include; solar radiation, temperature variation, wind, precipitation, vegetation, air and ground contaminants.
Material degradation effects includes (but not limited to); corrosion, swelling or shrinkage, fading, or rotting.</td>
<td>1</td>
<td>1</td>
</tr>
</table>

<table>
<tr><td>Mat 06

Material Efficiency</td><td>One Credit:

Where evidence provided demonstrates that opportunities have been identified and appropriate measures investigated and implemented to optimise the use of materials in building design, procurement, construction, maintenance and end of life. This process must be carried out by the design/construction team in consultation with relevant parties at each RIBA stage.

Preparation and Brief
Concept Design
Developed Design
Technical Design
Construction</td><td>1</td><td>1</td></tr>
<tr><td rowspan="3">Wst 01 (M)

Construction waste management

Mandatory:

1 credit for Outstanding</td><td>First credit: Pre-refurbishment audit
The client shall ensure that a pre-refurbishment audit of all existing buildings, structures or hard surfaces within the scope of the refurbishment or fit-out zone is completed at the concept design stage and identifies, quantifies and sets targets on the waste production as a result of the refurbishment.
The audit must be referenced in the resource management plan and include, quantification of the key materials where present on the project, applications for reuse and recycling, recycling rate predication, re-use targets and landfill diversion rates.</td><td>1</td><td>1</td></tr>
<tr><td>2nd–3rd Credit: Reuse and direct recycling of materials
Where waste material types detailed in Table - 64 are either directly re-used on-site or off-site or are sent back to the manufacturer for closed loop recycling:
One credit is achieved where 50% of the total available points for the waste material types detailed in Table - 64 that are present on the project have been achieved.

Two credits are achieved where 75% of the total available points for the waste material types detailed in Table - 64 that are present on the project have been achieved.

Please note that in most instances any materials specified in Table - 64 that are sent to a Material Recovery Facility (MRF) for recovery does not qualify for this credit.</td><td>2</td><td>1</td></tr>
<tr><td>Up to 3 Credits: Resource efficiency
Develop and implement a compliant resource management plan covering the waste arising from the refurbishment or fit-out project with the aim of minimising waste, recording and reporting accurate data on waste arising.
The non-hazardous waste relating to on-site refurbishment or fit-out, and dedicated off-site manufacture or fabrication processes generated by the building's design and construction meets, or exceeds, the resource efficiency benchmarks set out below.

<table><tr><th rowspan="2">BREEAM Credits</th><th colspan="2">Amount of construction waste generated per 100m² (gross internal floor area)</th></tr><tr><th>m³</th><th>Tonnes</th></tr><tr><td>1</td><td><11.83</td><td><5.52</td></tr><tr><td>2</td><td><5.29</td><td><2.6</td></tr><tr><td>3</td><td><2.44</td><td><1.14</td></tr><tr><td>Exemplary</td><td><1.45</td><td><0.72</td></tr></table></td><td>3</td><td>2</td></tr>
<tr><td></td><td>4th Credit - Diversion of resources from landfill:
The following percentages of non-hazardous construction and demolition waste (where applicable) generated have been diverted from landfill:

<table><tr><th>BREEAM Credits</th><th>Type of Waste</th><th>Volume (m³)</th><th>Weight (tonnes)</th></tr><tr><td rowspan="2">One Credit</td><td>Refurbishment / fit out</td><td>81%</td><td>87%</td></tr><tr><td>Demolition</td><td>87%</td><td>93%</td></tr><tr><td rowspan="2">Exemplary level</td><td>Refurbishment</td><td>92%</td><td>95%</td></tr><tr><td>Demolition</td><td>92%</td><td>96%</td></tr></table></td><td>1</td><td>1</td></tr>
</table>

Wst 02 Recycled Aggregates	One Credit The percentage of high grade aggregate that is recycled or secondary aggregate, specified in each application (present) must meet the following minimum % levels (by weight or volume) to contribute to the total amount of recycled or secondary aggregate, as specified in Table 68 in the BREEAM RFO (2014) Manual. The total amount of recycled or secondary aggregate specified, and meeting criterion 1, is greater than 25% (by weight or volume) of the total high grade aggregate specified for the project. Where the minimum level in criterion 1 is not met for an application, all the aggregate in that application must be considered as primary aggregate when calculating the total high grade aggregate specified. The recycled or secondary aggregates are EITHER: Construction, demolition and excavation waste obtained on-site or off-site; OR Secondary aggregates obtained from a non-construction post-consumer industrial by product source (see Relevant definitions section).	1	0
Wst 03 (M) Operational waste Mandatory: 1 credit for Excellent and above	One Credit: Where evidence provided demonstrates that there is dedicated space(s) to cater for the segregation and storage of operational recyclable waste volumes generated by the assessed building/unit, its occupant(s) and activities. The dedicated space(s) must be: Clearly labelled, to assist with segregation, storage and collection of the recyclable waste streams Accessible to building occupants / facilities operators for the deposit of materials and collections by waste management contractors Of a capacity appropriate to the building type, size, number of units (if relevant) and predicted volumes of waste that will arise from daily/weekly operational activities and occupancy rates. Where the consistent generation in volume of the appropriate operational waste streams is likely to exist, e.g. large amounts of packaging or compostable waste generated by the building's use and operation, the following facilities must be provided as part of its waste management strategy: Static waste compactor(s) or baler(s); situated in a service area or dedicated waste management space. Vessel(s) for composting suitable organic waste resulting from the building's daily operation and use OR adequate space(s) for storing segregated food waste and compostable organic material prior to collection and delivery to an alternative composting facility. Where organic waste is to be stored/ composted on site, a water outlet is provided adjacent to or within the facility for cleaning and hygiene purposes.	1	1
Wst 04 Speculative finishes	One credit: Speculative floor and ceiling finishes <u>Office building types only</u> For tenanted areas (where the future occupant is not known), prior to full fit-out works, interior finishes (including carpets, other floor finishes, ceiling finishes and any other interior finishes) have been installed in a show area only. In a building being refurbished or fitted out for a specific occupant, that occupant has selected (or agreed to) the specified interior finishes.	1	1
Wst 05 Adaptation to climate change	One credit - Structural and fabric resilience: Where evidence provided demonstrates that a climate change adaptation strategy appraisal for structural and fabric resilience has been conducted by the end of Concept design (RIBA Stage 2) covering hazard identification and assessment, risk estimation, evaluation and management. Appraisal to identify & evaluate impact on the building over its life cycle from expected extreme weather conditions arising from climate change and, where feasible, mitigate against these impacts ID hazards taking into account the following: structural stability, robustness, weather proofing and detailing, material durability, health and safety of occupants, impact on building contents and business continuity	1	1
Wst 06 Functional Adaptability	One Credit - Functional adaptability: Where evidence provided demonstrates that a building-specific functional adaptation strategy study has been undertaken by the client and design team by Concept Design (RIBA Stage 2) which includes recommendations for measures to be incorporated to facilitate future adaptation. Additionally functional adaptation measures have been implemented by RIBA Stage 4 in accordance with the functional adaptation strategy recommendations, where practical and cost effective.	1	1

<table>
<tr>
<td>LE 02
Protection of ecological features</td>
<td>Protection of ecological features:
Where evidence provided demonstrates that all existing features of ecological value within and surrounding the construction zone and site boundary are adequately protected from damage during clearance, site preparation and construction activities in line with BS42020:2013, and in all cases the principal contractor is required to construct ecological protection recommended by the preliminary site construction or preparation works.</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>LE 04
Enhancing site ecology</td>
<td>Ecologist's report and recommendations:
Where the design team (or client) has appointed a Suitably Qualified Ecologist to advise and report on enhancing and protecting the ecological value of the site; and implemented the professional's recommendations for general enhancement and protection of site ecology.</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>LE 05
Long term impact on biodiversity</td>
<td>Mandatory requirements:
Where evidence provided demonstrates that:
A Suitably Qualified Ecologist has been appointed prior to the commencement of activities on-site.
The SQE confirms that all relevant UK and EU legislation relating to the protection and enhancement of ecology has been complied with during the design and construction process.
Where a landscape and habitat management plan, appropriate to the site, is produced, covering at least the first five years after project completion in accordance with BS42020:2013 Section 11.1, this is to be handed over to the building owner/occupier.

Additional requirements:
Where additional measures to improve the assessed site's long term biodiversity are adopted, according to the table below.
<table>
<tr><th>Application</th><th>Applicable Measures</th><th></th><th></th><th></th><th></th></tr>
<tr><td></td><td>All</td><td>4</td><td>3</td><td>2</td><td>1</td></tr>
<tr><td>Credits</td><td colspan="5">Number of additional measures to assess</td></tr>
<tr><td>1</td><td>2</td><td>2</td><td>2</td><td>N/A</td><td>N/A</td></tr>
<tr><td>2</td><td>4</td><td>4</td><td>3</td><td>2</td><td>1</td></tr>
</table>
Additional measures include:
Nominate Biodiversity Champion
Contractor trains workforce on how to protect site ecology
Principle contractor records actions taken to protect biodiversity and monitors effectiveness
New ecologically valuable habitat appropriate to local area is created
Where flora/fauna habitats exist on-site, the contractor programmes site works to minimise disturbance to wildlife</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Pol 01
Impact of refrigerants</td>
<td>Pre-requisite:
All systems (with electronic compressors) must comply with the requirements of BS EN 378:2008, and where refrigeration systems containing ammonia are installed, they must comply with the Institute of Refrigeration Ammonia Refrigeration Systems Code of Practice.

Three credits:
Where evidence provided demonstrates that the building does not require the use of refrigerant within its building services or plant.

Two credits:
Where evidence provided demonstrates that the systems specified using refrigerants have Direct Effect Life Cycle CO_2 equivalent emissions (DELC CO_{2e}) of ≤100 $kgCO_{2e}$/kW cooling/heating capacity.

OR

Where air-conditioning or refrigeration systems are installed the refrigerants used have a Global Warming Potential (GWP) ≤10.</td>
<td>2</td>
<td>1</td>
</tr>
</table>

<table>
<tr><td></td><td>One credit:
Where evidence provided demonstrates that the systems using refrigerants have Direct Effect Life Cycle CO_2 equivalent emissions of (DELC CO_{2e}) of ≤1000 kgCO_{2e}/kW cooling/heating capacity.</td><td></td><td></td></tr>
<tr><td></td><td>One Credit - Leak detection

Where systems using refrigerants have a permanent automated refrigerant leak detection system installed; OR where an inbuilt automated diagnostic procedure for detecting leakage is installed. In all instances a robust and tested refrigerant leak detection system must be installed and must be capable of continuously monitoring for leaks.

The system must be capable of automatically isolating and containing the remaining refrigerant(s) charge in response to a leak detection incident</td><td>1</td><td>0</td></tr>
<tr><td>Pol 02
NO_x emissions</td><td>Up to three credits:

<table><tr><th>NO_x emissions levels for heating and hot water (mg/kWh)</th><th>Credits</th></tr><tr><td>≤ 100mg/kWh</td><td>1 credit</td></tr><tr><td>≤ 70mg/kWh</td><td>2 credits</td></tr><tr><td>≤ 40mg/kWh</td><td>3 credits</td></tr></table>
Where evidence provided demonstrates where the plant specified to meet the building's delivered heating and cooling demand has, under normal operating conditions, a dry NO_x emission level (measured at 0% excess O_2) as follows for non-industrial buildings)</td><td>3</td><td>0</td></tr>
<tr><td>Pol 03

Surface Water Run Off</td><td>Part 1: Flood resilience (Up to two credits)
Two credits - Low flood risk:
Where evidence provided demonstrates that the site is of low risk of flooding and a site specific flood risk assessment has been completed in line with PPS25, taking account of current and future sources of flooding.</td><td>2</td><td>2</td></tr>
<tr><td></td><td>One credit - Medium/high flood risk:
Where evidence provided demonstrates that the assessed development is located in a zone defined as having a medium or high annual probability of flooding AND the ground level of the building, car parking and access is at least 600mm above the design flood level of the flood zone for the site's location.</td><td>-</td><td>-</td></tr>
<tr><td></td><td>Part 2: Surface water run-off
Pre-requisite:
An appropriate consultant has been appointed.

One credit:
Where evidence provided demonstrates that the consultant has confirmed that the drainage measures specified ensure that the peak rate of run-off from the site to the watercourses (natural or municipal) is no greater for the developed site than it was for the pre-development site. This should comply at the 1-year and 100-year return period events, taking into account climate change.
Additionally relevant maintenance agreements for the ownership, long term operation and maintenance of all specified SUDs are in place.

One credit
Where evidence provided demonstrates that the consultant has confirmed that there is no risk of flooding of property in the event of a local drainage system failure (caused either by extreme rainfall or a lack of maintenance), AND

EITHER</td><td>2</td><td>2</td></tr>
</table>

	The post development run-off volume, over the development lifetime, is no greater than it would have been prior to the assessed site's development, including an allowance for climate change. Any additional predicted volume of run-off for the 100-year 6-hour event must be prevented from leaving the site by using infiltration or other Surface Drainage System (SUDs) techniques OR (only where criterion no. 9 or 10 for this credit cannot be achieved) Justification from the appropriate consultant indicating why the above criteria cannot be achieved i.e. where infiltration or other SUDS techniques are not technically viable options. The post development peak rate of run-off is reduced to a limiting discharge.		
	Part 3: Minimising watercourse pollution One credit: Where evidence provided demonstrates that the following water course pollution prevention measures are covered: Appropriate consultant confirms that there will be no discharge from the developed site for rainfall up to 5mm. Specification of Sustainable Urban Drainage Systems (SUDs) or source control systems such as permeable surfaces or infiltration trenches Specification of oil/petrol separators (or equivalent system) in surface water drainage systems, where there is a high risk of contamination or spillage of substances All water pollution prevention systems have been designed and detailed in accordance with the recommendations of Pollution Prevention Guideline 3 (PPG3) A comprehensive and up-to-date drainage plan of the site will be made available for the building/site occupiers.	1	0
Pol 04 Reduction in night time light pollution	One credit: Where evidence provided demonstrates that the lighting system has been designed in accordance with the following requirements: The external lighting strategy has been designed in compliance with Table 2 (and its accompanying notes) of the ILE Guidance notes for the reduction of obtrusive light, 2011. All external lighting (except for safety and security lighting) can be automatically switched off between 2300hrs and 0700hrs. This can be achieved by providing a timer for all external lighting set to the appropriate hours. If safety or security lighting is provided and will be used between 2300hrs and 0700hrs, this part of the lighting system complies with the lower levels of lighting recommended during these hours in Table 2 of the ILE's Guidance notes, for example by using an automatic switch to reduce the lighting levels at 2300 or earlier. Illuminated advertisements, where specified, must be designed in compliance with ILE Technical Report 5 – The Brightness of Illuminated Advertisements.	1	1
Pol 05 Reduction of noise pollution	One credit: Where evidence provided demonstrates that there is either no noise-sensitive areas or buildings within 800m radius of the assessed development OR Where there are or will be noise-sensitive areas or buildings within 800m radius of the assessed development a noise impact assessment in compliance with BS 7445:1991 has been carried out and the following noise levels measured/determined: Existing background noise levels at the nearest or most exposed noise-sensitive development to the proposed development or at a location where background condition can be argued to be similar. The noise level from the proposed site/building, as measured in the locality of the nearest or most exposed noise-sensitive development is a difference no greater than +5dB during the day (07:00 to 23:00) and +3dB at night (23:00 to 07:00).	1	1
Innovation Credits	Up to 10 credits: Where the building demonstrates exemplary performance by meeting defined exemplary level performance criteria in one or more of following BREEAM assessment issues: Man 03 Responsible construction practices Hea 01 Visual comfort Hea 02 Indoor air quality Ene 01 Reduction of energy use and carbon emissions	10	2

	Wat 01 Water consumption Mat 01 Environmental impact of materials Mat 03 Responsible sourcing of materials Wst 01 Project waste management Wst 02 Recycled aggregates Wst 05 Adaptation to climate change Pol 03 Flood risk management and reducing surface water run-off Please refer to the relevant BREEAM issue within this Scheme Document for the exemplary level performance assessment criteria. OR One innovation credit can be awarded for each innovation application approved by BRE Global, where the building complies with the criteria defined within an Approved Innovation Application Form.		

Appendix B: Part L Compliance Modelling Inputs

General Information

Project Details	Project Name	Avalon House
	Full Postal Address	Richmond
	Postcode	
	Weather location, e.g. LONDON	London
Building and System Data	Air Permeability (m^3/m^2hr@50PA)	3
	Building Use	B1: Office or Workshop (Office)
	Building Type	Office type 3 (air conditioned, 2000-8000m²)
	Building Sub-type	4 Stories: 2000m² (25m x 20m x 3m
	Exposure	Exposed
	Electrical Power Factor	>0.95
	Lighting Systems Have Provision for Metering	Y
	Lighting Systems Metering Warns of 'out of range' Values	Y
	Project Complexity	Level 5
	Stage of Analysis	As Designed
District Heating	District Heating CO_2 Conversion Factor (kgCO2/kWh)	n/a
	District Heating Primary Energy Factor (kWh/kWh)	n/a

Construction

Opaque Construction Element	U-value W/m²·K
e.g. External wall	*e.g. 0.25*
Roof (new)	0.10
Roof (refurbished)	0.10
External Wall (new)	0.12
External Wall (refurbished)	0.12
Exposed Floor (new)	0.10
Exposed Floor (refurbished)	0.10
External Door	1.60

Glazing Element	Location	U-value (inc. frame) W/m²·K	g-value EN 410	Light Transmittance %	Frame Factor %
e.g. Office Glazing	*e.g. Offic*	*e.g. 1.20*	*e.g. 0.40*	*e.g. 62*	*e.g. 10*
Windows	New	1.00	0.28	0.60	10
Windows	Refurbishe	1.00	0.28	0.60	10
Rooflight	New	2.00	0.28	0.60	15

Plant System Parameters

Solar PV	Number of panels	59
	Size of panels (m2)	1.67
	Total array area (m2)	98.53
	Technology Type	Monocrys
	Azimuth (° clockwise from north)	160.22
	Inclination (° from horizontal)	30
	Shading factor	1
	Module Nominal Efficiency	0.22
	Nominal Cell Temperature (NOCT) (°C)	IES
	Reference Irradiance for NOCT (W/m^2)	IES
	Temperature Coefficient for Module Efficiency Pmax (%/°C)	IES
	Degradation Factor	IES
	Electrical Conversion Efficiency	IES

	Detail	Units	System 01	System 02	System 03	System 04	System 05	System 06
	System Name/Description	-	Office Upper Floors - Internal Zones - Displacement Ventilation	Office Upper Floors - Perimeter Zones - Trench H+C Units	Office Ground Floor - 4 Pipe FCUs	Toilet Ventilation	Comms TBC	Stair
	UK NCM System Type	-	Central heating using air distribution	Fan coil system	Fan coil system	Other local room heater - unfanned	Split or multi-split system	Other local room heater - unfanned
Heating	Heat Source	-	Heat pump (electric): air source	Heat pump (electric): air source	Heat pump (electric): air source	Direct or electrical storage heater	Heat pump (electric): air source	Direct or electrical storage heater
	Fuel Type	-	Electricity	Electricity	Electricity	Electricity	Electricity	Electricity
	Does the System use CHP?	Y/N	N	N	N	N	N	N
	Was the System Installed After 1998	Y/N	N	N	N	N	N	N
	Generator Seasonal Efficiency (SCOP)	%	362	362	362	1.00	362	1.00
Cooling	Pack Chiller Type	-	Heat pump (electric)	Heat pump (electric)	Heat pump (electric)		Heat pump (electric)	
	Pack Chiller Power	kW	101 - 500kW	101 - 500kW	101 - 500kW		101 - 500kW	
	Chiller Fuel Type	-	Electricity	Electricity	Electricity		Electricity	
	Generator Seasonal EER (SEER)	%	376.00	376.00	376.00		600.00	
	Does it Qualify for ECAs	Y/N						
Adjustment & Metering	Ductwork Air Leakage CEN Classification	-	L1?					
	AHU Air Leakage CEN Classification	-						
	System Specific Fan Power (SFP)	W/l/s	1.60	1.60	1.60	1.60	1.60	
	Terminal Specific Fan Power (SFP)	W/l/s		0.15 (Perimeter only)	0.17		0.17	
	Pump Type	-	Variable speed - sensor in system	Variable speed - sensor in system	Variable speed - sensor in system	Variable speed - sensor in system	Variable speed - sensor in system	
	Does the System have Provision for Metering	Y/N	Y	Y	Y	Y	Y	
	Does the Metering Warn "Out of Range" Values?	Y/N	Y	Y	Y	Y	Y	
Ventilation	Cooling / Ventilation Mechanism	-	Mechanical ventilation	Mechanical ventilation	Mechanical ventilation	Mechanical ventilation	Mechanical ventilation	
	Air Supply Mechanism	-	Centralised A/C or mechanical ventilation	Centralised A/C or mechanical ventilation	Centralised A/C or mechanical ventilation	Centralised A/C or	Centralised A/C or	
	Heat Recovery Type	-	Thermal wheel	Thermal wheel	Thermal wheel	Plate heat exchanger	Plate heat exchanger	
	Heat Recovery Seasonal Efficiency	%	79.50	79.50	79.50	75.00	75.00	
	Demand Control Ventilation	-	DCV Occupancy	DCV Occupancy	DCV Occupancy	No DCV	No DCV	
			Office Upper Floor - Internal	Office Upper Floors - Perimeter	Ground Floor Office, Reception, Bike Store, lift lobby, corridor	WC/shower/store/plant	Comms Room	Stair

	Detail	Units	DHW System 1
Domestic Hot Water	System Name/Description	-	All
	Heat Source	-	Direct or electrical storage heater
	Fuel Type	-	
	Generator Seasonal Efficiency (COP)	%	1.00
	DHW Delivery Efficiency	%	0.95
	OR		
	DHW Secondary Circulation Losses	W/m	N/A
	DHW Secondary Circulation Pump Power	kW	N/A
	DHW Secondary Circulation Loop Length	m	N/A
	DHW Storage Volume	litres	N/A
	DHW Storage Losses	kWh/	N/A
	OR	(l.day)	N/A
	Insulation Type	-	N/A
	Thickness	mm	N/A
	Is there a time switch?	Y/N	N/A

Lighting

Specific Lighting System/Area	Main Lighting Gains			Display Lighting		Main Lighting Controls									
								Photoelectric Options					Occupancy Options		
	Installed Power Density (W/m²/ 100lux)	Design Illumin-ance (lux)	W/m2	Lamp Efficacy (lm/W)	Time Switch?	Local Manual Switch?	Constant Illumin-ance Control?	Daylight Dimmin in Perimeter?	Control type	Sensor Type	Time-switch?	Parasitic Power (W/m²)	Sensing Type	Parasitic Power (W/m²)	Time-Switch?
PLANT		200		120		Y	N	N					NONE (1.0)		
CIRCULATION		100		120		N	Y	Y					AUTO-ON-DIMMED (0.95)		
LIFT LOBBY		200		120		N	Y	Y					AUTO-ON-DIMMED (0.95)		
COMMS INTAKE		200		120		Y	N	N					NONE (1.0)		
MER		500		120		Y	N	N					NONE (1.0)		
CHANGING/SHOWERS		200		120		N	Y	N					AUTO-ON-DIMMED (0.95)		
KITCHEN		500		120		Y	N	N					NONE (1.0)		
STORE		100		120		N	Y	N					AUTO-ON-OFF (0.90)		
BOH CIRCULAITON		100		120		N	Y	N					AUTO-ON-DIMMED (0.95)		
OFFICE	1.1	400	8.1			N	Y	Y					AUTO-ON-DIMMED (0.95)		
WC		200		120		N	Y	N					AUTO-ON-DIMMED (0.95)		
RECEPTION		300		120		N	Y	Y					AUTO-ON-OFF (0.90)		

Appendix C: BRUKL Documents

C1: New Build Be Lean (Part L 2021)

C2: New Build Be Green (Part L 2021)

C3: Refurbishment Baseline

C4: Refurbishment Be Lean

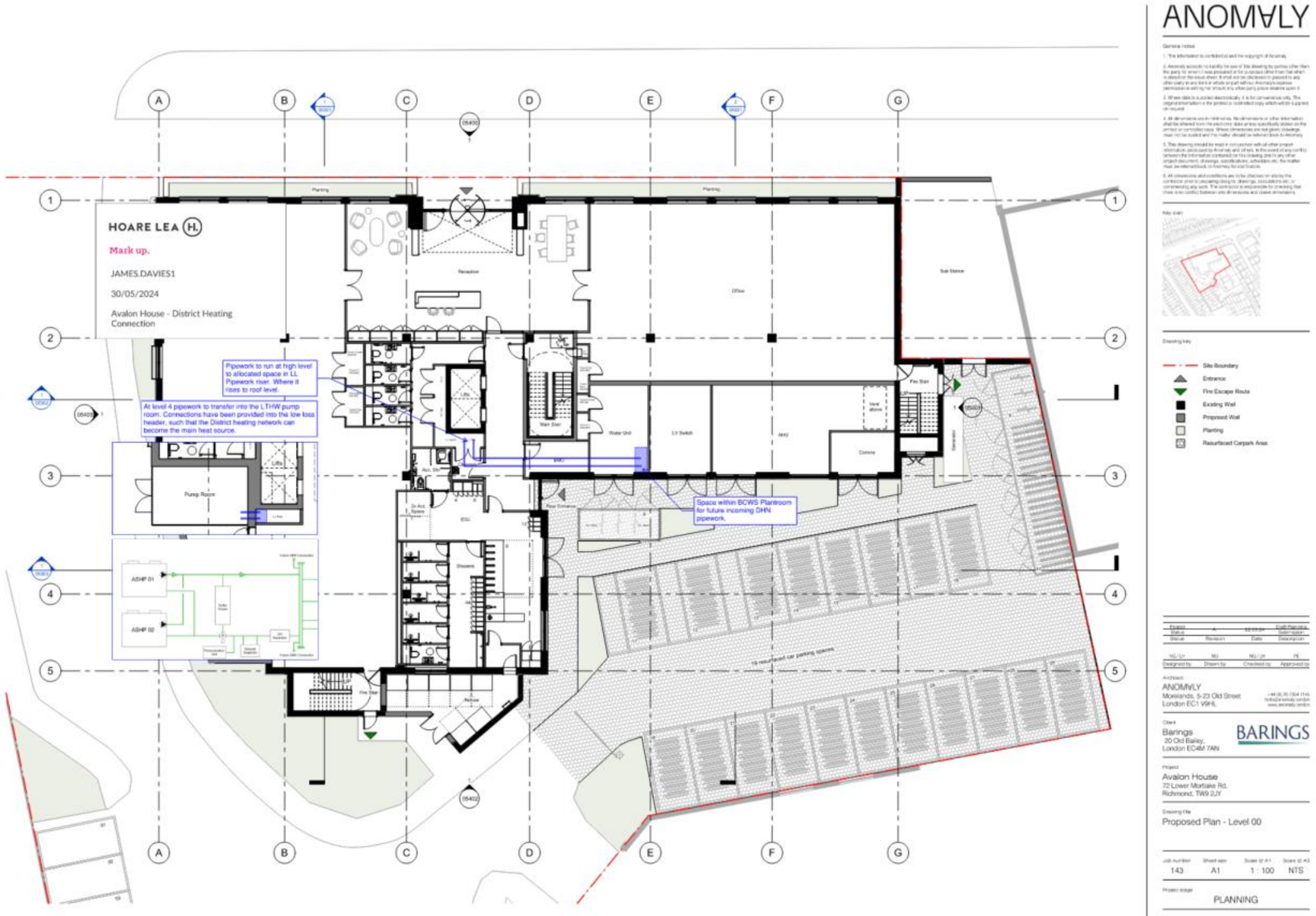
C5: Refurbishment Be Green

C6: New Build Be Lean (Part L 2013)

C7: New Build Be Green (Part L 2013)

Appendix D – District Heat Network.

Development future proofed for DHN connection



Communication with District Energy Officer

Avalon House DHN Connections

Mayfield, Thomas
To jamila.atta@richmondandwandsworth.gov.uk

Reply | Reply All | Forward

Tue 28/05/2024 13:02

This is the most recent version, but you made changes to another copy. Click here to see the other versions.

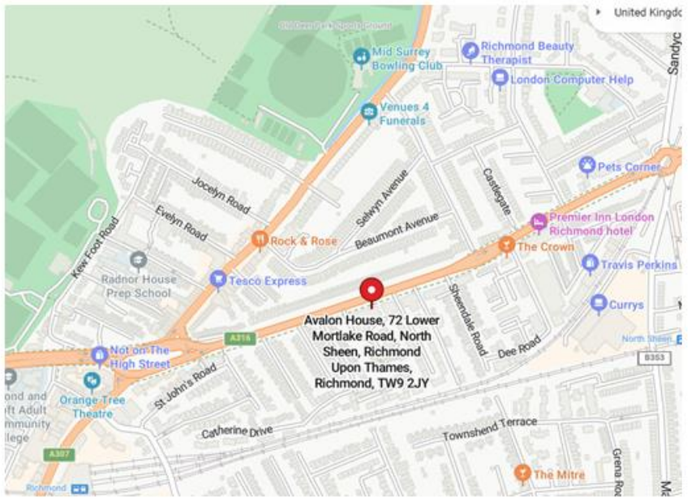
Hi Jamila,

I hope this email finds you well.

We are working on the refurbishment and expansion of Avalon House in Richmond. I am dropping you an email to enquire whether there are any potential heat networks that we could connect to?

The address is:

72 Lower Mortlake Road
Richmond upon Thames
London
TW9 2JY



All the best,

Thomas Mayfield (He / Him)
Graduate Sustainability Consultant

Appendix E – Heat Pump System Datasheets

CLIMAVENETA

TECHNICAL SELECTION
Software version: ELCA World v. 1.8.1.1
User: Daniel Hunt
Database version: 1.9.1.0
Print data:19/12/2023 16:02

HEATING

TECHNICAL SELECTION

NX-Q-G06 /LN /EC /0804
INTEGRA unit for 4-pipe systems, air source for outdoor installation

SCROLL

Code		NX-Q-G06 /LN /EC /0804
Version		LN
Size		0804
OPTIONS		Unit with EC FANS accessory selected
Power supply	V/ph/Hz	400/3/50

MITSUBISHI ELECTRIC
Changes for the Better

1.1 PERFORMANCE AT DESIGN CONDITIONS

RUNNING CONDITIONS		
CHILLED WATER HEAT EX. USER SIDE		
Fluid type		ETHYLENE GLYCOL
Glycol	%	12
Fouling factor	m²K/kW	0.000
COOLING		
Fluid inlet temperature (cooling mode)	°C	12.00
Fluid outlet temperature (cooling mode)	°C	7.00
Water flow	l/s	8.355
Pressure drop at the heat exchanger	kPa	40.3
Available unit head	kPa	262
COOLING + HEAT RECOVERY		
Fluid inlet temperature (cooling + heat recovery)	°C	12.00
Fluid outlet temperature (cooling + heat recovery)	°C	7.00
Water flow	l/s	9.152
Pressure drop at the heat exchanger	kPa	48.4
WARM WATER HEAT EX. USER SIDE		
Fluid		WATER
Glycol	%	0
Fouling factor	m²K/kW	0.000
HEATING		
Fluid inlet temperature (heating mode)	°C	40.00
Fluid outlet temperature (heating mode)	°C	45.00
Water flow	l/s	7.244
Pressure drop at the heat exchanger	kPa	31.6
Available unit head	kPa	284
COOLING + HEAT RECOVERY		
Fluid inlet temperature (cooling + heat recovery mode)	°C	40.00
Fluid outlet temperature (cooling + heat recovery mode)	°C	45.00
Water flow	l/s	11.61
Pressure drop at the heat exchanger	kPa	81.1
OUTDOOR CONDITION		
Air temperature (cooling mode)	°C	35.0
Air temperature (heating mode)	°C	-4.0

COOLING (EN 14511)		
Cooling capacity	kW	168.9
Compressor power input	kW	68.37
Fans power input (cooling mode)	kW	3.40
Total power input	kW	73.10
EER	kW/kW	2.310
ESEER EN 14511	kW/kW	3.760

The performance shown are obtained from theoretical calculations and tolerances will apply.Rpt.version:1.0.6.0

TECHNICAL SELECTION — **NX-Q-G06 /LN /EC /0804**

Software version: ELCA World v. 1.8.1.1
Database version: 1.9.1.0
User: Daniel Hunt
Print data:19/12/2023 16:02
Calculation type:EN 14511 - EN 14825

EUROVENT CERTIFIED PERFORMANCE www.eurovent-certification.com

EC FAN · HEATING · SCROLL

COOLING WITH HEAT RECOVERY (EN 14511 VALUE)		
Cooling capacity	kW	186.2
Recovery heat exchanger capacity	kW	240.5
Total power input	kW	62.05
TER	kW/kW	6.876

HEATING (EN14511)		
Total heating capacity	kW	133.3
Compressors power input (heating mode)	kW	55.49
Fan power input (heating mode)	kW	3.40
Total power input	kW	58.70
COP	kW/kW	2.270

SCOP		
SCOP Official (Reg. 813/2013 EU)		
LOW TEMPERATURE		
Type climate		Average
Temperature application	°C	35
Type flow		Fixed
Type Temperature		Variable
Bivalent temperature	°C	-7.0
PDesign	kW	143
Qhe	kWh	81655
SCOP		3.62
Performance ηs	%	142
Seasonal efficiency class		-

SCOP Editable (EN 14825)				
LOW TEMPERATURE				
Type climate		Colder	Average	Warmer
Temperature application	°C	0.00	35.00	0.00
Type flow		-	Fixed	-
Type Temperature		-	Variable	-
Bivalent temperature	°C	0.0	-7.0	0.0
PDesign	kW	0.00	143	0.00
Qhe	kWh	0	81655	0
SCOP		0.00	3.62	0.00
Performance ηs	%	0	142	0
Seasonal efficiency class		-	-	-

Note	
	Any SCOP values different from what is reported in commercial documentations are due to the different configuration of the unit and/or different calculation parameters input by the user.

The performance shown are obtained from theoretical calculations and tolerances will apply.Rpt version:1.0.6.0

CLIMAVENETA

4 of 12

TECHNICAL SELECTION — **NX-Q-G06 /LN /EC /0804**

Software version: ELCA World v. 1.8.1.1
Database version: 1.9.1.0
User: Daniel Hunt
Print data:19/12/2023 16:02
Calculation type:EN 14511 - EN 14825

EUROVENT CERTIFIED PERFORMANCE www.eurovent-certification.com

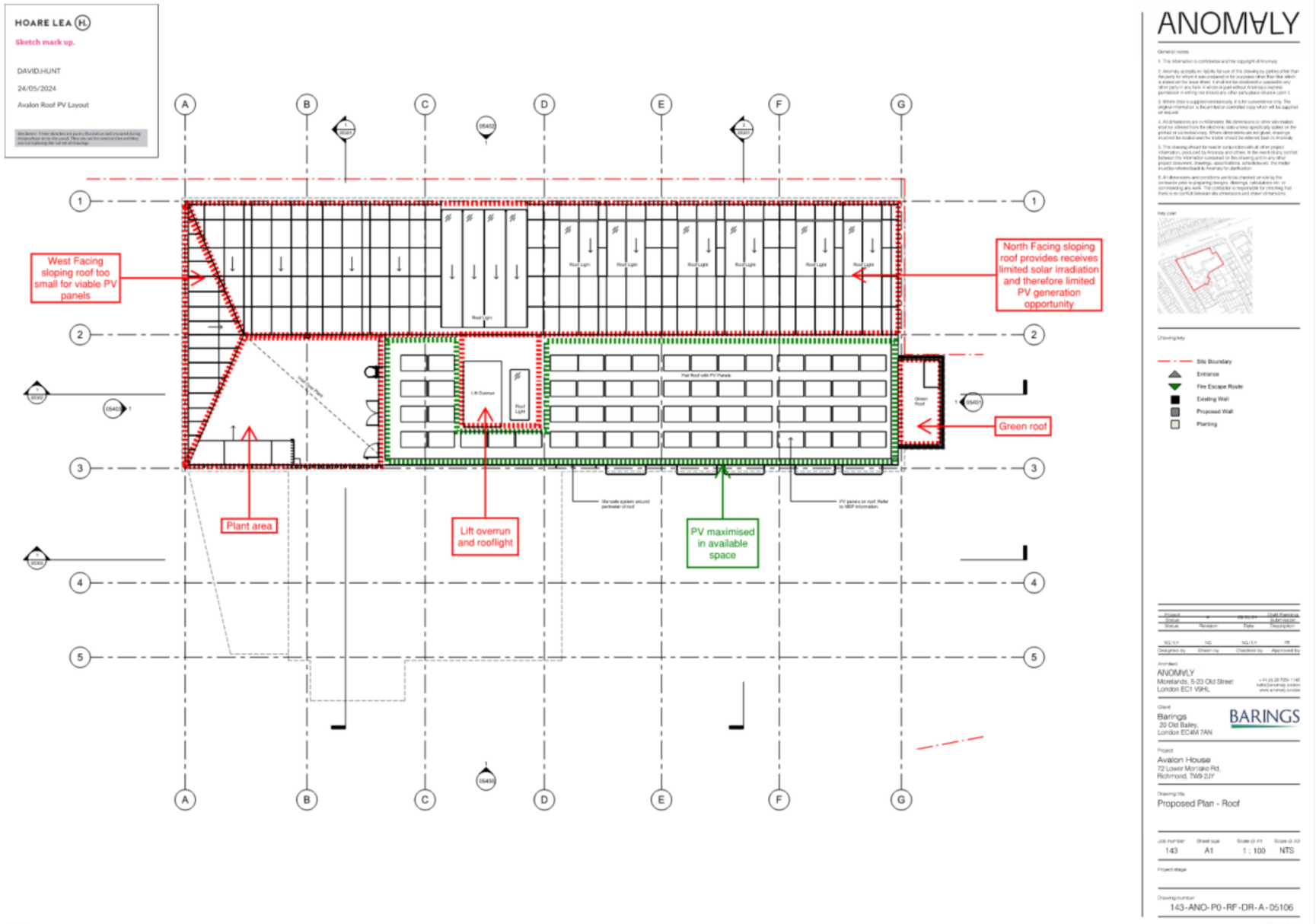
EC FAN · HEATING · SCROLL

1.2 PART LOAD DATA

COOLING PARTIAL LOADS											
Load	%	100.0	90.0	80.0	70.0	60.0	50.0	40.0	30.0	*20.0*	*10.0*
Outdoor air temperature	°C	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	*35.0*	*35.0*
Cooling load	kWh	169	152	135	118	101	85	68	51	*34*	*17*
Fans power input (cooling mode)	kW	3.40	3.40	3.40	3.40	3.40	2.92	2.35	1.78	*1.24*	*0.71*
Total power input	kW	73.20	61.20	49.70	41.70	33.70	28.10	22.90	17.70	*12.40*	*7.020*
Temp. evaporator inlet	°C	12.00	11.50	10.99	10.49	9.99	9.49	8.99	8.49	*8.41*	*8.41*
Temp. evaporator outlet	°C	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	*7.00*	*7.00*
Evaporator water flow	l/s	8.355	8.356	8.356	8.356	8.356	8.355	8.355	8.354	*8.354*	*8.354*
EER	kW/kW	2.310	2.480	2.720	2.830	3.010	3.010	2.950	2.870	*2.740*	*2.410*
Note		Note: italics texts mean integrated values under minimum step									

HEATING PART LOAD											
Load	%	100.0	90.0	80.0	70.0	60.0	50.0	40.0	30.0	*20.0*	*10.0*
Outdoor air temp.	°C	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	*-4.0*	*-4.0*
Heating load	kWh	133	120	107	93	80	67	53	40	*27*	*13*
Total power input	kW	58.80	52.60	46.40	40.00	33.60	27.90	22.60	17.40	*12.20*	*6.860*
Condenser input temperature	°C	40.00	40.50	40.99	41.49	41.99	42.48	42.98	43.48	*43.61*	*43.61*
Condenser output temperature	°C	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	*45.00*	*45.00*
Condenser fluid flow	l/s	7.244	7.244	7.244	7.244	7.244	7.244	7.244	7.244	*7.244*	*7.244*
COP	kW/kW	2.270	2.280	2.300	2.330	2.380	2.390	2.360	2.300	*2.200*	*1.940*
Note		Note: italics texts mean integrated values under minimum step									

Appendix F – PV Layout



HOARE LEA

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