O2 Masterplan Site, Finchley Road

Energy Strategy

Version 1, January 2022

Prepared for LS (Finchley Road) Limited by Hoare Lea

Landsec

HOARE LEA

O2 Masterplan Site.
Finchley Road.
LS (Finchley Road) Ltd.

SUSTAINABILITY

ENERGY STRATEGY

REVISION 01 – JANUARY 2022

Audit sheet.

Rev.	Date	Description of change / purpose of issue	Prepared	Reviewed	Authorised
01	January 2022	Issue for planning	CD	ER	GJ

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Contents.

Executive summary.

This Energy Strategy has been prepared by Hoare Lea on behalf of LS (Finchley Road) Limited ('the Applicant'), to support an application made in part in detail and part in outline (the 'Application') for the demolition and redevelopment of land encompassing the O2 Centre and associated car park, Homebase store, car showrooms and a Builder's Merchant (the "Site") within the London Borough of Camden ('LBC').

Development Plots N3-E, N4 and N5 and the associated landscaping, access roads and infrastructure form the detailed element of the Application which extends to 1.79ha and these proposals are referred to as the "Detailed Proposals".

The remainder of the Application (comprising Development Plots N1, N2, N3, N6, N7, S1 and S8) is submitted in outline and these proposals are referred to as the "Outline Proposals".

The Detailed Proposals and Outline Proposals together are referred to as the "Proposed Development".

Full details and scope of the Applications is described in the submitted Planning Statement, prepared by Gerald Eve LLP.

The main body of this report provides the Energy Strategy for the Proposed Development, setting the principles across the site, including both Outline and Detailed Proposal areas. The Energy Strategy for the detailed planning application covering Blocks N3-E, N4 and N5, builds on these principles, and can be found in Appendix A. The calculated results for the Detailed Proposal areas in Appendix A are incorporated within the results of the main report.

Proposed Development.

A strategic approach has been taken for the overarching Energy Strategy for the Proposed Development to futureproof and encourage the best measures for the site to come forwards.

The Application is for the following Proposed Development:

> "Part full and part outline planning permission comprising the following:
>
> Detailed planning permission for Development Plots N3-E, N4, and N5 including demolition of existing above ground structures and associated works, and for residential development (Class C3) and commercial, business and service (Class E) uses in Development Plot N3-E, residential development (Class C3) and local community (Class F2) and commercial, business and service (Class E) uses in Development Plot N4, and residential development (Use Class C3) and commercial, business and service uses (Class E) uses in Development Plot N5 together with all landscaping, public realm, cycle parking and disabled car parking, highway works and infrastructure within and associated with those Development Plots."
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> Outline planning permission for Development Plots N1, N2, N3, N6, N7 ,S1 and S8 including the demolition of all existing structures and redevelopment to include residential development (Class C3) commercial, business and service uses (Class E), sui generis leisure uses (including cinema and drinking establishments) together with all landscaping, public realm, cycle parking and disabled car parking, highway works and infrastructure within and associated with those Development Plots."

Approach to Energy Strategy.

The Energy Strategy for the Proposed Development is a key part of the sustainability strategy considered from the start of the project and is central and integral to the proposals. As a large-scale phased masterplan, the overarching strategy is to provide a simple, policy compliant, future-proofed approach to energy efficient and low carbon buildings. The strategy is intended to exploit the benefits of current technologies while providing flexibility for future technologies and policy developments. Performance outcomes will be delivered in practice, minimising carbon emission now and in the future, whilst also considering running costs to tenants and residents. The flexibility that this Energy Strategy provides will permit an exceedance over the minimum policy requirements, which has been demonstrated within the detailed application in Appendix A.

The all-electric Energy Strategy approach is based on a fabric first approach, with good levels of insulation, efficient systems and controls, and the use of Air Source Heat Pump (ASHP) technology, supplemented with photovoltaic (PV) panels where feasible on roof spaces. Therefore, the strategy has been developed to ensure the Proposed Development is both efficient and economical by reducing heating demand in the first instance and then meeting the remainder through highly efficient means.

The electricity-led strategy will result in not only a low carbon scenario as of today, but continuous improvement as the grid continues to decarbonise. This approach will also enable the Proposed Development to be combustion free, facilitating a shift towards clean energy systems, with the associated benefits in local air quality and human health.

Furthermore, space may be provided for inclusion of connection to a site wide heat network, should a future connection become available in the area. This space provision also allows for future conversion to an ambient loop system to enable energy to be shared between buildings, and to import or export heat to or from the Site. In this way, future proofing is at the core of the proposed strategy to reduce energy demand and carbon emissions during the operational lifespan of the Proposed Development.

Drivers.

A policy review has been undertaken and is outlined in Section 2. As a summary, energy-related planning policy applicable to the Application include:

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 new buildings. The assessment of the Application against policy targets has been carried out using Building Regulations Part L 2013.

Regional drivers; Greater London Authority (GLA) policy

This Energy Strategy follows the Mayor's energy hierarchy: 'Be Lean, Be Clean, Be Green, Be Seen' as detailed in the Greater London Authority (GLA) London Plan. Calculations demonstrating the energy requirements and associated CO_2 emissions for the Proposed Development have been carried out using Building Regulations approved software.

SAP10 carbon factors have been utilised in line with GLA Energy Assessment Guidance issued in 2020.

Local drivers; Camden

The Camden Local plan, adopted in 2017 is the primary local policy document, along with the Energy Efficiency and Adaptation Camden Planning Guidance (January 2021).

Applicant drivers; Landsec

Landsec have a number of sustainability commitments which have been incorporated into the design, driving sustainability aspirations beyond those of national and regional policy. The following commitments are integrated into the Energy Strategy for the Proposed Development:

Landsec released their Net Zero Carbon Pathway in late 2020, as part of their founding signatory role for the Better Buildings Partnership - Climate Change Commitment. The pathway sets out an ambitious, but credible strategy to support limiting world global climate warming to 1.5°C. The overall commitment from Landsec is to achieve net zero by 2030.

Carbon intensity is reduced against Landsec's Science-Based Target, by developing an Energy Strategy which minimises energy demand in the first instance, supplies energy using low or zero carbon energy sources and maximises on-site renewable energy generation.

Landsec intend to procure 100% renewable energy and achieve 3 MW of on-site renewable electricity capacity by 2030 across the portfolio.

Energy Strategy summary: Proposed Development.

With a fabric-first approach, passive design and energy efficiency measures will provide the cornerstone to the energy demand and CO_2 emission reduction strategies achieved for the Proposed Development.

The baseline scenario, against which each step of the energy hierarchy is compared, is established by the gas boiler baseline; the Part L Target Emission rate for a gas boiler scenario, as per GLA guidance.

In line with current GLA guidance, carbon emission reductions have been evaluated using the carbon factors set out in the SAP10 guidance.

Given the outline nature of the proposals, carbon reductions are based on indicative energy assessments at this stage (except for Blocks N3-E, N4 and N5 which are brought forward in detail and for which detailed energy assessments have been undertaken – refer to Appendix A).

Be Lean

The Proposed Development is anticipated to meet London Plan targets by achieving a 10% - 15% reduction in CO_2 emissions for the residential and non-residential aspects respectively, prior to the consideration of any Low or Zero Carbon (LZC) technologies. This will be achieved via passive design and energy efficiency measures such as high performance glazing, good insulation and highly efficient Mechanical Ventilation with Heat Recovery (MVHR) systems. This is split between the two use-types, which are outlined in Table 1.

Table 1: Be lean results summary (Proposed Development).

Residential	Non-Residential	Site wide
10% Reduction over Part L1A baseline	15% Reduction over Part L2A baseline	10% - 15% Reduction over Part L baseline

Be Clean

The feasibility of connecting to any existing district heating networks has been reviewed, however no opportunities have been identified within the vicinity of the Site. Future-proofing measures have been set out to enable connection to any future low carbon district heating network. For example, space will be provided for inclusion of connection to a Site-wide heat network, should a future connection become available in the area. This space provision (see Appendix I for plan) also allows for future conversion to an ambient loop system to enable energy to be shared between buildings, and to import or export heat to or from the Site. In this way, future proofing is at the core of the proposed strategy to reduce energy demand and carbon emissions during the operational lifespan of the Proposed Development.

On-site Combined Heat and Power (CHP) is not proposed due to limited carbon reduction potential in light of recent grid decarbonisation (i.e. SAP10 carbon factors), and the adverse impact on air quality from flue emissions. Therefore, no additional carbon reductions are anticipated at the Be Clean stage.

Table 2: Be clean results summary (Proposed Development).

Residential	Non-Residential	Site wide
10% Reduction over Part L1A baseline (No change from Be Lean)	15% Reduction over Part L2A baseline (No change from Be Lean)	10% - 15% Reduction over Part L baseline (No change from Be Lean)

Be Green

A feasibility assessment of integrating low and zero carbon energy systems has been undertaken (Section 8.0). It has been found that Air Source Heat Pumps (ASHP) and Photovoltaic panels (PVs) would be the most suitable options.

It is proposed that heat pump technology will be utilised to provide all space heating, cooling and domestic hot water. PV provision will be determined on a building-by-building basis within subsequent reserved matters applications, dependant on available roof space once ASHP plant is accommodated. Overall, it is anticipated that a further 38%-43% CO_2 emission reduction is anticipated on-Site, giving a total CO_2 emissions reduction of 52.9%, exceeding the GLA policy minimum target of 35% total by 17.9%.

Table 3: Be green results summary (Proposed Development).

Residential	Non-Residential	Site wide
56% Reduction over Part L1A baseline	34% Reduction over Part L2A baseline	53% Reduction over Part L baseline

Be Seen

The strategy will allow for metering of all the various energy uses in the Proposed Development. 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 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 will also complete the GLA's suggested "Be Seen" energy reporting protocols via the appropriate web portals, at the appropriate stage.

Summary.

Overall, it is anticipated that the Proposed Development areas will achieve a circa 53% on-site reduction in CO_2 emissions beyond the gas boiler baseline, through fabric-performance and energy efficiency measures alongside the use of low/zero carbon technologies such as solar PV and heat pumps. PV provision will be determined on a building-by-building basis within subsequent reserved matters applications, dependant on available roof space once ASHP plant is accommodated.

Please refer to Appendix A for CO_2 emissions reductions calculations at each stage of the energy hierarchy for Detailed Proposal areas seeking full planning permission.

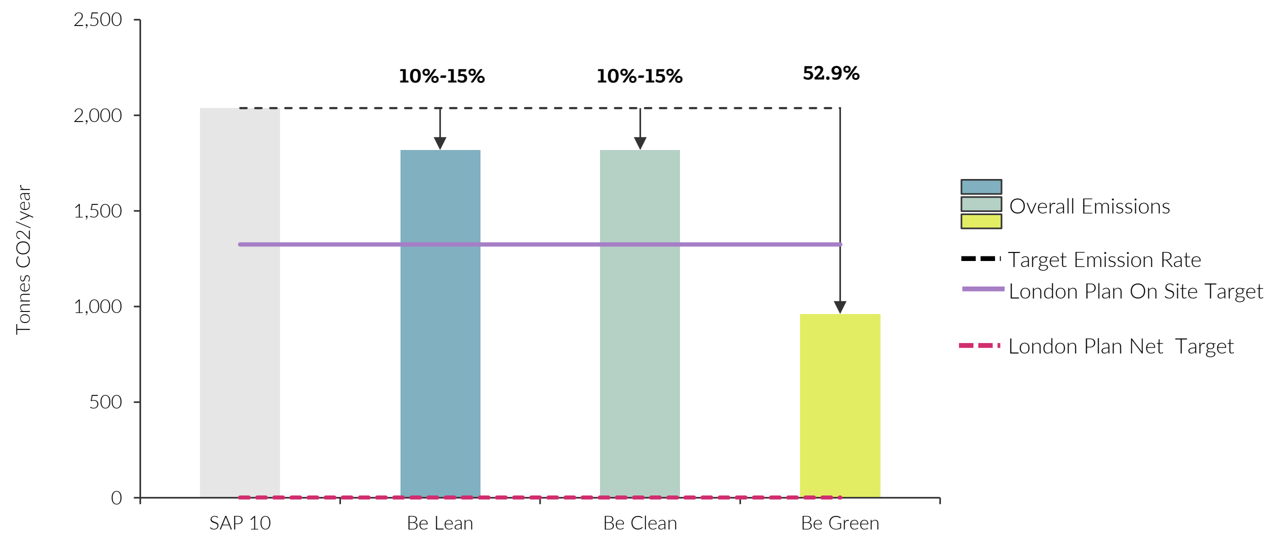

Figure 1: Regulated carbon emissions summary (Proposed Development).

1. Introduction.

1.1 The Application.

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A strategic approach has been taken for the overarching Energy Strategy for the development to futureproof and encourage the best measures for the site to come forwards.

1.2 Description of Development.

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1.3 Key facts and figures.

The Application Site has been subdivided into 10 no. of Plots. The Application seeks planning permission for a maximum total of 189,862sqm GIA of floorspace.

The Outline Proposals are for a maximum of 132,410 sqm GIA. The maximum total floor space by land use (in GIA sqm) is set out in Table 4.

Table 4: Maximum residential and commercial/ non-residential floorspace (GIA) by land use for Outline Proposals

Use	Maximum floorspace caps (sqm GIA)
Residential including car parking (Class C3)	115,000
Commercial/ Non residential	17,410

Detailed Proposals

The Detailed Proposals are for 57,452 sqm GIA. The proposed total floor space by land use (in GIA sqm) for the Detailed Proposals is set out in Table 5.

Table 5: Total GIA Floorspace by use for Detailed Proposals.

Use	Use Class	Plot N3-E (GIA sqm)	Plot N4 (GIA sqm)	Plot N5 (GIA sqm)	Total (GIA sqm)
Residential including car parking	C3	5,269	23,420	26,491	55,180
Community	F2	0	270	0	270
Retail	E (a)	186	186	1,361	1,733
Food and drink	E (b)	114	0	0	114
Professional Services	E (c)	0	155	0	155
Sub Station- Sui generis		Included in Resi			
Includes all built floorspace – plant, podium car parking, BOH, etc.		5,569	24,031	27,852	57,452

1.4 Purpose of this report.

This Energy Strategy sets out the proposed approach regarding reducing carbon dioxide (CO_2) emissions and optimising energy efficiency within the Proposed Development. This strategy summarises the pertinent regulatory and planning policies applicable to the Application, and sets targets commensurate with these policies, which the Proposed Development will seek to achieve.

The Energy Strategy for the Proposed Development is set out in high level terms within the main body of this report, defining the proposed approach to carbon reduction, but commensurate with the level of design detail contained in the parameter plans.

Areas brought forward in detail (Blocks N3-E, N4 and N5) are assessed in further detail, with Part L assessments, and technical parameters identified. The detailed application for Blocks N3-E, N4 and N5 is included in Appendix A.

This strategy takes a tiered approach to systematically driving down energy consumption and carbon emissions through applying the energy hierarchy:

- Be Lean;
- Be Clean;
- Be Green;
- Be Seen.

This approach is required by the GLA (Greater London Authority) for London based planning submissions and sets carbon emissions reduction targets corresponding to the tiers in order to reduce the energy consumption as much as possible.

1.5 Definitions.

The following definitions should be understood throughout this statement:

- Energy demand: the 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 requirement: the ‘system-side’ requirement for energy (fuel). In the context of a space heating system using n Air Source Heat Pump, this is the amount of energy required (i.e. electricity) 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, i.e. excluding unregulated emissions).

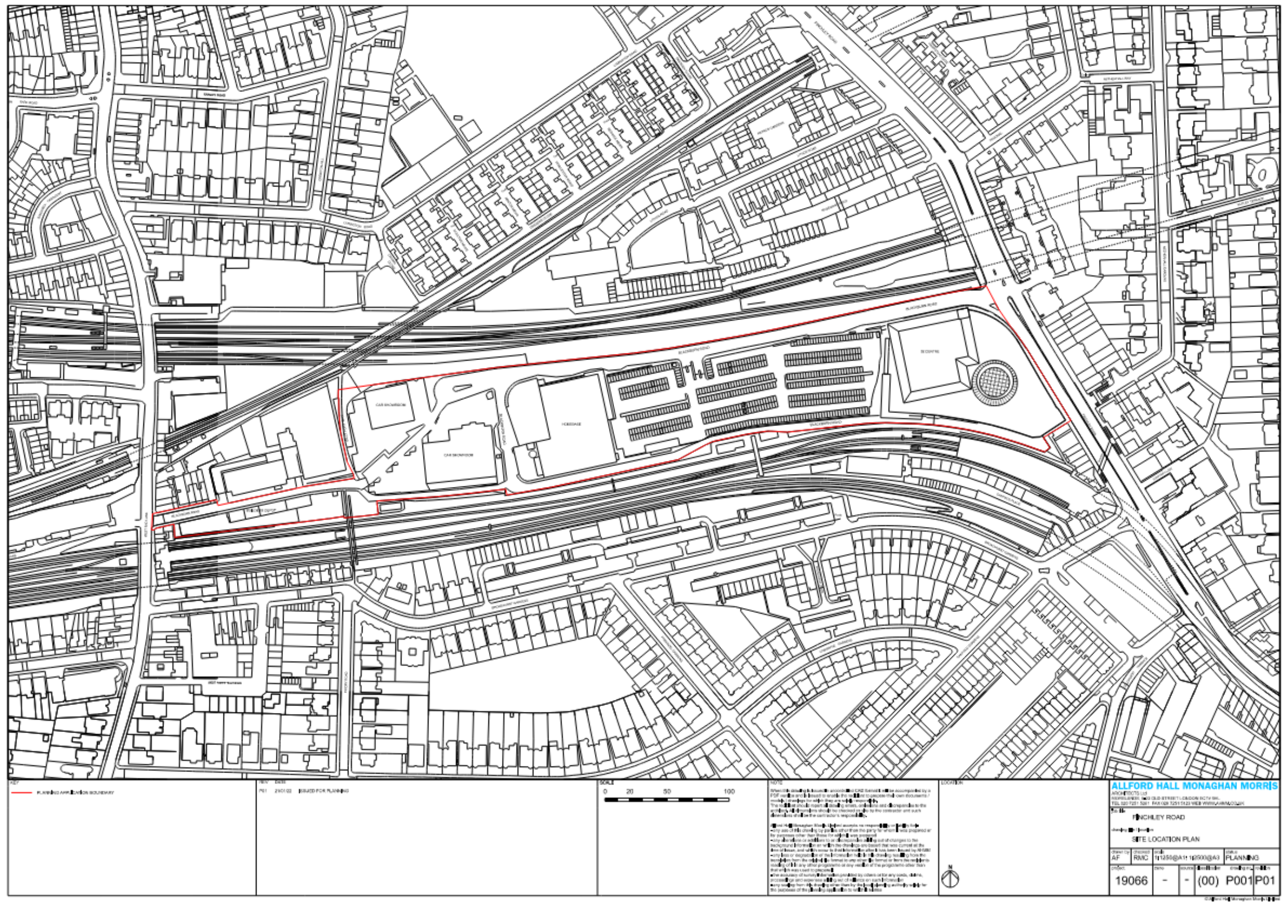


Figure 2: Site location plan. (Source: AHMM).

2. Drivers.

The proposed strategy responds first and foremost to the universal challenges facing humanity of the Climate Emergency, the Biodiversity Crisis, and Health and Wellbeing. National and local policy will shape the baseline of performance, alongside Landsec's sustainability ambitions, and best practice principles of design, delivery, and operation determining the Application design as outlined in the following sections of this Energy Strategy.

The following chapter presents a summary of the current policies relevant to the energy aspect of the Development.

2.1 Greater London Authority (GLA).

New Energy Assessment Guidance (2020)
The new Energy Assessment Guidance aligns with the adopted London Plan, and provides further guidance on the new 'Be Seen' stage of the energy hierarchy and whole life carbon calculation methodology.

New London Plan Policy SI2 – "Minimising Greenhouse Gas Emissions" has set more stretching targets for carbon emissions for London developments, both overall, and at stipulated stages of the energy hierarchy, as seen in Table 6.

Table 6: Carbon Emission Targets proposed under Intend to Publish London Plan (Policy SI2)

	Target
All Major Developments	Zero Carbon for regulated emissions against Part L 2013 Baseline (i.e. 100% reduction in carbon emissions)
Minimum Target	35% reduction in regulated emissions against the Part L 2013 Baseline to be met on-site with remainder to be met via offset payments.
Residential	10% reduction in regulated emissions against the Part L 2013 Baseline from the Be Lean stage (i.e. energy efficiency measures only)
Non-residential	15% reduction in regulated emissions against the Part L 2013 Baseline from the Be Lean stage (i.e. energy efficiency measures only)

2.2 Local policy- London Borough of Camden.

The Site is located within the London Borough of Camden; the primary policy document being the Camden Local Plan (2017) supported by the Camden Planning Guidance (CPG) document, Energy Efficiency and Adaptation (January 2021).

Policy CC1 (Climate change mitigation) of the Camden Local Plan outlines the following directives for all developments to minimise the effects of climate change:

- Promote zero carbon development by reducing carbon dioxide emissions through the energy hierarchy
- Require all major development to demonstrate how London Plan targets for CO_2 emissions have been met
- Ensure the location of development and mix of land uses minimise the need to travel by car and help support decentralised energy networks
- Require all proposals that involve substantial demolition to demonstrate it is not possible to retain and improve the existing building
- All developments to optimise resource efficiency.

In addition, for decentralised energy networks, Camden will promote decentralised energy by:

- Working with local organisations and developers to implement decentralised energy networks in the parts of Camden most likely to support them
- Protect existing networks (e.g. Gower Street, Bloomsbury, King's Cross, Gospel Oak and Somers Town) and safeguard potential network routes.
- Require all major developments to assess the feasibility of connecting to an existing decentralised network.

All major developments will also be expected to demonstrate how relevant London Plan targets for CO_2 reduction, including targets for renewable energy, have been met. Where it is demonstrated that the required London Plan reductions in carbon dioxide emissions cannot be met on site, the Council will require a financial contribution to an agreed borough wide programme to provide for local low carbon projects.

Policy CC2 (Adapting to climate change) outlines requirements for developments to incorporate climate adaptation measures such as:

- Protection of existing green spaces and promoting new green infrastructure
- Not increasing, and wherever possible reducing, surface water run-off through increased permeable surfaces and use of SUDs
- Incorporating bio-diverse roofs, combination green and blue roofs and green walls where appropriate
- Measures to reduce the impact of urban and dwelling overheating, including application of the cooling hierarchy.

The Council will promote and measure sustainable design and construction by:

- Ensuring development schemes demonstrate how adaptation measures and sustainable development principles have been incorporated into the design and proposed implementation
- Encourage new build residential development to use the Home Quality Mark and Passivhaus design standards
- Expecting non-domestic developments of 500 sqm of floorspace or above to achieve "excellent" in BREEAM assessments and encouraging zero carbon in new development from 2019.

Supplementary to the key policies within the Camden Local Plan (2017), Camden published an Energy Efficiency and Adaptation (2021) SPG outlining the preferred Energy Strategy for Applications and expanding on the principles underpinning their key policies as stated above. The targets set within the Local Plan echo those required by the GLA London Plan (2021).

Climate Emergency declaration
In 2019, Camden Council declared a climate and ecological emergency and held the UK's first Citizen's Assembly on the climate crisis, resulting in committing the Council to a target net zero carbon by 2030. With input from local stakeholders, 17 actions were developed and agreed, forming the Camden Climate Action Plan 2020-2025.

The Plan sets out a vision across four themes:

1. People – raising awareness and increasing active contribution to tackle the climate crisis.
2. Places – encouraging and enabling healthy and sustainable travel choices and promoting biodiversity.
3. Buildings – to be energy efficient, comfortable and fit-for-purpose for a zero carbon future.
4. Organisations – to operate responsibly and embed tackling climate change throughout their operations.

In November 2020, Camden Council adopted amendments to the council's constitution, ensuring that all council decisions seek to enhance the natural environment and to act to mitigate and adapt to climate change.

2.3 Client drivers: Landsec.

Landsec have a number of sustainability commitments which are being incorporated into the design, driving sustainability aspirations beyond those of National and Regional policy.

Landsec's sustainability commitments focus on the following three areas:

1. Creating jobs and opportunities
1. Efficient use of natural resources
2. Sustainable design and innovation

The following commitments are pertinent to the Energy Strategy for the O2 Centre, Finchley Road.

Carbon

Landsec commitment: Reduce carbon emissions ($tCO2_e$) by 70% by 2030 – compared to a 2013/14 baseline – for property under our management for at least two years, in accordance with our Science Based Target.

Developing an Energy Strategy which minimises energy demand in the first instance, supplies the energy required efficiently using low/zero carbon energy sources, and maximises the provision of renewable energy generation will be the primary objective. Any remaining emissions would be offset via Camden's Carbon Offset Fund or appropriate mechanism, in line with local policy requirements.

Renewable energy

Landsec commitment: Procure 100% renewable energy across our portfolio and achieve 3MW of on-site renewable electricity capacity by 2030.

As per the carbon commitment, the Energy Strategy would seek to maximise the provision of renewable energy onsite.

Energy

Landsec commitment: A 40% reduction in energy intensity (kWh/m^2) by 2030 compared to a 2013/14 baseline, for property under our management for at least two years.

In line with the Energy Hierarchy, demand for energy would be reduced as far possible as the first priority when design the buildings and infrastructure. GLA policy requires a minimum reduction in regulated carbon of 10% and 15% through passive design and energy efficiency measures alone, for non-domestic and domestic developments respectively.

Waste

Landsec commitment: Send zero waste to landfill with at least 75% recycled across all our activities and reduce construction waste to 6.5 tonnes/100m^2 as a minimum.

As the operational performance of buildings improves and the carbon intensity of the energy supplying them decreases, the proportion of a building's whole life carbon which can be attributed to the manufacture of the materials, construction of the building, and its eventual deconstruction ever-increases. Any waste from the construction and demolition process contributes to this, and the strategy should seek to maximise adaptability and flexibility (to ease any change of use) and material efficiency during the design and construction process.

Resilience

Landsec commitment: Assess and mitigate site-specific climate change adaptation risks which are material across our portfolio.

Assessing and mitigating the risk of overheating will form a key part of the future strategy. Dynamic overheating analysis in line with recognised industry methodologies will be conducted.

Materials

Landsec commitment: Source core construction products and materials from ethical and sustainable sources.

As noted, the proportion of a building's whole life carbon which is represented by the manufacture of the materials used to construct it is increasing and often represents the majority share for new, efficient buildings. As such, sourcing materials with low embodied carbon and robust social and environmental sustainability certification would be sought.

Wellbeing

Landsec commitment: Ensure our buildings are designed and managed to maximise wellbeing and productivity.

A holistic Energy Strategy, seeking to reduce carbon but also improve air quality and demonstrate low operational cost, can improve respiratory health and reduce fuel poverty.

Landsec Net Zero Carbon Pathway

Continuing their leadership in the global sustainability sector, Landsec released their Net Zero Carbon Pathway in late 2020, as part of their founding signatory role for the Better Buildings Partnership Climate Change Commitment and in support of their commitment to becoming a net zero carbon business by 2030. The pathway sets out an ambitious, but credible strategy to support limiting world global climate warming to 1.5°C.

2.4 Other drivers.

Decarbonisation of the electricity grid

The carbon factor of the National Grid – the amount of carbon dioxide released per kilowatt hour of electricity generated and distributed – is recognised in current (2013 with 2016 amendments) Building Regulations as being 0.519 $kgCO_2/kWh$. However, the national mix of electricity generation methods is progressing towards greener solutions with renewable sources accounting for 33.4% of the electricity generated in the UK in 2018; up from 24.4% in 2016 (Ofgem).

As a consequence, the Building Regulations Part L 2013 value of the National Grid carbon factor has been shown to be substantially higher than how the grid is performing in reality. This severely impacts the calculated emissions produced by all heat raising plant which either use electricity directly or generate it to offset other emissions. Figure 3 shows how the mix of generation techniques serving the National Grid, as well as the associated carbon factor, has varied over the past seven years – encouragingly, the carbon intensity of the grid has reduced to almost a third of its value between 2012 and 2018 – to 0.177 $kgCO_2/kWh$ (BEIS). The carbon emissions associated with electricity consumption are therefore much lower than reported in Building Regulations. This means that, under the Part L 2013 methodology the CO_2 emissions associated with electrically driven plant are being overestimated by over 200%.

Future projections

The Future Energy Scenarios (FES) document, produced by the National Grid, discusses how the UK's energy landscape is changing. The FES 2019 makes projections of how the mix of generation in the grid is likely to change between now and 2050 – the year by which the Climate Change Act 2008 set the target of reducing the UK's CO_2 emissions by 80% from 1990 levels. This target has now been revised to be Net Zero in light of the Committee on Climate Change's recent report and the declaration of a Climate Emergency.

The latest version, FES 2021, discusses these projections in four scenarios and Figure 3 combines these future trajectories with the actual carbon intensity of the National Grid over the past 13 years. The reported emissions associated with electricity generation have fallen steeply since 2012 and in three cases, the FES 2021 scenarios see carbon factors trending towards zero by the early 2030s. This is on the basis that FES 2021 have deemed it necessary to offset other industries such as freight, shipping and aviation, which will be unable to reduce their carbon emissions to zero. Offsetting the emissions of other industries will involve Carbon Capture and Storage (CCS) technologies on a significant scale in order for the UK as a nation to meet net zero carbon by 2050. It is important to note that CCS technology is not currently commercially demonstrated at a large scale, but the FES 2021 studies are useful as future forecasts.

Aligning with policy requirements and client commitments, the Energy Strategy for the Application proposes an all-electric approach utilising ASHPs and PVs which will enable reduced operational carbon emissions in line with grid decarbonisation.

In addition, further futureproofing measures have been considered, incorporating space allowance for potential future conversion to an ambient loop system to enable energy sharing within the site, or for connection to a District Heat Network.

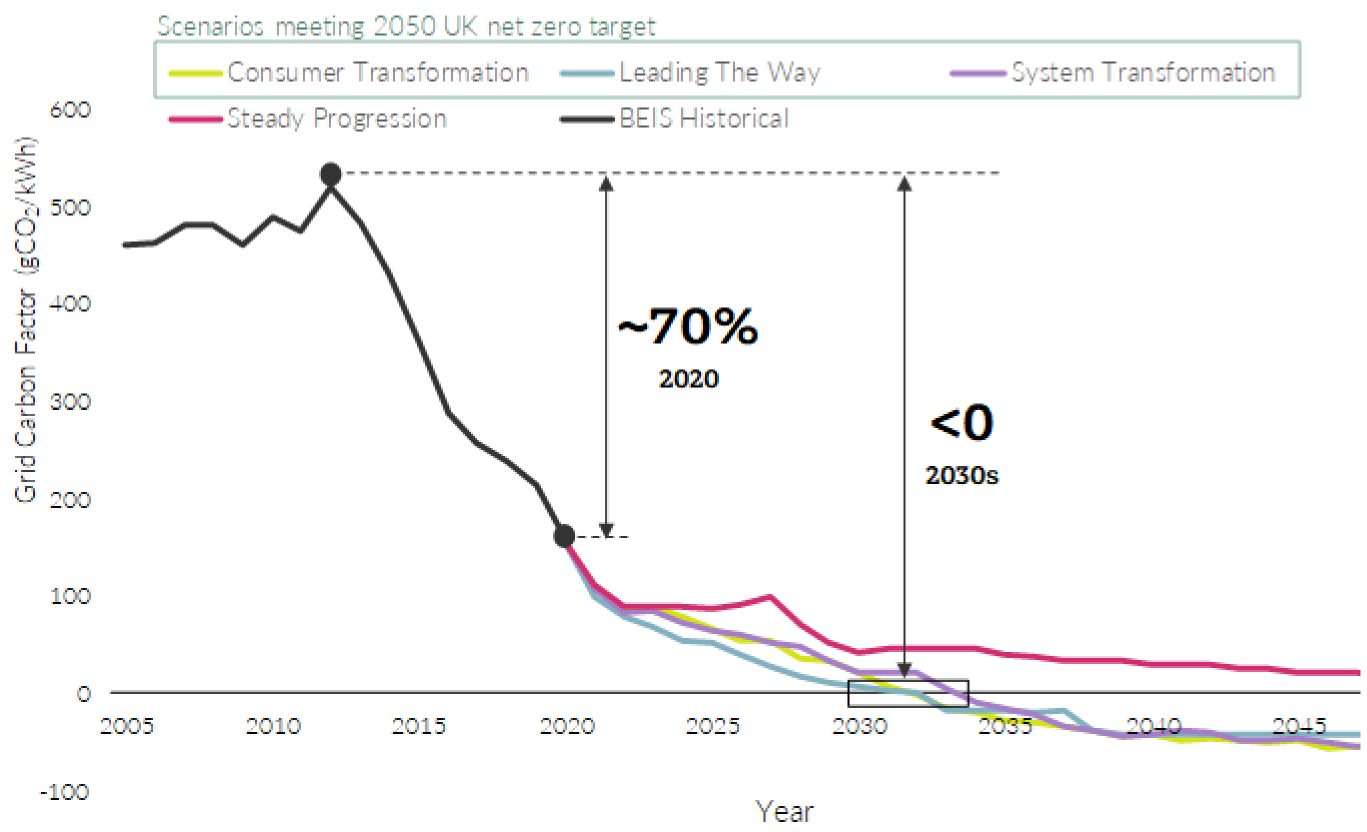


Figure 3: Historic and future projected carbon factor for the National Grid. Sources: *BEIS Green Book* (historic carbon factors); *National Grid Future Energy Scenarios (FES) 2021* (future projected carbon factors).

Future Buildings Standard

The Future Building Standard (FBS) comprises a newly launched consultation principally focused on delivering improved energy and carbon performance of non-domestic buildings.

The FBS proposes that:

- This new standard will apply to non-domestic buildings from 2025.
- There will be improvements to the non-domestic energy modelling methodologies.
- Improvements to standards when work is carried out in existing non-domestic properties.
- Ensure the transition of non-domestic buildings to use low-carbon heat sources for heating and hot water and become zero carbon over time (i.e. be zero carbon ready) as the electricity grid and heat networks decarbonise.
- Uplift in minimum energy efficiency and building services standards.

As an interim step, updates to the non-domestic Building Regulations Part L are to be implemented in June 2022 to act as a step change towards the FBS in 2025.

Building Regulations Part L 2021

Alongside the FBS consultation, updates to Building Regulations Part L for both domestic and non-domestic properties have been released. As noted above, it is intended that these will act as a step change to the 2025 FBS performance standards.

Buildings built to the new Part L 2021, as it will be known, are expected to deliver a 27% (on average) improvement in carbon emissions over current standards for non-domestic buildings.

For non-domestic properties, compliance metrics for Part L 2021 will include:

- Primary energy target
- CO_2 emissions target

There will also be improvements to minimum performance standards for building fabric and building services as well as significant improvement in carbon factors for fuel types, most notably for electricity which will drive servicing strategies to all electric solutions.

*Definition of primary energy used here is, 'energy from renewable and non-renewable sources which has not undergone any conversion or transformation process'. For example, the chemical energy contained in fossil fuels is a source of primary energy. However, a unit of electricity generated by burning that fossil fuel will not be considered primary energy because it has gone through a conversion process.

Considering primary energy first and foremost (rather than CO_2 emissions) and including a consideration of the affordability of a given servicing strategy, reflects the challenges and consequences of a shift to all-electric servicing strategies, including the increased demand on an already strained electricity grid and the likely increase in energy bills due to the higher relative cost of electricity compared to gas.

Future detailed applications will need to comply with Part L 2021.

3. Site context analysis.

The following provides a summary of the early preliminary performance modelling and analysis undertaken for the Proposed Development.

The aim of the modelling is to provide design recommendations to the design team to effectively inform the Site layout, approach to improve pedestrian comfort, approach to fenestration, building fabric specification, and deployment of renewable generation for the Application.

The site context appraisal covers:

- Local wind environment
- Incident solar irradiance mapping
- Universal Thermal Climate Index (UTCI)

3.1 Site context summary.

Wind
- Annual prevailing wind is from the south-southwesterly direction (and south and south-west), with low wind speeds of ~2-4 m/s.
- Winter wind distribution is similar to annual, with slightly higher wind speeds.
- Summer wind distribution is more even, with higher frequency of westerly and north-northwesterly winds.
- The design of the public realm across the site should consider shielding from south-southwesterly cold winter winds, and encouraging summer wind flows from the west and north-northwest to improve pedestrian thermal comfort and opportunity for natural ventilation.
- Taller towers in the development need to consider safety on balconies and at any facade openings due to higher wind speeds.
- Ventilation system fresh air intakes are best located upwind of any air exhaust locations.

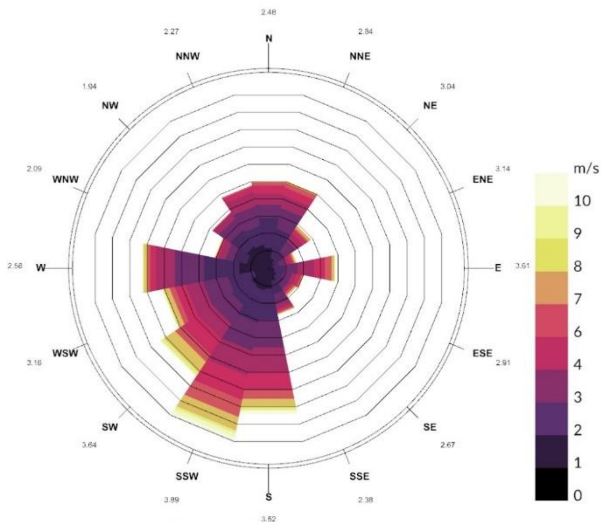


Figure 4: Annual wind rose showing wind speeds affecting the site. Each enclosed polyline shows a frequency of 0.6% (49 hours).

3.2 Irradiance.
- Incident solar radiation is concentrated from the east, south and west.
- Total annual irradiance for the site is 1,100kWh/m^2/year; renewables reliant on solar will be well placed on unshaded rooftops.
- Generally the buildings are higher than those neighbouring the site, so will not receive much shading from off-site. On-site, buildings will shade adjacent buildings, reducing solar irradiance levels where buildings are closer together.
- South facades are exposed to high levels of solar irradiance; careful consideration has been made for solar shading and material selection.
- North facades and areas of the public realm to the north of proposed buildings will receive much lower annual irradiance, including deeper courtyard areas, concave corners where facades meet.

3.3 Universal Thermal Climate Index.
Analysis of the Universal Thermal Climate Index showed an indication of perceived thermal conditions in the public realm of the site, with higher temperatures perceived in unshaded areas on the perimeter of the site, and cooler temperatures perceived in shaded areas in between buildings. As expected, areas along the southern edge of the public realm are unshaded by buildings throughout the day and site pedestrians are anticipated to experience higher temperatures. The anticipated UTCI correlates with the high solar irradiance exposure. To improve pedestrian comfort at the southern edges of the site, consider:

- Blue and green infrastructure and landscaping materials with high surface albedos to mitigate any added local microclimate effect that may occur due to the urban heat island phenomenon.
- Shading opportunities in the landscape, either natural or man-made, including deciduous trees that will shade in summer, but allow solar irradiation through in winter.

3.4 Design considerations.

Renewables deployment
The high levels of irradiance experienced by the roofs and some terraces mean they are ideal for placement of renewable energy generating technologies, such as solar photovoltaics (PV). This could be combined with green roofs which are known to have the ability to complement the efficiency of solar panels by reducing local air temperatures via evapotranspiration.

Minimising overheating and reducing heating demand
A combination of informed internal layout, appropriate glazing areas and properties, and considered materials specification will help to minimise the overheating risk and reduce heating demand:

Courtyards
Courtyards are generally protected from high solar irradiation in summer, with medium to low solar irradiance, and good perceived thermal comfort expected during peak summer months. With both the courtyards and the facades adjacent to the courtyards receiving less irradiance due to the building form:

- Light coloured materials should be considered in design development, to improve brightness levels and reflectance into adjacent internal spaces.
- Planting which does not require high levels of direct sunlight should be chosen for landscaping.

In winter months, with low solar irradiation, the courtyard pedestrian areas should ideally be protected from the south/ south-southwesterly and southwesterly cold winds with wind shading elements such as evergreen planting..

Wider public realm
Aside from the courtyards, open space to the south of the site will experience high levels of solar irradiation, while areas directly to the north of buildings will receive low levels of solar irradiation. Therefore approaches to improve pedestrian comfort, and local microclimate temperatures include:

- Provide summer shading, but allow through winter sun using deciduous trees in areas of high solar irradiation.
- Again consider winter wind shading elements such as evergreen planting, or fences to shelter areas with low levels of solar irradiation.

Roofs

As well as high irradiance, the roofs are likely to be subject to high solar gains, particularly during the summer months, where the majority of the annual irradiance incident on a building is experienced. This will increase the risk of overheating. This effect can be mitigated:

- By using materials with a high solar reflectivity index (SRI) and technologies such as green roofs, which provide evaporative cooling.
- Installing green roofs to lower surface temperatures, increase biodiversity and provide visual interest and amenity.

Lower roofs, which are partially shaded by adjacent buildings will be best suited for amenity spaces, increasing site biodiversity with green roofs, or for locating mechanical plant, such as air source heat pumps if acoustic and visual requirements are met.

Internal layout

Dual aspect has been sought wherever possible however some apartments may be single aspect and as such, strategic locating of bedrooms is not possible for most dwellings. Instead, consideration of appropriate shading and glazing ratio has been made.

Solar shading

With solar irradiance on southern facades almost as high as levels received on roofs, solar shading is provided via:

- Horizontal shading elements, such as balconies designed to block out high angle summer sun to mitigate overheating and admit low angle winter solar irradiation for passive heating and reducing heating demands and associated energy costs.

Glazing ratio

Glazing is thermally less efficient than insulated walls. This, along with the fact solar radiation can pass through glazing into, or out of, the internal environment means the greater the area of glazing, the greater heat losses in winter and heat gains in summer. Glazing percentages have been proposed in line with other design requirements, including architecture, daylight, views out and natural ventilation and mitigation of overheating risk.

4. Cooling and overheating.

4.1 Cooling hierarchy.

The London Plan Policy SI4 (Managing Heat Risk) requests that developments should reduce potential overheating risk and reliance on air conditioning systems. The 'cooling hierarchy' is provided below and the Application has followed this hierarchy to limit the effects of heat gains in the summer.

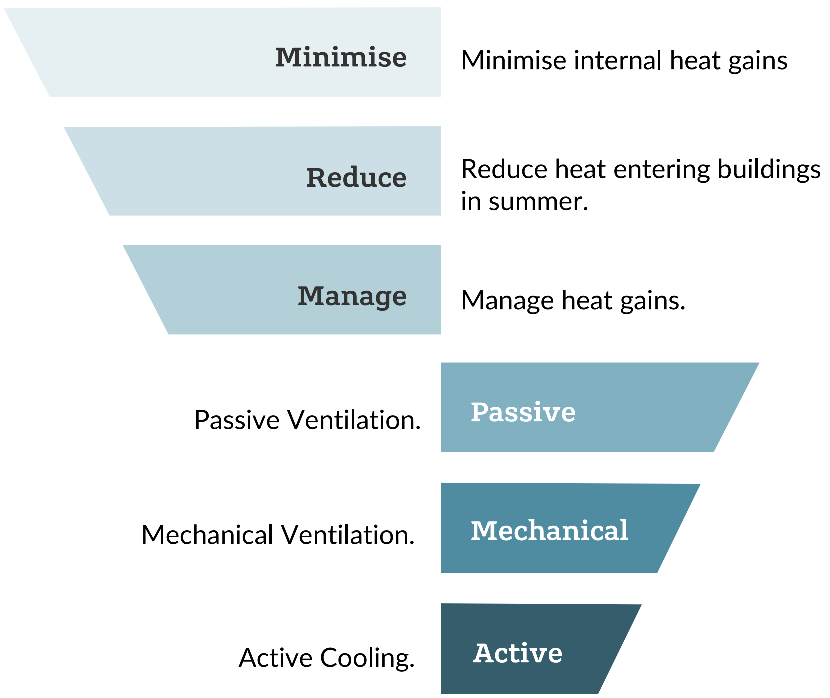


Figure 5: Cooling hierarchy.

4.2 Mitigation strategy.

The following mitigation methods will be implemented within the Proposed Development.

Minimising internal heat generation through energy efficient design

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

- Energy efficient lighting (such as LED) with low heat output
- Insulation to heating and hot water pipework and minimisation of dead legs to avoid standing heat loss (from pipework to dwellings)
- 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 Application:

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

Manage heat gains

- Opportunities to expose thermal mass (i.e. exposed concrete soffits) to help to further regulate internal temperatures will be explored.

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. Providing fresh air minimises the risk of stale and stagnant air and limits the risk of condensation and mould growth as well as benefitting the occupants physical and mental wellbeing. Heat recovery mechanisms will be provided to save heating energy. For residential areas, systems will feature a bypass to avoid returning hot air to the dwellings in summer months.

Mechanical ventilation plant will be located away from pollution sources. It is anticipated that increasing the flow rate will aid the mitigation of high internal temperatures in summer months where required.

4.3 Part L heat gain check.

It is anticipated that the Application will achieve compliance with the Building Regulations Part L 2013 Criterion 3 and limit the effects of heat gains in summer months and reduce the demand on active cooling systems.

4.4 Overheating risk assessment.

The cooling hierarchy principles will be followed as a means of reducing the amount of solar and internal gains, reducing the risk of overheating, and subsequently reducing the demand placed upon active systems.

Overheating risk assessments utilising dynamic thermal modelling will be undertaken for the residential areas in the outline planning application as part of the reserved matters application. (An assessment for the residential areas within the detailed application is included in Appendix B.) The risk assessments follow the appropriate CIBSE guidance (TM59) and weather files as specified in GLA guidance, including consideration of the urban heat island effect, future weather, and any acoustic and security constraints which may impact on the likely operation of openable windows.

Reliance on openable windows alone for mitigating overheating has been identified by acoustic surveys to lead to unacceptable internal noise levels and therefore mechanical ventilation systems with air tempering are recommended to any flats where unacceptable internal comfort conditions are predicted in accordance with the cooling hierarchy.

5. Approach to energy.

5.1 The energy hierarchy.

The energy hierarchy is a widely adopted method to identify opportunities to reduce energy demand and so decrease the related carbon dioxide (CO_2) emissions. As a consequence of the optimized results derived from the application of the energy hierarchy approach, both energy demand CAPEX and OPEX will be minimised.

The Energy Strategy has been developed using a 'fabric first' approach through the Be Lean, Be Clean, Be Green and Be Seen energy hierarchy to maximise reduction in energy through passive design measures in the first instance, before seeking opportunities to deliver energy efficiently, maximising the provision of low and zero carbon technologies, and finally measuring, monitoring, verifying and reporting on energy performance annually.

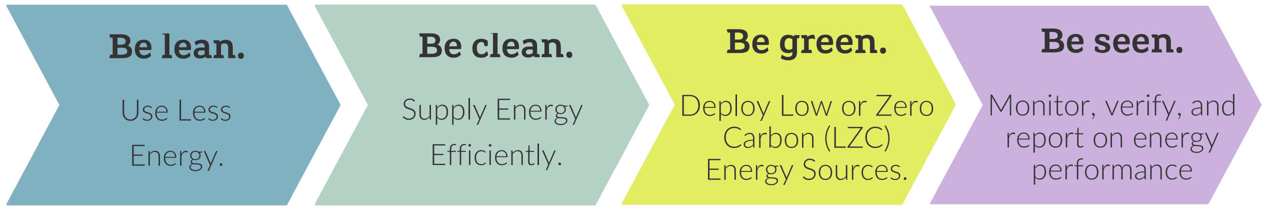


Figure 6: Energy hierarchy.

Be lean – Use less energy.
The initial stage of the analysis is mainly focused on the architectural layouts, façade composition and external thermal envelope. The scope of this stage is to optimise the shape of the new buildings based on internal parameters (i.e. daylighting requirement, function of the space, thermal characteristic of the space) but also external factors such as surrounding buildings, site morphology, and local weather data.

A second step within this analysis phase involves optimising the thermal performance of the building(s') envelope(s). This could be achieved through solutions such as targeting low U-values, air permeability and efficient glazing to minimise heat losses in winter and maximise coolth retention in summer months.

Be clean – Supply energy efficiently.
Combined Heat and Power (CHP) offers high emissions savings under the Part L 2013 methodology. However, this is not representative of the performance of CHP in reality. Low carbon grid electricity means CHP can actually increase emissions relative to the baseline. therefore, a CHP led strategy is unlikely to be appropriate for the Application.

Decarbonising the UK's existing heat networks is a known challenge and there is a strong case to be made that only in rare situations are heat networks appropriate as an effective means of providing low carbon heat to new homes. However, opportunities to deploy both traditional heat network and an ambient loop network, to share energy between areas requiring heating and cooling, will be explored as a part of the development of the Energy Strategy.

Be green – Low or zero carbon energy sources.
The strategy will seek to maximise the provision of low and zero carbon energy capture and generation to meet the remaining demands of the development.

During this phase, Heat Pump technology will be evaluated together with the potential to include Photovoltaic system (PV), solar thermal and battery storage systems to further reduce emissions produced on site.

Be seen – Monitor, verify and report on energy performance.
The final stage of the process will facilitate optimal the performance of building services in all seasons and verify performance against the design intent, seeking to close any performance gap and reporting on true performance and lessons learned.

This is a key new phase of the process because it will provide actual energy usage data to the building user and it provides useful feedback about the difference between estimated and actual energy usage and carbon emissions, and a practical basis for managing energy use in operation.

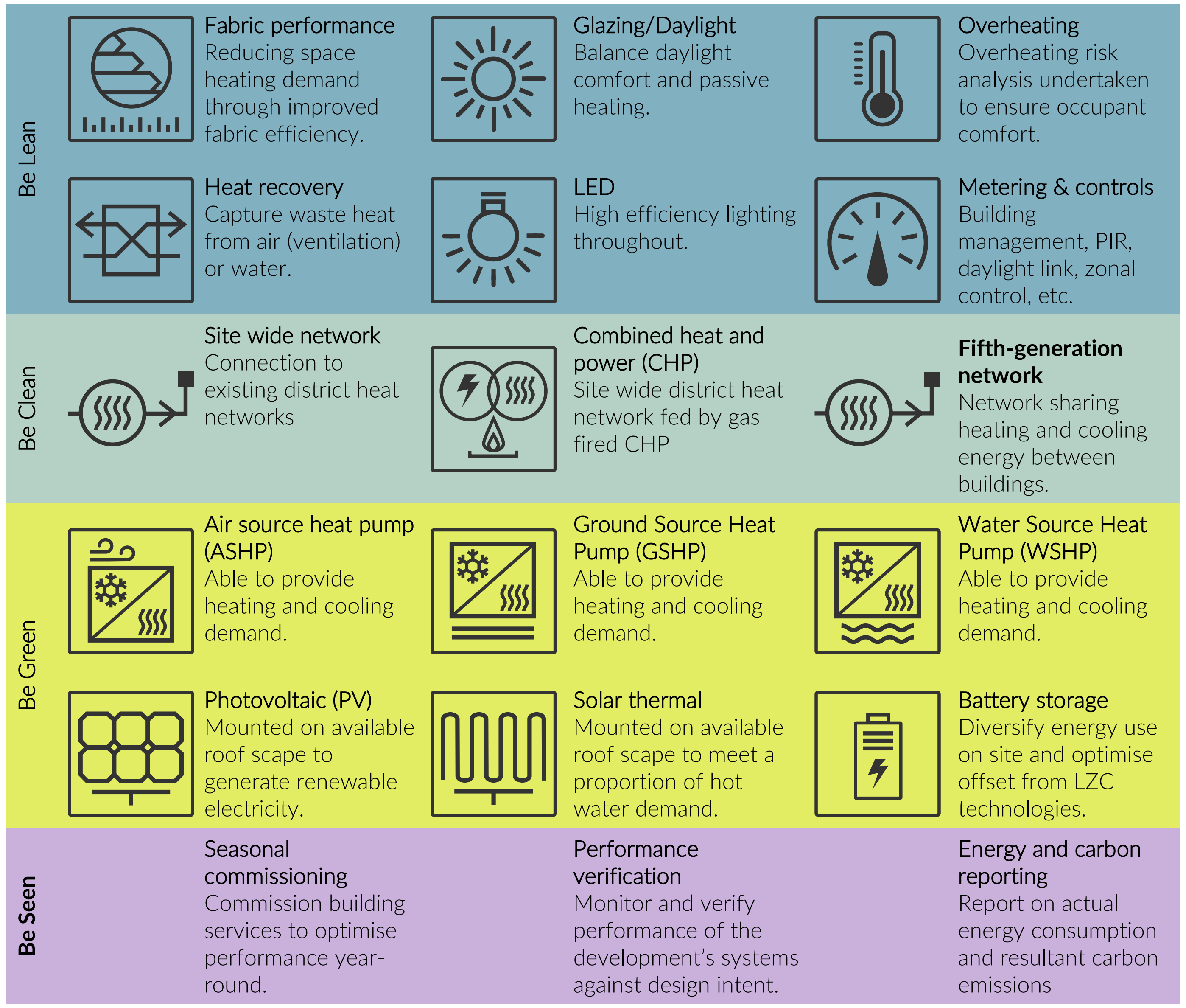


Figure 7: Technology options which could be explored for the development.

6. Be Lean.

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

	Fabric performance A 'fabric first' approach will be taken in order to reduce the energy demand and CO_2 emissions from the Development. This includes fabric efficient design, glazing areas and performance and elimination of thermal bridging junctions. The Application will seek high standards of fabric performance as the foundation of the Energy Strategy in order to provide a development that is comfortable to occupants and reduce fuel poverty through reduced running costs. Thermal Insulation The newly constructed buildings will seek to utilise efficient thermal envelopes. Typically, demand for space heating can be dominant in dwellings, whilst space heating is less dominant in commercial spaces such as office and retail. Heat losses and gains will be controlled by the optimisation of the fabric of each building, i.e. ensuring appropriate levels of glazing to control winter heat loss and summer heat gain. Reducing the thermal transmittance of the building envelope where appropriate will help to reduce both heating requirement and result in lower energy requirements. Glazing Energy & Light Transmittance Elevations for the dwellings will be developed with a suitable approach to fenestration and glazed areas, and glazing specification (light transmission and solar control) to ensure an appropriate balance between the benefits of passive solar heating in winter months whilst limiting the likelihood of high internal temperatures in summer, as applicable to each building type.
	Domestic hot water (DHW) system To limit the demand for hot water, all spaces will include the use of water-efficient fixtures and fittings including WCs with low flush volume, flow reducers in the taps of wash hand basins and aerated shower heads, to limit overall water consumption in line with Building Regulations Part G, and the GLA London Plan 2021.

	Mechanical ventilation It is anticipated that high-efficiency mechanical ventilation with heat recovery will be adopted for all apartments. The strategy for commercial areas is anticipated to be shell and core, providing space for tenant installation of VRF within allocated areas and façade louvres for tenant installation of an MVHR system. Mechanical ventilation is an important addition to the building services to maintain good indoor air quality by providing fresh air and extracting vitiated air. Providing fresh air minimises the risk of stale and stagnant air and limits the risk of condensation and mould. Coupled to a heat exchanger, the warmth in extracted air can be recovered and delivered to the supply air. In this mode, the ventilation system reduces space heating demand.
	Natural daylight and lighting strategy For commercial spaces, lighting often represents a majority proportion of energy demand. Non-domestic spaces should look to lighting manufacturers to seek highest performance in efficacy (lumens/circuit Watt) to reduce lighting demand and reduce operational costs to building users. All buildings will be provided with low-energy, efficient light fittings throughout, and external lighting for dwelling amenity and communal areas will also be low-energy efficient fittings and will be linked to daylight sensors and / or presence detectors to prevent unnecessary use.
	Wastewater heat recovery Wastewater from homes and buildings is warm. This is due to both the energy retained in water used for showers, baths, or other domestic hot water uses and the warmth of human waste, which can also be supplemented while in the sewers by bacterial activity. This means sewers operate at a near constant 15°C. Within apartments The energy from DHW uses can be captured at the building-level, for example wastewater heat recovery (WWHR) systems can be fitted into shower trays, recovering heat from the water draining away and transferring the heat to the shower cold water supply before mixing to reduce overall hot water heating required. However, practically, it is understood that the use of horizontal WWHR units will raise shower trays considerably higher than a standard shower tray and decrease the height of the shower area, meaning that they are not suitable for any apartments needing to comply with Building Regulations Part M, and the height limitations will have a cumulative impact on the overall height of the development. They are also more likely to get blocked which will cause issues for future tenants. The use of vertical WWHR units will require maintenance access from a different tenant space below, which is unacceptable. For these reasons, WWHR systems within apartments has been discounted. From sewers The warm wastewater from dishwashers, washing machines and kitchen sinks will still discharge to sewers, and the energy can be recovered in a centralised way, either within the sewers or, more typically, in the wastewater treatment plant. Large scale heat pumps can uplift the low-grade heat to district heating temperatures to be distributed to nearby buildings. This generation of heat can be more efficient than via traditional air to water heat pumps. The most effective situation to apply this technology is through direct connection to a wastewater treatment works, which is not applicable at this site. A centralised WWHR system has been considered, however, they are an emerging technology with limited installations within the UK, and only one provider and as such have been discounted for the Application.

6.1 Be lean summary.

The following is an appraisal of the anticipated CO_2 emissions of the Proposed Development, after the inclusion of the passive design and energy efficiency measures described above, across the building typologies. Please refer to Appendix A for CO_2 emissions reductions calculations at each stage of the energy hierarchy for areas of the Proposed Development seeking full planning permission.

The results presented below are based on indicative Building Regulations Part L 2013 assessments, utilising SAP10 carbon factors.

Overall, the Proposed Development is anticipated to achieve up to a 10%-15% reduction in annual regulated CO_2 emissions beyond the gas boiler baseline via passive design and energy efficiency measures (i.e. before any benefit from low or zero carbon technologies). The GLA London Plan 2021 requires a minimum reduction at Be Lean of 10% for residential units, and 15% for non-residential.

Considering the residential apartments in isolation, the predicted improvement equates to 10% which meets the London Plan policy requirement.

Considering the commercial units in isolation, the predicted improvement equates to 15% which also meets the London Plan policy requirement.

Table 7: Summary of carbon reduction at 'Be Lean' for each assessment type (Proposed Development).

Residential	Non-Residential	Site wide
10% Reduction over Part L1A baseline	15% Reduction over Part L2A baseline	10% - 15% Reduction over Part L baseline

7. 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.

Be lean. | **Be clean.** Supply Energy Efficiently. | Be green. | Be seen.

Decentralised heat networks

The Site is within a heat priority area on the London Heat Map however as seen in Figure 8, there are no existing or proposed heat networks within close proximity. The closest proposed network is located ~2.6km South of the site in Lisson Grove, near Regent's Park. The Kilburn proposed network will be 1.2km from Site. The railway track to the south also presents a natural barrier to direct access to the Site from either network.

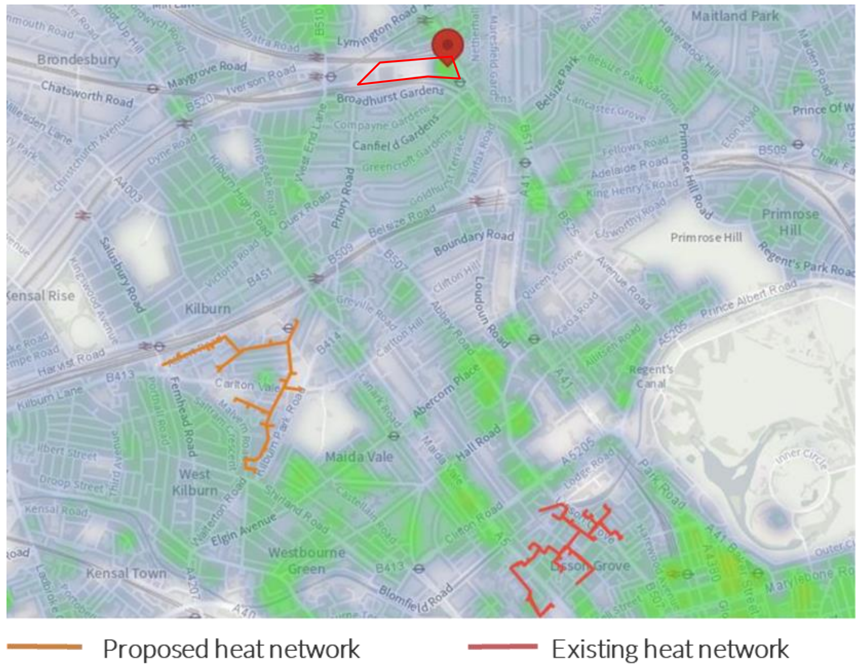


Figure 8: Extract from the London Heat Map showing heat demand density (red = high, green = low and existing and proposed heat networks in the area).

Therefore, no connection to a district heating network will be provided initially, however the Proposed Development will ensure suitable space will be provided to enable future connection and provision for pipework and heat exchanger plant rooms per building.

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, schemes using CHP engines for the delivery of heating energy at the Application leads to net increase carbon emissions (over the gas boiler baseline),

In contrast, electric systems are far more likely to achieve substantial carbon emission savings with future carbon factors. Further, CHP engines are an on-site source of particulate pollutants which will adversely affect local air quality.

In light of grid decarbonisation and increased focus on air quality, CHP is therefore not proposed.

7.1 Be clean summary.

No connection opportunities to district heating networks in the vicinity of the site currently exist and therefore no connection will be provided initially. However, spatial provision for a future connection to a low carbon district heat network has been provided (see Appendix I), subject to detailed technical, practical and economic feasibility evaluation, beyond the scope of this outline appraisal.

CHP is not proposed due to poor carbon reduction and adverse air quality impacts.

Therefore, no further carbon reductions are envisaged for the Be Clean stage of the energy hierarchy.

Table 8: Be clean results summary (Proposed Development).

Residential	Non-Residential	Site wide
10% Reduction over Part L1A baseline (No change from Be Lean)	15% Reduction over Part L2A baseline (No change from Be Lean)	10% - 15% Reduction over Part L baseline (No change from Be Lean)

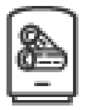
8. Be Green.

The third 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.

Be lean. → Be clean. → **Be green.** Deploy Low or Zero Carbon (LZC) Energy Sources. → Be seen.

8.1 Low and zero carbon (LZC) technology assessment.

	Ground source heat pumps Ground Source systems work to extract heat or cooling energy from the ground. They are generally more efficient than air source systems, as the ground temperature is more constant throughout the course of the year relative to air temperature. Due to grid decarbonisation and the proposed SAP10 carbon factors, it is expected that GSHP technology will offer significant carbon emission reductions over the gas boiler baseline scenario There are four common varieties of ground source systems: – Vertical, open loop, direct cooling (i.e. without heat pump) – Vertical, open loop, with heat pump – Horizontal, closed loop, with heat pump – Vertical, closed loop, with heat pump Suitability to Application: Regardless of the type of ground source heat loop used, all would require extensive below ground works to bury and install the system on site. Given the subterranean constraints present at the site, and heating-led energy profile of the development, Ground Source Heat Pumps are therefore not considered to be a sustainable or viable option and are therefore not proposed.
	Water source heat pumps Water source heat pumps use bodies of water, such as rivers, lakes or oceans to provide heating or cooling energy to a building. Suitability to Application: The closest body of water is the River Thames, located approximately 6km south west of the site boundary. As there is no direct access to the river to the site this technology has not been considered. The Application is not within the vicinity of a suitable water body and as such water source heat pumps are not deemed suitable.
	Air source heat pumps Air source heat pumps (ASHP) use thermodynamic principles to convert heat from the air into useable heat within the building. Unlike some other sources of renewable energy, heat pumps do require energy (typically electricity or gas) to pump and compress refrigerant through the system. However, under the Renewable Energy Directive 2009/28/EC they are classified as renewable technologies provided that the final energy output significantly exceeds the primary energy input required to drive the heat pump. ASHP need to be located externally with access to the ambient air, typically at roof level. Suitability to Application: Due to grid decarbonisation and the proposed SAP10 carbon factors, it is expected that ASHP technology will offer significant carbon emission reductions over the gas boiler baseline scenario. ASHP plant can be located at roof level and integrated into space heating and hot water systems (albeit with some degree of ancillary top-up heating to raise water temperatures). Implementing heat-pump technology brings the additional benefit of a shift towards combustion-free development, with the associated benefit to local air quality. This approach is expected to result in regulated CO_2 emission reductions of approximately 53% (using SAP10 carbon factors) beyond the Building Regulations Part L (2013) 'baseline' on a site-wide basis. Air Source Heat Pumps are therefore proposed for the development as the primary heat generating technology.
	Photovoltaics Photovoltaic panels harness energy from sunlight and convert this into useful energy in the form of electricity. A PV system requires viable roof space in order for the system array to be installed and function effectively. Suitability to Application: Solar irradiance analysis on the site has shown a good opportunity for the deployment of solar Photovoltaic technologies for onsite electricity generation. The provision and location of PV panels will be subject to a detailed assessment of roof layouts as part of reserved matters applications, with consideration of the following aspects: – Overshading – View from surrounding buildings – Area required for access – Area required for plant (ASHP) At the outline submission stage an estimation of the potential available roof space has been made for allowance of PVs. The feasible roof areas will be evaluated on a block-by-block basis within each detailed application to give greatest benefit. Further discussion of the proposed PV applicable to the detailed application phase of this development (Blocks N3-E, N4 and N5) are outlined within Appendix A. On this basis, Solar PV panels are proposed.
	Solar thermal Solar Thermal Panels are similar to PV Panels in that they harness energy from solar radiation. This technology however converts solar into thermal energy that can offset the demand on hot water generation systems. Suitability to Application: Utilising the roof space considered available for PV, an approximate 545m^2 solar thermal array could generate approximately 248,600 kWh of thermal energy per annum for the Application. This would reduce CO_2 emissions by 62 tonnes per annum, equivalent to a reduction in regulated CO_2 emissions of 3.1% beyond the GLA gas boiler 'baseline'. Given the low CO_2 savings compared to the heat pump option explored, solar thermal is not a proposed technology.

	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, fuel deliveries in city-centre locations can prove difficult and add to traffic flow and associated emissions. Impacts on local air quality and security of fuel supply are also important considerations. Biomass boilers are the least preferred strategy of Camden Borough Council due to the impact on local air quality. For this reason biomass is not proposed.

8.2 ASHP considerations within the Energy Strategy.

8.2.1 **On-site Centralised ASHP.**
A site-wide energy network with heat-pumps located in one or more energy centres, distributing heating around the development, would follow the principles commonly adopted for most recent developments utilising CHP technology.

However, unlike CHP technology, heat-pumps do not increase in efficiency at larger scale, and therefore there is not the same specific benefit in efficiency or operation in aggregating thermal loads and serving multiple buildings via a single energy centre. Locating ASHP in one central energy centre and distributing heat to the various buildings will require hydraulic separation via heat exchangers, which leads to a small drop in temperature. These temperature step-downs across the network would require the central plant to operate at a higher temperature to deliver the required end temperatures at the point of use.

The efficiency of heat-pumps is sensitive to their operating temperature, and system performance decreases if operating temperatures increase. In addition to thermal losses from the distribution pipework, additional pumping energy will be used for distribution around the network. For these reasons, large networks with a single energy centre are not necessarily conducive to effective ASHP operation and maximising carbon emission reductions.

Within a phased development process, a single energy centre approach places high spatial requirement on the initially completed phases, as these must accommodate space for sufficient plant to serve all subsequent phases. Due to their nature, ASHP require access to atmosphere, and therefore this approach can lead to onerous requirements at roof level of the initial phase. An energy centre would also create negative environmental impacts such as increased noise and a colder microclimate in winter. Various commercial and legal ownership aspects would also require consideration with this arrangement.

8.2.2 **Decentralised ASHP.**
A decentralised approach would utilise ASHP located locally on each block, typically located at roof level. The ASHP plant would serve the individual block and would not be connected to other blocks. The benefits of this approach would be that the temperature regime could be optimised for the building loads, enabling optimum system efficiency, and that distribution thermal losses and distribution pump energy would be minimised. Furthermore, this approach would also enable greater flexibility in regard to phasing, and would simplify operation and maintenance.

A decentralised ASHP approach has therefore been recommended for the Proposed Development, with ASHPs per block located on highest rooftops to minimise acoustic, environmental and visual impact.

8.3 Energy sharing feasibility study utilising ASHPs.

Heat pumps use electricity to move heat from one location to another, utilising the refrigeration cycle (in the same way that a domestic fridge moves heat from inside the fridge body to the external coils). Electricity drives the process, powering a compressor which circulates a refrigerant fluid through a circuit of pipes connecting two heat exchangers. As there is no fossil-fuel combustion involved in the process, local flue-gas emissions (and the associated detrimental impact on air quality) are avoided. Heat pump seasonal efficiencies are in the order of 300% (i.e. for every 1kW of electrical energy put into the heat pump, 3kW of useful heating is obtained).

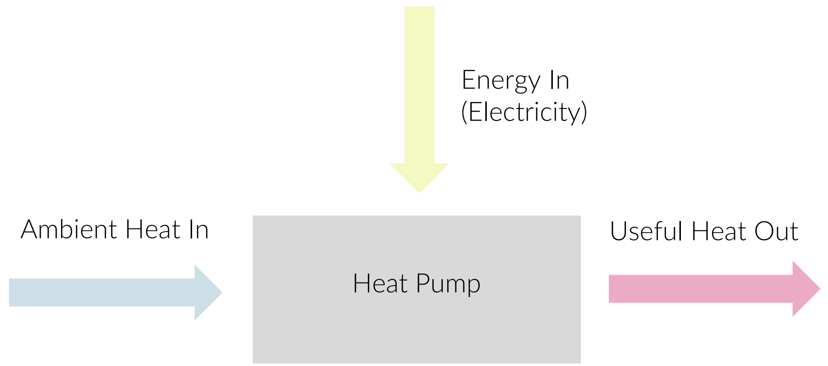


Figure 9: Simplified Heat-pump Schematic

A range of engineering solutions are available for the implementation of the proposed approach for a heat-pump led Energy Strategy (with the dual aims of minimising both carbon emissions and air quality pollutants). These range from centralised network systems to decentralised approaches. The following sections explore these different approaches and their suitability and pros and cons in relation to the Application.

8.3.1 **System Efficiency.**
This section seeks to clarify the heat pump efficiency, measured in Coefficient of Performance (COP) considering typical practical operating temperatures, and the impact domestic hot water (DHW) temperatures requirements can have.

Air Source Heat Pumps (ASHPs) can attain a seasonal COP of ~3 in the London climate whilst providing a flow temperature of 55°C. This flow temperature is suitable for space heating from emitters such as radiators, fan coil units or underfloor heating. DHW temperature requirements are typically higher. With a flow temperature of 55°C the typical approach would be to use this as pre-heat, with a higher temperature provided by a secondary heat source such as direct electric immersion heating.

Direct electric heating achieves a COP of 1, i.e. each unit of electrical energy put in is converted directed to heat. This is evidently lower than a heat pump, and therefore the introduction of direct electric heating decreases the overall system COP. The extent to which the system COP decreases is dependent on the ratio of energy produced by direct electric vs heat pump, which is directly proportional to the temperature uplift achieved by each technology.

With a temperature of 55°C achieved via heat-pumps, and then raised to 65°C via direct electric for DHW purposes. An overall system COP of 2.0 for DHW provision has been used, as summarised in Figure 10.

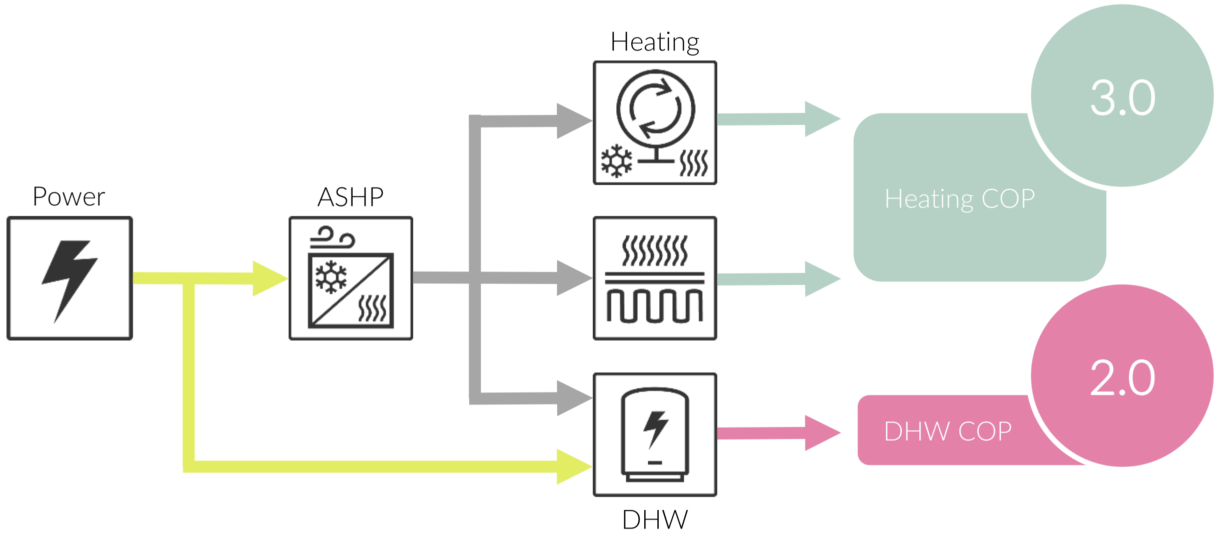


Figure 10: ASHP heating and DHW with direct electric heat

The same ASHPs can be used for heating, hot water and cooling as illustrated in Figure 11. In cooling mode only, the COP is ~4 or greater depending on the ambient conditions. The significant benefit of the system is established where the ASHP has a simultaneous heating and cooling load. With both loads maximised the system efficiency is optimised and would equal the sum of the cooling and heating COP i.e. 5.5 + 3 = 8.3. Imbalanced loads would see a reduced system COP yet still offer a greater efficiency than either operating independently. The provision of full cooling is not anticipated for the residential areas of the Proposed Development.

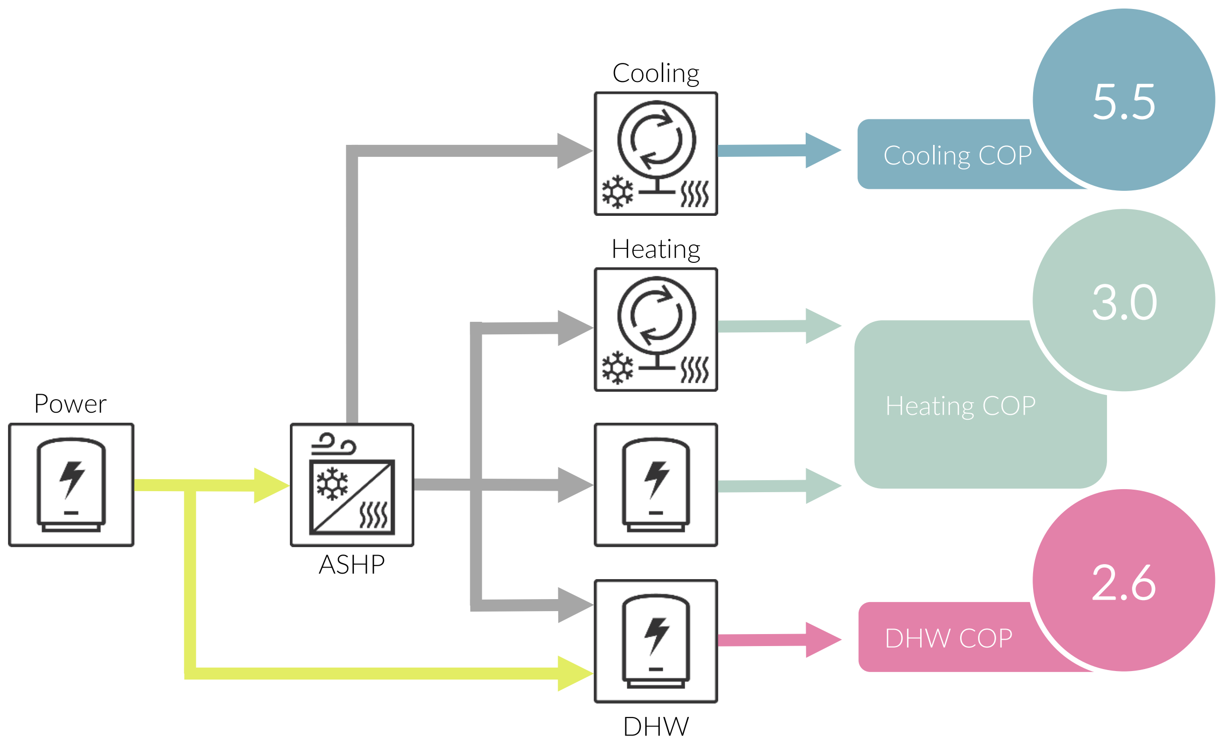


Figure 11: ASHP heating, DHW with direct electric heat and cooling

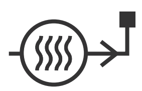
8.3.2 **Principles of ambient loop or energy sharing networks.**

Modern energy sharing networks, whether applied within buildings or across masterplans, consist of a lower temperature distribution circuit (“ambient loop”), with individual building heat-pumps connected to the circuit. Rather than exchanging heat with the ambient air, the heat pumps exchange heat with the low temperature circuit, raising the temperature to that required for its own heating and hot water requirements. Alternatively, if in cooling mode, spaces will contribute heat into the network (rather than “rejecting” heat into the ambient air as with traditional cooling systems). In this way individual spaces will either extract or inject heat into the network depending on whether they are in heating or cooling mode. This enables energy to be shared between areas, for example, a heat pump providing cooling to an office area will produce heat, which can be utilised to generate domestic hot water.

Opportunities and effectiveness of sharing thermal energy within or between buildings utilising heat-pumps, repurposing waste thermal energy, are therefore dependant on the likely heating and cooling load profiles of the buildings in question.

Consideration would also need to be given to the following:

- Capital expenditure: the creation of a Site-wide or phase-wide network would require additional distribution pipework compared to each building having a standalone Energy Strategy, using ASHP or other technology. This directly impacts the embodied carbon of the development.
- Long term involvement: creating a single energy centre for the Proposed Development that contains plant that serves the whole or a phase/cluster of buildings will require an element of management of the plant, infrastructure and billing. This could have implications for the future sale of an individual building within each of the phases or Site-wide.
- Building regulations: one of the disadvantages of requiring buildings to connect to a single network is accounting for changing regulations and the implications of a fixed carbon factor for the heat/coolth provided by a network that may not provide the greatest carbon emissions reduction as a future technology.
- CO_2 emissions: The energy sharing network is a significant step to reducing CO_2 emissions. Controlling the use of energy across different use types could allow for further emissions reductions and a reduction in operational costs.



Ambient loop energy sharing network – summary

So-called ambient loop or fifth generation energy networks differ from traditional heat networks – which generate heat centrally, distributing it to meet the thermal demand of buildings on the network – as they facilitate the sharing of energy between buildings with simultaneous heating and cooling demand. This is achieved by circulating water at ambient ground temperatures, with local heat pumps allowing buildings to both extract heat from and reject heat to the network i.e. buildings with cooling demand are able to share what would typically be waste heat rejected to atmosphere with buildings in the vicinity that demonstrate a demand for heat.

Conclusions from analysis of energy sharing opportunities on site:

- Given the high proportion of residential use compared to commercial, energy sharing via an ambient loop is not likely to be beneficial in initial phases of the development, and therefore an LTHW system is currently proposed instead of an ambient loop system.
- Highest energy sharing potential expected where commercial mix is highest (Phase 4) and will therefore be explored in detailed design stages.
- If an ambient loop is adopted in future, decentralised energy sharing within individual buildings where the energy sharing potential is highest is recommended (to minimise additional distribution heat losses, temperature step-downs, pumping power and embodied carbon of infrastructure associated with a site-wide network).

The Energy Strategy is not currently proposing an ambient loop system, but space has been allowed throughout all phases of the Proposed Development for future inclusion if adopted in future.

8.4 Be green summary.

Through the measures outlined in the Be Green stage, it is anticipated that a further site wide reduction of around 38%-43%% could be achieved beyond the 'gas boiler baseline' through the use of on-site low/zero carbon technologies including heat pumps and rooftop solar PV arrays.

It is proposed that heat pump technology will be utilised to provide all space heating, cooling and domestic hot water. PV provision will be determined on a building by building basis within subsequent reserved matters applications, dependant on available roof space once ASHP plant is accommodated.

Overall, it is anticipated that a further 38%-43% CO_2 emission reduction is anticipated on-Site, giving a total CO_2 emissions reduction of 52.9%, exceeding the GLA policy minimum target of 35% total by around 17.9%.

Table 9: Be green results summary (Outline Proposals).

Residential	Non-Residential	Site wide
56% Reduction over Part L1A baseline	34% Reduction over Part L2A baseline	53% Reduction over Part L baseline

9. Be Seen.

Be lean. Be clean. Be green. **Be seen.**

Monitor, verify, and report on energy performance

The "Be Seen" stage is acknowledged as a crucial element of the national net-zero commitment. Energy will be monitored and reported to a level of granularity consistent with "Be Seen" requirements.

9.1 Monitoring and Reporting.

Effective energy metering in line with Be Seen requirements will be enabled by the provision of suitable infrastructure within the buildings services systems.

9.2 Development Monitoring and Reporting Plan.

The developed strategy will allow for an exhaustive metering of all the various energy usage in the Proposed Development. 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 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 will also complete the GLA's suggested "Be Seen" energy reporting protocols via the appropriate web portals, at the appropriate stage.

Table 10 includes a high-level summary of the reporting requirements for the three 'be seen' stages for all reportable units (RU) types. This table intends to capture the overarching similarities between various stages and RUs.

Table 10: Performance indicators for Be Seen.

Indicators	Planning stage	As-built stage	In-use stage
Contextual data	– Location Unique Property Reference Number (UPRN) or Address (if no UPRN available) – Site plan – Typology / Planning Use Class (all included) – GIA (m^2) for each Typology / Use Class – Anticipated target dates for each 'be seen' reporting stage (i.e. 'as-built' and 'in-use')	– Updates of contextual data provided at planning stage, if necessary – GIA (m^2) for each RU – Confirmation that a verified metering plan is in place	– GIA (m^2) update for each RU, if necessary
Building energy use	– Grid electricity consumption (kWh) – Gas consumption (kWh) – Other fuels consumption (kWh) – District heating/cooling consumption (kWh) (if applicable)	(SAME AS PLANNING STAGE plus) – *Predicted* DEC grade and rating (for non-residential RUs only)	(SAME AS PLANNING STAGE plus) – *Measured* DEC grade and rating (for non-residential RUs only)
Renewable energy use	– Energy generation (kWh)	– Renewable electricity generation (gross) (kWh) – Solar thermal heat generation (kWh)	(SAME AS AS-BUILT STAGE plus) – Renewable electricity exported (kWh) – Renewable energy used on site (kWh)
Energy storage		– Net electricity flow to EVs (kWh) – Battery storage capacity (kWh)	
Plant parameters		Energy centres: – Grid electricity, Gas and/or other fuel consumption – Delivered efficiency of each heating/ cooling) generation plant (%) – % of heat supplied from each heating/ cooling generation plant – Predicted losses from heat/cooling distribution pipework (kWh) – District heating/cooling energy import/export (kWh) Residential and non-residential: – District heating energy exported (kWh) – District cooling energy exported (kWh)	Energy centres: (SAME AS AS-BUILT STAGE plus) – Energy input/output to/from each heating/ cooling energy conversion plant (kWh) – Total district heating/ cooling output from production centre (kWh) – Total district heating/ cooling supplied to customers (kWh) Residential and non-residential: (SAME AS AS-BUILT STAGE)

Indicators	Planning stage	As-built stage	In-use stage
Carbon	– Carbon emissions estimates (tonnes $CO2/m^2$) for residential and non-residential uses separately as well as the whole development – Carbon shortfall for the entire development (tonnes CO_2) – Estimated carbon offset amount (£)	– Carbon shortfall for the entire development (tonnes CO_2) – Confirmation of carbon offset amount (£)	

9.3 Operational cost: space heating and DHW.

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 operation expenditure of the energy systems and networks are passed on to end users.

This section provides an appraisal of potential end user costs for both boiler-led communal heating, and communal heat-pump strategies. A summary of the appraisal is shown below in Table 11.

The applicability of Renewable Heat Incentive payments relies specifically on two inputs: The efficiency of the ASHP in heating mode, and whether or not the ASHP is designed to provide cooling.

For this assessment, it has been assumed that the same efficiency (3.0) in heating mode can be achieved, and no cooling will be provided.

It should be noted here that funding for the Renewable Heat Incentive is currently confirmed by the government to be available for installations made prior to March 2022. This was confirmed by the Chancellor, Rishi Sunak, in the recent Budget. This is an extension by one year compared to the previous confirmed date of March 2021. It is currently not confirmed whether installations made after this date will be able to make use of this grant. Consumer cost estimates with and without RHI are given below.

System:	Estimated Cost per Unit of Heat (pence/kWh)	Notes / Basis of Assessment:
Communal gas boiler (for comparison)	7.8p / kWh	District heating network, no local thermal storage.
ASHP with Renewable Heat Incentive (RHI) included	5.1p / kWh	ASHP system + local storage with immersion. Renewable Heat Incentive (RHI) included.
ASHP with no Renewable Heat Incentive (RHI)	7.7p / kWh	ASHP system + local storage with immersion. Renewable Heat Incentive (RHI) not included.

Table 11: Operational Cost Appraisal Summary

It is expected that the actual running cost for the DHW system will fall between the two estimated costs calculated in Table 11 above, provided the Renewable Heat Incentive is still available to the scheme at the time of project completion.

Details of the cost assessment for each scenario, including assumptions, are shown below.

Global inputs		
Commercial gas	p/kWh	4.82
Commercial electricity	p/kWh	17.74
Dwelling gas	p/kWh	2.86
Dwelling electricity	p/kWh	14.53
ASHP RHI	p/kWh	2.81
Communal riser air temperature	C	20
Cold water temperature	C	10

Table 12: Cost Assessment Global Inputs. Unit cost source: BEIS (September 2021).

10. Conclusion.

The Energy Strategy for the Proposed Development is a key part of the sustainability strategy, considered from the start of the project and is central and integral to the proposals. As a large-scale phased masterplan, the overarching strategy is to provide a simple, future-proofed approach to energy efficient and low carbon buildings. The strategy is intended to exploit the benefits of current technologies while providing flexibility for future technologies and policy developments. Performance outcomes will be delivered in practice, minimising carbon emission now and in the future, whilst also considering running costs to tenants and residents.

The all-electric Energy Strategy approach is based on a fabric first approach, with good levels of insulation, efficient systems and controls, and the use of Air Source Heat Pump technology, supplemented with PV panels where feasible on roof spaces. Therefore, the strategy has been developed to ensure the Proposed Development is both efficient and economical by reducing heating demand in the first instance and then meeting the remainder through highly efficient means.

The electricity-led strategy will result in not only a low carbon scenario as of today, but continuous improvement as the grid continues to decarbonise. This approach will also enable the Proposed Development to be combustion free, facilitating a shift towards clean energy systems, with the associated benefits in local air quality and human health.

Furthermore, space will be provided for inclusion of connection to a site wide heat network, should a future connection become available in the area. This space provision also allows for future conversion to an ambient loop system to enable energy to be shared within and between buildings, and to import or export heat to or from the site. In this way, future proofing is at the core of the proposed strategy to reduce energy demand and carbon emissions during the operational lifespan of the development.

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

The carbon emissions from regulated energy uses of the Application have been assessed against the GLA London Plan emissions targets, following the energy hierarchy methodology.

10.1 The Energy Strategy.

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.

The following table provides a summary of the Energy Strategy for the Proposed Development, utilising SAP10 carbon factors.

Please refer to Appendix A for CO_2 emissions reductions calculations at each stage of the energy hierarchy for Detailed Proposal areas seeking full planning permission.

Table 13: Energy Strategy summary (Proposed Development).

Be lean	Target 10-15% regulated carbon emission reduction against Part L baseline for domestic and non-domestic uses respectively. High energy efficient building fabric and building services will be utilised to reduce carbon emissions and energy demand through good practice passive design measures.
Be clean	No further carbon emission reduction Incorporation of an onsite district heating and a CHP system has been deemed to be unsuitable as it would offer no benefit to the Application, therefore a heat network and CHP technology has been discounted. Space will be provided for inclusion of a site wide heat network, or for conversion to an ambient loop system in the future.
Be green	Target cumulative 53% sitewide regulated carbon emission reduction against Part L baseline via heat Pumps and Rooftop PV. Utilisation of high efficiency air source heat pumps with heat recovery is anticipated to reduce energy consumption and carbon emissions for the Application. Rooftop PV is anticipated to further reduce emissions.
Be Seen	Effective monitoring and metering The "Be Seen" stage is acknowledged as a crucial element of the national net-zero commitment. Energy will be monitored and reported to a level of granularity consistent with "Be Seen" requirements. Effective energy metering in line with Be Seen requirements will be enabled by the provision of suitable infrastructure within the buildings services systems.

10.2 Results.

The following provides details of the anticipated percentage carbon reductions at each stage of the energy hierarchy for the Proposed Development.

Table 14: Carbon reduction breakdown (Proposed Development).

	Residential (% reduction from Part L baseline)	Non-Residential (% reduction from Part L baseline)	Sitewide (% reduction from Part L baseline)
Be lean.	10%	15%	10%-15%
Be clean.	10%	15%	10%-15%
Be green.	56%	34%	53%

Through the measures outlined in the Energy Strategy, it is anticipated that overall, a circa 53% reduction in CO_2 emissions could be achieved beyond the 'gas boiler baseline', inclusive of all measures.

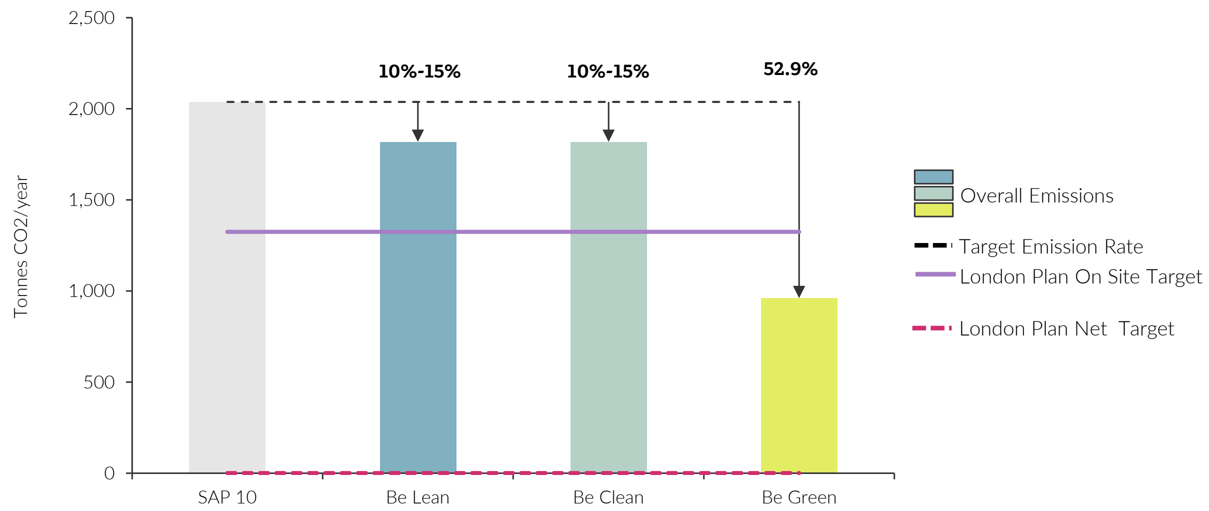


Figure 12: Regulated carbon emissions summary (Proposed Development).

Appendix A: Detailed Energy Strategy.

Executive Summary
This section of the report addresses the detailed part of the Application, defined as:

> "Detailed planning permission for Development Plots N3-E, N4, and N5 including demolition of existing above ground structures and associated works, and for residential development (Class C3) and commercial, business and service (Class E) uses in Development Plot N3-E, residential development (Class C3) and local community (Class F2) and commercial, business and service (Class E) uses in Development Plot N4, and residential development (Use Class C3) and commercial, business and service uses (Class E) uses in Development Plot N5 together with all landscaping, public realm, cycle parking and disabled car parking, highway works and infrastructure within and associated with those Development Plots."

Development Plots N3-E, N4 and N5 and the associated landscaping, access roads and infrastructure form the detailed element of the Application which extends to 1.79ha and these proposals are referred to as the "Detailed Proposals".

Drivers
A policy review has been undertaken and is outlined in Section 2 of the main report. As a summary, planning policy documents applicable to the Application include:

- National; Building Regulations Part L
- Regional; Greater London Authority (GLA) Policy
- Local; London Borough of Camden Policy

Approach
The Energy Strategy approach for Blocks N3-E, N4 and N5 is as outlined in the main body of this report. As Blocks N3-E, N4 and N5 have been brought forward in detail, the specific design proposals have been fully assessed using the Part L methodology and specific carbon reduction percentages calculated.

Energy Strategy summary
The Energy Strategy has been developed using a 'fabric first' approach through the Be Lean, Be Clean Be Green, Be Seen energy hierarchy to maximise reduction in energy through passive design measures in the first instance, before seeking opportunities to deliver energy efficiently, maximising the provision of low and zero carbon technologies, and finally measuring, monitoring, verifying and reporting on energy performance annually.

Be lean
The Detailed Proposals are anticipated to achieve up to a 13% reduction in CO_2 emissions (equivalent to 112.5 tCO_2) beyond the Building Regulations Part L 2013 'baseline' through the inclusion of efficient building fabric as well as energy efficient lighting and ventilation. This exceeds policy requirements by 2.8% for residential and 2.3% for non-residential elements respectively.

Table 15: Be lean results summary (Detailed Proposals).

Residential	Non-Residential	N3-E, N4 and N5 overall
12.8% Reduction over Part L1A baseline	17.3% Reduction over Part L2A baseline	13.0% Reduction over Part L baseline, surpassing GLA minimum requirement at Be Lean

Be clean
An investigation into the availability of existing and proposed district heating networks has been carried out for the Detailed Proposals, as described within the outline section of this report. Given that there are currently no available district heat network connections that can be utilised and the relative merits of installing a CHP are negligible due to the decarbonisation of the UK electricity grid, there are no further CO_2 savings proposed at the 'Be Clean' stage of the energy hierarchy.

Table 16: Be Clean results summary (Detailed Proposals)

Residential	Non-Residential	N3-E, N4 and N5 overall
12.8% Reduction over Part L1A baseline (No change from Be Lean)	17.3% Reduction over Part L2A baseline (No change from Be Lean)	13.0% Reduction over Part L baseline (No change from Be Lean)

Be green
An investigation into the availability of low and zero carbon technologies has been carried out for the Detailed Proposals, as described within the outline section of this report, which concluded that Air Source Heat Pumps (ASHP) and Photovoltaics (PV) were the most suitable technologies. The inclusion of ASHP and PV is expected to lead to a further 53.3% reduction in CO_2 emissions (459.6 tCO_2) beyond the Part L 2013 'baseline'.

This strategy exceeds the GLA London Plan (2021) requirement for a 35% minimum reduction over a Part L baseline by 31.3% Site-wide.

Table 17: Be green results summary (Detailed Proposals).

Residential	Non-Residential	N3-E, N4 and N5 overall
67.8% Reduction over Part L1A baseline	34.6% Reduction over Part L2A baseline	66.3% Reduction over Part L baseline, significantly surpassing GLA policy target of 35% on-site CO_2 emission reductions

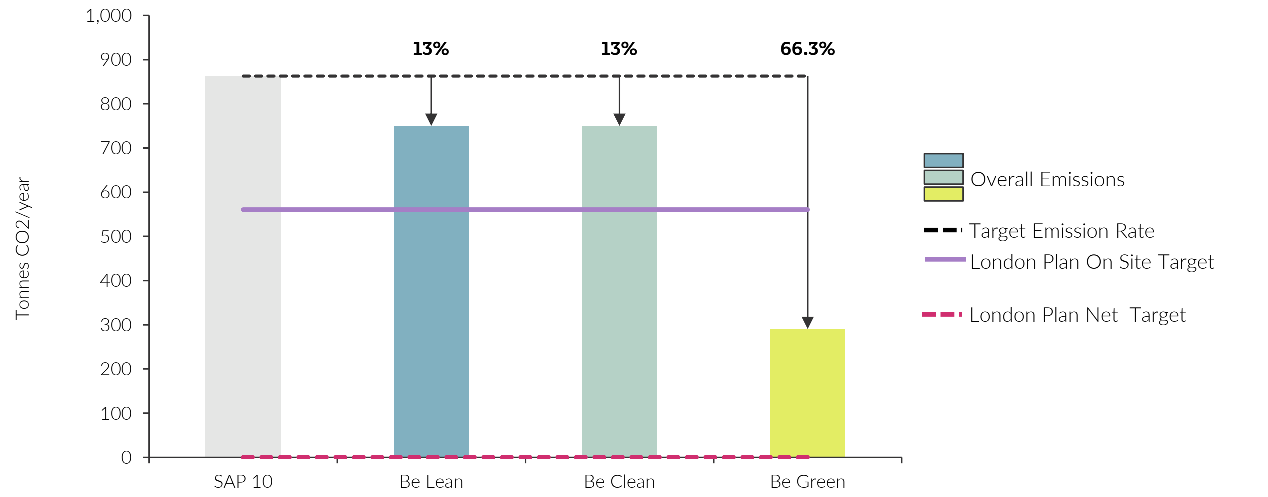


Figure 13: Sitewide regulated carbon reduction per each stage of the energy hierarchy (Detailed Proposals).

Overheating risk assessment

The Detailed Proposals have followed the cooling hierarchy principles as a means of reducing the amount of solar and internal gains, reducing the risk of overheating, and subsequently reducing the demand placed upon the systems to condition the space.

Within the representative sample apartments that have been assessed it can be confirmed that they will achieve compliance with the Building Regulations Part L 2013 Criterion 3 and limit the effects of heat gains in summer months and reduce the demand on active cooling systems.

A CIBSE TM59 assessment has also been carried out for a sample of dwellings (see Appendix B), demonstrating that 86% of assessed spaces are anticipated to meet the thermal comfort criteria through passive design measures alone.

Additionally, mechanical ventilation systems with air tempering to lower peak temperatures will be provided to the residential units where required to manage internal temperatures when occupants choose to leave windows closed due to external noise levels.

The flexible commercial spaces (planning use class E) are notionally modelled as retail, office and community use spaces (previous use classes A1 & A3, B1 and F2). For these elements, the low solar transmittance proposed for the glazing results in a marginally higher cooling demand compared to the notional building. This will be explored further during detailed design development.

Carbon reductions and carbon offset estimate

The Detailed Proposals will deliver buildings which are very energy efficient, resulting in a reduction in energy consumed and carbon emitted by the Site, targeting improvements over what is required by the Building Regulations.

The estimated CO_2 emissions reductions are presented separately for residential and non-residential areas, as outlined in section 9 of the GLA guidance on preparing energy assessments.

Figures presented within this section are for the Detailed Proposals only. Offset payments for the Outline Proposals are to be confirmed in subsequent Reserved Matters Applications.

Residential

Table 18 and Table 19 outline the anticipated CO_2 emissions reductions and carbon offset payment for residential areas of the Detailed Proposals. The combined on-site savings and zero carbon target shortfall is used to calculate a total carbon offset payment in the region of ~£755,382.

Table 18: Residential CO_2 emissions (Detailed Proposals).

	Carbon Dioxide Emissions (tCO_2/yr.)	
	Regulated	Unregulated
Baseline	823.6	405.0
Be Lean	717.9	405.0
Be Clean	717.9	405.0
Be Green	265.0	405.0

Table 19: Residential CO_2 savings and offset payment (Detailed Proposals).

	Regulated Carbon Dioxide Emissions savings	
	(tCO_2/yr.)	%
Reduction from Be Lean	105.8	13%
Reduction from Be Clean	0.0	0%
Reduction from Be Green	452.8	55%
Total	558.6	68%
Target	823.6	100%
Shortfall	-265.0	32%
Offset rate	£2,850	
Cash in-lieu contribution	£755,382	

Non-Residential

Table 20 and Table 21 outline the anticipated CO_2 emissions reductions and carbon offset payment for non-residential areas of the Detailed Proposals. The combined on-site savings and zero carbon target shortfall is used to calculate a total carbon offset payment in the region of ~£72,963.

Table 20: Non-Residential CO_2 emissions (Detailed Proposals).

	Carbon Dioxide Emissions (tCO_2/yr.)	
	Regulated	Unregulated
Baseline	39.1	11.0
Be Lean	32.4	11.0
Be Clean	32.4	11.0
Be Green	25.6	11.0

Table 21: Non-Residential CO_2 savings and offset payment (Detailed Proposals).

	Regulated Carbon Dioxide Emissions savings	
	(tCO_2/yr.)	%
Reduction from Be Lean	6.8	17%
Reduction from Be Clean	0.0	0%
Reduction from Be Green	6.8	17%
Total	13.5	35%
Target	39.1	100%
Shortfall	-25.6	65%
Offset rate	£2,850	
Cash in-lieu contribution	£72,963	

Detailed Proposals summary

Table 22 and Table 23 outline the anticipated CO_2 emissions reductions and carbon offset payment for the combined domestic and non-domestic areas of the Detailed Proposals. The combined on-site savings and zero carbon target shortfall is used to calculate a total carbon offset payment in the region of ~£828,345.

Table 22: Detailed Proposals CO_2 emissions summary

	Carbon Dioxide Emissions (tCO_2/yr.)	
	Regulated	Unregulated
Baseline	862.8	416.0
Be Lean	750.3	416.0
Be Clean	750.3	416.0
Be Green	290.6	416.0

Table 23: Detailed Proposals CO_2 savings and offset payment summary

	Regulated Carbon Dioxide Emissions savings	
	(tCO_2/yr.)	%
Reduction from Be Lean	112.5	13%
Reduction from Be Clean	0.0	0%
Reduction from Be Green	459.6	53%
Total	**572.1**	**66%**
Target	862.8	100%
Shortfall	-290.7	34%
Offset rate	£2,850	
Cash in-lieu contribution	**£828,345**	

Introduction.

Detailed planning permission is sought for Development Plots N3-E, N4, and N5 including demolition of existing above ground structures and associated works, and for residential development (Class C3) and commercial, business and service (Class E) uses in Development Plot N3-E, residential development (Class C3) and local community (Class F2) and commercial, business and service (Class E) uses in Development Plot N4, and residential development (Use Class C3) and commercial, business and service uses (Class E) uses in Development Plot N5 together with all landscaping, public realm, cycle parking and disabled car parking, highway works and infrastructure within and associated with those Development Plots."

The Detailed Proposals are for 57,452 sqm GIA. The proposed total floor space by land use (in GIA sqm) for the Detailed Proposals is set out in Table 24.

Table 24: Total GIA Floorspace by use for Detailed Proposals.

Use	Use Class	Plot N3-E (GIA sqm)	Plot N4 (GIA sqm)	Plot N5 (GIA sqm)	Total (GIA sqm)
Residential including car parking	C3	5,269	23,420	26,491	55,180
Community	F2	0	270	0	270
Retail	E (a)	186	186	1,361	1,733
Food and drink	E (b)	114	0	0	114
Professional Services	E (c)	0	155	0	155
Sub Station- Sui generis		Included in Resi			
Includes all built floorspace – plant, podium car parking, BOH, etc.		5,569	24,031	27,852	57,452

Cooling and overheating.

Cooling hierarchy

The London Plan Policy SI4 (Managing Heat Risk) requests that developments should reduce potential overheating risk and reliance on air conditioning systems. A 'cooling hierarchy' is provided and the Application has sought to follow this hierarchy as outlined in Section 4 of this report in order to limit the effects of heat gains in summer.

Mitigation strategy

The following mitigation methods will be implemented within blocks N3-E, N4 and N5 of the Application.

Minimising internal heat generation through energy efficient design

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

- Energy efficient lighting (such as LED) with low heat output
- Insulation to heating and hot water pipework and minimisation of dead legs to avoid standing heat loss (from pipework to dwellings)
- 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 Application:

- G-value of 0.4 specified to control solar heat gains
- Living room sliding doors and full height window selections to maximise openable area for natural ventilation
- Window reveals to be increased to 1.5 brick width (337.5mm) to increase shading.
- Horizontal balcony shading to be provided above south-facing openings in living/ kitchen areas.
- Living room openings to enable secure night-time ventilation.
- Internal blinds to be included within base-build specification.

Manage heat gains

- Opportunities to expose thermal mass (i.e. exposed concrete soffits) to help to further regulate internal temperatures will be explored.

Mechanical ventilation

All dwellings will also be provided with ventilation at a rate in accordance with Part F through Mechanical Ventilation with Heat Recovery (MVHR) units within each dwelling that are ducted through the façade.

MVHR units are an important addition to the building services to maintain good indoor air quality, by providing fresh air to living rooms and bedrooms and extracting vitiated air from bathrooms and kitchens. Providing fresh air minimises the risk of stale and stagnant air and limits the risk of condensation and mould growth. The heat recovery mechanism will be provided with a bypass to avoid returning hot air to the dwellings in summer.

Where dwellings are constrained by acoustic conditions which make occupants less likely to rely on opening windows for managing internal temperatures, air tempering will be provided to lower peak internal temperatures and mitigate the risk of overheating with windows closed.

The fit out of the flexible commercial spaces will be the responsibility of the individual tenants, however the units will be provided with capped services connections.

Part L heat gain check

Part L compliance has been carried out for the sample apartments and non-dwelling areas. The analysis includes a Criterion 3 compliance check.

To reflect the flexible commercial spaces (planning use class E), the commercial units are notionally modelled as retail, office and community use spaces (previous use classes A1 & A3, B1 and F2). It is confirmed that they will achieve compliance with the Building Regulations Part L 2013 Criterion 3. For these elements, the low solar transmittance proposed for the glazing results in a marginally higher cooling demand compared to the notional building.

Within the representative sample apartments that have been assessed for each block of the Application, it can be confirmed that they will achieve compliance with the Building Regulations Part L 2013 Criterion 3 and limit the effects of heat gains in summer months and reduce the demand on active cooling systems.

Overheating risk assessment

The cooling hierarchy principles will be followed as a means of reducing the amount of solar and internal gains, reducing the risk of overheating, and subsequently reducing the demand placed upon active systems.

Overheating risk assessments utilising dynamic thermal modelling have been undertaken for the residential areas and a summary is included within Appendix B. The risk assessments have followed the appropriate CIBSE guidance (TM59) and weather files as specified in GLA guidance, including consideration of the urban heat island effect, future weather, and any acoustic and security constraints which may impact on the likely operation of openable windows.

All dwellings will be provided with mechanical ventilation with heat recovery (MVHR) and openable windows, allowing occupants to adapt to their internal environment according to their own needs.

The building has therefore been assessed against the predominantly naturally ventilated criteria. This is representative of 'free running' type buildings where people expect internal temperature to follow external temperature, and as such they can adapt and tolerate higher temperatures in accordance with the adaptive comfort model. It is currently anticipated that 86% of the assessed spaces will meet the adaptive thermal comfort criteria for naturally ventilated spaces. Further simulations have also been undertaken to include the additional Design Summer Years listed in CIBSE TM49: DSY2 and DSY3. 48% rooms are anticipated to meet the criteria using the DSY2 heatwave scenario, and 0% of rooms meet the comfort criteria using the DSY3 heatwave scenario.

With regards to the external acoustic environment, the acoustic consultant has advised that the site is exposed to varying levels of environmental sound levels, governed by rail traffic. Reliance on openable windows alone for mitigating overheating is therefore identified to lead to unacceptable internal noise levels and a mechanical ventilation system with air tempering is proposed in accordance with the cooling hierarchy to units where unacceptable internal comfort conditions are predicted.

Cooling Demand: commercial units

The external envelope performances, windows to wall ratio and HVAC strategy has been tailored to the project requirements. A balance between heating and cooling demand has been reached so to minimise the peak load for both winter and summer scenario. The proposed design is deemed to have been optimised with respect to the heating/cooling energy demand with commercial unit cooling demand marginally higher than the Notional values as shown below.

Notional Cooling demand: 45.4 MJ/m^2

Actual Cooling demand: 48.3 MJ/m^2

Be lean.

Passive design and energy efficiency measures form the basis for the reduction in overall energy demand and carbon emissions for the Blocks N3-E, N4 and N5. As per the overarching Energy Strategy, Blocks N3-E, N4 and N5 aim to reduce the energy demand initially by optimising the envelope and building services within the development.

Passive design and energy efficiency features

Detailed passive design and energy efficiency features proposed for Blocks N3-E, N4 and N5 are included in Appendix D.

Be lean results

The following is an appraisal of the anticipated energy requirements and resultant CO_2 emissions from Blocks N3-E, N4 and N5, after the inclusion of the passive design and energy efficiency measures described above and within Section 6 of the main report strategy.

It is anticipated that overall, the Application will meet GLA policy and achieve at least a 10%-15% (for residential and non-residential areas respectively) reduction in annual regulated CO_2 emissions beyond the requirements of the Building Regulations Part L 2013 through improvements to the building fabric and energy efficiency measures (i.e. before any benefit from low or zero carbon technologies).

Energy performance

The table below outlines the anticipated annual energy requirement and associated CO_2 emissions by service for the detailed areas of the Application. Note that these figures represent the total energy demand for each use. The total energy consumed by plant and systems includes additional factors for system efficiencies and losses and is outlined in the following sections.

Table 25: Total energy demand (Detailed Proposals).

Space Use	Space heating MWh/year	Hot water MWh/year	Lighting MWh/year	Auxiliary MWh/year	Cooling MWh/year	Unregulated electricity MWh/year
Residential	946	2,047	242	141	0	1,738
Non-residential	34	21	64	14	11	49
Total:	980	2,068	306	155	11	1,787

Energy demand by end use

Figure 14 shows the regulated energy demand by use-type for the assessed dwellings. The majority of the regulated energy demand is attributable to hot water and heating generation.

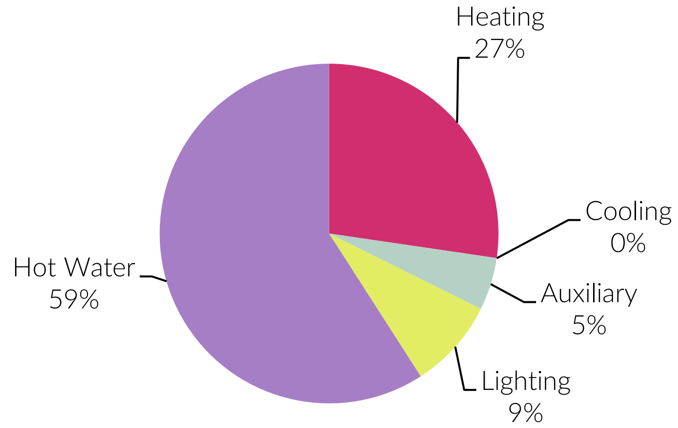


Figure 14: Energy demand by end-use (kWh/yr) for the assessed dwellings (Detailed Proposals).

Figure 15 shows the regulated energy demand by use-type for the assessed non-residential units. The majority of the regulated energy demand is attributable to hot water and heating generation.

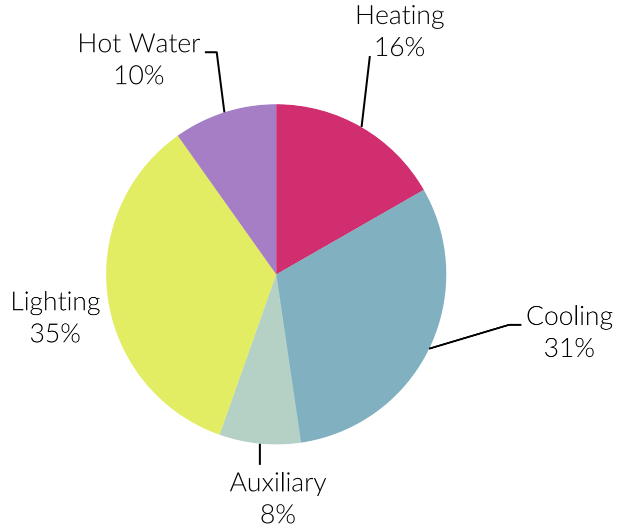


Figure 15: Energy demand by end-use (kWh/yr) for the assessed non-residential units (Detailed Proposals).

Be lean summary

At the 'Be Lean' stage, Blocks N3-E, N4 and N5 are anticipated to achieve a circa 13% reduction in CO_2 emissions (equivalent to 113 tCO_2) beyond the Building Regulations Part L 2013 'baseline', surpassing GLA policy requirements. This will be realised through the inclusion of efficient building fabric which will reduce the space heating demand, as well as enabling good levels of natural light which will reduce the reliance on artificial lighting. The building services strategy will include mechanical ventilation with heat recovery to further reduce energy consumption and CO_2 emissions. In line with the London Plan (2021) requirements, the Be Lean calculations utilise highly efficient gas boilers to provide space heating and domestic hot water to both the residential and commercial aspects of the development.

The residential results are based on SAP calculations using approved software Elmhurst Design SAP 2012 v4.14r16 in accordance with Building Regulations Part L1A.

The non-residential areas have been assessed using IESve (2019) software in accordance with Building Regulations Part L2A. The anticipated CO_2 emissions reduction has been calculated using a notional A1/A3/B1 use-mix as there is currently no class E use available within the National Calculation Methodology for non-domestic energy calculations. The Actual CO_2 emission reduction from the commercial area will therefore be informed by the final end-use for the spaces as well as the future tenant fit-out. However, the fabric first approach demonstrated here by the Application will assist the future tenants in minimising energy demand.

The carbon emissions presented have utilised SAP10 carbon factors in accordance with the London Plan methodology of reporting.

Table 26: Summary of carbon reduction at 'Be Lean' for each assessment type (Detailed Proposals).

Residential	Non-Residential	Site wide
12.8% Reduction over Part L1A baseline	17.3% Reduction over Part L2A baseline	13.0% Reduction over Part L baseline, surpassing GLA minimum requirement at Be Lean

The graph below illustrates the 'Be Lean' regulated carbon results against the gas boiler baseline.

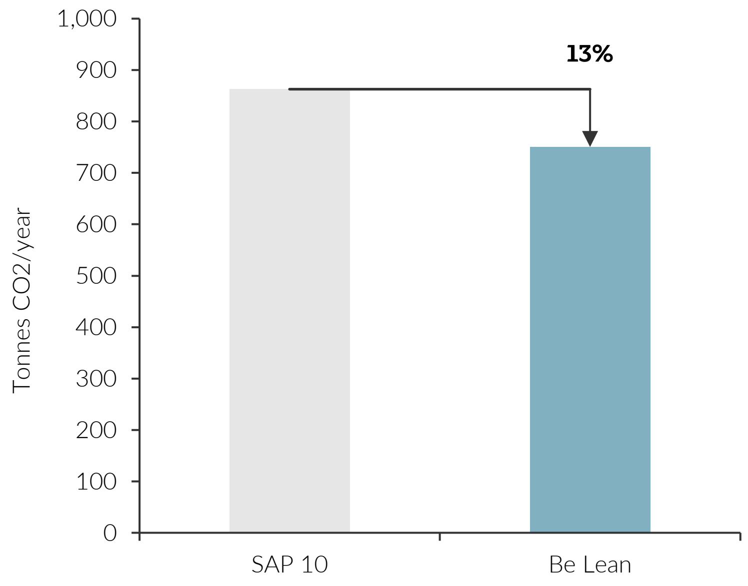
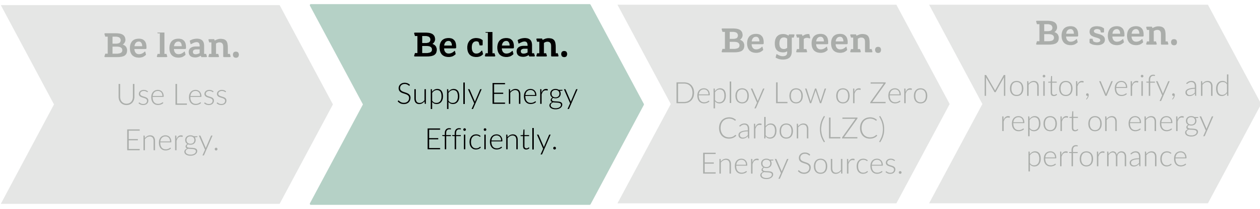


Figure 16: Be lean results summary (Detailed Proposals).

Be clean.

This' stage of the energy hierarchy refers to the use of heat networks or decentralised energy technologies 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.



Be clean summary

As per section 7 within the outline strategy above, an investigation into the availability of existing and proposed district heating networks has been undertaken for the Application. Examination of the London Heat Map as well as correspondence with a district heat network provider has confirmed that no connection opportunities to existing district heating networks in the vicinity of the site have been identified.

Whilst CHP offers high emissions savings under the Part L 2013 methodology, this is not representative of the performance of CHP in reality. Low carbon grid electricity means CHP can actually increase emissions relative to the development served by gas boilers (the baseline). As such CHP is not proposed for the scheme.

With the mix of heating and cooling-led elements, there is potential for energy sharing, particularly in summer, where the demand for domestic hot water can be offset by the demand for cooling in spaces with active cooling. An ambient or condenser loop network allows areas or buildings to reject and extract heat from the same network, meaning energy is not lost to the atmosphere, but transferred, increasing efficiency, and reducing CO_2 emissions. The benefit of and opportunities to deploy an ambient loop energy sharing network are limited due to minimal heat sharing available and has therefore been discounted.

Opportunities would exist for future connection to a low carbon district heating network should one become available in the future (subject to detailed technical, practical and economic feasibility evaluation), as such the proposed infrastructure of the development will make spatial allowance for connection to a heat network.

Space will be provided for inclusion of a site wide heat network, or for conversion to an ambient loop system to provide opportunities to share energy between buildings, as well as the potential to import or export heat to or from the site subject to further need.

There are therefore no further CO_2 savings at the 'Be Clean' stage of the energy hierarchy.

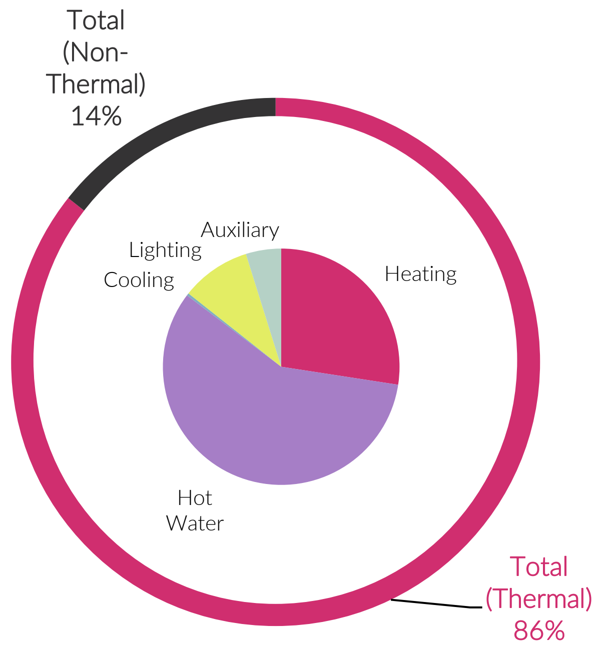


Figure 17: Predicted thermal demand breakdown for the development based on current area schedule (Detailed Proposals).

Be green.

The Be Green 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 offer a further reduction in carbon emissions.

Low and zero carbon (LZC) technology assessment

Section 8 of the main body of this report details the assessment of on-site renewable energy technologies for the Application. This assessment concluded Air Source Heat Pumps (ASHP) and Photovoltaics (PV) are the most suitable technologies. Therefore, Blocks N3-E, N4 and N5 will implement ASHP technologies for the provision of heating and DHW and PV arrays on suitable roof areas.

PV Feasibility Study

Blocks N3-E, N4 and N5 have a range of different roof levels, which have been assessed for their potential to support a photovoltaic array. Proposed rooftop areas for PV coordinated with requirements for amenity space, ecology and building services plant are shown in Appendix C.

- The upper roofs provide a greater opportunity for solar PV given the higher solar irradiance received, whilst the lower roofs are shadowed by adjacent tower or block massing.
- The southern roofs are also more exposed to solar irradiance, however these are more suited for amenity space architecturally.
- The lower roofs have therefore been discounted, and the spaces will be utilised by amenity space for the occupants and/or space for ecology such as green roofs;
- The upper roofs have a number of space requirements for the building services plant as well as the lift and core overruns.

The areas identified for PV would provide space for approximately ~645m^2 of photovoltaic panels which would reduce CO_2 emissions of the whole development by 2.6% (~22 tonnes of CO_2).

Be green summary

At the 'Be Green' stage, Blocks N3-E, N4 and N5 are anticipated to achieve up to an overall 66.3% reduction in CO_2 emissions (equivalent to 572 tCO_2) beyond the Building Regulations Part L 2013 'baseline'. This surpasses the GLA policy requirement of 35% CO_2 emission reduction on-site.

A decentralised approach with roof-mounted air source heat pumps per block is the preferred strategy to meet the space heating and a proportion of hot water demands of the development. Heat pumps significantly reduce CO_2 compared to gas boiler or direct electric heating strategies. Twinned with 645m^2 solar PV, heat pumps offer a route to zero carbon, reducing demand on a strained electricity grid and reducing operating costs.

The residential apartments will utilise ASHPs distributing LTHW through a heat pump system. The heat pump system will supply 100% of space heating demand as well as a proportion of the domestic hot water demand, with electric immersion top-up. Annual space heating and hot water energy is anticipated to be 3,048 MWh/yr. In addition, further reduction in CO_2 emissions will be provided from the PV array: ~645 sqm of PV, with an estimated energy output of ~96.7 MWh per year.

The non-domestic areas will be shell and core with capped off connections and spatial provision for tenant installation of VRF units within allocated courtyard areas and façade louvres for tenant installations of MVHRs.

Results.

The following tables illustrate the regulated and unregulated carbon emissions reductions for Blocks N3-E, N4 and N5 after each stage of the energy hierarchy.

Table 27: Carbon emissions after each stage of energy hierarchy (Detailed Proposals).

	Carbon emissions	
	Regulated Tonnes CO_2/year	Unregulated Tonnes CO_2/year
Part L baseline	863	416
Reduction after Be lean.	750	416
Reduction after Be clean.	750	416
Reduction after Be green.	291	416

Table 28: Regulated carbon emissions savings from each stage of the energy hierarchy (Detailed Proposals).

	Regulated carbon emissions savings	
	Tonnes CO_2/year	Percentage
Savings from Be lean.	112.5	13.0%
Savings from Be clean.	0.0	0.0%
Savings from Be green.	459.6	53.3%
Total reduction:	572.1	66.3%
Target reduction:	862.8	100%
Annual shortfall	-290.7	33.7%
Carbon offset payment Rate (£/tCO_2)	£2,850	
Total offset payment	£828,345	

Be seen.

The “Be Seen” stage is acknowledged as a crucial element of the national net-zero commitment. Energy will be monitored and reported to a level of granularity consistent with “Be Seen”.

Monitoring and Reporting

Effective energy metering in line with Be Seen requirements will be enabled by the provision of suitable infrastructure within the buildings services systems.

Further details are provided in Section 9 of the main report.

Conclusion.

The Energy Strategy for Phase 1; Blocks N3-E, N4 and N5, will minimise energy use and CO_2 emissions through the incorporation of a highly efficient thermal envelope, efficient building services systems, as well as ASHP technology and roof-mounted solar PV. The following table provides a summary of the Energy Strategy for Blocks N3-E, N4 and N5.

Table 29: Energy Strategy summary (Detailed Proposals).

Be lean	13.0% sitewide betterment achieved against Part L baseline, meeting GLA policy targets. High energy efficient building fabric and building services have been utilised to reduce carbon emissions and energy demand through good practice passive measures.
Be clean	‘Be clean’ measures have been deemed unfeasible. Incorporation of an onsite district heating and a CHP system has been deemed to be unsuitable as it would offer no benefit to the Application, therefore a heat network and CHP technology has been discounted. Space will be provided for inclusion of a site wide heat network, and for conversion to an ambient loop system in the future.
Be green	A further 53.3% sitewide betterment achieved through LZC technologies. At 66.3% overall, this surpasses the GLA policy target of 35% on-site CO_2 emission reductions. Utilisation of a high efficiency air source heat pumps and 645m^2 of solar PV further reduces energy consumption and carbon emissions for the Application.
Be Seen	Effective monitoring and metering The “Be Seen” stage is acknowledged as a crucial element of the national net-zero commitment. Energy will be monitored and reported to a level of granularity consistent with “Be Seen” requirements. Effective energy metering in line with Be Seen requirements will be enabled by the provision of suitable infrastructure within the buildings services systems.

Results

The Energy Strategy has been developed using a ‘fabric first’ approach with energy savings through the ‘Be Lean’, ‘Be Clean’, ‘Be Green’ energy hierarchy. Be Lean carbon emission reduction targets are met, and overall on-site emission reduction targets of 35% are surpassed with an anticipated circa 66% reduction in CO_2 emissions achieved beyond the Building Regulations Part L 2013 baseline, inclusive of all measures.

Table 30: Carbon reduction breakdown (Detailed Proposals).

	Cumulative CO_2 emissions
Be lean.	13.0% reduction
Be clean.	13.0% reduction
Be green.	66.3% reduction

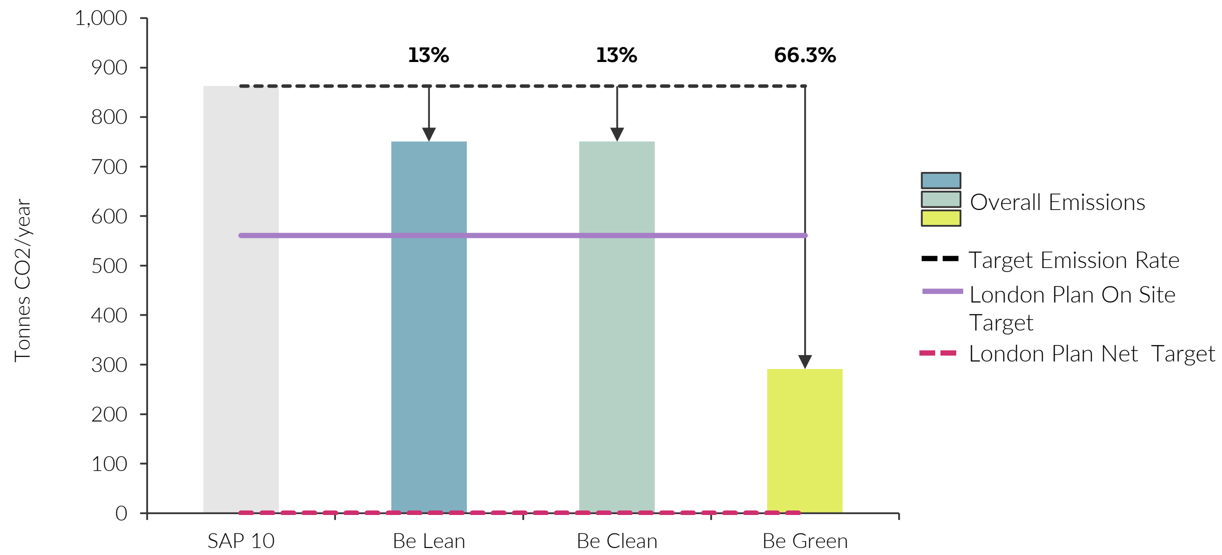


Figure 18: Blocks N3-E, N4 and N5 regulated carbon reduction per each stage of the energy hierarchy (Detailed Proposals).

Overheating and Cooling.

The development of the design has followed the cooling hierarchy principles as a means of reducing the amount of solar and internal gains, reducing the risk of overheating, and subsequently reducing the demand placed upon the systems to condition the space.

Within the representative sample apartments and commercial units that have been assessed for each block of the Application, it can be confirmed that they will achieve compliance with the Building Regulations Part L 2013 Criterion 3 and limit the effects of heat gains in summer months and reduce the demand on active cooling systems.

A CIBSE TM59 assessment has been carried out for a sample of dwellings (see Appendix B), demonstrating that 86% of assessed spaces are anticipated to meet the thermal comfort criteria through passive design measures alone.

Additionally, mechanical ventilation systems with air tempering to lower peak temperatures will be provided to the residential units where unacceptable internal comfort conditions are predicted to manage internal temperatures when occupants choose to leave windows closed for noise reasons.

The flexible commercial spaces (planning use class E) are notionally modelled as retail, office and community use spaces (previous use classes A1 & A3, B1 and F2). For these elements, the low solar transmittance proposed for the glazing results in a marginally higher cooling demand compared to the notional building. At the next stage of design, criterion 3 and display glazing exemptions will be investigated.

Appendix B: Summary of overheating risk assessment (CIBSE TM59).

Summary of input parameters
The overview of parameters/ modelling assumptions is provided below.

Table 31: Summary of input parameters used in the TM59 assessment (Detailed Proposals).

Software	IES VE 2019	Window covering (Internal blinds)	Shading factor: 0.5 Short wave radiant fraction: 0.3
Weather Data	London Heathrow 2020 High Emissions 50th Percentile Scenario Design Summer Year (DSY) 1, 2 & 3	Window opening type	Balconies: Sliding doors, 50% openable area. Windows: Inward opening (90°), 90% openable area.
Assessment Criteria	CIBSE TM59	Occupancy	Bedrooms: 24/7 Living room/Kitchen: 9am-10pm
External Wall U-Value	0.16 W/m^2.K	Max. Occupancy Density	1Bed – 2 People 2 Bed – 4 People 3 Bed – 6 People
Window U-value (including frame)	0.95 W/m^2.K	Occupancy Heat Gains	75W / person (Sensible) 55W / person (Latent)
Window g-Value	0.4	Communal Corridor Internal Gains	Communal heating distribution: 9W/m (flow & return)
Roof U-Value	0.10 W/m^2.K	Lighting Gains	Apartments: 2 W/m^2 Corridors: 0 W/m^2 (PIR sensors)
Floor (ground) U-value	0.13 W/m^2.K	Max. Equipment Gains – Kitchen & Living	450 W (6pm-8pm)
Floor (exposed) U-value	0.13 W/m^2.K	Max. Equipment Gains – Bedroom	80 W (8am-11pm)
Infiltration	0.15 ACH	Heat Interface Unit	77 W (1.85 kWh/day)

Mechanical ventilation in dwellings	6 l/s in bedrooms, 7 l/s in living rooms
Temperature offset (MVHR fan gain)	0.6°C

Figure 19 shows the sample of 7 units tested. These were selected to represent the highest risk of overheating due to their size, orientation, design and location.

Results summary
The following tables summarise the results of the TM59 analysis. Calculations have been completed on a selected representative sample of higher-risk apartments for analysis to determine risk of overheating, i.e. single aspect, west and south facing on upper floors. All dwellings will be provided with mechanical ventilation with heat recovery and openable windows, allowing the occupant to adapt their internal environment according to their own needs. The building has therefore been assessed against the predominantly naturally ventilated criteria. This is representative of 'free running' type buildings where people expect internal temperature to follow external temperature, and as such they can adapt and tolerate higher temperatures in accordance with the adaptive comfort model.

Table 32: Summary of natural ventilation analysis results (Detailed Proposals).

Simulation Scenario	Number of assessed rooms meeting TM59 Criterion 1 and Criterion 2
DSY1-2020-High50 (without blinds)	67%
DSY1-2020-High50 (with blinds)	86%
DSY2-2020-High50 (with blinds)	48%
DSY3-2020-High50 (with blinds)	0%

The 86% pass rate above is expected to improve as more apartments are tested in the next stage, as lower-risk apartments include dual aspect, north facing and apartments at lower levels with greater shading.

Additionally, mechanical ventilation systems with air tempering to lower peak temperatures will also be provided to the residential units to manage internal temperatures when occupants choose to leave windows closed for noise reasons.

Building fabric
The following table provides a summary of the building fabric specification used in this analysis.

Table 33: Building Fabric Specification (Detailed Proposals).

Parameter	Value
External Wall U-value (W/m^2.K)	0.16
Roof U-value (W/m^2.K)	0.10
Ground / Exposed Floor U-value (W/m^2.K)	0.13
Window U-value (including frame) (W/m^2.K)	0.95
Window g-value - general	0.40

Infiltration
For this analysis, the infiltration rate is taken to be 0.15 air changes per hour (ach) aligning with a high performing fabric air permeability of 2 m^3/m^2/hr at 50 Pa will be targeted to meet CO_2 emission rates targets for planning.

Balustrades
For the purposes of this analysis shading from opaque balustrades to the balcony openings has been included where the elevations show a solid balustrade on N5 and glass balustrades have been allowed for on N4 and N3-E.

Figure 19: 3D views of IES model geometry. Modelled zones shown in light grey, adjacent spaces shown in dark grey. Shading objects shown in yellow. (Top view from southwest, bottom view from southeast).

Appendix C: Indicative rooftop PV locations.

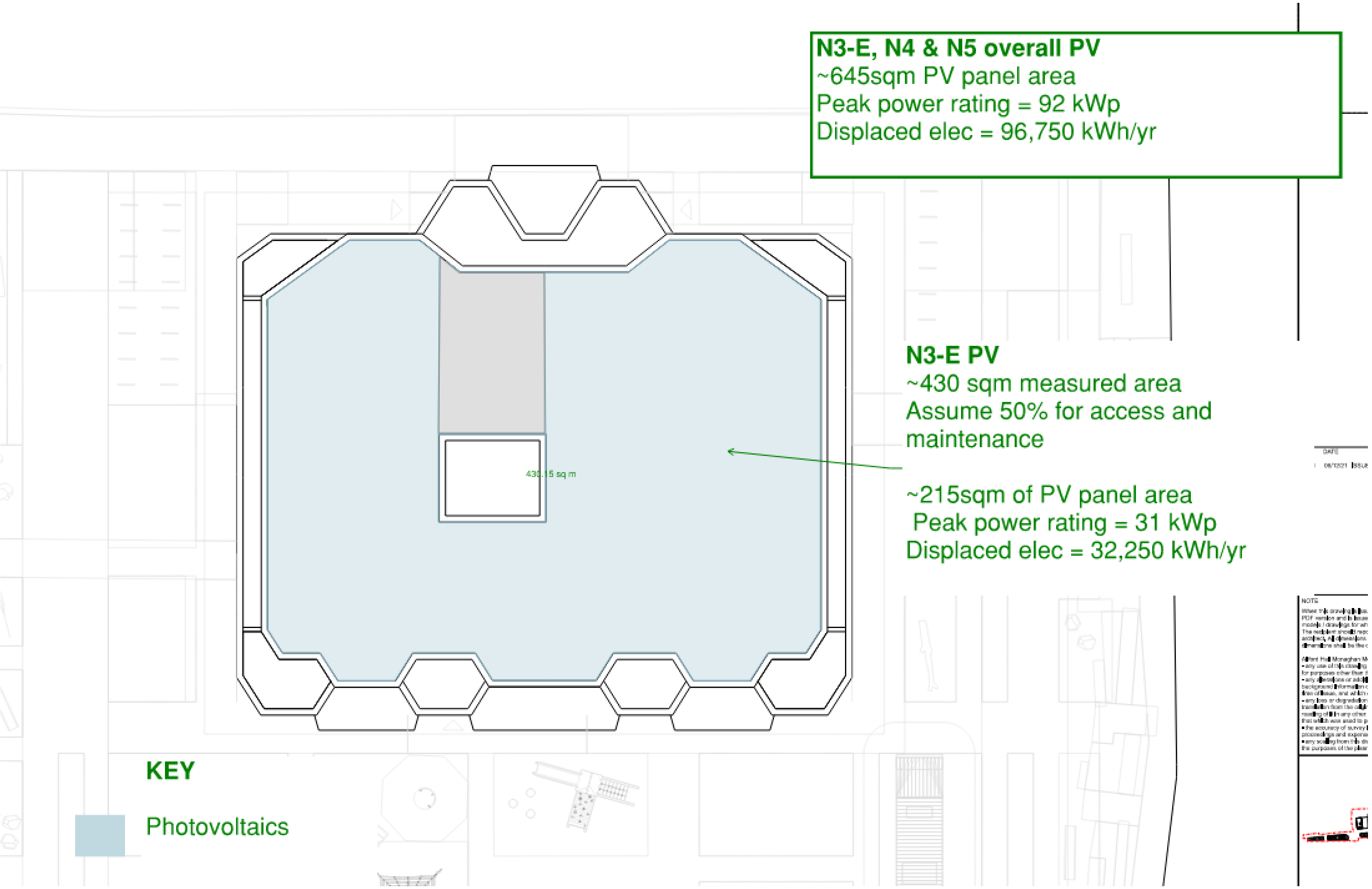


Figure 20: N3E - proposed area for solar photovoltaics on roof plan

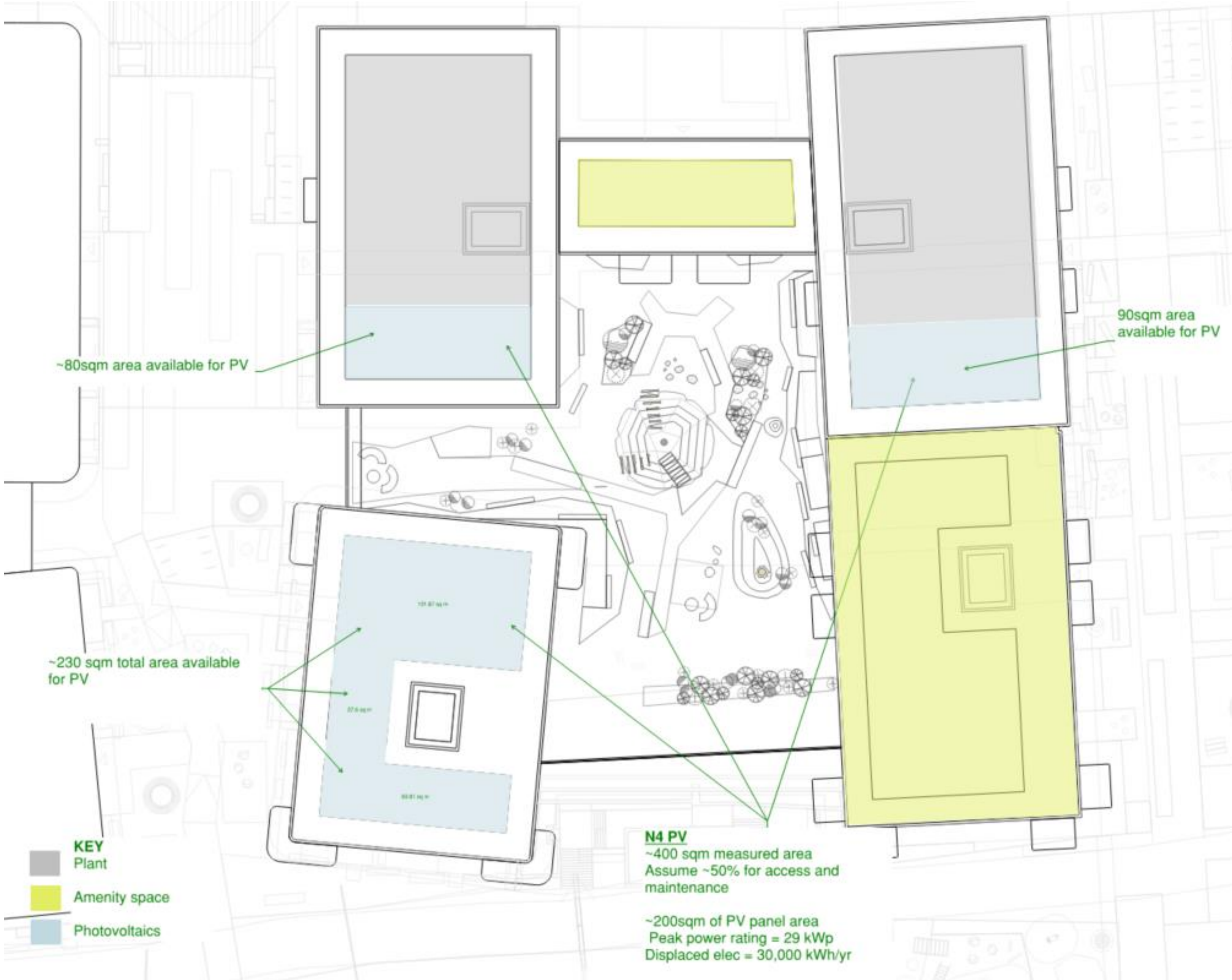
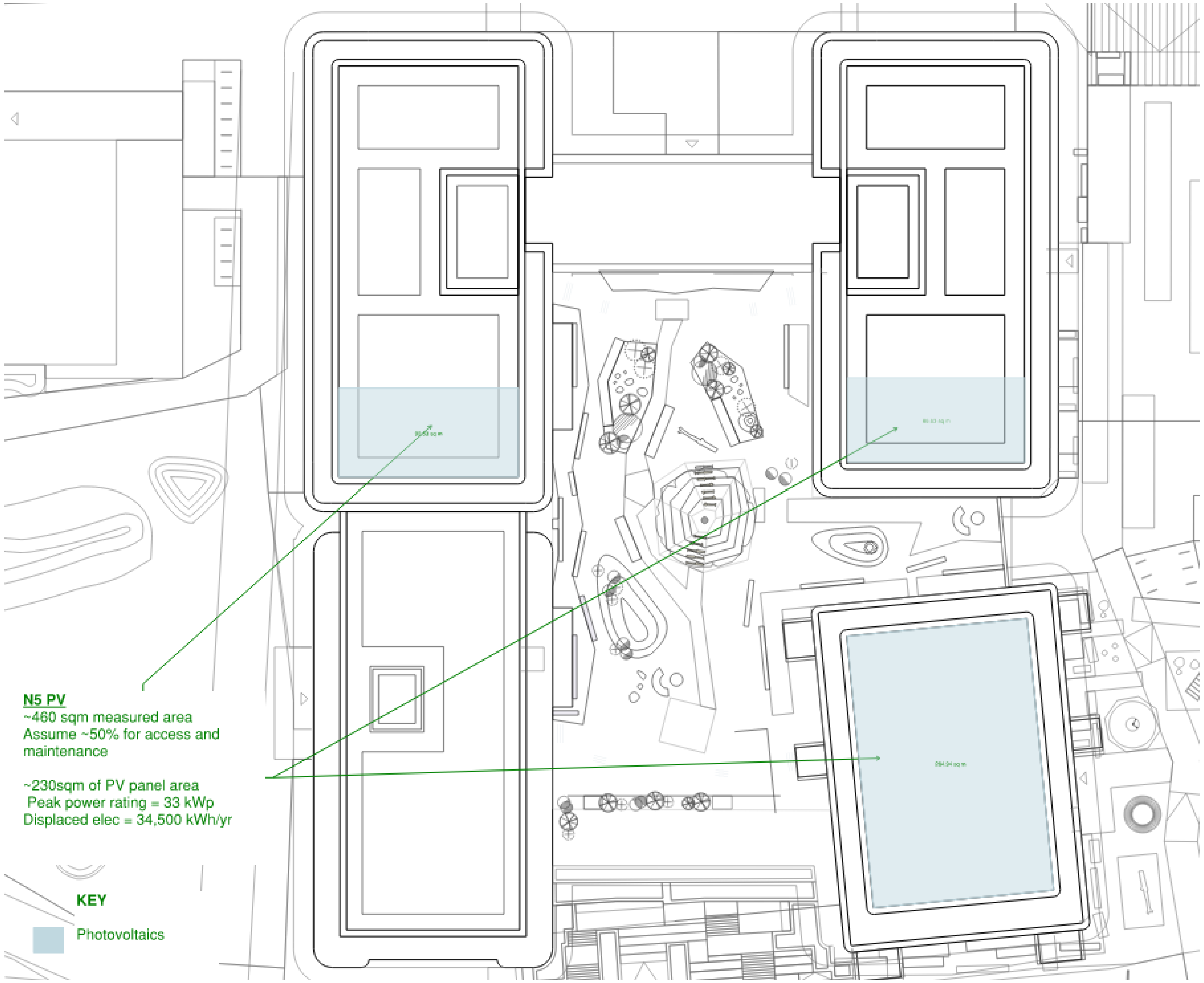


Figure 21: N4 - proposed area for solar photovoltaics on roof plan


N5 PV
~460 sqm measured area
Assume ~50% for access and maintenance
~230sqm of PV panel area
Peak power rating = 33 kWp
Displaced elec = 34,500 kWh/yr
KEY
Photovoltaics

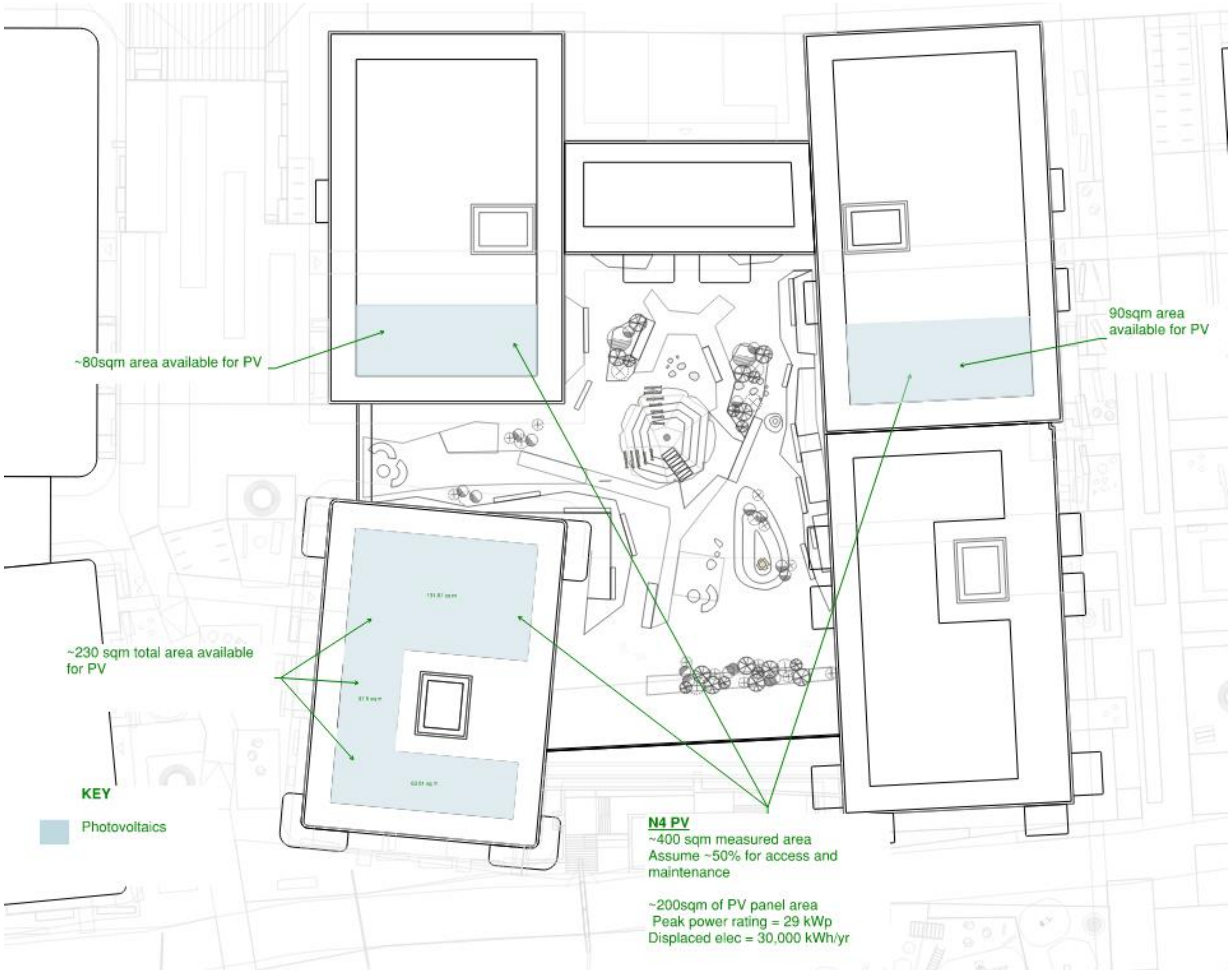


Figure 22: N5 - proposed area for solar photovoltaics on roof plan

Appendix D: Energy modelling parameters.

Compliance software and procedure
Calculations demonstrating the energy requirements and associated CO_2 emissions have been modelled as follows:

- New Build Residential - Building Regulations Part L1A 2013: Conservation of Fuel and Power in New Dwellings. A sample of dwellings have been modelled using SAP methodology.
- New build commercial areas. Building Regulations Part L2A 2013: Conservation of Fuel and Power in New Buildings other than Dwellings. These elements have been modelled using IESve 2019.
- In line with current GLA guidance, carbon emission reductions have been calculated using the carbon factors set out in the SAP10 guidance.

Calculation parameters
The parameters below outline the inputs into the calculations at this stage in the design process. The fabric parameters have been determined after consultation with AHMM architects, whilst the system parameters have been developed in conjunction with the M&E engineers.

The fit out of the flexible commercial spaces will be the responsibility of the individual tenants; however reasonable assumptions in line with the non-domestic building compliance guide have been used to carry out the assessment.

Fabric parameters
Table 34: Target building fabric performance parameters.

	Residential Areas	Flexible Commercial Areas
Exposed Floor U-value (W/m^{2}K)	0.13	0.13
External Wall U-value (W/m^{2}K)	0.16	0.16
Roof U-value (W/m^{2}K)	0.10	0.10
Glazing U-value (W/m^{2}K)	0.95 (g value: 40%)	1.40 (g value: 40%)
External Opaque Door U-value (W/m^{2}K)	1.10	-
Air Permeability (m^3/h.m^2) @ 50Pa	2.00	3.00

Glazing to wall ratio
The glazing ratio has been optimised to balance levels of solar gain and daylight levels.

System parameters
Table 35: System parameters per space type.

	Residential Areas	Flexible Commercial Areas
Space Heating & Cooling	**ASHP –** heat generated by roof-mounted ASHPs, distributed at 55°C and boosted as required by direct electric. Coupled to hot water systems and radiators. SCOP Space heating: 3.0	**VRF –**tenant installation of VRF within allocated courtyard areas. SCOP Space heating: 3.5 SEER Cooling: 5.5
Ventilation	Mechanical ventilation with heat recovery Heat recovery efficiency: 85%. Specific fan power: 0.65 W/l/s (average).	Mechanical ventilation with heat recovery Heat recovery efficiency: 85% System specific fan power: 1.4 W/(l/s)
Lighting	High efficiency lighting throughout.	– Target efficacy of >100 luminaire lumens per circuit Watt. – Display Lighting is 75 lamp lumens per circuit Watt. – Occupancy sensing lighting controls: Office and community spaces. – Daylight dimming: Office and community spaces.

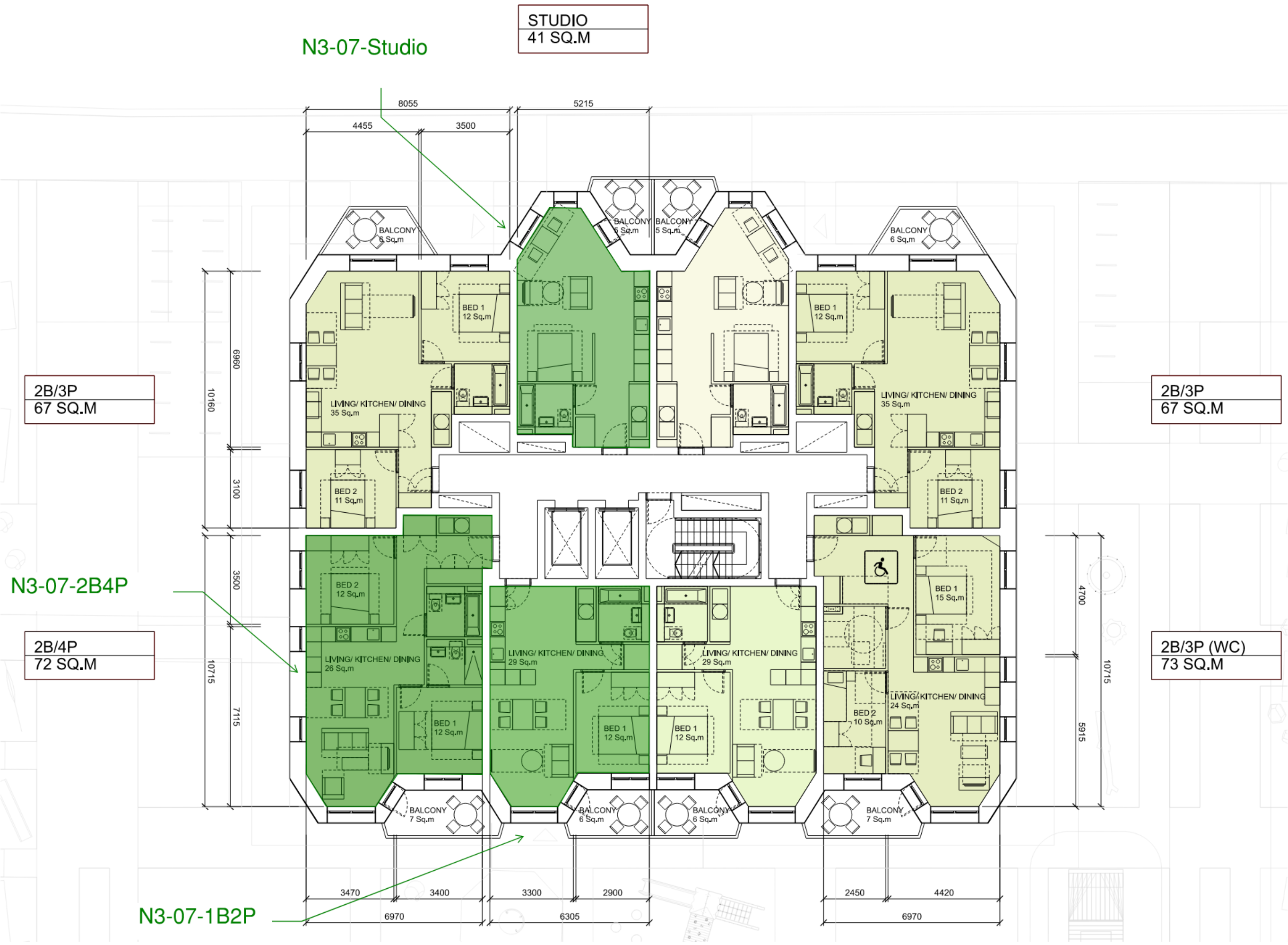
Table 36: Domestic Hot Water system parameters per space type.

	Residential Areas	Flexible Commercial Areas
Generator	**ASHP –** heat generated by roof-mounted ASHPs, distributed at 55°C and boosted as required by electric immersion top-up within dwellings. SCOP: 3.0	**Point of use electric –** SCOP: 1.0 (office, retail & community spaces) **ASHP** – SCOP: 2.0 (Food & Beverage)
Storage	Storage volume: 180 litres Storage losses: 1.85 kWh/(day)	95% DHW delivery efficiency

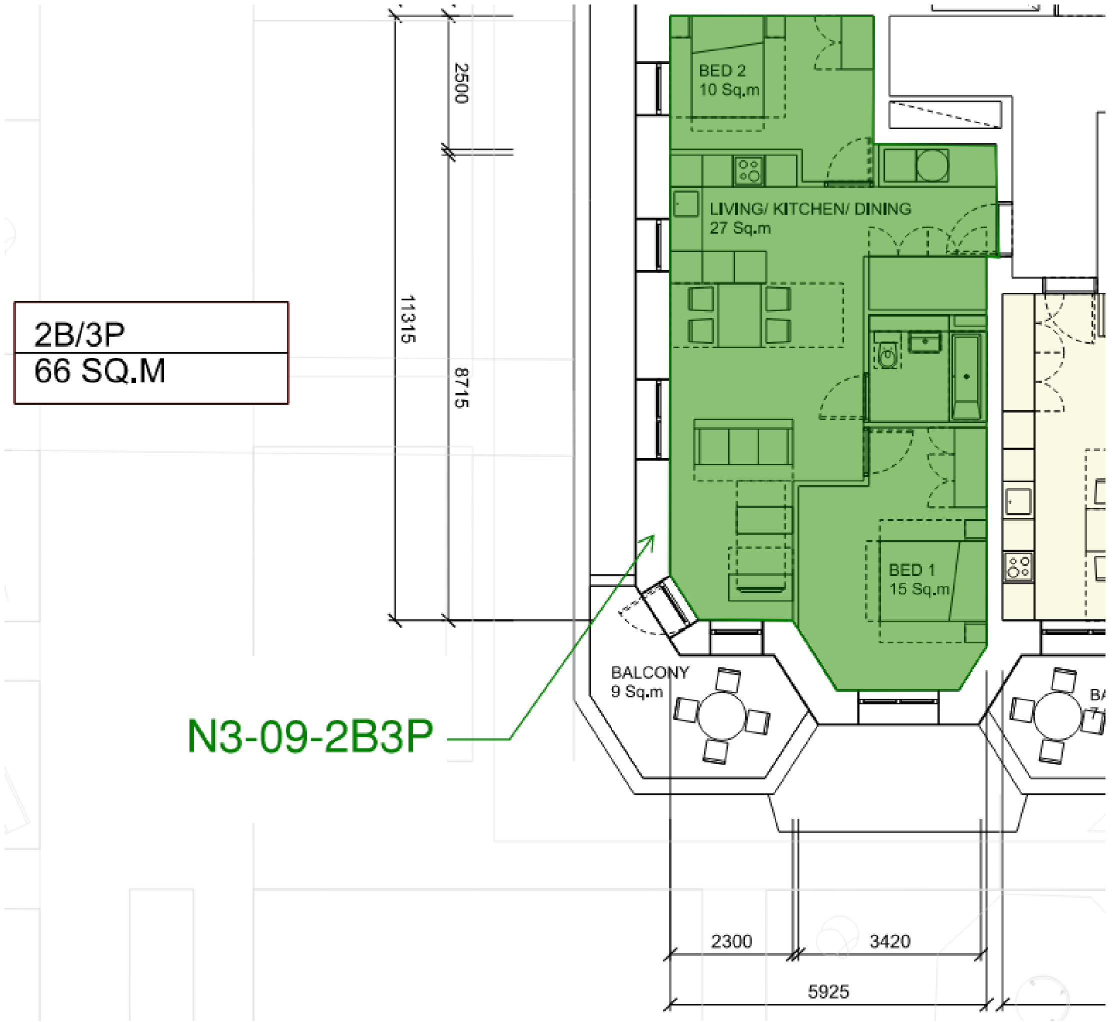
System parameters are to be developed and finalised in detailed design stage.

Appendix E: Sample dwelling locations.

Block N3



Units N3-07-Studio, N3-07-2B4P and N3-07-1B2P.



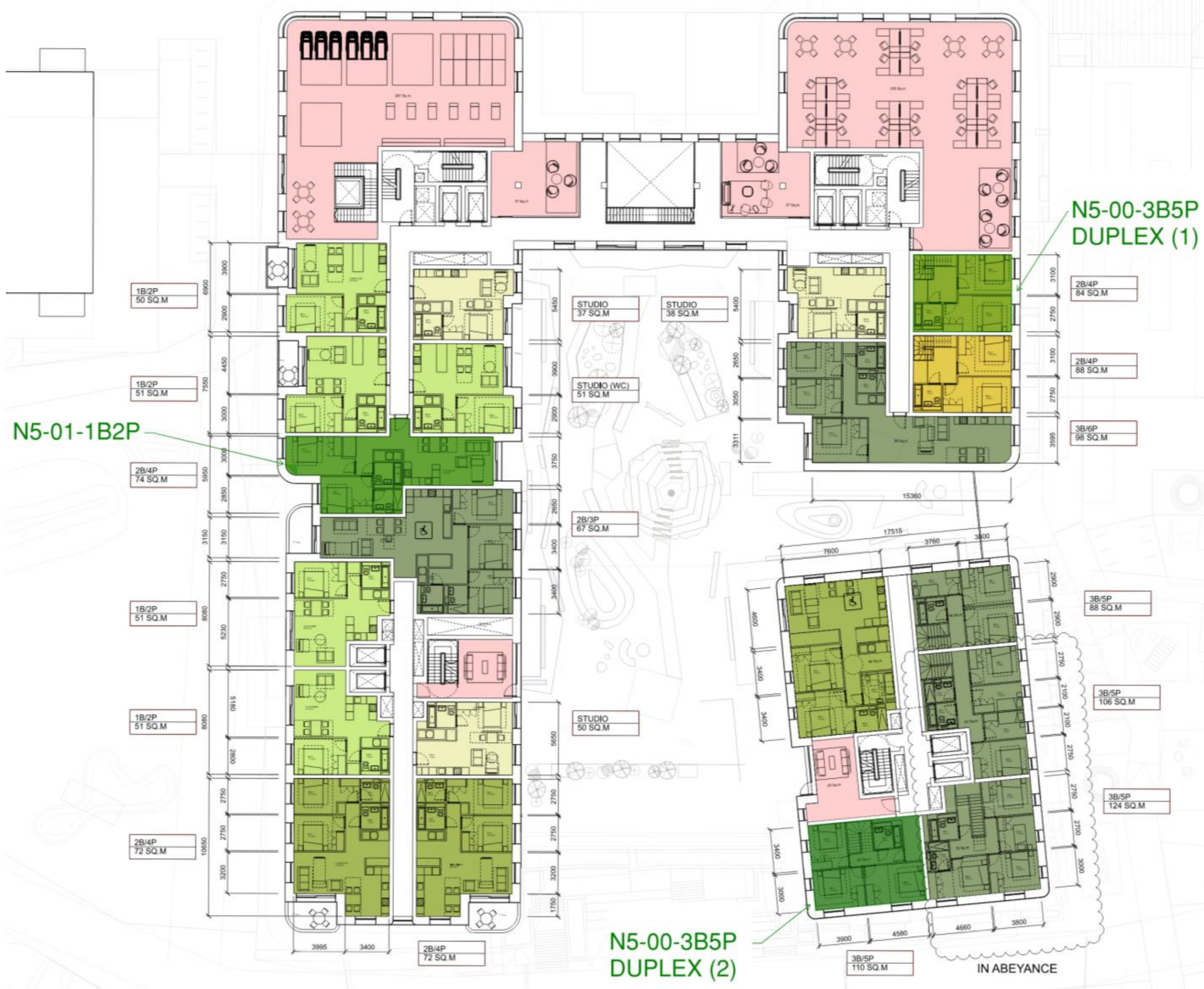
Unit N3-09-2B3P.

Block N4

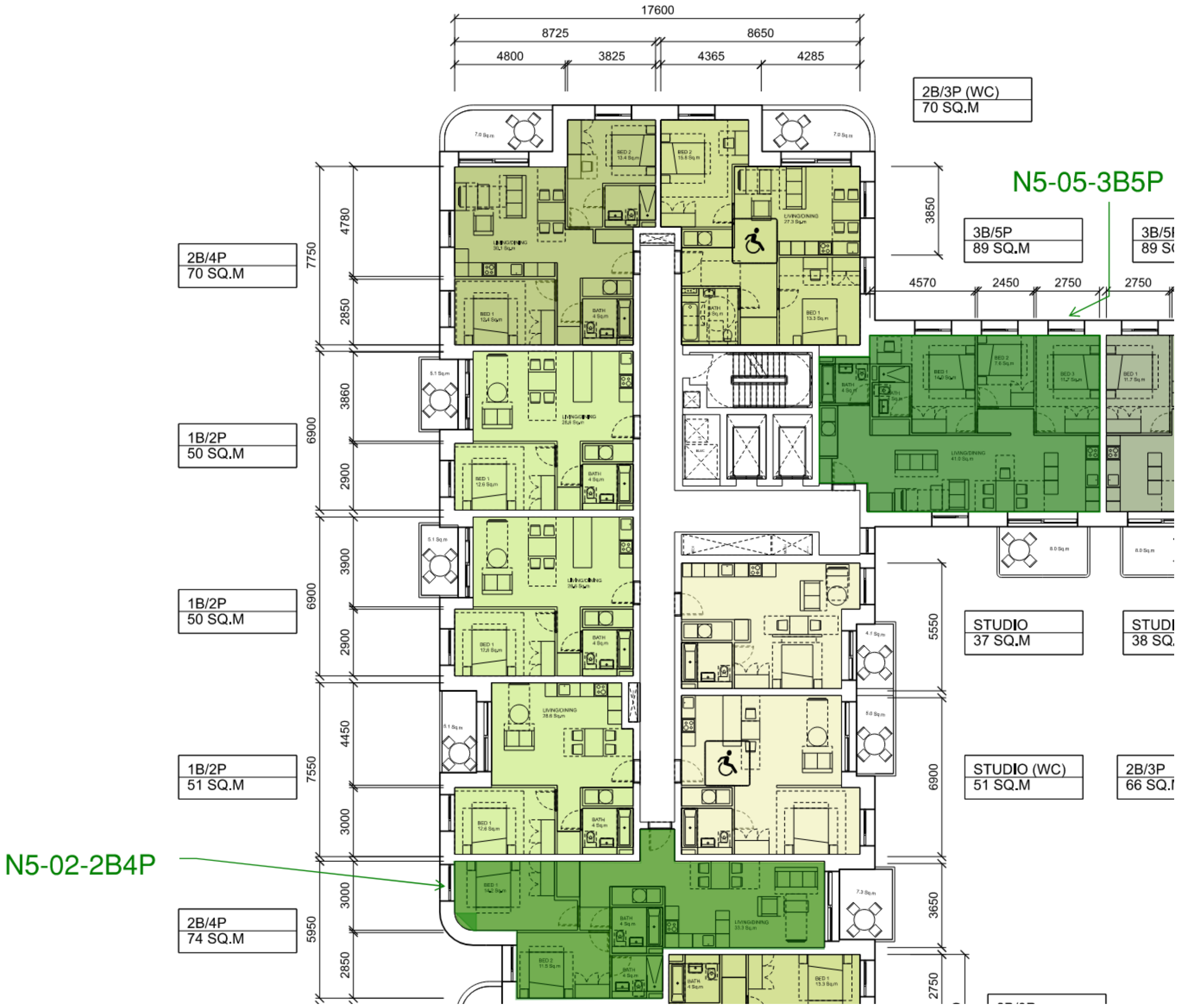
Units N4-07-3B5P, N4-07-2B3P and N4-07-1B2P.

Block N5

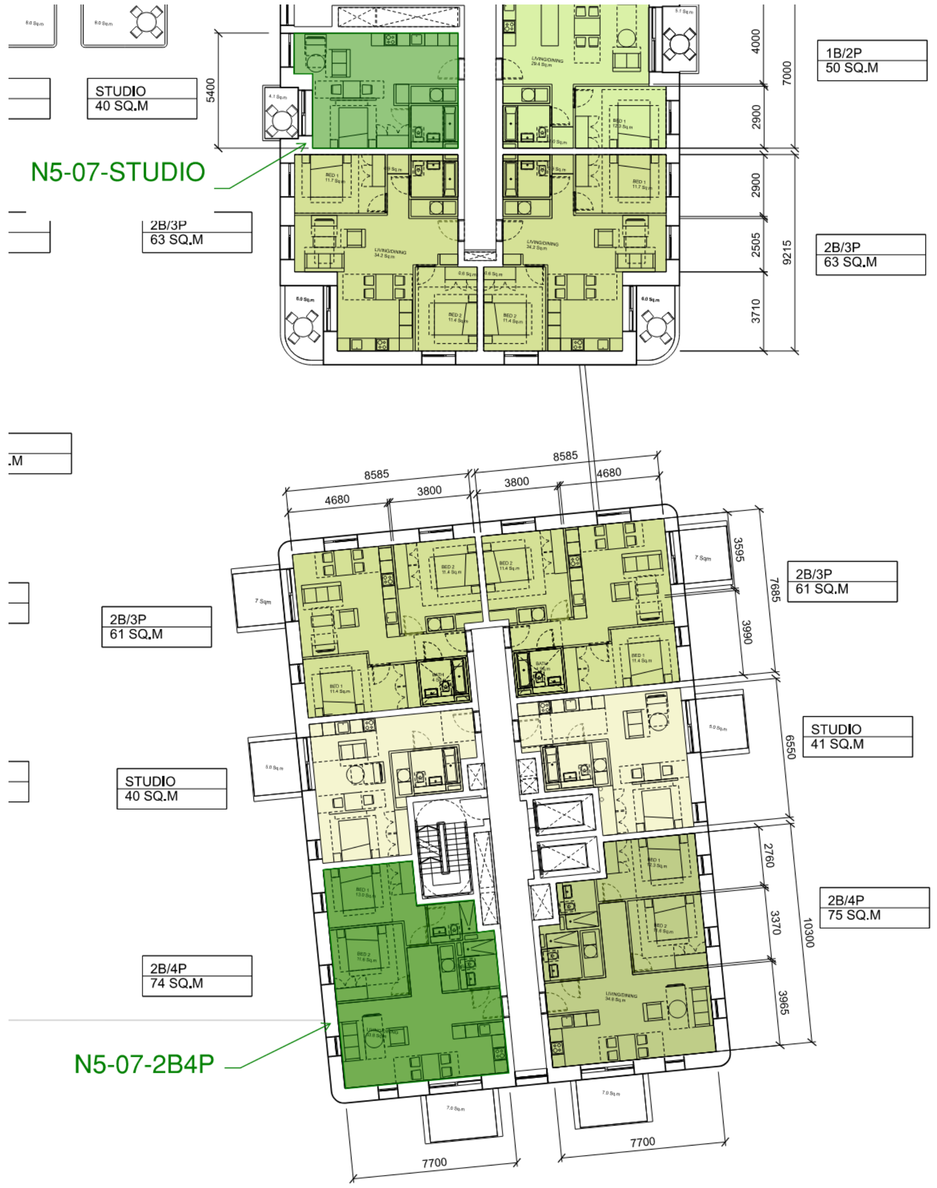
Units N5-00-3B5P Duplex (1) and N5-00-Duplex (2), highlighting the lowest occupied floors of these two storey dwellings.



Units N5-01-1B2P, and the upper levels of both Duplexes.

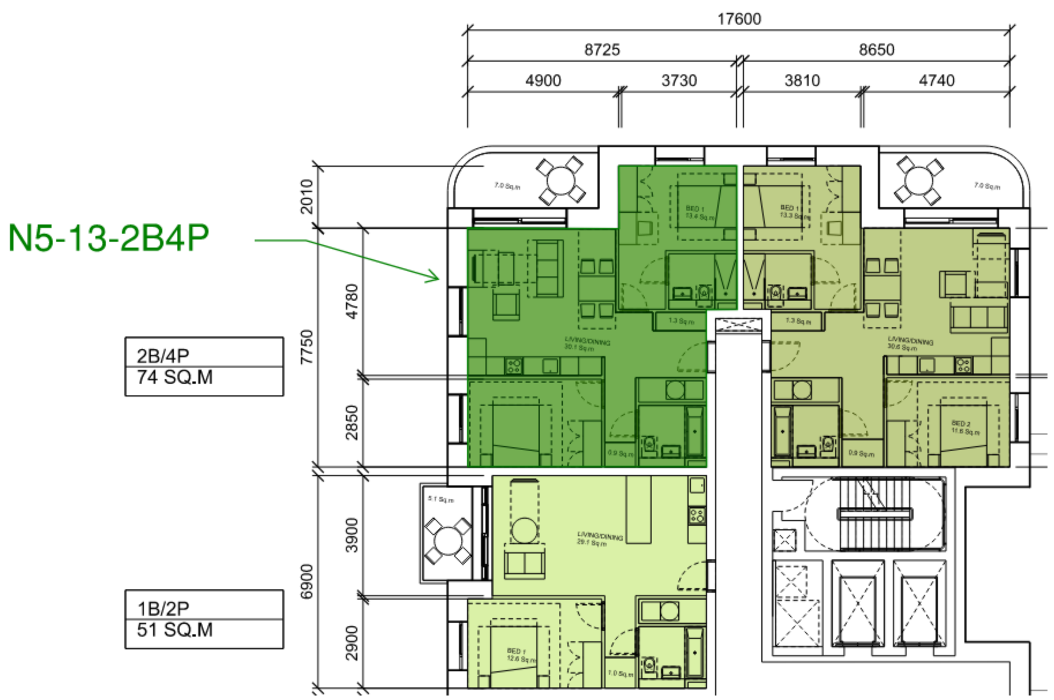


Units N5-02-2B4P and N5-05-SB5P.



Units N5-07-Studio and N5-07-2B4P.

Unit N5-09-3B5P.



Unit N5-13-2B4P.

Appendix F: SAP worksheets and block compliance.

Be Lean.

BLOCK COMPLIANCE
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Block Reference	000324	Issued on Date	06/01/2022
Block Name	N5 (A-C) - Be Lean		
Assessor Details	Miss Emma Jolly, Emma Jolly, Tel: 01454806691, emmajolly@hoarelea.com	Assessor ID	T689-0001
Client			

Block Compliance Report - DER

Block Reference: 000324		Block Name: N5 (A-C) - Be Lean			
Property-Assessment Reference	Multiplier	Floor Area (m^2)	DER ($kgCO_2/m^2$)	TER ($kgCO_2/m^2$)	% DER/TER
N3-07-2B4P Be Lean-Unit 03_3B5P_L2 Be Lean	30	72.46	13.90	15.52	10.45 %
N3-07-1B2P Be Lean-Unit 04_3B5P_L9 Be Lean	16	50.11	16.47	17.59	6.38 %
N3-07-Studio Be Lean-Unit 05_Studio_L9 Be Lean	18	42.15	19.04	22.17	14.12 %
N3-09-2B3P Be Lean-Unit 09_Studio_L14 Be Lean	6	66.04	19.89	20.57	3.31 %
N4-07-3B5P Be Lean-Unit 12_Studio_L14 Be Lean	40	86.49	14.76	16.11	8.36 %
N4-07-2B3P Be Lean-Unit 12_Studio_L14 Be Lean	46	66.86	16.93	16.98	0.32 %
N4-07-1B2P Be Lean-Unit 14_Studio_L14 Be Lean	181	52.5	16.21	17.89	9.39 %
N5-00-3B5P DUPLEX (1) Be Lean-Unit 19_Studio_L14 Be Lean	8	87	17.97	20.39	11.89 %
N5-00-3B5P DUPLEX (2) Be Lean-Unit 20_Studio_L14 Be Lean	6	110.65	15.70	17.79	11.74 %
N5-01-2B4P (1) Be Lean-Unit 21_Studio_L14 Be Lean	3	74.06	15.43	17.37	11.18 %
N5-01-2B4P (2) Be Lean-Unit 22_Studio_L14 Be Lean	17	74.06	12.82	14.89	13.91 %
N5-05-3B5P Be Lean-Unit 22_Studio_L14 Be Lean	24	88.7	13.14	14.90	11.84 %
N5-07-Studio Be Lean-Unit 28_Studio_L14 Be Lean	37	39.1	20.28	23.88	15.07 %
N5-07-2B4P Be Lean-Unit 28_Studio_L14 Be Lean	58	70.52	15.00	16.51	9.15 %
N5-09-3B5P (1) Be Lean-Unit 28_Studio_L14 Be Lean	3	88.07	20.87	21.86	4.55 %
N5-09-3B5P (2) Be Lean-Unit 32_Studio_L14 Be Lean	116	70.25	15.30	16.96	9.80 %
Totals:	609	39088.13	263.71	291.40	
Average DER = 15.72 $kgCO_2/m^2$		% DER/TER	PASS		
Average TER = 17.32 $kgCO_2/m^2$		9.24 %			

elmhurst energy

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Regs Region: England
Elmhurst Energy Systems
SAP2012 Calculator (Design System) version 4.14r19

BLOCK COMPLIANCE
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Block Compliance Report - DFEE

Block Reference: 000324		Block Name: N5 (A-C) - Be Lean			
Property-Assessment Reference	Multiplier	Floor Area (m^2)	DFEE ($kWh/m^2/yr$)	TFEE ($kWh/m^2/yr$)	% DFEE/TFEE
N3-07-2B4P Be Lean-Unit 03_3B5P_L2 Be Lean	30	72.46	31.48	36.32	13.32 %
N3-07-1B2P Be Lean-Unit 04_3B5P_L9 Be Lean	16	50.11	33.96	36.97	8.13 %
N3-07-Studio Be Lean-Unit 05_Studio_L9 Be Lean	18	42.15	40.55	43.74	7.30 %
N3-09-2B3P Be Lean-Unit 09_Studio_L14 Be Lean	6	66.04	52.42	60.30	13.08 %
N4-07-3B5P Be Lean-Unit 12_Studio_L14 Be Lean	40	86.49	38.72	44.65	13.28 %
N4-07-2B3P Be Lean-Unit 12_Studio_L14 Be Lean	46	66.86	41.13	41.99	2.05 %
N4-07-1B2P Be Lean-Unit 14_Studio_L14 Be Lean	181	52.5	34.23	39.98	14.38 %
N5-00-3B5P DUPLEX (1) Be Lean-Unit 19_Studio_L14 Be Lean	8	87	53.98	64.08	15.76 %
N5-00-3B5P DUPLEX (2) Be Lean-Unit 20_Studio_L14 Be Lean	6	110.65	49.59	59.15	16.16 %
N5-01-2B4P (1) Be Lean-Unit 21_Studio_L14 Be Lean	3	74.06	38.62	46.38	16.73 %
N5-01-2B4P (2) Be Lean-Unit 22_Studio_L14 Be Lean	17	74.06	27.78	33.71	17.58 %
N5-05-3B5P Be Lean-Unit 22_Studio_L14 Be Lean	24	88.7	32.74	38.40	14.74 %
N5-07-Studio Be Lean-Unit 28_Studio_L14 Be Lean	37	39.1	43.47	48.63	10.63 %
N5-07-2B4P Be Lean-Unit 28_Studio_L14 Be Lean	58	70.52	35.95	40.94	12.17 %
N5-09-3B5P (1) Be Lean-Unit 28_Studio_L14 Be Lean	3	88.07	61.61	74.31	17.09 %
N5-09-3B5P (2) Be Lean-Unit 32_Studio_L14 Be Lean	116	70.25	36.75	43.32	15.15 %
Totals:	609	39088.13	652.98	752.86	
Average DFEE = 36.90 $kWh/m^2/yr$		% DFEE/TFEE	PASS		
Average TFEE = 42.42 $kWh/m^2/yr$		13.01 %			

elmhurst energy

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Regs Region: England
Elmhurst Energy Systems
SAP2012 Calculator (Design System) version 4.14r19

Be Green.

BLOCK COMPLIANCE
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Block Reference	000328	Issued on Date	06/01/2022
Block Name	N5 (A-C) - Be Green		
Assessor Details	Miss Emma Jolly, Emma Jolly, Tel: 01454806691, emmajolly@hoarelea.com	Assessor ID	T689-0001
Client			

Block Compliance Report - DER

Block Reference: 000328		Block Name: N5 (A-C) - Be Green			
Property-Assessment Reference	Multiplier	Floor Area (m^2)	DER ($kgCO_2/m^2$)	TER ($kgCO_2/m^2$)	% DER/TER
N3-07-2B4P Be Green-Unit 03_3B5P_L2 Be Green	30	72.46	9.83	22.49	56.30 %
N3-07-1B2P Be Green-Unit 04_3B5P_L9 Be Green	16	50.11	11.29	25.51	55.75 %
N3-07-Studio Be Green-Unit 05_Studio_L9 Be Green	18	42.15	12.85	32.43	60.37 %
N3-09-2B3P Be Green-Unit 09_Studio_L14 Be Green	6	66.04	13.89	30.28	54.13 %
N4-07-3B5P Be Green-Unit 12_Studio_L14 Be Green	40	86.49	10.51	23.51	55.29 %
N4-07-2B3P Be Green-Unit 12_Studio_L14 Be Green	46	66.86	11.86	24.73	52.04 %
N4-07-1B2P Be Green-Unit 14_Studio_L14 Be Green	181	52.5	11.15	26.00	57.11 %
N5-00-3B5P DUPLEX (1) Be Green-Unit 19_Studio_L14 Be Green	8	87	12.94	29.99	56.86 %
N5-00-3B5P DUPLEX (2) Be Green-Unit 20_Studio_L14 Be Green	6	110.65	11.40	26.23	56.54 %
N5-01-2B4P (1) Be Green-Unit 21_Studio_L14 Be Green	3	74.06	10.89	25.35	57.05 %
N5-01-2B4P (2) Be Green-Unit 22_Studio_L14 Be Green	17	74.06	9.09	21.51	57.74 %
N5-05-3B5P Be Green-Unit 22_Studio_L14 Be Green	24	88.7	9.40	21.66	56.60 %
N5-07-Studio Be Green-Unit 28_Studio_L14 Be Green	37	39.1	13.59	35.01	61.19 %
N5-07-2B4P Be Green-Unit 28_Studio_L14 Be Green	58	70.52	10.55	24.02	56.08 %
N5-09-3B5P (1) Be Green-Unit 28_Studio_L14 Be Green	3	88.07	14.73	32.44	54.60 %
N5-09-3B5P (2) Be Green-Unit 32_Studio_L14 Be Green	116	70.25	10.72	24.72	56.64 %
Totals:	609	39088.13	184.69	425.89	
Average DER = 10.97 $kgCO_2/m^2$		% DER/TER	PASS		
Average TER = 25.24 $kgCO_2/m^2$		56.54 %			

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SAP2012 Calculator (Design System) version 4.14r19

BLOCK COMPLIANCE
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Block Compliance Report - DFEE

Block Reference: 000328		Block Name: N5 (A-C) - Be Green			
Property-Assessment Reference	Multiplier	Floor Area (m^2)	DFEE ($kWh/m^2/yr$)	TFEE ($kWh/m^2/yr$)	% DFEE/TFEE
N3-07-2B4P Be Green-Unit 03_3B5P_L2 Be Green	30	72.46	31.48	36.32	13.32 %
N3-07-1B2P Be Green-Unit 04_3B5P_L9 Be Green	16	50.11	33.96	36.97	8.13 %
N3-07-Studio Be Green-Unit 05_Studio_L9 Be Green	18	42.15	40.55	43.74	7.30 %
N3-09-2B3P Be Green-Unit 09_Studio_L14 Be Green	6	66.04	52.42	60.30	13.08 %
N4-07-3B5P Be Green-Unit 12_Studio_L14 Be Green	40	86.49	38.72	44.65	13.28 %
N4-07-2B3P Be Green-Unit 12_Studio_L14 Be Green	46	66.86	41.13	41.99	2.05 %
N4-07-1B2P Be Green-Unit 14_Studio_L14 Be Green	181	52.5	34.23	39.98	14.38 %
N5-00-3B5P DUPLEX (1) Be Green-Unit 19_Studio_L14 Be Green	8	87	53.98	64.08	15.76 %
N5-00-3B5P DUPLEX (2) Be Green-Unit 20_Studio_L14 Be Green	6	110.65	49.59	59.15	16.16 %
N5-01-2B4P (1) Be Green-Unit 21_Studio_L14 Be Green	3	74.06	38.62	46.38	16.73 %
N5-01-2B4P (2) Be Green-Unit 22_Studio_L14 Be Green	17	74.06	27.78	33.71	17.58 %
N5-05-3B5P Be Green-Unit 22_Studio_L14 Be Green	24	88.7	32.74	38.40	14.74 %
N5-07-Studio Be Green-Unit 28_Studio_L14 Be Green	37	39.1	43.47	48.63	10.63 %
N5-07-2B4P Be Green-Unit 28_Studio_L14 Be Green	58	70.52	35.95	40.94	12.17 %
N5-09-3B5P (1) Be Green-Unit 28_Studio_L14 Be Green	3	88.07	61.61	74.31	17.09 %
N5-09-3B5P (2) Be Green-Unit 32_Studio_L14 Be Green	116	70.25	36.75	43.32	15.15 %
Totals:	609	39088.13	652.98	752.86	
Average DFEE = 36.90 $kWh/m^2/yr$		% DFEE/TFEE	PASS		
Average TFEE = 42.42 $kWh/m^2/yr$		13.01 %			

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Appendix G: BRUKL documents.

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name **Shell and Core**

O2 Finchley N3 Retail - Be Lean

As designed

Date: Thu Jan 06 15:15:07 2022

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.12

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.12

BRUKL compliance check version: v5.6.a.1

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	36
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	36
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	27.5
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.16	0.16	00000000:Surf[5]
Floor	0.25	0.13	0.13	00000000:Surf[0]
Roof	0.25	0.1	0.1	00000000:Surf[1]
Windows***, roof windows, and rooflights	2.2	1.4	1.4	00000000:Surf[2]
Personnel doors	2.2	1.39	1.39	00000000:Surf[10]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	3

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	100.1	100.1
External area [m²]	196.7	196.7
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	5
Average conductance [W/K]	71.62	91.64
Average U-value [W/m²K]	0.36	0.47
Alpha value* [%]	10	10

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
100	**A1/A2 Retail/Financial and Professional services**
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	13.75	13.74
Cooling	5.31	7.85
Auxiliary	6.24	3.06
Lighting	36.17	53.61
Hot water	1.86	1.86
Equipment*	20.26	20.26
TOTAL**	**63.34**	**80.13**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	122.73	149.77
Primary energy* [kWh/m²]	161.89	212.17
Total emissions [kg/m²]	27.5	36

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name — **Shell and Core**

O2 Finchley N3 Retail - Be Green

As designed

Date: Thu Jan 06 15:13:19 2022

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.12

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.12

BRUKL compliance check version: v5.6.a.1

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	35.6
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	35.6
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	26.8
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	Surface where the maximum value occurs*
Wall**	0.35	0.16	0.16	00000000:Surf[5]
Floor	0.25	0.13	0.13	00000000:Surf[0]
Roof	0.25	0.1	0.1	00000000:Surf[1]
Windows***, roof windows, and rooflights	2.2	1.4	1.4	00000000:Surf[2]
Personnel doors	2.2	1.39	1.39	00000000:Surf[10]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]
U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
m³/(h.m²) at 50 Pa	10	3

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Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	100.1	100.1
External area [m²]	196.7	196.7
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	5
Average conductance [W/K]	71.62	91.64
Average U-value [W/m²K]	0.36	0.47
Alpha value* [%]	10	10

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
100	**A1/A2 Retail/Financial and Professional services**
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	3.58	4.63
Cooling	5.31	7.85
Auxiliary	6.24	3.06
Lighting	36.17	53.61
Hot water	1.7	1.86
Equipment*	20.26	20.26
TOTAL**	**52.99**	**71.02**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	122.73	149.77
Primary energy* [kWh/m²]	158.62	209.04
Total emissions [kg/m²]	26.8	35.6

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

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BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name — **Shell and Core**

O2 Finchley N4 Community Space - Be Lean

As designed

Date: Thu Jan 06 15:21:03 2022

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.12

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.12

BRUKL compliance check version: v5.6.a.1

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	12.6
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	12.6
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	12.2
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	Surface where the maximum value occurs*
Wall**	0.35	0.16	0.16	RM000002:Surf[9]
Floor	0.25	0.13	0.13	RM000002:Surf[10]
Roof	0.25	-	-	UNKNOWN
Windows***, roof windows, and rooflights	2.2	1.4	1.4	RM000002:Surf[0]
Personnel doors	2.2	1.39	1.39	RM000002:Surf[17]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]
U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	3

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Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	268.7	268.7
External area [m²]	454	454
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	170.65	191.57
Average U-value [W/m²K]	0.38	0.42
Alpha value* [%]	10	10

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
100	**D1 Non-residential Institutions: Community/Day Centre**
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	16.11	17.04
Cooling	1.99	3.03
Auxiliary	7.39	2.95
Lighting	5.87	9.58
Hot water	4.85	4.85
Equipment*	4.72	4.72
TOTAL**	**36.2**	**37.45**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	81.15	94.23
Primary energy* [kWh/m²]	71.2	73.28
Total emissions [kg/m²]	12.2	12.6

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

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BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name **Shell and Core**

O2 Finchley N4 Community Space - Be Green

As designed

Date: Thu Jan 06 15:18:46 2022

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.12

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.12

BRUKL compliance check version: v5.6.a.1

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	12.3
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	12.3
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	12.1
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	Surface where the maximum value occurs*
Wall**	0.35	0.16	0.16	RM000002:Surf[9]
Floor	0.25	0.13	0.13	RM000002:Surf[10]
Roof	0.25	-	-	UNKNOWN
Windows***, roof windows, and rooflights	2.2	1.4	1.4	RM000002:Surf[0]
Personnel doors	2.2	1.39	1.39	RM000002:Surf[17]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]
U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	3

Page 1 of 6

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	268.7	268.7
External area [m²]	454	454
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	170.65	191.57
Average U-value [W/m²K]	0.38	0.42
Alpha value* [%]	10	10

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
100	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	4.19	5.74
Cooling	1.99	3.03
Auxiliary	7.39	2.95
Lighting	5.87	9.58
Hot water	4.41	4.85
Equipment*	4.72	4.72
TOTAL**	**23.85**	**26.15**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	81.15	94.23
Primary energy* [kWh/m²]	71.37	69.1
Total emissions [kg/m²]	12.1	12.3

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

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BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name **Shell and Core**

O2 Finchley N4 Workspace - Be Lean

As designed

Date: Thu Jan 06 15:29:18 2022

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.12

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.12

BRUKL compliance check version: v5.6.a.1

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	16.8
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	16.8
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	14.8
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	Surface where the maximum value occurs*
Wall**	0.35	0.16	0.16	00000003:Surf[3]
Floor	0.25	0.13	0.13	00000003:Surf[9]
Roof	0.25	-	-	UNKNOWN
Windows***, roof windows, and rooflights	2.2	1.4	1.4	00000003:Surf[0]
Personnel doors	2.2	1.39	1.39	00000003:Surf[4]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]
U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
m³/(h.m²) at 50 Pa	10	3

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Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	158	158
External area [m²]	287.8	287.8
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	5
Average conductance [W/K]	143.58	130.85
Average U-value [W/m²K]	0.5	0.45
Alpha value* [%]	10	10

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
100	**B1 Offices and Workshop businesses**
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	25.51	20.02
Cooling	3.39	4.38
Auxiliary	5.23	2.08
Lighting	8.43	16.8
Hot water	3.17	3.17
Equipment*	42.19	42.19
TOTAL**	**45.74**	**46.46**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	132.19	121.93
Primary energy* [kWh/m²]	86.04	97.96
Total emissions [kg/m²]	14.8	16.8

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

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BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name **Shell and Core**

O2 Finchley N4 Workspace - Be Green

As designed

Date: Thu Jan 06 15:23:27 2022

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.12

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.12

BRUKL compliance check version: v5.6.a.1

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	16.2
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	16.2
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	13.4
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.16	0.16	00000003:Surf[3]
Floor	0.25	0.13	0.13	00000003:Surf[9]
Roof	0.25	-	-	UNKNOWN
Windows***, roof windows, and rooflights	2.2	1.4	1.4	00000003:Surf[0]
Personnel doors	2.2	1.39	1.39	00000003:Surf[4]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	3

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Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	158	158
External area [m²]	287.8	287.8
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	5
Average conductance [W/K]	143.58	130.85
Average U-value [W/m²K]	0.5	0.45
Alpha value* [%]	10	10

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
100	**B1 Offices and Workshop businesses**
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	6.63	6.75
Cooling	3.39	4.38
Auxiliary	5.23	2.08
Lighting	8.43	16.8
Hot water	2.89	3.17
Equipment*	42.19	42.19
TOTAL**	**26.58**	**33.19**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	132.19	121.93
Primary energy* [kWh/m²]	79.55	93.35
Total emissions [kg/m²]	13.4	16.2

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

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BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name **Shell and Core**

O2 Finchley N5 Food & Drink - Be Lean

As designed

Date: Thu Jan 06 15:07:06 2022

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.12

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.12

BRUKL compliance check version: v5.6.a.1

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	45
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	45
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	43.5
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.16	0.16	00000009:Surf[13]
Floor	0.25	0.13	0.13	00000009:Surf[31]
Roof	0.25	0.1	0.1	00000009:Surf[32]
Windows***, roof windows, and rooflights	2.2	1.4	1.4	00000009:Surf[0]
Personnel doors	2.2	1.39	1.39	00000009:Surf[12]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
m³/(h.m²) at 50 Pa	10	3

Page 1 of 6

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	140.4	140.4
External area [m²]	293.9	293.9
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	5
Average conductance [W/K]	127.39	136.19
Average U-value [W/m²K]	0.43	0.46
Alpha value* [%]	10	10

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
100	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	17.34	15.05
Cooling	3.98	6.67
Auxiliary	9.63	3.84
Lighting	5.27	12.35
Hot water	139.81	139.81
Equipment*	61.61	61.61
TOTAL**	**176.03**	**177.71**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	114.66	137.71
Primary energy* [kWh/m²]	248.23	257.35
Total emissions [kg/m²]	43.5	45

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

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BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name **Shell and Core**

O2 Finchley N5 Food & Drink - Be Green

As designed

Date: Thu Jan 06 20:09:01 2022

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.12

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.12

BRUKL compliance check version: v5.6.a.1

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

The building does not comply with England Building Regulations Part L 2013

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	38
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	38
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	45.7
Are emissions from the building less than or equal to the target?	BER > TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.16	0.16	00000009:Surf[13]
Floor	0.25	0.13	0.13	00000009:Surf[31]
Roof	0.25	0.1	0.1	00000009:Surf[32]
Windows***, roof windows, and rooflights	2.2	1.4	1.4	00000009:Surf[0]
Personnel doors	2.2	1.39	1.39	00000009:Surf[12]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	3

Page 1 of 6

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	140.4	140.4
External area [m²]	293.9	293.9
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	5
Average conductance [W/K]	127.39	136.19
Average U-value [W/m²K]	0.43	0.46
Alpha value* [%]	10	10

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
100	**A1/A2 Retail/Financial and Professional services**
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	4.51	5.07
Cooling	3.98	6.67
Auxiliary	9.63	3.84
Lighting	5.27	12.35
Hot water	66.96	47.12
Equipment*	61.61	61.61
TOTAL**	**90.35**	**75.05**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	114.66	137.71
Primary energy* [kWh/m²]	270.44	224.65
Total emissions [kg/m²]	45.7	38

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

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Appendix H: GLA energy reporting tool summary.

SAP 2012 Performance

Domestic

Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	932.4	902.0
After energy demand reduction (be lean)	845.4	902.0
After heat network connection (be clean)	845.4	902.0
After renewable energy (be green)	590.4	902.0

Table 2: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for domestic buildings

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean: savings from energy demand reduction	87.0	9%
Be clean: savings from heat network	0.0	0%
Be green: savings from renewable energy	255.0	27%
Cumulative on site savings	**342.0**	**37%**
Annual savings from off-set payment	590.4	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**17,711**	-
Cash in-lieu contribution (£)	**1,682,590**	

*carbon price is based on GLA recommended price of £95 per tonne of carbon dioxide unless Local Planning Authority price is inputted in the 'Development Information' tab

Non-domestic

Table 3: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for non-domestic buildings

	Carbon Dioxide Emissions for non-domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	73.6	25.0
After energy demand reduction (be lean)	58.3	25.0
After heat network connection (be clean)	58.3	25.0
After renewable energy (be green)	57.0	25.0

Table 4: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for non-domestic buildings

	Regulated non-domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean: savings from energy demand reduction	15.3	21%
Be clean: savings from heat network	0.0	0%
Be green: savings from renewable energy	1.2	2%
Total Cumulative Savings	**16.5**	**22%**
Annual savings from off-set payment	57.0	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**1,711**	-
Cash in-lieu contribution (£)	**162,522**	

*carbon price is based on GLA recommended price of £95 per tonne of carbon dioxide unless Local Planning Authority price is inputted in the 'Development Information' tab

SAP 10.0 Performance

Domestic

Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	823.6	405.0
After energy demand reduction (be lean)	717.9	405.0
After heat network connection (be clean)	717.9	405.0
After renewable energy (be green)	265.0	405.0

Table 2: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for domestic buildings

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean: Savings from energy demand reduction	105.8	13%
Be clean: Savings from heat network	0.0	0%
Be green: Savings from renewable energy	452.8	55%
Cumulative on site savings	**558.6**	**68%**
Annual savings from off-set payment	265.0	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**7,951**	-
Cash in-lieu contribution (£)	**755,382**	

*carbon price is based on GLA recommended price of £95 per tonne of carbon dioxide unless Local Planning Authority price is inputted in the 'Development Information' tab

Non-domestic

Table 3: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for non-domestic buildings

	Carbon Dioxide Emissions for non-domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	39.1	11.0
After energy demand reduction (be lean)	32.4	11.0
After heat network connection (be clean)	32.4	11.0
After renewable energy (be green)	25.6	11.0

Table 4: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for non-domestic buildings

	Regulated non-domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean: savings from energy demand reduction	6.8	17%
Be clean: savings from heat network	0.0	0%
Be green: savings from renewable energy	6.8	17%
Total Cumulative Savings	**13.5**	**35%**
Annual savings from off-set payment	25.6	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**768**	-
Cash in-lieu contribution (£)*	**72,963**	

*carbon price is based on GLA recommended price of £95 per tonne of carbon dioxide unless Local Planning Authority price is inputted in the 'Development Information' tab

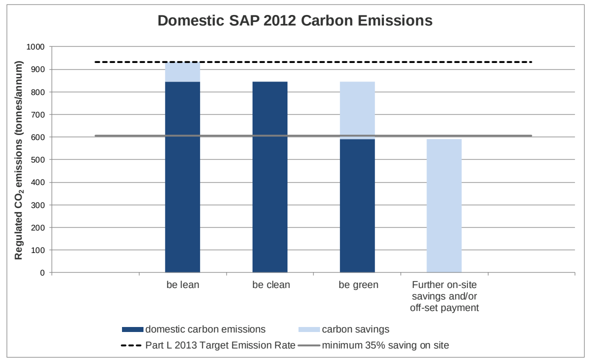
SITE-WIDE

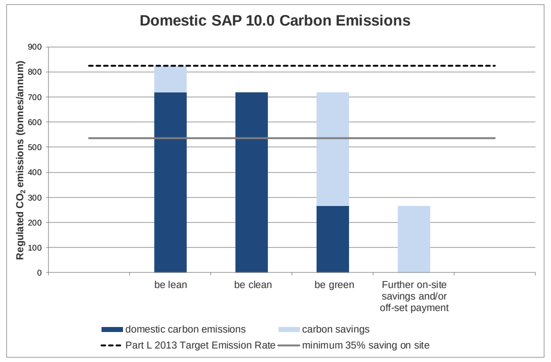
	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2013 baseline	1,005.9		
Be lean	903.7	102.3	10%
Be clean	903.7	0.0	0%
Be green	647.4	256.2	25%
Total Savings	-	358.5	36%
	-	CO_2 savings off-set (Tonnes CO_2)	-
Off-set	-	**19,422.2**	-

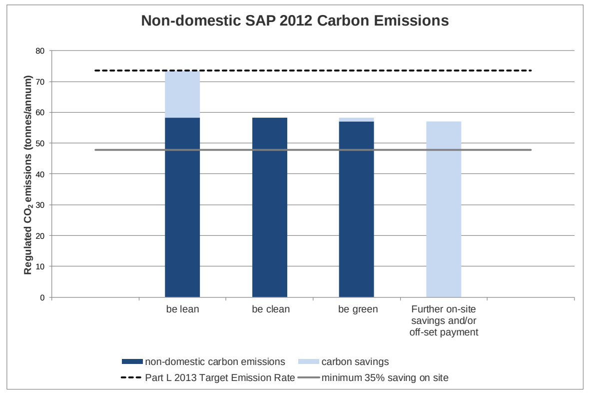
	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2013 baseline	862.8		
Be lean	750.3	112.5	13%
Be clean	750.3	0.0	0%
Be green	290.6	459.6	53%
Total Savings	-	572.1	66%
	-	CO_2 savings off-set (Tonnes CO_2)	-
Off-set	-	**8,719.4**	-

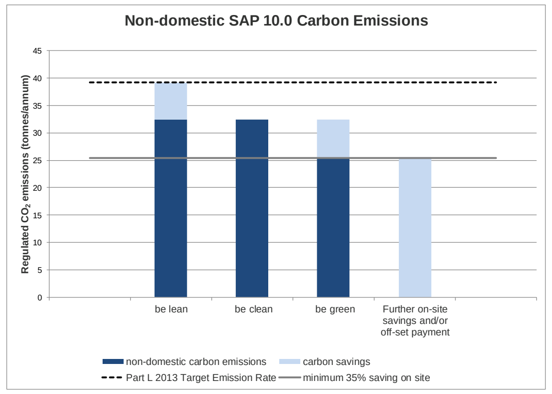
	Target Fabric Energy Efficiency (kWh/m²)	Dwelling Fabric Energy Efficiency (kWh/m²)	Improvement (%)
Development total	42.42	36.90	13%

	Area weighted non-domestic cooling demand (MJ/m^2)	Total area weighted non-domestic cooling demand (MJ/year)
Actual	48.25897887	109644.4
Notional	45.43635563	103231.4









Appendix I: Indicative spatial provision for future heat network.

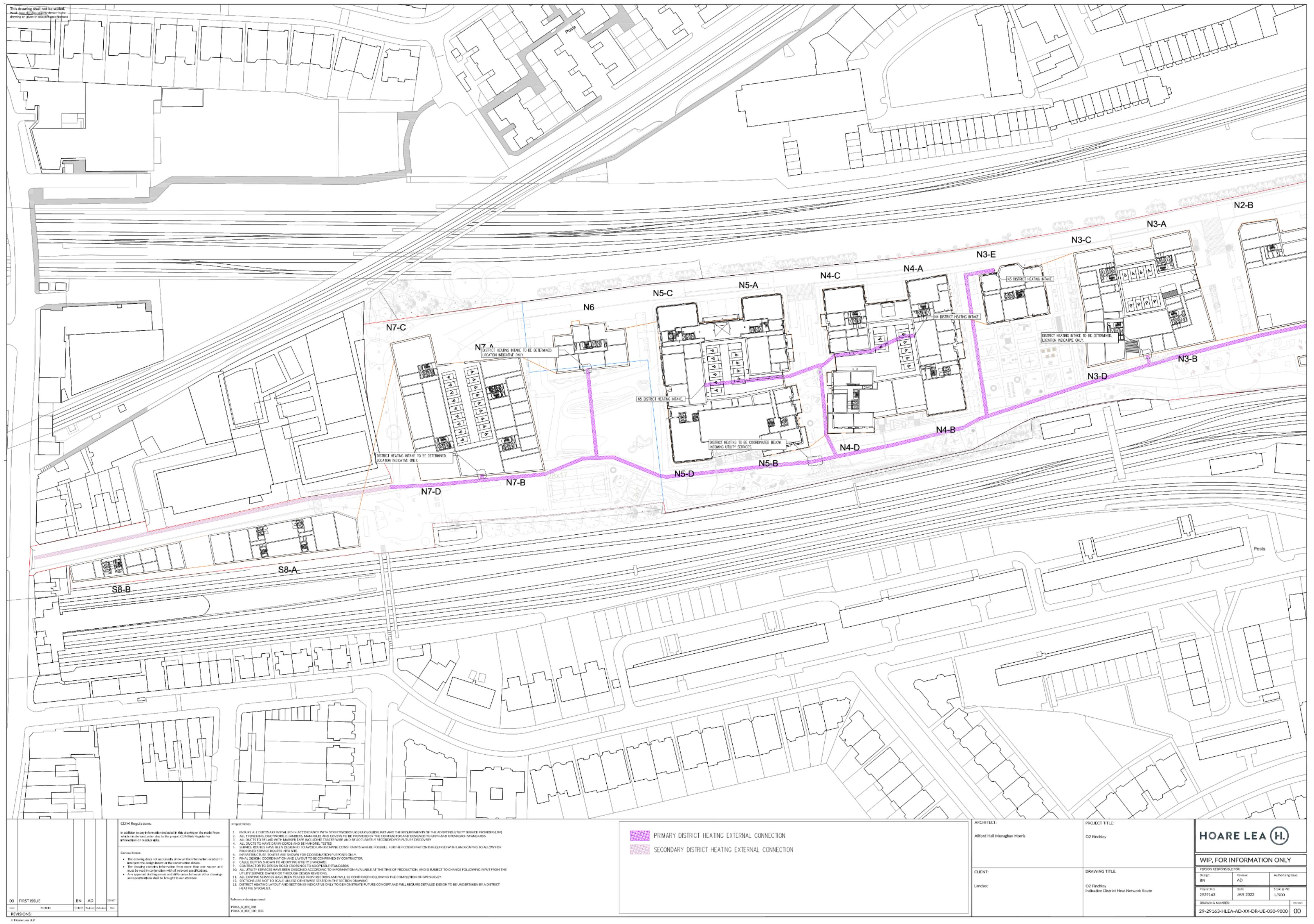


Figure 23: Indicative spatial provision for future connection to a potential low carbon district heat networks (East). Illustrative spatial provision subject to final coordination.

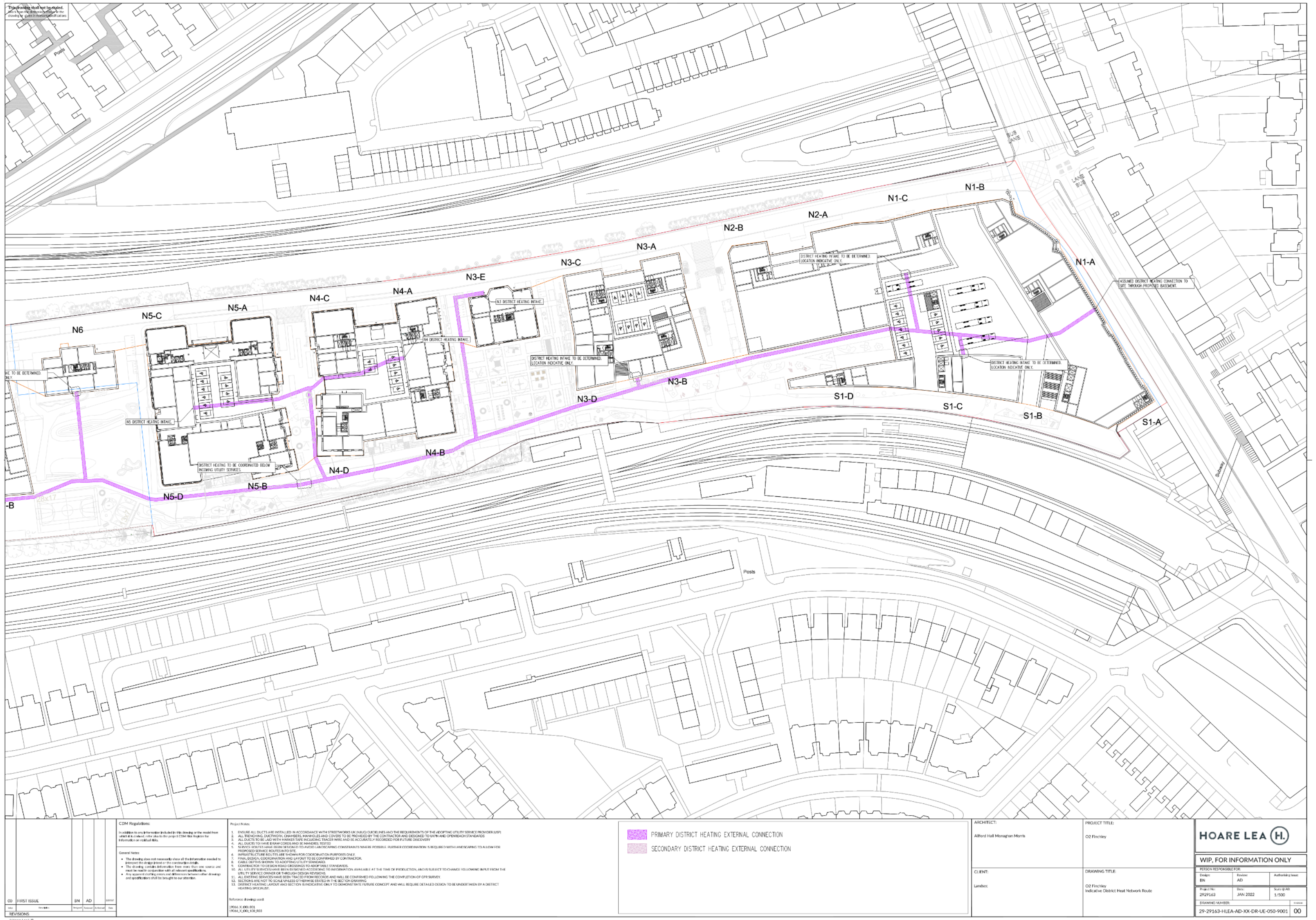


Figure 24: Indicative spatial provision for future connection to a potential low carbon district heat networks (West). Illustrative spatial provision subject to final coordination.

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