Former Holloway Prison

Sustainable Design and Construction Statement

Peabody

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Islington, London.
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SUSTAINABILITY
SUSTAINABLE DESIGN & CONSTRUCTION STATEMENT

REVISION 1 – 29 OCTOBER 2021

Audit sheet.

Rev.	Date	Description of change / purpose of issue	Prepared	Reviewed	Authorised
0	11/10/2021	First draft for comment	LH/AB	JD	RE
1	29/10/2021	Issue for planning submission	LH/AB	JD	RE

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Introduction

The proposed development consists of the phased comprehensive redevelopment including demolition of existing structures; site preparation and enabling works; and the construction of 985 residential homes including 60 extra care homes (Use Class C3), a Women's Building (Use Class F.2) and flexible commercial floorspace (Use Class E) in buildings of up to 14 storeys in height; highways/access works; landscaping; pedestrian and cycle connections, publicly accessible park; car (blue badge) and cycle parking; and other associated works.

The aim of this document is to demonstrate that the Proposed Development meets the highest standard of Sustainable Development and meets the planning policies of the National Planning Policy Framework, the London Plan, and the local policies of the London Borough of Islington (LBI).

Energy Strategy.

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

Further reductions are ensured through the specification of high efficiency building services to limit losses in energy supply, storage, and distribution.

After the inclusion of passive design and energy efficiency measures, various options have been investigated to reduce CO_2 emissions associated with energy supply.

The feasibility of LZC technologies has been investigated in line with the policy aspirations and as part of the Energy Strategy submitted in support of the application. Air source heat pumps and photovoltaic panels will supply a large percentage of energy for the site.

Table 1 Energy Hierarchy site wide results summary.

Be Lean	Be Clean	Be Green
9.8%	9.8%	52.1%

Net Zero Carbon Feasibility

A Net Zero Carbon Feasibility assessment has been undertaken on the development in order to consider the project's ability and options to be defined as Net Zero against the UK Green Building Council (UK-GBC) framework definition to help achieve Net Zero.

Sustainable building standards.

The BREEAM assessment and the potential rating which can be achieved, has been high on the design team agenda during the concept design stages. The Proposed Development is targeting a rating of BREEAM 'Excellent with a targeted score of 77.81% (Flexible commercial space) and 78.31% (Women's Building). As a minimum, the proposed development is expected to achieve a rating of BREEAM 'Excellent' with a baseline score of 70%.

Adaptive design strategy.

The Circular Economy Statement has been completed in support of the planning application, which sets out the strategic approach to Circular Economy implemented by the project. This Circular Economy Statement is focused on the work carried out to define a strategic approach to Circular Economy principles for the project and identify high level strategic opportunities early in the development process.

In line with Peabody's Sustainability aspirations, the following design considerations have been made throughout the initial early-stage design in line with the key Circular Economy principles.

- Conserve resources increase efficiency and source sustainably: The scheme will look at adopting efficient design, demolition, construction process as well as implementing efficient monitoring and management features once in operation.
- Design to eliminate waste (and for ease of maintenance): All spaces throughout the development will be designed with reusability / recoverability / longevity / adaptability / flexibility principles in mind.
- Manage waste sustainably and at the highest value: Key KPI targets will be outlined to the Contractor, informing the team of the appropriate reuse.

Landscape design strategy.

Landscaping has been a key consideration of the design from the on-set, with great consideration on four key principles:

1. Connection to the wider landscape
2. Reduction of cars, and prioritising of people
3. Multi-generational and community focused
4. Use ecology to design spatial types.

These principles underpin the design of the landscape masterplan and all key spaces at the Proposed Development. These principles draw on the uniqueness of the site and its challenges and considers them alongside the ambitions as a modern, highly functioning, and desirable 'home' to many Londoners in the future. Biodiversity is considered in further detail within the submitted Environmental Statement, produced by Avison Young, the Biodiversity Net Gain Assessment, produced by Penny Anderson Associates, and Open Space & Recreation Assessment, incorporating Landscape Design Strategy, produced by Exterior Architecture

Integrated water management and sustainable drainage.

Sustainable water use in the operation of each building will be carefully considered, identifying processes of reducing overall potable water consumption, as well as ensuring appropriate mitigation and management procedures are in place throughout the building life cycle.

In terms of reducing potable water consumption for the scheme, highly efficient sanitaryware will be specified throughout all kitchens, bathrooms, and other water consuming areas. In support of this, water monitoring equipment such as easily accessible sub-meters and/or integral to the plant space, will also be incorporated into the design ensuring building occupants can easily access and monitor overall water usage throughout the building operation. This approach will also assist building users in identifying patterns of change when necessary, as well as reduce costs related to water consumption, and understand the water demand for different building areas and uses.

Drainage and SUDS are considered in further detail in the submitted Flood Risk Assessment & Drainage Report, produced by Waterman and Open Space & Recreation Assessment, incorporating Landscape Design Strategy, produced by Exterior Architecture.

Operational sustainability.

The Proposed Development will include energy monitoring devices to ensure that the major energy consuming systems and functional zones are recorded and monitored. The mechanical and electrical engineers for the project have specified energy meters in line with Part L of the Building Regulations and according to the requirements of the BREEAM Ene 02 credit. The energy meters will connect to the newly installed BMS system. The Proposed Development will be commissioned to ensure all complex building services are operating as designed and will be completed in accordance with Building Regulations, BSRIA and CIBSE guidelines.

Air quality.

As part of the air quality positive approach, an Air Quality Assessment has been undertaken and has been issued to the design team to aid the design of the development, this forms part of the Environmental Statement submitted with the application. The Air Quality Assessment is based on existing air quality data including local monitoring and shows the Site has no specific air quality constraints to residential development, and as such air quality conditions for future users of the proposed Development are expected to be below the air quality objectives. From an air quality perspective, it is expected that the air quality modelling will show that there would be no need for windows to be sealed / mechanical ventilation provided, however this will be determined, as well as the suitability of the Site during the air quality modelling assessment for the planning application.

1. Introduction.

1.1 The Application

This Sustainable Design and Construction Statement is submitted in support of a full planning application for the proposed redevelopment of the former Holloway Prison within the London Borough of Islington (LBI).

1.2 Aim

The aim of this document is to demonstrate that the Proposed Development meets the highest standard of Sustainable Development and meets the planning policies of the National Planning Policy Framework, the London Plan, and the local policies of the London Borough of Islington (LBI).

This document aligns with the reporting framework set out in Policy S2 of LBI's Draft Local Plan (DLP) and Islington Council's Environmental Design SPD.

The following section headings are covered throughout the report.

- Energy Strategy (including the Overheating Assessment and Net Zero Carbon Feasibility Study)
- Whole Life Cycle Carbon Assessment
- Adaptive Design Strategy
- Landscape Design Strategy and Biodiversity
- Climate Change Adaption
- Integrated Water Management and Sustainable Drainage
- Operational Sustainability (including Green Performance Plan)
- Air Quality

1.3 Description of the Development

The proposed development consists of the phased comprehensive redevelopment including demolition of existing structures; site preparation and enabling works; and the construction of 985 residential homes including 60 extra care homes (Use Class C3), a Women's Building (Use Class F.2) and flexible commercial floorspace (Use Class E) in buildings of up to 14 storeys in height; highways/access works; landscaping; pedestrian and cycle connections, publicly accessible park; car (blue badge) and cycle parking; and other associated works.

A site image showing the location of the Proposed Development can be found in Figure 1.

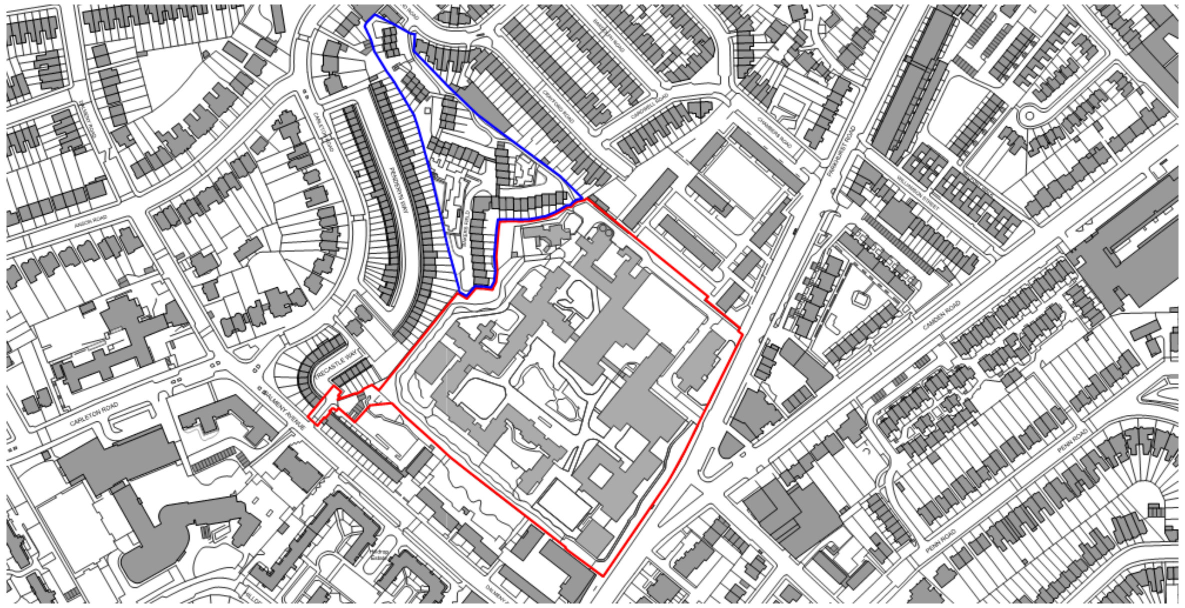

Figure 1 Site Location

The site consists of 5 plots across a total site area of 4.16 ha and the proposed land uses are as follows:

- 985 residential units (Use Class C3). This includes 60 extra care homes (Use Class C3)
- 1,489 sqm (GIA) Women's Building (Use Class F.2)
- 1,822 sqm (GIA) Commercial Floorspace (Use Class E)

A CGI image of the scheme is shown in Figure 2.

Figure 2 Site Image (Credit: AHMM)

2. Energy Statement.

New and redeveloped buildings can make a significant contribution to reducing the consumption of non-renewable energy sources and carbon emissions in the UK. Through designing a building which consumes less energy and by sourcing the energy from renewable or low carbon sources, it is more resilient to future scarcity of fuel supply and will assist in preventing further climate change.

2.1 Introduction

This Energy Statement is submitted in support of a full planning application for the proposed redevelopment of the former Holloway Prison within the London Borough of Islington (LBI).

The site consists of 5 plots across a total site area of 4.16 ha.

2.1.1 The proposed development

The proposed development consists of the phased comprehensive redevelopment including demolition of existing structures; site preparation and enabling works; and the construction of 985 residential homes including 60 extra care homes (Use Class C3), a Women's Building (Use Class F.2) and flexible commercial floorspace (Use Class E) in buildings of up to 14 storeys in height; highways/access works; landscaping; pedestrian and cycle connections, publicly accessible park; car (blue badge) and cycle parking; and other associated works.

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2.1.2 Approach to the strategy

This Energy Statement proposes recommendations regarding the approach to the reducing carbon dioxide (CO_2) emissions and optimising energy efficiency within the development.

This strategy summarises the pertinent regulatory and planning policies applicable to the Proposed Development, and sets targets commensurate with these policies, which the Proposed Development will seek to achieve. The Energy Strategy has been developed using a 'fabric first' approach through the 'Be Lean', 'Be Clean', 'Be Green' energy hierarchy.

Be lean. Use Less Energy.

Be clean. Supply Energy Efficiently.

Be green. Assess Low or Zero Carbon (LZC) Energy Sources.

Be seen. Monitor and report operational energy.

After 'be green' an additional stage of the energy hierarchy has been introduced: Be seen - monitor, verify and report on energy performance in-use. The 'be seen' stage endorses the disclosure of the Proposed Development's energy use with annual energy consumption being displayed on a public online platform accompanied by the predicted energy performance at the design stage.

This approach will demonstrate how developments are performing in-use and will underpin progress in reducing carbon emissions, operational running costs and will encourage the industry's route to achieving zero carbon buildings.

2.1.3 Definitions and limitations

Include the following and further information if required:

Definitions:

The following definitions should be understood throughout this statement:

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

Limitations:

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

2.2 Drivers.

The planning policies applicable to the Proposed Development are outlined within this section.

2.2.1 Greater London Authority (GLA)

2.2.1.1 Overview

The London Plan is the strategic plan for London, setting out an integrated social, economic, and environmental framework for the future development over the next 15-20 years. It provides the London-wide context within which individual boroughs should set their local planning policies and sets the policy framework for the Mayor's involvement in major planning decisions in London.

2.2.1.2 Updated Energy Guidance April 2020

The GLA issued updated Energy Assessment Guidance in April 2020. The guidance confirms that planning applications are encouraged to use SAP 10 carbon factor for grid electricity (0.233 $kgCO_2/kWh$) for all applications referable to GLA, from January 2019.

This corresponds to a 55% reduction in emissions related to grid-supplied electricity compared to the current Part L (2013) carbon factor (0.519 kgCO2/kWh). Any applicants proposing to use the 2013 Part L / SAP 2012 emissions factors will be required to provide justification for this.

In the Energy Assessment Guidance (April 2020) Gas CHP is no longer explicitly mentioned in the second stage of the energy hierarchy (Be Clean) and will not be considered appropriate unless justification can be provided - including demonstration that air quality emission limits are not exceeded. Alternative low carbon heating technologies are expected to be considered in place of CHP.

Applications proposing direct electric strategies (resistance heating) will not normally be approved as they do not offer suitable carbon emissions reductions and can result in high heating bills for occupants.

2.2.1.3 The London Plan (2021)

The Mayor approved a new London Plan in March 2021. The key policy targets in relation to energy within the London Plan include:

Table 2 Carbon Emission Targets for the 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)

2.2.2 Local

Adopted Local Policy - London Borough of Islington (LBI) Core Strategy (2011)

The council has a strategic objective of achieving wider sustainability and adopts policies that will enable it to achieve this objective. LBI's current adopted development plan comprises the Core Strategy (2011) and Development Management Policies DPD (2013), which sets out the following policies in relation to energy:

Table 3 LBI Policy - Adopted

Islington Policy	Summary
CS 10 Sustainable Design	- All developments to demonstrate minimisation of on-site carbon emissions through passive design, energy efficiency and through Low or Zero Carbon technologies. Major developments are to meet 30% reduction in total (regulated and unregulated) CO_2 emissions or 40% if connecting to a decentralised energy network (based upon 2010 Building Regulations) - Promote and develop decentralised energy networks and connecting to existing networks where they exist. - Make financial contribution towards an offset payment if the required emissions reduction cannot be met on site. - Verification of carbon emissions reduction through independently verified sustainable building schemes (BREEAM).
DM 7.1 Sustainable Design and Construction	- Implement renewable energy technologies to contribute to wider policy requirements linked to air quality and general design. - Major developments, minor developments, and extensions of $100m^2$ or greater require the submission of a Sustainable Design and Construction Statement (SDCS) and where relevant and Energy Statement. - Major developments are required to submit a Green Performance Plan to detail measurable outputs for the occupied building, particularly associated with energy consumption, CO_2 emissions and water use.
DM 7.2 Energy Efficiency and Carbon Reduction in Minor Schemes	- Developments are required to achieve best practice energy efficiency standards in terms of design and specification.
DM 7.2 Decentralised Energy Networks	- Major developments are required to connect to available Decentralised Energy Network (DEN) and minor developments should be designed to be able to connect wherever reasonably possible.
DM 7.4 Sustainable Design Standards	- Non-residential major developments are required to achieve BREEAM 'Excellent' and make reasonable endeavours to achieve 'Outstanding'.
DM 7.5 Heating and Cooling	- Developments are required to demonstrate that they maximise opportunities for passive design to control heat gain and deliver passive cooling. The following hierarchy should be considered: Passive design to minimise unwanted heat gain, passive/natural cooling, mixed model cooling with local mechanical ventilation, full building mechanical ventilation with low energy mechanical cooling.

Draft Local Policy - London Borough of Islington (LBI) Local Plan (2019)

The Council is currently preparing a new Local Plan. The Council submitted the Draft Islington Local Plan to the Secretary of State on 12th February 2020 for examination. Examination in Public took place in September to October 2021. Draft LBI Local Plan (DLP) (2019, as modified 2021) sets out the following draft policies in relation to energy:

Table 4 LBI Policy - Draft

Islington Policy	Summary
LBI DLP – Policy S4 Minimising greenhouse gas emissions	- *All development proposals are required to demonstrate how greenhouse gas emissions will be reduced in accordance with the energy hierarchy (set out in Policy S1) as part of the SDCS.* - *All major developments and minor new-build residential developments of one unit or more must be net zero carbon. These developments must demonstrate, as part of the SDCS, how the net zero carbon target will be met within the framework of the energy hierarchy.* - *Major developments must achieve a minimum on-site reduction in total* - *(regulated and unregulated) emissions of at least 27 per cent beyond Part L of the Building Regulations.* - *All major development proposals must calculate whole life-cycle carbon emissions through a nationally recognised whole life-cycle carbon assessment and demonstrate actions taken to reduce life-cycle carbon emissions.* - *Major residential and non-residential development must achieve at least 10 and 15 per cent respectively out of the overall reduction target through energy efficiency measures in order to reduce energy demand.* - *Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall must be provided through a cash in lieu contribution to Islington's carbon offset fund.* - *Major developments must submit a Green Performance Plan (GPP) detailing the actual measurable outputs for the occupied building in*

Islington Policy	Summary
	relation to energy consumption and carbon emissions, based on the commitments in the SDCS. - *An assessment of predicted future energy use based on PHPP for residential and low energy non-domestic buildings; and CIBSE TM54 for non-domestic buildings (or any equivalent methodology), rather than Part L only assessments. Predicted energy use must be declared in kWh/m2/yr. and kWh/yr. and this will become one of the GPP indicator targets in the future.*
LBI DLP – Policy S5 Energy infrastructure	- *All major developments are required to have a communal low-temperature heating system.* - *As part of the SDCS, all major developments must demonstrate that they have assessed the feasibility of heat network connection (including SHN) or other appropriate heat sources, in accordance with the heating hierarchy, in order to ensure low and zero carbon heating options are prioritised.* - *All major residential developments and larger minor new-build residential developments are required to provide an estimate of the anticipated heat unit supply price (£/kWh), annual standing charge and estimated annual maintenance costs of their proposed heating system within the SDCS. Major applications must provide estimates of the life cycle costs of the proposed heating system using CIBSE quoted plant lifetimes.* - *The SDCS should set out a strategy for how the development will be future proofed to achieve zero carbon emissions on-site by 2050.*

2.2.3 Grid decarbonisation

Recent progress in the energy sector has seen emissions associated with electricity consumption reduce drastically, however this is not reflected in the current Building Regulations which were last updated in 2013. Building Regulations are unlikely to be updated before the end of 2021, increasing the gap between compliance and reality.

The carbon factor for grid-supplied electricity in the current Building Regulations (2013) is 0.519kgCO2/kWh; as can be seen in the graph below, this is a fair reflection of the performance of the grid at that time. However, in response to legally binding targets established in line with the Paris Agreement, significant progress has been made in decarbonising the electricity grid over the past six years.

At the end of 2020, the Department for Business, Energy, and Industrial Strategy (BEIS) reported the carbon factor of electricity as having fallen to 0.159kgCO_2/kWh; a 69% reduction compared to that in Part L, 2013. The consequence of this is a discrepancy between emissions calculated using current building regulations methodology from electrical plant and any technologies which offset grid electricity (such as solar PV) compared to the reality of their performance. This leads to the risk that buildings could be specified with technologies with the objective of reducing CO_2 emissions which, in fact, may not offer any real benefit in practice.

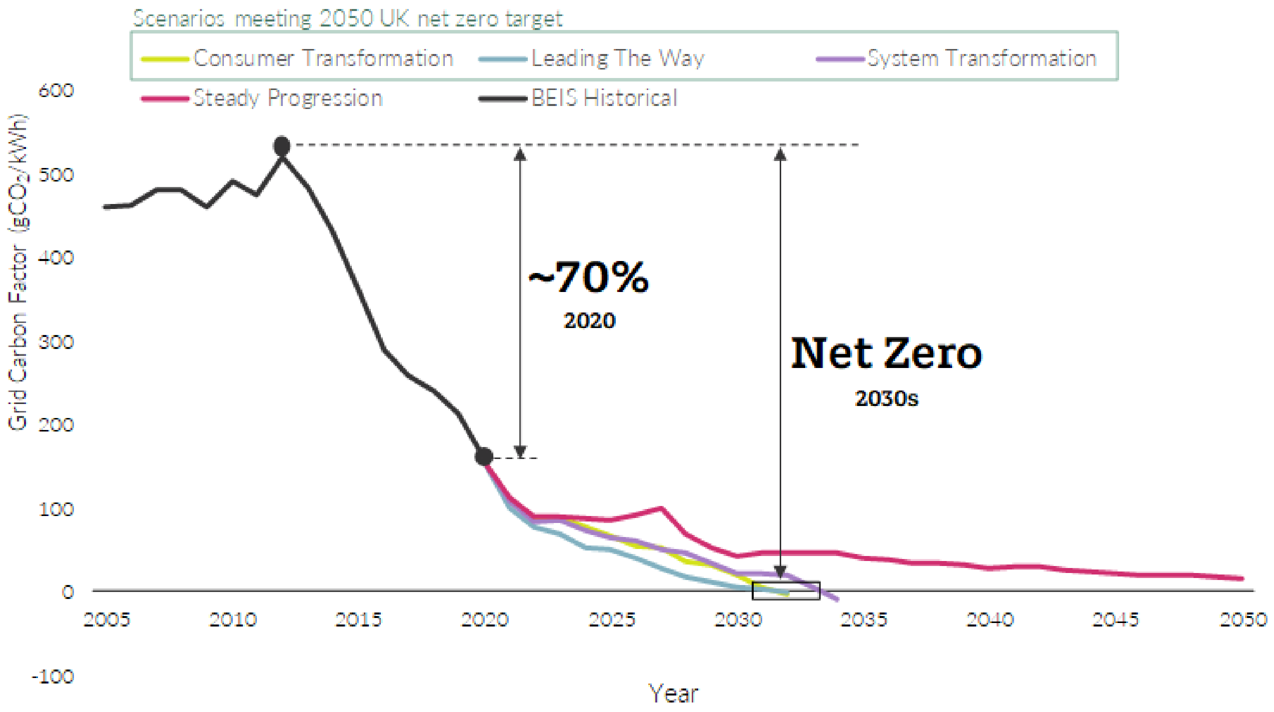

Figure 3 Historic and future projected carbon factor for the National Grid (8% transmission and distribution losses are included).

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2.3 Cooling and overheating.

2.3.1 Cooling hierarchy

The London Plan Policy S14 requests that developments should reduce potential overheating risk and reliance on air conditioning systems. A 'cooling hierarchy' is provided, and the Proposed Development has sought to follow this hierarchy.

The following cooling hierarchy has been followed to limit the effects of heat gains in summer:

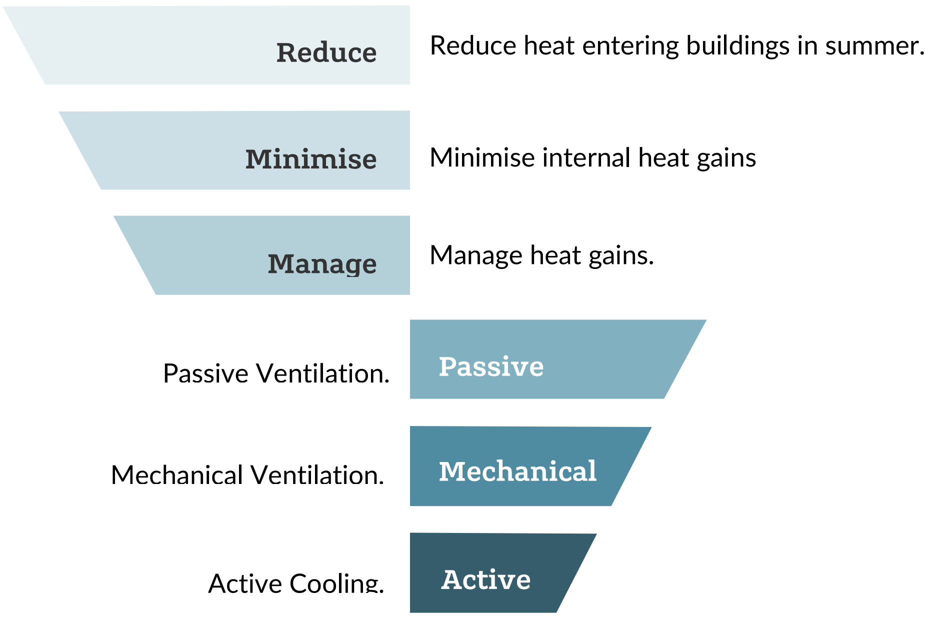


Figure 4 Cooling hierarchy.

2.3.2 Mitigation strategy

Reducing the amount of heat entering the building in summer

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

- Facades have been developed with suitable glazing-to-solid ratios
- Suitable g-values will be specified to further control solar heat gains as required; and
- Solar control blinds will be incorporated.

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 Proposed Development:

- Energy efficient lighting (i.e., LED) with low heat output.
- Insulation to all heating and hot water pipework
- Energy efficient equipment with low heat output to reduce unnecessary heat gain.

Manage heat gains

Opportunities to expose thermal mass to help to further regulate internal temperatures will be explored where possible.

Passive ventilation

The Proposed Development currently allows for passive ventilation via opening windows in all areas of the development allowing occupants the option to make use of natural ventilation to improve thermal comfort in the spaces. However, in response to the acoustician's advice, openings should remain closed on some façades with high external noise levels. In these areas, mechanical ventilation solutions will be proposed.

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.

Mechanical ventilation plant will be located away from pollution sources, typically at roof level. It is anticipated that the design flow rates specified will aid the regulation of internal temperatures in summer months. All areas of the development will be provided with mechanical ventilation with heat recovery (MVHR).

Active cooling

As the final step, active cooling is proposed in the form of tempered air units which work with the MVHR, in order to keep internal temperatures within acceptable limits, for those identified within the overheating risk assessment as at risk.

2.3.3 Part L heat gain check

It is anticipated that the Proposed Development 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.

2.3.4 Overheating risk assessment

The Good Homes Alliance (GHA) Early Stage Overheating Risk Tool was completed earlier in the design process in order to identify potential overheating risk in residential accommodation. This has helped to trigger the incorporation of passive measures within the building envelope and services design to mitigate overheating and reduce cooling demand in line with London Plan Policy SI4. This GHA Tool can be found in Appendix A.

An overheating risk assessment was undertaken on a set of sample dwellings across the whole development. The dwellings selected for the assessment accounted for changes in orientation, glazing ratio, layout, and the external acoustic environment.

The assessment was also based on the closest available weather file, London Heathrow, and also accounted for future projected climate change.

With regards to the external acoustic environment, the acoustician has advised the site is exposed to varying noise levels. Road traffic noise is the primary influencer on the acoustic environment and is most apparent on the south east elevations. Exposure to noise levels reduce with height. For further details on the noise exposure, please refer to the overheating assessment in Appendix B.

All dwellings will be provided with mechanical ventilation with heat recovery. A selection of units which require closed windows will be provided with a tempered air solution.

Full details on the overheating assessment are provided in Appendix B.

2.3.5 Cooling demand reduction

The following table indicates that the actual cooling demand for the non-domestic elements of the development are lower than the notional cooling demand.

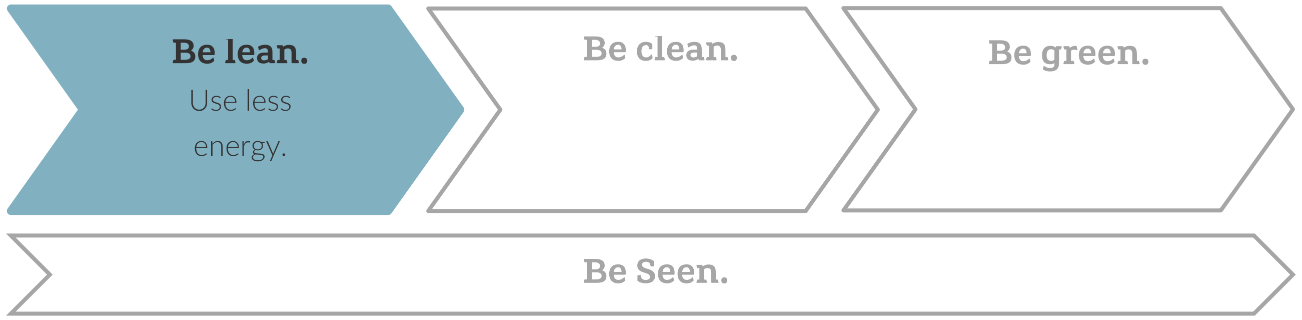
Table 5 Actual cooling demand for the non-domestic elements.

	Cooling Demand (MJ/m^2)	
Space Use	Actual building	Notional Part L Building
Women's Building	48.4	88.3

	Cooling Demand (MJ/m^2)	
Flexible commercial space	88.2	122.1

2.4 Be lean.

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



New efficiency targets in the London Plan (2021):

- Domestic developments should achieve at least a 10 percent improvement on Building Regulations from energy efficiency (be lean).
- Non-domestic developments should achieve at least a 15 percent improvement on Building Regulations from energy efficiency (be lean).

2.4.1 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 Proposed Development. The overriding objective for the façade design of each building will be to achieve the optimum balance between providing natural daylighting benefits to reduce the use of artificial lighting, the provision of passive solar heating to limit the need for space heating in winter and limiting summertime solar gains to reduce space cooling demands.

Thermal Insulation

The Proposed Development will seek to utilise efficient thermal envelopes. 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 and cooling requirement and result in lower energy requirements.

Glazing Energy & Light Transmittance

Elevations 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.

Mechanical ventilation

It is anticipated that high-efficiency mechanical ventilation with heat recovery will be adopted for all building areas.

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 and cooling demand.

To reduce the electrical energy associated with fan usage, plant and systems will be optimised to achieve low specific fan powers.

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.

Water consumption requirements in environmental assessment methods such as BREEAM will be considered further during detailed design stages.

Natural daylight and lighting strategy

In the context of the Women's Building and flexible commercial space, lighting tends to provide a significant contribution to regulated CO$_2$ emissions. As such, the implementation of energy efficiency lighting design is paramount to reducing overall emissions for these spaces. Therefore, it is anticipated that the Proposed Development will be supplied with high efficiency lighting installations representing best practise. Full lighting control systems including daylight linkage and presence detection will also be incorporated.

As well as reduced energy requirement that will be achieved by implementing these strategies, the contribution to the cooling requirements and internal heat gains will be reduced. This will further reduce the total energy requirements and CO$_2$ emissions of each building.

2.5 Passive design and energy efficiency features

Specific passive design and energy efficiency features proposed are detailed below. The parameters below outline the inputs into the calculations at this stage in the design process.

Table 6 Target building fabric performance parameters.

	Domestic	Non-domestic
Exposed Floor U-value (W/m^{2}K)	0.10	0.10
External Wall U-value (W/m^{2}K)	0.13	0.13
Roof U-value (W/m^{2}K)	0.10	0.12
Glazing U-value (W/m^{2}K)	1.20 (g value: 0.35)	1.20 (g-value: 0.30)
Air Permeability (m^3/h.m^2) @ 50Pa	3.00	3.00

2.5.1 Be lean results

The following is an appraisal of the anticipated energy requirements and resultant CO_2 emissions that could arise as a result of the Proposed Development, after the inclusion of the passive design and energy efficiency measures described above.

The results presented below are based on Building Regulations Part L 2013. The SAP calculations are based on a representative sample of dwellings and assessed under Part L1A 2013, while the Women's Building and flexible commercial space have been assessed under Part L2A 2013. Refer to Appendix C for the TER and Be Lean DER outputs for the SAP calculations and the Be Lean BRUKL.

Energy performance

The table below outlines the anticipated annual energy requirement and associated CO_2 emissions by service and space use at the Proposed Development.

Table 7 Total energy demand.

Space Use	Space heating MWh/year	Hot water MWh/year	Lighting MWh/year	Auxiliary MWh/year	Cooling MWh/year	Unregulated electricity MWh/year	Unregulated gas MWh/year
Domestic:	495.2	1355.5	308.6	218.6	0.0	1167.5	0.0
Non-domestic:	29.4	32.0	120.6	28.3	71.2	84.4	0.0
Total:	524.6	1387.5	429.2	246.9	71.2	1251.9	0.0

Be Lean Domestic carbon performance

The table and figure below outline the anticipated domestic CO_2 emissions for the Proposed Development at the Be Lean stage.

Table 8 Be Lean domestic carbon performance and fabric energy efficiency results.

Dwelling Reference	Dwelling emission rate (DER) kg.CO_2/year	Target emission rate (TER) kg.CO_2/year	Percentage variance	Dwelling fabric energy efficiency (DFEE) kWh/year	Target fabric energy efficiency (TFEE) kWh/year	Percentage variance
Area-weighted average:	14.3	15.9	10.1%	42.3	48.5	12.7%

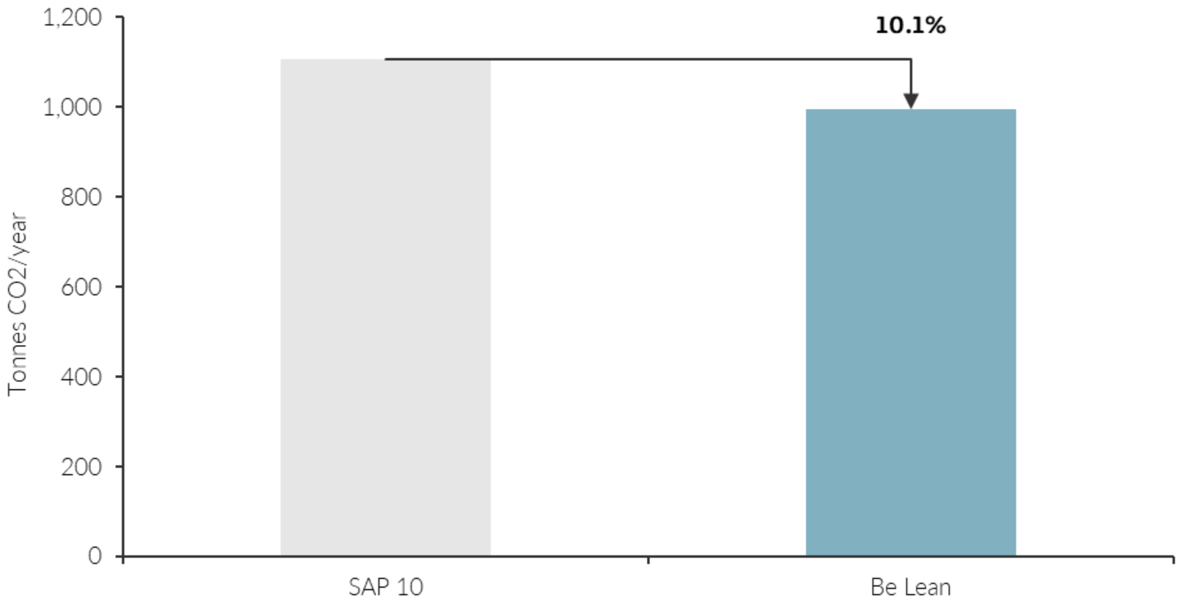


Figure 5 Be lean domestic reduction

Be Lean Non-domestic carbon performance

The following table outlines the anticipated non-domestic CO_2 emissions for the Proposed Development at the Be Lean stage.

Table 9: Be Lean non-domestic carbon performance.

Space reference	Building emission rate (BER) kg.CO_2/year	Target emission rate (TER) kg.CO_2/year	Percentage variance
Total:	13.3	13.9	4.3%

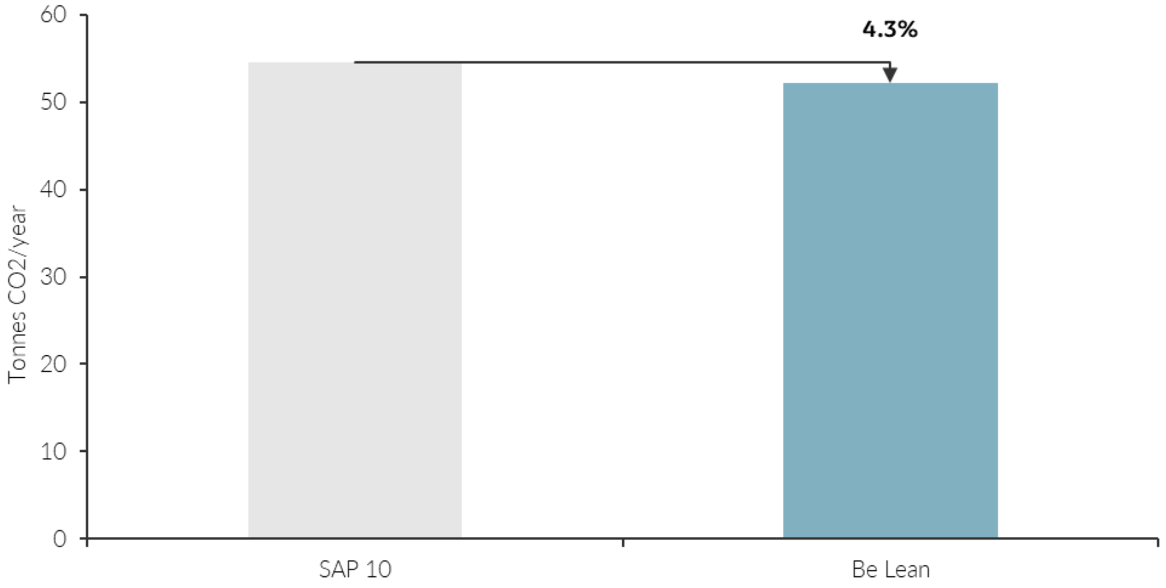


Figure 6 Be lean non-domestic reduction

Site-wide performance

The anticipated regulated CO_2 emissions at the 'Be Lean' stage of the energy hierarchy is determined based on the performance specification outlined in the above section.

The results detailed below for the 'Be Lean' assessment demonstrate the percentage variance against Approved Document Part L1A for the residential dwellings and Approved Document Part L2A for the non-domestic aspects of the Proposed Development.

Table 10 'Be lean' sitewide carbon performance.

Development emission rate:	1,046 tonnes.CO_2/year
Target emission rate:	1,159 tonnes.CO_2/year
Percentage variance:	9.8 %

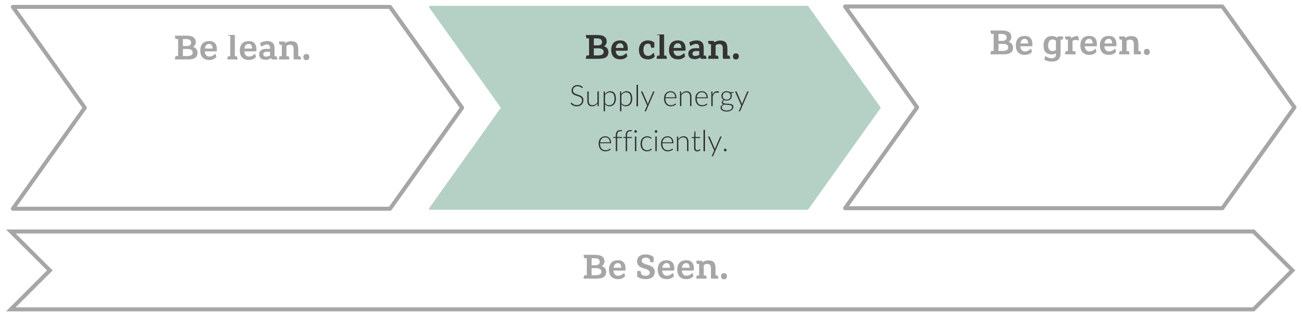
2.5.2 Be lean summary

The results above show that at this stage, the site-wide development demonstrates a 9.8% reduction against the Part L baseline case. This is comprised of a 10.1% reduction for the residential elements and a 4.3% reduction for the non-domestic elements. The domestic elements are compliant with the London Plan target of 10% reduction at Be Lean.

The non-domestic elements fall short of the 15% Be Lean target. This is predominantly due to the Part L methodology for non-domestic buildings and how the notional building is calculated, in some cases unrealistically, especially for auxiliary and DHW. As the heating demand is significantly higher than the cooling demand, the fabric parameters were lowered as much as economically feasible for the development to reduce heat losses, yet only a 4% improvement was achieved, despite the fabric parameters being more than 4% better than the notional fabric parameters. This meant that in order to improve this reduction, the lighting, auxiliary and DHW would need to have unrealistic performances, and this was not an option.

2.6 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.



2.6.1 Be clean: network and technologies

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

Decentralised heat networks

The majority of central London is identified as a Heat Network Priority Area, i.e., areas where heat density is sufficient for heat networks to provide a competitive solution for supplying heat to buildings and consumers. The Proposed Development is located within an area of moderate heat density, as identified by the London Heat Map (http://www.londonheatmap.org.uk).

The nearest existing heat networks to the site are the Shoreditch Heating Network (SHN) district scheme to the south east of the site and also the Bunhill Heating Network (BHN) to the south east of the site and close to the SHN. These networks are 2.1 and 2.2 miles respectively and therefore are not feasible to establish a connection. The London Heat Map highlights these heating networks in Figure 7 below. The nearest proposed heat network is the Euston Road Heating Network (ERHN) which is 1 mile to the south of the site.

Due to the distance of the existing and potential heating networks, a connection to these is not feasible for this scheme. However, future-proofing measures to enable a connection to a future heating district scheme have been considered. It is envisioned that feasibility of such a connection would be reviewed at the end of life of this system when plant replacement options are under consideration. If a heat network had been brought forward at that point, incoming district heating distribution pipework would pass into an intake room, which would house suitable heat exchanger equipment, facilitating a connection to the building heating systems.

Therefore, suitable measures are proposed in order to safeguard a future connection to any external low carbon district heating network should they become available (subject to detailed technical, practical, and economic feasibility evaluation). Refer to Appendix D for the plant room layout.

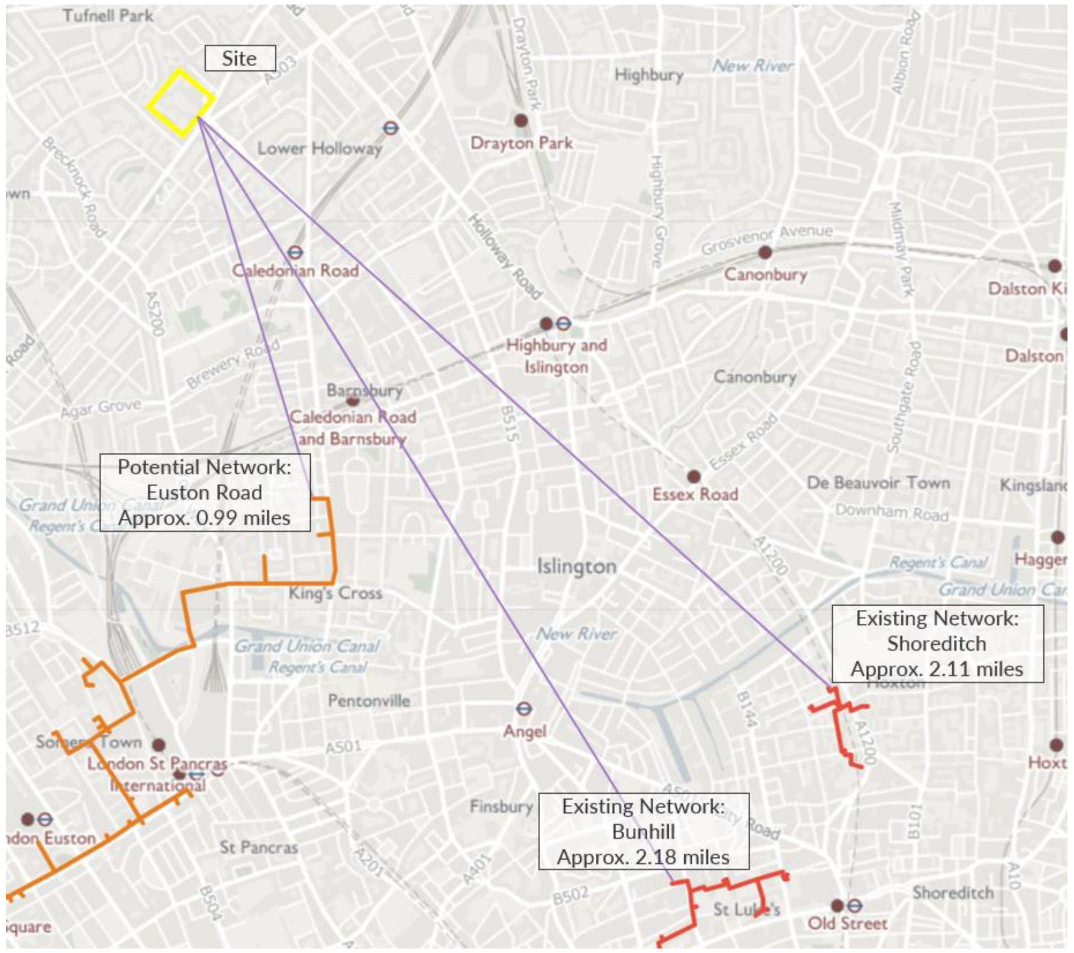


Figure 7 Extract from the London Heat Map

Shared heat networks
In response to LBI Development Management Policy DM7.3 and Draft Local Plan Policy S5, the design team have reviewed a series of local sites with regard to the provision of a Shared Heating Network (SHN). The document produced as a result of these discussions can be found in Appendix E.

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 Proposed Development leads to a net increase in carbon emissions (over the gas boiler baseline).

Furthermore, 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.

2.6.2 Be clean summary

No connection opportunities to existing district heating networks in the vicinity of the Site have been identified.

Opportunities for future connection to any low carbon district heating network (subject to detailed technical, practical, and economic feasibility evaluation) have been considered, and future-proofing measures proposed. 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.

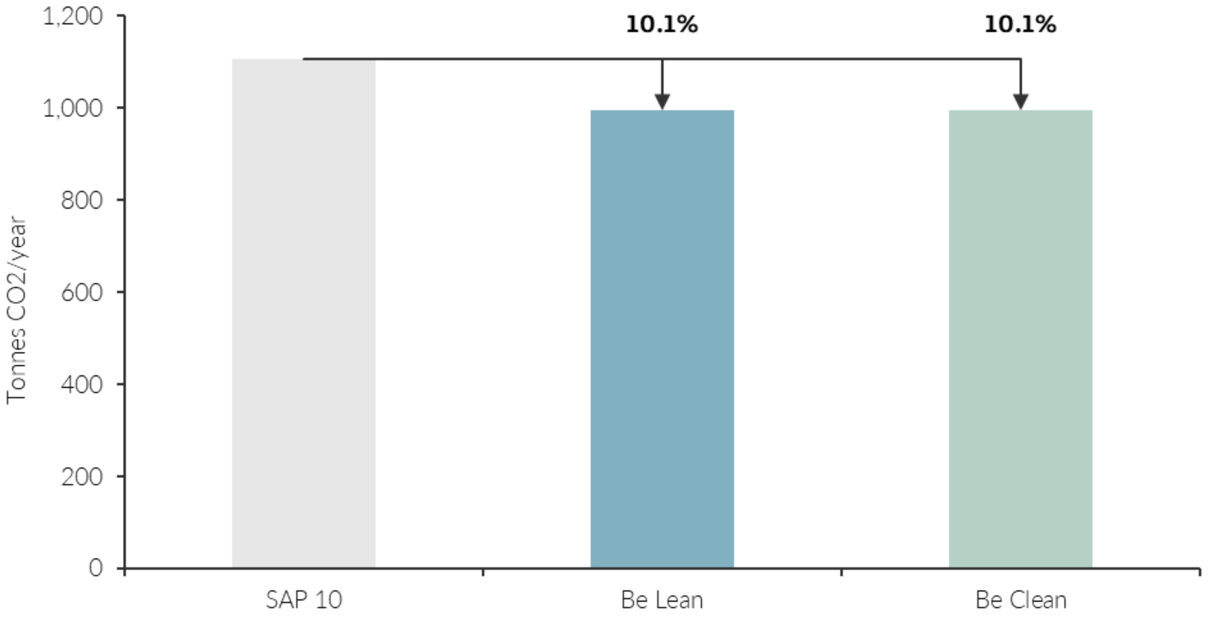


Figure 8 Be clean domestic reduction

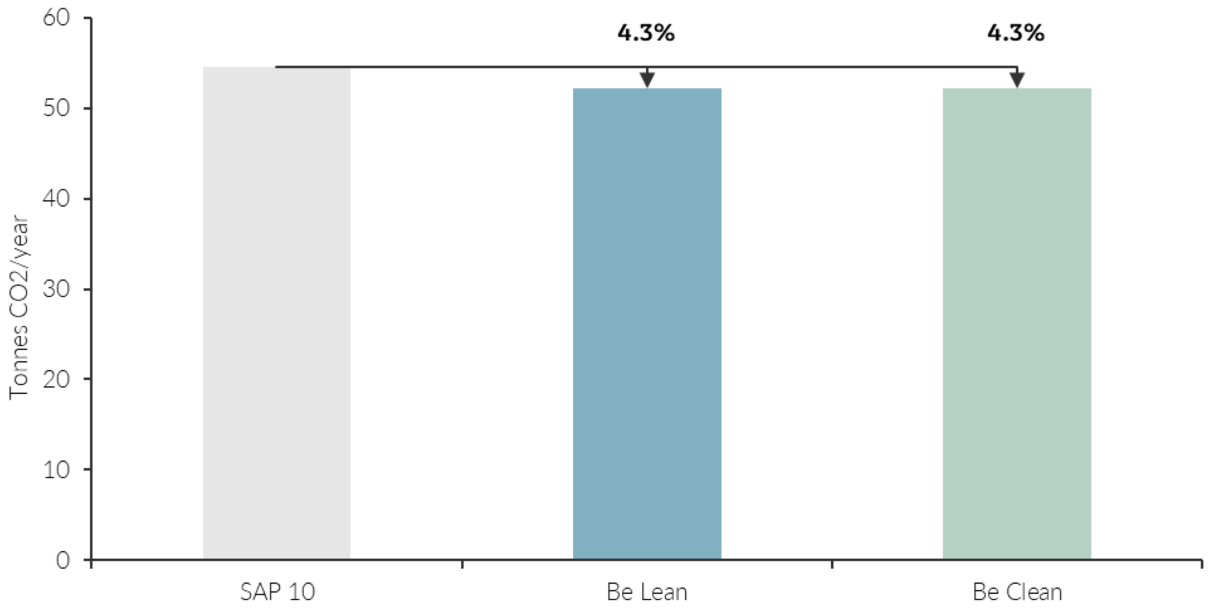
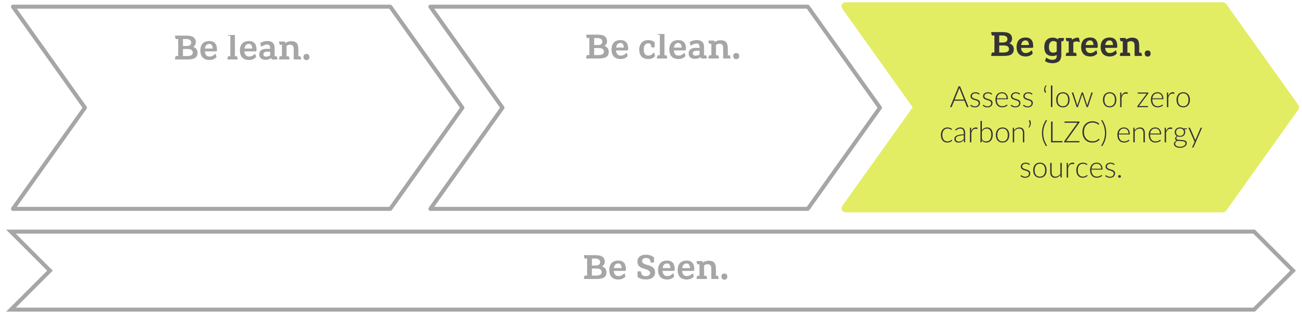


Figure 9 Be clean non-domestic reduction

2.7 Be green.

The final step of the energy hierarchy explores the feasibility of Low and Zero Carbon (LZC) technologies to allow for the production of renewable energy onsite in order to deliver further reduction in carbon emissions.



2.7.1 Low and zero carbon (LZC) technology assessment

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

Ground source heat pumps
Ground Source systems work to extract heat or cooling energy from the ground. They are generally slightly more efficient than air source systems, as the ground temperature is more stable over the course of the year relative to air temperature. 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

Throughout the pre-planning process a number of extensive investigations were undertaken to determine the feasibility of GSHP on the site.

Peabody engaged with both G-Core and Ener-vate in order to appraise the technology fully. These extensive appraisals identified a number of site specific technical and practical challenges associated with both closed and open loop options that preclude the use of GSHP on the development. These are listed below.

- Unbalanced load (i.e., majority residential heating & hot water) will likely have an adverse impact on ground conditions which will degrade network performance over time.
- The Thames Water tunnel runs under the site and would need to be avoided by a considerable margin, which restricts an area of the site from deep piles/works in relation to the installation of GSHP.
- Existing trees which the scheme seeks to retain and their associated root protection area which need to be avoided by any GSHP infrastructure
- All existing foundations would need to be removed, which could lead to further damage to the existing trees and would potentially increase the amount of existing waste materials that then need to be disposed of.
- Significantly increased utility design works to avoid likely co-ordination clashes
- Uncertainty on obtaining a licence from the Environment Agency and the risk that there is no certainty that licences will continue to be issued in the long term future, potentially limiting the overall life span of the technology as part of the scheme
- Abstraction influence on groundwater
- Transmissivity of aquifer
- Long term groundwater elevation
- Requires central Energy Centre of 450m^2 and plant rooms of 200m^2 per block,
- GCore report estimates aquifer extraction rates under 10l/s however the development will require much more than this so further detailed investigation will be required.

For these reasons GSHP is not considered an appropriate technology for the development is therefore not proposed.

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 Proposed Development:

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 has been reviewed in detail, with consideration of the following aspects:

- Over shading
- Terraces
- Area required for access
- Area required for plant (ASHP)

The roof level of every plot has been utilised to provide green and brown roof, photovoltaics, ASHP and areas of resident amenity space. The scheme has sought to maximise the provision of photovoltaics and provides approximately 1500m^2 of PV panels. The proposed roof layout can be seen in Appendix F.

Solar thermal

Solar Thermal Panels are similar to PV Panels in that they harness energy from solar. This technology however converts solar into thermal energy that can offset the demand on hot water generation systems.

Suitability to Proposed Development:

As above, no further roof area is available following the prioritisation of solar PVs, since the electrical output from PV panels will be more suitable for implementation with the heat-pump led Energy Strategy and building energy usage. Therefore, solar thermal is not proposed for the development.

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 Proposed Development:

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 significant regulated CO_2 emission reductions 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.

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. However, as there are no such bodies of water local to site, this technology is not suitable.

Wind turbine

For efficient operation and to yield high energy output, wind turbines require a consistent flow of air. The Proposed Development is located within a dense urban environment therefore the wind flow profile is erratic and consequently, is not conducive to high annual yields.

Suitability to Proposed Development:

Moreover, mounting wind turbines on the roof of the building could result in unacceptable vibration and resonance being felt within occupied spaces. The turbines are also likely to generate noise which may be a nuisance to neighbouring residential properties. This scenario is likely to result in the turbines being switched off.

Therefore, given the complexities of installing this technology, the use of wind turbines is not proposed at the Proposed Development.

Biomass

Biomass boilers burn wood fuel or other bio-fuel sources to generate heat. These boilers can operate at high efficiencies, comparable to condensing gas boilers. However, they require a large fuel store to maintain continuous operation during the winter months. As such, area take for such plant is high.

	Furthermore, fuel deliveries in city-centre locations can prove difficult and security of fuel supply is an important consideration. The reasons listed above alongside high maintenance implications and air quality implications mean that biomass boilers are not considered a suitable technology for the scheme.

2.7.2 Air Source Heat Pump Implementation

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 300-400% (i.e., for every 1kW of electrical energy put into the heat pump, 3kW of useful heating is obtained).

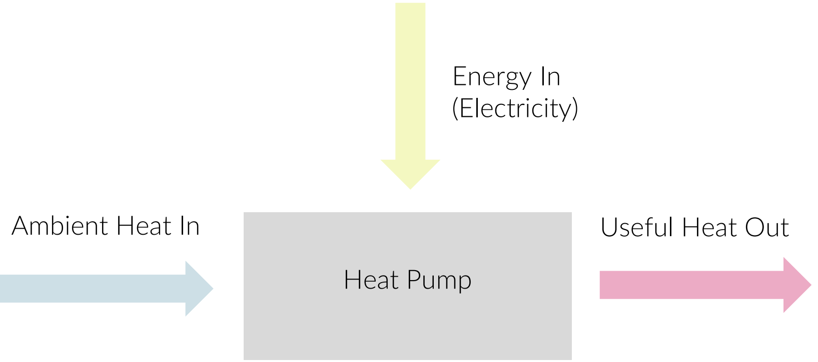


Figure 10 Simplified Heat-pump Schematic

2.7.3 Photovoltaic Panel Incorporation

The Proposed Development will include approximately 1500 sqm of photovoltaic panels, with a total of circa 220 kWp of energy. This reduces the carbon output compared to the ‘gas boiler baseline.

2.7.4 Be Green Domestic carbon performance

The table and figure below outline the anticipated domestic CO_2 emissions for the Proposed Development at the Be Green stage.

Table 11 Be Green domestic carbon performance and fabric energy efficiency results.

	Dwelling emission rate (DER) kg.CO_2/year	Target emission rate (TER) kg.CO_2/year	Percentage variance
Area-weighted average:	7.5	15.9	52.8%

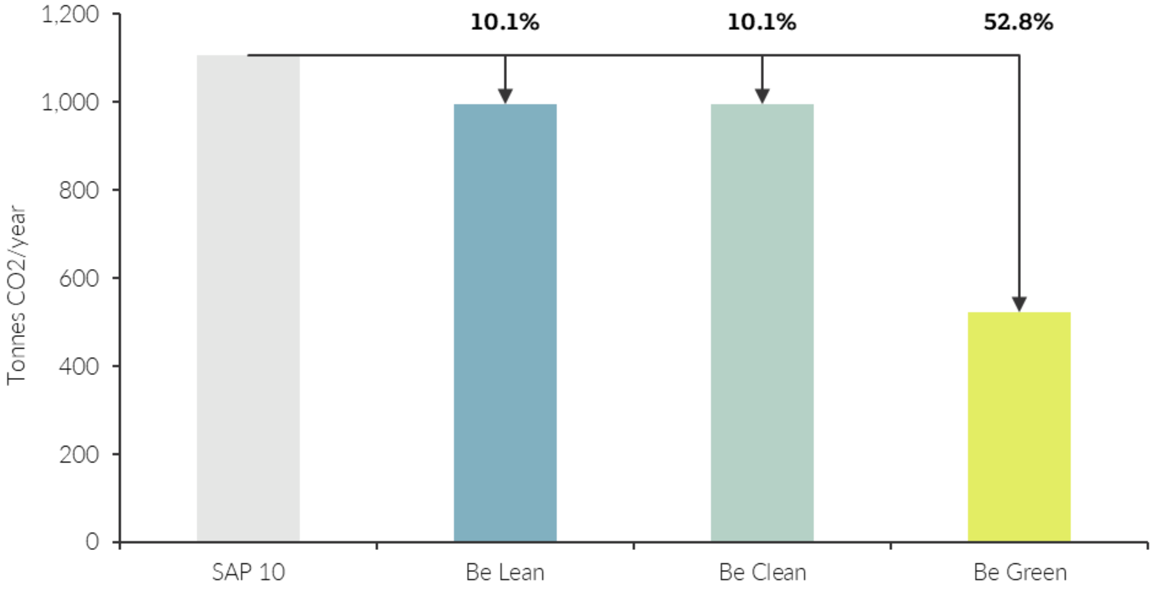


Figure 11 Be green domestic reduction

2.7.5 Be Green Non-domestic carbon performance

The following table outlines the anticipated non-domestic CO_2 emissions for the Proposed Development at the Be Green stage.

Table 12 Be Green non-domestic carbon performance.

Space reference	Building emission rate (BER) kg.CO_2/year	Target emission rate (TER) kg.CO_2/year	Percentage variance
Total:	8.6	13.9	38.1%

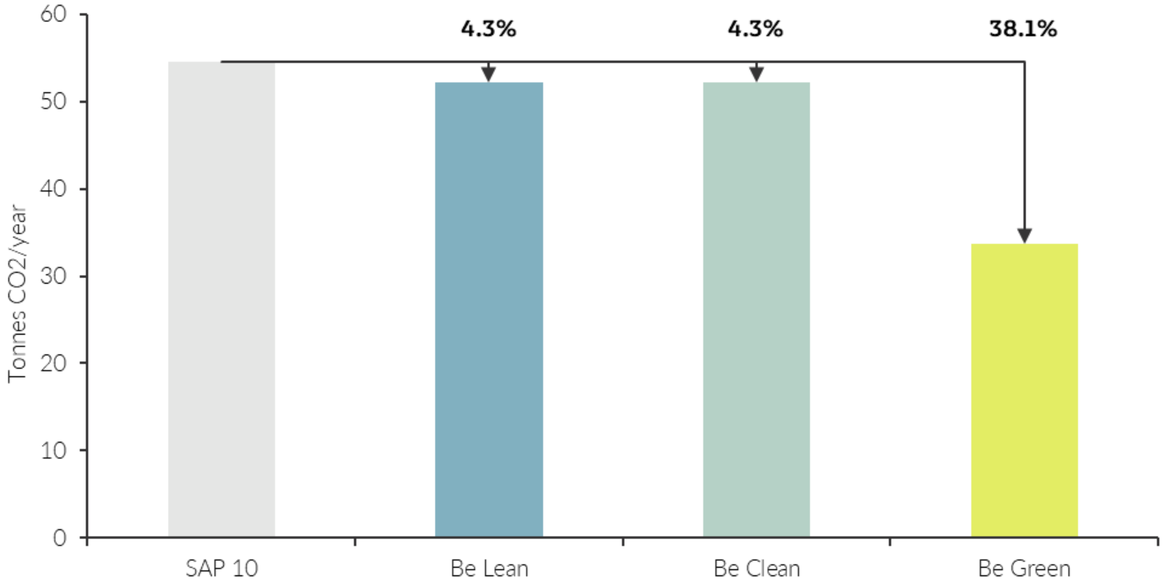


Figure 12 Be Green non-domestic reduction

2.7.6 Assessment summary

The feasibility of on-site renewable energy technologies has been assessed, and Air Source Heat Pumps (ASHP) have been found suitable. ASHP will be implemented to provide space heating, cooling, and a proportion of domestic hot water requirements (the remainder topped up using direct electricity), refer to Appendix G for the site-wide heating network schematics and ASHP datasheet. In addition, remaining roof space will house photovoltaic panels.

The ASHP with PV Energy Strategy is anticipated to result in carbon emission reductions of approximately 52.8% for the domestic elements and 38.1% for the non-domestic elements compared to a Part L 'gas boiler baseline'. Refer to Appendix H for the Be Green SAP outputs and Be Green BRUKL.

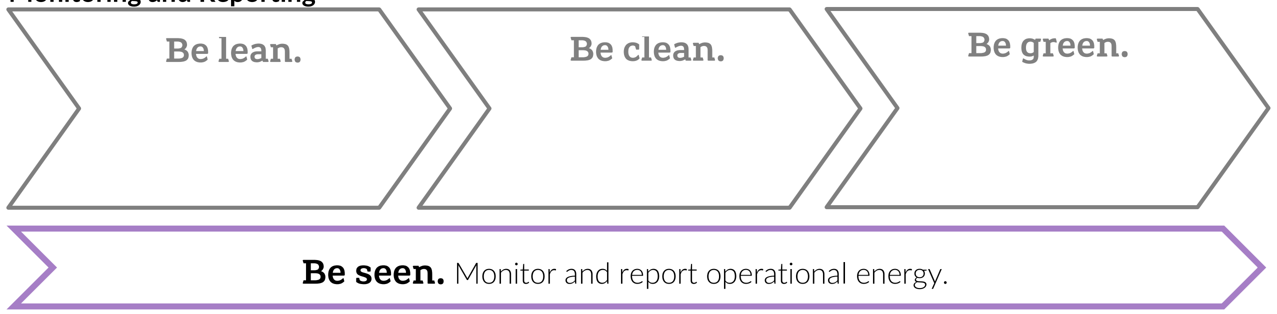
The carbon factor for the heating system will be based on the National Grid carbon factor for electricity of 233 gCO_2/kWh. The estimated costs for ASHP system per building can be seen in the table below. This included the capital costs, running costs (total and per apartment), maintenance costs and life cycle costs.

Table 13 Estimated Costs of ASHP

Option	Description	Estimated Capital Costs	Estimated Annual Running Costs	Estimated Typical Apartment Annual Running Costs	Estimated Annual Maintenance Costs	Estimated Life Cycle Costs
1	Air Source Heat Pumps - Per Building	£12,972,085	£230,000	£232	£42,000	£35,561,214

2.8 Be Seen.

Monitoring and Reporting



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

Sustainability Monitoring and Reporting

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

Development Monitoring and Reporting Plan

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

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

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

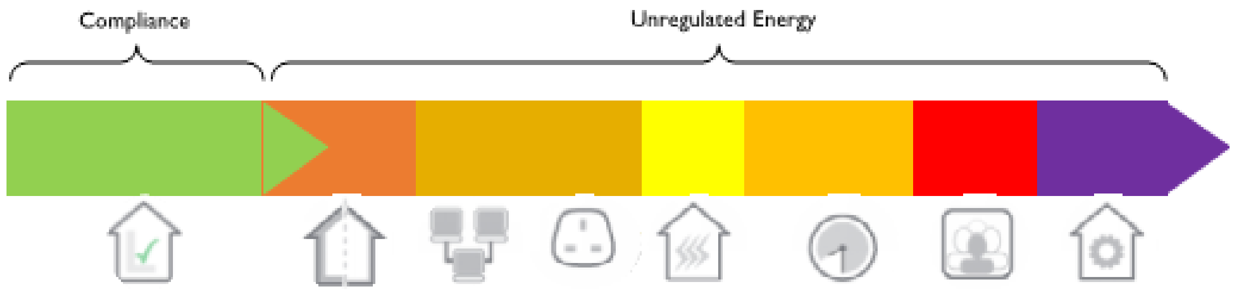
The applicant will also complete the GLA's suggested "Be Seen" energy reporting protocols via the appropriate webs portals once these are available, at the appropriate stage.

Unregulated Energy

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

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

It is therefore foreseeable that energy efficiency and the rising cost of energy would play an increasing role when future building users are deciding which appliances to purchase and the frequency of their use. It is not possible at present to quantify the exact extent of this potential reduction, however, the Net Zero Feasibility study submitted as part of the planning application looked into the small power and unregulated energy more than the Part L assessment and should be consulted on in tandem with this report.



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

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

2.9 Conclusion.

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

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

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

The carbon emissions from regulated energy uses at the Proposed Development have been compared with the GLA London Plan (2021) emissions targets.

2.9.1 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.

Table 14 Energy strategy summary.

Be lean	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 little to no benefit to the proposed development, therefore a heat network and CHP technology has been discounted.
Be green	Utilisation of high efficiency air source heat pump technology further reduces carbon emissions and the incorporation of a $1500m^2$ photovoltaic array offsets the proposed developments energy consumption.

2.9.2 Results

The following provides details in the percentage carbon reduction seen from the baseline case.

Table 15 Carbon reduction breakdown.

	Residential	Non-Residential	Sitewide
Be lean.	10.1% reduction	4.3% reduction	9.8% reduction
Be clean.	0.0% reduction	0.0% reduction	0.0% reduction
Be green.	42.8% reduction	33.8% reduction	42.3% reduction
Total	52.8% reduction	38.1% reduction	52.1% reduction

Through the measures outlined in the Energy Strategy, it is anticipated that overall, approximately 52.1% reduction in CO_2 emissions could be achieved beyond the 'gas boiler baseline', inclusive of all measures. This incorporates a 52.8% reduction for the domestic elements and 38.1% reduction for the non-domestic elements.

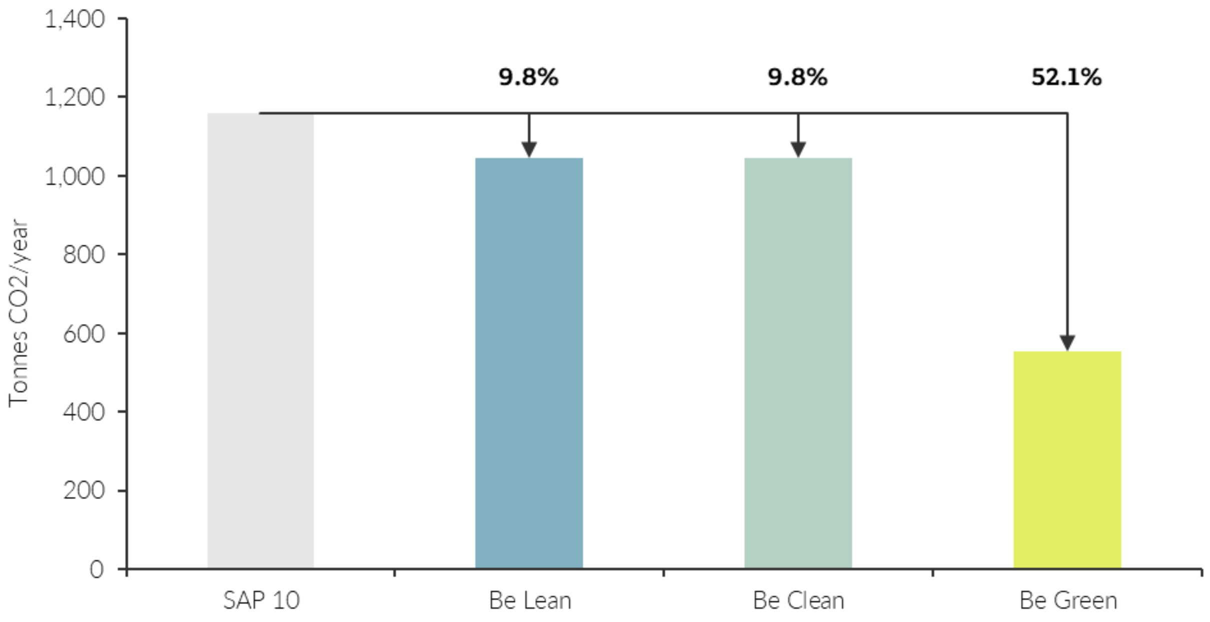


Figure 13 Sitewide regulated carbon reduction per each stage of the energy hierarchy.

2.9.3 Overall Carbon Dioxide Emissions Reduction

The estimated CO_2 emissions reductions are presented below in Table 14 which outlines the anticipated CO_2 emissions reductions. The combined on-site savings falls short of the London Plan zero carbon target and therefore an offset payment is required. The carbon offset is confirmed in Table 14 and is based on the London Plan price of £95 per tonne over 30 years which is also the charge carried forward into the LBI Draft Local Plan.

Table 16 Overall Carbon Dioxide Emissions Reduction

	Regulated Carbon Dioxide Emission Savings (tonnes CO_2/yr.)	
	Regulated	Unregulated
Baseline: Part L 2013 Building Regulations with SAP 10 carbon factors	1,159	166
After energy demand reduction (Be Lean)	1,046	166
After heat network / CHP (Be Clean)	1,046	166
After renewable energy (Be Green)	555	166
	Regulated domestic carbon dioxide savings	
	(tonnes CO_2/yr.)	(%)
Savings from energy demand reduction	114	9.8%
Savings from heat network / CHP	0	0.0%
Savings from renewable energy	491	42.3%
Cumulative on-site savings	605	52.1%
Total target savings	1,159	
Shortfall	555	47.9%
GLA Offset Payment Rate (£/tCO_2)	£2,850	
Total Offset Payment	£1,581,500	

2.10 Net Zero Carbon Feasibility Assessment.

Alongside the Energy Strategy a Net Zero Carbon Feasibility Assessment has been provided in order to consider the project's ability and options to be defined as Net Zero against the UK Green Building Council (UK-GBC) framework definition to help achieve Net Zero, full details can be found in Appendix I.

2.11 Whole Life Cycle Carbon Assessment.

In addition, a Whole Life Cycle Carbon Assessment has been completed for all Plots (A-E), assessing the carbon emissions resulting from the construction and the use of the building over its entire life, including its demolition and disposal. The full report can be found in Appendix J.

3. Sustainable Building Standards.

Building environmental assessment methodologies and sustainable building standards are an effective way to ensure that a building is designed to be holistically more sustainable. By setting a methodology for assessment which includes a scoring system, design teams are encouraged to improve upon the standard construction requirements of the Building Regulations, leading to a more resource efficient building, and one with a lower environmental and social impact.

3.1 Adopted Policy

Islington Policy	Summary
CS 10 (B) Sustainable Design	- All developments to achieve the highest feasible level of nationally recognised sustainable building standard. For non-domestic buildings, this is the Building Research Establishment's Environmental Assessment Methodology (BREEAM).
DM 7.4 Sustainable Design Standards	- Non-residential major developments are required to achieve BREEAM 'Excellent' and make reasonable endeavours to achieve 'Outstanding'. - Major developments are required to score a minimum number of BREEAM credits on materials and waste. - Developments are to demonstrate how all credits for water efficiency in the relevant BREEAM scheme can be achieved. Where this is not possible 2 credits are required as a minimum.

3.2 Draft Policy

Islington Policy	Summary
LBI DLP – Policy S3 Sustainable design standards	- *Major and minor new-build residential developments must achieve a four-star rating (as a minimum) under the BRE Home Quality Mark scheme.* - *All non-residential and mixed-use developments proposing 500sqm or more net additional floorspace are required to achieve a final (post-construction stage) certified rating of Excellent as part of a fully fitted assessment within BREEAM New Construction 2018 (or equivalent scheme) and must make reasonable endeavours to achieve an Outstanding rating.* - *All developments assessed under BREEAM New Construction 2018 (as required by Part C) and Non-Domestic Refurbishment and Fit-out schemes (as required by Part D) are required to score minimum 'credits'*

3.3 Response

3.3.1 BREEAM

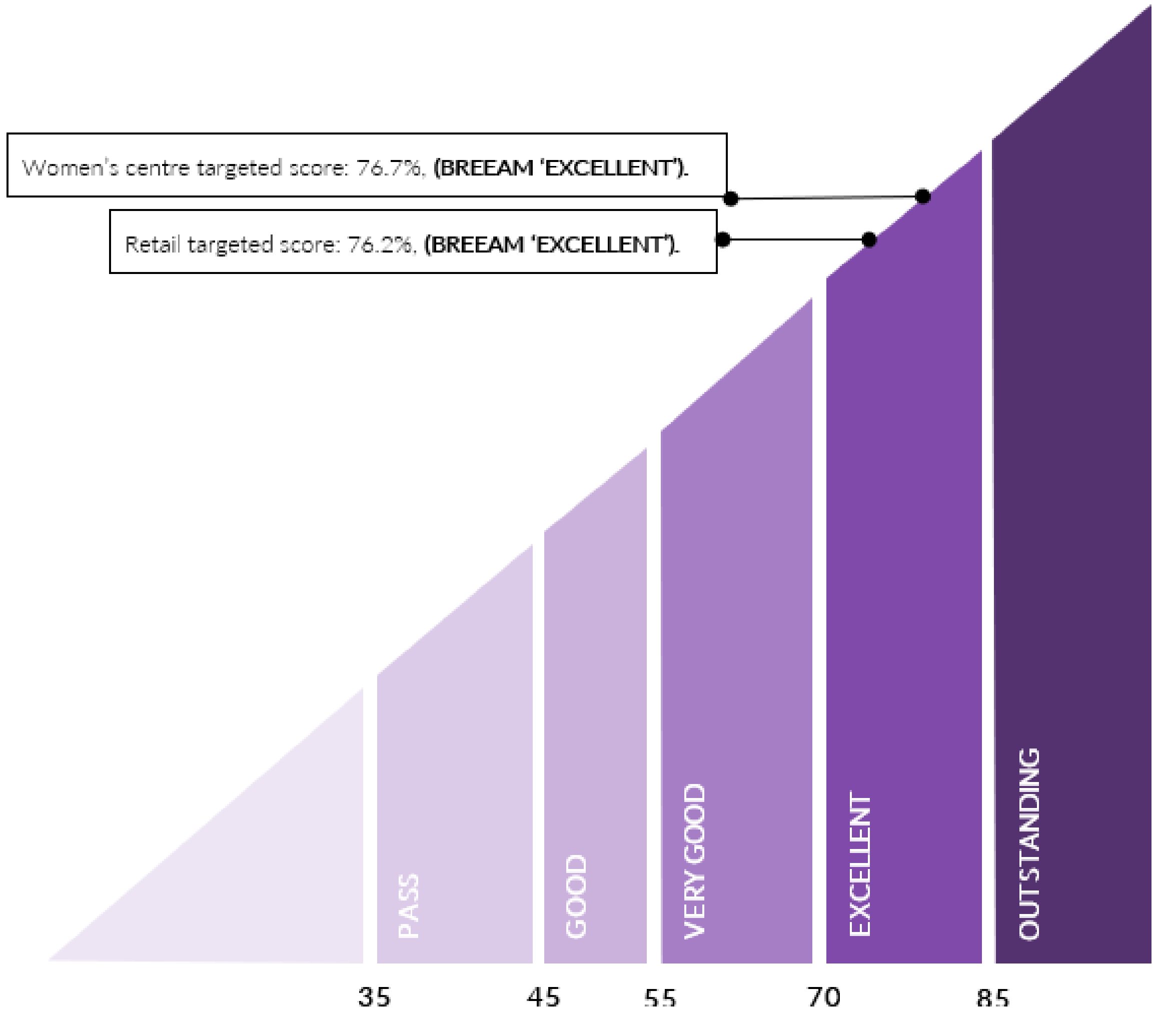
The BREEAM assessment and the potential rating which can be achieved, has been high on the design team agenda during the concept design stages. The Proposed Development is targeting a rating of BREEAM 'Excellent with a targeted score of 76.2% (Retail: Flexible commercial space) and 76.7% (Women's Building). As a minimum, the proposed development is expected to achieve a rating of BREEAM 'Excellent' with a baseline score of 70%.

The assessed areas with align with the BREEAM UK New Construction 2018 (Issue 3.0) Shell Only criteria (equivalent to an MEP shell and core fit out). The scheme will be targeting to achieve BREEAM Excellent in line with London Borough of Islington requirements, as well as Peabody's Sustainability Aspirations.

In line with Draft Local Plan Policy requirement S3 Sustainable Design Standards the following credits have been captured within the initial strategy for the team to incorporate with the design:

- At least 50% of credits on Environmental impacts from construction products (Mat01).
- At least 1 credit on Responsible sourcing of materials (Mat 03), in addition Criterion E(i).
- At least 50% of credits on Construction waste management (Wst 01).
- All credits on Water consumption (Wat 01), or a minimum of 3 credits were rainwater and/or greywater recycling is demonstrated not to be feasible: *Not applicable to design. It will be the incoming tenant's responsibility to ensure all sanitaryware components meet the required 40% improvement above baseline water calculations (Part G) (equivalent to 3 credits).*
- The second credit on energy monitoring (Ene 02 – Sub-metering of high energy load and tenancy areas), where feasible.
- Reasonable endeavours should be made to achieve two credits under the Ene 01exemplary level criteria, in order to demonstrate zero carbon development: and

BREEAM New Construction only - all 4 credits for Energy modelling and reporting as part of Reduction of energy use and carbon emissions (Ene 01).


Women's centre targeted score: 76.7%, **(BREEAM 'EXCELLENT').**

Retail targeted score: 76.2%, **(BREEAM 'EXCELLENT').**

Figure 14 BREEAM 2018 Scale and Anticipated Performance Scores.

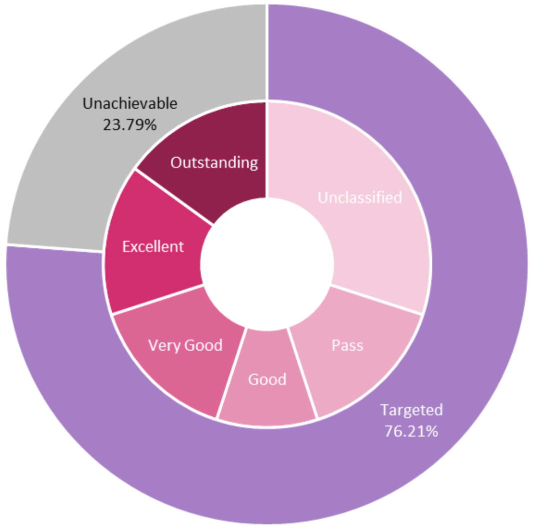


Figure 15 BREEAM Performance Summary and Targeted Credits (Pie Representation) – Flexible commercial space.

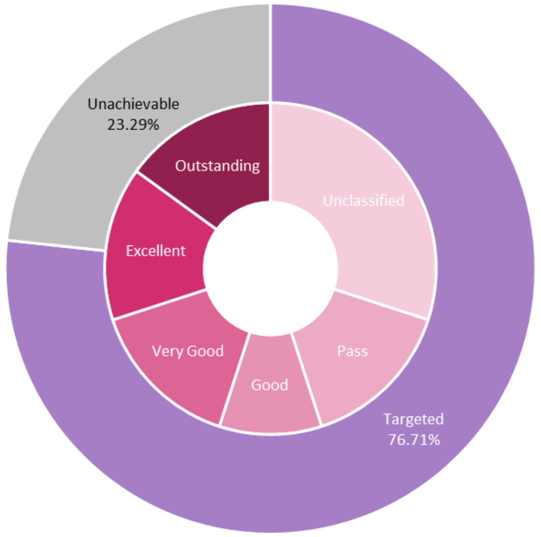


Figure 16 BREEAM Performance Summary and Targeted Credits (Pie Representation) – Women's Building

Table 17 BREEAM Assessment Score

Category	Issue	Flexible commercial space & Women's Building (Other Building Type) Shell Only Assessments	
		Available	Targeted
Management	Man 01: Project brief and design	4	4
	Man 02: Lifecycle cost and service life planning	4	2
	Man 03: Responsible construction practices (M_e), (M_o)	6 (+1)	6 (+1)
	Man 04: Commissioning and handover (M_e), (M_o)	1	1
	Man 05: Aftercare (M_e), (M_o)	N/A	N/A
Health & Wellbeing	Hea 01: Visual comfort	Flexible commercial space: 4 (+1) Women's Building: 3 (+1)	2
	Hea 02: Indoor air quality	N/A	N/A
	Hea 04: Thermal comfort	N/A	N/A
	Hea 05: Acoustic performance	1	1
	Hea 06: Safety	1 (+1)	0
	Hea 07 Safe and healthy surroundings	2	1
Energy	Ene 01: Reduction of energy use and CO_2 emissions (M_e) (M_o)	9	4
	Ene 02: Energy monitoring (M) (M_e) (M_o)	N/A	N/A
	Ene 03: External lighting	1	1
	Ene 04: Low carbon design	3	0
	Ene 05: Energy efficient cold storage	N/A	N/A
	Ene 06: Energy efficient transportation systems	N/A	N/A
	Ene 07 Energy efficient laboratory systems	N/A	N/A
	Ene 08: Energy efficient equipment	N/A	N/A
Transport	Tra 01: Transport assessment and travel plan	2	2
	Tra 02: Sustainable transport measures	10	10
Water	Wat 01: Water consumption (M) (M_e) (M_o)	N/A	N/A
	Wat 02: Water monitoring (M) (M_e) (M_o)	1	1
	Wat 03: Water leak detection and prevention	1	1
	Wat 04: Water efficient equipment	1	1
Materials	Mat 01: Environmental impacts from construction products - Building life cycle assessment	7 (+2)	4 (+1)
	Mat 02: Environmental impacts from construction products	1	1
	Mat 03: Responsible sourcing of materials (M) (M_e) (M_o)	4	2
	Mat 05: Designing for durability and resilience	1	1
	Mat 06: Material efficiency	1	1
Waste	Wst 01: Construction waste management (M_o)	5 (+1)	4
	Wst 02: Use of recycled and sustainably sourced aggregates	1 (+1)	0
	Wst 03: Operational waste (M_e), (M_o)	1	1
	Wst 04 Speculative floor and ceiling finishes	N/A	N/A
	Wst 05: Adaptation to climate change	1	1
	Wst 06: Design for disassembly and adaptability	2	2
Land Use and Ecology	LE 01: Site selection	2	1
	LE 02: Identifying and understanding the risks and opportunities for the project	2	2
	LE 03: Managing negative impacts on ecology	3	2
	LE 04: Change and enhancement of ecological value	4 (+1)	3
	LE 05: Long term ecology management and maintenance	2	2
Pollution	Pol 01: Impact of refrigerants	N/A	N/A
	Pol 02: Local air quality	N/A	N/A

Category	Issue	Flexible commercial space & Women's Building (Other Building Type) Shell Only Assessments	
		Available	Targeted
	Pol 03: Flood and surface water management	5	4
	Pol 04: Reduction of night-time light pollution	1	1
	Pol 05: Reduction of noise pollution	N/A	N/A
Innovation	Inn 01: Approved Innovation and Exemplary Level Credits	10	1
Total	Targeted weighted score: Retail: Flexible commercial space:	76.2% BREEAM 'Excellent'	
	Targeted weighted score: Women's Building	76.7% BREEAM 'Excellent'	

3.3.2 Home Quality Mark

We have explored the credit requirements and associated value that they bring to the scheme in advance of the Planning submission to determine whether or not to pursue a HQM Rating.

A Home Quality Mark (HQM) pre-assessment has been undertaken, by a qualified HQM assessor for the residential part of the site. HQM ONE is the updated and current version of HQM which applies to this project. The target rating for the project is a Four-Star rating, in line with Policy S3 from Islington's emerging Draft Local Plan.

This pre-assessment was developed with the intention of achieving a score of at least 265 out of a possible 500 points. This is equivalent to a Four-Star rating, providing a generous margin over and above the Four-Star target of 240, which is recommended during early stages of the project.

A workshop was held with the design team in order to discuss and agree the targets for the development.

Following on from the workshop and review of the pre-assessment, it was determined that there was limited benefit associated with the HQM Rating for future occupants. We understand that the emerging policy has been subject to a number of objections. As such we consider that little weight can be afforded to the Council's emerging policy in relation to HQM rating at this time. Therefore, the HQM accreditation is not pursued on this scheme.

4. Adaptive Design Strategy.

Buildings require a large quantity of raw materials, and manufactured goods to be constructed. Traditional construction methods use non-renewable minerals, ore, and energy to construct the structure and the façade, consuming a significant amount of energy for extraction, refining, processing, and transport. In addition, many materials in a building cannot easily be recovered or recycled, which minimises the likelihood that the building can be disassembled or adapted, and often leads to waste management practices that contribute to natural resource depletion (incineration / landfill).

In the UK and the EU, policy has historically been developed with the aim to reduce the carbon emissions associated with the operation of a building. It is now increasingly important to identify the 'embodied' energy and carbon emissions of a building's materials, in order to further reduce their contribution to climate change.

4.1 Policy

Islington Policy	Summary
LBI DLP – Policy S10 Circular economy and adaptive design	- *All developments must adopt a circular economy approach to building design and construction in order to keep products and materials in use for as long as possible and to minimise construction waste.* - *A minimum 10% of the total value of materials used in the construction of both major and minor developments must derive from recycled and re-used content in the products and materials selected.* - *All developments must be designed to be flexible and adaptable to changing requirements and circumstances over their lifetime; including changes to the physical environment, market demands and land use.* - *All development must minimise the environmental impact of materials through the use of sustainably sourced, low impact and recycled materials, using local supplies where feasible.* - *All developments are required to take all possible measures to minimise the impact of construction on the environment and comply with Islington's Code of Practice for Construction Sites.*

4.2 Response

The Circular Economy Statement has been completed in support of the planning application, which sets out the strategic approach to Circular Economy implemented by the project. This Circular Economy Statement is focused on the work carried out to define a strategic approach to Circular Economy principles for the project and identify high level strategic opportunities early in the development process.

In line with Peabody's Sustainability aspirations, the following design considerations have been made throughout the initial early-stage design in line with the key Circular Economy principles.

4.2.1 Conserve resources increase efficiency and source sustainably.

The scheme will look at adopting efficient design, demolition, construction process as well as implementing efficient monitoring and management features once in operation. Key considerations including pre-fabrication of elements, using standard material dimensions, undertaking a Pre-demolition audit in order to identify existing materials and components available for re-use, will be undertaken on the scheme. In addition to this, appropriate energy and water monitoring systems will also be captured within the design allowing building users to identify leaks and issues within the system and rectifying them at the earliest opportunity.

In addition to the approach, the processes considered for the design will reduce the demand for energy and water within the design and construction phase of the scheme, thus providing further environmental benefits in the interim.

Finally, in line with Peabody's approach to sustainable design, the scheme will opt to ensure at least ≥ 20% of the superstructure, substructure, hard landscaping, and internal finishes are responsibly sourced in line with appropriate certification schemes such as BES 6001, ISO 14001, CARES, and EPD. All timber use for and on site will be sourced in line with the UK Governments Timber Procurement Policy (TPP).

4.2.2 Design to eliminate waste (and for ease of maintenance)

All commercial and residential spaces throughout the development will be designed with reusability / recoverability / longevity / adaptability / flexibility principles in mind. The scheme will look to create a space flexible and accommodating to all needs of the building users and tenants ensuring an inclusive development is delivered for the community.

In terms of design out waste, efficient waste reduction practices and design will be incorporated into the scheme from commencement of stage 3 design through until the building occupation. This consideration and throughout process will ensure suitable space is provided, process is identified and established by both design team, demolition, and construction team, and finally facilities will be provided to account for the operational waste generated by commercial and residential units once in operation. This approach will ensure all opportunities to reduce, reuse, and recover waste are identified and adopted into the scheme where practical.

4.2.3 Manage waste sustainably and at the highest value

Key KPI targets will be outlined to the Contractor, informing the team of the appropriate reuse. Recycling and recovery targets to be met in line with both GLA and BREEAM guidance. In regard to managing waste sustainably, will ensure key materials available for reuse and recovery are identified and managed in accordance with best waste practises.

In addition to construction waste, municipal waste on the scheme will also be well thought out. The team will be sure to comply with local, and recommended waste legislation, accounting for the different waste streams, estimated waste amounts to be generated as well as encourager residents and building occupied to reduce their waste as far as possible also.

For further detail please refer to the accompanying Circular Economy Statement (Hoare Lea, October 2021).

5. Landscape Design Strategy.

In urban environments, access to nature is often very limited. Forests, fields & parks are often competing for land space with housing, workspaces, and transport infrastructure. Limited access to natural landscapes reduces access to the diversity of wildlife which a natural ecosystem supports.

It is now accepted that humans have an innate affinity to nature, and this is described through the concept of Biophilia. By developing to enhance local biodiversity and increasing the area and diversity of green spaces, an environment can become physically, socially, and economically more valuable.

5.1 Adopted Policy

Islington Policy	Summary
CS 10 (D) Sustainable Design	- All developments are to protect existing site ecology and make the fullest contribution to enhancing biodiversity.
DM 3.4 Private Outdoor Space	- The use of roofs for amenity purposes are to be balanced with the use for green roofs and renewable energy installations, integrating the benefit of amenity, biodiversity, and carbon reduction.
DM 6.2 (C) New and Improved Public Open Spaces	- New or improved open space is to incorporate areas of biodiversity habitat and support species to maximise biodiversity benefit.
DM 6.5 Landscaping, Trees and Biodiversity	- Developments must protect, contribute to, and enhance the landscape, biodiversity value and growing conditions of the surrounding area. - Requirements to maximise soft landscaping, including trees, shrubs, and other vegetation in order to maximise biodiversity benefits. - Developments should maximise the provision of green roofs and of green vertical surfaces as far as practically possible. - Green roofs specified must maximise benefits for biodiversity, sustainable drainage, and cooling, with a substrate depth of 80-150mm unless demonstrated that this is not possible.

5.2 Draft Policy

Islington Policy	Summary
LBI DLP – Policy G4 *Biodiversity, landscape design and trees*	- *All developments must protect, enhance, and contribute to the landscape, biodiversity value and growing conditions of the development site and surrounding area, including protecting and enhancing connectivity between habitats.* - *Development proposals involving the creation of new buildings, redevelopment of existing buildings or large extensions must submit a Landscape Design Strategy (as part of the Sustainable Design and Construction Statement) which maximises green infrastructure, biodiversity, and sustainable drainage.* - *All developments must protect and enhance site biodiversity, including wildlife habitats, trees, and measures to reduce deficiencies in access to nature.*

5.3 Response: Biodiversity and access to nature

Landscaping has been a key consideration of the design from the on-set, with great consideration on four key principles:

1. Connection to the wider landscape
2. Reduction of cars, and prioritising of people
3. Multi-generational and community focused
4. Use ecology to design spatial types.

These principles underpin the design of the landscape masterplan and all key spaces at the Proposed Development. These principles draw on the uniqueness of the site and its challenges and considers them alongside the ambitions as a modern, highly functioning, and desirable 'home' to many Londoners in the future.

The landscape at the Proposed Development embraces the constraints of the site to create interesting level transitions and enhance green and blue infrastructure.

Key character areas captured within the design have been identified as follows:

5.3.1 Public Garden

The Public Garden at the centre of the scheme is envisioned as an open and accessible park space which is framed by proposed buildings to provide an area for performance, gathering, and pop-up activities, such as food trucks and markets. This central park evokes the garden of the existing prison to provide a connection between past and present landscapes, and a flexible series of community-centric spaces.

Central to the design of this space is the introduction of a destination play area which encompasses a feature play tower with elevated play areas, bridges, climbing nets and a slide, along with natural play and Eco play trails under existing retained trees.

Embedded in verdant, ecologically focused planting, the Public Garden provides a large portion of the site play provision, thus creating a well-used community asset for all Islington residents to enjoy. The flexible lawn area provides an open space for events, such as outdoor cinemas, and sports, such as lawn games and picnics.

5.3.2 Nature Garden

The Nature Garden provides an area centred around the connection of people to nature through shared ownership, learning, growing, and harvesting. This community garden encompasses productive plots, self-grow beds, greenhouses, and an orchard to provide a transition space between existing and proposed buildings, and an area for residents to appropriate and retain as their own.

New vegetation combined with the existing trees in this area provide an 'eco-buffer' to retain neighbours privacy and create wildlife habitats and refugia for birds, bees, bats, and bugs, along with a natural play trail.

5.3.3 City Street (Camden / Parkhurst Road)

The City Street provides the sites major commercial offering - a well-used and activated public realm/street with pockets of activity, spill-out and seating against the existing roadway. This linear space celebrates and reinforces the existing tree line and canopy to improve the pedestrian experience and create an identifiable address and streetscape.

Botanically rich swathes of new planting beneath the trees provide series of spaces stepped back from the carriageway so the commercial units can 'spill-out' comfortably without disrupting pedestrian movement along the footpath. In the centre of the linear space is a distinctive gateway or entrance space which serves to 'open up' and make prevalent the previously closed site, creating views into the new Public Garden.

5.3.4 Plant Tree Gateway

The main pedestrian entrance to the site along Camden and Parkhurst Roads. This unique and exciting gateway centres around the retention of the large London Plane tree. This creates a memorial landscape marker and generates a distinctive threshold and contemplative space. Seating spaces will frame the central tree which acts as a beacon, linking the site's history with its community-centric future to create a memorial and reflective space at the site entrance.

Trecastle Connection

The Trecastle Connection provides a ramped and stepped route from the Holloway site to Trecastle Way as a mechanism to promote connectivity between the Holloway site and the surrounding schools, greenspaces, and streets. The 1:15 ramps manage the level change and are used to create a central area within the ramping landscape which has play-along-the-way equipment and a seating area. Vegetation is used to frame the ramped path and provide a lineal tree line to assist wayfinding.

Women's Garden

The Women's Garden is a communal garden connected to Plot C (the Women's Building). The space is comprised of a series of small and enclosed seating areas embedded in lush planting for physical and mental rehabilitation, contemplation, gathering, workshops, meetings, and socialising. These inclusive spaces are designed to connect users to their surroundings and provide a calming and secure environment embedded within a scented plant palette of edible species and vibrant, warming colour.

Communal resident gardens

The Communal Residents Gardens serve as areas for social exchange, and encompass communal dining areas, places to rest and relax, and outdoor spaces for quiet work, reading or recreation. Doorsteps play with additional elements for a range of ages are located across the gardens creating a diverse social space which can cater for a multitude of users and activities. Plots A and B are connected to the ground floor public realm through a series of slopes and steps, providing alternate access routes for residents and visitors. The Plot D gardens overlook the central park, providing spill-out space from the site concierge and smaller play areas for young children.

Extra-Care Garden

The Extra-Care Garden is imagined as a quiet and contemplative space centred around the creation of small intimate environments which seek to encourage mental well-being. The creation of a variety of experiences including infinite paths, water and sound features, self-grow areas and spaces for gathering and reflection can provide for a range of users and abilities.

Colour and textural changes in planting, surfaces and features encourages exploration and movement. The more intimate spaces are protected from the sun and wind to create a series of spaces nestled in lush planting.

In coordination with the above approach, as part of the BREEAM assessment for the scheme, a Suitably Qualified Ecologist has been engaged from the onset, advising the team on the baseline ecological value of the site, as well as identifying and seeking opportunities to ensure the scheme is maximised to its full potential. The ecologist will propose measures which will be incorporated into the design to improve the nature conservation value of the site and enhance local biodiversity, in accordance with the Islington Biodiversity Strategy and Action Plan (2010).

For further detail please refer to the 'Open Space and Recreation Assessment and Landscape Design Strategy' (Exterior Architecture, October 2021) accompanying the planning submission.

The application is accompanied by an Environmental Statement, produced by Avison Young, which includes a chapter on ecology. In addition, a Biodiversity Net Gain Assessment, produced by Penny Anderson Associates, is submitted which demonstrates the net gain the proposed development will deliver with respect to biodiversity

Figure 17 Proposed landscaping strategy: (Credit: Exterior Architect)

6. Climate Change Adaptation.

A primary function of a building is to provide shelter from the climate and weather patterns of the surrounding environment. Considering the predicted effects of climate change - unpredictable intense weather spells contributing to increased temperatures & rainfall - it is necessary to now design buildings that can adapt and withstand the predicted effects of climate change.

6.1 Adopted Policy

Islington Policy	Summary
CS 10 (E) Sustainable Design	- All developments to be designed to adapt to climate change through minimising overheating and implementing sustainable drainage systems (SuDS)
DM 6.6 Flood Prevention	- Major developments and major Changes of Use are required to demonstrate that SuDS have been incorporated. - Schemes should be designed to reduce flows to a 'greenfield rate' of runoff, allowing for the impact of climate change.
DM 7.5 Heating and Cooling	- Developments are required to demonstrate how the proposed design has incorporated passive design measures to control heat gain and deliver passive cooling. - The cooling hierarchy should be followed - Applications for major developments are required to include internal temperature modelling under project summer temperatures to demonstrate that the risk of overheating has been assessed.

6.2 Draft Policy

Islington Policy	Summary
LBI DLP – Policy S6 *Managing heat risk*	- *Development proposals must minimise internal heat gain and the impacts of the 'urban heat island effect' through design, layout, orientation, and materials.* - *All developments (excluding smaller minor extensions) must demonstrate, as part of the SDCS, how the proposed design will reduce the potential for overheating and reliance on air conditioning systems and maximise the incorporation of passive design measures in accordance with the cooling hierarchy.* - *Major developments are required to include details of internal temperature modelling under projected increased future summer temperatures, to demonstrate that the risk of overheating has been addressed as part of the SDCS.*

6.3 Response

6.3.1 SuDs

Surface water runoff from the development will be managed through a combination of permeable paving, green roofs, rain gardens, podium tanks and underground storage. Through consultation with the LLFA, it has been agreed that surface water should be limited to the 1 in 100-year greenfield runoff rate to the public combined sewer in Parkhurst Road. The proposed SuDS will provide appropriate treatment for runoff from the development, and water butts are proposed to be incorporated into the development (to be confirmed at detailed design stage) to limit the impact of the development on potable water resources.

Surface water runoff from the development will be managed through a combination of.

- permeable paving.
- green roofs.
- rain gardens.
- podium tanks; and
- underground storage.

The proposed SuDs Strategy will ensure that the development achieves Greenfield Run-Off rates.

Drainage and SUDS is considered in further detail in the submitted Flood Risk Assessment & Drainage Report, produced by Waterman and 'Open Space and Recreation Assessment and Landscape Design Strategy', produced by Exterior Architecture.

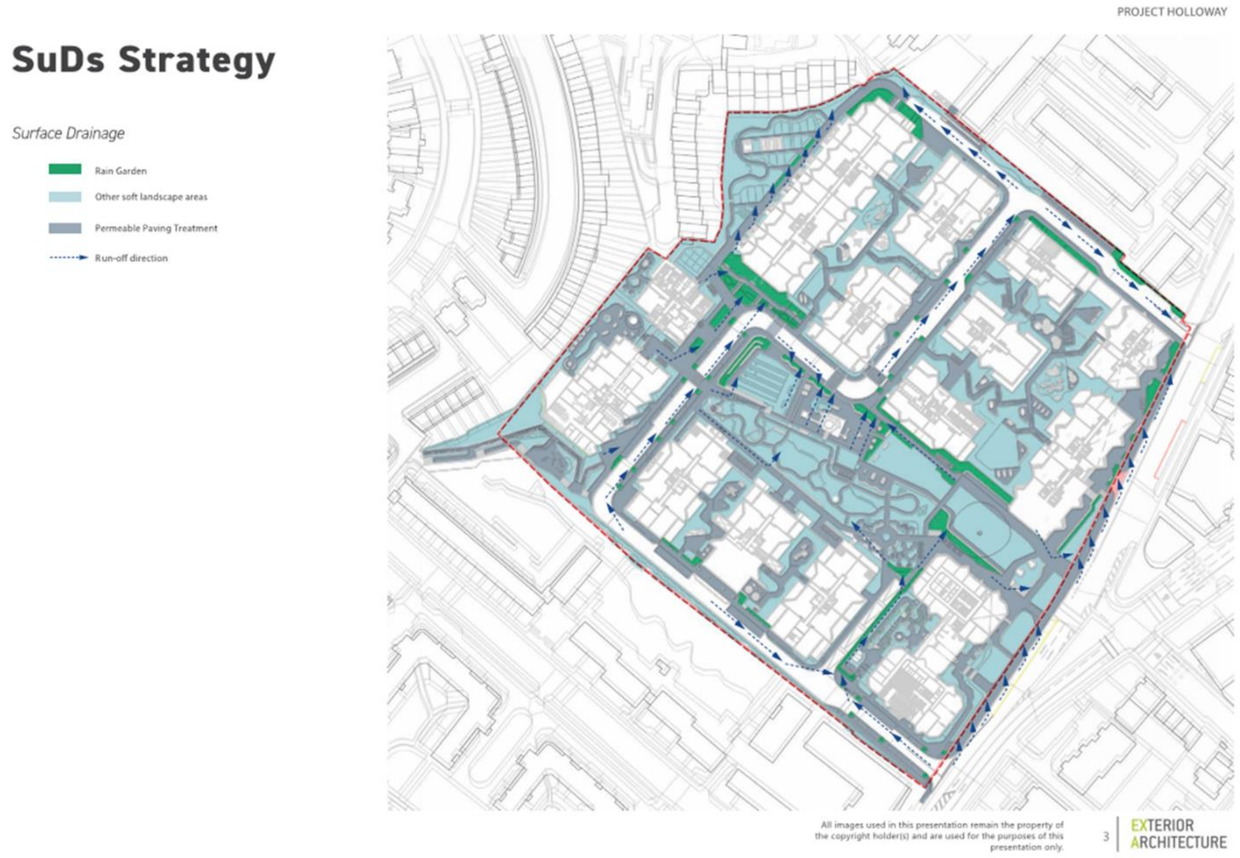
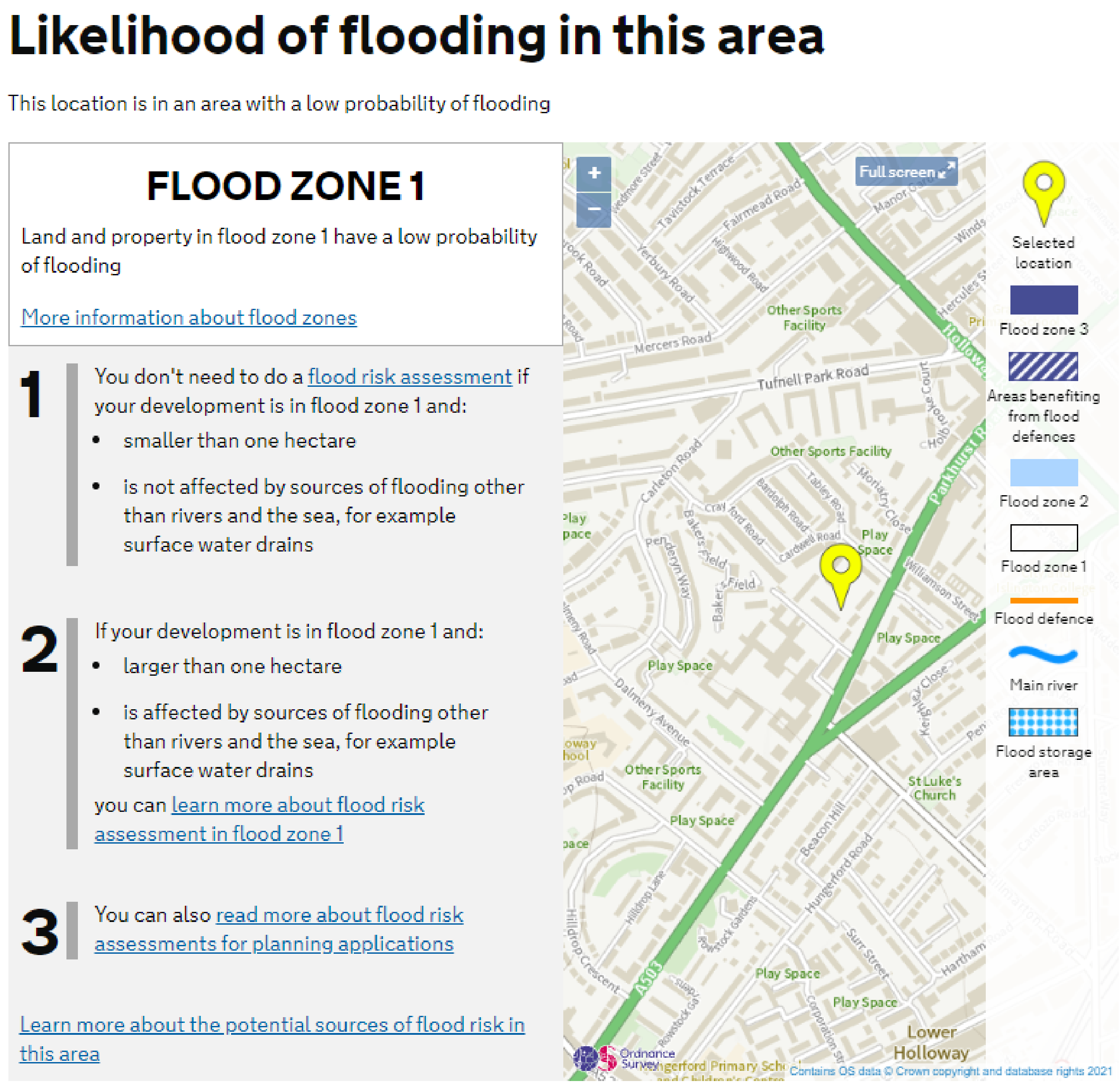


Figure 18 Surface water drainage drawing (Credit: Exterior Architect)

6.3.2 Flood Risk

By consulting the UK Government's Flood Map for Planning Service (Figure 13); the Proposed Development resides in Flood Zone 1 area and is therefore situated in an area with a low probability of flooding.



Likelihood of flooding in this area

This location is in an area with a low probability of flooding

FLOOD ZONE 1

Land and property in flood zone 1 have a low probability of flooding

More information about flood zones

1 You don't need to do a flood risk assessment if your development is in flood zone 1 and:

- smaller than one hectare
- is not affected by sources of flooding other than rivers and the sea, for example surface water drains

2 If your development is in flood zone 1 and:

- larger than one hectare
- is affected by sources of flooding other than rivers and the sea, for example surface water drains

you can learn more about flood risk assessment in flood zone 1

3 You can also read more about flood risk assessments for planning applications

Learn more about the potential sources of flood risk in this area

Figure 19 Flood Map for the Proposed Development

In line with Islington Policy, the scheme will incorporate sustainable drainage systems (SuDS) on site, reducing and delaying the discharge of rainfall to public sewers and watercourses. This approach will lessen the risk and impact of localised flooding on and off site, as well as watercourse pollution and other environmental damage within the community.

6.3.3 Overheating strategy

An overheating risk assessment was undertaken on a set of sample dwellings across the whole development. The dwellings selected for the assessment accounted for changes in orientation, glazing ratio, layout, and the external acoustic environment.

The assessment was also based on the closest available weather file, London Heathrow, and also accounted for future projected climate change.

With regards to the external acoustic environment, the acoustician has advised the site is exposed to varying noise levels. Road traffic noise is the primary influencer on the acoustic environment and is most apparent on the south east elevations. Exposure to noise levels reduce with height. For further details on the noise exposure, please refer to the overheating assessment in Appendix B.

All dwellings will be provided with mechanical ventilation with heat recovery. A selection of units which require closed windows will be provided with a tempered air solution.

7. Integrated Water Management and Sustainable Drainage.

Climate change is predicted to result in more variable weather patterns in the UK, with longer periods of low rainfall and a higher frequency of intense storm events. This means that the UK needs to develop and redevelop with water conservation in mind, in order to mitigate the potential negative effects associated with water scarcity.

7.1 Adopted Policy

Islington Policy	Summary
CS 10 (C) Sustainable Design	- Requiring all development to demonstrate that it meets best practice water efficiency targets and, unless it can be shown not to be feasible, incorporates rain and grey water recycling. - Residential schemes will be required to achieve a water efficiency target of 95 litres/person/day or less, with non-residential schemes achieving best practice efficiency levels as set out in Development Management Policies
DM 7.4 Sustainable Design Standards	- Developments are to demonstrate how all credits for water efficiency in the relevant BREEAM scheme can be achieved. Where this is not possible 2 credits are required as a minimum.

7.2 Draft Policy

Islington Policy	Summary
LBI – DLP – Policy S9 Integrated water management and sustainable drainage	- *All development proposals must adopt an integrated approach to water management which considers sustainable drainage, water efficiency, water quality and biodiversity holistically across a site and in the context of links with wider-than-site level plans.* - *All development proposals must ensure that surface water run-off is managed as close to its source as possible in line with the London Plan drainage hierarchy.* - *All developments are required to demonstrate that appropriate SUDS have been implemented in accordance with the drainage hierarchy to ensure that surface water runoff rates and volumes entering open space are predictable and water at the surface is clean and safe. All developments must identify how the initial run off from a site following a rainfall event will be dealt with; and demonstrate that an appropriate maintenance plan will be put place providing details of how the SUDS will be maintained after implementation to ensure their continued effectiveness.* - *Major developments creating new floorspace, and major changes of use that will result in an intensification of water use, must be designed to achieve standards.* - *All major developments must submit Surface Water Drainage Pro-forma to ensure surface water drainage proposals meet policy requirements.* - *All developments must demonstrate that they have minimised the use of mains water and have been designed to be water efficient, through the SDCS.* - *All developments are required to protect water quality and demonstrate that there will be no negative impacts on the quality of local water resources as a result of the development.*

7.3 Response

Sustainable water use in the operation of each building will be carefully considered, identifying processes of reducing overall potable water consumption, as well as ensuring appropriate mitigation and management procedures are in place throughout the building life cycle.

In terms of reducing potable water consumption for the scheme, the team will aim to specify highly efficient sanitaryware throughout all kitchens, bathrooms, and other water consuming areas. In support of this, water monitoring equipment such as easily accessible sub-meters and/or integral to the plant space, will also be incorporated into the design ensuring building occupants can easily access and monitor overall water usage throughout the building operation. This approach will also assist building users in identifying patterns of change when necessary, as well as reduce costs related to water consumption, and understand the water demand for different building areas and uses.

Water leak detection will also be considered for the design, ensuring potable water waste associated with leaks is reduced as far as possible; reduce the damage and associated costs arising from water leak and high-water consumption.

For unregulated water usage proposed on the site, this will also be considered as far as possible by the design team. Unregulated water loads such as equipment used for irrigation, will be reduced as far as possible through design measures such as drip-fed irrigation, gravity fed irrigation, and/or hand irrigation by the Facilities Management team on the site.

For external water management, the design will ensure attenuation is incorporated into the landscaping and roofs of the design, minimising surface-water run-off.

The Green roof will ensure water retention is maintained within the space, and in some instances can be seen to reduce surface water runoff by up to 90%. The attainment of water will also ensure ecological benefits are acquired, nurturing the space to its full ecological capacity.

The ground floor will incorporate permeable pacing, underground storage tank and podium tank for the design. The permeable paving will act as a porous surface, slowing absorbing rainfall/surface water and capturing this eventually within the appropriate tanks beneath the grounds surface. This approach will ensure the slower drainage of water off site, as well as reduce overall the heat island affect (through the use of using permeable pacing, as oppose to typical concrete/asphalt paving).

8. Operational Sustainability.

To succeed in achieving a Sustainable Development, a holistic approach is required from the outset of design, through construction and throughout the operation of the building. Buildings can often be complex to operate and without a robust and thorough handover between the designers, contractors and operators, a building is more likely to function with higher energy consumption, water consumption and with lower occupant wellbeing.

8.1 Adopted Policy

Islington Policy	Summary
CS 10 (G) Sustainable Design	- All developments to be designed and managed to promote sustainability throughout operation.
DM 7.1 (E) Sustainable Design and Construction	- Applications for major development are required to include a Green Performance Plan (GPP) detailing measurable outputs for the occupied building, particularly for energy, consumption, CO$_2$ emissions and water consumption.
DM 7.1 (F) Sustainable Design and Construction	- Developers are required to support monitoring of the implementation of the Sustainable Design and Construction Statement and the Green Performance Plan and allowing council officers access to the development & monitoring data when requested.

8.2 Draft Policy

Islington Policy	Summary
LBI DLP – Policy S4 *Minimising greenhouse gas emissions*	- *See section 2.1 for Policy S4*
LBI DLP – Policy S6 *Managing heat risk*	- *See section 5.2.1 for Policy S6*

8.3 Response

8.3.1 Energy monitoring

The Proposed Development will include energy monitoring devices to ensure that the major energy consuming systems and functional zones are recorded and monitored. The mechanical and electrical engineers for the project have specified energy meters in line with Part L of the Building Regulations and according to the requirements of the BREEAM Ene 02 credit. The energy meters will connect to the newly installed BMS system.

8.3.2 Commissioning & Aftercare Support

The Proposed Development will be commissioned to ensure all complex building services are operating as designed and will be completed in accordance with Building Regulations, BSRIA and CIBSE guidelines. Additionally, the building fabric will be tested through a thermographic survey and air tightness testing, with any defects rectified. To achieve the BREEAM credit for Man 04, the principal contractor will account for commissioning and testing requirements within their budget and programme of works.

The contractor for the proposed development will be required to ensure that operational infrastructure will be in place to provide aftercare support to the building occupiers, ensuring that the management team are appropriately acquainted with the newly installed equipment. This will include seasonal commissioning and training of the facilities management staff in the use of the new systems.

8.3.3 Dissemination of information

The contractor of the Proposed Development will be required to produce a Building User Guide (BUG) and will be made available to the building users, as well as the technical and non-technical management teams and staff. This user guide will assist to bridge the gap between the technical and non-technical operation of the building and act as an aid to direct the reader to more technical information (maintenance, O&M manual, building logbook).

A training schedule will be developed by the contractor at the hand over stage and will cover, the intent of the refurbishment, the provision of aftercare, demonstration of the installed systems, the BUG and maintenance requirements.

8.3.4 Green Performance Plan

The Green Performance Plan aims to set initial key performance indicators for the Proposed Development to monitor and manage once complete. This is to better understand and mitigate against potential shortfalls in the performance of the building, with particular focus on energy consumption, carbon emissions, water consumption and user satisfaction. Please refer to Policy S4 of the LBI Draft Local Plan for detailed requirements.

The Green Performance Plan will set out:

- Measurable performance targets and indicators
- Arrangements for management and monitoring of the plan covering the first two years of operation
- Arrangement for addressing performance in the event that the agreed objectives are not met after the monitoring period has ended.

Please see Appendix K for the Green Performance Plan.

9. Air Quality.

Air pollution is one of the most significant challenges of today. Air pollutants have a significant impact on health, quality of life and life expectancy, and the risk of exposure to air pollution is often worse in deprived areas, as these areas are often located near too busy roads and have a lack of green space. Poor air quality contributes to numerous diseases and conditions, particularly among more vulnerable people such as children, older people, and those with existing health conditions. New developments must be designed, constructed and operated to limit their contribution to air pollution and improve local air quality as far as possible and reduce the extent to which the public are exposed to poor air quality, including vulnerable people.

9.1 Adopted Policy

Islington Policy	Summary
DM 6.1 (E) Healthy development	- Developments in locations of poor air quality should be designed to mitigate the impact of poor air quality to within acceptable limits. Where adequate mitigation is not provided and/or is not practical planning permission may be refused.

9.2 Draft Policy

Islington Policy	Summary
LBI DLP – Policy S7 Improving air quality	- *All development proposals must mitigate or prevent adverse impacts on air quality and investigate and implement all reasonable opportunities to improve air quality.* - *Major developments, minor new build developments, and larger minor extensions must be at least Air Quality Neutral through provision of on-site measures. Such developments are required to submit an Air Quality Assessment (AQA) as part of the SDCS; the level of detail of the AQA must be proportionate to the scale of proposed development but must include details of how Air Quality Neutral will be achieved. A preliminary AQA must be carried out before designing the development, to inform the design process.* - *Developments in excess of 200 net additional residential units or 10,000sqm net additional gross external floorspace must be Air Quality Positive and implement measures on-site to actively reduce air pollution as far as possible.*

9.3 Response

In accordance with Policy SI 1 (c) of the London Plan an air quality positive approach has been undertaken to maximise benefits to local air quality and reduce exposure. In addition, an air quality neutral assessment will be undertaken as part of the air quality assessment to comply with Policy SI 1(b).

As part of the air quality positive approach, an Air Quality Assessment has been undertaken and has been issued to the design team to aid the design of the development; this forms part of the Environmental Statement submitted with the application. The assessment has confirmed the following:

- Consideration was given to the potential air quality impacts associated with The Works, including impacts associated with construction dust and exhaust emissions from construction vehicles on local air quality.
- Operational impacts from the Development considered the impacts of emissions from traffic generated by the Development.
- Baseline air quality conditions in the study area were determined based on LBIs monitoring data and other publicly available data. It was shown that existing nitrogen dioxide (NO2) and particulate matter (PM10 and PM2.5) concentrations were below the national air quality objectives for most of the study area, with the exception of receptors on the junction between Parkhurst Road and Holloway Road.
- A qualitative construction dust risk assessment was carried out. Based on the identified level of risk, a list of suitable mitigation measures to apply during the construction works was provided which have been incorporated into the CEMP. A quantitative assessment using dispersion modelling of impacts from construction vehicles exhaust emissions was also carried out, based on the number of vehicles generated by The Works. The impacts of construction vehicles is anticipated to be insignificant.
- Air quality dispersion modelling was also carried out to predict the impacts of additional road traffic on local roads, resulting from the operation of the Development, as well as the expected concentrations of key pollutants at sensitive receptors within the Development. The Development would utilise air source heat pumps (ASHPs) and photovoltaics (PVs) to provide heating and hot water and therefore would have no building-related emissions.
- The operation of the Development is not predicted to result in any significant effects on the receptors considered. Within the Development predicted future concentrations are below the relevant objectives and, as such, air quality for future residents within the Development would be acceptable.
- In accordance with the London Plan an air quality neutral assessment has been undertaken, which shows the Development is air quality neutral. An air quality positive approach has also been completed, and an Air Quality Positive Statement provided which sets out the design and operational measures to reduce exposure to air pollution and maximise air quality benefits.
- The Development together with other Cumulative Schemes would not give rise to any materially different air quality effects over and above those identified for the Development in isolation.

Please refer to the full Air Quality review as included within Environmental Statement, Chapter 8.

10. Conclusion.

This document has demonstrated that the Proposed Development meets the highest standard of Sustainable Development and meets the planning policies of the National Planning Policy Framework, the London Plan, and the local policies of the London Borough of Islington (LBI).

This document aligns with the reporting framework set out in Policy S2 of LBI's Draft Local Plan (DLP) and Islington Council's Environmental Design SPD.

The following section headings were covered throughout the report.

- Energy Strategy (including the Overheating Assessment and Net Zero Carbon Feasibility Study)
- Whole Life Cycle Carbon Assessment
- Adaptive Design Strategy
- Landscape Design Strategy and Biodiversity
- Climate Change Adaption
- Integrated Water Management and Sustainable Drainage
- Operational Sustainability (including Green Performance Plan)
- Air Quality

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

The feasibility of LZC technologies has been investigated in line with the policy aspirations and as part of the Energy Strategy submitted in support of the application. Air source heat pumps and photovoltaic panels will supply a large percentage of energy for the site.

A Net Zero Carbon Feasibility assessment has been undertaken on the development in order to consider the project's ability and options to be defined as Net Zero against the UK Green Building Council (UK-GBC) framework definition to help achieve Net Zero.

The BREEAM assessment and the potential rating which can be achieved, has been high on the design team agenda during the concept design stages. The Proposed Development is targeting a rating of BREEAM 'Excellent with a targeted score of 77.81% (Flexible commercial space) and 78.31% (Women's Building). As a minimum, the proposed development is expected to achieve a rating of BREEAM 'Excellent' with a baseline score of 70%.

The Circular Economy Statement has been completed in support of the planning application, which sets out the strategic approach to Circular Economy implemented by the project. This Circular Economy Statement is focused on the work carried out to define a strategic approach to Circular Economy principles for the project and identify high level strategic opportunities early in the development process.

Landscaping has been a key consideration of the design from the on-set, with great consideration on four key principles:

1. Connection to the wider landscape
2. Reduction of cars, and prioritising of people
3. Multi-generational and community focused
4. Use ecology to design spatial types.

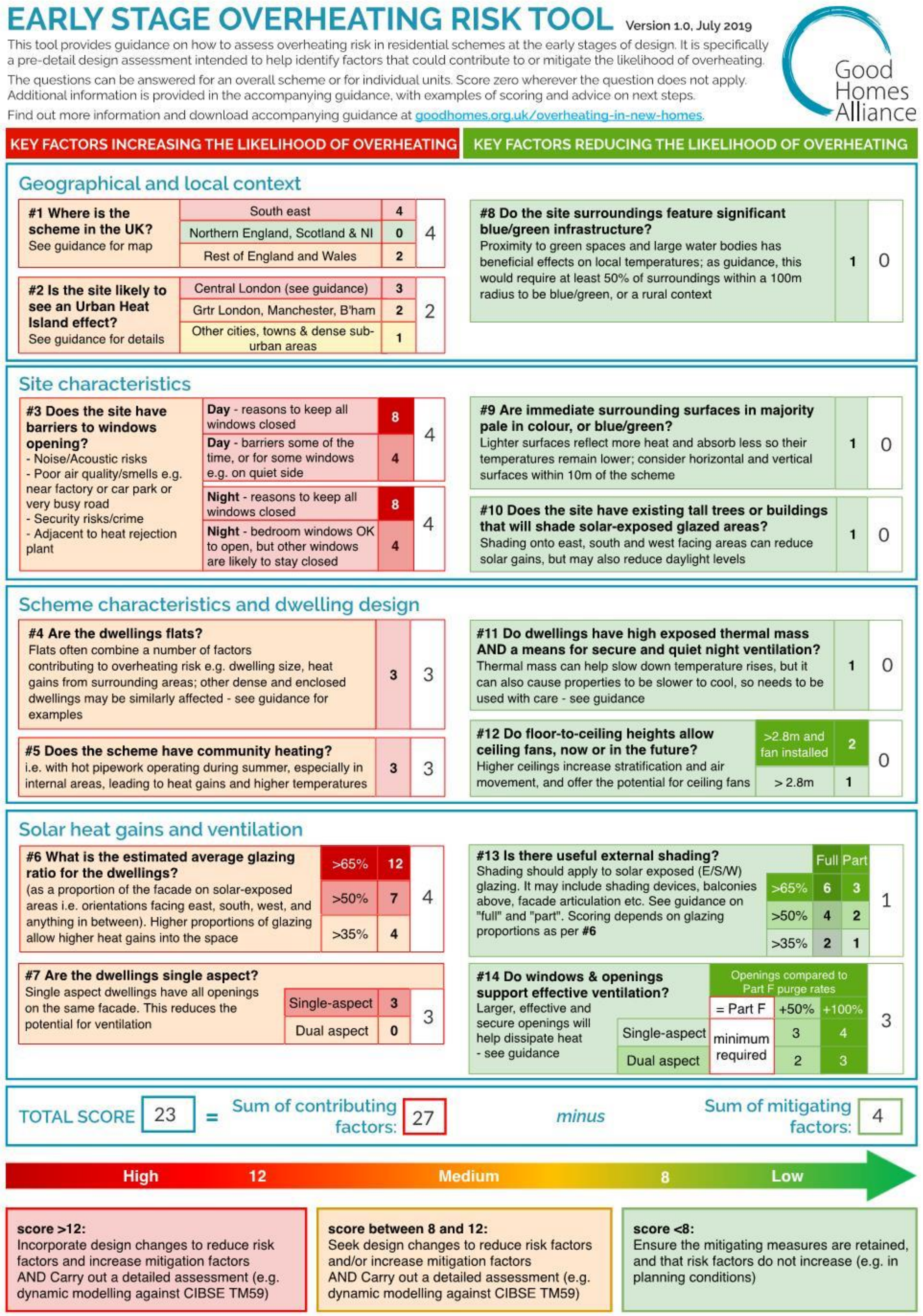
Sustainable water use in the operation of each building will be carefully considered, identifying processes of reducing overall potable water consumption, as well as ensuring appropriate mitigation and management procedures are in place throughout the building life cycle.

Drainage and SUDS are considered in further detail in the submitted Flood Risk Assessment & Drainage Report, produced by Waterman and Open Space & Recreation Assessment, incorporating Landscape Design Strategy, produced by Exterior Architecture.

The Proposed Development will include energy monitoring devices to ensure that the major energy consuming systems and functional zones are recorded and monitored. The mechanical and electrical engineers for the project have specified energy meters in line with Part L of the Building Regulations and according to the requirements of the BREEAM Ene 02 credit. The energy meters will connect to the newly installed BMS system. The Proposed Development will be commissioned to ensure all complex building services are operating as designed and will be completed in accordance with Building Regulations, BSRIA and CIBSE guidelines.

As part of the air quality positive approach, a Preliminary Air Quality Assessment has been undertaken and has been issued to the design team to aid the design of the development, this forms part of the Environmental Statement submitted with the application. The Preliminary Air Quality Assessment is based on existing air quality data including local monitoring and shows the Site has no specific air quality constraints to residential development, and as such air quality conditions for future users of the proposed Development are expected to be below the air quality objectives. From an air quality perspective, it is expected that the air quality modelling will show that there would be no need for windows to be sealed / mechanical ventilation provided, however this will be determined, as well as the suitability of the Site during the air quality modelling assessment for the planning application.

Appendix A: GHA Overheating Risk Tool.



EARLY STAGE OVERHEATING RISK TOOL

Version 1.0, July 2019

This tool provides guidance on how to assess overheating risk in residential schemes at the early stages of design. It is specifically a pre-detail design assessment intended to help identify factors that could contribute to or mitigate the likelihood of overheating.

The questions can be answered for an overall scheme or for individual units. Score zero wherever the question does not apply. Additional information is provided in the accompanying guidance, with examples of scoring and advice on next steps.

Find out more information and download accompanying guidance at goodhomes.org.uk/overheating-in-new-homes.

Good Homes Alliance

KEY FACTORS INCREASING THE LIKELIHOOD OF OVERHEATING | **KEY FACTORS REDUCING THE LIKELIHOOD OF OVERHEATING**

Geographical and local context

#1 Where is the scheme in the UK? See guidance for map	South east	4	4
	Northern England, Scotland & NI	0	
	Rest of England and Wales	2	

#2 Is the site likely to see an Urban Heat Island effect? See guidance for details	Central London (see guidance)	3	2
	Grtr London, Manchester, B'ham	2	
	Other cities, towns & dense sub-urban areas	1	

#8 Do the site surroundings feature significant blue/green infrastructure? Proximity to green spaces and large water bodies has beneficial effects on local temperatures; as guidance, this would require at least 50% of surroundings within a 100m radius to be blue/green, or a rural context	1	0

Site characteristics

#3 Does the site have barriers to windows opening? - Noise/Acoustic risks - Poor air quality/smells e.g. near factory or car park or very busy road - Security risks/crime - Adjacent to heat rejection plant	**Day** - reasons to keep all windows closed	8	4
	Day - barriers some of the time, or for some windows e.g. on quiet side	4	
	Night - reasons to keep all windows closed	8	4
	Night - bedroom windows OK to open, but other windows are likely to stay closed	4	

#9 Are immediate surrounding surfaces in majority pale in colour, or blue/green? Lighter surfaces reflect more heat and absorb less so their temperatures remain lower; consider horizontal and vertical surfaces within 10m of the scheme	1	0
#10 Does the site have existing tall trees or buildings that will shade solar-exposed glazed areas? Shading onto east, south and west facing areas can reduce solar gains, but may also reduce daylight levels	1	0

Scheme characteristics and dwelling design

#4 Are the dwellings flats? Flats often combine a number of factors contributing to overheating risk e.g. dwelling size, heat gains from surrounding areas; other dense and enclosed dwellings may be similarly affected - see guidance for examples	3	3
#5 Does the scheme have community heating? i.e. with hot pipework operating during summer, especially in internal areas, leading to heat gains and higher temperatures	3	3

#11 Do dwellings have high exposed thermal mass AND a means for secure and quiet night ventilation? Thermal mass can help slow down temperature rises, but it can also cause properties to be slower to cool, so needs to be used with care - see guidance	1	0

#12 Do floor-to-ceiling heights allow ceiling fans, now or in the future? Higher ceilings increase stratification and air movement, and offer the potential for ceiling fans	>2.8m and fan installed	2	0
	> 2.8m	1	

Solar heat gains and ventilation

#6 What is the estimated average glazing ratio for the dwellings? (as a proportion of the facade on solar-exposed areas i.e. orientations facing east, south, west, and anything in between). Higher proportions of glazing allow higher heat gains into the space	>65%	12	4
	>50%	7	
	>35%	4	

#7 Are the dwellings single aspect? Single aspect dwellings have all openings on the same facade. This reduces the potential for ventilation	Single-aspect	3	3
	Dual aspect	0	

#13 Is there useful external shading? Shading should apply to solar exposed (E/S/W) glazing. It may include shading devices, balconies above, facade articulation etc. See guidance on "full" and "part". Scoring depends on glazing proportions as per **#6**		Full	Part	1
	>65%	6	3	
	>50%	4	2	
	>35%	2	1	

#14 Do windows & openings support effective ventilation? Larger, effective and secure openings will help dissipate heat - see guidance		Openings compared to Part F purge rates			3
		= Part F	+50%	+100%	
	Single-aspect	minimum required	3	4	
	Dual aspect		2	3	

TOTAL SCORE 23 = Sum of contributing factors: 27 *minus* Sum of mitigating factors: 4

High 12 Medium 8 Low

score >12:
Incorporate design changes to reduce risk factors and increase mitigation factors
AND Carry out a detailed assessment (e.g. dynamic modelling against CIBSE TM59)

score between 8 and 12:
Seek design changes to reduce risk factors and/or increase mitigation factors
AND Carry out a detailed assessment (e.g. dynamic modelling against CIBSE TM59)

score <8:
Ensure the mitigating measures are retained, and that risk factors do not increase (e.g. in planning conditions)

Appendix B: TM59 Overheating Risk Assessment.

HOARE LEA

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SUSTAINABILITY
TM59 ASSESSMENT OF OVERHEATING RISK

REVISION 1 – 29 OCTOBER 2021

Audit Sheet.

Rev.	Date	Description of change / purpose of issue	Prepared	Reviewed	Authorised
0	15/10/2021	Draft issue for comment	LH	JD	JD
1	29/10/2021	Issue for planning submission	MT	LH	JD

This document has been prepared for Peabody only and solely for the purposes expressly defined herein. We owe no duty of care to any third parties in respect of its content. Therefore, unless expressly agreed by us in signed writing, we hereby exclude all liability to third parties, including liability for negligence, save only for liabilities that cannot be so excluded by operation of applicable law. The consequences of climate change and the effects of future changes in climatic conditions cannot be accurately predicted. This report has been based solely on the specific design assumptions and criteria stated herein.

Project number: 23/24131
Document reference: REP-2324131-5A-HL-20211029-TM59 Report Rev 1.docx

Contents.

Executive Summary.

The proposed development consists of the phased comprehensive redevelopment including demolition of existing structures; site preparation and enabling works; and the construction of 985 residential homes including 60 extra care homes (Use Class C3), a Women's Building (Use Class F.2) and flexible commercial floorspace (Use Class E) in buildings of up to 14 storeys in height; highways/access works; landscaping; pedestrian and cycle connections, publicly accessible park; car (blue badge) and cycle parking; and other associated works.

Figure 1 - Site Image (Credit: AHMM)

This report provides a summary of the results of the overheating assessment undertaken on a representative sample of the dwellings with higher risk of overheating of the Holloway Prison development. 44 dwellings located across the five plots were selected for the assessment chosen among the ones with higher overheating risk (higher exposure, topmost floors, less shading, less ventilation area).

CIBSE TM59:2017 is the recommended methodology for the assessment of overheating risk in dwellings and is the methodology adopted for this overheating study.

Throughout the pre-planning process a number of discussions and workshops were held with the design team to improve the development's façade design and to identify the most effective measures that could be included in the development to minimise the overheating risk while considering other factors like daylight access, and acoustics.

The following passive design measures have been included, where technically and economically viable, within the development (Baseline passive design solution):

- Glazing reductions
- Solar control glass (g-value of 0.35)
- Balconies
- Tilt/turn windows - side hung during the day and bottom hung overnight
- Ventilation panels (louvres)

The following additional high impact passive design measures (Enhanced passive design solution) have been identified to further reduce the overheating risk through passive design measures within the dwellings that are not meeting the TM59 requirements with the above passive design measures

- External blinds
- Side hung balcony doors 20% open overnight

It is important to note that all the above passive design measures will not be applied to all the apartments of the development. The extent of the measures required for each apartment will be determined at the next stage of design.

An additional option has been assessed which includes MVHR with tempered air. This option (tempered air solution – with external blinds) may be required for the dwellings with limitations to natural ventilation provision due to acoustic constraints and the dwellings that baseline and enhanced passive design measures alone are either not viable or would not suffice to meet the TM59 overheating requirements.

Based on the inputs and assumptions outlined within this report, the results of the simulation using Enhanced passive design measures show that 98% of the assessed worse-case scenario living-kitchen areas are passing the TM59 methodology and 86% of assessed bedrooms, where louvres could be provided. 10% of bedrooms where louvres could not be provided are passing the TM59 methodology with passive design measures and will therefore require tempered air cooling.

A summary of the overheating study results is provided in the table below:

Table 1: Overheating study results summary

Assessed rooms		Number of assessed rooms	Passive design measures - compliant rooms		Tempered air solution (with external blinds)
			Baseline passive design solution	Enhanced passive design solution	
Bedrooms	Rooms with ventilation panels	35	77%	86%	100%
	Rooms without ventilation panels	39	0%	10%	100%
	All assessed bedrooms	74	36%	46%	100%
Living-Kitchen	All assessed living-kitchen rooms	47	51%	98%	100%

The information in Section 5 of this report highlights all the options that have been considered throughout the design process, with a summary of those that have been or that will be incorporated in the design and the ones that were excluded and the reason behind that.

In addition, communal corridors are also compliant with TM59 criteria with the inclusion of mechanical cooling (using FCUs fed by the proposed ASHP on the roof). At the next stage of design, the possibility to omit cooling will be considered and the possibility to provide mechanical ventilation through environmental fans will be investigated further.

Results of the enhanced passive design solution using DSY2 can be found in Appendix C and results using DSY3 can be found in Appendix D.

The building design and building services design have maximised all available measures to minimise heat generation within the dwellings, to reduce the amount of heat entering the building, and to passively and mechanically ventilate the dwellings in line with the cooling hierarchy in Policy SI4 of the London Plan and Policy S6 of LBI's Draft Local Plan.

It should be noted that whilst industry guidance has been followed, results in practice are likely to be dependent on factors which are highly user dependent, this can include occupancy levels, internal gains from equipment and user behaviour such as operation of windows.

1. Introduction.

1.1 The Application

This TM59 Assessment of Overheating Risk is submitted in support of a full planning application for the proposed redevelopment of the former Holloway Prison within the London Borough of Islington (LBI).

1.2 Site Description

The proposed development consists of the phased comprehensive redevelopment including demolition of existing structures; site preparation and enabling works; and the construction of 985 residential homes including 60 extra care homes (Use Class C3), a Women's Building (Use Class F.2) and flexible commercial floorspace (Use Class E) in buildings of up to 14 storeys in height; highways/access works; landscaping; pedestrian and cycle connections, publicly accessible park; car (blue badge) and cycle parking; and other associated works.

1.3 Policy Requirements

Policy SI4 of the London Plan (March 2021) 'Overheating and Cooling' seeks to reduce the impact of the urban heat island effect in London. It encourages the design of places and spaces to avoid overheating and excessive heat generation and to reduce overheating due to the impacts of climate change and the urban heat island effect on an area wide basis.

In order to reduce overheating and the reliance on air conditioning, the design of the Proposed Development has followed the Cooling Hierarchy detailed in Policy SI4:

- Reduce the amount of heat entering a building in summer through orientation, shading, materials, fenestration, insulation and the provision of green infrastructure;
- Minimise internal heat generation through energy efficient design;
- Manage the heat within the building through exposed internal thermal mass and high ceilings;
- Provide passive ventilation;
- Provide mechanical ventilation; and
- Provide active cooling systems.

In addition to Policy SI4 of the London Plan, Policy S6 (managing heat risk) of the LBI Draft Local Plan has been followed in order to minimise the impacts of the 'urban heat island effect' through design, layout, orientation and materials.

2. Cooling Hierarchy.

This section sets out how the design of the development has followed the six-step approach to minimising overheating and excessive heat generation.

2.1 Reduce the Heat Entering the Building.

The amount of heat entering the building will be reduced by:

- Energy efficient facades with appropriate proportions of glazing; and
- Carefully selecting a glazing shading coefficient to reduce the amount of solar radiation passing through the glazing in summer but also to maximise beneficial solar gains during the winter heating season.

2.2 Minimise Internal Heat Generation.

A number of energy efficient design measures have been incorporated into the design to minimise internal heat generation. These include:

- Energy efficient light fittings;
- Locating the heat interface unit in a non-occupied space (utility room) so that heat is not emitted into an occupied space. The units will be specified with fully insulated components and casing;
- Space heating and domestic hot water pipework will be insulated beyond the levels required by the Domestic Building Services Compliance Guide;
- EU Energy Efficiency Labelling Scheme Information will be provided to encourage the procurement of energy efficient white goods (if white goods are not provided as part of the fit-out); and

2.3 Manage the Heat within the Building.

Due to the residential nature of the development there is a need to conceal services, which reduces the possibility of incorporating exposed internal thermal mass. Ceiling heights have been maximised within the constraints of the overall building's height and massing.

2.4 Passive Ventilation.

Although windows are designed to be openable, the acoustic engineer from Max Fordham has provided acoustic advice, suggesting that the windows of certain façades should be assumed to be closed due to acoustic constraints on site.

It is for this reason that results for both a passive solution and a mechanical solution are included in this report.

There will also be a small amount of natural ventilation through building fabric infiltration.

2.5 Mechanical Ventilation.

Apartments will have an MVHR unit which will supply air to the habitable spaces. Extract air will be taken from the bathrooms and the kitchen and the supplied air will be distributed into the living room/kitchen and bedrooms.

2.6 Active Cooling Systems.

Although Active cooling systems are not proposed for this development, as detailed above, a tempered air solution is required via the MVHR units to achieve the required comfort levels when the windows are closed. Further details of MVHR with tempered air strategy are provided within Section 7 of this report.

3. Overheating Criteria.

The TM59:2017 is a design methodology for the assessment of overheating risk in homes, published by the Chartered Institution of Building Services Engineers (CIBSE), in April 2017.

This is a standardised approach to predict overheating risk for residential building designs using a dynamic thermal analysis. It provides a baseline which includes specific weather files, defined internal gains and a set of profiles that represent reasonable usage patterns of a home suitable for evaluating overheating risk. In addition, defined thresholds to provide a pass / fail result are clearly provided as written in section 3.1 below.

3.1 CIBSE TM59 Assessment Criteria.

Table 2 below provides a summary of the assessment criteria outlined in CIBSE TM59. For the purposes of this analysis, the dwellings have been assessed against criteria 1 for the passive design options and criteria 2 for the enhanced mechanical ventilation option.

Table 2 - CIBSE TM59 Compliance Requirements

	CIBSE TM59 Compliance Requirements
Criteria 1 - Predominantly Naturally Ventilated Dwelling	Criteria (a) for living rooms, kitchen and bedrooms: the number of hours during which ΔT is greater than or equal to one degree (K) during the period May to September inclusive shall not be more than 3% of occupied hours. (CIBSE TM52 Criterion 1: Hours of exceedance, which is the number of hours during which the difference between the actual operative temperature and maximum acceptable temperature); Criteria (b) for bedrooms only: to guarantee comfort during sleeping hours the operative temperature in the bedroom from 22:00 to 07:00 shall not exceed 26 °C for more than 1% of annual hours. (Note: 1% of the annual hours between 22:00 and 07:00 for bedrooms is 32 hours, therefore 33 or more hours above 26 °C will be recorded as a fail); Note: Criteria 2 and 3 of CIBSE TM52 may fail to be met, but both (a) and (b) above must be passed for all relevant rooms.
Criteria 2 - Predominantly Mechanically Ventilated Dwelling	CIBSE Guide A fixed temperature test: Occupied spaces should not exceed operative temperature of 26°C for more than 3% of annual occupied hours.
Communal Corridors (where communal heating present)	CIBSE Guide A fixed temperature test: Where corridors should not exceed operative temperature of 28°C for more than 3% of total annual hours (262 hours or less).

4. Model.

The TM59 methodology provides a baseline and guidance for a domestic overheating risk assessment. In line with this methodology, this section includes the model inputs used to assess overheating risks to the proposed representative sample dwellings.

4.1 Sample Dwellings and Geometry.

A representative sample of dwellings have been selected in line with the TM59 methodology. These dwellings have the highest risk of overheating due to the inclusion of a number of the following characteristics: a) south, southeast and southwest orientation; b) single aspect; c) topmost floors; d) high ratio of southerly facing glazing; and e) limited external shading opportunities.

44 dwellings located across the five plots were selected for the assessment. The section below provides a table showing the units selected for the overheating assessment and images of their locations within the plots.

4.1.1 **Selected units**

Table 2 below shows the number of selected units in each plot.

Table 3 - Number of units

Plot Name	Number of units
Plot A	8
Plot B	16
Plot C	5
Plot D	6
Plot E	9
Total	44

4.1.2 **Plot A**

Figure 2 shows the selected units from Plot A.

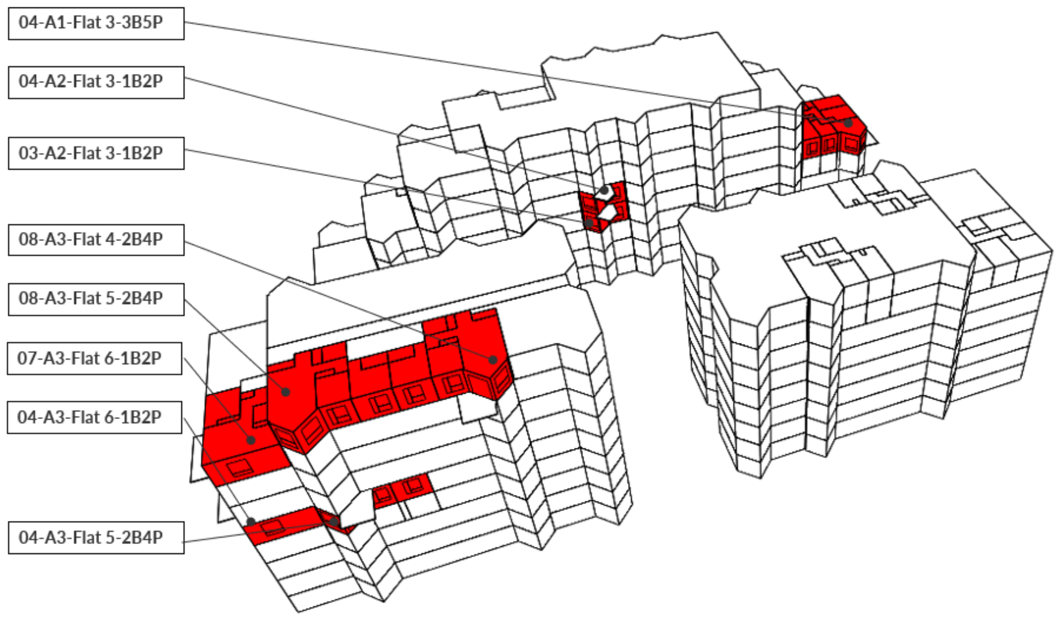


Figure 2 - Units from Plot A

4.1.3 **Plot B**

Figure 3 shows the selected units from Plot B.

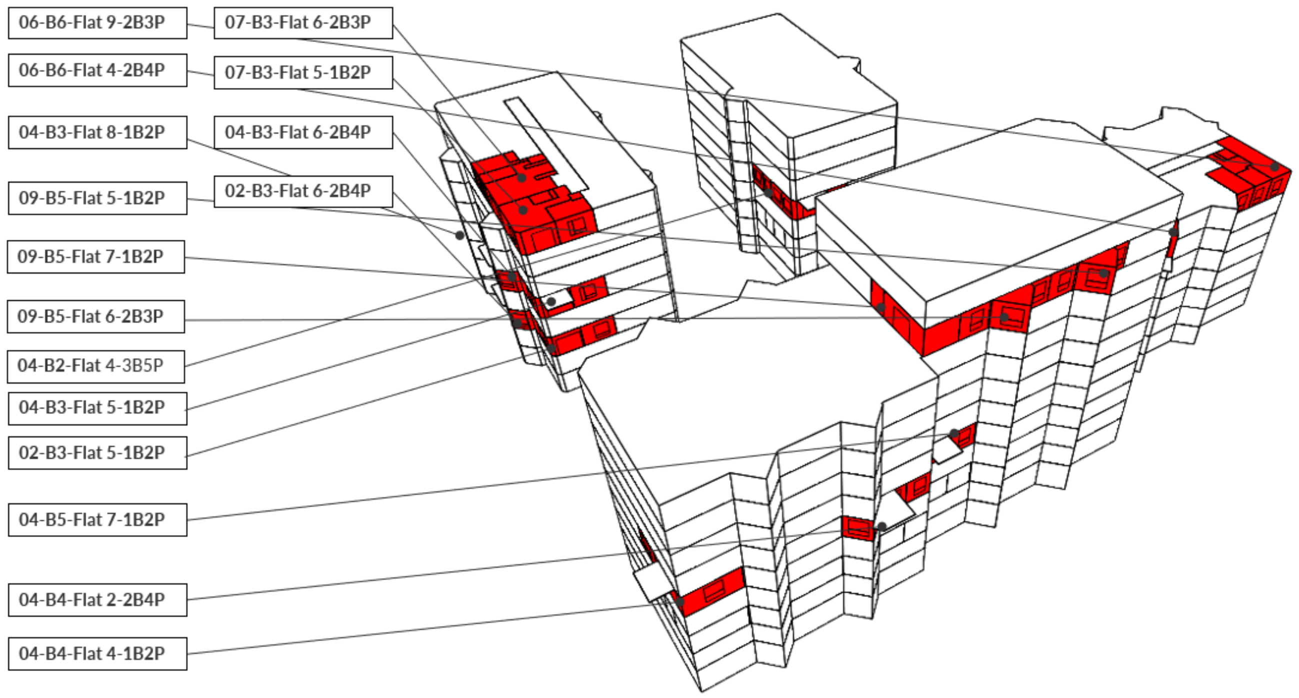


Figure 3 - Units from Plot B

4.1.4 **Plot C**

Figure 4 shows the selected units from Plot C.

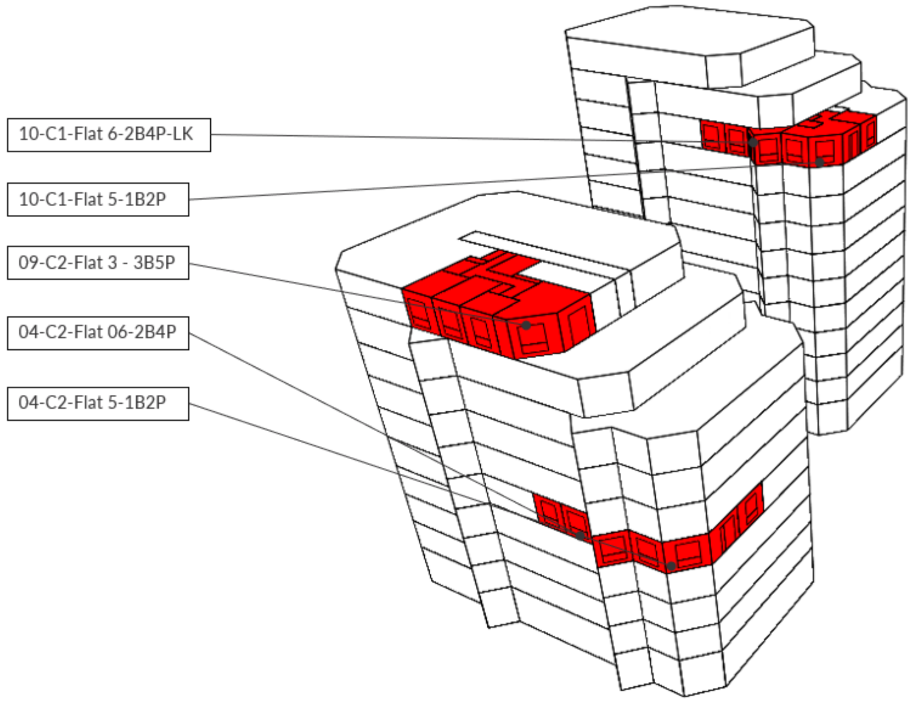


Figure 4 - Units from Plot C

4.1.5 **Plot D**

Figure 5 shows the selected units from Plot D.

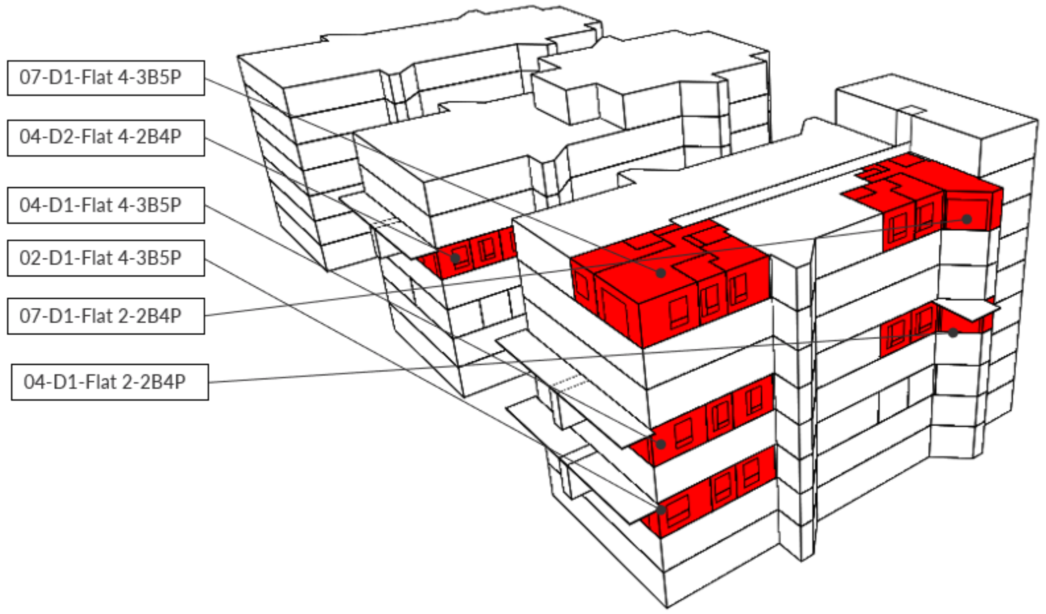


Figure 5 - Units from Plot D

4.1.6 **Plot E**

Figure 6 shows the selected units from Plot E.

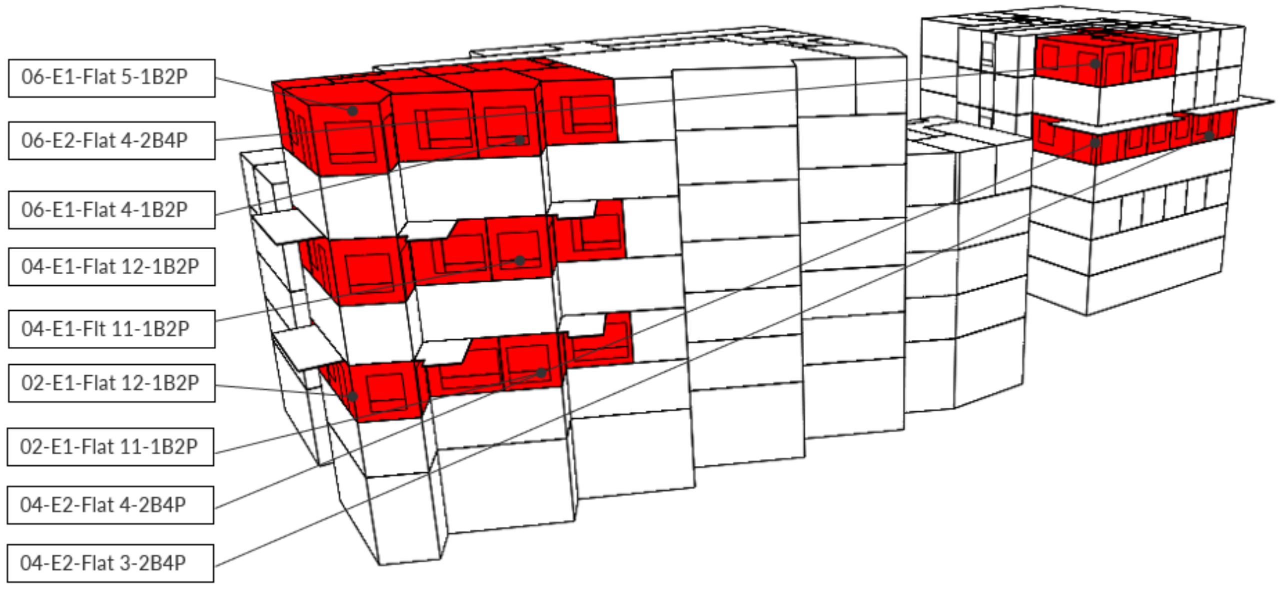


Figure 6 - Units from Plot E

4.2 Software.

The model was created in IES 2019.3.0.0 to simulate the internal conditions in each of the occupied spaces highlighted in the above Figures. Screenshots of the model are shown in Figure 7

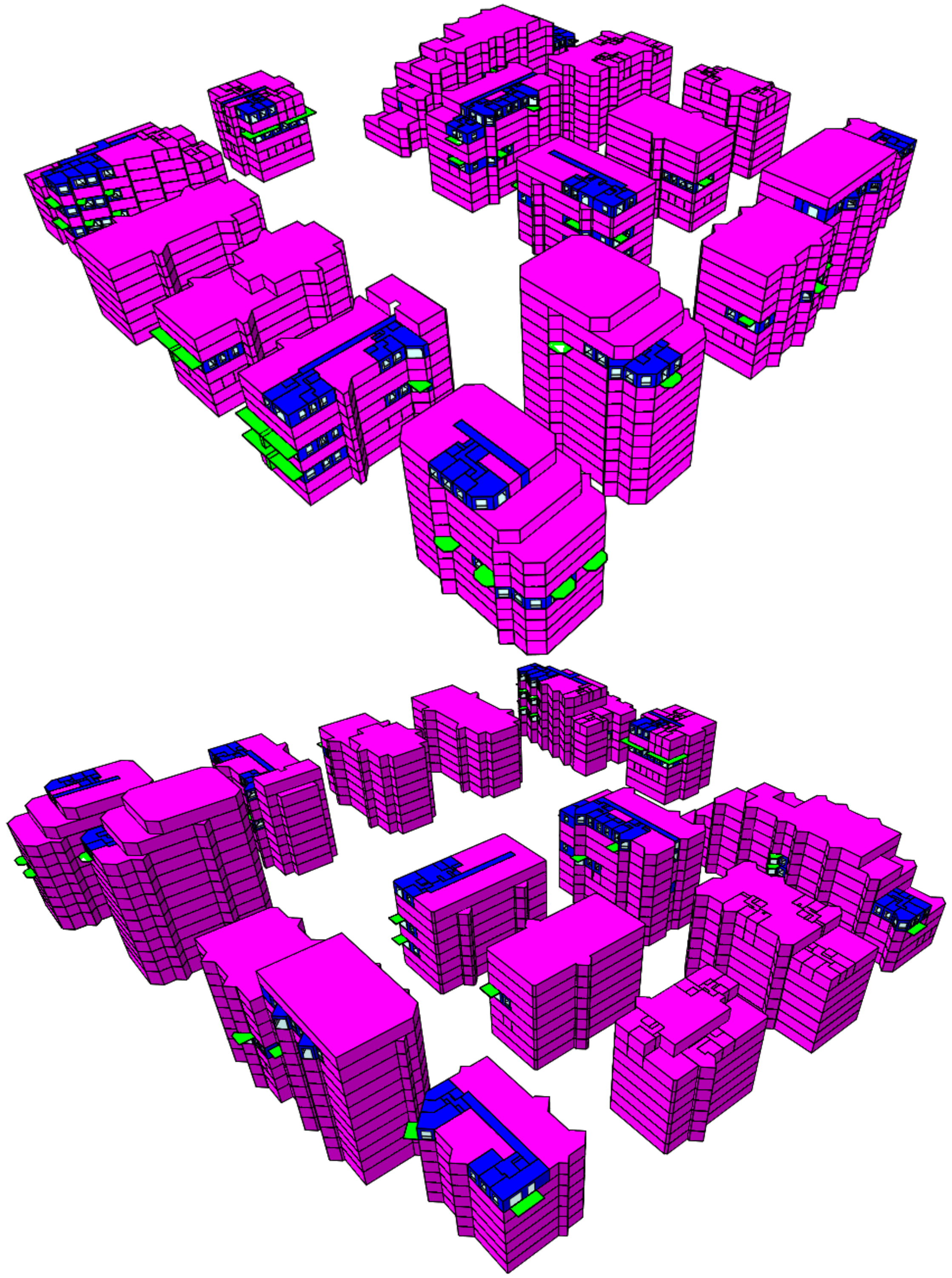


Figure 7 - Screenshots of thermal model. Top: View from South. Bottom: View from East

4.3 Weather Data.

The CIBSE design summer year (DSY1) weather file to London Heathrow, for the 2020s, high emissions, 50% percentile scenario has been used for the simulations as required by TM59 methodology. The CIBSE DSY1 represents a moderately warm summer. In addition, results using DSY2 (a short, intense warm spell) can be found in Appendix C, and results using DSY3 (long, less intense warm spell) can be found in Appendix D.

5. Passive Design analysis.

Throughout the pre-planning process the façade design has been developed in tandem with the passive design and overheating analysis. Modelling of the development has been conducted and workshops have taken place with the design team to feedback the results and develop the façade. The main drivers behind this were to reduce overheating and energy use. The following list details a timeline of the process:

- First iteration – Hoare Lea (HL) selected several worse-case scenario dwellings. The results were showing a high risk of overheating for the current design and therefore the following measures were suggested: reducing glazing areas, providing thermal mass, external and internal shading together with providing safe night-time ventilation through operable windows and opaque ventilation louvres.
- Second iteration – HL ran an additional iteration for 4 sample dwellings – following discussions with the architect (AHMM) - on a façade critical for visualisation. HL confirmed that for those less exposed dwellings, in order to minimise the overheating risk, glazing reductions, together with opaque ventilation louvres, external shading and thermal mass should be included.
- AHMM reviewed the glazing areas and provided updated plans and elevations including glazing reductions and ventilation louvres where it was deemed possible, depending on daylight access.
- Third iteration (planning): HL selected several more worse-case scenario dwellings as per the GLA requirement for planning. These dwelling incorporate several of the passive design measures listed below; the results can be found in the results section of this report and also Appendix B.

The information in this section highlights the options considered throughout the process, with a summary of those incorporated into the design alongside those which weren't incorporated and the reasons behind their exclusion.

5.1 Considered Passive design measures.

5.1.1 **Balconies**

External balconies, whether inset or bolt-on provide the spaces below with a good amount of shading, especially to southern façades. This will reduce overheating and therefore energy and works well with the architectural design of the development. It is for this reason that balconies have been included in the design.

The design of Holloway includes balconies and was therefore simulated within the modelling. The image to the right shows example balconies (from a different project for reference only).

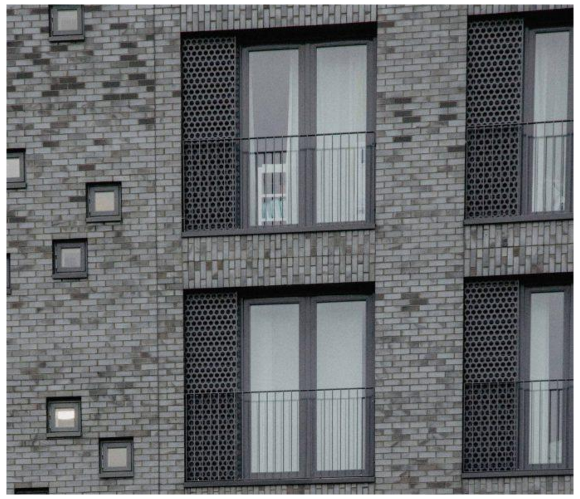
5.1.2 **Ventilation Panels (Louvres)**

Incorporating ventilation panels (louvres) into the design will reduce the solar gain entering the space and increase the ventilation. This will therefore help to mitigate against overheating.

As Criterion 2 of TM59 focuses on the overnight temperatures in the bedrooms, it is important to have good levels of secure ventilation. It was therefore noted early in the design process that louvres would be required.

In addition, the acoustician recommended that they were used to help comply with internal noise levels where windows were required to be closed.

The design of Holloway includes ventilation panels (louvres) and was therefore simulated within the modelling.



In a number of dwellings ventilation panels could not be included, because of lack of wall spaces and daylight requirements.

The image shows an example of ventilation panels (from a different project for reference only).

5.1.3 **Internal Blinds**

Internal blinds can assist with mitigating overheating by blocking solar gains from entering the space and/or reflecting unwanted solar gains away from the room. With internal blinds some solar gain has already passed through the glass before being reflected by the blind and therefore will contribute a little to raising the temperature of the room and therefore are considered less effective than external blinds.

However, given the fact that they are easy to install and to maintain, they may be considered to be included in the design.

The image to the right shows an example of internal blinds (from a different project for reference only).

The results showing the impact of internal blinds alone can be found in Appendix B – Iteration 1.

5.1.4 **External Blinds**

Typically, external blinds perform better than internal blinds as they can completely stop any solar gains from hitting the glass. When used correctly, these can help control the temperature in the room. Light-coloured external blinds/shutters will offer a high reflectance.

Because of their potential maintenance related costs, in some cases internal blinds could be preferred to external blinds

The external blinds boxes will be recessed and hidden as per the picture to the right.

The results showing the impact of external blinds alone can be found in Appendix B – Iteration 2.

5.1.5 **Opening Type**

The type of opening can have a significant effect on mitigating overheating. Windows or doors with a high amount of opening free area can enable passive ventilation and therefore will remove heat from the spaces.

In the iterations referenced above, when the internal room temperatures exceed 22°C, glazed doors to balconies operate as fully side hung during the daytime and closed during the night-time. Bedroom and living room windows operate as fully side hung during the daytime and with a bottom hung 100mm restrictor overnight to protect from rainfall.

5.1.6 **Increased Thermal Mass**

A higher thermal mass can have a benefit regarding mitigating overheating if the thermal mass is exposed. Exposed thermal mass to bedrooms and living areas was tested and found that only increasing thermal mass in the living areas had a benefit regarding mitigating overheating. However, there are other aspects of both the architectural and structure design where a higher thermal mass has diminishing returns in performance. The thermal mass of this building is already significant and exceeds the minimum standard for building regulations. It is therefore not proposed to increase the thermal mass any higher than the current design.

The results using higher thermal mass alone can be found in Appendix B – Iteration 3.

5.1.7 Additional Night-time Ventilation

During hot periods, occupants will generally leave windows and doors open overnight when the external air temperature is cool. The baseline iteration includes top-hung windows to bedrooms open 100mm overnight, while balcony doors remain closed. The possibility to open living area doors overnight was considered, however, TM59 requires that windows and doors should only be left open overnight if secure and rainproof. It is for this reason that the balcony doors were set to open only 20% overnight (this could be achievable through a door blocker), to remain secure and rainproof. The results using the additional night-time ventilation are included in the results section of this report.

5.2 Passive design measures summary

The following passive design measures have been included, where technically and economically viable within the development (Baseline passive design solution):

- Glazing reductions
- Solar control glass (g-value of 0.35)
- Balconies
- Tilt/turn windows - side hung during the day and bottom hung overnight
- Ventilation panels (louvres)

The following additional high impact passive design measures (Enhanced passive design solution) have been identified to reduce further the overheating risk through passive design measures within the dwellings that are not meeting the TM59 requirements with the above passive design measures:

- External blinds
- Side hung balcony doors 20% open overnight

An additional option has been assessed which includes MVHR with tempered air. This option (tempered air solution – with external blinds) may be required for the dwellings with limitations to natural ventilation provision due to acoustic constraints and the dwellings that baseline and enhanced passive design measures alone are either not viable or would not suffice to meet the TM59 overheating requirements.

The results of this design solution can be found in the results section of this report.

6. Fabric Parameters and Internal Gains.

6.1 Building Fabric.

The building fabric parameters have been devised in conjunction with those stated in the Energy Strategy by Hoare Lea. A summary of the thermal envelope values used in the assessment is shown in Table 4 and Table 5.

Table 4 - Element U-Values

Element	U-Value (W/m^{2}K)
External Wall	0.13
Window (glazing and frame)	1.20
Heat Loss Floors	0.10
Heat Loss Roofs	0.10

Table 5 - Further Glazing Unit Parameters

Parameter	Value
g-value	0.35
Frame Proportion	15%
Light transmittance	0.71

6.1.1 External blinds

Table 6 below shows the specification for the external blinds.

Table 6 - Blinds Specification

	Parameter	Value
External blinds	Operational Profile	Solar irradiation > 200 W/m^2
	Transmission factor	0.05

6.2 Internal Gains.

In line with TM59 methodology, this section sets out the internal heat gains that have been assumed in this model.

6.2.1 Occupancy

These are the gains associated with humans in the space. Based on CIBSE Guide A (2015a), a maximum sensible heat gain of 75 W/person and a maximum latent heat gain of 55 W/person are assumed in the living spaces. An allowance of 30% reduced gain during sleeping is based on Addendum G to ANSI/ASHRAE Standard 55-2010, Table 5.2.1.2 'Metabolic rates for typical tasks'. The values used are summarised in Table 7 below.

Table 7 - Occupancy Heat Gains

Gains	Living / Kitchen Value per Person (W)	Bedroom (sleeping) Value per Person (W)
Sensible	75	52.5
Latent	55	38.5

Table 8 shows the occupancy levels in each room. The profiles used to describe when the occupants will be present are shown in Appendix A and were extracted from TM59 methodology.

Table 8 - Occupancy Levels

Dwelling	Unit / Room Type	Occupancy
1 Bedroom units	Kitchen / Living / Dining	1 person from 9am to 10pm; room is unoccupied for the rest of the day
	Double Bedroom	2 people at 70% gains from 11pm to 8am; 2 people at full gains from 8am to 9am and from 10pm to 11pm; 1 person at full gain from 9am to 10pm.
2 Bedroom units	Kitchen / Living / Dining	2 people from 9am to 10pm; room is unoccupied for the rest of the day
	Single Bedroom	1 person at 70% gains from 11pm to 8am 1 person at full gains from 8am to 11pm
	Double Bedroom	2 people at 70% gains from 11pm to 8am; 2 people at full gains from 8am to 9am and from 10pm to 11pm; 1 person at full gain from 9am to 10pm.
3 Bedroom units	Kitchen / Living / Dining	3 people from 9am to 10pm; room is unoccupied for the rest of the day
	Single Bedroom	1 person at 70% gains from 11pm to 8am 1 person at full gains from 8am to 11pm
	Double Bedroom	2 people at 70% gains from 11pm to 8am; 2 people at full gains from 8am to 9am and from 10pm to 11pm; 1 person at full gain from 9am to 10pm.

6.2.2 **Lighting**

An internal lighting gain of 2.0 W/m² from 6pm to 11pm has been assumed to the living / dining / kitchen aspect rooms and bedrooms, as acceptable daylight levels are available to these dwellings.

6.2.3 **Casual Gains**

There are gains associated with the equipment in the space. The values were taken from TM59 and are summarised in Table 9 below.

Table 9 - Equipment Load

Dwelling	Unit / Room Type	Equipment Load
1 Bedroom units	Kitchen / Living / Dining	Peak load of 450 W from 6 pm to 8 pm 200 W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 am Base load of 85 W for the rest of the day
	Double Bedroom	Peak load of 80 W from 8 am to 11 pm Base load of 10 W during sleeping hours
2 Bedroom units	Kitchen / Living / Dining	Peak load of 450 W from 6 pm to 8 pm 200 W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 am Base load of 85 W for the rest of the day
	Single Bedroom	Peak load of 80 W from 8 am to 11 pm Base load of 10 W during sleeping hours
	Double Bedroom	Peak load of 80 W from 8 am to 11 pm Base load of 10 W during sleeping hours
3 Bedroom units	Kitchen / Living / Dining	Peak load of 450 W from 6 pm to 8 pm 200 W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 am Base load of 85 W for the rest of the day
	Single Bedroom	Peak load of 80 W from 8 am to 11 pm Base load of 10 W during sleeping hours
	Double Bedroom	Peak load of 80 W from 8 am to 11 pm Base load of 10 W during sleeping hours

In addition to equipment load, a heat loss from the community heating system has also been included within the ceiling void of the communal corridors and hallways. This includes heat loss from domestic hot water distribution pipework. A further heat loss from the HIU within the utility cupboard has been included. Table 10 summarises these heat losses.

Table 10 - Heat loss from community domestic hot water system

Room	Heat Loss
Utility room containing HIU and LTHW pipework	40W
LTHW Pipework located in the ceiling void of the hallway	46W
Pipework LTHW located in the ceiling void of the communal corridor	7.4W/m²

7. Ventilation.

7.1 Passive Ventilation.

Windows and doors to balconies are designed to be openable, therefore the occupants will have the opportunity to open windows and doors during the hottest days of the year. Results including openable windows have been included in this report to assess the overheating risk after adopting this strategy. Windows are considered open when both the internal dry bulb temperature exceeds 22°C and the room is occupied, in line with the TM59 methodology.

The openable windows strategy encompasses the following opening types based on exposure of the window, the opening category, openable area, maximum opening angle, opening proportion and profile. Table 11 includes assumptions given to all opening types. Further information on the passive design is included in Section 5.1.3.

Table 11 – Window Opening Types

Opening Types	Opening Category	Exposure Type	Openable Area (%)	Max. Angle (°)	Profile	Location
1	Side hung window/door (Balcony doors)	47. High-rise semi-exposed wall h/H=0.8	80%	90	Daytime: On when >22°C Night-time. off	Living areas
2	Side/Bottom hung window (tilt and turn windows)	47. High-rise semi-exposed wall h/H=0.8	80%	90	Daytime: On when >22°C Night-time: when >22°C 100mm bottom-hung open when >22°C	Living areas/bedrooms
3	Side hung window/door (Opaque louver)	47. High-rise semi-exposed wall h/H=0.8	44% (0.3 coefficient of discharge)	90	Daytime: On when >22°C Night-time: On when >22°C	Bedrooms
4	Side hung window/door (Opaque louver - attenuated)	47. High-rise semi-exposed wall h/H=0.8	35% (0.24 coefficient of discharge)	90	Daytime: On when >22°C Night-time: On when >22°C	Bedrooms
5	Internal doors	Internal door	90%	90	Daytime: fully open	Living areas/bedrooms

7.2 Infiltration.

An infiltration rate of 0.25 air changes per hour has been used for the dwellings. This infiltration rate has been derived from CIBSE Guide A (2015a) for a dwelling with an air permeability of 3.00m^3/hm^2 at 50Pa for high-rise dwellings.

7.3 Mechanical Ventilation and Enhanced Tempered Air.

Apartments will have a mechanical ventilation with heat recovery (MVHR) unit. Extract air will be taken from the bathrooms, utility room and the kitchen. The first two sets of results have background mechanical ventilation, while the third set of results has enhanced mechanical ventilation with tempered air. The tempered air will be distributed into the living/kitchen and bedrooms at 16°C.

A tempered air solution works alongside the MVHR by cooling the air to 16°C before supplying it into the space. If the outside air is cooler than 16°C then it will supply the outside air without further cooling. This is the most energy efficient way of reducing indoor temperatures by mechanical means.

The following mechanical ventilation rates were included (see Table 12).

Enhanced ventilation flow rates are in addition to the background ventilation flow rates.

Table 12 – Mechanical Ventilation Flow Rates

Room	Background Mechanical Ventilation Flow Rate (l/s)	Tempered air solution - Ventilation Flow Rate (l/s)
Bedrooms (1 & 2-bed units)	8	20
Bedrooms (3-bed units)	8	18
Living rooms (3-bed units only)	10	18
Kitchens (3-bed units only)	13	18
Living room/kitchen/dining room (1 & 2-bed units)	20	50
Living room/kitchen/dining room (3-bed units)	20	36
Corridors	-	-

The maximum assumed flow rate per apartment is 90 l/s. The flow rate of the tempered air solution could be potentially varied at the next stage of design dwelling by dwelling depending on the included passive design measures (e.g. external/internal blinds).

7.4 Centralised Cooling.

A centralised cooling option would only be possible by having a centralised air handling unit (AHU) and fan coil units instead of MVHR's. The occupant would still be required to have control of the system. This system is much more energy intensive than a tempered air solution and would result in ongoing maintenance. In addition, if the apartment is not occupied then the centralised system would still be running and thus there would be no energy saving. On top of this, the additional embodied carbon associated with a centralised cooling system would have a negative effect on the development.

As a result of the above, a centralised cooling system is not deemed feasible for the residential elements of the development.

7.5 Corridor Cooling.

The communal corridors will be supplied with mechanical cooling via fan coil fed by the ASHP units placed on the roof to reduce the risk of overheating. The FCU's will operate to keep the internal temperature within the corridors less than 28°C. The ambient loop heat gain has been reduced through increased insulation and low water temperatures. The possibility to omit cooling and provide mechanical ventilation instead through the smoke shafts will be investigated at the next stage of design together with the potential inclusion of further pipe insulation to minimise pipe heat gains and the required ventilation flow rate.

8. Results.

8.1 Iteration 1 - Baseline passive design solution.

Table 13 below shows the results of the simulation with background mechanical ventilation, windows and doors open, g-value of 0.35, ventilation panels and no blinds – the baseline passive design solution.

Table 13 - TM59 Criteria Compliance Results

Iteration 1 – Baseline passive design solution	TM59 Criterion 1	TM59 Criterion 2	Communal Corridors	Compliance
Room	(% Hours of Exceedance)	(% annual hours above 26°C between 22:00 – 07:00)	(% annual hours above 28°C)	
Target	≤3%	≤32 hours	≤3%	
02-B3-Flat 5-1B2P-Bed	1.6	37		FAIL
02-B3-Flat 5-1B2P-LK	3.1			FAIL
02-B3-Flat 6-2B4P- Bed 1	1.8	47		FAIL
02-B3-Flat 6-2B4P-Bed 2	1.8	44		FAIL
02-B3-Flat 6-2B4P-LK	3.1			FAIL
02-D1-Flat 4-3B5P- Single bed	2	36		FAIL
02-D1-Flat 4-3B5P-Bed 1	1.4	49		FAIL
02-D1-Flat 4-3B5P-Bed 2	1.6	43		FAIL
02-D1-Flat 4-3B5P-LK	2.8			PASS
02-E1-Flat 11-1B2P-Bed	1.6	45		FAIL
02-E1-Flat 11-1B2P-LK	3.1			FAIL
02-E1-Flat 12-1B2P-Bed	1.7	47		FAIL
02-E1-Flat 12-1B2P-LK	3.4			FAIL
03-A2-Flat 3-1B2P-Bed	1.4	47		FAIL
03-A2-Flat 3-1B2P-LK	2.1			PASS
04-A1-Flat 3-3B5P- Single bed	1.5	23		PASS
04-A1-Flat 3-3B5P-Bed 1	1.3	28		PASS
04-A1-Flat 3-3B5P-Bed 2	1.1	26		PASS
04-A1-Flat 3-3B5P-K	2.9			PASS
04-A1-Flat 3-3B5P-L	3.6			FAIL
04-A2-Flat 3-1B2P-Bed	1.6	32		PASS
04-A2-Flat 3-1B2P-LK	2.9			PASS
04-A3-Flat 5-2B4P-Bed 1	1.6	33		FAIL
04-A3-Flat 5-2B4P-Bed 2	1.3	35		FAIL
04-A3-Flat 5-2B4P-LK	2.6			PASS
04-A3-Flat 6-1B2P-Bed	1.4	31		PASS
04-A3-Flat 6-1B2P-LK	2.7			PASS
04-B2-Flat 4-3B5P- Single bed	1.5	22		PASS
04-B2-Flat 4-3B5P-Bed 1	1.3	24		PASS
04-B2-Flat 4-3B5P-Bed 2	1.3	24		PASS
04-B2-Flat 4-3B5P-K	2.8			PASS
04-B2-Flat 4-3B5P-L	3.4			FAIL
04-B3-Flat 5-1B2P-Bed	1.4	26		PASS
04-B3-Flat 5-1B2P-LK	2.8			PASS
04-B3-Flat 6-2B4P- Bed 1	1.6	34		FAIL
04-B3-Flat 6-2B4P-Bed 2	1.7	33		FAIL
04-B3-Flat 6-2B4P-LK	2.9			PASS
04-B3-Flat 8-1B2P-Bed	1.5	28		PASS
04-B3-Flat 8-1B2P-LK	3.1			FAIL
04-B4-Flat 2-2B4P-Bed 1	1.6	59		FAIL
04-B4-Flat 2-2B4P-Bed 2	1.7	50		FAIL
04-B4-Flat 2-2B4P-LK	2.8			PASS
04-B4-Flat 4-1B2P-Bed	1.9	64		FAIL
04-B4-Flat 4-1B2P-LK	2.7			PASS
04-B5-Flat 7-1B2P-Bed	1.3	58		FAIL
04-B5-Flat 7-1B2P-LK	2			PASS
04-C2-Flat 06-2B4P-Bed 1	1.8	50		FAIL
04-C2-Flat 06-2B4P-Bed 2	1.8	51		FAIL
04-C2-Flat 06-2B4P-LK	3			PASS
04-C2-Flat 5-1B2P-Bed	2.3	92		FAIL
04-C2-Flat 5-1B2P-LK	3.3			FAIL

Iteration 1 – Baseline passive design solution	TM59 Criterion 1	TM59 Criterion 2	Communal Corridors	Compliance
Room	(% Hours of Exceedance)	(% annual hours above 26°C between 22:00 – 07:00)	(% annual hours above 28°C)	
Target	≤3%	≤32 hours	≤3%	
04-D1-Flat 2-2B4P-Bed 1	1.4	36		FAIL
04-D1-Flat 2-2B4P-Bed 2	1.6	32		PASS
04-D1-Flat 2-2B4P-LK	2.9			PASS
04-D1-Flat 4-3B5P- Single bed	1.9	25		PASS
04-D1-Flat 4-3B5P-Bed 1	1.4	49		FAIL
04-D1-Flat 4-3B5P-Bed 2	1.5	30		PASS
04-D1-Flat 4-3B5P-LK	2.8			PASS
04-D2-Flat 4-2B4P-Bed 1	1.3	39		FAIL
04-D2-Flat 4-2B4P-Bed 2	1.6	35		FAIL
04-D2-Flat 4-2B4P-LK	3.2			FAIL
04-E1-Flat 12-1B2P-Bed	1.5	31		PASS
04-E1-Flat 12-1B2P-LK	3.4			FAIL
04-E1-Flt 11-1B2P-Bed	1.4	28		PASS
04-E1-Flt 11-1B2P-LK	3			PASS
04-E2-Flat 3-2B4P-Bed 1	1.5	48		FAIL
04-E2-Flat 3-2B4P-Bed 2	1.7	47		FAIL
04-E2-Flat 3-2B4P-LK	3.2			FAIL
04-E2-Flat 4-2B4P-Bed 1	1.6	41		FAIL
04-E2-Flat 4-2B4P-Bed 2	1.5	45		FAIL
04-E2-Flat 4-2B4P-LK	3.3			FAIL
06-B6-Flat 4-2B4P-Bed 1	1.2	50		FAIL
06-B6-Flat 4-2B4P-Bed 2	1.6	42		FAIL
06-B6-Flat 4-2B4P-LK	3.3			FAIL
06-B6-Flat 9-2B3P- Single bed	1.8	45		FAIL
06-B6-Flat 9-2B3P-Bed 1	1.6	51		FAIL
06-B6-Flat 9-2B3P-LK	3.3			FAIL
06-E1-Flat 4-1B2P-Bed	1.6	25		PASS
06-E1-Flat 4-1B2P-LK	3.1			FAIL
06-E1-Flat 5-1B2P-Bed	1.6	30		PASS
06-E1-Flat 5-1B2P-LK	3.5			FAIL
06-E2-Flat 4-2B4P-Bed 1	1.8	38		FAIL
06-E2-Flat 4-2B4P-Bed 2	1.6	41		FAIL
06-E2-Flat 4-2B4P-LK	3.4			FAIL
07-A3-Flat 6-1B2P-Bed	1.7	41		FAIL
07-A3-Flat 6-1B2P-LK	2.7			PASS
07-B3-Flat 5-1B2P-Bed	1.5	25		PASS
07-B3-Flat 5-1B2P-LK	2.7			PASS
07-B3-Flat 6-2B3P- Single bed	2	27		PASS
07-B3-Flat 6-2B3P-Bed	1.6	33		FAIL
07-B3-Flat 6-2B3P-LK	1.8			PASS
07-D1-Flat 2-2B4P-Bed 1	1.4	32		PASS
07-D1-Flat 2-2B4P-Bed 2	1.6	29		PASS
07-D1-Flat 2-2B4P-LK	3.1			FAIL
07-D1-Flat 4-3B5P- Single bed	1.8	25		PASS
07-D1-Flat 4-3B5P-Bed 1	1.6	48		FAIL
07-D1-Flat 4-3B5P-Bed 2	1.5	31		PASS

Iteration 1 – Baseline passive design solution	TM59 Criterion 1	TM59 Criterion 2	Communal Corridors	Compliance
Room	(% Hours of Exceedance)	(% annual hours above 26°C between 22:00 – 07:00)	(% annual hours above 28°C)	
Target	≤3%	≤32 hours	≤3%	
07-D1-Flat 4-3B5P-LK	3.1			FAIL
08-A3-Flat 4-2B4P-Bed 1	1.6	24		PASS
08-A3-Flat 4-2B4P-Bed 2	1.4	30		PASS
08-A3-Flat 4-2B4P-LK	2.7			PASS
08-A3-Flat 5-2B4P-Bed 1	1.6	23		PASS
08-A3-Flat 5-2B4P-Bed 2	1.5	27		PASS
08-A3-Flat 5-2B4P-LK	3.4			FAIL
09-B5-Flat 5-1B2P-Bed	1.6	54		FAIL
09-B5-Flat 5-1B2P-LK	2.9			PASS
09-B5-Flat 6-2B3P- Single bed	1.8	43		FAIL
09-B5-Flat 6-2B3P-Bed	1.3	49		FAIL
09-B5-Flat 6-2B3P-LK	2.8			PASS
09-B5-Flat 7-1B2P-Bed	1.6	61		FAIL
09-B5-Flat 7-1B2P-LK	3			PASS
09-C2-Flat 3 - 3B5P- Single bed	2	43		FAIL
09-C2-Flat 3 - 3B5P-Bed 1	1.9	48		FAIL
09-C2-Flat 3 - 3B5P-Bed 2	2	50		FAIL
09-C2-Flat 3 - 3B5P-K	2.4			PASS
09-C2-Flat 3 - 3B5P-L	3.4			FAIL
10-C1-Flat 5-1B2P-Bed	1.9	43		FAIL
10-C1-Flat 5-1B2P-LK	3.4			FAIL
10-C1-Flat 6-2B4P-Bed 2	1.9	51		FAIL
10-C1-Flat 6-2B4P-Bed 2	2.1	51		FAIL

Iteration 1 – Baseline passive design solution	TM59 Criterion 1	TM59 Criterion 2	Communal Corridors	Compliance
Room	(% Hours of Exceedance)	(% annual hours above 26°C between 22:00 – 07:00)	(% annual hours above 28°C)	
Target	≤3%	≤32 hours	≤3%	
10-C1-Flat 6-2B4P-LK	3.2			FAIL
02-B3-communal corridor			0	PASS
02-D1-communal corridor			0	PASS
02-E1-Communal Corridor 1			0	PASS
02-E1-Communal Corridor 2			0	PASS
02-E1-Communal Corridor 3			0	PASS
03-A2-Communal Corridor			0	PASS
04-A1-Communal Corridor			0	PASS
04-A2-Communal Corridor			0	PASS
04-A3-Communal Corridor			0	PASS
04-B2-communal corridor			0	PASS
04-B3-communal corridor			0	PASS
04-B4- Communal corridor			0	PASS
04-B5- Communal corridor			0	PASS
04-C2-communal corridor			0	PASS
04-D1-communal corridor			0	PASS
04-D2-communal corridor			0	PASS
04-E1-Communal Corridor 1			0	PASS
04-E2-Communal Corridor			0	PASS
06-B6-communal corridor			0	PASS
06-E1-Communal Corridor 1			0	PASS
06-E1-Communal Corridor 2			0	PASS
06-E2-Communal Corridor			0	PASS

Iteration 1 – Baseline passive design solution	TM59 Criterion 1	TM59 Criterion 2	Communal Corridors	Compliance
Room	(% Hours of Exceedance)	(% annual hours above 26°C between 22:00 – 07:00)	(% annual hours above 28°C)	
Target	≤3%	≤32 hours	≤3%	
07-A3-Communal Corridor			0	PASS
07-B3- communal corridor			0	PASS
07-D1-communal corridor			0	PASS
08-A3-Communal Corridor			0	PASS
09-B5-communal corridor			0	PASS
09-C2-communal corridor			0	PASS
10-C1-communal corridor			0	PASS

8.2 Iteration 2 - Enhanced passive design solution.

Table 14 below shows the results of the simulation with the addition of external blinds and night-time ventilation within the living-kitchen areas.

Table 14 - TM59 Criteria Compliance Results

Iteration 2 Enhanced passive design solution	TM59 Criterion 1	TM59 Criterion 2	Communal Corridors	Compliance
Room	(% Hours of Exceedance)	(% annual hours above 26°C between 22:00 – 07:00)	(% annual hours above 28°C)	
Target	≤3%	≤32 hours	≤3%	
02-B3-Flat 5-1B2P-Bed	1.4	30		PASS
02-B3-Flat 5-1B2P-LK	2.6			PASS
02-B3-Flat 6-2B4P- Bed 1	1.4	45		FAIL
02-B3-Flat 6-2B4P-Bed 2	1.7	39		FAIL
02-B3-Flat 6-2B4P-LK	2.4			PASS
02-D1-Flat 4-3B5P- Single bed	1.8	31		PASS
02-D1-Flat 4-3B5P-Bed 1	1.4	45		FAIL
02-D1-Flat 4-3B5P-Bed 2	1.5	41		FAIL
02-D1-Flat 4-3B5P-LK	2.7			PASS
02-E1-Flat 11-1B2P-Bed	1.5	41		FAIL
02-E1-Flat 11-1B2P-LK	2.9			PASS
02-E1-Flat 12-1B2P-Bed	1.5	40		FAIL
02-E1-Flat 12-1B2P-LK	3			PASS
03-A2-Flat 3-1B2P-Bed	1.4	41		FAIL
03-A2-Flat 3-1B2P-LK	1.9			PASS
04-A1-Flat 3-3B5P- Single bed	1.5	23		PASS
04-A1-Flat 3-3B5P-Bed 1	1.3	27		PASS
04-A1-Flat 3-3B5P-Bed 2	1.1	25		PASS
04-A1-Flat 3-3B5P-K	2.8			PASS
04-A1-Flat 3-3B5P-L	3.3			FAIL
04-A2-Flat 3-1B2P-Bed	1.4	25		PASS
04-A2-Flat 3-1B2P-LK	2.6			PASS
04-A3-Flat 5-2B4P-Bed 1	1.6	28		PASS
04-A3-Flat 5-2B4P-Bed 2	1.3	34		FAIL
04-A3-Flat 5-2B4P-LK	2.5			PASS
04-A3-Flat 6-1B2P-Bed	1.3	27		PASS

Iteration 2 Enhanced passive design solution	TM59 Criterion 1	TM59 Criterion 2	Communal Corridors	Compliance
Room	(% Hours of Exceedance)	(% annual hours above 26°C between 22:00 – 07:00)	(% annual hours above 28°C)	
Target	≤3%	≤32 hours	≤3%	
04-A3-Flat 6-1B2P-LK	2.4			PASS
04-B2-Flat 4-3B5P- Single bed	1.1	21		PASS
04-B2-Flat 4-3B5P-Bed 1	0.9	22		PASS
04-B2-Flat 4-3B5P-Bed 2	1.2	24		PASS
04-B2-Flat 4-3B5P-K	2			PASS
04-B2-Flat 4-3B5P-L	2.8			PASS
04-B3-Flat 5-1B2P-Bed	1.3	23		PASS
04-B3-Flat 5-1B2P-LK	2.6			PASS
04-B3-Flat 6-2B4P- Bed 1	1.4	33		FAIL
04-B3-Flat 6-2B4P-Bed 2	1.5	27		PASS
04-B3-Flat 6-2B4P-LK	2.3			PASS
04-B3-Flat 8-1B2P-Bed	1.3	26		PASS
04-B3-Flat 8-1B2P-LK	2.4			PASS
04-B4-Flat 2-2B4P-Bed 1	1.4	48		FAIL
04-B4-Flat 2-2B4P-Bed 2	1.6	44		FAIL
04-B4-Flat 2-2B4P-LK	2.5			PASS
04-B4-Flat 4-1B2P-Bed	1.4	53		FAIL
04-B4-Flat 4-1B2P-LK	2.5			PASS
04-B5-Flat 7-1B2P-Bed	1.2	48		FAIL
04-B5-Flat 7-1B2P-LK	1.6			PASS
04-C2-Flat 06-2B4P-Bed 1	1.4	46		FAIL
04-C2-Flat 06-2B4P-Bed 2	1.6	45		FAIL
04-C2-Flat 06-2B4P-LK	2.4			PASS
04-C2-Flat 5-1B2P-Bed	1.7	78		FAIL
04-C2-Flat 5-1B2P-LK	2.7			PASS
04-D1-Flat 2-2B4P-Bed 1	1.4	33		FAIL
04-D1-Flat 2-2B4P-Bed 2	1.6	30		PASS
04-D1-Flat 2-2B4P-LK	2.8			PASS
04-D1-Flat 4-3B5P- Single bed	1.6	24		PASS

Iteration 2 Enhanced passive design solution	TM59 Criterion 1	TM59 Criterion 2	Communal Corridors	Compliance
Room	(% Hours of Exceedance)	(% annual hours above 26°C between 22:00 – 07:00)	(% annual hours above 28°C)	
Target	≤3%	≤32 hours	≤3%	
04-D1-Flat 4-3B5P-Bed 1	1.4	44		FAIL
04-D1-Flat 4-3B5P-Bed 2	1.4	30		PASS
04-D1-Flat 4-3B5P-LK	2.5			PASS
04-D2-Flat 4-2B4P-Bed 1	1.1	39		FAIL
04-D2-Flat 4-2B4P-Bed 2	1.5	33		FAIL
04-D2-Flat 4-2B4P-LK	3			PASS
04-E1-Flat 12-1B2P-Bed	1.5	26		PASS
04-E1-Flat 12-1B2P-LK	3			PASS
04-E1-Flt 11-1B2P-Bed	1.4	26		PASS
04-E1-Flt 11-1B2P-LK	2.9			PASS
04-E2-Flat 3-2B4P-Bed 1	1.4	48		FAIL
04-E2-Flat 3-2B4P-Bed 2	1.6	40		FAIL
04-E2-Flat 3-2B4P-LK	3			PASS
04-E2-Flat 4-2B4P-Bed 1	1.5	36		FAIL
04-E2-Flat 4-2B4P-Bed 2	1.5	44		FAIL
04-E2-Flat 4-2B4P-LK	2.7			PASS
06-B6-Flat 4-2B4P-Bed 1	1.1	48		FAIL
06-B6-Flat 4-2B4P-Bed 2	1.5	37		FAIL
06-B6-Flat 4-2B4P-LK	2.9			PASS
06-B6-Flat 9-2B3P- Single bed	1.6	37		FAIL
06-B6-Flat 9-2B3P-Bed 1	1.5	48		FAIL
06-B6-Flat 9-2B3P-LK	3			PASS
06-E1-Flat 4-1B2P-Bed	1.4	24		PASS
06-E1-Flat 4-1B2P-LK	2.8			PASS

Iteration 2 Enhanced passive design solution	TM59 Criterion 1	TM59 Criterion 2	Communal Corridors	Compliance
Room	(% Hours of Exceedance)	(% annual hours above 26°C between 22:00 – 07:00)	(% annual hours above 28°C)	
Target	≤3%	≤32 hours	≤3%	
06-E1-Flat 5-1B2P-Bed	1.4	25		PASS
06-E1-Flat 5-1B2P-LK	2.8			PASS
06-E2-Flat 4-2B4P-Bed 1	1.6	31		PASS
06-E2-Flat 4-2B4P-Bed 2	1.5	37		FAIL
06-E2-Flat 4-2B4P-LK	2.7			PASS
07-A3-Flat 6-1B2P-Bed	1	33		FAIL
07-A3-Flat 6-1B2P-LK	1.8			PASS
07-B3-Flat 5-1B2P-Bed	1.2	23		PASS
07-B3-Flat 5-1B2P-LK	2.2			PASS
07-B3-Flat 6-2B3P- Single bed	1.4	26		PASS
07-B3-Flat 6-2B3P-Bed	1	29		PASS
07-B3-Flat 6-2B3P-LK	1.3			PASS
07-D1-Flat 2-2B4P-Bed 1	1.4	30		PASS
07-D1-Flat 2-2B4P-Bed 2	1.6	26		PASS
07-D1-Flat 2-2B4P-LK	2.7			PASS
07-D1-Flat 4-3B5P- Single bed	1.6	23		PASS
07-D1-Flat 4-3B5P-Bed 1	1.2	40		FAIL
07-D1-Flat 4-3B5P-Bed 2	1.4	28		PASS
07-D1-Flat 4-3B5P-LK	2.2			PASS
08-A3-Flat 4-2B4P-Bed 1	1.4	22		PASS
08-A3-Flat 4-2B4P-Bed 2	1.2	28		PASS
08-A3-Flat 4-2B4P-LK	2.2			PASS
08-A3-Flat 5-2B4P-Bed 1	1.5	21		PASS

Iteration 2 Enhanced passive design solution	TM59 Criterion 1	TM59 Criterion 2	Communal Corridors	Compliance
Room	(% Hours of Exceedance)	(% annual hours above 26°C between 22:00 – 07:00)	(% annual hours above 28°C)	
Target	≤3%	≤32 hours	≤3%	
08-A3-Flat 5-2B4P-Bed 2	1.4	25		PASS
08-A3-Flat 5-2B4P-LK	2.4			PASS
09-B5-Flat 5-1B2P-Bed	1.4	42		FAIL
09-B5-Flat 5-1B2P-LK	2.6			PASS
09-B5-Flat 6-2B3P- Single bed	1.6	31		PASS
09-B5-Flat 6-2B3P-Bed	1.2	43		FAIL
09-B5-Flat 6-2B3P-LK	2.5			PASS
09-B5-Flat 7-1B2P-Bed	1.4	42		FAIL
09-B5-Flat 7-1B2P-LK	2			PASS
09-C2-Flat 3 - 3B5P- Single bed	1.4	38		FAIL
09-C2-Flat 3 - 3B5P-Bed 1	1.3	45		FAIL
09-C2-Flat 3 - 3B5P-Bed 2	1.3	47		FAIL
09-C2-Flat 3 - 3B5P-K	2.2			PASS
09-C2-Flat 3 - 3B5P-L	2.7			PASS
10-C1-Flat 5-1B2P-Bed	1.5	37		FAIL
10-C1-Flat 5-1B2P-LK	2.7			PASS
10-C1-Flat 6-2B4P-Bed 2	1.4	43		FAIL
10-C1-Flat 6-2B4P-Bed 2	1.3	43		FAIL
10-C1-Flat 6-2B4P-LK	2.4			PASS
02-B3-communal corridor			0	PASS
02-D1-communal corridor			0	PASS
02-E1-Communal Corridor 1			0	PASS
02-E1-Communal Corridor 2			0	PASS

Iteration 2 Enhanced passive design solution	TM59 Criterion 1	TM59 Criterion 2	Communal Corridors	Compliance
Room	(% Hours of Exceedance)	(% annual hours above 26°C between 22:00 – 07:00)	(% annual hours above 28°C)	
Target	≤3%	≤32 hours	≤3%	
02-E1-Communal Corridor 3			0	PASS
03-A2-Communal Corridor			0	PASS
04-A1-Communal Corridor			0	PASS
04-A2-Communal Corridor			0	PASS
04-A3-Communal Corridor			0	PASS
04-B2-communal corridor			0	PASS
04-B3-communal corridor			0	PASS
04-B4- Communal corridor			0	PASS
04-B5- Communal corridor			0	PASS
04-C2-communal corridor			0	PASS
04-D1-communal corridor			0	PASS
04-D2-communal corridor			0	PASS
04-E1-Communal Corridor 1			0	PASS
04-E2-Communal Corridor			0	PASS
06-B6-communal corridor			0	PASS
06-E1-Communal Corridor 1			0	PASS
06-E1-Communal Corridor 2			0	PASS
06-E2-Communal Corridor			0	PASS
07-A3-Communal Corridor			0	PASS
07-B3- communal corridor			0	PASS
07-D1-communal corridor			0	PASS
08-A3-Communal Corridor			0	PASS
09-B5-communal corridor			0	PASS

Iteration 2 Enhanced passive design solution	TM59 Criterion 1	TM59 Criterion 2	Communal Corridors	Compliance
Room	(% Hours of Exceedance)	(% annual hours above 26°C between 22:00 – 07:00)	(% annual hours above 28°C)	
Target	≤3%	≤32 hours	≤3%	
09-C2-communal corridor			0	PASS
10-C1-communal corridor			0	PASS

8.3 Iteration 3 - Tempered air solution (with external blinds).

Although windows are designed to be openable, a mechanical solution will need to be considered for the areas of the development with acoustic constraints as per Section 2.4 and where the passive design measures alone would not suffice to achieve compliance with TM59 requirements.

Table 15 below shows the results of the simulation with tempered air, windows closed and external blinds.

Table 15 - TM59 Criteria Compliance Results

Iteration 3 – Tempered air (external blinds)	TM59 Criterion 3	Communal Corridors	Compliance
Room	(% annual hours above 26°C)	(% annual hours above 28°C)	
Target	≤3%	≤3%	
02-B3-Flat 5-1B2P-Bed	0.0		PASS
02-B3-Flat 5-1B2P-LK	0.0		PASS
02-B3-Flat 6-2B4P- Bed 1	0.0		PASS
02-B3-Flat 6-2B4P-Bed 2	0.0		PASS
02-B3-Flat 6-2B4P-LK	0.0		PASS
02-D1-Flat 4-3B5P- Single bed	0.0		PASS
02-D1-Flat 4-3B5P-Bed 1	0.0		PASS
02-D1-Flat 4-3B5P-Bed 2	0.0		PASS
02-D1-Flat 4-3B5P-LK	0.9		PASS
02-E1-Flat 11-1B2P-Bed	0.0		PASS
02-E1-Flat 11-1B2P-LK	0.0		PASS
02-E1-Flat 12-1B2P-Bed	0.0		PASS
02-E1-Flat 12-1B2P-LK	0.0		PASS
03-A2-Flat 3-1B2P-Bed	0.0		PASS
03-A2-Flat 3-1B2P-LK	0.0		PASS
04-A1-Flat 3-3B5P- Single bed	0.0		PASS
04-A1-Flat 3-3B5P-Bed 1	0.0		PASS
04-A1-Flat 3-3B5P-Bed 2	0.0		PASS
04-A1-Flat 3-3B5P-K	0.3		PASS
04-A1-Flat 3-3B5P-L	3.0		PASS
04-A2-Flat 3-1B2P-Bed	0.0		PASS
04-A2-Flat 3-1B2P-LK	0.0		PASS
04-A3-Flat 5-2B4P-Bed 1	0.0		PASS
04-A3-Flat 5-2B4P-Bed 2	0.0		PASS
04-A3-Flat 5-2B4P-LK	0.0		PASS
04-A3-Flat 6-1B2P-Bed	0.0		PASS
04-A3-Flat 6-1B2P-LK	0.0		PASS
04-B2-Flat 4-3B5P- Single bed	0.0		PASS
04-B2-Flat 4-3B5P-Bed 1	0.0		PASS
04-B2-Flat 4-3B5P-Bed 2	0.0		PASS
04-B2-Flat 4-3B5P-K	0.2		PASS
04-B2-Flat 4-3B5P-L	2.8		PASS
04-B3-Flat 5-1B2P-Bed	0.0		PASS
04-B3-Flat 5-1B2P-LK	0.0		PASS
04-B3-Flat 6-2B4P- Bed 1	0.0		PASS
04-B3-Flat 6-2B4P-Bed 2	0.0		PASS
04-B3-Flat 6-2B4P-LK	0.0		PASS
04-B3-Flat 8-1B2P-Bed	0.0		PASS
04-B3-Flat 8-1B2P-LK	0.0		PASS
04-B4-Flat 2-2B4P-Bed 1	0.0		PASS
04-B4-Flat 2-2B4P-Bed 2	0.0		PASS
04-B4-Flat 2-2B4P-LK	0.0		PASS
04-B4-Flat 4-1B2P-Bed	0.0		PASS
04-B4-Flat 4-1B2P-LK	0.0		PASS
04-B5-Flat 7-1B2P-Bed	0.0		PASS
04-B5-Flat 7-1B2P-LK	0.0		PASS
04-C2-Flat 06-2B4P-Bed 1	0.0		PASS
04-C2-Flat 06-2B4P-Bed 2	0.0		PASS
04-C2-Flat 06-2B4P-LK	0.0		PASS
04-C2-Flat 5-1B2P-Bed	0.0		PASS
04-C2-Flat 5-1B2P-LK	0.0		PASS
04-D1-Flat 2-2B4P-Bed 1	0.0		PASS
04-D1-Flat 2-2B4P-Bed 2	0.0		PASS
04-D1-Flat 2-2B4P-LK	0.0		PASS
04-D1-Flat 4-3B5P- Single bed	0.0		PASS
04-D1-Flat 4-3B5P-Bed 1	0.0		PASS

Iteration 3 – Tempered air (external blinds)	TM59 Criterion 3	Communal Corridors	Compliance
Room	(% annual hours above 26°C)	(% annual hours above 28°C)	
Target	≤3%	≤3%	
04-D1-Flat 4-3B5P-Bed 2	0.0		PASS
04-D1-Flat 4-3B5P-LK	0.8		PASS
04-D2-Flat 4-2B4P-Bed 1	0.0		PASS
04-D2-Flat 4-2B4P-Bed 2	0.0		PASS
04-D2-Flat 4-2B4P-LK	0.0		PASS
04-E1-Flat 12-1B2P-Bed	0.0		PASS
04-E1-Flat 12-1B2P-LK	0.0		PASS
04-E1-Flt 11-1B2P-Bed	0.0		PASS
04-E1-Flt 11-1B2P-LK	0.0		PASS
04-E2-Flat 3-2B4P-Bed 1	0.0		PASS
04-E2-Flat 3-2B4P-Bed 2	0.0		PASS
04-E2-Flat 3-2B4P-LK	0.0		PASS
04-E2-Flat 4-2B4P-Bed 1	0.0		PASS
04-E2-Flat 4-2B4P-Bed 2	0.0		PASS
04-E2-Flat 4-2B4P-LK	0.0		PASS
06-B6-Flat 4-2B4P-Bed 1	0.0		PASS
06-B6-Flat 4-2B4P-Bed 2	0.0		PASS
06-B6-Flat 4-2B4P-LK	0.0		PASS
06-B6-Flat 9-2B3P- Single bed	0.0		PASS
06-B6-Flat 9-2B3P-Bed 1	0.0		PASS
06-B6-Flat 9-2B3P-LK	0.0		PASS
06-E1-Flat 4-1B2P-Bed	0.0		PASS
06-E1-Flat 4-1B2P-LK	0.0		PASS
06-E1-Flat 5-1B2P-Bed	0.0		PASS
06-E1-Flat 5-1B2P-LK	0.0		PASS
06-E2-Flat 4-2B4P-Bed 1	0.0		PASS
06-E2-Flat 4-2B4P-Bed 2	0.0		PASS
06-E2-Flat 4-2B4P-LK	0.0		PASS
07-A3-Flat 6-1B2P-Bed	0.0		PASS
07-A3-Flat 6-1B2P-LK	0.0		PASS

Iteration 3 – Tempered air (external blinds)	TM59 Criterion 3	Communal Corridors	Compliance
Room	(% annual hours above 26°C)	(% annual hours above 28°C)	
Target	≤3%	≤3%	
07-B3-Flat 5-1B2P-Bed	0.0		PASS
07-B3-Flat 5-1B2P-LK	0.0		PASS
07-B3-Flat 6-2B3P- Single bed	0.0		PASS
07-B3-Flat 6-2B3P-Bed	0.0		PASS
07-B3-Flat 6-2B3P-LK	0.0		PASS
07-D1-Flat 2-2B4P-Bed 1	0.0		PASS
07-D1-Flat 2-2B4P-Bed 2	0.0		PASS
07-D1-Flat 2-2B4P-LK	0.0		PASS
07-D1-Flat 4-3B5P- Single bed	0.0		PASS
07-D1-Flat 4-3B5P-Bed 1	0.0		PASS
07-D1-Flat 4-3B5P-Bed 2	0.0		PASS
07-D1-Flat 4-3B5P-LK	0.2		PASS
08-A3-Flat 4-2B4P-Bed 1	0.0		PASS
08-A3-Flat 4-2B4P-Bed 2	0.0		PASS
08-A3-Flat 4-2B4P-LK	0.0		PASS
08-A3-Flat 5-2B4P-Bed 1	0.0		PASS
08-A3-Flat 5-2B4P-Bed 2	0.0		PASS
08-A3-Flat 5-2B4P-LK	0.0		PASS
09-B5-Flat 5-1B2P-Bed	0.0		PASS
09-B5-Flat 5-1B2P-LK	0.0		PASS
09-B5-Flat 6-2B3P- Single bed	0.0		PASS
09-B5-Flat 6-2B3P-Bed	0.0		PASS
09-B5-Flat 6-2B3P-LK	0.0		PASS
09-B5-Flat 7-1B2P-Bed	0.0		PASS
09-B5-Flat 7-1B2P-LK	0.0		PASS
09-C2-Flat 3 - 3B5P- Single bed	0.0		PASS
09-C2-Flat 3 - 3B5P-Bed 1	0.0		PASS
09-C2-Flat 3 - 3B5P-Bed 2	0.0		PASS

Iteration 3 – Tempered air (external blinds)	TM59 Criterion 3	Communal Corridors	Compliance
Room	(% annual hours above 26°C)	(% annual hours above 28°C)	
Target	≤3%	≤3%	
09-C2-Flat 3 - 3B5P-K	0.0		PASS
09-C2-Flat 3 - 3B5P-L	0.9		PASS
10-C1-Flat 5-1B2P-Bed	0.0		PASS
10-C1-Flat 5-1B2P-LK	0.0		PASS
10-C1-Flat 6-2B4P-Bed 2	0.0		PASS
10-C1-Flat 6-2B4P-Bed 2	0.0		PASS
10-C1-Flat 6-2B4P-LK	0.0		PASS
02-B3-communal corridor		0.0	PASS
02-D1-communal corridor		0.0	PASS
02-E1-Communal Corridor 1		0.0	PASS
02-E1-Communal Corridor 2		0.0	PASS
02-E1-Communal Corridor 3		0.0	PASS
03-A2-Communal Corridor		0.0	PASS
04-A1-Communal Corridor		0.0	PASS
04-A2-Communal Corridor		0.0	PASS
04-A3-Communal Corridor		0.0	PASS
04-B2-communal corridor		0.0	PASS
04-B3-communal corridor		0.0	PASS
04-B4- Communal corridor		0.0	PASS
04-B5- Communal corridor		0.0	PASS
04-C2-communal corridor		0.0	PASS
04-D1-communal corridor		0.0	PASS
04-D2-communal corridor		0.0	PASS
04-E1-Communal Corridor 1		0.0	PASS

Iteration 3 – Tempered air (external blinds)	TM59 Criterion 3	Communal Corridors	Compliance
Room	(% annual hours above 26°C)	(% annual hours above 28°C)	
Target	≤3%	≤3%	
04-E2-Communal Corridor		0.0	PASS
06-B6-communal corridor		0.0	PASS
06-E1-Communal Corridor 1		0.0	PASS
06-E1-Communal Corridor 2		0.0	PASS
06-E2-Communal Corridor		0.0	PASS
07-A3-Communal Corridor		0.0	PASS
07-B3- communal corridor		0.0	PASS
07-D1-communal corridor		0.0	PASS
08-A3-Communal Corridor		0.0	PASS
09-B5-communal corridor		0.0	PASS
09-C2-communal corridor		0.0	PASS
10-C1-communal corridor		0.0	PASS

9. Conclusion.

The following passive design measures have been included, where technically and economically viable, within the development (Baseline passive design solution):

- Glazing reductions
- Solar control glass (g-value of 0.35)
- Balconies
- Tilt/turn windows - side hung during the day and bottom hung overnight
- Ventilation panels (louvres)

The following additional high impact passive design measures (Enhanced passive design solution) have been identified to further reduce the overheating risk through passive design measures within the dwellings that are not meeting the TM59 requirements with the above passive design measures

- External blinds
- Side hung balcony doors 20% open overnight

It is important to note that all the above passive design measures will not be applied to all the apartments of the development. The extent of the measures required for each apartment will be determined at the next stage of design.

An additional option has been assessed which includes MVHR with tempered air. This option (tempered air solution – with external blinds) may be required for the dwellings with limitations to natural ventilation provision due to acoustic constraints and the dwellings that baseline and enhanced passive design measures alone are either not viable or would not suffice to meet the TM59 overheating requirements.

Based on the inputs and assumptions outlined within this report, the results of the simulation using Enhanced passive design measures show that 98% of the assessed worse-case scenario living-kitchen areas are passing the TM59 methodology and 86% of assessed bedrooms, where louvres could be provided. 10% of bedrooms where louvres could not be provided are passing the TM59 methodology with passive design measures and will therefore require tempered air cooling.

The information in Section 5 of this report highlights all the options that have been considered throughout the design process, with a summary of those that have been or that will be incorporated in the design and the ones that were excluded and the reason behind that.

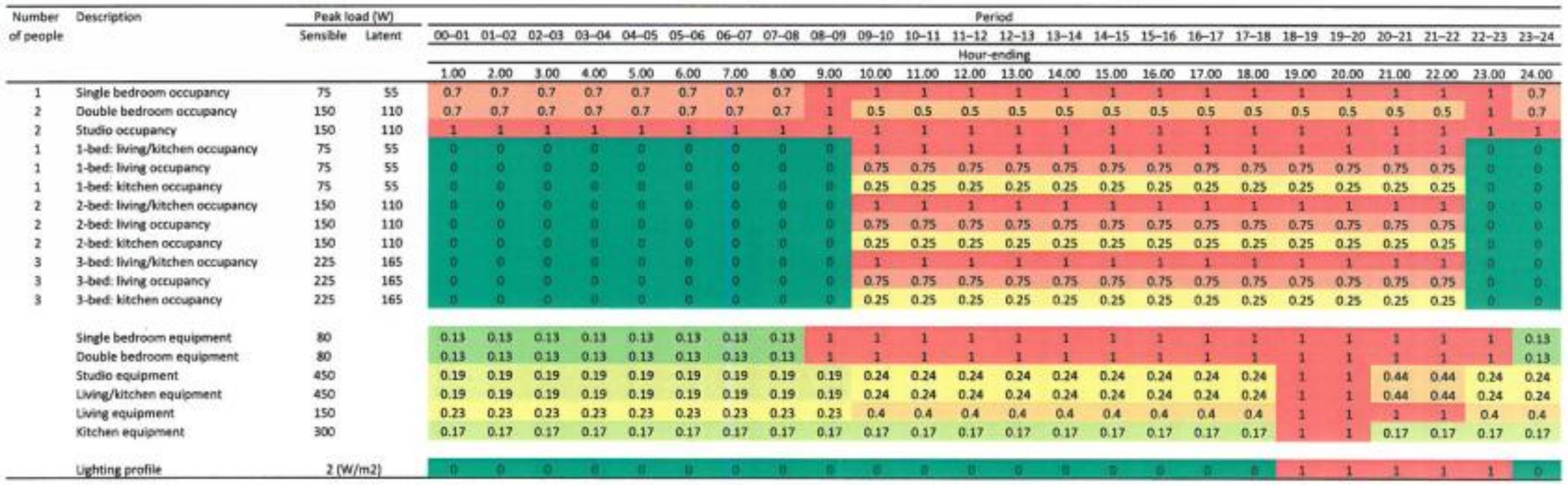
In addition, communal corridors are also compliant with TM59 criteria with the inclusion of mechanical cooling (using FCUs fed by the proposed ASHP on the roof). At the next stage of design, the possibility to omit cooling will be considered and the possibility to provide mechanical ventilation through environmental fans will be investigated further.

Results of the enhanced passive design solution using DSY2 can be found in Appendix C and results using DSY3 can be found in Appendix D.

The building design and building services design have maximised all available measures to minimise heat generation within the dwellings, to reduce the amount of heat entering the building, and to passively and mechanically ventilate the dwellings in line with the cooling hierarchy in Policy SI4 of the London Plan and Policy S6 of LBI's Draft Local Plan.

It should be noted that whilst industry guidance has been followed, results in practice are likely to be dependent on factors which are highly user dependent, this can include occupancy levels, internal gains from equipment and user behaviour such as operation of windows.

Appendix A – Heat Gain Profiles.



Number of people	Description	Peak load (W)		Period																							
		Sensible	Latent	00–01	01–02	02–03	03–04	04–05	05–06	06–07	07–08	08–09	09–10	10–11	11–12	12–13	13–14	14–15	15–16	16–17	17–18	18–19	19–20	20–21	21–22	22–23	23–24
				Hour-ending																							
				1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	24.00
1	Single bedroom occupancy	75	55	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.7
2	Double bedroom occupancy	150	110	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	0.7
2	Studio occupancy	150	110	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1-bed: living/kitchen occupancy	75	55	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
1	1-bed: living occupancy	75	55	0	0	0	0	0	0	0	0	0	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0	0
1	1-bed: kitchen occupancy	75	55	0	0	0	0	0	0	0	0	0	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0	0
2	2-bed: living/kitchen occupancy	150	110	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
2	2-bed: living occupancy	150	110	0	0	0	0	0	0	0	0	0	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0	0
2	2-bed: kitchen occupancy	150	110	0	0	0	0	0	0	0	0	0	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0	0
3	3-bed: living/kitchen occupancy	225	165	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
3	3-bed: living occupancy	225	165	0	0	0	0	0	0	0	0	0	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0	0
3	3-bed: kitchen occupancy	225	165	0	0	0	0	0	0	0	0	0	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0	0
	Single bedroom equipment	80		0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.13
	Double bedroom equipment	80		0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.13
	Studio equipment	450		0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	1	1	0.44	0.44	0.24	0.24
	Living/kitchen equipment	450		0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	1	1	0.44	0.44	0.24	0.24
	Living equipment	150		0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	1	1	1	1	0.4	0.4
	Kitchen equipment	300		0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	1	1	0.17	0.17	0.17	0.17
	Lighting profile	2 (W/m2)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0

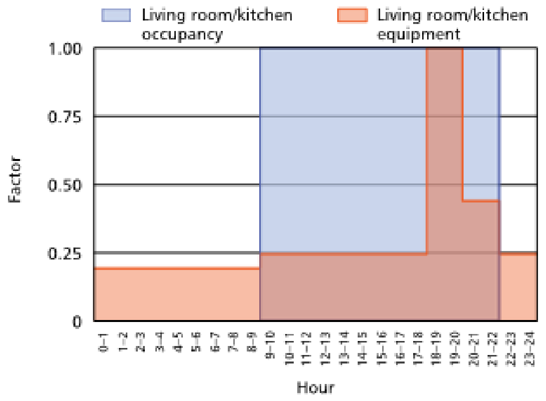


Figure 4 Heat gain profile: combined living room/kitchen

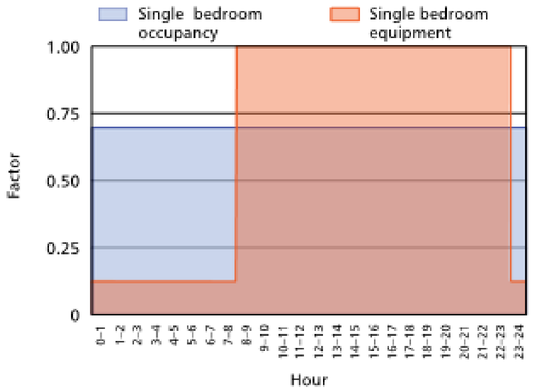
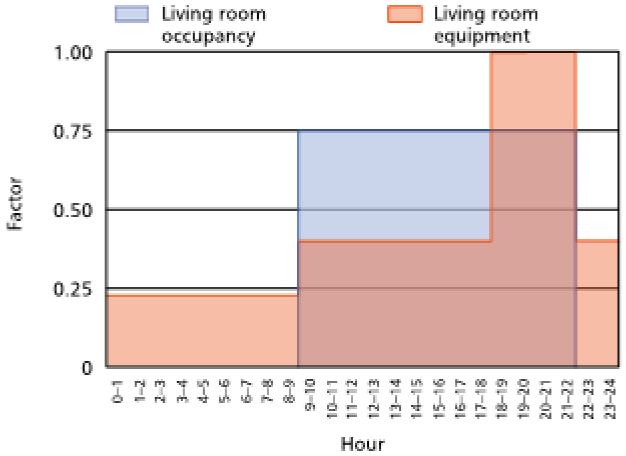
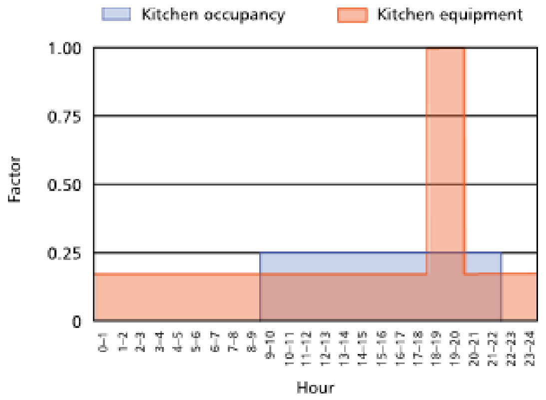
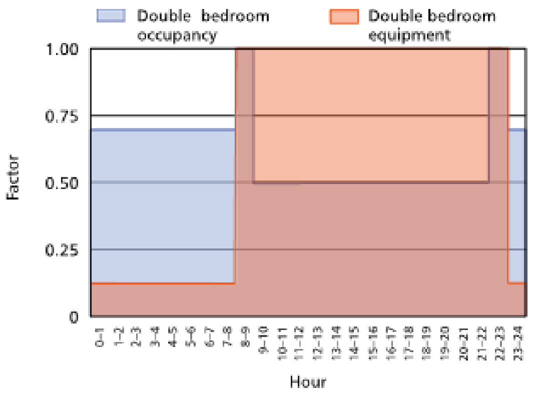


Figure 2 Heat gain profile: single bedroom







Appendix B – Passive Design further iterations.

Iteration 4 – Internal blinds.

Baseline passive design solution with inclusion of internal blinds. Blinds have been assumed to be down when irradiation is over 200 W/m^2.

Iteration 4 – Internal blinds	TM59 Criterion 1	TM59 Criterion 2	Communal Corridors	Compliance
Room	(% Hours of Exceedance)	(% annual hours above 26°C between 22:00 – 07:00)	(% annual hours above 28°C)	
Target	≤3%	≤32 hours	≤3%	
02-B3-Flat 5-1B2P-Bed	1.5	37		FAIL
02-B3-Flat 5-1B2P-LK	3.1			FAIL
02-B3-Flat 6-2B4P- Bed 1	1.7	47		FAIL
02-B3-Flat 6-2B4P-Bed 2	1.8	41		FAIL
02-B3-Flat 6-2B4P-LK	3			PASS
02-D1-Flat 4-3B5P- Single bed	1.9	36		FAIL
02-D1-Flat 4-3B5P-Bed 1	1.4	49		FAIL
02-D1-Flat 4-3B5P-Bed 2	1.6	43		FAIL
02-D1-Flat 4-3B5P-LK	2.8			PASS
02-E1-Flat 11-1B2P-Bed	1.6	45		FAIL
02-E1-Flat 11-1B2P-LK	3.1			FAIL
02-E1-Flat 12-1B2P-Bed	1.6	47		FAIL
02-E1-Flat 12-1B2P-LK	3.4			FAIL
03-A2-Flat 3-1B2P-Bed	1.4	47		FAIL
03-A2-Flat 3-1B2P-LK	2.1			PASS
04-A1-Flat 3-3B5P- Single bed	1.5	23		PASS
04-A1-Flat 3-3B5P-Bed 1	1.3	27		PASS
04-A1-Flat 3-3B5P-Bed 2	1.1	25		PASS
04-A1-Flat 3-3B5P-K	2.8			PASS
04-A1-Flat 3-3B5P-L	3.5			FAIL
04-A2-Flat 3-1B2P-Bed	1.5	30		PASS
04-A2-Flat 3-1B2P-LK	2.7			PASS
04-A3-Flat 5-2B4P-Bed 1	1.6	33		FAIL
04-A3-Flat 5-2B4P-Bed 2	1.3	35		FAIL
04-A3-Flat 5-2B4P-LK	2.6			PASS
04-A3-Flat 6-1B2P-Bed	1.4	31		PASS
04-A3-Flat 6-1B2P-LK	2.6			PASS
04-B2-Flat 4-3B5P- Single bed	1.4	22		PASS
04-B2-Flat 4-3B5P-Bed 1	1.3	24		PASS
04-B2-Flat 4-3B5P-Bed 2	1.3	24		PASS
04-B2-Flat 4-3B5P-K	2.6			PASS
04-B2-Flat 4-3B5P-L	3.4			FAIL
04-B3-Flat 5-1B2P-Bed	1.4	25		PASS
04-B3-Flat 5-1B2P-LK	2.7			PASS
04-B3-Flat 6-2B4P- Bed 1	1.6	34		FAIL
04-B3-Flat 6-2B4P-Bed 2	1.6	32		PASS
04-B3-Flat 6-2B4P-LK	2.6			PASS
04-B3-Flat 8-1B2P-Bed	1.4	27		PASS
04-B3-Flat 8-1B2P-LK	3			PASS
04-B4-Flat 2-2B4P-Bed 1	1.5	58		FAIL
04-B4-Flat 2-2B4P-Bed 2	1.7	48		FAIL
04-B4-Flat 2-2B4P-LK	2.7			PASS
04-B4-Flat 4-1B2P-Bed	1.8	62		FAIL
04-B4-Flat 4-1B2P-LK	2.7			PASS
04-B5-Flat 7-1B2P-Bed	1.3	55		FAIL
04-B5-Flat 7-1B2P-LK	2			PASS

Iteration 4 – Internal blinds	TM59 Criterion 1	TM59 Criterion 2	Communal Corridors	Compliance
Room	(% Hours of Exceedance)	(% annual hours above 26°C between 22:00 – 07:00)	(% annual hours above 28°C)	
Target	≤3%	≤32 hours	≤3%	
04-C2-Flat 06-2B4P-Bed 1	1.7	48		FAIL
04-C2-Flat 06-2B4P-Bed 2	1.7	48		FAIL
04-C2-Flat 06-2B4P-LK	2.9			PASS
04-C2-Flat 5-1B2P-Bed	2.1	88		FAIL
04-C2-Flat 5-1B2P-LK	3.2			FAIL
04-D1-Flat 2-2B4P-Bed 1	1.4	36		FAIL
04-D1-Flat 2-2B4P-Bed 2	1.6	32		PASS
04-D1-Flat 2-2B4P-LK	2.9			PASS
04-D1-Flat 4-3B5P- Single bed	1.7	25		PASS
04-D1-Flat 4-3B5P-Bed 1	1.4	49		FAIL
04-D1-Flat 4-3B5P-Bed 2	1.5	30		PASS
04-D1-Flat 4-3B5P-LK	2.8			PASS
04-D2-Flat 4-2B4P-Bed 1	1.3	39		FAIL
04-D2-Flat 4-2B4P-Bed 2	1.6	34		FAIL
04-D2-Flat 4-2B4P-LK	3.2			FAIL
04-E1-Flat 12-1B2P-Bed	1.5	31		PASS
04-E1-Flat 12-1B2P-LK	3.4			FAIL
04-E1-Flt 11-1B2P-Bed	1.4	28		PASS
04-E1-Flt 11-1B2P-LK	3			PASS
04-E2-Flat 3-2B4P-Bed 1	1.5	48		FAIL
04-E2-Flat 3-2B4P-Bed 2	1.7	47		FAIL
04-E2-Flat 3-2B4P-LK	3.2			FAIL
04-E2-Flat 4-2B4P-Bed 1	1.6	40		FAIL
04-E2-Flat 4-2B4P-Bed 2	1.5	45		FAIL
04-E2-Flat 4-2B4P-LK	3.3			FAIL
06-B6-Flat 4-2B4P-Bed 1	1.2	49		FAIL
06-B6-Flat 4-2B4P-Bed 2	1.6	41		FAIL
06-B6-Flat 4-2B4P-LK	3.2			FAIL
06-B6-Flat 9-2B3P- Single bed	1.7	43		FAIL
06-B6-Flat 9-2B3P-Bed 1	1.5	51		FAIL
06-B6-Flat 9-2B3P-LK	3.2			FAIL
06-E1-Flat 4-1B2P-Bed	1.5	25		PASS
06-E1-Flat 4-1B2P-LK	2.9			PASS
06-E1-Flat 5-1B2P-Bed	1.6	28		PASS
06-E1-Flat 5-1B2P-LK	3.5			FAIL
06-E2-Flat 4-2B4P-Bed 1	1.6	37		FAIL
06-E2-Flat 4-2B4P-Bed 2	1.5	40		FAIL
06-E2-Flat 4-2B4P-LK	3.4			FAIL
07-A3-Flat 6-1B2P-Bed	1.4	38		FAIL
07-A3-Flat 6-1B2P-LK	2.4			PASS
07-B3-Flat 5-1B2P-Bed	1.4	25		PASS
07-B3-Flat 5-1B2P-LK	2.6			PASS
07-B3-Flat 6-2B3P- Single bed	1.7	27		PASS
07-B3-Flat 6-2B3P-Bed	1.4	32		PASS
07-B3-Flat 6-2B3P-LK	1.7			PASS
07-D1-Flat 2-2B4P-Bed 1	1.4	32		PASS

Iteration 4 – Internal blinds	TM59 Criterion 1	TM59 Criterion 2	Communal Corridors	Compliance
Room	(% Hours of Exceedance)	(% annual hours above 26°C between 22:00 – 07:00)	(% annual hours above 28°C)	
Target	≤3%	≤32 hours	≤3%	
07-D1-Flat 2-2B4P-Bed 2	1.6	28		PASS
07-D1-Flat 2-2B4P-LK	2.9			PASS
07-D1-Flat 4-3B5P- Single bed	1.7	25		PASS
07-D1-Flat 4-3B5P-Bed 1	1.5	46		FAIL
07-D1-Flat 4-3B5P-Bed 2	1.5	30		PASS
07-D1-Flat 4-3B5P-LK	3			PASS
08-A3-Flat 4-2B4P-Bed 1	1.5	23		PASS
08-A3-Flat 4-2B4P-Bed 2	1.3	30		PASS
08-A3-Flat 4-2B4P-LK	2.5			PASS
08-A3-Flat 5-2B4P-Bed 1	1.6	23		PASS
08-A3-Flat 5-2B4P-Bed 2	1.4	25		PASS
08-A3-Flat 5-2B4P-LK	3.1			FAIL
09-B5-Flat 5-1B2P-Bed	1.4	51		FAIL
09-B5-Flat 5-1B2P-LK	2.8			PASS
09-B5-Flat 6-2B3P- Single bed	1.7	42		FAIL
09-B5-Flat 6-2B3P-Bed	1.3	48		FAIL
09-B5-Flat 6-2B3P-LK	2.7			PASS
09-B5-Flat 7-1B2P-Bed	1.6	60		FAIL
09-B5-Flat 7-1B2P-LK	2.7			PASS
09-C2-Flat 3 - 3B5P- Single bed	1.8	41		FAIL
09-C2-Flat 3 - 3B5P-Bed 1	1.8	48		FAIL
09-C2-Flat 3 - 3B5P-Bed 2	1.8	49		FAIL
09-C2-Flat 3 - 3B5P-K	2.3			PASS

Iteration 4 – Internal blinds	TM59 Criterion 1	TM59 Criterion 2	Communal Corridors	Compliance
Room	(% Hours of Exceedance)	(% annual hours above 26°C between 22:00 – 07:00)	(% annual hours above 28°C)	
Target	≤3%	≤32 hours	≤3%	
09-C2-Flat 3 - 3B5P-L	3.1			FAIL
10-C1-Flat 5-1B2P-Bed	1.7	43		FAIL
10-C1-Flat 5-1B2P-LK	3.2			FAIL
10-C1-Flat 6-2B4P-Bed 2	1.9	47		FAIL
10-C1-Flat 6-2B4P-Bed 2	1.7	47		FAIL
10-C1-Flat 6-2B4P-LK	3.1			FAIL
02-B3-communal corridor			0	PASS
02-D1-communal corridor			0	PASS
02-E1-Communal Corridor 1			0	PASS
02-E1-Communal Corridor 2			0	PASS
02-E1-Communal Corridor 3			0	PASS
03-A2-Communal Corridor			0	PASS
04-A1-Communal Corridor			0	PASS
04-A2-Communal Corridor			0	PASS
04-A3-Communal Corridor			0	PASS
04-B2-communal corridor			0	PASS
04-B3-communal corridor			0	PASS
04-B4- Communal corridor			0	PASS
04-B5- Communal corridor			0	PASS
04-C2-communal corridor			0	PASS
04-D1-communal corridor			0	PASS
04-D2-communal corridor			0	PASS
04-E1-Communal Corridor 1			0	PASS

Iteration 4 – Internal blinds	TM59 Criterion 1	TM59 Criterion 2	Communal Corridors	Compliance
Room	(% Hours of Exceedance)	(% annual hours above 26°C between 22:00 – 07:00)	(% annual hours above 28°C)	
Target	≤3%	≤32 hours	≤3%	
04-E2-Communal Corridor			0	PASS
06-B6-communal corridor			0	PASS
06-E1-Communal Corridor 1			0	PASS
06-E1-Communal Corridor 2			0	PASS
06-E2-Communal Corridor			0	PASS
07-A3-Communal Corridor			0	PASS
07-B3- communal corridor			0	PASS
07-D1-communal corridor			0	PASS
08-A3-Communal Corridor			0	PASS
09-B5-communal corridor			0	PASS
09-C2-communal corridor			0	PASS
10-C1-communal corridor			0	PASS

Iteration 5 – External blinds.

Baseline passive design solution model with inclusion of external blinds.

Iteration 5 – External blinds	TM59 Criterion 1	TM59 Criterion 2	Communal Corridors	Compliance
Room	(% Hours of Exceedance)	(% annual hours above 26°C between 22:00 – 07:00)	(% annual hours above 28°C)	
Target	≤3%	≤32 hours	≤3%	
02-B3-Flat 5-1B2P-Bed	1.5	37		FAIL
02-B3-Flat 5-1B2P-LK	2.6			PASS
02-B3-Flat 6-2B4P- Bed 1	1.4	47		FAIL
02-B3-Flat 6-2B4P-Bed 2	1.7	41		FAIL
02-B3-Flat 6-2B4P-LK	2.4			PASS
02-D1-Flat 4-3B5P- Single bed	1.8	36		FAIL
02-D1-Flat 4-3B5P-Bed 1	1.4	49		FAIL
02-D1-Flat 4-3B5P-Bed 2	1.5	43		FAIL
02-D1-Flat 4-3B5P-LK	2.8			PASS
02-E1-Flat 11-1B2P-Bed	1.6	44		FAIL
02-E1-Flat 11-1B2P-LK	3			PASS
02-E1-Flat 12-1B2P-Bed	1.6	47		FAIL
02-E1-Flat 12-1B2P-LK	3.1			FAIL
03-A2-Flat 3-1B2P-Bed	1.4	46		FAIL
03-A2-Flat 3-1B2P-LK	2			PASS
04-A1-Flat 3-3B5P- Single bed	1.5	23		PASS
04-A1-Flat 3-3B5P-Bed 1	1.3	27		PASS
04-A1-Flat 3-3B5P-Bed 2	1.1	25		PASS
04-A1-Flat 3-3B5P-K	2.8			PASS
04-A1-Flat 3-3B5P-L	3.3			FAIL
04-A2-Flat 3-1B2P-Bed	1.4	27		PASS
04-A2-Flat 3-1B2P-LK	2.6			PASS
04-A3-Flat 5-2B4P-Bed 1	1.6	33		FAIL
04-A3-Flat 5-2B4P-Bed 2	1.3	34		FAIL
04-A3-Flat 5-2B4P-LK	2.6			PASS
04-A3-Flat 6-1B2P-Bed	1.4	30		PASS
04-A3-Flat 6-1B2P-LK	2.4			PASS

Iteration 5 – External blinds	TM59 Criterion 1	TM59 Criterion 2	Communal Corridors	Compliance
Room	(% Hours of Exceedance)	(% annual hours above 26°C between 22:00 – 07:00)	(% annual hours above 28°C)	
Target	≤3%	≤32 hours	≤3%	
04-B2-Flat 4-3B5P- Single bed	1.1	22		PASS
04-B2-Flat 4-3B5P-Bed 1	0.9	22		PASS
04-B2-Flat 4-3B5P-Bed 2	1.2	24		PASS
04-B2-Flat 4-3B5P-K	2			PASS
04-B2-Flat 4-3B5P-L	2.8			PASS
04-B3-Flat 5-1B2P-Bed	1.3	24		PASS
04-B3-Flat 5-1B2P-LK	2.6			PASS
04-B3-Flat 6-2B4P- Bed 1	1.4	33		FAIL
04-B3-Flat 6-2B4P-Bed 2	1.6	32		PASS
04-B3-Flat 6-2B4P-LK	2.4			PASS
04-B3-Flat 8-1B2P-Bed	1.3	27		PASS
04-B3-Flat 8-1B2P-LK	2.6			PASS
04-B4-Flat 2-2B4P-Bed 1	1.4	55		FAIL
04-B4-Flat 2-2B4P-Bed 2	1.7	48		FAIL
04-B4-Flat 2-2B4P-LK	2.7			PASS
04-B4-Flat 4-1B2P-Bed	1.4	59		FAIL
04-B4-Flat 4-1B2P-LK	2.6			PASS
04-B5-Flat 7-1B2P-Bed	1.3	53		FAIL
04-B5-Flat 7-1B2P-LK	2			PASS
04-C2-Flat 06-2B4P-Bed 1	1.4	48		FAIL
04-C2-Flat 06-2B4P-Bed 2	1.6	48		FAIL
04-C2-Flat 06-2B4P-LK	2.5			PASS
04-C2-Flat 5-1B2P-Bed	1.8	84		FAIL
04-C2-Flat 5-1B2P-LK	2.7			PASS
04-D1-Flat 2-2B4P-Bed 1	1.4	34		FAIL
04-D1-Flat 2-2B4P-Bed 2	1.6	32		PASS
04-D1-Flat 2-2B4P-LK	2.9			PASS
04-D1-Flat 4-3B5P- Single bed	1.6	25		PASS
04-D1-Flat 4-3B5P-Bed 1	1.4	49		FAIL
04-D1-Flat 4-3B5P-Bed 2	1.4	30		PASS
04-D1-Flat 4-3B5P-LK	2.7			PASS
04-D2-Flat 4-2B4P-Bed 1	1.1	39		FAIL
04-D2-Flat 4-2B4P-Bed 2	1.5	34		FAIL
04-D2-Flat 4-2B4P-LK	3.1			FAIL
04-E1-Flat 12-1B2P-Bed	1.5	31		PASS
04-E1-Flat 12-1B2P-LK	3.1			FAIL
04-E1-Flt 11-1B2P-Bed	1.4	27		PASS
04-E1-Flt 11-1B2P-LK	2.9			PASS
04-E2-Flat 3-2B4P-Bed 1	1.5	48		FAIL
04-E2-Flat 3-2B4P-Bed 2	1.7	47		FAIL
04-E2-Flat 3-2B4P-LK	3.1			FAIL
04-E2-Flat 4-2B4P-Bed 1	1.6	40		FAIL
04-E2-Flat 4-2B4P-Bed 2	1.5	44		FAIL
04-E2-Flat 4-2B4P-LK	2.9			PASS
06-B6-Flat 4-2B4P-Bed 1	1.1	48		FAIL
06-B6-Flat 4-2B4P-Bed 2	1.5	41		FAIL
06-B6-Flat 4-2B4P-LK	2.9			PASS
06-B6-Flat 9-2B3P- Single bed	1.6	42		FAIL
06-B6-Flat 9-2B3P-Bed 1	1.5	50		FAIL
06-B6-Flat 9-2B3P-LK	3			PASS
06-E1-Flat 4-1B2P-Bed	1.4	25		PASS
06-E1-Flat 4-1B2P-LK	2.8			PASS
06-E1-Flat 5-1B2P-Bed	1.5	26		PASS
06-E1-Flat 5-1B2P-LK	2.8			PASS
06-E2-Flat 4-2B4P-Bed 1	1.6	34		FAIL
06-E2-Flat 4-2B4P-Bed 2	1.5	38		FAIL
06-E2-Flat 4-2B4P-LK	2.7			PASS
07-A3-Flat 6-1B2P-Bed	1	36		FAIL

Iteration 5 – External blinds	TM59 Criterion 1	TM59 Criterion 2	Communal Corridors	Compliance
Room	(% Hours of Exceedance)	(% annual hours above 26°C between 22:00 – 07:00)	(% annual hours above 28°C)	
Target	≤3%	≤32 hours	≤3%	
07-A3-Flat 6-1B2P-LK	1.8			PASS
07-B3-Flat 5-1B2P-Bed	1.3	24		PASS
07-B3-Flat 5-1B2P-LK	2.3			PASS
07-B3-Flat 6-2B3P- Single bed	1.4	26		PASS
07-B3-Flat 6-2B3P-Bed	1	30		PASS
07-B3-Flat 6-2B3P-LK	1.3			PASS
07-D1-Flat 2-2B4P-Bed 1	1.4	31		PASS
07-D1-Flat 2-2B4P-Bed 2	1.6	28		PASS
07-D1-Flat 2-2B4P-LK	2.8			PASS
07-D1-Flat 4-3B5P- Single bed	1.6	24		PASS
07-D1-Flat 4-3B5P-Bed 1	1.2	45		FAIL
07-D1-Flat 4-3B5P-Bed 2	1.4	29		PASS
07-D1-Flat 4-3B5P-LK	2.3			PASS
08-A3-Flat 4-2B4P-Bed 1	1.4	23		PASS
08-A3-Flat 4-2B4P-Bed 2	1.2	28		PASS
08-A3-Flat 4-2B4P-LK	2.3			PASS
08-A3-Flat 5-2B4P-Bed 1	1.5	21		PASS
08-A3-Flat 5-2B4P-Bed 2	1.4	25		PASS
08-A3-Flat 5-2B4P-LK	2.4			PASS
09-B5-Flat 5-1B2P-Bed	1.4	49		FAIL
09-B5-Flat 5-1B2P-LK	2.7			PASS
09-B5-Flat 6-2B3P- Single bed	1.6	39		FAIL
09-B5-Flat 6-2B3P-Bed	1.2	47		FAIL
09-B5-Flat 6-2B3P-LK	2.6			PASS
09-B5-Flat 7-1B2P-Bed	1.4	55		FAIL
09-B5-Flat 7-1B2P-LK	2.2			PASS
09-C2-Flat 3 - 3B5P- Single bed	1.4	39		FAIL
09-C2-Flat 3 - 3B5P-Bed 1	1.3	45		FAIL
09-C2-Flat 3 - 3B5P-Bed 2	1.3	48		FAIL

Iteration 5 – External blinds	TM59 Criterion 1	TM59 Criterion 2	Communal Corridors	Compliance
Room	(% Hours of Exceedance)	(% annual hours above 26°C between 22:00 – 07:00)	(% annual hours above 28°C)	
Target	≤3%	≤32 hours	≤3%	
09-C2-Flat 3 - 3B5P-K	2.2			PASS
09-C2-Flat 3 - 3B5P-L	2.8			PASS
10-C1-Flat 5-1B2P-Bed	1.5	41		FAIL
10-C1-Flat 5-1B2P-LK	2.7			PASS
10-C1-Flat 6-2B4P-Bed 2	1.4	46		FAIL
10-C1-Flat 6-2B4P-Bed 2	1.3	46		FAIL
10-C1-Flat 6-2B4P-LK	2.4			PASS
02-B3-communal corridor			0	PASS
02-D1-communal corridor			0	PASS
02-E1-Communal Corridor 1			0	PASS
02-E1-Communal Corridor 2			0	PASS
02-E1-Communal Corridor 3			0	PASS
03-A2-Communal Corridor			0	PASS
04-A1-Communal Corridor			0	PASS
04-A2-Communal Corridor			0	PASS
04-A3-Communal Corridor			0	PASS
04-B2-communal corridor			0	PASS
04-B3-communal corridor			0	PASS
04-B4- Communal corridor			0	PASS
04-B5- Communal corridor			0	PASS
04-C2-communal corridor			0	PASS
04-D1-communal corridor			0	PASS
04-D2-communal corridor			0	PASS
04-E1-Communal Corridor 1			0	PASS
04-E2-Communal Corridor			0	PASS
06-B6-communal corridor			0	PASS
06-E1-Communal Corridor 1			0	PASS
06-E1-Communal Corridor 2			0	PASS
06-E2-Communal Corridor			0	PASS

Iteration 5 – External blinds	TM59 Criterion 1	TM59 Criterion 2	Communal Corridors	Compliance
Room	(% Hours of Exceedance)	(% annual hours above 26°C between 22:00 – 07:00)	(% annual hours above 28°C)	
Target	≤3%	≤32 hours	≤3%	
07-A3-Communal Corridor			0	PASS
07-B3- communal corridor			0	PASS
07-D1-communal corridor			0	PASS
08-A3-Communal Corridor			0	PASS
09-B5-communal corridor			0	PASS
09-C2-communal corridor			0	PASS
10-C1-communal corridor			0	PASS

Iteration 6 – Increased Thermal Mass.
Baseline passive design solution with increased thermal mass (exposed soffits) within living areas only.

Iteration 3 - Increased Thermal Mass	TM59 Criterion 1	TM59 Criterion 2	Communal Corridors	Compliance
Room	(% Hours of Exceedance)	(% annual hours above 26°C between 22:00 – 07:00)	(% annual hours above 28°C)	
Target	≤3%	≤32 hours	≤3%	
02-B3-Flat 5-1B2P-Bed	1.5	40		FAIL
02-B3-Flat 5-1B2P-LK	2.2			PASS
02-B3-Flat 6-2B4P- Bed 1	1.8	48		FAIL
02-B3-Flat 6-2B4P-Bed 2	1.8	47		FAIL
02-B3-Flat 6-2B4P-LK	2.2			PASS
02-D1-Flat 4-3B5P- Single bed	1.9	39		FAIL
02-D1-Flat 4-3B5P-Bed 1	1.4	54		FAIL
02-D1-Flat 4-3B5P-Bed 2	1.6	43		FAIL
02-D1-Flat 4-3B5P-LK	2.2			PASS
02-E1-Flat 11-1B2P-Bed	1.6	47		FAIL
02-E1-Flat 11-1B2P-LK	2.4			PASS
02-E1-Flat 12-1B2P-Bed	1.6	52		FAIL
02-E1-Flat 12-1B2P-LK	2.5			PASS
03-A2-Flat 3-1B2P-Bed	1.4	54		FAIL
03-A2-Flat 3-1B2P-LK	1.6			PASS
04-A1-Flat 3-3B5P- Single bed	1.4	23		PASS
04-A1-Flat 3-3B5P-Bed 1	1.3	27		PASS
04-A1-Flat 3-3B5P-Bed 2	1.1	27		PASS
04-A1-Flat 3-3B5P-K	1.8			PASS
04-A1-Flat 3-3B5P-L	2.7			PASS
04-A2-Flat 3-1B2P-Bed	1.4	33		FAIL
04-A2-Flat 3-1B2P-LK	2.1			PASS
04-A3-Flat 5-2B4P-Bed 1	1.5	33		FAIL
04-A3-Flat 5-2B4P-Bed 2	1.3	35		FAIL
04-A3-Flat 5-2B4P-LK	2.1			PASS
04-A3-Flat 6-1B2P-Bed	1.4	32		PASS
04-A3-Flat 6-1B2P-LK	2			PASS

Iteration 3 - Increased Thermal Mass	TM59 Criterion 1	TM59 Criterion 2	Communal Corridors	Compliance
Room	(% Hours of Exceedance)	(% annual hours above 26°C between 22:00 – 07:00)	(% annual hours above 28°C)	
Target	≤3%	≤32 hours	≤3%	
04-B2-Flat 4-3B5P- Single bed	1.4	22		PASS
04-B2-Flat 4-3B5P-Bed 1	1.3	24		PASS
04-B2-Flat 4-3B5P-Bed 2	1.3	26		PASS
04-B2-Flat 4-3B5P-K	2			PASS
04-B2-Flat 4-3B5P-L	2.7			PASS
04-B3-Flat 5-1B2P-Bed	1.3	26		PASS
04-B3-Flat 5-1B2P-LK	2.1			PASS
04-B3-Flat 6-2B4P- Bed 1	1.6	34		FAIL
04-B3-Flat 6-2B4P-Bed 2	1.7	34		FAIL
04-B3-Flat 6-2B4P-LK	2.2			PASS
04-B3-Flat 8-1B2P-Bed	1.4	29		PASS
04-B3-Flat 8-1B2P-LK	2.4			PASS
04-B4-Flat 2-2B4P-Bed 1	1.6	63		FAIL
04-B4-Flat 2-2B4P-Bed 2	1.7	55		FAIL
04-B4-Flat 2-2B4P-LK	2.1			PASS
04-B4-Flat 4-1B2P-Bed	1.8	63		FAIL
04-B4-Flat 4-1B2P-LK	2.1			PASS
04-B5-Flat 7-1B2P-Bed	1.3	60		FAIL
04-B5-Flat 7-1B2P-LK	1.3			PASS
04-C2-Flat 06-2B4P-Bed 1	1.8	50		FAIL
04-C2-Flat 06-2B4P-Bed 2	1.8	54		FAIL
04-C2-Flat 06-2B4P-LK	2.3			PASS
04-C2-Flat 5-1B2P-Bed	2.2	102		FAIL
04-C2-Flat 5-1B2P-LK	2.6			PASS
04-D1-Flat 2-2B4P-Bed 1	1.4	37		FAIL
04-D1-Flat 2-2B4P-Bed 2	1.6	34		FAIL
04-D1-Flat 2-2B4P-LK	2.1			PASS
04-D1-Flat 4-3B5P- Single bed	1.7	26		PASS
04-D1-Flat 4-3B5P-Bed 1	1.4	53		FAIL

Iteration 3 - Increased Thermal Mass	TM59 Criterion 1	TM59 Criterion 2	Communal Corridors	Compliance
Room	(% Hours of Exceedance)	(% annual hours above 26°C between 22:00 – 07:00)	(% annual hours above 28°C)	
Target	≤3%	≤32 hours	≤3%	
04-D1-Flat 4-3B5P-Bed 2	1.4	30		PASS
04-D1-Flat 4-3B5P-LK	2.2			PASS
04-D2-Flat 4-2B4P-Bed 1	1.2	39		FAIL
04-D2-Flat 4-2B4P-Bed 2	1.5	37		FAIL
04-D2-Flat 4-2B4P-LK	2.3			PASS
04-E1-Flat 12-1B2P-Bed	1.5	32		PASS
04-E1-Flat 12-1B2P-LK	2.7			PASS
04-E1-Flt 11-1B2P-Bed	1.4	28		PASS
04-E1-Flt 11-1B2P-LK	2.2			PASS
04-E2-Flat 3-2B4P-Bed 1	1.5	50		FAIL
04-E2-Flat 3-2B4P-Bed 2	1.6	49		FAIL
04-E2-Flat 3-2B4P-LK	2.3			PASS
04-E2-Flat 4-2B4P-Bed 1	1.6	42		FAIL
04-E2-Flat 4-2B4P-Bed 2	1.5	46		FAIL
04-E2-Flat 4-2B4P-LK	2.3			PASS
06-B6-Flat 4-2B4P-Bed 1	1.2	50		FAIL
06-B6-Flat 4-2B4P-Bed 2	1.5	44		FAIL
06-B6-Flat 4-2B4P-LK	2.2			PASS
06-B6-Flat 9-2B3P- Single bed	1.8	44		FAIL
06-B6-Flat 9-2B3P-Bed 1	1.5	51		FAIL
06-B6-Flat 9-2B3P-LK	2.3			PASS
06-E1-Flat 4-1B2P-Bed	1.5	26		PASS
06-E1-Flat 4-1B2P-LK	2.3			PASS
06-E1-Flat 5-1B2P-Bed	1.5	28		PASS
06-E1-Flat 5-1B2P-LK	2.8			PASS
06-E2-Flat 4-2B4P-Bed 1	1.6	39		FAIL
06-E2-Flat 4-2B4P-Bed 2	1.5	41		FAIL
06-E2-Flat 4-2B4P-LK	2.6			PASS
07-A3-Flat 6-1B2P-Bed	1.6	42		FAIL

Iteration 3 - Increased Thermal Mass	TM59 Criterion 1	TM59 Criterion 2	Communal Corridors	Compliance
Room	(% Hours of Exceedance)	(% annual hours above 26°C between 22:00 – 07:00)	(% annual hours above 28°C)	
Target	≤3%	≤32 hours	≤3%	
07-A3-Flat 6-1B2P-LK	1.9			PASS
07-B3-Flat 5-1B2P-Bed	1.4	25		PASS
07-B3-Flat 5-1B2P-LK	1.9			PASS
07-B3-Flat 6-2B3P- Single bed	1.9	26		PASS
07-B3-Flat 6-2B3P-Bed	1.5	32		PASS
07-B3-Flat 6-2B3P-LK	1			PASS
07-D1-Flat 2-2B4P-Bed 1	1.4	32		PASS
07-D1-Flat 2-2B4P-Bed 2	1.6	30		PASS
07-D1-Flat 2-2B4P-LK	2.1			PASS
07-D1-Flat 4-3B5P- Single bed	1.7	24		PASS
07-D1-Flat 4-3B5P-Bed 1	1.6	47		FAIL
07-D1-Flat 4-3B5P-Bed 2	1.5	30		PASS
07-D1-Flat 4-3B5P-LK	2.2			PASS
08-A3-Flat 4-2B4P-Bed 1	1.5	24		PASS
08-A3-Flat 4-2B4P-Bed 2	1.3	30		PASS
08-A3-Flat 4-2B4P-LK	2			PASS
08-A3-Flat 5-2B4P-Bed 1	1.6	22		PASS
08-A3-Flat 5-2B4P-Bed 2	1.5	26		PASS
08-A3-Flat 5-2B4P-LK	2.3			PASS
09-B5-Flat 5-1B2P-Bed	1.5	59		FAIL
09-B5-Flat 5-1B2P-LK	2.2			PASS
09-B5-Flat 6-2B3P- Single bed	1.8	45		FAIL
09-B5-Flat 6-2B3P-Bed	1.3	52		FAIL
09-B5-Flat 6-2B3P-LK	2.1			PASS
09-B5-Flat 7-1B2P-Bed	1.6	61		FAIL
09-B5-Flat 7-1B2P-LK	2.3			PASS
09-C2-Flat 3 - 3B5P- Single bed	2	43		FAIL
09-C2-Flat 3 - 3B5P-Bed 1	1.9	49		FAIL
09-C2-Flat 3 - 3B5P-Bed 2	2	49		FAIL
09-C2-Flat 3 - 3B5P-K	1.1			PASS
09-C2-Flat 3 - 3B5P-L	2.5			PASS
10-C1-Flat 5-1B2P-Bed	1.7	43		FAIL
10-C1-Flat 5-1B2P-LK	2.4			PASS
10-C1-Flat 6-2B4P-Bed 2	1.9	54		FAIL
10-C1-Flat 6-2B4P-Bed 2	2	54		FAIL
10-C1-Flat 6-2B4P-LK	2.5			PASS
02-B3-communal corridor			0	PASS
02-D1-communal corridor			0	PASS
02-E1-Communal Corridor 1			0	PASS
02-E1-Communal Corridor 2			0	PASS
02-E1-Communal Corridor 3			0	PASS
03-A2-Communal Corridor			0	PASS
04-A1-Communal Corridor			0	PASS
04-A2-Communal Corridor			0	PASS
04-A3-Communal Corridor			0	PASS
04-B2-communal corridor			0	PASS
04-B3-communal corridor			0	PASS
04-B4- Communal corridor			0	PASS
04-B5- Communal corridor			0	PASS
04-C2-communal corridor			0	PASS
04-D1-communal corridor			0	PASS
04-D2-communal corridor			0	PASS
04-E1-Communal Corridor 1			0	PASS
04-E2-Communal Corridor			0	PASS
06-B6-communal corridor			0	PASS
06-E1-Communal Corridor 1			0	PASS
06-E1-Communal Corridor 2			0	PASS
06-E2-Communal Corridor			0	PASS

Iteration 3 - Increased Thermal Mass	TM59 Criterion 1	TM59 Criterion 2	Communal Corridors	Compliance
Room	(% Hours of Exceedance)	(% annual hours above 26°C between 22:00 – 07:00)	(% annual hours above 28°C)	
Target	≤3%	≤32 hours	≤3%	
07-A3-Communal Corridor			0	PASS
07-B3- communal corridor			0	PASS
07-D1-communal corridor			0	PASS
08-A3-Communal Corridor			0	PASS
09-B5-communal corridor			0	PASS
09-C2-communal corridor			0	PASS
10-C1-communal corridor			0	PASS

Appendix C - Results using CIBSE DSY 2 Weather File.

The table below shows the results taken from the Enhanced passive design solution and using the DSY 2 weather file. The DSY2 weather file represents a heat wave scenario of a summer with a short intense warm spell.

The calculations have been carried out for a worse-case scenario including passive design measures only, and no active measures (e.g. tempered air, comfort cooling).

The results show that the current design would struggle to comply even with most impacting passive design measures deployed, hence it is likely that enhanced mechanical ventilation with tempered air will be required to comply with this weather scenario.

DSY 2 (heat wave scenario: short intense warm spell)	TM59 Criterion 1	TM59 Criterion 2	Communal Corridors	Compliance
Room	(% Hours of Exceedance)	(% annual hours above 26°C between 22:00 – 07:00)	(% annual hours above 28°C)	
Target	≤3%	≤32 hours	≤3%	
02-B3-Flat 5-1B2P-Bed	2.1	57		FAIL
02-B3-Flat 5-1B2P-LK	3.9			FAIL
02-B3-Flat 6-2B4P- Bed 1	2.1	73		FAIL
02-B3-Flat 6-2B4P-Bed 2	2.3	60		FAIL
02-B3-Flat 6-2B4P-LK	3.6			FAIL
02-D1-Flat 4-3B5P- Single bed	2.3	56		FAIL
02-D1-Flat 4-3B5P-Bed 1	2.1	77		FAIL
02-D1-Flat 4-3B5P-Bed 2	2.2	70		FAIL
02-D1-Flat 4-3B5P-LK	3.9			FAIL
02-E1-Flat 11-1B2P-Bed	2.2	67		FAIL
02-E1-Flat 11-1B2P-LK	4			FAIL
02-E1-Flat 12-1B2P-Bed	2.2	66		FAIL
02-E1-Flat 12-1B2P-LK	4.1			FAIL
03-A2-Flat 3-1B2P-Bed	2.1	63		FAIL
03-A2-Flat 3-1B2P-LK	3.1			FAIL
04-A1-Flat 3-3B5P- Single bed	2.1	35		FAIL
04-A1-Flat 3-3B5P-Bed 1	2	47		FAIL
04-A1-Flat 3-3B5P-Bed 2	1.8	47		FAIL
04-A1-Flat 3-3B5P-K	3.6			FAIL
04-A1-Flat 3-3B5P-L	4.1			FAIL
04-A2-Flat 3-1B2P-Bed	2.1	44		FAIL
04-A2-Flat 3-1B2P-LK	3.7			FAIL
04-A3-Flat 5-2B4P-Bed 1	2.2	47		FAIL
04-A3-Flat 5-2B4P-Bed 2	2	53		FAIL
04-A3-Flat 5-2B4P-LK	3.6			FAIL
04-A3-Flat 6-1B2P-Bed	2	49		FAIL
04-A3-Flat 6-1B2P-LK	3.6			FAIL
04-B2-Flat 4-3B5P- Single bed	1.8	36		FAIL
04-B2-Flat 4-3B5P-Bed 1	1.7	42		FAIL
04-B2-Flat 4-3B5P-Bed 2	2	43		FAIL
04-B2-Flat 4-3B5P-K	3.2			FAIL
04-B2-Flat 4-3B5P-L	4.2			FAIL
04-B3-Flat 5-1B2P-Bed	2.1	43		FAIL
04-B3-Flat 5-1B2P-LK	3.7			FAIL
04-B3-Flat 6-2B4P- Bed 1	2	53		FAIL
04-B3-Flat 6-2B4P-Bed 2	2.2	47		FAIL
04-B3-Flat 6-2B4P-LK	3.6			FAIL
04-B3-Flat 8-1B2P-Bed	2	46		FAIL
04-B3-Flat 8-1B2P-LK	3.7			FAIL
04-B4-Flat 2-2B4P-Bed 1	2.2	82		FAIL
04-B4-Flat 2-2B4P-Bed 2	2.2	64		FAIL
04-B4-Flat 2-2B4P-LK	3.8			FAIL
04-B4-Flat 4-1B2P-Bed	2	86		FAIL
04-B4-Flat 4-1B2P-LK	3.8			FAIL
04-B5-Flat 7-1B2P-Bed	1.9	82		FAIL
04-B5-Flat 7-1B2P-LK	3.1			FAIL
04-C2-Flat 06-2B4P-Bed 1	2	82		FAIL
04-C2-Flat 06-2B4P-Bed 2	2.2	77		FAIL
04-C2-Flat 06-2B4P-LK	3.6			FAIL
04-C2-Flat 5-1B2P-Bed	2.7	115		FAIL
04-C2-Flat 5-1B2P-LK	3.9			FAIL

DSY 2 (heat wave scenario: short intense warm spell)	TM59 Criterion 1	TM59 Criterion 2	Communal Corridors	Compliance
Room	(% Hours of Exceedance)	(% annual hours above 26°C between 22:00 – 07:00)	(% annual hours above 28°C)	
Target	≤3%	≤32 hours	≤3%	
04-D1-Flat 2-2B4P-Bed 1	2.1	54		FAIL
04-D1-Flat 2-2B4P-Bed 2	2.2	48		FAIL
04-D1-Flat 2-2B4P-LK	3.9			FAIL
04-D1-Flat 4-3B5P- Single bed	2.3	43		FAIL
04-D1-Flat 4-3B5P-Bed 1	2.1	74		FAIL
04-D1-Flat 4-3B5P-Bed 2	2.2	51		FAIL
04-D1-Flat 4-3B5P-LK	3.9			FAIL
04-D2-Flat 4-2B4P-Bed 1	1.9	60		FAIL
04-D2-Flat 4-2B4P-Bed 2	2.2	52		FAIL
04-D2-Flat 4-2B4P-LK	4.1			FAIL
04-E1-Flat 12-1B2P-Bed	2.1	47		FAIL
04-E1-Flat 12-1B2P-LK	4			FAIL
04-E1-Flt 11-1B2P-Bed	2.1	46		FAIL
04-E1-Flt 11-1B2P-LK	3.9			FAIL
04-E2-Flat 3-2B4P-Bed 1	2.1	81		FAIL
04-E2-Flat 3-2B4P-Bed 2	2.2	61		FAIL
04-E2-Flat 3-2B4P-LK	3.9			FAIL
04-E2-Flat 4-2B4P-Bed 1	2.2	57		FAIL
04-E2-Flat 4-2B4P-Bed 2	2.2	71		FAIL
04-E2-Flat 4-2B4P-LK	3.9			FAIL
06-B6-Flat 4-2B4P-Bed 1	1.9	76		FAIL
06-B6-Flat 4-2B4P-Bed 2	2.2	58		FAIL
06-B6-Flat 4-2B4P-LK	3.9			FAIL
06-B6-Flat 9-2B3P- Single bed	2.2	59		FAIL
06-B6-Flat 9-2B3P-Bed 1	2.1	76		FAIL
06-B6-Flat 9-2B3P-LK	4			FAIL
06-E1-Flat 4-1B2P-Bed	2	41		FAIL
06-E1-Flat 4-1B2P-LK	3.8			FAIL
06-E1-Flat 5-1B2P-Bed	2.1	43		FAIL
06-E1-Flat 5-1B2P-LK	3.9			FAIL
06-E2-Flat 4-2B4P-Bed 1	2.1	54		FAIL
06-E2-Flat 4-2B4P-Bed 2	2.1	60		FAIL
06-E2-Flat 4-2B4P-LK	3.7			FAIL
07-A3-Flat 6-1B2P-Bed	1.8	55		FAIL
07-A3-Flat 6-1B2P-LK	3.3			FAIL
07-B3-Flat 5-1B2P-Bed	1.9	42		FAIL
07-B3-Flat 5-1B2P-LK	3.4			FAIL
07-B3-Flat 6-2B3P- Single bed	2	42		FAIL
07-B3-Flat 6-2B3P-Bed	1.7	48		FAIL
07-B3-Flat 6-2B3P-LK	2.5			PASS
07-D1-Flat 2-2B4P-Bed 1	2.1	47		FAIL
07-D1-Flat 2-2B4P-Bed 2	2.1	42		FAIL
07-D1-Flat 2-2B4P-LK	3.7			FAIL
07-D1-Flat 4-3B5P- Single bed	2.2	38		FAIL
07-D1-Flat 4-3B5P-Bed 1	2	65		FAIL
07-D1-Flat 4-3B5P-Bed 2	2.1	47		FAIL

DSY 2 (heat wave scenario: short intense warm spell)	TM59 Criterion 1	TM59 Criterion 2	Communal Corridors	Compliance
Room	(% Hours of Exceedance)	(% annual hours above 26°C between 22:00 – 07:00)	(% annual hours above 28°C)	
Target	≤3%	≤32 hours	≤3%	
07-D1-Flat 4-3B5P-LK	3.6			FAIL
08-A3-Flat 4-2B4P-Bed 1	2	37		FAIL
08-A3-Flat 4-2B4P-Bed 2	2	47		FAIL
08-A3-Flat 4-2B4P-LK	3.4			FAIL
08-A3-Flat 5-2B4P-Bed 1	2.2	36		FAIL
08-A3-Flat 5-2B4P-Bed 2	2.1	45		FAIL
08-A3-Flat 5-2B4P-LK	3.5			FAIL
09-B5-Flat 5-1B2P-Bed	2.1	65		FAIL
09-B5-Flat 5-1B2P-LK	3.8			FAIL
09-B5-Flat 6-2B3P- Single bed	2.2	55		FAIL
09-B5-Flat 6-2B3P-Bed	1.9	64		FAIL
09-B5-Flat 6-2B3P-LK	3.6			FAIL
09-B5-Flat 7-1B2P-Bed	2.1	74		FAIL
09-B5-Flat 7-1B2P-LK	3.5			FAIL
09-C2-Flat 3 - 3B5P- Single bed	2.1	59		FAIL
09-C2-Flat 3 - 3B5P-Bed 1	2	66		FAIL
09-C2-Flat 3 - 3B5P-Bed 2	2	70		FAIL
09-C2-Flat 3 - 3B5P-K	3.3			FAIL
09-C2-Flat 3 - 3B5P-L	3.9			FAIL
10-C1-Flat 5-1B2P-Bed	2.2	61		FAIL
10-C1-Flat 5-1B2P-LK	3.8			FAIL
10-C1-Flat 6-2B4P-Bed 2	2	73		FAIL
10-C1-Flat 6-2B4P-Bed 2	2	73		FAIL
10-C1-Flat 6-2B4P-LK	3.6			FAIL
02-B3-communal corridor			0	PASS
02-D1-communal corridor			0	PASS
02-E1-Communal Corridor 1			0	PASS
02-E1-Communal Corridor 2			0	PASS
02-E1-Communal Corridor 3			0	PASS
03-A2-Communal Corridor			0	PASS
04-A1-Communal Corridor			0	PASS
04-A2-Communal Corridor			0	PASS
04-A3-Communal Corridor			0	PASS
04-B2-communal corridor			0	PASS
04-B3-communal corridor			0	PASS
04-B4- Communal corridor			0	PASS
04-B5- Communal corridor			0	PASS
04-C2-communal corridor			0	PASS
04-D1-communal corridor			0	PASS
04-D2-communal corridor			0	PASS
04-E1-Communal Corridor 1			0	PASS
04-E2-Communal Corridor			0	PASS
06-B6-communal corridor			0	PASS
06-E1-Communal Corridor 1			0	PASS
06-E1-Communal Corridor 2			0	PASS
06-E2-Communal Corridor			0	PASS

DSY 2 (heat wave scenario: short intense warm spell)	TM59 Criterion 1	TM59 Criterion 2	Communal Corridors	Compliance
Room	(% Hours of Exceedance)	(% annual hours above 26°C between 22:00 – 07:00)	(% annual hours above 28°C)	
Target	≤3%	≤32 hours	≤3%	
07-A3-Communal Corridor			0	PASS
07-B3- communal corridor			0	PASS
07-D1-communal corridor			0	PASS
08-A3-Communal Corridor			0	PASS
09-B5-communal corridor			0	PASS
09-C2-communal corridor			0	PASS
10-C1-communal corridor			0	PASS

Appendix D – Results using CIBSE DSY 3 Weather File.

The table below shows the results taken from the Enhanced passive design solution and using the DSY 3 weather file. The DSY3 weather file represents a heat wave scenario of a summer with a long less intense warm spell.

The calculations have been carried out for a worse-case scenario including passive design measures only, and no active measures (e.g. tempered air, comfort cooling).

The results show that the current design would struggle to comply even with most impacting passive design measures deployed, hence it is likely that enhanced mechanical ventilation with tempered air will be required to comply with this weather scenario.

DSY 3 (heat wave scenario: long less intense warm spell)	TM59 Criterion 1	TM59 Criterion 2	Communal Corridors	Compliance
Room	(% Hours of Exceedance)	(% annual hours above 26°C between 22:00 – 07:00)	(% annual hours above 28°C)	
Target	≤3%	≤32 hours	≤3%	
02-B3-Flat 5-1B2P-Bed	3.3	75		FAIL
02-B3-Flat 5-1B2P-LK	5.5			FAIL
02-B3-Flat 6-2B4P- Bed 1	3.2	93		FAIL
02-B3-Flat 6-2B4P-Bed 2	3.5	80		FAIL
02-B3-Flat 6-2B4P-LK	5.3			FAIL
02-D1-Flat 4-3B5P- Single bed	3.6	73		FAIL
02-D1-Flat 4-3B5P-Bed 1	3.4	87		FAIL
02-D1-Flat 4-3B5P-Bed 2	3.3	88		FAIL
02-D1-Flat 4-3B5P-LK	5.7			FAIL
02-E1-Flat 11-1B2P-Bed	3.4	84		FAIL
02-E1-Flat 11-1B2P-LK	6.1			FAIL
02-E1-Flat 12-1B2P-Bed	3.5	82		FAIL
02-E1-Flat 12-1B2P-LK	6			FAIL
03-A2-Flat 3-1B2P-Bed	3.3	81		FAIL
03-A2-Flat 3-1B2P-LK	5			FAIL
04-A1-Flat 3-3B5P- Single bed	3.3	53		FAIL
04-A1-Flat 3-3B5P-Bed 1	3.2	62		FAIL
04-A1-Flat 3-3B5P-Bed 2	2.8	69		FAIL
04-A1-Flat 3-3B5P-K	5.7			FAIL
04-A1-Flat 3-3B5P-L	6.4			FAIL
04-A2-Flat 3-1B2P-Bed	3.2	63		FAIL
04-A2-Flat 3-1B2P-LK	5.6			FAIL

DSY 3 (heat wave scenario: long less intense warm spell)	TM59 Criterion 1	TM59 Criterion 2	Communal Corridors	Compliance
Room	(% Hours of Exceedance)	(% annual hours above 26°C between 22:00 – 07:00)	(% annual hours above 28°C)	
Target	≤3%	≤32 hours	≤3%	
04-A3-Flat 5-2B4P-Bed 1	3.4	66		FAIL
04-A3-Flat 5-2B4P-Bed 2	3.1	72		FAIL
04-A3-Flat 5-2B4P-LK	5.4			FAIL
04-A3-Flat 6-1B2P-Bed	3.1	66		FAIL
04-A3-Flat 6-1B2P-LK	5.3			FAIL
04-B2-Flat 4-3B5P- Single bed	2.9	53		FAIL
04-B2-Flat 4-3B5P-Bed 1	2.8	59		FAIL
04-B2-Flat 4-3B5P-Bed 2	2.8	62		FAIL
04-B2-Flat 4-3B5P-K	5.1			FAIL
04-B2-Flat 4-3B5P-L	6			FAIL
04-B3-Flat 5-1B2P-Bed	3.1	62		FAIL
04-B3-Flat 5-1B2P-LK	5.5			FAIL
04-B3-Flat 6-2B4P- Bed 1	3	72		FAIL
04-B3-Flat 6-2B4P-Bed 2	3.3	67		FAIL
04-B3-Flat 6-2B4P-LK	5.1			FAIL
04-B3-Flat 8-1B2P-Bed	2.9	62		FAIL
04-B3-Flat 8-1B2P-LK	5.3			FAIL
04-B4-Flat 2-2B4P-Bed 1	3.5	101		FAIL
04-B4-Flat 2-2B4P-Bed 2	3.6	85		FAIL
04-B4-Flat 2-2B4P-LK	5.6			FAIL
04-B4-Flat 4-1B2P-Bed	3.3	105		FAIL
04-B4-Flat 4-1B2P-LK	5.5			FAIL
04-B5-Flat 7-1B2P-Bed	3	104		FAIL
04-B5-Flat 7-1B2P-LK	4.6			FAIL
04-C2-Flat 06-2B4P-Bed 1	3	95		FAIL
04-C2-Flat 06-2B4P-Bed 2	3.4	92		FAIL
04-C2-Flat 06-2B4P-LK	5.3			FAIL
04-C2-Flat 5-1B2P-Bed	4.2	163		FAIL
04-C2-Flat 5-1B2P-LK	5.5			FAIL

DSY 3 (heat wave scenario: long less intense warm spell)	TM59 Criterion 1	TM59 Criterion 2	Communal Corridors	Compliance
Room	(% Hours of Exceedance)	(% annual hours above 26°C between 22:00 – 07:00)	(% annual hours above 28°C)	
Target	≤3%	≤32 hours	≤3%	
04-D1-Flat 2-2B4P-Bed 1	3.3	75		FAIL
04-D1-Flat 2-2B4P-Bed 2	3.4	67		FAIL
04-D1-Flat 2-2B4P-LK	5.8			FAIL
04-D1-Flat 4-3B5P- Single bed	3.5	59		FAIL
04-D1-Flat 4-3B5P-Bed 1	3.3	87		FAIL
04-D1-Flat 4-3B5P-Bed 2	3.2	70		FAIL
04-D1-Flat 4-3B5P-LK	5.6			FAIL
04-D2-Flat 4-2B4P-Bed 1	3	83		FAIL
04-D2-Flat 4-2B4P-Bed 2	3.3	76		FAIL
04-D2-Flat 4-2B4P-LK	6.1			FAIL
04-E1-Flat 12-1B2P-Bed	3.2	65		FAIL
04-E1-Flat 12-1B2P-LK	5.9			FAIL
04-E1-Flt 11-1B2P-Bed	3.1	61		FAIL
04-E1-Flt 11-1B2P-LK	5.9			FAIL
04-E2-Flat 3-2B4P-Bed 1	3.4	97		FAIL
04-E2-Flat 3-2B4P-Bed 2	3.5	84		FAIL
04-E2-Flat 3-2B4P-LK	5.9			FAIL
04-E2-Flat 4-2B4P-Bed 1	3.5	81		FAIL
04-E2-Flat 4-2B4P-Bed 2	3.4	89		FAIL
04-E2-Flat 4-2B4P-LK	5.7			FAIL
06-B6-Flat 4-2B4P-Bed 1	2.9	108		FAIL
06-B6-Flat 4-2B4P-Bed 2	3.2	86		FAIL
06-B6-Flat 4-2B4P-LK	6			FAIL
06-B6-Flat 9-2B3P- Single bed	3.6	83		FAIL
06-B6-Flat 9-2B3P-Bed 1	3.3	101		FAIL
06-B6-Flat 9-2B3P-LK	5.9			FAIL
06-E1-Flat 4-1B2P-Bed	3	59		FAIL

DSY 3 (heat wave scenario: long less intense warm spell)	TM59 Criterion 1	TM59 Criterion 2	Communal Corridors	Compliance
Room	(% Hours of Exceedance)	(% annual hours above 26°C between 22:00 – 07:00)	(% annual hours above 28°C)	
Target	≤3%	≤32 hours	≤3%	
06-E1-Flat 4-1B2P-LK	5.9			FAIL
06-E1-Flat 5-1B2P-Bed	3.1	62		FAIL
06-E1-Flat 5-1B2P-LK	5.9			FAIL
06-E2-Flat 4-2B4P-Bed 1	3.4	79		FAIL
06-E2-Flat 4-2B4P-Bed 2	3.2	87		FAIL
06-E2-Flat 4-2B4P-LK	5.6			FAIL
07-A3-Flat 6-1B2P-Bed	2.9	77		FAIL
07-A3-Flat 6-1B2P-LK	4.8			FAIL
07-B3-Flat 5-1B2P-Bed	3	61		FAIL
07-B3-Flat 5-1B2P-LK	5.2			FAIL
07-B3-Flat 6-2B3P- Single bed	2.9	61		FAIL
07-B3-Flat 6-2B3P-Bed	2.6	71		FAIL
07-B3-Flat 6-2B3P-LK	3.7			FAIL
07-D1-Flat 2-2B4P-Bed 1	3.3	70		FAIL
07-D1-Flat 2-2B4P-Bed 2	3.4	63		FAIL
07-D1-Flat 2-2B4P-LK	5.6			FAIL
07-D1-Flat 4-3B5P- Single bed	3.4	59		FAIL
07-D1-Flat 4-3B5P-Bed 1	3.1	85		FAIL
07-D1-Flat 4-3B5P-Bed 2	3.1	69		FAIL
07-D1-Flat 4-3B5P-LK	5.2			FAIL
08-A3-Flat 4-2B4P-Bed 1	3.2	57		FAIL
08-A3-Flat 4-2B4P-Bed 2	3.2	67		FAIL
08-A3-Flat 4-2B4P-LK	5.4			FAIL

DSY 3 (heat wave scenario: long less intense warm spell)	TM59 Criterion 1	TM59 Criterion 2	Communal Corridors	Compliance
Room	(% Hours of Exceedance)	(% annual hours above 26°C between 22:00 – 07:00)	(% annual hours above 28°C)	
Target	≤3%	≤32 hours	≤3%	
08-A3-Flat 5-2B4P-Bed 1	3.3	53		FAIL
08-A3-Flat 5-2B4P-Bed 2	3.2	65		FAIL
08-A3-Flat 5-2B4P-LK	5.4			FAIL
09-B5-Flat 5-1B2P-Bed	3.4	85		FAIL
09-B5-Flat 5-1B2P-LK	5.5			FAIL
09-B5-Flat 6-2B3P- Single bed	3.5	75		FAIL
09-B5-Flat 6-2B3P-Bed	3.1	84		FAIL
09-B5-Flat 6-2B3P-LK	5.3			FAIL
09-B5-Flat 7-1B2P-Bed	3.3	91		FAIL
09-B5-Flat 7-1B2P-LK	5			FAIL
09-C2-Flat 3 - 3B5P- Single bed	3.2	82		FAIL
09-C2-Flat 3 - 3B5P-Bed 1	3.1	95		FAIL
09-C2-Flat 3 - 3B5P-Bed 2	3.2	97		FAIL
09-C2-Flat 3 - 3B5P-K	4.7			FAIL
09-C2-Flat 3 - 3B5P-L	5.7			FAIL
10-C1-Flat 5-1B2P-Bed	3.5	86		FAIL
10-C1-Flat 5-1B2P-LK	5.5			FAIL
10-C1-Flat 6-2B4P-Bed 2	3.1	89		FAIL
10-C1-Flat 6-2B4P-Bed 2	3	89		FAIL
10-C1-Flat 6-2B4P-LK	5.2			FAIL
02-B3-communal corridor			0	PASS
02-D1-communal corridor			0	PASS
02-E1-Communal Corridor 1			0	PASS

DSY 3 (heat wave scenario: long less intense warm spell)	TM59 Criterion 1	TM59 Criterion 2	Communal Corridors	Compliance
Room	(% Hours of Exceedance)	(% annual hours above 26°C between 22:00 – 07:00)	(% annual hours above 28°C)	
Target	≤3%	≤32 hours	≤3%	
02-E1-Communal Corridor 2			0	PASS
02-E1-Communal Corridor 3			0	PASS
03-A2-Communal Corridor			0	PASS
04-A1-Communal Corridor			0	PASS
04-A2-Communal Corridor			0	PASS
04-A3-Communal Corridor			0	PASS
04-B2-communal corridor			0	PASS
04-B3-communal corridor			0	PASS
04-B4- Communal corridor			0	PASS
04-B5- Communal corridor			0	PASS
04-C2-communal corridor			0	PASS
04-D1-communal corridor			0	PASS
04-D2-communal corridor			0	PASS
04-E1-Communal Corridor 1			0	PASS
04-E2-Communal Corridor			0	PASS
06-B6-communal corridor			0	PASS
06-E1-Communal Corridor 1			0	PASS
06-E1-Communal Corridor 2			0	PASS
06-E2-Communal Corridor			0	PASS
07-A3-Communal Corridor			0	PASS
07-B3- communal corridor			0	PASS
07-D1-communal corridor			0	PASS
08-A3-Communal Corridor			0	PASS
09-B5-communal corridor			0	PASS
09-C2-communal corridor			0	PASS
10-C1-communal corridor			0	PASS

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Appendix C: TER Outputs and Be Lean SAP Results and BRUKL.

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	009163	**Issued on Date**	27/10/2021
Assessment Reference	Lean	**Prop Type Ref**	B1_01_04 (M)
Property			

SAP Rating	83 B	**DER**	18.16	**TER**	20.00
Environmental	88 B	**% DER<TER**	9.21		
CO_2 Emissions (t/year)	0.81	**DFEE**	42.45	**TFEE**	50.99
General Requirements Compliance	Pass	**% DFEE<TFEE**	16.75		

Assessor Details	Mr. Liam Holden, Liam Holden, Tel: 01202 654600, liamholden@hoarelea.com	**Assessor ID**	P624-0001
Client			

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Mid-floor flat, total floor area 52 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
----------------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Mains gas (c)
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 20.00 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 18.16 kgCO□/m²OK
----------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)51.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)42.4 kWh/m²/yrOK
----------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                 Highest
External wall   0.13 (max. 0.30)        0.13 (max. 0.70)          OK
Party wall      0.00 (max. 0.20)         -                        OK
Floor           0.10 (max. 0.25)        0.10 (max. 0.70)          OK
Roof            (no roof)
Openings        1.17 (max. 2.00)        1.20 (max. 3.30)          OK
----------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
----------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:         3.00 (design value)
Maximum                                 10.0                                              OK
----------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                    Community heating scheme                          -

Secondary heating system:               None
----------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                       Measured cylinder loss: 1.85 kWh/day
Permitted by DBSCG 1.89                           OK
Primary pipework insulated:             Yes (assumed)                                     OK
----------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                 Charging system linked to use of community heating, programmer and TRVsOK


Hot water controls:                     Cylinderstat                                      OK


----------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                 75%                                               OK
----------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power:                     0.62
Maximum                                 1.5                                               OK
MVHR efficiency:                        94%
Minimum:                                70%                                               OK
----------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Thames Valley):       Slight                                            OK
Based on:
Overshading:                            Average
Windows facing North East:              6.50 m², Overhang width less than twice window, ratio 0.81
Windows facing South East:              5.58 m², No overhang
Air change rate:                        6.00 ach
Blinds/curtains:                        Dark-coloured curtain or roller blind, closed 100% of daylight hours
----------------------------------------------------------------------------------------------------
10 Key features
External wall U-value                   0.13 W/m²K
External wall U-value                   0.13 W/m²K
Party wall U-value                      0.00 W/m²K
Floor U-value                           0.10 W/m²K
Door U-value                            1.00 W/m²K
Air permeability                        3.0 m³/m²h



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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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----------------------------------------------------------------------------------------------------
SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE      09 Jan 2014
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----------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
----------------------------------------------------------------------------------------------------
                                                                                                   Area         Storey height              Volume
                                                                                                   (m2)              (m)                    (m3)
Ground floor                                                                                    52.0100 (1b)    x     2.6000 (2b)    =    135.2260 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)              52.0100                                                                (4)
Dwelling volume                                                                                       (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =    135.2260 (5)



----------------------------------------------------------------------------------------------------
2. Ventilation rate
----------------------------------------------------------------------------------------------------
                                                                 main          secondary              other              total       m3 per hour
                                                              heating            heating
Number of chimneys                                                  0      +           0      +           0      =           0 * 40 =       0.0000 (6a)
Number of open flues                                                0      +           0      +           0      =           0 * 20 =       0.0000 (6b)
Number of intermittent fans                                                                                                  0 * 10 =       0.0000 (7a)
Number of passive vents                                                                                                      0 * 10 =       0.0000 (7b)
Number of flueless gas fires                                                                                                 0 * 40 =       0.0000 (7c)

                                                                                                                             Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                                          0.0000 / (5) =       0.0000 (8)
Pressure test                                                                                                                                  Yes
Measured/design AP50                                                                                                                        3.0000
Infiltration rate                                                                                                                           0.1500 (18)
Number of sides sheltered                                                                                                                        2 (19)

Shelter factor                                                                                        (20) = 1 - [0.075 x (19)] =          0.8500 (20)
Infiltration rate adjusted to include shelter factor                                                            (21) = (18) x (20) =       0.1275 (21)


                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Wind speed       5.1000     5.0000     4.9000     4.4000     4.3000     3.8000     3.8000     3.7000     4.0000     4.3000     4.5000     4.7000 (22)
Wind factor      1.2750     1.2500     1.2250     1.1000     1.0750     0.9500     0.9500     0.9250     1.0000     1.0750     1.1250     1.1750 (22a)
Adj infilt rate
                 0.1626     0.1594     0.1562     0.1403     0.1371     0.1211     0.1211     0.1179     0.1275     0.1371     0.1434     0.1498 (22b)
 Balanced mechanical ventilation with heat recovery
If mechanical ventilation:                                                                                                                  0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =                                               79.9000 (23c)

Effective ac     0.2631     0.2599     0.2567     0.2408     0.2376     0.2216     0.2216     0.2184     0.2280     0.2376     0.2439     0.2503 (25)



----------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
----------------------------------------------------------------------------------------------------
Element                                             Gross       Openings          NetArea        U-value          A x U        K-value         A x K
                                                       m2             m2               m2          W/m2K            W/K         kJ/m2K          kJ/K
Door                                                                               2.1400         1.0000         2.1400                               (26)
Window (Uw = 1.20)                                                                12.0800         1.1450        13.8321                               (27)
Heat Loss Floor 1                                                                 49.4200         0.1000         4.9420                               (28a)
External Wall 1                                   41.5800        12.0800          29.5000         0.1300         3.8350                               (29a)
Sheltered wall                                     9.0200         2.1400           6.8800         0.1236         0.8502                               (29a)
Total net area of external elements Aum(A, m2)                                   100.0200                                                         (31)
Fabric heat loss, W/K = Sum (A x U)                                                     (26)...(30) + (32) =    25.5993                               (33)
Party Wall 1                                                                      32.5600         0.0000         0.0000                               (32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                                        175.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                                                  6.4922 (36)
Total fabric heat loss                                                                                               (33) + (36) =       32.0915 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(38)m           11.7391    11.5968    11.4546    10.7434    10.6011     9.8899     9.8899     9.7477    10.1744    10.6011    10.8856    11.1701 (38)
Heat transfer coeff
                43.8305    43.6883    43.5460    42.8348    42.6926    41.9814    41.9814    41.8391    42.2659    42.6926    42.9771    43.2615 (39)
Average = Sum(39)m / 12 =                                                                                                                  42.7993 (39)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP              0.8427     0.8400     0.8373     0.8236     0.8209     0.8072     0.8072     0.8044     0.8126     0.8209     0.8263     0.8318 (40)
HLP (average)                                                                                                                               0.8229 (40)
Days in month
                     31         28         31         30         31         30         31         31         30         31         30         31 (41)



----------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
----------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                                           1.7494 (42)
Average daily hot water use (litres/day)                                                                                                   75.7474 (43)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
                83.3222    80.2923    77.2624    74.2325    71.2026    68.1727    68.1727    71.2026    74.2325    77.2624    80.2923    83.3222 (44)
Energy conte   123.5644   108.0702   111.5188    97.2248    93.2895    80.5017    74.5967    85.6008    86.6231   100.9509   110.1958   119.6655 (45)
Energy content (annual)                                                                                                 Total = Sum(45)m =     1191.8022 (45)
Distribution loss  (46)m = 0.15 x (45)m
                18.5347    16.2105    16.7278    14.5837    13.9934    12.0753    11.1895    12.8401    12.9935    15.1426    16.5294    17.9498 (46)
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Water storage loss:
Store volume                                                                                                                 150.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                  1.8500 (48)
  Temperature factor from Table 2b                                                                                             0.6000 (49)
Enter (49) or (54) in (55)                                                                                                     1.1100 (55)
Total storage loss
                34.4100     31.0800     34.4100     33.3000     34.4100     33.3000     34.4100     34.4100     33.3000     34.4100     33.3000     34.4100 (56)
If cylinder contains dedicated solar storage
                34.4100     31.0800     34.4100     33.3000     34.4100     33.3000     34.4100     34.4100     33.3000     34.4100     33.3000     34.4100 (57)
Primary loss    23.2624     21.0112     23.2624     22.5120     23.2624     22.5120     23.2624     23.2624     22.5120     23.2624     22.5120     23.2624 (59)
Total heat required for water heating calculated for each month
               181.2368    160.1614    169.1912    153.0368    150.9619    136.3137    132.2691    143.2732    142.4351    158.6233    166.0078    177.3379 (62)
Solar input      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000 (63)
                                                                                           Solar input (sum of months) = Sum(63)m =       0.0000 (63)
Output from w/h
               181.2368    160.1614    169.1912    153.0368    150.9619    136.3137    132.2691    143.2732    142.4351    158.6233    166.0078    177.3379 (64)
                                                                                             Total per year (kWh/year) = Sum(64)m =    1870.8482 (64)
Heat gains from water heating, kWh/month
                87.2231     77.6063     83.2179     76.9768     77.1567     71.4164     70.9413     74.6002     73.4518     79.7041     81.2897     85.9267 (65)



----------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
----------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                  Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
(66)m           87.4683     87.4683     87.4683     87.4683     87.4683     87.4683     87.4683     87.4683     87.4683     87.4683     87.4683     87.4683 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                13.5905     12.0710      9.8168      7.4319      5.5555      4.6902      5.0679      6.5874      8.8416     11.2265     13.1029     13.9682 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               152.4519    154.0338    150.0473    141.5605    130.8474    120.7786    114.0520    112.4700    116.4565    124.9434    135.6565    145.7253 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                31.7468     31.7468     31.7468     31.7468     31.7468     31.7468     31.7468     31.7468     31.7468     31.7468     31.7468     31.7468 (69)
Pumps, fans      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
               -69.9746    -69.9746    -69.9746    -69.9746    -69.9746    -69.9746    -69.9746    -69.9746    -69.9746    -69.9746    -69.9746    -69.9746 (71)
Water heating gains (Table 5)
               117.2353    115.4856    111.8520    106.9123    103.7052     99.1895     95.3512    100.2691    102.0164    107.1292    112.9024    115.4929 (72)
Total internal gains
               332.5182    330.8309    320.9566    305.1452    289.3485    273.8987    263.7116    268.5670    276.5550    292.5395    310.9023    324.4269 (73)



----------------------------------------------------------------------------------------------------
6. Solar gains
----------------------------------------------------------------------------------------------------

[Jan]                                            Area        Solar flux                g                 FF              Access                Gains
                                                   m2          Table 6a    Specific data      Specific data              factor                    W
                                                                   W/m2      or Table 6b        or Table 6c            Table 6d
----------------------------------------------------------------------------------------------------
Northeast                                      6.5000           11.2829           0.3500             0.7700              0.7700              13.6971 (75)
Southeast                                      5.5800           36.7938           0.3500             0.7700              0.7700              38.3443 (77)
----------------------------------------------------------------------------------------------------

Solar gains     52.0414     93.1954    139.5986    193.2250    234.9165    241.3501    229.3029    196.9559    157.9736    106.2591     63.1621     44.0005 (83)
Total gains    384.5596    424.0263    460.5552    498.3702    524.2650    515.2488    493.0145    465.5229    434.5287    398.7986    374.0644    368.4274 (84)



----------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
----------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                   21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                  Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
tau             57.6827     57.8706     58.0596     59.0236     59.2202     60.2235     60.2235     60.4282     59.8181     59.2202     58.8282     58.4414
alpha            4.8455      4.8580      4.8706      4.9349      4.9480      5.0149      5.0149      5.0285      4.9879      4.9480      4.9219      4.8961
util living area
                 0.9785      0.9642      0.9310      0.8474      0.6999      0.5117      0.3730      0.4106      0.6379      0.8732      0.9602      0.9820 (86)

MIT             20.0914     20.2470     20.4816     20.7536     20.9226     20.9871     20.9978     20.9966     20.9628     20.7540     20.3889     20.0649 (87)
Th 2            20.2165     20.2188     20.2212     20.2329     20.2353     20.2471     20.2471     20.2495     20.2424     20.2353     20.2306     20.2259 (88)
util rest of house
                 0.9742      0.9571      0.9176      0.8204      0.6555      0.4550      0.3100      0.3449      0.5782      0.8445      0.9512      0.9783 (89)
MIT 2           19.0079     19.2326     19.5659     19.9450     20.1572     20.2372     20.2460     20.2476     20.2108     19.9547     19.4471     18.9769 (90)
Living area fraction                                                                                  fLA = Living area / (4) =       0.5816 (91)
MIT             19.6381     19.8226     20.0985     20.4153     20.6024     20.6733     20.6833     20.6832     20.6482     20.4196     19.9949     19.6097 (92)
Temperature adjustment                                                                                                                 0.0000
adjusted MIT    19.6381     19.8226     20.0985     20.4153     20.6024     20.6733     20.6833     20.6832     20.6482     20.4196     19.9949     19.6097 (93)



----------------------------------------------------------------------------------------------------
8. Space heating requirement
----------------------------------------------------------------------------------------------------

                  Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
Utilisation      0.9703      0.9530      0.9153      0.8272      0.6773      0.4874      0.3466      0.3830      0.6108      0.8519      0.9480      0.9747 (94)
Useful gains   373.1349    404.0815    421.5433    412.2452    355.0950    251.1294    170.8609    178.2954    265.4105    339.7559    354.6012    359.1078 (95)
Ext temp.        4.3000      4.9000      6.5000      8.9000     11.7000     14.6000     16.6000     16.4000     14.1000     10.6000      7.1000      4.2000 (96)
Heat loss rate W
               672.2774    651.9430    592.1603    493.2545    380.0659    254.9669    171.4213    179.2050    276.7634    419.2229    554.1837    666.6475 (97)
Month fracti     1.0000      1.0000      1.0000      1.0000      1.0000      0.0000      0.0000      0.0000      0.0000      1.0000      1.0000      1.0000 (97a)
Space heating kWh
               222.5620    166.5629    126.9391     58.3267     18.5783      0.0000      0.0000      0.0000      0.0000     59.1235    143.6993    228.8095 (98)
Space heating                                                                                                                      1024.6013 (98)
Space heating per m2                                                                                            (98) / (4) =      19.7001 (99)


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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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8c. Space cooling requirement
----------------------------------------------------------------------------------------------------
Not applicable



----------------------------------------------------------------------------------------------------
9b. Energy requirements
----------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                                                         0.0000 (301)
Fraction of space heat from community system                                                                                  1.0000 (302)
Fraction of heat from community Boilers                                                                                       1.0000 (303a)
Fraction of total space heat from community Boilers                                                                           1.0000 (304a)
Factor for control and charging method (Table 4c(3)) for community space heating                                              1.0000 (305)
Factor for control and charging method (Table 4c(3)) for community water heating                                              1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system                                                             1.0500 (306)
Space heating:
Annual space heating requirement                                                                                           1024.6013 (98)
Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                                                        1075.8313 (307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)                                       0.0000 (308)
Space heating fuel for secondary/supplementary system                                                                         0.0000 (309)

Water heating
Annual water heating requirement                                                                                           1870.8482 (64)
Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                                                        1964.3906 (310a)
Electricity used for heat distribution                                                                                       30.4022 (313)
Annual totals kWh/year

Electricity for pumps and fans:
    (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7750)
   mechanical ventilation fans (SFP =       0.7750)                                                                         127.8562 (330a)
Total electricity for the above, kWh/year                                                                                   127.8562 (331)
Electricity for lighting (calculated in Appendix L)                                                                         240.0129 (332)
Total delivered energy for all uses                                                                                        3408.0910 (338)



----------------------------------------------------------------------------------------------------
12b. Carbon dioxide emissions - Community heating scheme
----------------------------------------------------------------------------------------------------
                                                                                              Energy      Emission factor             Emissions
                                                                                            kWh/year          kg CO2/kWh           kg CO2/year
Efficiency of heat source Boilers                                                                                                   89.0000 (367a)
Space heating from Boilers                                                                 3415.9797              0.2160           737.8516 (367)
Electrical energy for heat distribution                                                      30.4022              0.5190            15.7788 (372)
Total CO2 associated with community systems                                                                                        753.6304 (373)
 (negative value allowed since DFEE <= TFEE)
Space and water heating                                                                                                            753.6304 (376)
Pumps and fans                                                                              127.8562              0.5190            66.3574 (378)
Energy for lighting                                                                         240.0129              0.5190           124.5667 (379)
Total CO2, kg/year                                                                                                                 944.5544 (383)
Dwelling Carbon Dioxide Emission Rate (DER)                                                                                         18.1600 (384)


16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES
DER                                                                                                                                 18.1600 ZC1
Total Floor Area                                                                                                            TFA     52.0100
Assumed number of occupants                                                                                                   N      1.7494
CO2 emission factor in Table 12 for electricity displaced from grid                                                          EF      0.5190
CO2 emissions from appliances, equation (L14)                                                                                       17.3697 ZC2
CO2 emissions from cooking, equation (L16)                                                                                           3.0953 ZC3
Total CO2 emissions                                                                                                                 38.6250 ZC4
Residual CO2 emissions offset from biofuel CHP                                                                                       0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year                                                                             0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation                                                      0.0000 ZC7
Net CO2 emissions                                                                                                                   38.6250 ZC8


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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS      09 Jan 2014
----------------------------------------------------------------------------------------------------
----------------------------------------------------------------------------------------------------



----------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
----------------------------------------------------------------------------------------------------
                                                                                                Area         Storey height                Volume
                                                                                                (m2)                   (m)                  (m3)
Ground floor                                                                                 52.0100 (1b)    x      2.6000 (2b)    =    135.2260 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)              52.0100                                                                     (4)
Dwelling volume                                                                                    (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =    135.2260 (5)



----------------------------------------------------------------------------------------------------
2. Ventilation rate
----------------------------------------------------------------------------------------------------
                                                                main          secondary              other              total        m3 per hour
                                                             heating            heating
Number of chimneys                                                 0      +           0      +           0      =           0 * 40 =      0.0000 (6a)
Number of open flues                                               0      +           0      +           0      =           0 * 20 =      0.0000 (6b)
Number of intermittent fans                                                                                                 2 * 10 =     20.0000 (7a)
Number of passive vents                                                                                                     0 * 10 =      0.0000 (7b)
Number of flueless gas fires                                                                                                0 * 40 =      0.0000 (7c)

                                                                                                                            Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                                         20.0000 / (5) =       0.1479 (8)
Pressure test                                                                                                                                Yes
Measured/design AP50                                                                                                                      5.0000
Infiltration rate                                                                                                                         0.3979 (18)
Number of sides sheltered                                                                                                                      2 (19)

Shelter factor                                                                                       (20) =  1  -  [0.075 x (19)]  =      0.8500 (20)
Infiltration rate adjusted to include shelter factor                                                           (21) = (18) x (20)  =      0.3382 (21)


                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Wind speed       5.1000     5.0000     4.9000     4.4000     4.3000     3.8000     3.8000     3.7000     4.0000     4.3000     4.5000     4.7000 (22)
Wind factor      1.2750     1.2500     1.2250     1.1000     1.0750     0.9500     0.9500     0.9250     1.0000     1.0750     1.1250     1.1750 (22a)
Adj infilt rate
                 0.4312     0.4228     0.4143     0.3720     0.3636     0.3213     0.3213     0.3128     0.3382     0.3636     0.3805     0.3974 (22b)
Effective ac     0.5930     0.5894     0.5858     0.5692     0.5661     0.5516     0.5516     0.5489     0.5572     0.5661     0.5724     0.5790 (25)



----------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
----------------------------------------------------------------------------------------------------
Element                                          Gross       Openings        NetArea        U-value          A x U         K-value          A x K
                                                    m2             m2             m2          W/m2K            W/K          kJ/m2K           kJ/K
TER Opaque door                                                               2.1400         1.0000         2.1400                               (26)
TER Opening Type (Uw = 1.40)                                                 10.8600         1.3258        14.3977                               (27)
Heat Loss Floor 1                                                            49.4200         0.1300         6.4246                               (28a)
External Wall 1                                41.5800        10.8600        30.7200         0.1800         5.5296                               (29a)
Sheltered wall                                  9.0200         2.1400         6.8800         0.1800         1.2384                               (29a)
Total net area of external elements Aum(A, m2)                              100.0200                                                             (31)
Fabric heat loss, W/K = Sum (A x U)                                              (26)...(30) + (32) =     29.7303                               (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                                       250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                                                4.7972 (36)
Total fabric heat loss                                                                                                   (33) + (36) =     34.5275 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(38)m           26.4614    26.3003    26.1423    25.4006    25.2618    24.6157    24.6157    24.4961    24.8646    25.2618    25.5425    25.8361 (38)
Heat transfer coeff
                60.9889    60.8278    60.6699    59.9281    59.7893    59.1433    59.1433    59.0236    59.3921    59.7893    60.0701    60.3636 (39)
Average = Sum(39)m / 12 =                                                                                                                59.9274 (39)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP              1.1726     1.1695     1.1665     1.1522     1.1496     1.1372     1.1372     1.1349     1.1419     1.1496     1.1550     1.1606 (40)
HLP (average)                                                                                                                             1.1522 (40)
Days in month
                     31         28         31         30         31         30         31         31         30         31         30         31 (41)



----------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
----------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                                         1.7494 (42)
Average daily hot water use (litres/day)                                                                                                 75.7474 (43)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
                83.3222    80.2923    77.2624    74.2325    71.2026    68.1727    68.1727    71.2026    74.2325    77.2624    80.2923    83.3222 (44)
Energy conte   123.5644   108.0702   111.5188    97.2248    93.2895    80.5017    74.5967    85.6008    86.6231   100.9509   110.1958   119.6655 (45)
Energy content (annual)                                                                                           Total = Sum(45)m =    1191.8022 (45)
Distribution loss  (46)m = 0.15 x (45)m
                18.5347    16.2105    16.7278    14.5837    13.9934    12.0753    11.1895    12.8401    12.9935    15.1426    16.5294    17.9498 (46)
Water storage loss:
Store volume                                                                                                                            150.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                             1.3938 (48)
  Temperature factor from Table 2b                                                                                                        0.5400 (49)
Enter (49) or (54) in (55)                                                                                                                0.7527 (55)
```

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

```
Total storage loss
                23.3325    21.0745    23.3325    22.5798    23.3325    22.5798    23.3325    23.3325    22.5798    23.3325    22.5798    23.3325 (56)
If cylinder contains dedicated solar storage
                23.3325    21.0745    23.3325    22.5798    23.3325    22.5798    23.3325    23.3325    22.5798    23.3325    22.5798    23.3325 (57)
Primary loss    23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
               170.1593   150.1559   158.1137   142.3166   139.8844   125.5936   121.1916   132.1957   131.7150   147.5458   155.2877   166.2604 (62)
Solar input      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                         Solar input (sum of months) = Sum(63)m =       0.0000 (63)
Output from w/h
               170.1593   150.1559   158.1137   142.3166   139.8844   125.5936   121.1916   132.1957   131.7150   147.5458   155.2877   166.2604 (64)
                                                                                           Total per year (kWh/year) = Sum(64)m =    1740.4196 (64)
Heat gains from water heating, kWh/month
                78.3611    69.6019    74.3559    68.4007    68.2947    62.8403    62.0793    65.7382    64.8757    70.8421    72.7136    77.0647 (65)


----------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
----------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m           87.4683    87.4683    87.4683    87.4683    87.4683    87.4683    87.4683    87.4683    87.4683    87.4683    87.4683    87.4683 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                13.6341    12.1097     9.8483     7.4558     5.5733     4.7052     5.0841     6.6085     8.8700    11.2625    13.1449    14.0130 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               152.4519   154.0338   150.0473   141.5605   130.8474   120.7786   114.0520   112.4700   116.4565   124.9434   135.6565   145.7253 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                31.7468    31.7468    31.7468    31.7468    31.7468    31.7468    31.7468    31.7468    31.7468    31.7468    31.7468    31.7468 (69)
Pumps, fans      3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
               -69.9746   -69.9746   -69.9746   -69.9746   -69.9746   -69.9746   -69.9746   -69.9746   -69.9746   -69.9746   -69.9746   -69.9746 (71)
Water heating gains (Table 5)
               105.3240   103.5743    99.9407    95.0010    91.7939    87.2782    83.4399    88.3578    90.1051    95.2179   100.9911   103.5816 (72)
Total internal gains
               323.6505   321.9583   312.0768   296.2577   280.4551   265.0025   254.8166   259.6768   267.6721   283.6642   302.0330   315.5604 (73)


----------------------------------------------------------------------------------------------------
6. Solar gains
----------------------------------------------------------------------------------------------------
[Jan]                                            Area        Solar flux              g                FF              Access                Gains
                                                   m2         Table 6a     Specific data    Specific data             factor                    W
                                                                  W/m2       or Table 6b       or Table 6c           Table 6d
----------------------------------------------------------------------------------------------------
Northeast                                        5.8400          11.2829           0.6300           0.7000            0.7700              20.1376 (75)
Southeast                                        5.0200          36.7938           0.6300           0.7000            0.7700              56.4483 (77)
----------------------------------------------------------------------------------------------------

Solar gains     76.5858   137.1429   205.4118   284.2951   345.6160   355.0731   337.3527   289.7766   232.4412   156.3625    92.9503    64.7533 (83)
Total gains    400.2363   459.1012   517.4886   580.5529   626.0711   620.0755   592.1692   549.4534   500.1133   440.0267   394.9833   380.3137 (84)


----------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
----------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                           21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau             59.2207    59.3776    59.5321    60.2690    60.4089    61.0688    61.0688    61.1925    60.8129    60.4089    60.1265    59.8342
alpha            4.9480     4.9585     4.9688     5.0179     5.0273     5.0713     5.0713     5.0795     5.0542     5.0273     5.0084     4.9889
util living area
                 0.9940     0.9875     0.9692     0.9114     0.7810     0.5900     0.4356     0.4871     0.7422     0.9413     0.9875     0.9953 (86)

MIT             19.8838    20.0536    20.3192    20.6462    20.8789    20.9770    20.9959    20.9930    20.9302    20.6251    20.1973    19.8545 (87)
Th 2            19.9420    19.9444    19.9469    19.9584    19.9606    19.9706    19.9706    19.9725    19.9667    19.9606    19.9562    19.9516 (88)
util rest of house
                 0.9921     0.9834     0.9592     0.8838     0.7224     0.5037     0.3357     0.3819     0.6584     0.9166     0.9827     0.9938 (89)
MIT 2           18.4751    18.7226    19.1046    19.5628    19.8505    19.9566    19.9692    19.9698    19.9160    19.5471    18.9412    18.4394 (90)
Living area fraction                                                                                fLA = Living area / (4) =       0.5816 (91)
MIT             19.2944    19.4967    19.8110    20.1930    20.4486    20.5501    20.5663    20.5649    20.5059    20.1741    19.6718    19.2625 (92)
Temperature adjustment                                                                                                               0.0000
adjusted MIT    19.2944    19.4967    19.8110    20.1930    20.4486    20.5501    20.5663    20.5649    20.5059    20.1741    19.6718    19.2625 (93)


----------------------------------------------------------------------------------------------------
8. Space heating requirement
----------------------------------------------------------------------------------------------------

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation      0.9905     0.9813     0.9577     0.8907     0.7513     0.5532     0.3939     0.4432     0.7043     0.9225     0.9810     0.9924 (94)
Useful gains   396.4358   450.5101   495.5874   517.1034   470.3776   343.0158   233.2842   243.5259   352.2110   405.9169   387.4972   377.4380 (95)
Ext temp.        4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
               914.4936   887.8866   807.5783   676.7663   523.0736   351.9066   234.5826   245.8276   380.4576   572.4273   755.1861   909.2250 (97)
Month fracti     1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
               385.4350   293.9170   232.1212   114.9573    39.2058     0.0000     0.0000     0.0000     0.0000   123.8837   264.7360   395.6495 (98)
Space heating                                                                                                                    1849.9056 (98)
Space heating per m2                                                                                          (98) / (4) =      35.5683 (99)


----------------------------------------------------------------------------------------------------
8c. Space cooling requirement
----------------------------------------------------------------------------------------------------
Not applicable
```

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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---------------------------------------------------------------------------------------------------
9a. Energy requirements - Individual heating systems, including micro-CHP
---------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                                                                                  0.0000 (201)
Fraction of space heat from main system(s)                                                                                                             1.0000 (202)
Efficiency of main space heating system 1 (in %)                                                                                                      93.5000 (206)
Efficiency of secondary/supplementary heating system, %                                                                                                0.0000 (208)
Space heating requirement                                                                                                                           1978.5087 (211)

               Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Space heating requirement
               385.4350   293.9170   232.1212   114.9573    39.2058     0.0000     0.0000     0.0000     0.0000   123.8837   264.7360   395.6495 (98)
Space heating efficiency (main heating system 1)
                93.5000    93.5000    93.5000    93.5000    93.5000     0.0000     0.0000     0.0000     0.0000    93.5000    93.5000    93.5000 (210)
Space heating fuel (main heating system)
               412.2299   314.3498   248.2580   122.9490    41.9313     0.0000     0.0000     0.0000     0.0000   132.4960   283.1401   423.1546 (211)
Water heating requirement
                 0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (215)

Water heating
Water heating requirement
               170.1593   150.1559   158.1137   142.3166   139.8844   125.5936   121.1916   132.1957   131.7150   147.5458   155.2877   166.2604 (64)
Efficiency of water heater                                                                                                                            79.8000 (216)
(217)m          86.9302    86.5748    85.8367    84.2509    81.9203    79.8000    79.8000    79.8000    79.8000    84.3518    86.2256    87.0465 (217)
Fuel for water heating, kWh/month
               195.7425   173.4407   184.2030   168.9199   170.7566   157.3854   151.8692   165.6588   165.0564   174.9171   180.0947   191.0018 (219)
Water heating fuel used                                                                                                                             2079.0460 (219)
Annual totals kWh/year
Space heating fuel - main system                                                                                                                    1978.5087 (211)
Space heating fuel - secondary                                                                                                                         0.0000 (215)

Electricity for pumps and fans:
   central heating pump                                                                                                                               30.0000 (230c)
   main heating flue fan                                                                                                                              45.0000 (230e)
Total electricity for the above, kWh/year                                                                                                             75.0000 (231)
Electricity for lighting (calculated in Appendix L)                                                                                                  240.7823 (232)
Total delivered energy for all uses                                                                                                                 4373.3370 (238)



---------------------------------------------------------------------------------------------------
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP
---------------------------------------------------------------------------------------------------
                                                                                            Energy      Emission factor            Emissions
                                                                                          kWh/year         kg CO2/kWh           kg CO2/year
Space heating - main system 1                                                            1978.5087              0.2160             427.3579 (261)
Space heating - secondary                                                                   0.0000              0.0000               0.0000 (263)
Water heating (other fuel)                                                               2079.0460              0.2160             449.0739 (264)
Space and water heating                                                                                                              876.4318 (265)
Pumps and fans                                                                             75.0000              0.5190              38.9250 (267)
Energy for lighting                                                                       240.7823              0.5190             124.9660 (268)
Total CO2, kg/m2/year                                                                                                               1040.3228 (272)
Emissions per m2 for space and water heating                                                                                          16.8512 (272a)
Fuel factor (mains gas)                                                                                                                1.0000
Emissions per m2 for lighting                                                                                                          2.4027 (272b)
Emissions per m2 for pumps and fans                                                                                                    0.7484 (272c)
Target Carbon Dioxide Emission Rate (TER) = (16.8512 * 1.00) + 2.4027 + 0.7484, rounded to 2 d.p.                                    20.0000 (273)
```

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	009166	**Issued on Date**	27/10/2021
Assessment Reference	Lean	**Prop Type Ref**	C1_11_04 (T)
Property			

SAP Rating	82 B	**DER**	19.08	**TER**	20.58
Environmental	86 B	**% DER<TER**	7.27		
CO$_2$ Emissions (t/year)	1.14	**DFEE**	52.38	**TFEE**	62.96
General Requirements Compliance	Pass	**% DFEE<TFEE**	16.81		

Assessor Details	Mr. Liam Holden, Liam Holden, Tel: 01202 654600, liamholden@hoarelea.com	**Assessor ID**	P624-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Top-floor flat, total floor area 71 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
-----------------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Mains gas (c)
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 20.58 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 19.08 kgCO□/m²OK
-----------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)63.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)52.4 kWh/m²/yrOK
-----------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                 Highest
External wall   0.13 (max. 0.30)        0.13 (max. 0.70)            OK
Party wall      0.00 (max. 0.20)         -                          OK
Floor           (no floor)
Roof            0.10 (max. 0.20)        0.10 (max. 0.35)            OK
Openings        1.18 (max. 2.00)        1.20 (max. 3.30)            OK
-----------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
-----------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:         3.00 (design value)
Maximum                                 10.0                                               OK
-----------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                    Community heating scheme                           -

Secondary heating system:               None
-----------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                       Measured cylinder loss: 1.85 kWh/day
Permitted by DBSCG 1.89                           OK
Primary pipework insulated:             Yes (assumed)                                      OK
-----------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                 Charging system linked to use of community heating, programmer and TRVsOK


Hot water controls:                     Cylinderstat                                       OK


-----------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                 75%                                                OK
-----------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power:                     0.62
Maximum                                 1.5                                                OK
MVHR efficiency:                        94%
Minimum:                                70%                                                OK
-----------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Thames Valley):       Not significant                                    OK
Based on:
Overshading:                            Average
Windows facing South East:              4.55 m², No overhang
Windows facing South West:              7.25 m², No overhang
Windows facing North West:              4.05 m², Overhang width less than twice window, ratio 0.86
Air change rate:                        6.00 ach
Blinds/curtains:                        Dark-coloured curtain or roller blind, closed 100% of daylight hours
-----------------------------------------------------------------------------------------------------
10 Key features
External wall U-value                   0.13 W/m²K
External wall U-value                   0.13 W/m²K
Party wall U-value                      0.00 W/m²K
Roof U-value                            0.10 W/m²K
Door U-value                            1.00 W/m²K
Air permeability                        3.0 m³/m²h



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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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----------------------------------------------------------------------------------------------------
SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE      09 Jan 2014
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----------------------------------------------------------------------------------------------------



----------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
----------------------------------------------------------------------------------------------------
                                                                                        Area         Storey height                 Volume
                                                                                        (m2)              (m)                       (m3)
Ground floor                                                                         70.9900 (1b)    x       2.7500 (2b)    =     195.2225 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)                   70.9900                                                      (4)
Dwelling volume                                                                            (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =     195.2225 (5)



----------------------------------------------------------------------------------------------------
2. Ventilation rate
----------------------------------------------------------------------------------------------------
                                                                  main          secondary               other              total        m3 per hour
                                                               heating            heating
Number of chimneys                                                   0       +          0       +           0       =          0 * 40 =       0.0000 (6a)
Number of open flues                                                 0       +          0       +           0       =          0 * 20 =       0.0000 (6b)
Number of intermittent fans                                                                                                    0 * 10 =       0.0000 (7a)
Number of passive vents                                                                                                        0 * 10 =       0.0000 (7b)
Number of flueless gas fires                                                                                                   0 * 40 =       0.0000 (7c)

                                                                                                                               Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                                             0.0000 / (5) =       0.0000 (8)
Pressure test                                                                                                                                  Yes
Measured/design AP50                                                                                                                        3.0000
Infiltration rate                                                                                                                           0.1500 (18)
Number of sides sheltered                                                                                                                        2 (19)

Shelter factor                                                                                              (20) = 1 - [0.075 x (19)] =       0.8500 (20)
Infiltration rate adjusted to include shelter factor                                                                (21) = (18) x (20) =       0.1275 (21)


                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Wind speed       5.1000     5.0000     4.9000     4.4000     4.3000     3.8000     3.8000     3.7000     4.0000     4.3000     4.5000     4.7000 (22)
Wind factor      1.2750     1.2500     1.2250     1.1000     1.0750     0.9500     0.9500     0.9250     1.0000     1.0750     1.1250     1.1750 (22a)
Adj infilt rate
                 0.1626     0.1594     0.1562     0.1403     0.1371     0.1211     0.1211     0.1179     0.1275     0.1371     0.1434     0.1498 (22b)
 Balanced mechanical ventilation with heat recovery
If mechanical ventilation:                                                                                                                  0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =                                               79.9000 (23c)

Effective ac     0.2631     0.2599     0.2567     0.2408     0.2376     0.2216     0.2216     0.2184     0.2280     0.2376     0.2439     0.2503 (25)



----------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
----------------------------------------------------------------------------------------------------
Element                                             Gross         Openings          NetArea         U-value           A x U          K-value           A x K
                                                       m2               m2               m2          W/m2K             W/K          kJ/m2K            kJ/K
Door                                                                                 2.1400          1.0000          2.1400                                 (26)
Window (Uw = 1.20)                                                                  15.8500          1.1450         18.1489                                 (27)
External Wall 1                                   50.1200          15.8500          34.2700          0.1300          4.4551                                 (29a)
Sheltered wall                                    37.2300           2.1400          35.0900          0.1231          4.3202                                 (29a)
External Roof 1                                   52.8400                           52.8400          0.1000          5.2840                                 (30)
Total net area of external elements Aum(A, m2)                                     140.1900                                                                 (31)
Fabric heat loss, W/K = Sum (A x U)                                                       (26)...(30) + (32) =     34.3482                                 (33)
Party Wall 1                                                                        17.1700          0.0000          0.0000                                 (32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                                        175.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                                                21.5169 (36)
Total fabric heat loss                                                                                                     (33) + (36) =    55.8651 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(38)m           16.9474    16.7420    16.5367    15.5099    15.3046    14.2778    14.2778    14.0725    14.6885    15.3046    15.7153    16.1260 (38)
Heat transfer coeff
                72.8124    72.6071    72.4017    71.3750    71.1696    70.1429    70.1429    69.9375    70.5536    71.1696    71.5803    71.9910 (39)
Average = Sum(39)m / 12 =                                                                                                                  71.3237 (39)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP              1.0257     1.0228     1.0199     1.0054     1.0025     0.9881     0.9881     0.9852     0.9939     1.0025     1.0083     1.0141 (40)
HLP (average)                                                                                                                               1.0047 (40)
Days in month
                     31         28         31         30         31         30         31         31         30         31         30         31 (41)



----------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
----------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                                           2.2699 (42)
Average daily hot water use (litres/day)                                                                                                   88.1105 (43)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
                96.9216    93.3972    89.8728    86.3483    82.8239    79.2995    79.2995    82.8239    86.3483    89.8728    93.3972    96.9216 (44)
Energy conte   143.7319   125.7089   129.7203   113.0933   108.5157    93.6408    86.7720    99.5721   100.7613   117.4276   128.1814   139.1967 (45)
Energy content (annual)                                                                                            Total = Sum(45)m =    1386.3220 (45)
Distribution loss  (46)m = 0.15 x (45)m
                21.5598    18.8563    19.4580    16.9640    16.2774    14.0461    13.0158    14.9358    15.1142    17.6141    19.2272    20.8795 (46)
```

```
Water storage loss:
Store volume                                                                                                                150.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                 1.8500 (48)
  Temperature factor from Table 2b                                                                                            0.6000 (49)
Enter (49) or (54) in (55)                                                                                                    1.1100 (55)
Total storage loss
                34.4100    31.0800    34.4100    33.3000    34.4100    33.3000    34.4100    34.4100    33.3000    34.4100    33.3000    34.4100 (56)
If cylinder contains dedicated solar storage
                34.4100    31.0800    34.4100    33.3000    34.4100    33.3000    34.4100    34.4100    33.3000    34.4100    33.3000    34.4100 (57)
Primary loss    23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
               201.4043   177.8001   187.3927   168.9053   166.1881   149.4528   144.4444   157.2445   156.5733   175.1000   183.9934   196.8691 (62)
Solar input      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                         Solar input (sum of months) = Sum(63)m =     0.0000 (63)
Output from w/h
               201.4043   177.8001   187.3927   168.9053   166.1881   149.4528   144.4444   157.2445   156.5733   175.1000   183.9934   196.8691 (64)
                                                                                          Total per year (kWh/year) = Sum(64)m =  2065.3680 (64)
Heat gains from water heating, kWh/month
                93.9288    83.4712    89.2699    82.2531    82.2194    75.7852    74.9896    79.2456    78.1527    85.1826    87.2699    92.4208 (65)
```

```
---------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
---------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          113.4959   113.4959   113.4959   113.4959   113.4959   113.4959   113.4959   113.4959   113.4959   113.4959   113.4959   113.4959 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                17.8178    15.8257    12.8703     9.7436     7.2835     6.1490     6.6442     8.6364    11.5918    14.7184    17.1786    18.3131 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               199.5965   201.6677   196.4484   185.3371   171.3110   158.1285   149.3218   147.2506   152.4699   163.5812   177.6073   190.7898 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                34.3496    34.3496    34.3496    34.3496    34.3496    34.3496    34.3496    34.3496    34.3496    34.3496    34.3496    34.3496 (69)
Pumps, fans      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
               -90.7967   -90.7967   -90.7967   -90.7967   -90.7967   -90.7967   -90.7967   -90.7967   -90.7967   -90.7967   -90.7967   -90.7967 (71)
Water heating gains (Table 5)
               126.2484   124.2130   119.9864   114.2404   110.5099   105.2572   100.7925   106.5130   108.5455   114.4927   121.2082   124.2215 (72)
Total internal gains
               400.7115   398.7552   386.3539   366.3699   346.1532   326.5835   313.8073   319.4488   329.6559   349.8412   373.0429   390.3732 (73)
```

```
---------------------------------------------------------------------------------------------------
6. Solar gains
---------------------------------------------------------------------------------------------------
[Jan]                                        Area          Solar flux                g                  FF              Access                 Gains
                                               m2            Table 6a    Specific data      Specific data              factor                     W
                                                                 W/m2      or Table 6b        or Table 6c            Table 6d
---------------------------------------------------------------------------------------------------
Southeast                                  4.5500             36.7938           0.3500             0.7700              0.7700               31.2664 (77)
Southwest                                  7.2500             36.7938           0.3500             0.7700              0.7700               49.8202 (79)
Northwest                                  4.0500             11.2829           0.3500             0.7700              0.7700                8.5343 (81)
---------------------------------------------------------------------------------------------------

Solar gains     89.6209   155.4923   220.2810   285.5597   331.3703   334.0412   319.9426   284.9911   242.7658   173.8823   107.8614    76.3628 (83)
Total gains    490.3324   554.2475   606.6349   651.9296   677.5235   660.6246   633.7499   604.4399   572.4218   523.7235   480.9043   466.7360 (84)
```

```
---------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
---------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                  21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau             47.3944    47.5285    47.6633    48.3489    48.4884    49.1982    49.1982    49.3426    48.9118    48.4884    48.2102    47.9352
alpha            4.1596     4.1686     4.1776     4.2233     4.2326     4.2799     4.2799     4.2895     4.2608     4.2326     4.2140     4.1957
util living area
                 0.9862     0.9761     0.9546     0.9029     0.7993     0.6316     0.4752     0.5150     0.7392     0.9191     0.9753     0.9886 (86)

MIT             19.6910    19.8768    20.1575    20.5060    20.7837    20.9429    20.9866    20.9812    20.8853    20.5348    20.0560    19.6592 (87)
Th 2            20.0620    20.0644    20.0668    20.0788    20.0812    20.0933    20.0933    20.0957    20.0885    20.0812    20.0764    20.0716 (88)
util rest of house
                 0.9831     0.9708     0.9443     0.8804     0.7542     0.5576     0.3825     0.4211     0.6716     0.8957     0.9689     0.9860 (89)
MIT 2           18.3196    18.5895    18.9936    19.4898    19.8561    20.0485    20.0864    20.0854    19.9881    19.5398    18.8594    18.2802 (90)
Living area fraction                                                                                 fLA = Living area / (4) =     0.3775 (91)
MIT             18.8373    19.0755    19.4330    19.8734    20.2063    20.3861    20.4263    20.4235    20.3268    19.9154    19.3111    18.8008 (92)
Temperature adjustment                                                                                                             0.0000
adjusted MIT    18.8373    19.0755    19.4330    19.8734    20.2063    20.3861    20.4263    20.4235    20.3268    19.9154    19.3111    18.8008 (93)
```

```
---------------------------------------------------------------------------------------------------
8. Space heating requirement
---------------------------------------------------------------------------------------------------

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation      0.9777     0.9636     0.9358     0.8747     0.7608     0.5825     0.4172     0.4560     0.6906     0.8908     0.9620     0.9813 (94)
Useful gains   479.4079   534.0454   567.6774   570.2522   515.4752   384.7935   264.4294   275.6339   395.3062   466.5103   462.6528   458.0015 (95)
Ext temp.        4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
              1058.4978  1029.2414   936.3707   783.2278   605.3881   405.8561   268.3846   281.3968   439.3240   662.9747   874.0776  1051.1259 (97)
Month fracti     1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
               430.8429   332.7717   274.3078   153.3424    66.8952     0.0000     0.0000     0.0000     0.0000   146.1695   296.2258   441.2845 (98)
Space heating                                                                                                                   2141.8399 (98)
Space heating per m2                                                                                            (98) / (4) =     30.1710 (99)
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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----------------------------------------------------------------------------------------------------
8c. Space cooling requirement
----------------------------------------------------------------------------------------------------
Not applicable



----------------------------------------------------------------------------------------------------
9b. Energy requirements
----------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                                                         0.0000 (301)
Fraction of space heat from community system                                                                                  1.0000 (302)
Fraction of heat from community Boilers                                                                                       1.0000 (303a)
Fraction of total space heat from community Boilers                                                                           1.0000 (304a)
Factor for control and charging method (Table 4c(3)) for community space heating                                              1.0000 (305)
Factor for control and charging method (Table 4c(3)) for community water heating                                              1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system                                                             1.0500 (306)
Space heating:
Annual space heating requirement                                                                                           2141.8399 (98)
Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                                                        2248.9319 (307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)                                       0.0000 (308)
Space heating fuel for secondary/supplementary system                                                                         0.0000 (309)

Water heating
Annual water heating requirement                                                                                           2065.3680 (64)
Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                                                        2168.6364 (310a)
Electricity used for heat distribution                                                                                       44.1757 (313)
Annual totals kWh/year

Electricity for pumps and fans:
    (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7750)
   mechanical ventilation fans (SFP =       0.7750)                                                                         184.5829 (330a)
Total electricity for the above, kWh/year                                                                                   184.5829 (331)
Electricity for lighting (calculated in Appendix L)                                                                         314.6687 (332)
Total delivered energy for all uses                                                                                        4916.8200 (338)



----------------------------------------------------------------------------------------------------
12b. Carbon dioxide emissions - Community heating scheme
----------------------------------------------------------------------------------------------------
                                                                                       Energy      Emission factor             Emissions
                                                                                     kWh/year           kg CO2/kWh          kg CO2/year
Efficiency of heat source Boilers                                                                                               89.0000 (367a)
Space heating from Boilers                                                          4963.5600               0.2160            1072.1290 (367)
Electrical energy for heat distribution                                               44.1757               0.5190              22.9272 (372)
Total CO2 associated with community systems                                                                                   1095.0561 (373)
 (negative value allowed since DFEE <= TFEE)
Space and water heating                                                                                                       1095.0561 (376)
Pumps and fans                                                                       184.5829               0.5190              95.7985 (378)
Energy for lighting                                                                  314.6687               0.5190             163.3131 (379)
Total CO2, kg/year                                                                                                            1354.1677 (383)
Dwelling Carbon Dioxide Emission Rate (DER)                                                                                     19.0800 (384)


16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES
DER                                                                                                                           19.0800 ZC1
Total Floor Area                                                                                                      TFA     70.9900
Assumed number of occupants                                                                                             N      2.2699
CO2 emission factor in Table 12 for electricity displaced from grid                                                    EF      0.5190
CO2 emissions from appliances, equation (L14)                                                                                 16.6610 ZC2
CO2 emissions from cooking, equation (L16)                                                                                     2.4437 ZC3
Total CO2 emissions                                                                                                           38.1847 ZC4
Residual CO2 emissions offset from biofuel CHP                                                                                 0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year                                                                       0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation                                                0.0000 ZC7
Net CO2 emissions                                                                                                             38.1847 ZC8


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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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----------------------------------------------------------------------------------------------------
SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS      09 Jan 2014
----------------------------------------------------------------------------------------------------
----------------------------------------------------------------------------------------------------




----------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
----------------------------------------------------------------------------------------------------
                                                                                                Area         Storey height                 Volume
                                                                                                (m2)                   (m)                   (m3)
Ground floor                                                                                 70.9900 (1b)    x       2.7500 (2b)    =    195.2225 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)               70.9900                                                                     (4)
Dwelling volume                                                                                    (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =    195.2225 (5)




----------------------------------------------------------------------------------------------------
2. Ventilation rate
----------------------------------------------------------------------------------------------------
                                                                main          secondary              other              total        m3 per hour
                                                             heating            heating
Number of chimneys                                                 0      +           0      +           0      =           0 * 40 =      0.0000 (6a)
Number of open flues                                               0      +           0      +           0      =           0 * 20 =      0.0000 (6b)
Number of intermittent fans                                                                                                 3 * 10 =     30.0000 (7a)
Number of passive vents                                                                                                     0 * 10 =      0.0000 (7b)
Number of flueless gas fires                                                                                                0 * 40 =      0.0000 (7c)

                                                                                                                            Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                                         30.0000 / (5) =      0.1537 (8)
Pressure test                                                                                                                                Yes
Measured/design AP50                                                                                                                      5.0000
Infiltration rate                                                                                                                         0.4037 (18)
Number of sides sheltered                                                                                                                      2 (19)

Shelter factor                                                                                       (20) = 1 - [0.075 x (19)] =      0.8500 (20)
Infiltration rate adjusted to include shelter factor                                                           (21) = (18) x (20) =      0.3431 (21)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Wind speed       5.1000     5.0000     4.9000     4.4000     4.3000     3.8000     3.8000     3.7000     4.0000     4.3000     4.5000     4.7000 (22)
Wind factor      1.2750     1.2500     1.2250     1.1000     1.0750     0.9500     0.9500     0.9250     1.0000     1.0750     1.1250     1.1750 (22a)
Adj infilt rate
                 0.4375     0.4289     0.4203     0.3774     0.3689     0.3260     0.3260     0.3174     0.3431     0.3689     0.3860     0.4032 (22b)
Effective ac     0.5957     0.5920     0.5883     0.5712     0.5680     0.5531     0.5531     0.5504     0.5589     0.5680     0.5745     0.5813 (25)




----------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
----------------------------------------------------------------------------------------------------
Element                                          Gross       Openings        NetArea        U-value          A x U         K-value          A x K
                                                    m2             m2             m2          W/m2K            W/K          kJ/m2K           kJ/K
TER Opaque door                                                                2.1400         1.0000         2.1400                                 (26)
TER Opening Type (Uw = 1.40)                                                  15.6100         1.3258        20.6951                                 (27)
External Wall 1                                50.1200        15.6100         34.5100         0.1800         6.2118                                 (29a)
Sheltered wall                                 37.2300         2.1400         35.0900         0.1800         6.3162                                 (29a)
External Roof 1                                52.8400                        52.8400         0.1300         6.8692                                 (30)
Total net area of external elements Aum(A, m2)                               140.1900                                                               (31)
Fabric heat loss, W/K = Sum (A x U)                                                  (26)...(30) + (32) =     42.2323                                 (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                                       250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                                               19.6251 (36)
Total fabric heat loss                                                                                                 (33) + (36) =     61.8574 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(38)m           38.3766    38.1372    37.9026    36.8004    36.5942    35.6343    35.6343    35.4565    36.0040    36.5942    37.0114    37.4475 (38)
Heat transfer coeff
               100.2340    99.9946    99.7600    98.6578    98.4516    97.4917    97.4917    97.3139    97.8614    98.4516    98.8688    99.3049 (39)
Average = Sum(39)m / 12 =                                                                                                                98.6568 (39)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP              1.4119     1.4086     1.4053     1.3897     1.3868     1.3733     1.3733     1.3708     1.3785     1.3868     1.3927     1.3989 (40)
HLP (average)                                                                                                                             1.3897 (40)
Days in month
                     31         28         31         30         31         30         31         31         30         31         30         31 (41)




----------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
----------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                                         2.2699 (42)
Average daily hot water use (litres/day)                                                                                                 88.1105 (43)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
                96.9216    93.3972    89.8728    86.3483    82.8239    79.2995    79.2995    82.8239    86.3483    89.8728    93.3972    96.9216 (44)
Energy conte   143.7319   125.7089   129.7203   113.0933   108.5157    93.6408    86.7720    99.5721   100.7613   117.4276   128.1814   139.1967 (45)
Energy content (annual)                                                                                   Total = Sum(45)m =   1386.3220 (45)
Distribution loss  (46)m = 0.15 x (45)m
                21.5598    18.8563    19.4580    16.9640    16.2774    14.0461    13.0158    14.9358    15.1142    17.6141    19.2272    20.8795 (46)
Water storage loss:
Store volume                                                                                                                            150.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                            1.3938 (48)
  Temperature factor from Table 2b                                                                                                        0.5400 (49)
Enter (49) or (54) in (55)                                                                                                                0.7527 (55)
```

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

```
Total storage loss
                23.3325    21.0745    23.3325    22.5798    23.3325    22.5798    23.3325    23.3325    22.5798    23.3325    22.5798    23.3325 (56)
If cylinder contains dedicated solar storage
                23.3325    21.0745    23.3325    22.5798    23.3325    22.5798    23.3325    23.3325    22.5798    23.3325    22.5798    23.3325 (57)
Primary loss    23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
               190.3268   167.7946   176.3152   158.1851   155.1106   138.7326   133.3669   146.1670   145.8532   164.0225   173.2732   185.7916 (62)
Solar input      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                            Solar input (sum of months) = Sum(63)m =      0.0000 (63)
Output from w/h
               190.3268   167.7946   176.3152   158.1851   155.1106   138.7326   133.3669   146.1670   145.8532   164.0225   173.2732   185.7916 (64)
                                                                                              Total per year (kWh/year) = Sum(64)m =   1934.9394 (64)
Heat gains from water heating, kWh/month
                85.0668    75.4668    80.4079    73.6770    73.3574    67.2090    66.1276    70.3836    69.5766    76.3206    78.6938    83.5588 (65)



----------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
----------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          113.4959   113.4959   113.4959   113.4959   113.4959   113.4959   113.4959   113.4959   113.4959   113.4959   113.4959   113.4959 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                17.8006    15.8103    12.8578     9.7342     7.2764     6.1431     6.6378     8.6281    11.5806    14.7042    17.1620    18.2953 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               199.5965   201.6677   196.4484   185.3371   171.3110   158.1285   149.3218   147.2506   152.4699   163.5812   177.6073   190.7898 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                34.3496    34.3496    34.3496    34.3496    34.3496    34.3496    34.3496    34.3496    34.3496    34.3496    34.3496    34.3496 (69)
Pumps, fans      3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
               -90.7967   -90.7967   -90.7967   -90.7967   -90.7967   -90.7967   -90.7967   -90.7967   -90.7967   -90.7967   -90.7967   -90.7967 (71)
Water heating gains (Table 5)
               114.3371   112.3017   108.0752   102.3292    98.5987    93.3459    88.8812    94.6017    96.6342   102.5814   109.2969   112.3103 (72)
Total internal gains
               391.7830   389.8286   377.4301   357.4492   337.2349   317.6662   304.8895   310.5291   320.7334   340.9157   364.1150   381.4442 (73)



----------------------------------------------------------------------------------------------------
6. Solar gains
----------------------------------------------------------------------------------------------------

[Jan]                                       Area         Solar flux                  g                 FF             Access              Gains
                                              m2           Table 6a      Specific data      Specific data             factor                  W
                                                               W/m2        or Table 6b        or Table 6c           Table 6d
----------------------------------------------------------------------------------------------------
Southeast                                 4.4800            36.7938             0.6300             0.7000             0.7700            50.3761 (77)
Southwest                                 7.1400            36.7938             0.6300             0.7000             0.7700            80.2870 (79)
Northwest                                 3.9900            11.2829             0.6300             0.7000             0.7700            13.7584 (81)
----------------------------------------------------------------------------------------------------

Solar gains    144.4215   250.5732   354.9838   460.1884   534.0205   538.3276   515.6058   459.2748   391.2208   280.2096   173.8159   123.0562 (83)
Total gains    536.2045   640.4017   732.4140   817.6376   871.2554   855.9938   820.4953   769.8039   711.9542   621.1253   537.9308   504.5003 (84)



----------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
----------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                          21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau             49.1835    49.3013    49.4172    49.9693    50.0740    50.5670    50.5670    50.6594    50.3759    50.0740    49.8627    49.6437
alpha            4.2789     4.2868     4.2945     4.3313     4.3383     4.3711     4.3711     4.3773     4.3584     4.3383     4.3242     4.3096
util living area
                 0.9948     0.9883     0.9727     0.9294     0.8323     0.6682     0.5077     0.5575     0.7912     0.9517     0.9894     0.9960 (86)

MIT             19.5599    19.7656    20.0720    20.4501    20.7584    20.9339    20.9842    20.9765    20.8578    20.4511    19.9332    19.5245 (87)
Th 2            19.7542    19.7568    19.7593    19.7712    19.7734    19.7839    19.7839    19.7858    19.7798    19.7734    19.7689    19.7642 (88)
util rest of house
                 0.9930     0.9844     0.9631     0.9040     0.7736     0.5647     0.3749     0.4220     0.7015     0.9288     0.9851     0.9946 (89)
MIT 2           17.8741    18.1742    18.6163    19.1523    19.5490    19.7429    19.7787    19.7771    19.6749    19.1674    18.4279    17.8293 (90)
Living area fraction                                                                                       fLA = Living area / (4) =      0.3775 (91)
MIT             18.5105    18.7750    19.1658    19.6423    20.0056    20.1926    20.2338    20.2299    20.1215    19.6521    18.9962    18.4693 (92)
Temperature adjustment                                                                                                                0.0000
adjusted MIT    18.5105    18.7750    19.1658    19.6423    20.0056    20.1926    20.2338    20.2299    20.1215    19.6521    18.9962    18.4693 (93)



----------------------------------------------------------------------------------------------------
8. Space heating requirement
----------------------------------------------------------------------------------------------------

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation      0.9904     0.9801     0.9572     0.9008     0.7860     0.6016     0.4255     0.4735     0.7295     0.9259     0.9813     0.9925 (94)
Useful gains   531.0617   627.6485   701.0671   736.5654   684.8269   514.9861   349.0862   364.5046   519.3663   575.1219   527.8630   500.6928 (95)
Ext temp.        4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
              1424.3762  1387.4267  1263.5423  1059.8080   817.6957   545.2271   354.2658   372.7053   589.2710   891.1890  1176.1622  1417.0098 (97)
Month fracti     1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
               664.6260   510.5709   418.4815   232.7347    98.8544     0.0000     0.0000     0.0000     0.0000   235.1539   466.7754   681.7398 (98)
Space heating                                                                                                                      3308.9366 (98)
Space heating per m2                                                                                                    (98) / (4) =     46.6113 (99)



----------------------------------------------------------------------------------------------------
8c. Space cooling requirement
----------------------------------------------------------------------------------------------------
Not applicable
```

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

```
----------------------------------------------------------------------------------------------------
9a. Energy requirements - Individual heating systems, including micro-CHP
----------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                                                                 0.0000 (201)
Fraction of space heat from main system(s)                                                                                            1.0000 (202)
Efficiency of main space heating system 1 (in %)                                                                                     93.5000 (206)
Efficiency of secondary/supplementary heating system, %                                                                               0.0000 (208)
Space heating requirement                                                                                                          3538.9697 (211)

                 Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
Space heating requirement
               664.6260    510.5709    418.4815    232.7347     98.8544      0.0000      0.0000      0.0000      0.0000    235.1539    466.7754    681.7398 (98)
Space heating efficiency (main heating system 1)
                93.5000     93.5000     93.5000     93.5000     93.5000      0.0000      0.0000      0.0000      0.0000     93.5000     93.5000     93.5000 (210)
Space heating fuel (main heating system)
               710.8300    546.0652    447.5738    248.9141    105.7266      0.0000      0.0000      0.0000      0.0000    251.5015    499.2250    729.1335 (211)
Water heating requirement
                 0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000 (215)

Water heating
Water heating requirement
               190.3268    167.7946    176.3152    158.1851    155.1106    138.7326    133.3669    146.1670    145.8532    164.0225    173.2732    185.7916 (64)
Efficiency of water heater                                                                                                           79.8000 (216)
(217)m          87.8769     87.5948     87.0404     85.8424     83.6497     79.8000     79.8000     79.8000     79.8000     85.7742     87.3300     87.9738 (217)
Fuel for water heating, kWh/month
               216.5835    191.5577    202.5670    184.2739    185.4289    173.8504    167.1264    183.1667    182.7734    191.2259    198.4121    211.1898 (219)
Water heating fuel used                                                                                                            2288.1557 (219)
Annual totals kWh/year
Space heating fuel - main system                                                                                                   3538.9697 (211)
Space heating fuel - secondary                                                                                                        0.0000 (215)

Electricity for pumps and fans:
   central heating pump                                                                                                              30.0000 (230c)
   main heating flue fan                                                                                                             45.0000 (230e)
Total electricity for the above, kWh/year                                                                                            75.0000 (231)
Electricity for lighting (calculated in Appendix L)                                                                                 314.3640 (232)
Total delivered energy for all uses                                                                                                6216.4893 (238)



----------------------------------------------------------------------------------------------------
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP
----------------------------------------------------------------------------------------------------
                                                                                            Energy       Emission factor           Emissions
                                                                                          kWh/year            kg CO2/kWh         kg CO2/year
Space heating - main system 1                                                            3538.9697                0.2160            764.4174 (261)
Space heating - secondary                                                                   0.0000                0.0000              0.0000 (263)
Water heating (other fuel)                                                               2288.1557                0.2160            494.2416 (264)
Space and water heating                                                                                                          1258.6591 (265)
Pumps and fans                                                                             75.0000                0.5190             38.9250 (267)
Energy for lighting                                                                       314.3640                0.5190            163.1549 (268)
Total CO2, kg/m2/year                                                                                                            1460.7390 (272)
Emissions per m2 for space and water heating                                                                                       17.7301 (272a)
Fuel factor (mains gas)                                                                                                             1.0000
Emissions per m2 for lighting                                                                                                       2.2983 (272b)
Emissions per m2 for pumps and fans                                                                                                 0.5483 (272c)
Target Carbon Dioxide Emission Rate (TER) = (17.7301 * 1.00) + 2.2983 + 0.5483, rounded to 2 d.p.                                  20.5800 (273)
```

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Holloway Prison - Retail Unit (Be Lean)

As designed

Date: Wed Sep 22 11:36:58 2021

Administrative information

Building Details

Address: London,

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.13

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.13

BRUKL compliance check version: v5.6.b.0

Certifier details

Name: Hoare Lea

Telephone number: 01202 654600

Address: Enterprise House, Old School Cl, Ferndown,
Bournemouth, BH22 9UN

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	33.8
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	33.8
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	30.1
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	0.13	0.13	L0000064:Surf[2]
Floor	0.25	0.1	0.1	L0000064:Surf[20]
Roof	0.25	-	-	UNKNOWN
Windows***, roof windows, and rooflights	2.2	1.2	1.2	L0000064:Surf[1]
Personnel doors	2.2	-	-	No Personnel doors in building
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

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	>0.95

1- HP - VRF + AHU

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.91	3.5	0	0	0.9
Standard value	0.91*	2.6	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

1- HP - DHW

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	0.91	-
Standard value	0.8	N/A

Local mechanical ventilation, exhaust, and terminal units

ID	**System type in Non-domestic Building Services Compliance Guide**
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	**SFP [W/(l/s)]**									**HR efficiency**	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
B1-Flexible Commercial	-	-	-	1.4	-	-	-	-	-	-	N/A

General lighting and display lighting

Zone name	**Luminous efficacy [lm/W]**			
	Luminaire	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
B1-Flexible Commercial	-	100	40	1316

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	**Solar gain limit exceeded? (%)**	**Internal blinds used?**
B1-Flexible Commercial	NO (-78.4%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	145.8	145.8
External area [m²]	222.5	222.5
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	5
Average conductance [W/K]	57.18	93.14
Average U-value [W/m²K]	0.26	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
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	4.28	5.49
Cooling	8.21	8.95
Auxiliary	6.57	3.06
Lighting	41.98	51.58
Hot water	2.03	1.87
Equipment*	20.26	20.26
TOTAL**	**63.07**	**70.94**

* 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]	101.24	139.1
Primary energy* [kWh/m²]	177.61	199.29
Total emissions [kg/m²]	30.1	33.8

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	13.1	88.2	4.3	8.2	6.6	0.85	2.98	0.91	4.2
	Notional	17	122.1	5.5	8.9	3.1	0.86	3.79	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

Key to terms

Heat dem [MJ/m2] = Heating energy demand
Cool dem [MJ/m2] = Cooling energy demand
Heat con [kWh/m2] = Heating energy consumption
Cool con [kWh/m2] = Cooling energy consumption
Aux con [kWh/m2] = Auxiliary energy consumption
Heat SSEFF = Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER = Cooling system seasonal energy efficiency ratio
Heat gen SSEFF = Heating generator seasonal efficiency
Cool gen SSEER = Cooling generator seasonal energy efficiency ratio
ST = System type
HS = Heat source
HFT = Heating fuel type
CFT = Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	**$U_{i\text{-}Typ}$**	**$U_{i\text{-}Min}$**	**Surface where the minimum value occurs***
Wall	0.23	0.13	L0000064:Surf[2]
Floor	0.2	0.1	L0000064:Surf[20]
Roof	0.15	-	UNKNOWN
Windows, roof windows, and rooflights	1.5	1.2	L0000064:Surf[0]
Personnel doors	1.5	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)]

$U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	**Typical value**	**This building**
$m^3/(h.m^2)$ at 50 Pa	5	3

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Holloway Prison - Womens' centre (Be Lean)

As designed

Date: Wed Sep 22 11:17:00 2021

Administrative information

Building Details

Address: London,

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.13

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.13

BRUKL compliance check version: v5.6.b.0

Certifier details

Name: Hoare Lea

Telephone number: 01202 654600

Address: Enterprise House, Old School Cl, Ferndown,
Bournemouth, BH22 9UN

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	21.6
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	21.6
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	20
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	0.13	0.13	L0000026:Surf[5]
Floor	0.25	0.1	0.1	L0000016:Surf[0]
Roof	0.25	0.12	0.12	L0000069:Surf[1]
Windows***, roof windows, and rooflights	2.2	1.2	1.2	L0000026:Surf[2]
Personnel doors	2.2	-	-	No Personnel doors in building
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

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	>0.95

1- HP - Radiators (no vent)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.91	-	0	0	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

2- HP - Radiators + AHU

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.91	-	0	0	0.9
Standard value	0.91*	N/A	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

3- HP - VRF + AHU

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.91	3.5	0	0	0.9
Standard value	0.91*	2.6	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

4- HP - kitchen system

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.91	-	-	1.2	0.7
Standard value	0.91	N/A	N/A	1.1^	0.45
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

1- HP - DHW

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	0.91	-
Standard value	0.8	N/A

Local mechanical ventilation, exhaust, and terminal units

ID	**System type in Non-domestic Building Services Compliance Guide**
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
B1-Acc WC	-	-	0.3	-	-	-	-	-	-	-	N/A
B1-WC 1	-	-	0.3	-	-	-	-	-	-	-	N/A
B1-WC 2	-	-	0.3	-	-	-	-	-	-	-	N/A
B1-WC 3	-	-	0.3	-	-	-	-	-	-	-	N/A
B1-WC 4	-	-	0.3	-	-	-	-	-	-	-	N/A
L00-Acc WC 1	-	-	0.3	-	-	-	-	-	-	-	N/A
L00-Acc WC 2	-	-	0.3	-	-	-	-	-	-	-	N/A
L00-Acc WC 3	-	-	0.3	-	-	-	-	-	-	-	N/A
L00-WC 1	-	-	0.3	-	-	-	-	-	-	-	N/A
L00-WC 10	-	-	0.3	-	-	-	-	-	-	-	N/A
L00-WC 11	-	-	0.3	-	-	-	-	-	-	-	N/A
L00-WC 2	-	-	0.3	-	-	-	-	-	-	-	N/A
L00-WC 3	-	-	0.3	-	-	-	-	-	-	-	N/A
L00-WC 4	-	-	0.3	-	-	-	-	-	-	-	N/A
L00-WC 5	-	-	0.3	-	-	-	-	-	-	-	N/A
L00-WC 6	-	-	0.3	-	-	-	-	-	-	-	N/A
L00-WC 7	-	-	0.3	-	-	-	-	-	-	-	N/A
L00-WC 8	-	-	0.3	-	-	-	-	-	-	-	N/A
L00-WC 9	-	-	0.3	-	-	-	-	-	-	-	N/A
B1-Shower/Changing 1	-	-	-	1.4	-	-	-	-	-	-	N/A
B1-Shower/Changing 2	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Acc Shower	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Shower/Changing	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Creche 1	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Creche 2	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Creche 3	-	-	-	1.4	-	-	-	-	-	-	N/A
B1-Multipurpose Hall 1	-	-	-	1.4	-	-	-	-	-	-	N/A
B1-Multipurpose Hall 2	-	-	-	1.4	-	-	-	-	-	-	N/A
B1-Multipurpose Hall 3	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Multipurpose Room 1	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Multipurpose Room 10	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Multipurpose Room 11	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Multipurpose Room 12	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Multipurpose Room 13	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Multipurpose Room 14	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Multipurpose Room 15	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Multipurpose Room 16	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Multipurpose Room 17	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Multipurpose Room 18	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Multipurpose Room 19	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Multipurpose Room 2	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Multipurpose Room 3	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Multipurpose Room 4	-	-	-	1.4	-	-	-	-	-	-	N/A

Zone name	**SFP [W/(l/s)]**									**HR efficiency**	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
L00-Multipurpose Room 5	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Multipurpose Room 6	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Multipurpose Room 7	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Multipurpose Room 8	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Multipurpose Room 9	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Kitchen	-	-	-	-	-	1	-	-	1	-	N/A
L00-Cafe	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Staff Room	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Reception	-	-	-	1.4	-	-	-	-	-	-	N/A
B1-Tea Point / Waiting	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Tea Point/Waiting	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Meditation/Prayer Room	-	-	-	1.4	-	-	-	-	-	-	N/A

General lighting and display lighting	**Luminous efficacy [lm/W]**			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
B1-Acc WC	-	100	-	27
B1-WC 1	-	100	-	26
B1-WC 2	-	100	-	25
B1-WC 3	-	100	-	25
B1-WC 4	-	100	-	25
L00-Acc WC 1	-	100	-	36
L00-Acc WC 2	-	100	-	36
L00-Acc WC 3	-	100	-	34
L00-WC 1	-	100	-	15
L00-WC 10	-	100	-	27
L00-WC 11	-	100	-	27
L00-WC 2	-	100	-	14
L00-WC 3	-	100	-	15
L00-WC 4	-	100	-	14
L00-WC 5	-	100	-	25
L00-WC 6	-	100	-	26
L00-WC 7	-	100	-	24
L00-WC 8	-	100	-	24
L00-WC 9	-	100	-	28
B1-Shower/Changing 1	-	100	-	13
B1-Shower/Changing 2	-	100	-	13
L00-Acc Shower	-	100	-	23
L00-Shower/Changing	-	100	-	14
B1-Circulation 1	-	95	-	208
B1-WC Lobby 1	-	114	-	57
B1-WC Lobby 2	-	205	-	10
L00-Circulation 1	-	141	-	161

General lighting and display lighting

	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
L00-Circulation 2	-	131	-	173
L00-Circulation 3	-	102	-	277
L00-Circulation 4	-	119	-	243
L00-Circulation 5	-	124	-	244
L00-Entrance Lobby	-	71	-	82
L00-Shower/Changing Lobby	-	141	-	47
L00-WC Lobby 1	-	205	-	15
L00-WC Lobby 2	-	205	-	15
L00-WC Lobby 3	-	153	-	37
L00-WC Lobby 4	-	205	-	14
B1-Stair 3	-	108	-	45
L00-Stairs 3	-	157	-	40
B1-Cleaner's Cupboard	103	-	-	7
B1-Refuse Store 1	95	-	-	25
B1-Refuse Store 3	95	-	-	25
B1-Store	77	-	-	11
L00-Buggy/Cloak Area	101	-	-	6
L00-Creche Store	117	-	-	12
L00-Laundry/Cleaner's Cupboard	120	-	-	7
L00-Store 1	108	-	-	10
L00-Store 2	120	-	-	7
L00-Store 3	120	-	-	11
L00-Creche 1	100	-	-	164
L00-Creche 2	100	-	-	145
L00-Creche 3	100	-	-	164
B1-Multipurpose Hall 1	100	-	-	330
B1-Multipurpose Hall 2	100	-	-	343
B1-Multipurpose Hall 3	100	-	-	262
L00-Multipurpose Room 1	106	-	-	314
L00-Multipurpose Room 10	134	-	-	184
L00-Multipurpose Room 11	128	-	-	200
L00-Multipurpose Room 12	130	-	-	187
L00-Multipurpose Room 13	126	-	-	218
L00-Multipurpose Room 14	179	-	-	81
L00-Multipurpose Room 15	178	-	-	82
L00-Multipurpose Room 16	181	-	-	83
L00-Multipurpose Room 17	180	-	-	84
L00-Multipurpose Room 18	179	-	-	85
L00-Multipurpose Room 19	178	-	-	86
L00-Multipurpose Room 2	94	-	-	438
L00-Multipurpose Room 3	101	-	-	373
L00-Multipurpose Room 4	141	-	-	144
L00-Multipurpose Room 5	130	-	-	187

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
L00-Multipurpose Room 6	168	-	-	99
L00-Multipurpose Room 7	135	-	-	182
L00-Multipurpose Room 8	182	-	-	81
L00-Multipurpose Room 9	182	-	-	81
L00-Kitchen	-	100	-	252
L00-Cafe	-	100	-	220
L00-Staff Room	119	-	-	290
L00-Reception	-	63	40	724
B1-Tea Point / Waiting	100	-	-	106
L00-Tea Point/Waiting	100	-	-	112
L00-Meditation/Prayer Room	100	-	-	130

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
L00-Creche 1	NO (-84.3%)	NO
L00-Creche 2	NO (-82.5%)	NO
L00-Creche 3	NO (-91.1%)	NO
B1-Multipurpose Hall 1	NO (-49.3%)	NO
B1-Multipurpose Hall 2	NO (-27.6%)	NO
B1-Multipurpose Hall 3	NO (-73%)	NO
L00-Multipurpose Room 1	NO (-74.7%)	NO
L00-Multipurpose Room 10	NO (-84.2%)	NO
L00-Multipurpose Room 11	NO (-66.9%)	NO
L00-Multipurpose Room 12	NO (-71.9%)	NO
L00-Multipurpose Room 13	NO (-77.3%)	NO
L00-Multipurpose Room 14	N/A	N/A
L00-Multipurpose Room 15	N/A	N/A
L00-Multipurpose Room 16	N/A	N/A
L00-Multipurpose Room 17	N/A	N/A
L00-Multipurpose Room 18	N/A	N/A
L00-Multipurpose Room 19	N/A	N/A
L00-Multipurpose Room 2	NO (-64.8%)	NO
L00-Multipurpose Room 3	NO (-69.6%)	NO
L00-Multipurpose Room 4	NO (-81%)	NO
L00-Multipurpose Room 5	NO (-84%)	NO
L00-Multipurpose Room 6	NO (-71%)	NO
L00-Multipurpose Room 7	NO (-86%)	NO
L00-Multipurpose Room 8	NO (-80.4%)	NO
L00-Multipurpose Room 9	NO (-79.1%)	NO
L00-Cafe	NO (-62.2%)	NO
L00-Staff Room	NO (-99.3%)	NO
L00-Reception	NO (-71%)	NO
B1-Tea Point / Waiting	NO (-79.3%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
L00-Tea Point/Waiting	NO (-74.7%)	NO
L00-Meditation/Prayer Room	NO (-78.1%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	1480.3	1480.3
External area [m²]	1798.3	1798.3
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	583.55	843.57
Average U-value [W/m²K]	0.32	0.47
Alpha value* [%]	10.02	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
82	**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
13	**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
5	**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	16.81	16.7
Cooling	2.67	3.84
Auxiliary	8.33	4.3
Lighting	12.62	19.33
Hot water	20.46	18.83
Equipment*	23.83	23.83
TOTAL**	**60.9**	**63**

* 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]	78.81	104.17
Primary energy* [kWh/m²]	116.19	125.56
Total emissions [kg/m²]	20	21.6

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

HVAC Systems Performance

System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	39.3	48.4	12.9	4.5	6.9	0.85	2.98	0.91	4.2
Notional	45.4	88.3	14.6	6.5	2.6	0.86	3.79	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	47.1	0	16.1	0	6.8	0.81	0	0.91	0
Notional	60.2	0	19.4	0	3.2	0.86	0	----	----
[ST] Central heating using air distribution, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	0	0	0	0	209.4	0.78	0	0.91	0
Notional	0.3	0	0.1	0	122.6	0.86	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	87	0	29.7	0	1.9	0.81	0	0.91	0
Notional	79.3	0	25.5	0	2.1	0.86	0	----	----
[ST] No Heating or Cooling									
Actual	0	0	0	0	0	0	0	0	0
Notional	0	0	0	0	0	0	0	----	----

Key to terms

Heat dem [MJ/m2] = Heating energy demand
Cool dem [MJ/m2] = Cooling energy demand
Heat con [kWh/m2] = Heating energy consumption
Cool con [kWh/m2] = Cooling energy consumption
Aux con [kWh/m2] = Auxiliary energy consumption
Heat SSEFF = Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER = Cooling system seasonal energy efficiency ratio
Heat gen SSEFF = Heating generator seasonal efficiency
Cool gen SSEER = Cooling generator seasonal energy efficiency ratio
ST = System type
HS = Heat source
HFT = Heating fuel type
CFT = Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	**$U_{i\text{-}Typ}$**	**$U_{i\text{-}Min}$**	**Surface where the minimum value occurs***
Wall	0.23	0.13	L0000026:Surf[5]
Floor	0.2	0.1	L0000071:Surf[0]
Roof	0.15	0.12	L0000069:Surf[1]
Windows, roof windows, and rooflights	1.5	1.2	L0000026:Surf[1]
Personnel doors	1.5	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)]

$U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	**Typical value**	**This building**
$m^3/(h.m^2)$ at 50 Pa	5	3

Appendix D: Plant Room Layout showing Future Connection.

A0

This drawing shall not be scaled.
Work from the dimensions shown in the drawing or given in relevant specifications

17105_1_(00)_098 - HL [X:_PROJECTS_Projects 10100 - 10199\10168 - Holloway Prison\11 Issued and Received\11B Received\066 - 27-08-21 - AHMM updates\Item 06_Proposed scheme drawings\Plot A\DWG\17105_1_(00)_098 - HL.dwg]
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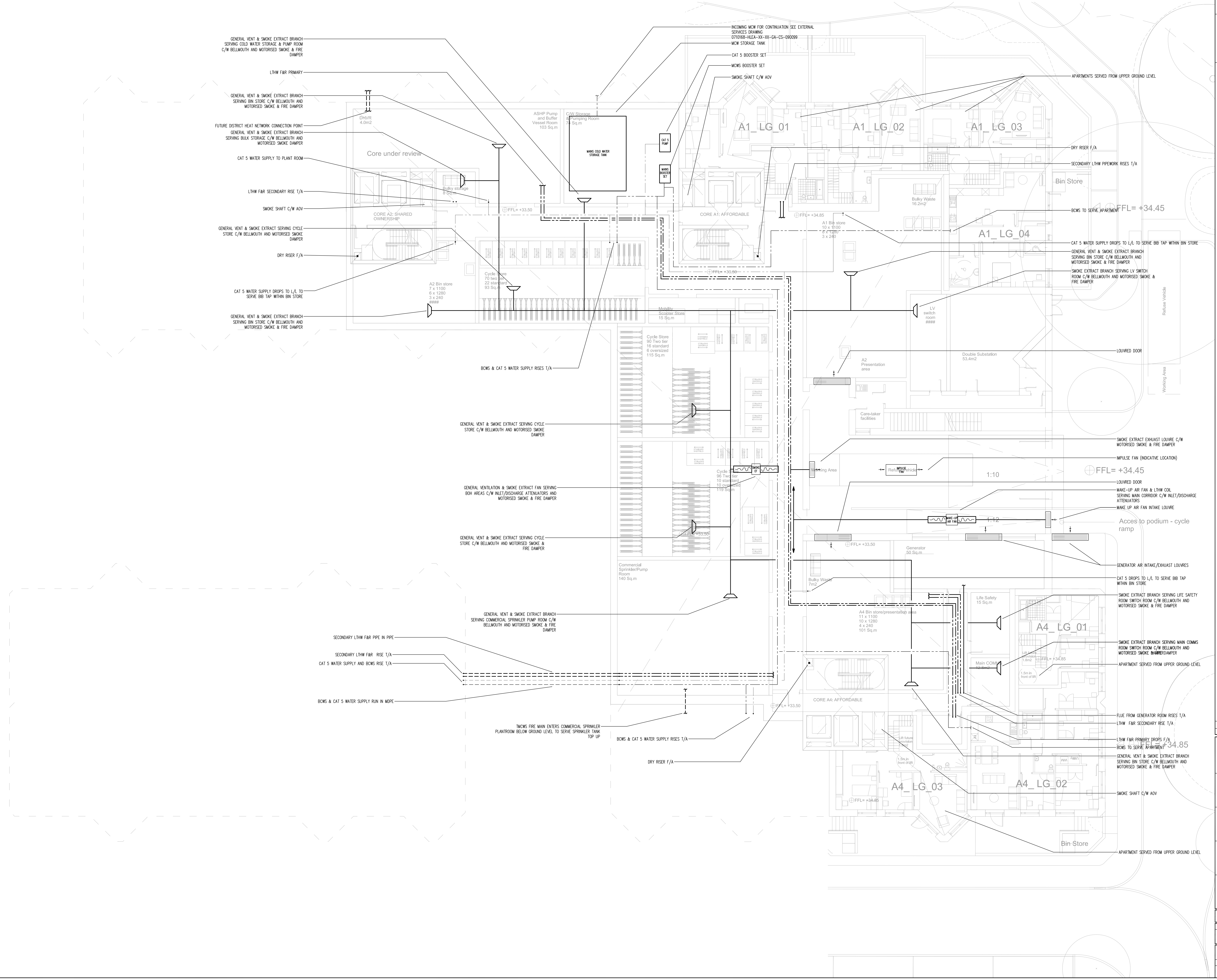

CDM Regulations:

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Project Notes:

Index	Description	Designed	Reviewed	Authorised	Date

REVISIONS:

HOARE LEA (H.)

ARCHITECT:
ALLFORD HALL MONAGHAN MORRIS

CLIENT:
PEABODY

PROJECT TITLE:
PROJECT HOLLOWAY

DRAWING TITLE:
MECHANICAL SERVICES
BLOCK A
LOWER GROUND FLOOR
SERVICES LAYOUT

STAGE 2 ISSUE

PERSON RESPONSIBLE FOR:

Design:	Review:	Authorising Issue:
DL	DC	NB
Project No:	Date:	Scale @ A0:
0710168	SEP 2021	1:100

DRAWING NUMBER:	Revision:
0710168-HLEA-A-LGF-GA-M-550300	P1

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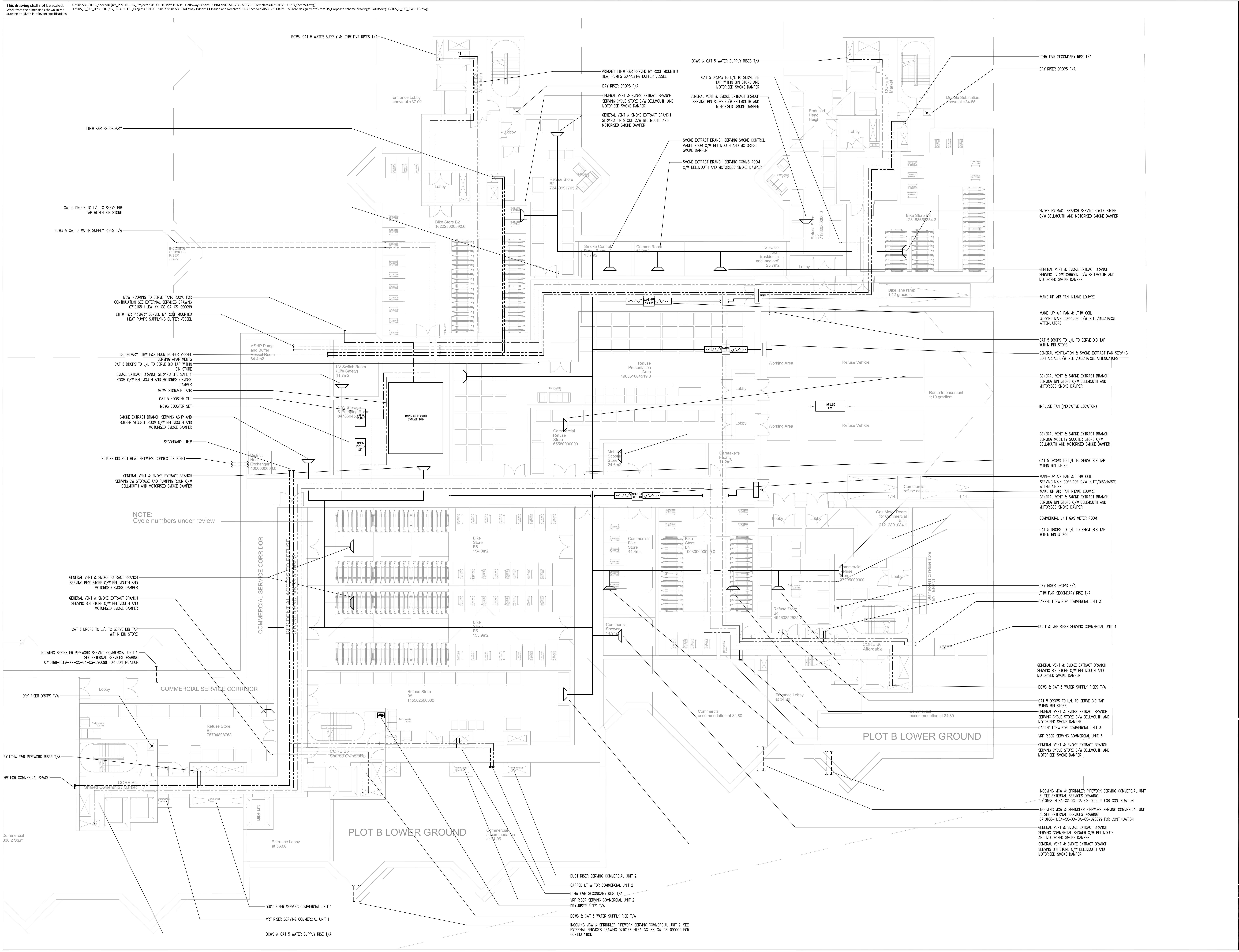

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DRAWING TITLE:
MECHANICAL SERVICES
BLOCK B
LOWER GROUND FLOOR
SERVICES LAYOUT

STAGE 2 ISSUE

PERSON RESPONSIBLE FOR:

Design:	Review:	Authorising Issue:
DL	DC	NB

Project No:	Date:	Scale @ A0:
0710168	SEP 2021	1:100

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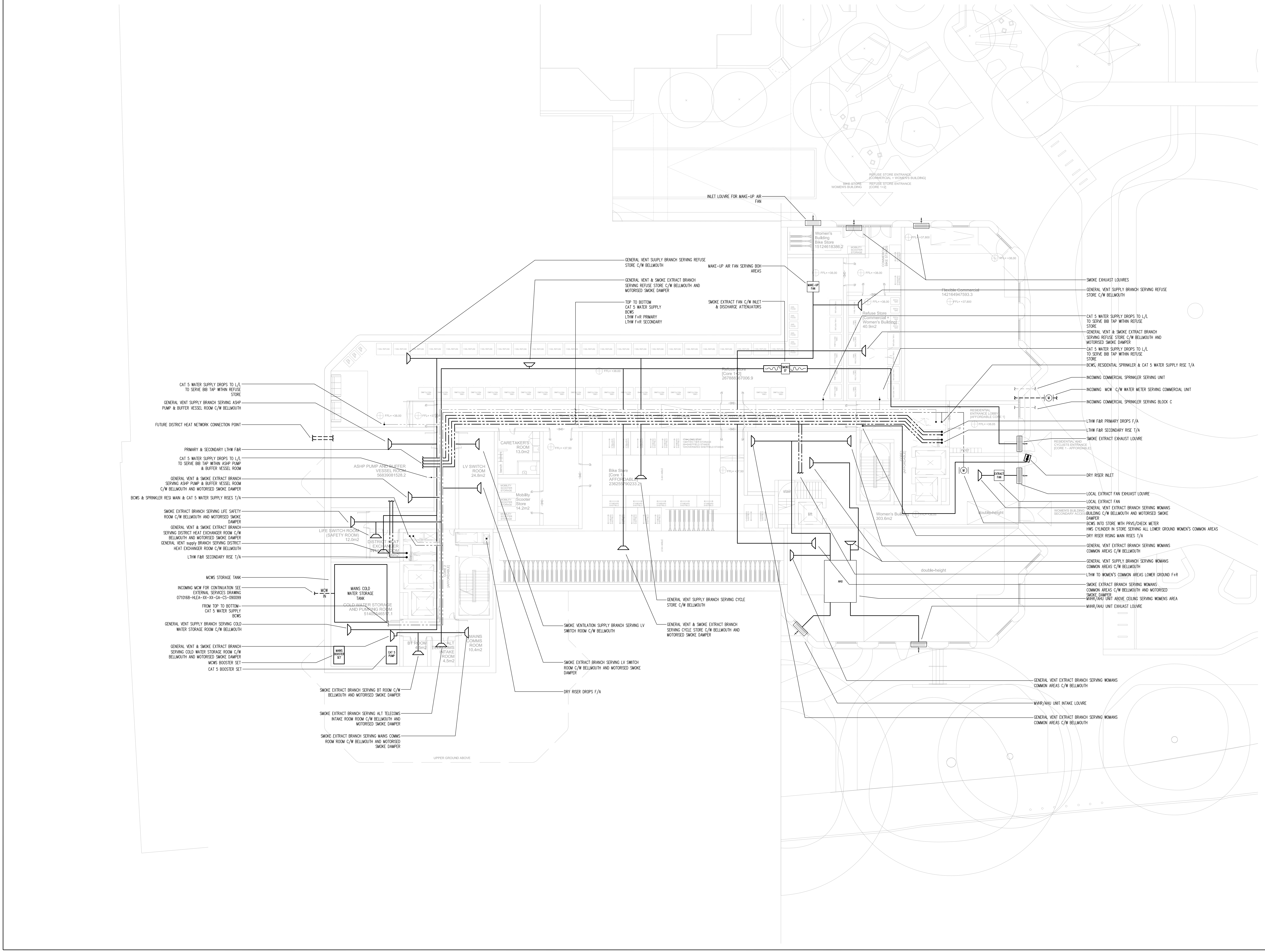

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CLIENT:
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PROJECT HOLLOWAY

DRAWING TITLE:
MECHANICAL SERVICES
BLOCK C
LOWER GROUND FLOOR
SERVICES LAYOUT

STAGE 2 ISSUE

PERSON RESPONSIBLE FOR:

Design:	Review:	Authorising Issue:
MC	DC	

Project No:	Date:	Scale @ A0:
0710168	SEP 2021	1:100

DRAWING NUMBER: 0710168-HLEA-C-LGF-GA-M-550320

Revision: P1

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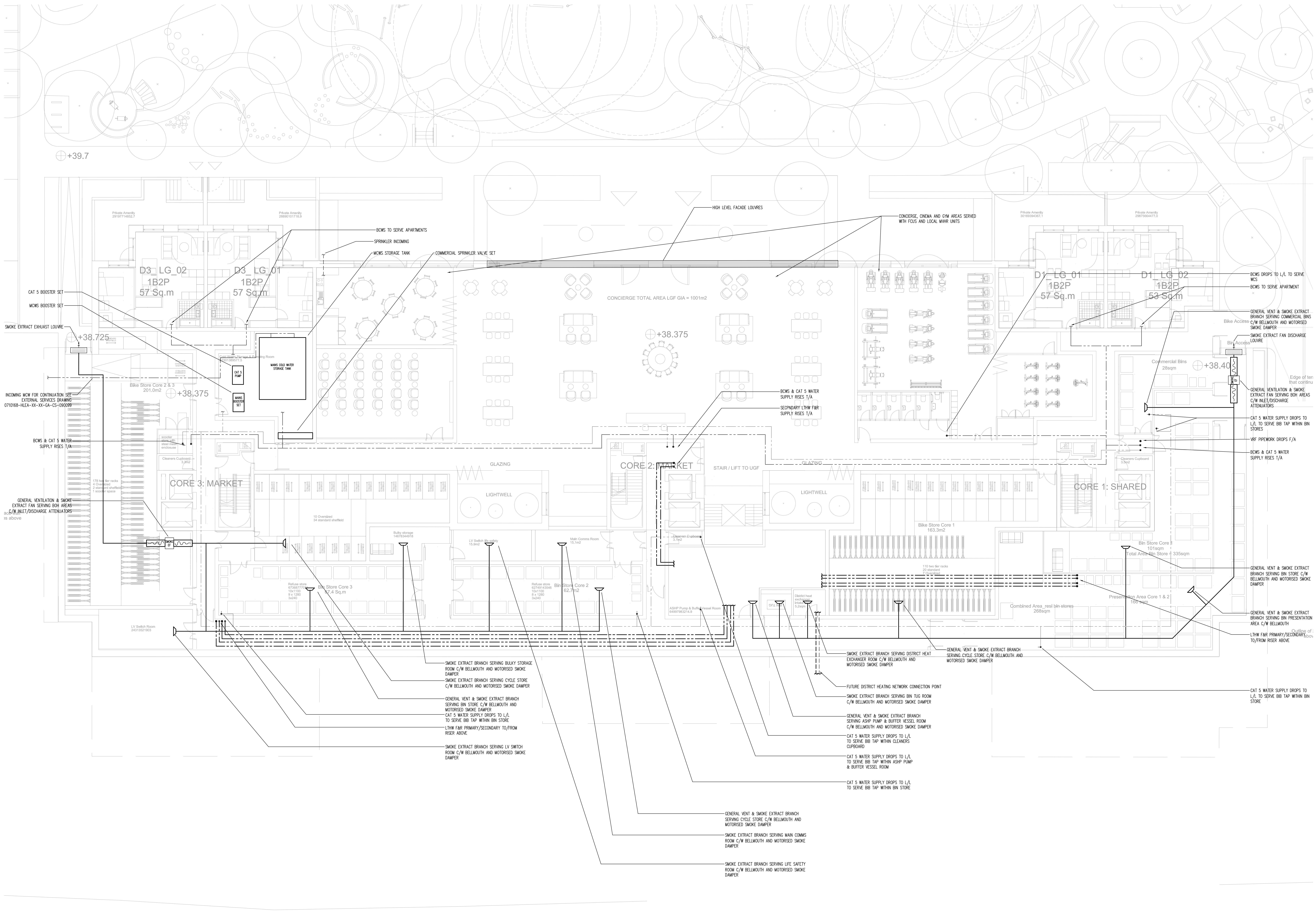

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PROJECT HOLLOWAY

DRAWING TITLE:
MECHANICAL SERVICES
BLOCK D
LOWER GROUND FLOOR
SERVICES LAYOUT

STAGE 2 ISSUE

PERSON RESPONSIBLE FOR:

Design:	Review:	Authorising Issue:
DL	DC	NB

Project No:	Date:	Scale @ A0:
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DRAWING NUMBER:	Revision:
0710168-HLEA-D-LGF-GA-M-550330	P1

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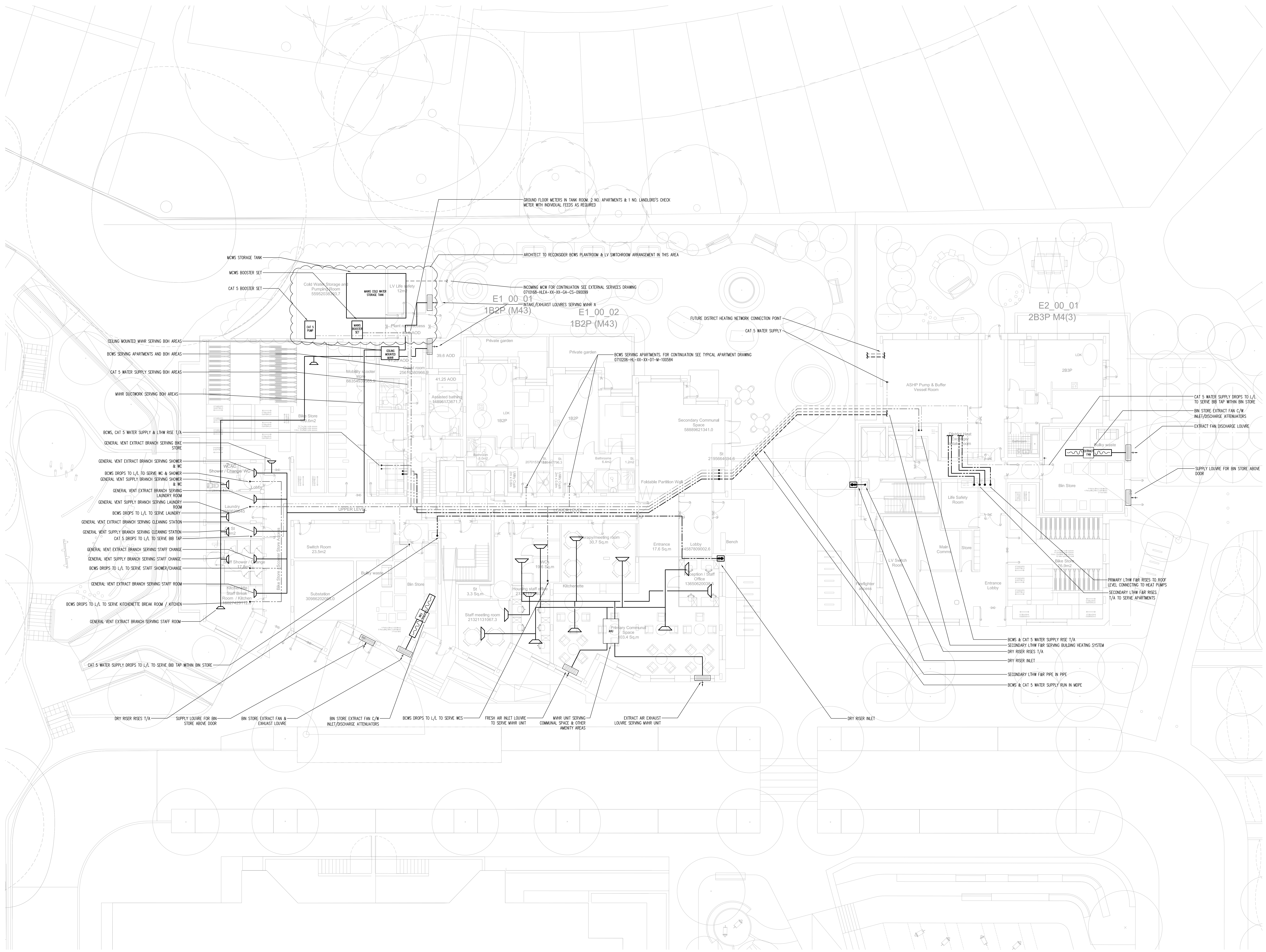

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BLOCK E
GROUND FLOOR
SERVICES LAYOUT

STAGE 2 ISSUE

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Design:	Review:	Authorising Issue:
DL	DC	NB

Project No:	Date:	Scale @ A0:
0710168	SEP 2021	1:100

DRAWING NUMBER:	Revision:
0710168-HLEA-E-00-GA-M-550340	P1

X:_PROJECTS_Projects 10100 - 10199\10168 - Holloway Prison\07 BIM And CAD\7B CAD\7B-2 Mechanical\002 Stage 2\003 GAs\0710168-HLEA-E-00-GA-M-550340.dwg,Phill Thomas,26/10/2021 21:18:45

Appendix E: Shared Heat Network review.

Overview

LBI Development Management Policy DM7.3 and Draft Local Plan Policy S5 sets out that where connection to an existing or future heat network is not possible, major developments should develop and/or connect to a low or zero carbon Shared Heating Network (SHN) linking neighbouring developments and/or existing buildings, unless it can be demonstrated that this is not reasonably possible. The Holloway Prison Site SPD states the heating network should explore opportunities to share heat with neighbouring buildings through providing additional capacity as well as potential connection to district networks in the wider area (including the Holloway Road and Highbury West clusters).

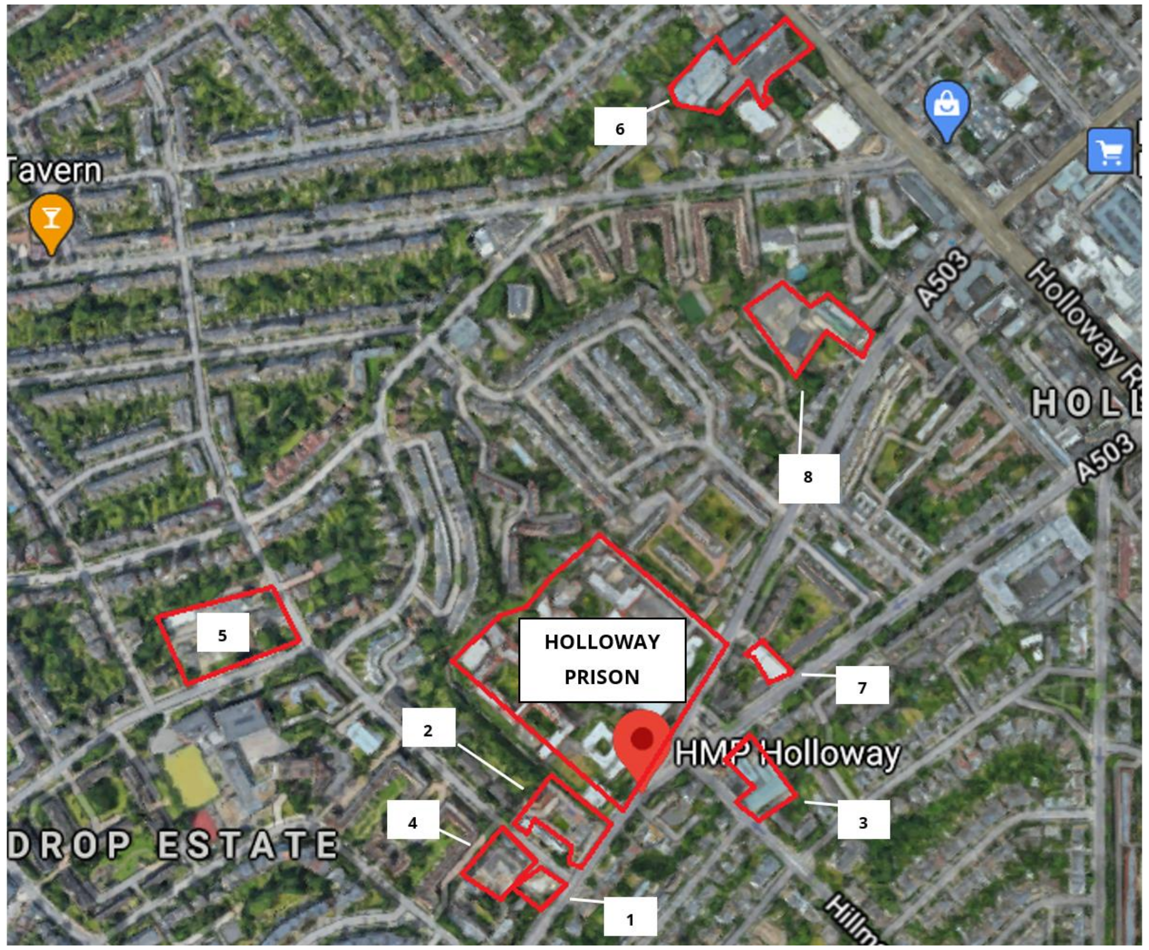
Following the pre-application meeting held in September 2020, Officers requested the applicant teams review nine sites with regard to the provision of a Shared Heating Network. In accordance with this request, these sites have been reviewed and in conclusion, it is not reasonably possible to connect to any of these sites and therefore the scheme will not provide a Shared Heating Network.

Introduction

Following the initial energy strategy meeting held with LBI Officers on 10th September 2020, pre-application meeting notes were issued by Officers on 25th September 2020 which requested that the following nine sites are reviewed with regard to provision of a Shared Heating Network.

1. 273 Camden Road
2. 275 Camden Road (John Barnes / Bramber House). This development is now known as the Cat & Mouse Library development.
3. 394 Camden Road
4. 1 Dalmeny Avenue (Ada Lewis House)
5. Dalmeny Road (& Carleton Road) (Tufnell Park Primary School)
6. 443 - 449 Holloway Road
7. 2 Parkhurst Road (Islington’s Arts Factory)
8. 65-69 Parkhurst Road (Former Territorial Army Centre)
9. 4 Dalmeny Avenue (Bramber House). This is a duplicate of the Cat & Mouse Library development (no. 2 above).

The location of these sites is shown in the figure below.



Policy Context

LBI current (DM Policy DM7.3 Part D) and emerging (Draft Local Plan Policy S5 Part H) policies state that where connection to an existing or future DEN is not possible, major developments must develop and/or connect to a Shared Heating Network (SHN) linking neighbouring developments and/or existing buildings, unless it can be demonstrated that this is not reasonably possible.

Supporting Text to these policies sets out that whether development of, or connection to, a SHN is reasonably possible will be assessed by the council, based on a range of factors, including:

- the size and nature of the heat load within the development and neighbouring communally heated sites;
- the distance between the sites;
- any physical barriers e.g. roads and railways;
- the practicality of connection, including willingness of existing building owners, timing of schemes and any other legal or management issues, and
- the carbon reduction likely from such a connection, including the feasibility of use of low or zero carbon technologies.

The Holloway Prison Site SPD states the heating network should explore opportunities to share heat with neighbouring buildings through providing additional capacity as well as potential connection to DE networks in the wider area (including the Holloway Road and Highbury West clusters).

Summary

Each of the sites have been reviewed with regard to provision of a Shared Heating Network. This is detailed in the enclosed table.

Peabody does not have control of any of these sites and cannot require the relevant owner/s to alter their existing or forthcoming heat source and connect to the Holloway Prison Site. In addition to this, the following site-specific circumstances apply:

- Site no. 1, 2, 4, and 5 are subject of extant consents which have been built out and occupied. These developments are utilising their respective consented energy strategies. If the owners were to connect to a network, this would result in the removal of current systems which they have installed at cost. This would not represent best use of resources and would not be practical. In addition, the S106 Agreements which are publicly available for Site no. 1, 2 & 5 do not oblige the owner/s to connect to a shared heating network.
- Site no. 3 is subject to a live application for retrospective change of use and alterations, which is not yet determined. The existing buildings on-site would be retained under the proposed development. The existing buildings do not have a communal heating system. The site (in its present form) is not anticipated to have any infrastructure which would enable connection to a network. The Energy Statement which accompanies the planning application currently under consideration does not propose connection to a network or the installation of infrastructure which could enable connection to a network if one became available in the future.
- Site no. 6 lies in excess of 500m from Holloway Prison at circa 700m. This is outside of what would be deemed a reasonable catchment area for a connection.
- Site no. 7 is subject to a live application (resolution to grant received at committee, decision not yet issued). The proposed Heads of Terms in the Committee Report requires the owner/s to provide an on-site solution and/or connection to a neighbouring site. The owner/s are therefore not obliged to connect to a shared heating network. As part of the application, the applicant's energy strategy proposed on-site CHP to serve the development.
- Site no. 8 is subject to an extant consent and construction is due to commence imminently (Q4 2020). The development owner/s are not obliged under the S106 to connect to a shared heating network. The Former TA site is required to connect to a 'District Heating Network' (S106 Agreement dated August 2020, Schedule 1 Clause 6.8 and 6.9). This is different to a Shared Heating Network by virtue of its definition. The Former TA Site S106 defines a 'District Heating Network' as:

> *'a network of insulated heating pipes designed to distribute heating energy to a geographic area from central sources of production, with the capability of supplying some or all of the Heat Demand of the Development, in accordance with the Submitted Energy Statement or any Updated Energy Statement approved by the Council under the terms of this Deed'*

This position is supported by the approach the Council took on Tufnell Park Primary School (Site no. 5). The School is required to connect to a 'District Heating Network' (S106 Agreement dated February 2018, Schedule 1 Clause 9.7 and 9.8). This S106 has the same definition for 'District Heating Network' as the Former TA site, with a separate definition of a 'Shared Heating Network'.

> *District Heating Network*
>
> *'a network of insulated heating pipes designed to distribute heating energy to a geographic area from central sources of production, with the capability of supplying some or all of the Heat Demand of the Development, in accordance with the Submitted Energy Statement or any Updated Energy Statement approved by the CDoER [Corporate Director of Environment and Regeneration] under the terms of this letter'*
>
> *Shared Heat Network*
>
> *'an energy source with the capability of supplying heating energy to supply some or all of the Heat Demand of the Development through insulated heating pipes, in accordance with the Submitted Energy Statement or any Updated Energy Statement approved by the CDoER under the terms of this letter'*

This S106 requires the School to connect to a 'District Heating Network' as soon as reasonably practicable under Schedule 1 Clause 9.7 and 9.8. This requirement does not apply to the 'Shared Heating Network'.

As summarised above and set out in the table below, neither the Former TA site nor Tufnell Park Primary School are obliged under their respective S106 Agreements to connect to a Shared Heating Network.

In summary, it is not reasonably possible to develop and/or connect to a Shared Heating Network (SHN) linking to any of the sites identified by LBI

	Address	Application Ref and Status	No. of residential units	Quantum of non-residential floorspace	Energy Strategy of the site	Comments			Conclusion
						Distance from Holloway Prison (site frontage)	Physical barriers	Practicality of connection	
1	273 Camden Road (also referred to as ICON7)	P2015/5306/FUL Consented 26.05.2017. Development completed July 2020.	21	n/a	Consented energy strategy is individual gas boilers. The Committee Report sets out the Energy Conservation Officer comments as follows: • The Energy Statement does not propose a Shared Heat Network (SHN) due to the scale of the proposed development and lack of local CHP plant within neighbouring developments. It is noted that the neighbouring approved development at 275 Camden Road [now known as Cat & Mouse Library] has proposed a 20kWth CHP energy centre to supply heat to the 34 residential units at that site, however due to the small scale of both sites it is unlikely that there would be sufficient capacity to share heat efficiently, and therefore it is accepted that a SHN is unlikely to be viable. • The Energy Statement does not provide an assessment of CHP, but concludes that the heat demand and profile is unlikely to make CHP viable due to the small scale of the site. We support this conclusion. The S106 required an Updated Energy Statement to be submitted and approved by the Council prior to implementation, and for the owner to comply with the Statement. The Statement was required to set out how the development will safeguard space to allow for pipework for a district heating network and how the boiler system would meet the requirements of a district heating network direct supply. The S106 did not include any clauses which require the owner (or future owner) to connect to a district heating network or shared heating network in the event one became available.	Circa 80m	Pipes would be required to be installed along the pavement or road to Camden Road which is a TfL red route. The pipes would also need to cross underneath Dalmeny Avenue, a two way vehicular road.	This site is owned by Third Party/ies. The applicant does not have control of the site and cannot require the relevant parties to connect to the Holloway Prison site.	**Connection to this development is not reasonably possible** for the following reasons: • The development has been built out and occupied and is utilising the consented energy strategy. • The development owner/s are not obliged under the S106 to connect to a shared heating network. • Peabody does not have control of the development and cannot require the relevant owner/s to connect to a network. • Pipework would be required to be installed along the pavement or road to Camden Road which is a TfL red route. Peabody does not have control of this land. • There is a physical barrier (Dalmeny Avenue, a vehicular road) between the development and the Holloway Prison Site.
2	275 Camden Road (John Barnes /	P2013/4758/FUL	34	495 sqm (library Use Class D1)	Consented energy strategy is CHP heating system plus PVs.	Circa 20m	Pipes would be required to be installed along the	This site is owned by Third Party/ies. The applicant does not	**Connection to this development is not reasonably possible** for the following reasons:

	Address	Application Ref and Status	No. of residential units	Quantum of non-residential floorspace	Energy Strategy of the site	Comments			Conclusion
						Distance from Holloway Prison (site frontage)	Physical barriers	Practicality of connection	
	Bramber House) Now known as Cat & Mouse Library	Consented 19.08.2014. Development complete and occupied.			The Committee Report set out that it was accepted that connection to a Shared Heating Network was not a feasible option in the short term during the construction of development, however the scheme should be future proofed to allow connection to any future network that comes forward in the area and a condition should be attached to require this. Neither the decision notice nor the s106 include a condition or obligation requiring the system to be future proofed to allow for connection to future network. It is therefore not known whether the scheme was future proofed to allow connection to a future network. The S106 did not include any clauses which require the owner (or future owner) to connect to a district heating network or shared heating network in the event one became available.		pavement or road to Camden Road which is a TfL red route.	have control of the site and cannot require the relevant parties to connect to the Holloway Prison site.	• The development has been built out and occupied and is utilising the consented energy strategy. • The development was not obliged to future proof to allow for connection to a future network. It is not known whether the installed and operational system would be able to connect to a network. • The development owner/s are not obliged under the S106 to connect to a shared heating network. • Peabody does not have control of the development and cannot require the relevant owner/s to connect to a network. • Connection to a network would result in the existing CHP plant, which was installed at cost to the owner, becoming redundant. This would be ahead of the expected end life period of the CHP plant. This would not represent best use or value. • Pipework would be required to be installed along the pavement or road to Camden Road which is a TfL red route. Peabody does not have control of this land.
3	394 Camden Road	The site is currently occupied by a vehicle repair depot (B2) and a warehouse to the rear (B8).	n/a	1,591sqm	The existing warehouses are currently heated using electric panel heaters. The Energy Statement (dated June 2019) submitted with ref. P2018/4071/FUL sets out the following proposed energy efficiency measures:	Circa 80m	Pipes would be required to be installed along the pavement or road to Parkhurst Road/ Camden Road and Hillmarton Road.	This site is owned by Third Party/ies. The applicant does not have control of the site and cannot require the relevant parties to connect to	Connection to this development is not reasonably possible for the following reasons: • The existing buildings do not have a communal heating system. The site (in its present form) is not anticipated

	Address	Application Ref and Status	No. of residential units	Quantum of non-residential floorspace	Energy Strategy of the site	Comments			Conclusion
						Distance from Holloway Prison (site frontage)	Physical barriers	Practicality of connection	
		There is a live application for a retrospective change of use from B8 to Use class B1/Sui Generis plus new roof structure (ref. P2018/4071/FUL)			- Replacement of the Roof with a Kingspan KS1000 RW Trapezoidal roof improving the U-Value by over 90%. - Upgrade of the Lighting to bulbs with a minimum luminous efficacy of 65 lumens/watt. - Implementation of new Lighting Controls - Installation of new Rooflights The Energy Statement does not propose the installation of a communal heating or energy system.		Parkhurst/Camden Road is a TfL red route. The pipes would also need to cross underneath the Parkhurst/Camden Road and Hillmarton Road junction.	the Holloway Prison site. The site is the subject of an emerging site allocation (NH5) for mixed-use residential and business use. There is no indication of a forthcoming application for these uses.	to have any infrastructure which would enable connection to a network. The Energy Statement which accompanies the application currently under consideration does not propose connection to a network or the installation of infrastructure which could enable connection to a network if one became available in the future. - Peabody does not have control of the development and cannot require the relevant owner/s to connect to a network. - Pipework would be required to be installed along the pavement or road to Camden/Parkhurst Road which is a TfL red route. Peabody does not have control of this land. - There is a physical barrier (Camden/Parkhurst Road and Hillmarton Road junction, a vehicular and pedestrian junction) between the development and the Holloway Prison Site.
4	1 Dalmeny Avenue (Ada Lewis House)	P2013/1564/FUL Consented 01.10.2014. Development complete and occupied.	45	n/a	Consented energy strategy is gas boiler feeding a communal heating system. The permission ref. P2013/1564/FUL included a condition that required details of how the system shall be designed for future connection to any neighbouring heating and cooling network. This condition was discharged under application ref. P2017/1093/AOD. The planning condition does not obligate the owner to connect to a network in the event one becomes available. The S106 is not available.	Circa 130m	Pipes would be required to be installed along the pavement or road to Camden Road which is a TfL red route. The pipes would also need to cross underneath Dalmeny Avenue, a two-way vehicular road.	This site is owned by Third Party/ies. The applicant does not have control of the site and cannot require the relevant parties to connect to the Holloway Prison site.	Connection to this development is not reasonably possible for the following reasons: - The development has been built out and occupied and is utilising the consented energy strategy. - The development owner/s are not obliged under the planning conditions to connect to a shared heating network.

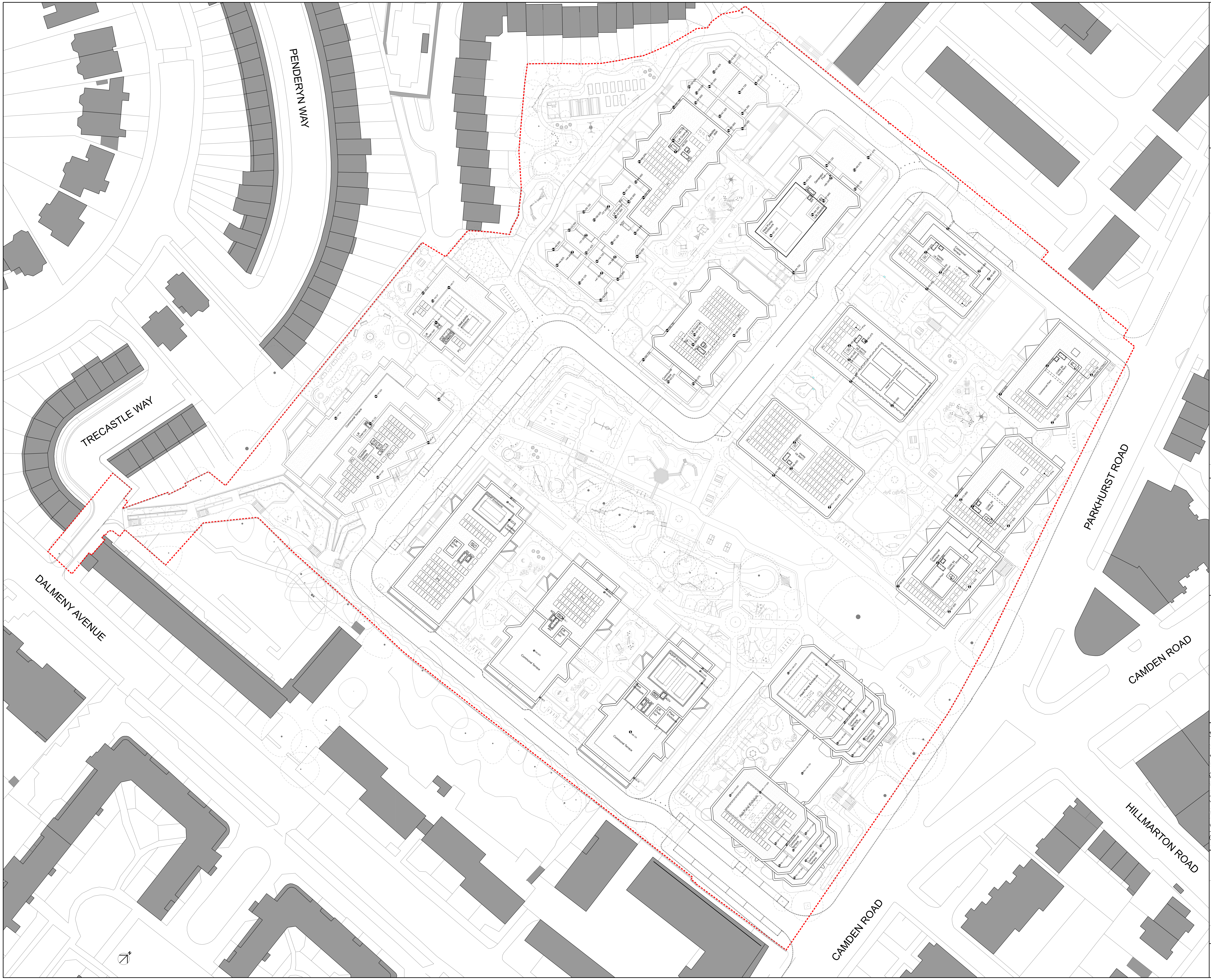
	Address	Application Ref and Status	No. of residential units	Quantum of non-residential floorspace	Energy Strategy of the site	Comments			Conclusion
						Distance from Holloway Prison (site frontage)	Physical barriers	Practicality of connection	
									• Peabody does not have control of the development and cannot require the relevant owner/s to connect to a network. • Pipework would be required to be installed along the pavement or road to Camden Road which is a TfL red route. Peabody does not have control of this land. • There is a physical barrier (Dalmeny Avenue, a vehicular road) between the development and the Holloway Prison Site.
5	Dalmeny Road and Carleton Road (Tufnell Park Primary School)	P2017/2822/FUL Consented 22.02.2018. Development complete and occupied.	n/a	3,371sqm (Primary School)	Consented energy strategy is heating via a LTHW gas fired boiler. Hot water to be provided by a condensing water heater. The Committee Report set out that whilst the design for a future connection had not been assessed, the legal agreement should include an obligation to require a commitment to ensuring that the development is designed to allow future connection to a district heating network. This is secured in Schedule 1, Section 9 of the S106. The S106 requires the School to connect to a 'District Heating Network' as soon as reasonably practicable under Schedule 1 Clause 9.7 and 9.8. This requirement does not apply to the 'Shared Heating Network'.	Circa 500m	Pipes would be required to be installed along the pavement or road to Camden Road, Dalmeny Avenue and Carlton Road. The pipes would also need to cross underneath Dalmeny Avenue and Carlton Road, both of which are two-way vehicular roads.	This site is owned by Third Party/ies. The applicant does not have control of the site and cannot require the relevant parties to connect to the Holloway Prison site.	**Connection to this development is not reasonably possible** for the following reasons: • The development has been built out and occupied and is utilising the consented energy strategy. • The development owner/s are not obliged under the S106 to connect to a shared heating network. • Peabody does not have control of the development and cannot require the relevant owner/s to connect to a network. • Pipework would be required to be installed along the pavement or road to Camden Road, Dalmeny Avenue and Carlton Road. Peabody does not have control of this land. • There are physical barriers (Dalmeny Avenue and Carlton Road, both vehicular roads) between the

	Address	Application Ref and Status	No. of residential units	Quantum of non-residential floorspace	Energy Strategy of the site	Comments			Conclusion
						Distance from Holloway Prison (site frontage)	Physical barriers	Practicality of connection	
									development and the Holloway Prison Site.
6	443-449 Holloway Road	P2013/3213/FUL Consented 13.06.2014. Consent required the development to commence by 13 June 2017. Unclear if commencement took place and if this is an extant consent. There are no available records of pre-commencement conditions being discharged.	80	2,668sqm	Consented energy strategy is on-site CHP plus gas boilers. The Sustainability Design and Construction Statement approved under P2013/3213/FUL which set out the energy strategy for the development, set out that connection to a future DEN will be safeguarded within the system design. The Decision Notice did not include a condition requiring this. There is no s106 available online. The Sustainability Design and Construction Statement did not refer to a Shared Heating Network and makes no reference as to whether the scheme was designed with the capability to connect to a Shared Heating Network.	Circa 700m	Pipes would be required to be installed along the pavement or road to Parkhurst Road and Holloway Road, both of which are TFL red routes.	This site is owned by Third Party/ies. The applicant does not have control of the site and cannot require the relevant parties to connect to the Holloway Prison site.	**Connection to this development is not reasonably possible** for the following reasons: • The development is in excess of 500m from Holloway Prison. This is outside of what would be deemed a reasonable catchment area for connection. • Peabody does not have control of the development and cannot require the relevant owner/s to connect to a network. • Pipework would be required to be installed along the pavement or road to Parkhurst Road and Holloway Road, both of which are TfL red routes. Peabody does not have control of this land. • There is a physical barrier (Dalmeny Avenue, a vehicular road) between the development and the Holloway Prison Site.
7	2 Parkhurst Road (Islington Arts Factory)	The site is currently occupied by Islington Arts Factory. There is a live application which received resolution to grant at committee in 2017 (ref. P2015/0330/FUL).	25	1337sqm	The energy strategy proposed under ref. P2015/0330/FUL is on-site CHP. The Heads of Terms listed in the Committee Report set out that the following obligations would be secured by way of s106: • In the event that a local energy network is not available or connection to it is not economically viable, the developer should develop an on-site solution and/or connect to a neighbouring site (a Shared Heating Network) and future proof any on-	Circa 10m	Pipes would be required to be installed along the pavement or road to Parkhurst Road which is a TfL red route. The pipes would also need to cross underneath Parkhurst Road.	This site is owned by Third Party/ies. The applicant does not have control of the site and cannot require the relevant parties to connect to the Holloway Prison site.	**Connection to this development is not reasonably possible** for the following reasons: • Peabody does not have control of the development and cannot require the relevant owner/s to connect to a network. • The proposed Heads of Terms in the Committee Report requires the owner/s to provide an on-site solution and/or connection to a neighbouring site. The owner/s are therefore not

	Address	Application Ref and Status	No. of residential units	Quantum of non-residential floorspace	Energy Strategy of the site	Comments			Conclusion
						Distance from Holloway Prison (site frontage)	Physical barriers	Practicality of connection	
		The S106 is not yet signed and decision not issued.			site solution so that in all cases (whether or not an on-site solution has been provided), the development can be connected to a local energy network if a viable opportunity arises in the future.				obliged to connect to a shared heating network. • Pipework would be required to be installed along the pavement or road to Parkhurst Road, which is a TfL red route. Peabody does not have control of this land. • There is a physical barrier (Parkhurst Road, a vehicular road) between the development and the Holloway Prison Site.
8	65-69 Parkhurst Road (Former Territorial Army Centre)	P2020/0648/FUL Consented 28.08.2020. Scheme commenced on 01.10.2020.	118	n/a	Consented energy strategy is Air Source Heat Pump (ASHP) system connected to a site-wide network. The S106 secured the future proofing of the system to allow for connection to a future district heating network.	300m	Pipes would be required to be installed along the pavement or road to Parkhurst Road which is a TfL red route.	This site is owned by Third Party/ies. The applicant does not have control of the site and cannot require the relevant parties to connect to the Holloway Prison site. Based on the Construction Logistics Plan submitted under ref. P2020/2319/AOD, demolition and enabling works will be carried out in 2020, with construction commencing Q4 2020 and complete Q4 2022. The development is therefore expected to be complete and occupied before the Holloway Prison site.	**Connection to this development is not reasonably possible** for the following reasons: • Peabody does not have control of the development and cannot require the relevant owner/s to connect to a network. • The development owner/s are not obliged under the S106 to connect to a shared heating network. • Pipework would be required to be installed along the pavement or road to Parkhurst Road, which is a TfL red route. Peabody does not have control of this land.

	Address	Application Ref and Status	No. of residential units	Quantum of non-residential floorspace	Energy Strategy of the site	Comments			Conclusion
						Distance from Holloway Prison (site frontage)	Physical barriers	Practicality of connection	
9	4 Dalmeny Avenue (Bramber House). This is a duplicate of the Cat & Mouse Library (Site no. 2 above). LPA ref. P2013/4758 /FUL	/	/	/	/	/	/	/	/

Appendix F: Roof Layout.



KEY

🟦	1 BED	🟦	CYCLE STORE
🟨	2 BED	🟨	EXTRA-CARE
🟧	3 BED	🟪	RESIDENT'S SHARED FACILITIES
☐	4 BED	🟥	SOCIAL RENT
🟪	WOMENS BUILDING	🟦	LONDON SHARED OWNERSHIP
🟩	REFUSE STORE	🟩	MARKET
🟥	COMMERCIAL	☐	SHARED BETWEEN MARKET AND LSO
🟧	PLANT	- - - -	SITE BOUNDARY
▨	BIODIVERSE ROOF	AH	ACCESS HATCH
		SV	SMOKE VENT
		PV	PHOTOVOLTAIC PANELS
		AOV	AUTOMATIC OPENING VENTS
		DR	DRY RISER INLET

0 1m 2m 5m 10m

LANDSCAPE AND PUBLIC REALM INDICATIVE. REFER TO LANDSCAPE ARCHITECT INFORMATION.

REV	DATE	
P01	01/11/2021	PLANNING

NOTE

When this drawing is issued in uncontrolled CAD format it will be accompanied by a PDF version and is issued to enable the recipient to prepare their own documents / models / drawings for which they are solely responsible.
The recipient should report all drawing errors, omissions and discrepancies to the architect. All dimensions should be checked on site by the contractor and such dimensions shall be the contractor's responsibility.

Allford Hall Monaghan Morris Limited accepts no responsibility or liability for:-
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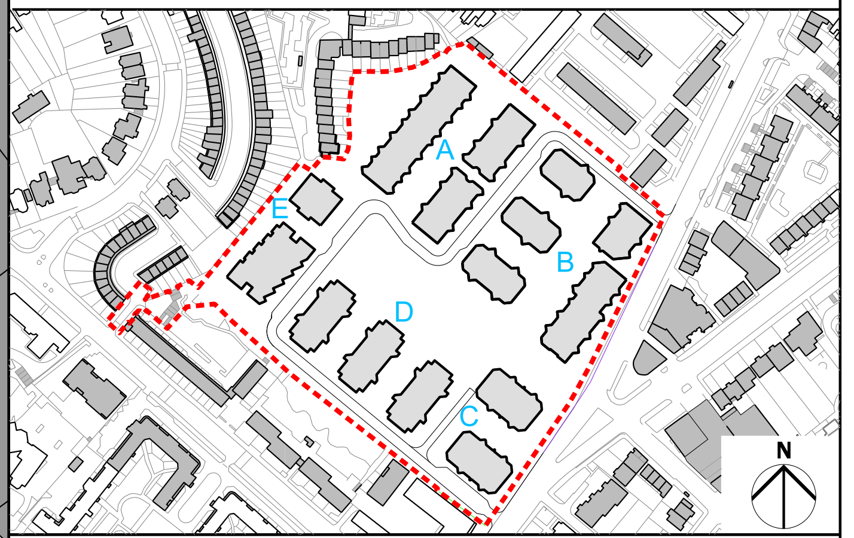
- the accuracy of survey information provided by others or for any costs, claims, proceedings and expenses arising out of reliance on such information
- any scaling from this drawing other than by the local planning authority solely for the purposes of the planning application to which it relates

LOCATION



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job title
PROJECT HOLLOWAY

drawing title / location
MASTERPLAN
ROOF PLAN

drawn by	checked	scale	status
AC	LL	1:500@A1; 1:1000@A3	PLANNING

project	zone	source	classification drawing no.	revision
17105	0	-	(00)_P122	P01

Appendix G: Site-wide Heating Schematic and ASHP Datasheet.

A0

This drawing shall not be scaled.
Work from the dimensions shown in the drawing or given in relevant specifications

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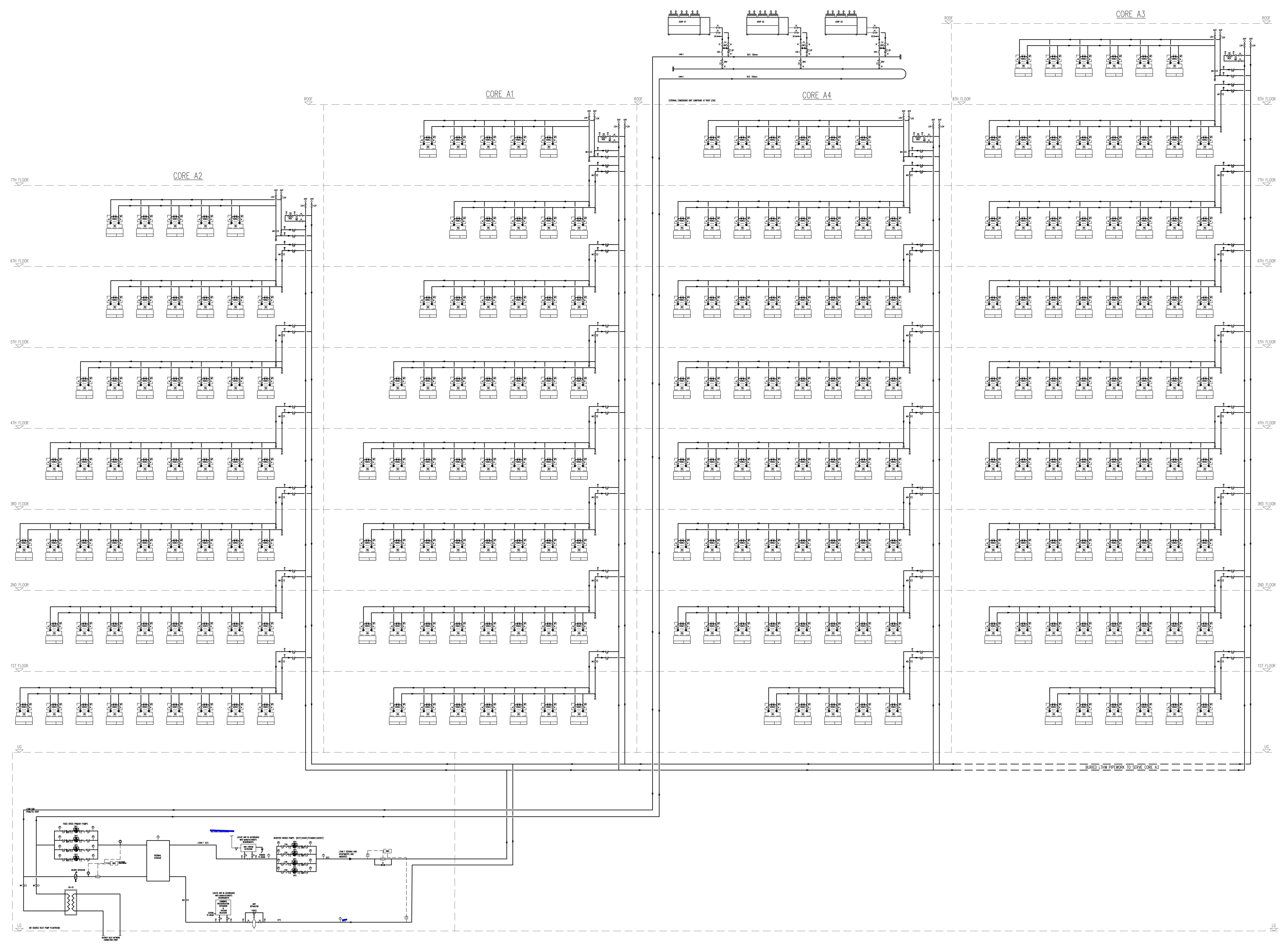

CDM Regulations:

In addition to any information included in this drawing or the model from which it is derived, refer also to the project CDM Risk Register for information on residual risks'

General Notes:

- The drawing does not necessarily show all the information needed to interpret the design intent or the construction details.
- The drawing contains information from more than one source and must be read in conjunction with all relevant specifications.
- Any apparent drafting errors and differences between other drawings and specifications shall be brought to our attention.

Project Notes:

1. PROVIDE DRAIN COCKS ON ALL LOW POINTS AND AUTOMATIC AIR VENTS ON ALL HIGH POINTS.
2. TEMPERATURE AND PRESSURE SENSOR TO BE LOCATED AT THE TOP OF RISER AND 2/3 ALONG INDEX RUN TO BE LINKED INTO THE PLANT ROOM.
3. BINDER TEST POINTS TO BE INCORPORATED WHERE SHOWN ON THE DRAWING AND ADDITIONALLY ACROSS COILS, PUMPS, 3 & 2-WAY VALVES AND STRAINERS.
4. CONTRACTOR SHALL MAKE ALL ALLOWANCE FOR ADDITIONAL VALVES/BALANCING ANCILLARIES AND COMPONENTS ETC. TO ENSURE STRICT COMPLIANCE WITH MANUFACTURER'S RECOMMENDATIONS AND TO GIVE A COMPLETE AND FULLY FUNCTIONAL INSTALLATION.
5. FOR DETAILS OF FCU CONNECTIONS AND ENERGY METERING REFER TO THE APARTMENT SCHEMATIC DRAWING.
6. DIFFERENTIAL PRESSURE SENSOR REQUIRED TO BE POSITIONED APPROXIMATELY AT A DISTANCE OF 2/3RDS ALONG THE INDEX RUN AND TOP OF RISER.
7. ISOLATING VALVES PRIOR TO APARTMENT ENTRANCE ARE TO BE LOCATED WITHIN THE CEILING VOID C/W LOCKABLE ACCESS PANEL.
8. ~~EXPANSION AND ANCHOR PROVISIONS SHOWN ARE INDICATIVE ONLY. THE CONTRACTOR SHALL DESIGN THESE IN CONJUNCTION WITH AN EXPANSION SPECIALIST BASED ON THE CONTRACTORS CONSTRUCTION ISSUE DRAWINGS.~~

Index	Description	Designed	Reviewed	Authorised	Date

REVISIONS:

HOARE LEA (H.)

ARCHITECT:
ALLFORD HALL MONAGHAN MORRIS

CLIENT:
PEABODY

PROJECT TITLE:
PROJECT HOLLOWAY

DRAWING TITLE:
MECHANICAL SERVICES
BLOCK A
LTHW CONCEPT SCHEMATIC

STAGE 2

PERSON RESPONSIBLE FOR:

Design:	Review:	Authorising Issue:
PJT	DC	NB

Project No:	Date:	Scale @ A0:
0710168	OCT 2021	N/A

DRAWING NUMBER:	Revision:
0710168-HLEA-A-XX-SM-M-600-460	P1

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This drawing shall not be scaled.
Work from the dimensions shown in the drawing or given in relevant specifications

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Index	Description	Designed	Reviewed	Authorised	Date

REVISIONS:

CDM Regulations:

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ARCHITECT:
ALLFORD HALL MONAGHAN MORRIS

PROJECT TITLE:
PROJECT HOLLOWAY

CLIENT:
PEABODY

DRAWING TITLE:
MECHANICAL SERVICES
BLOCK B
LTHW CONCEPT SCHEMATIC

HOARE LEA

STAGE 2

PERSON RESPONSIBLE FOR:

Design:	Review:	Authorising Issue:
PJT	DC	NB

Project No:	Date:	Scale @ A0:
0710168	OCTOBER 21	N/A

DRAWING NUMBER:	Revision:
0710168-HLEA-B-XX-SM-M-600461	P1

X:_PROJECTS_Projects 10100 - 10199\10168 - Holloway Prison\07 BIM And CAD\7B CAD\7B-2 Mechanical\002 Stage 2\002 Schematics\Block B\0710168-HLEA-B-XX-SM-M-600461.dwg,Phill Thomas,26/10/2021 21:23:54

A0

This drawing shall not be scaled.
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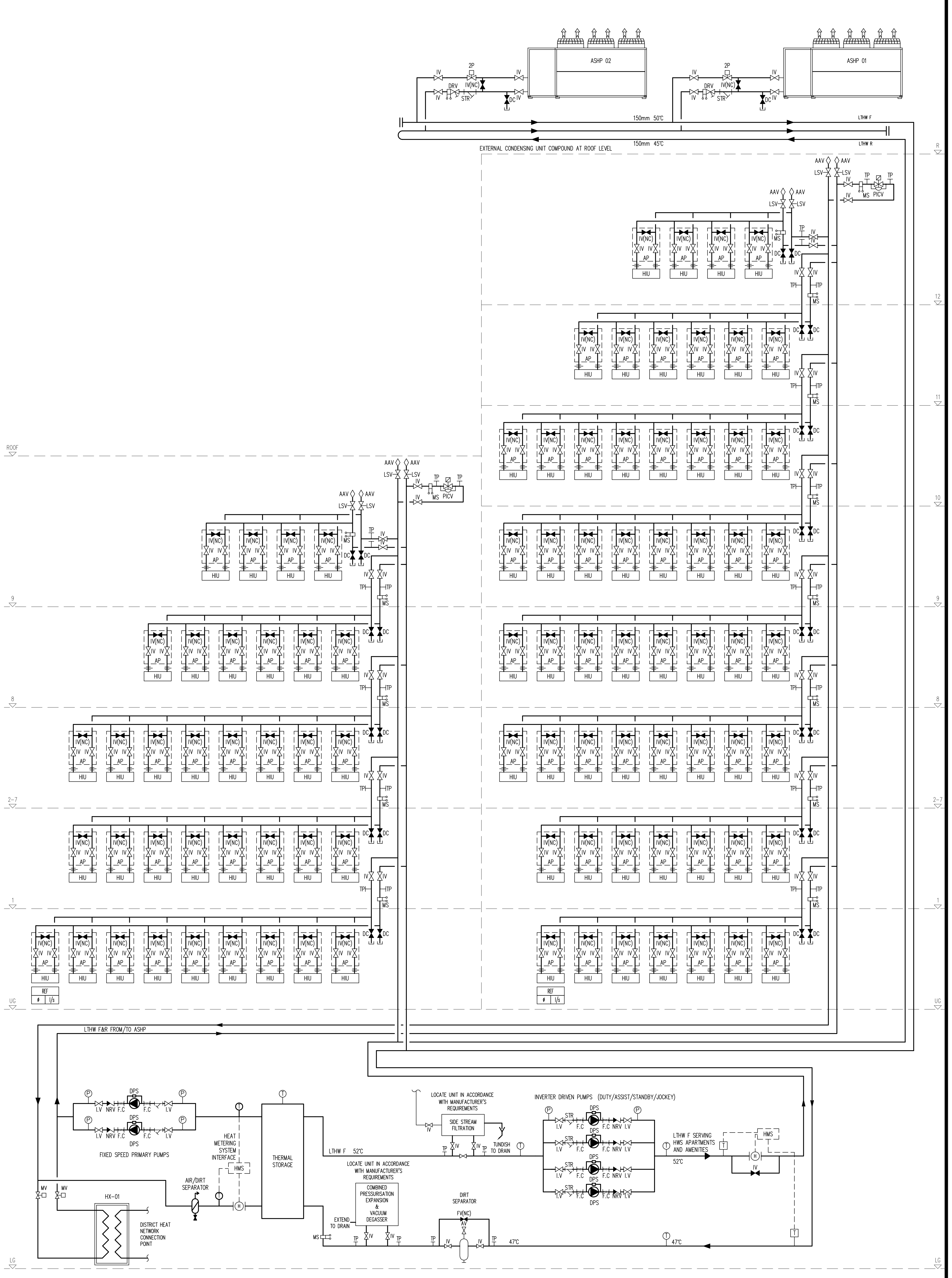
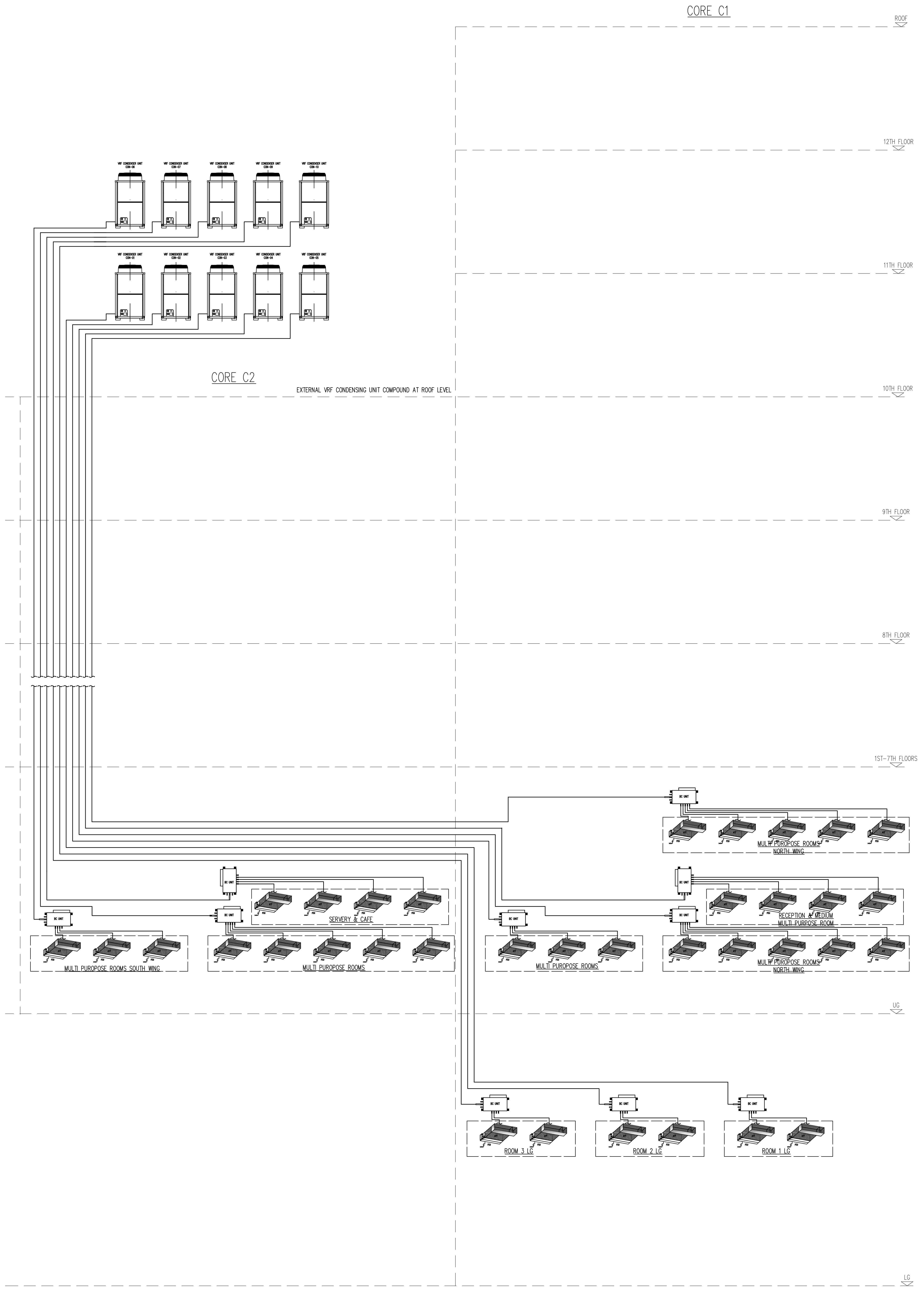
0710168 - HL18_sheetA0 [X:_PROJECTS_Projects 10100 - 10199\10168 - Holloway Prison\07 BIM and CAD\7B CAD\7B-1 Templates\0710168 - HL18_sheetA0.dwg]

LTHW SCHEMATIC



VRF SCHEMATIC



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Index	Description	Designed	Reviewed	Authorised	Date

REVISIONS:

HOARE LEA H.

ARCHITECT:
ALLFORD HALL MONAGHAN MORRIS

CLIENT:
PEABODY

PROJECT TITLE:
PROJECT HOLLOWAY

DRAWING TITLE:
MECHANICAL SERVICES
BLOCK C
LTHW & VRF CONCEPT SCHEMATIC

STAGE 2

PERSON RESPONSIBLE FOR:

Design:	Review:	Authorising Issue:
PJT	DC	NB
Project No:	**Date:**	**Scale @ A0:**
0710168	OCT 2021	N/A

DRAWING NUMBER:	Revision:
0710168-HLEA-C-XX-SM-M-600462	P1

A0

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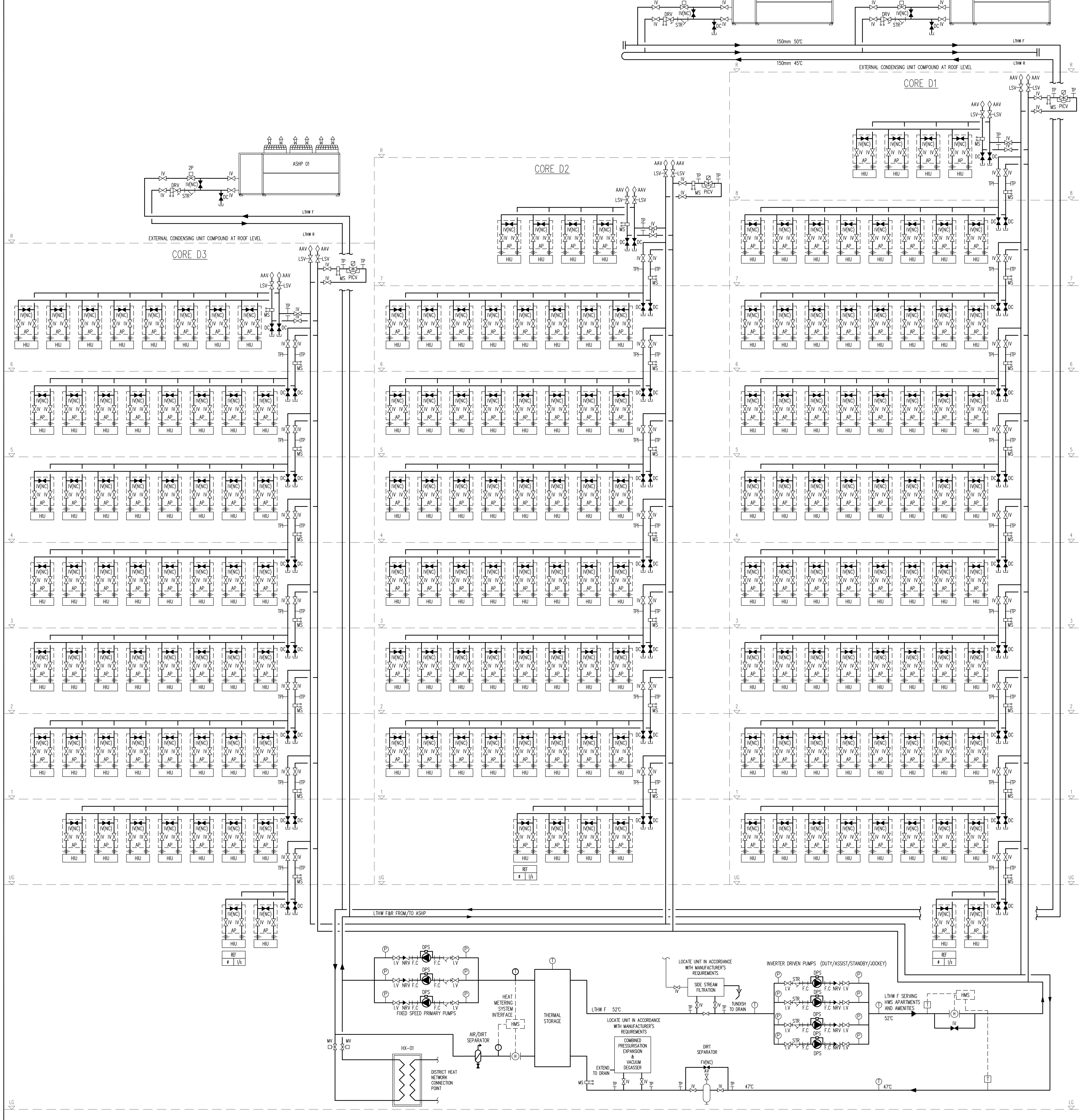
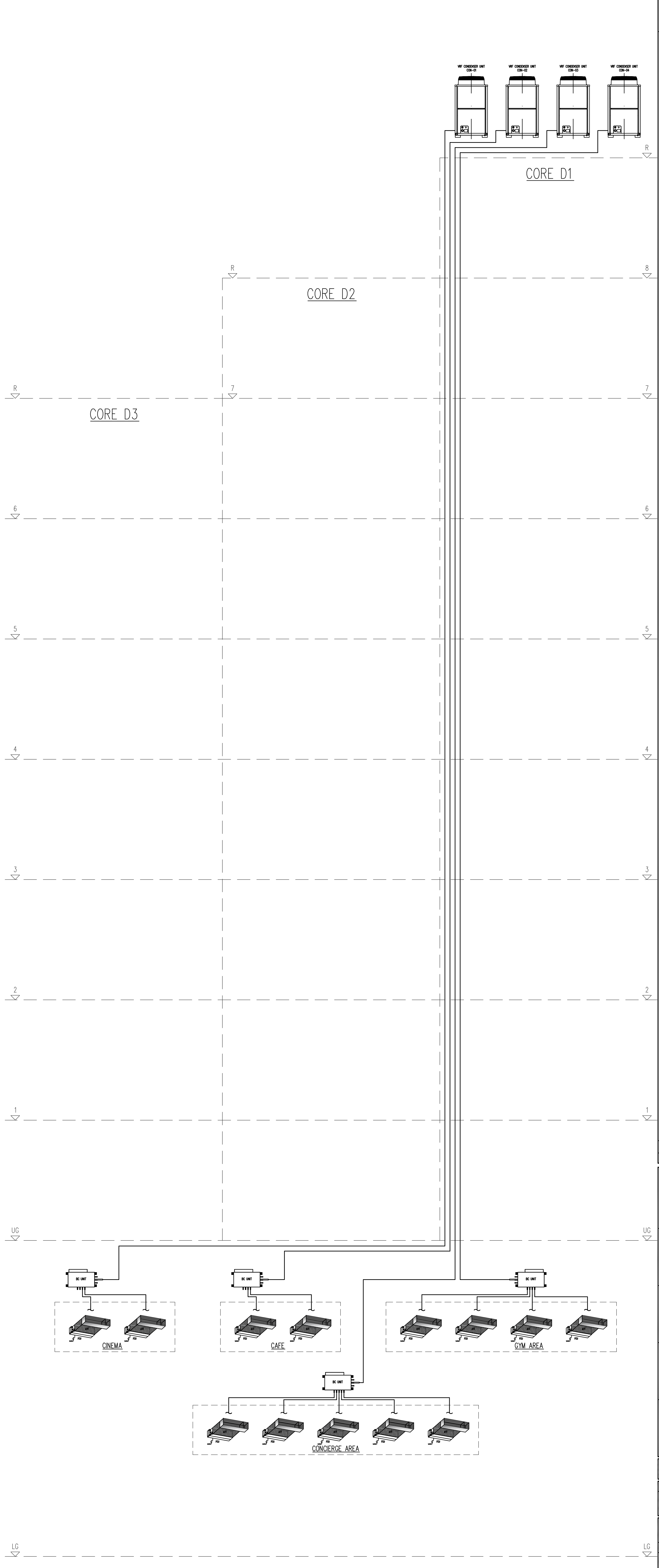
0710168 - HL18_sheetA0 [X:_PROJECTS_Projects 10100 - 10199\10168 - Holloway Prison\07 BIM and CAD\7B CAD\7B-1 Templates\0710168 - HL18_sheetA0.dwg]

LTHW SCHEMATIC



VRF SCHEMATIC



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REVISIONS:

HOARE LEA

ARCHITECT:
ALLFORD HALL MONAGHAN MORRIS

CLIENT:
PEABODY

PROJECT TITLE:
PROJECT HOLLOWAY

DRAWING TITLE:
MECHANICAL SERVICES
BLOCK D
LTHW & VRF CONCEPT SCHEMATIC

STAGE 2

PERSON RESPONSIBLE FOR:

Design:	Review:	Authorising Issue:
PJT	DC	NB

Project No:	Date:	Scale @ A0:
0710168	OCT 2021	N/A

DRAWING NUMBER:	Revision:
0710168-HLEA-D-XX-SM-M-600463	P1

A0

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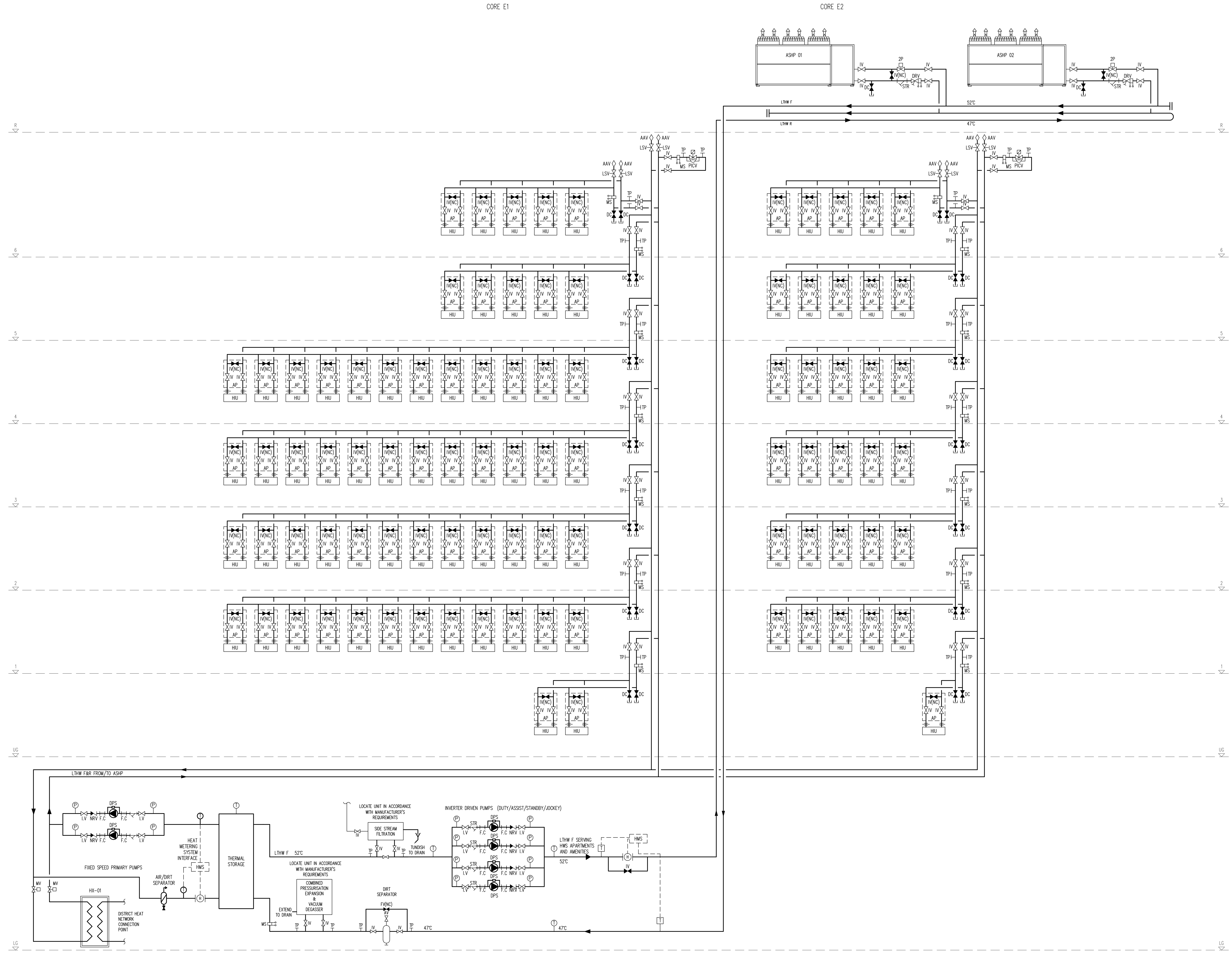

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PEABODY

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MECHANICAL SERVICES
BLOCK E
LTHW CONCEPT SCHEMATIC

HOARE LEA

STAGE 2

PERSON RESPONSIBLE FOR:

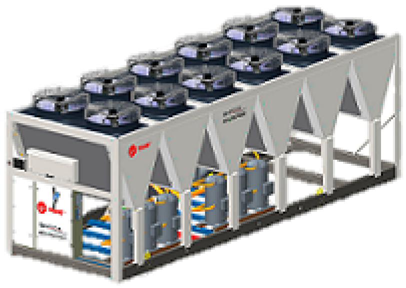
Design:	Review:	Authorising Issue:
PJT	DC	NB

Project No:	Date:	Scale @ A0:
0710168	OCTOBER 21	N/A

DRAWING NUMBER:	Revision:
0710168-HLEA-E-XX-SM-M-600464	P1

Unit Overview

Range	Sintesis Advantage		
Chiller model	CXAF air cooled reversible scroll		
Model	CXAF 080 HE XLN EC		
Unit Application	Comfort (cool=-10C/50C \ heat=-18C/20C)		
Compressor type	Scroll		
Refrigerant Type	Full charge R410A		
SCOP	3.940 kW/kW		
Seasonal space energy efficiency (s,c) / SEER (1)	196.50 %	4.99	
SCOP	3.940 kW/kW	Compliant	
SEPR HT	5.53	Compliant	
SEPR MT	4.14	Compliant	
Type of free cooling	No Free Cooling		
Type of pump	Pump signal On/Off		
Electrical supply	400/50/3		



Project conditions

	Cooling	Heating
Outdoor air dry bulb temperature	35.0 C	-5.0 C
Relative humidity		77 %
Fluid entering temperature	12.0 C	47.0 C
Fluid leaving temperature	7.0 C	52.0 C
Evap fluid type	Water	Water
Fouling Factor	0.017615 m2-deg C/kW	0.017615 m2-deg C/kW
Elevation	0.0 m	0.0 m

Unit performance data

	Cooling	(1)	Heating	(1)
Gross capacity	276.38 kW		202.90 kW	
Net capacity	276.05 kW			
Gross unit power	84.04 kW		91.83 kW	
Gross EER / COP	3.29 EER (kW/kW)		2.21	
Net EER / COP	3.25 EER (kW/kW)		2.20	
Design flow rate	13.17 L/s		9.81 L/s	
Evaporator Pressure drop (Design)	30.5 kPa		17.0 kPa	
Evaporator Min Flow	6.60 L/s		6.60 L/s	
Evaporator Max Flow	29.80 L/s		29.80 L/s	

Acoustic data

Outdoor sound power level	85 dBA	(4)
Outdoor sound pressure level	53 dBA	(3)

General data - refrigerant circuit

Refrigerant Type	Full charge R410A	
Refrigerant GWP (AR5)	2088.00	
Number of circuits	2	
Number of compressors (circuit 1 / 2… n)	4	
Compressor type	Scroll	
Compressor regulation type	Fixed Speed	
Oil charge per circuit	17 kg	
Refrigerant charge per circuit	49 kg	49 kg

General data - fan section

Number of outdoor fans	8
Fan type	EC fans
Total condenser air flow	36.67 m3/s

Electrical Information

Electrical supply	400/50/3
Current	139.19 kW
Compressor soft starter	Not Included
Start-up current	422.00 A
Max amps	208.20 A
Maximum power at maximum current	126.80 kW

Dimensions and weight

Length	4520 mm
Width	2200 mm
Height	2530 mm
Unit shipping weight	2930 kg
Operating weight	3000 kg

Note: Dimensions and weight include sound attenuation, hydraulic module, heat recovery and/or free cooling - if selected. Image is for illustration purposes only, options may not be shown.

Applicable standards

(1) According to EN14825:2018, considering average climate
(2) According to EN14511:2018
(3) Average sound pressure at 10 meter distance, unit in a free field on a reflective surface; non-binding value calculated from the sound power level
(4) Sound power measurements in accordance with ISO 9613
(5) Performance rating out of scope of Eurovent certification program

More information

Ecodesign datasheet	https://www.trane.com/litweb/Litweb.aspx?#/category/bd13efa5-a5bf-4f0a-afb4-9eab178d9081/range/a1a2a06b-b5ae-492a-bc17-b8ada8833fac/model/8234b149-20ff-41a9-9c2b-e189f8956901/section/1494a047-4efa-4319-a8cd-21fc4fa83daa
Model Number	CXAF080DE**R*2E1WWNBNBXXXBXEBAF1XLXXXXXXX1EXAXXXXXAXXAA2XX

Heating Mode

Heating: Ambient = -5 C. Water temperatures = 47/52

CXAF model	80	90	100	110	130	140	150	165	180	190	
Fluid Entering Temp	47	47	47	47	47	47	47	47	47	47	C
Fluid Leaving Temp	52	52	52	52	52	52	52	52	52	52	C
Ambient Temp	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	C
Gross heating capacity	202.67	227.08	253.57	285.57	317.5	347.84	373.04	402.64	443.1	474.12	Kw
Heating net capacity	202.9	227.38	253.87	285.88	317.83	348.19	373.4	402.95	443.43	474.46	Kw
Gross COP	2.21	2.19	2.19	2.21	2.22	2.17	2.16	2.16	2.21	2.21	Kw
Net COP	2.2	2.18	2.19	2.2	2.21	2.16	2.15	2.15	2.21	2.2	Kw
SCOP	3.94	3.89	3.87	3.85	3.85	3.79	3.74	3.71	3.83	3.78	Kw/Kw

Please note: 52 deg C is the highest leaving water temp this unit can achieve at -5 deg C ambient.

Appendix H: Be Green SAP Results and BRUKL.

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	009163	**Issued on Date**	27/10/2021
Assessment Reference	Be Green PV	**Prop Type Ref**	B1_01_04 (M)
Property			

SAP Rating	82 B	**DER**	18.72	**TER**	29.27
Environmental	87 B	**% DER<TER**	36.04		
CO_2 Emissions (t/year)	0.88	**DFEE**	42.45	**TFEE**	50.99
General Requirements Compliance	Pass	**% DFEE<TFEE**	16.75		

Assessor Details	Mr. Liam Holden, Liam Holden, Tel: 01202 654600, liamholden@hoarelea.com	**Assessor ID**	P624-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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----------------------------------------------------------------------------------------------------
REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Mid-floor flat, total floor area 52 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
----------------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Electricity (c)
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 29.27 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 18.72 kgCO□/m²OK
----------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)51.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)42.4 kWh/m²/yrOK
----------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                 Highest
External wall   0.13 (max. 0.30)        0.13 (max. 0.70)           OK
Party wall      0.00 (max. 0.20)         -                         OK
Floor           0.10 (max. 0.25)        0.10 (max. 0.70)           OK
Roof            (no roof)
Openings        1.17 (max. 2.00)        1.20 (max. 3.30)           OK
----------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
----------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:         3.00 (design value)
Maximum                                 10.0                                              OK
----------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                    Community heating scheme                          -

Secondary heating system:               None
----------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                       Measured cylinder loss: 1.85 kWh/day
Permitted by DBSCG 1.89                           OK
Primary pipework insulated:             Yes (assumed)                                     OK
----------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                 Charging system linked to use of community heating, programmer and TRVsOK


Hot water controls:                     Cylinderstat                                      OK


----------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                 75%                                               OK
----------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power:                     0.62
Maximum                                 1.5                                               OK
MVHR efficiency:                        94%
Minimum:                                70%                                               OK
----------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Thames Valley):       Slight                                            OK
Based on:
Overshading:                            Average
Windows facing North East:              6.50 m², Overhang width less than twice window, ratio 0.81
Windows facing South East:              5.58 m², No overhang
Air change rate:                        6.00 ach
Blinds/curtains:                        Dark-coloured curtain or roller blind, closed 100% of daylight hours
----------------------------------------------------------------------------------------------------
10 Key features
External wall U-value                   0.13 W/m²K
External wall U-value                   0.13 W/m²K
Party wall U-value                      0.00 W/m²K
Floor U-value                           0.10 W/m²K
Door U-value                            1.00 W/m²K
Air permeability                        3.0 m³/m²h
Photovoltaic array                      0.16 kW




----------------------------------------------------------------------------------------------------
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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----------------------------------------------------------------------------------------------------
SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE      09 Jan 2014
----------------------------------------------------------------------------------------------------
----------------------------------------------------------------------------------------------------



----------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
----------------------------------------------------------------------------------------------------
                                                                                                Area         Storey height                Volume
                                                                                                (m2)                (m)                    (m3)
Ground floor                                                                                 52.0100 (1b)    x       2.6000 (2b)    =     135.2260 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)                52.0100                                                              (4)
Dwelling volume                                                                                     (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =     135.2260 (5)



----------------------------------------------------------------------------------------------------
2. Ventilation rate
----------------------------------------------------------------------------------------------------
                                                                  main          secondary              other              total        m3 per hour
                                                               heating            heating
Number of chimneys                                                   0      +           0      +           0      =           0 * 40 =      0.0000 (6a)
Number of open flues                                                 0      +           0      +           0      =           0 * 20 =      0.0000 (6b)
Number of intermittent fans                                                                                                   0 * 10 =      0.0000 (7a)
Number of passive vents                                                                                                       0 * 10 =      0.0000 (7b)
Number of flueless gas fires                                                                                                  0 * 40 =      0.0000 (7c)

                                                                                                                            Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                                          0.0000 / (5) =       0.0000 (8)
Pressure test                                                                                                                                  Yes
Measured/design AP50                                                                                                                        3.0000
Infiltration rate                                                                                                                           0.1500 (18)
Number of sides sheltered                                                                                                                        2 (19)

Shelter factor                                                                                      (20) =  1  -  [0.075 x (19)]  =       0.8500 (20)
Infiltration rate adjusted to include shelter factor                                                          (21) = (18) x (20)  =       0.1275 (21)


                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Wind speed       5.1000     5.0000     4.9000     4.4000     4.3000     3.8000     3.8000     3.7000     4.0000     4.3000     4.5000     4.7000 (22)
Wind factor      1.2750     1.2500     1.2250     1.1000     1.0750     0.9500     0.9500     0.9250     1.0000     1.0750     1.1250     1.1750 (22a)
Adj infilt rate
                 0.1626     0.1594     0.1562     0.1403     0.1371     0.1211     0.1211     0.1179     0.1275     0.1371     0.1434     0.1498 (22b)
 Balanced mechanical ventilation with heat recovery
If mechanical ventilation:                                                                                                                  0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =                                               79.9000 (23c)

Effective ac     0.2631     0.2599     0.2567     0.2408     0.2376     0.2216     0.2216     0.2184     0.2280     0.2376     0.2439     0.2503 (25)



----------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
----------------------------------------------------------------------------------------------------
Element                                          Gross       Openings         NetArea         U-value          A x U         K-value          A x K
                                                    m2             m2              m2           W/m2K            W/K          kJ/m2K           kJ/K
Door                                                                           2.1400          1.0000         2.1400                                (26)
Window (Uw = 1.20)                                                            12.0800          1.1450        13.8321                                (27)
Heat Loss Floor 1                                                             49.4200          0.1000         4.9420                                (28a)
External Wall 1                                41.5800        12.0800         29.5000          0.1300         3.8350                                (29a)
Sheltered wall                                  9.0200         2.1400          6.8800          0.1236         0.8502                                (29a)
Total net area of external elements Aum(A, m2)                               100.0200                                                             (31)
Fabric heat loss, W/K = Sum (A x U)                                                 (26)...(30) + (32) =     25.5993                                (33)
Party Wall 1                                                                  32.5600          0.0000         0.0000                                (32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                                         175.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                                                  6.4922 (36)
Total fabric heat loss                                                                                                 (33) + (36) =       32.0915 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(38)m           11.7391    11.5968    11.4546    10.7434    10.6011     9.8899     9.8899     9.7477    10.1744    10.6011    10.8856    11.1701 (38)
Heat transfer coeff
                43.8305    43.6883    43.5460    42.8348    42.6926    41.9814    41.9814    41.8391    42.2659    42.6926    42.9771    43.2615 (39)
Average = Sum(39)m / 12 =                                                                                                                  42.7993 (39)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP              0.8427     0.8400     0.8373     0.8236     0.8209     0.8072     0.8072     0.8044     0.8126     0.8209     0.8263     0.8318 (40)
HLP (average)                                                                                                                               0.8229 (40)
Days in month
                     31         28         31         30         31         30         31         31         30         31         30         31 (41)



----------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
----------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                                           1.7494 (42)
Average daily hot water use (litres/day)                                                                                                   75.7474 (43)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
                83.3222    80.2923    77.2624    74.2325    71.2026    68.1727    68.1727    71.2026    74.2325    77.2624    80.2923    83.3222 (44)
Energy conte   123.5644   108.0702   111.5188    97.2248    93.2895    80.5017    74.5967    85.6008    86.6231   100.9509   110.1958   119.6655 (45)
Energy content (annual)                                                                                          Total = Sum(45)m =      1191.8022 (45)
Distribution loss  (46)m = 0.15 x (45)m
                18.5347    16.2105    16.7278    14.5837    13.9934    12.0753    11.1895    12.8401    12.9935    15.1426    16.5294    17.9498 (46)
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

```
Water storage loss:
Store volume                                                                                                                            150.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                             1.8500 (48)
  Temperature factor from Table 2b                                                                                                        0.6000 (49)
Enter (49) or (54) in (55)                                                                                                                1.1100 (55)
Total storage loss
                34.4100    31.0800    34.4100    33.3000    34.4100    33.3000    34.4100    34.4100    33.3000    34.4100    33.3000    34.4100 (56)
If cylinder contains dedicated solar storage
                34.4100    31.0800    34.4100    33.3000    34.4100    33.3000    34.4100    34.4100    33.3000    34.4100    33.3000    34.4100 (57)
Primary loss    23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
               181.2368   160.1614   169.1912   153.0368   150.9619   136.3137   132.2691   143.2732   142.4351   158.6233   166.0078   177.3379 (62)
Solar input      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                            Solar input (sum of months) = Sum(63)m =      0.0000 (63)
Output from w/h
               181.2368   160.1614   169.1912   153.0368   150.9619   136.3137   132.2691   143.2732   142.4351   158.6233   166.0078   177.3379 (64)
                                                                                              Total per year (kWh/year) = Sum(64)m =   1870.8482 (64)
Heat gains from water heating, kWh/month
                87.2231    77.6063    83.2179    76.9768    77.1567    71.4164    70.9413    74.6002    73.4518    79.7041    81.2897    85.9267 (65)



----------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
----------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m           87.4683    87.4683    87.4683    87.4683    87.4683    87.4683    87.4683    87.4683    87.4683    87.4683    87.4683    87.4683 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                13.5905    12.0710     9.8168     7.4319     5.5555     4.6902     5.0679     6.5874     8.8416    11.2265    13.1029    13.9682 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               152.4519   154.0338   150.0473   141.5605   130.8474   120.7786   114.0520   112.4700   116.4565   124.9434   135.6565   145.7253 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                31.7468    31.7468    31.7468    31.7468    31.7468    31.7468    31.7468    31.7468    31.7468    31.7468    31.7468    31.7468 (69)
Pumps, fans      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
               -69.9746   -69.9746   -69.9746   -69.9746   -69.9746   -69.9746   -69.9746   -69.9746   -69.9746   -69.9746   -69.9746   -69.9746 (71)
Water heating gains (Table 5)
               117.2353   115.4856   111.8520   106.9123   103.7052    99.1895    95.3512   100.2691   102.0164   107.1292   112.9024   115.4929 (72)
Total internal gains
               332.5182   330.8309   320.9566   305.1452   289.3485   273.8987   263.7116   268.5670   276.5550   292.5395   310.9023   324.4269 (73)



----------------------------------------------------------------------------------------------------
6. Solar gains
----------------------------------------------------------------------------------------------------

[Jan]                                        Area        Solar flux                  g                 FF             Access              Gains
                                               m2          Table 6a      Specific data      Specific data             factor                  W
                                                               W/m2        or Table 6b        or Table 6c          Table 6d
----------------------------------------------------------------------------------------------------
Northeast                                  6.5000           11.2829             0.3500             0.7700             0.7700            13.6971 (75)
Southeast                                  5.5800           36.7938             0.3500             0.7700             0.7700            38.3443 (77)
----------------------------------------------------------------------------------------------------

Solar gains     52.0414    93.1954   139.5986   193.2250   234.9165   241.3501   229.3029   196.9559   157.9736   106.2591    63.1621    44.0005 (83)
Total gains    384.5596   424.0263   460.5552   498.3702   524.2650   515.2488   493.0145   465.5229   434.5287   398.7986   374.0644   368.4274 (84)



----------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
----------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                              21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau             57.6827    57.8706    58.0596    59.0236    59.2202    60.2235    60.2235    60.4282    59.8181    59.2202    58.8282    58.4414
alpha            4.8455     4.8580     4.8706     4.9349     4.9480     5.0149     5.0149     5.0285     4.9879     4.9480     4.9219     4.8961
util living area
                 0.9785     0.9642     0.9310     0.8474     0.6999     0.5117     0.3730     0.4106     0.6379     0.8732     0.9602     0.9820 (86)

MIT             20.0914    20.2470    20.4816    20.7536    20.9226    20.9871    20.9978    20.9966    20.9628    20.7540    20.3889    20.0649 (87)
Th 2            20.2165    20.2188    20.2212    20.2329    20.2353    20.2471    20.2471    20.2495    20.2424    20.2353    20.2306    20.2259 (88)
util rest of house
                 0.9742     0.9571     0.9176     0.8204     0.6555     0.4550     0.3100     0.3449     0.5782     0.8445     0.9512     0.9783 (89)
MIT 2           19.0079    19.2326    19.5659    19.9450    20.1572    20.2372    20.2460    20.2476    20.2108    19.9547    19.4471    18.9769 (90)
Living area fraction                                                                                       fLA = Living area / (4) =      0.5816 (91)
MIT             19.6381    19.8226    20.0985    20.4153    20.6024    20.6733    20.6833    20.6832    20.6482    20.4196    19.9949    19.6097 (92)
Temperature adjustment                                                                                                                    0.0000
adjusted MIT    19.6381    19.8226    20.0985    20.4153    20.6024    20.6733    20.6833    20.6832    20.6482    20.4196    19.9949    19.6097 (93)



----------------------------------------------------------------------------------------------------
8. Space heating requirement
----------------------------------------------------------------------------------------------------

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation      0.9703     0.9530     0.9153     0.8272     0.6773     0.4874     0.3466     0.3830     0.6108     0.8519     0.9480     0.9747 (94)
Useful gains   373.1349   404.0815   421.5433   412.2452   355.0950   251.1294   170.8609   178.2954   265.4105   339.7559   354.6012   359.1078 (95)
Ext temp.        4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
               672.2774   651.9430   592.1603   493.2545   380.0659   254.9669   171.4213   179.2050   276.7634   419.2229   554.1837   666.6475 (97)
Month fracti     1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
               222.5620   166.5629   126.9391    58.3267    18.5783     0.0000     0.0000     0.0000     0.0000    59.1235   143.6993   228.8095 (98)
Space heating                                                                                                                          1024.6013 (98)
Space heating per m2                                                                                                    (98) / (4) =     19.7001 (99)


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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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8c. Space cooling requirement
----------------------------------------------------------------------------------------------------
Not applicable



----------------------------------------------------------------------------------------------------
9b. Energy requirements
----------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                                                                  0.0000 (301)
Fraction of space heat from community system                                                                                           1.0000 (302)
Fraction of heat from community Heat pump                                                                                              1.0000 (303a)
Fraction of total space heat from community Heat pump                                                                                  1.0000 (304a)
Factor for control and charging method (Table 4c(3)) for community space heating                                                       1.0000 (305)
Distribution loss factor (Table 12c) for community heating system                                                                      1.2900 (306)
Space heating:
Annual space heating requirement                                                                                                    1024.6013 (98)
Space heat from Heat pump = (98) x 1.00 x 1.05 x 1.29                                                                               1321.7357 (307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)                                                 0.0000 (308)
Space heating fuel for secondary/supplementary system                                                                                  0.0000 (309)

Water heating
Annual water heating requirement                                                                                                    1870.8482 (64)
Fraction of heat from community Heat pump                                                                                              1.0000 (303a)
Factor for control and charging method (Table 4c(3)) for community water heating                                                       1.0500 (305a)
Distribution loss factor (Table 12c) for community heating system                                                                      1.2900 (306)
Water heat from Heat pump = (64) x 1.00 x 1.05 x 1.29                                                                               2534.0639 (310a)
Electricity used for heat distribution (space)                                                                                        13.2174 (313)
Electricity used for heat distribution (water)                                                                                        25.3406 (313)
Annual totals kWh/year

Electricity for pumps and fans:
    (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7750)
   mechanical ventilation fans (SFP =       0.7750)                                                                                  127.8562 (330a)
Total electricity for the above, kWh/year                                                                                            127.8562 (331)
Electricity for lighting (calculated in Appendix L)                                                                                  240.0129 (332)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 0.16 * 1080 * 0.80) =                                                                 -110.5433              -110.5433 (333)
Total delivered energy for all uses                                                                                                 4113.1253 (338)



----------------------------------------------------------------------------------------------------
12b. Carbon dioxide emissions - Community heating scheme
----------------------------------------------------------------------------------------------------
                                                                                         Energy      Emission factor           Emissions
                                                                                       kWh/year           kg CO2/kWh         kg CO2/year
Efficiency of heat source Heat pump                                                                                        378.0000 (367a)
Space heating from Heat pump                                                           349.6655               0.5190       181.4764 (367)
Efficiency of heat source Heat pump                                                                                        206.0000 (367a)
Space heating from Heat pump                                                          1230.1281               0.5190       638.4365 (367)
Electrical energy for heat distribution (space)                                          13.2174               0.5190         6.8598 (372)
Electrical energy for heat distribution (water)                                          25.3406               0.5190        13.1518 (372)
Total CO2 associated with community systems                                                                                839.9245 (373)
 (negative value allowed since DFEE <= TFEE)
Space and water heating                                                                                                    839.9245 (376)
Pumps and fans                                                                          127.8562               0.5190        66.3574 (378)
Energy for lighting                                                                     240.0129               0.5190       124.5667 (379)

 Energy saving/generation technologies
PV Unit                                                                                -110.5433               0.5190       -57.3720 (380)
Total CO2, kg/year                                                                                                         973.4765 (383)
Dwelling Carbon Dioxide Emission Rate (DER)                                                                                 18.7200 (384)


16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES
DER                                                                                                                         18.7200 ZC1
Total Floor Area                                                                                                    TFA     52.0100
Assumed number of occupants                                                                                           N      1.7494
CO2 emission factor in Table 12 for electricity displaced from grid                                                  EF      0.5190
CO2 emissions from appliances, equation (L14)                                                                               17.3697 ZC2
CO2 emissions from cooking, equation (L16)                                                                                   3.0953 ZC3
Total CO2 emissions                                                                                                         39.1850 ZC4
Residual CO2 emissions offset from biofuel CHP                                                                               0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year                                                                     0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation                                              0.0000 ZC7
Net CO2 emissions                                                                                                           39.1850 ZC8


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FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	009166	**Issued on Date**	27/10/2021
Assessment Reference	Be Green PV	**Prop Type Ref**	C1_11_04 (T)
Property			

SAP Rating	81 B	**DER**	18.22	**TER**	30.33
Environmental	86 B	**% DER<TER**	39.92		
CO₂ Emissions (t/year)	1.14	**DFEE**	52.38	**TFEE**	62.96
General Requirements Compliance	Pass	**% DFEE<TFEE**	16.81		

Assessor Details	Mr. Liam Holden, Liam Holden, Tel: 01202 654600, liamholden@hoarelea.com	**Assessor ID**	P624-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Top-floor flat, total floor area 71 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
----------------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Electricity (c)
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 30.33 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 18.22 kgCO□/m²OK
----------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)63.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)52.4 kWh/m²/yrOK
----------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                 Highest
External wall   0.13 (max. 0.30)        0.13 (max. 0.70)           OK
Party wall      0.00 (max. 0.20)         -                         OK
Floor           (no floor)
Roof            0.10 (max. 0.20)        0.10 (max. 0.35)           OK
Openings        1.18 (max. 2.00)        1.20 (max. 3.30)           OK
----------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
----------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:         3.00 (design value)
Maximum                                 10.0                                              OK
----------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                    Community heating scheme                          -

Secondary heating system:               None
----------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                       Measured cylinder loss: 1.85 kWh/day
Permitted by DBSCG 1.89                           OK
Primary pipework insulated:             Yes (assumed)                                     OK
----------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                 Charging system linked to use of community heating, programmer and TRVsOK


Hot water controls:                     Cylinderstat                                      OK


----------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                 75%                                               OK
----------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power:                     0.62
Maximum                                 1.5                                               OK
MVHR efficiency:                        94%
Minimum:                                70%                                               OK
----------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Thames Valley):       Not significant                                   OK
Based on:
Overshading:                            Average
Windows facing South East:              4.55 m², No overhang
Windows facing South West:              7.25 m², No overhang
Windows facing North West:              4.05 m², Overhang width less than twice window, ratio 0.86
Air change rate:                        6.00 ach
Blinds/curtains:                        Dark-coloured curtain or roller blind, closed 100% of daylight hours
----------------------------------------------------------------------------------------------------
10 Key features
External wall U-value                   0.13 W/m²K
External wall U-value                   0.13 W/m²K
Party wall U-value                      0.00 W/m²K
Roof U-value                            0.10 W/m²K
Door U-value                            1.00 W/m²K
Air permeability                        3.0 m³/m²h
Photovoltaic array                      0.22 kW



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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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----------------------------------------------------------------------------------------------------
SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE      09 Jan 2014
----------------------------------------------------------------------------------------------------
----------------------------------------------------------------------------------------------------



----------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
----------------------------------------------------------------------------------------------------
                                                                                   Area         Storey height                Volume
                                                                                   (m2)              (m)                      (m3)
Ground floor                                                                    70.9900 (1b)    x       2.7500 (2b)    =    195.2225 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)               70.9900                                                  (4)
Dwelling volume                                                                       (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =    195.2225 (5)



----------------------------------------------------------------------------------------------------
2. Ventilation rate
----------------------------------------------------------------------------------------------------
                                                                  main           secondary              other              total        m3 per hour
                                                               heating             heating
Number of chimneys                                                   0       +           0       +          0       =          0 * 40 =      0.0000 (6a)
Number of open flues                                                 0       +           0       +          0       =          0 * 20 =      0.0000 (6b)
Number of intermittent fans                                                                                                    0 * 10 =      0.0000 (7a)
Number of passive vents                                                                                                        0 * 10 =      0.0000 (7b)
Number of flueless gas fires                                                                                                   0 * 40 =      0.0000 (7c)

                                                                                                                            Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                                         0.0000 / (5) =      0.0000 (8)
Pressure test                                                                                                                                  Yes
Measured/design AP50                                                                                                                        3.0000
Infiltration rate                                                                                                                           0.1500 (18)
Number of sides sheltered                                                                                                                        2 (19)

Shelter factor                                                                                        (20) = 1  -  [0.075 x (19)]  =      0.8500 (20)
Infiltration rate adjusted to include shelter factor                                                            (21) = (18) x (20)  =      0.1275 (21)


                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Wind speed       5.1000     5.0000     4.9000     4.4000     4.3000     3.8000     3.8000     3.7000     4.0000     4.3000     4.5000     4.7000 (22)
Wind factor      1.2750     1.2500     1.2250     1.1000     1.0750     0.9500     0.9500     0.9250     1.0000     1.0750     1.1250     1.1750 (22a)
Adj infilt rate
                 0.1626     0.1594     0.1562     0.1403     0.1371     0.1211     0.1211     0.1179     0.1275     0.1371     0.1434     0.1498 (22b)
 Balanced mechanical ventilation with heat recovery
If mechanical ventilation:                                                                                                                  0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =                                               79.9000 (23c)

Effective ac     0.2631     0.2599     0.2567     0.2408     0.2376     0.2216     0.2216     0.2184     0.2280     0.2376     0.2439     0.2503 (25)



----------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
----------------------------------------------------------------------------------------------------
Element                                           Gross        Openings          NetArea         U-value            A x U        K-value          A x K
                                                     m2              m2               m2            W/m2K              W/K         kJ/m2K           kJ/K
Door                                                                              2.1400          1.0000           2.1400                                (26)
Window (Uw = 1.20)                                                               15.8500          1.1450          18.1489                                (27)
External Wall 1                                 50.1200         15.8500          34.2700          0.1300           4.4551                                (29a)
Sheltered wall                                  37.2300          2.1400          35.0900          0.1231           4.3202                                (29a)
External Roof 1                                 52.8400                          52.8400          0.1000           5.2840                                (30)
Total net area of external elements Aum(A, m2)                                  140.1900                                                                 (31)
Fabric heat loss, W/K = Sum (A x U)                                                 (26)...(30) + (32) =      34.3482                                (33)
Party Wall 1                                                                     17.1700          0.0000           0.0000                                (32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                                         175.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                                                 21.5169 (36)
Total fabric heat loss                                                                                                    (33) + (36) =     55.8651 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(38)m           16.9474    16.7420    16.5367    15.5099    15.3046    14.2778    14.2778    14.0725    14.6885    15.3046    15.7153    16.1260 (38)
Heat transfer coeff
                72.8124    72.6071    72.4017    71.3750    71.1696    70.1429    70.1429    69.9375    70.5536    71.1696    71.5803    71.9910 (39)
Average = Sum(39)m / 12 =                                                                                                                  71.3237 (39)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP              1.0257     1.0228     1.0199     1.0054     1.0025     0.9881     0.9881     0.9852     0.9939     1.0025     1.0083     1.0141 (40)
HLP (average)                                                                                                                               1.0047 (40)
Days in month
                     31         28         31         30         31         30         31         31         30         31         30         31 (41)



----------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
----------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                                           2.2699 (42)
Average daily hot water use (litres/day)                                                                                                   88.1105 (43)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
                96.9216    93.3972    89.8728    86.3483    82.8239    79.2995    79.2995    82.8239    86.3483    89.8728    93.3972    96.9216 (44)
Energy conte   143.7319   125.7089   129.7203   113.0933   108.5157    93.6408    86.7720    99.5721   100.7613   117.4276   128.1814   139.1967 (45)
Energy content (annual)                                                                                           Total = Sum(45)m =     1386.3220 (45)
Distribution loss  (46)m = 0.15 x (45)m
                21.5598    18.8563    19.4580    16.9640    16.2774    14.0461    13.0158    14.9358    15.1142    17.6141    19.2272    20.8795 (46)
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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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Water storage loss:
Store volume                                                                                                                        150.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                         1.8500 (48)
  Temperature factor from Table 2b                                                                                                    0.6000 (49)
Enter (49) or (54) in (55)                                                                                                            1.1100 (55)
Total storage loss
                34.4100    31.0800    34.4100    33.3000    34.4100    33.3000    34.4100    34.4100    33.3000    34.4100    33.3000    34.4100 (56)
If cylinder contains dedicated solar storage
                34.4100    31.0800    34.4100    33.3000    34.4100    33.3000    34.4100    34.4100    33.3000    34.4100    33.3000    34.4100 (57)
Primary loss    23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
               201.4043   177.8001   187.3927   168.9053   166.1881   149.4528   144.4444   157.2445   156.5733   175.1000   183.9934   196.8691 (62)
Solar input      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                          Solar input (sum of months) = Sum(63)m =     0.0000 (63)
Output from w/h
               201.4043   177.8001   187.3927   168.9053   166.1881   149.4528   144.4444   157.2445   156.5733   175.1000   183.9934   196.8691 (64)
                                                                                             Total per year (kWh/year) = Sum(64)m =  2065.3680 (64)
Heat gains from water heating, kWh/month
                93.9288    83.4712    89.2699    82.2531    82.2194    75.7852    74.9896    79.2456    78.1527    85.1826    87.2699    92.4208 (65)


----------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
----------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          113.4959   113.4959   113.4959   113.4959   113.4959   113.4959   113.4959   113.4959   113.4959   113.4959   113.4959   113.4959 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                17.8178    15.8257    12.8703     9.7436     7.2835     6.1490     6.6442     8.6364    11.5918    14.7184    17.1786    18.3131 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               199.5965   201.6677   196.4484   185.3371   171.3110   158.1285   149.3218   147.2506   152.4699   163.5812   177.6073   190.7898 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                34.3496    34.3496    34.3496    34.3496    34.3496    34.3496    34.3496    34.3496    34.3496    34.3496    34.3496    34.3496 (69)
Pumps, fans      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
               -90.7967   -90.7967   -90.7967   -90.7967   -90.7967   -90.7967   -90.7967   -90.7967   -90.7967   -90.7967   -90.7967   -90.7967 (71)
Water heating gains (Table 5)
               126.2484   124.2130   119.9864   114.2404   110.5099   105.2572   100.7925   106.5130   108.5455   114.4927   121.2082   124.2215 (72)
Total internal gains
               400.7115   398.7552   386.3539   366.3699   346.1532   326.5835   313.8073   319.4488   329.6559   349.8412   373.0429   390.3732 (73)


----------------------------------------------------------------------------------------------------
6. Solar gains
----------------------------------------------------------------------------------------------------
[Jan]                                         Area         Solar flux              g                FF              Access            Gains
                                               m2            Table 6a      Specific data      Specific data          factor               W
                                                                 W/m2        or Table 6b        or Table 6c        Table 6d
----------------------------------------------------------------------------------------------------
Southeast                                   4.5500            36.7938             0.3500             0.7700          0.7700          31.2664 (77)
Southwest                                   7.2500            36.7938             0.3500             0.7700          0.7700          49.8202 (79)
Northwest                                   4.0500            11.2829             0.3500             0.7700          0.7700           8.5343 (81)
----------------------------------------------------------------------------------------------------

Solar gains     89.6209   155.4923   220.2810   285.5597   331.3703   334.0412   319.9426   284.9911   242.7658   173.8823   107.8614    76.3628 (83)
Total gains    490.3324   554.2475   606.6349   651.9296   677.5235   660.6246   633.7499   604.4399   572.4218   523.7235   480.9043   466.7360 (84)


----------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
----------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                          21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau             47.3944    47.5285    47.6633    48.3489    48.4884    49.1982    49.1982    49.3426    48.9118    48.4884    48.2102    47.9352
alpha            4.1596     4.1686     4.1776     4.2233     4.2326     4.2799     4.2799     4.2895     4.2608     4.2326     4.2140     4.1957
util living area
                 0.9862     0.9761     0.9546     0.9029     0.7993     0.6316     0.4752     0.5150     0.7392     0.9191     0.9753     0.9886 (86)

MIT             19.6910    19.8768    20.1575    20.5060    20.7837    20.9429    20.9866    20.9812    20.8853    20.5348    20.0560    19.6592 (87)
Th 2            20.0620    20.0644    20.0668    20.0788    20.0812    20.0933    20.0933    20.0957    20.0885    20.0812    20.0764    20.0716 (88)
util rest of house
                 0.9831     0.9708     0.9443     0.8804     0.7542     0.5576     0.3825     0.4211     0.6716     0.8957     0.9689     0.9860 (89)
MIT 2           18.3196    18.5895    18.9936    19.4898    19.8561    20.0485    20.0864    20.0854    19.9881    19.5398    18.8594    18.2802 (90)
Living area fraction                                                                                  fLA = Living area / (4) =     0.3775 (91)
MIT             18.8373    19.0755    19.4330    19.8734    20.2063    20.3861    20.4263    20.4235    20.3268    19.9154    19.3111    18.8008 (92)
Temperature adjustment                                                                                                              0.0000
adjusted MIT    18.8373    19.0755    19.4330    19.8734    20.2063    20.3861    20.4263    20.4235    20.3268    19.9154    19.3111    18.8008 (93)


----------------------------------------------------------------------------------------------------
8. Space heating requirement
----------------------------------------------------------------------------------------------------

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation      0.9777     0.9636     0.9358     0.8747     0.7608     0.5825     0.4172     0.4560     0.6906     0.8908     0.9620     0.9813 (94)
Useful gains   479.4079   534.0454   567.6774   570.2522   515.4752   384.7935   264.4294   275.6339   395.3062   466.5103   462.6528   458.0015 (95)
Ext temp.        4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
              1058.4978  1029.2414   936.3707   783.2278   605.3881   405.8561   268.3846   281.3968   439.3240   662.9747   874.0776  1051.1259 (97)
Month fracti     1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
               430.8429   332.7717   274.3078   153.3424    66.8952     0.0000     0.0000     0.0000     0.0000   146.1695   296.2258   441.2845 (98)
Space heating                                                                                                                    2141.8399 (98)
Space heating per m2                                                                                           (98) / (4) =     30.1710 (99)
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----------------------------------------------------------------------------------------------------
8c. Space cooling requirement
----------------------------------------------------------------------------------------------------
Not applicable



----------------------------------------------------------------------------------------------------
9b. Energy requirements
----------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                                                                     0.0000 (301)
Fraction of space heat from community system                                                                                              1.0000 (302)
Fraction of heat from community Heat pump                                                                                                 1.0000 (303a)
Fraction of total space heat from community Heat pump                                                                                     1.0000 (304a)
Factor for control and charging method (Table 4c(3)) for community space heating                                                          1.0000 (305)
Distribution loss factor (Table 12c) for community heating system                                                                         1.2900 (306)
Space heating:
Annual space heating requirement                                                                                                       2141.8399 (98)
Space heat from Heat pump = (98) x 1.00 x 1.05 x 1.29                                                                                  2762.9735 (307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)                                                   0.0000 (308)
Space heating fuel for secondary/supplementary system                                                                                     0.0000 (309)

Water heating
Annual water heating requirement                                                                                                       2065.3680 (64)
Fraction of heat from community Heat pump                                                                                                 1.0000 (303a)
Factor for control and charging method (Table 4c(3)) for community water heating                                                          1.0500 (305a)
Distribution loss factor (Table 12c) for community heating system                                                                         1.2900 (306)
Water heat from Heat pump = (64) x 1.00 x 1.05 x 1.29                                                                                  2797.5410 (310a)
Electricity used for heat distribution (space)                                                                                           27.6297 (313)
Electricity used for heat distribution (water)                                                                                           27.9754 (313)
Annual totals kWh/year

Electricity for pumps and fans:
    (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7750)
   mechanical ventilation fans (SFP =       0.7750)                                                                                     184.5829 (330a)
Total electricity for the above, kWh/year                                                                                               184.5829 (331)
Electricity for lighting (calculated in Appendix L)                                                                                     314.6687 (332)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 0.22 * 1080 * 0.80) =                                                                          -151.9971             -151.9971 (333)
Total delivered energy for all uses                                                                                                    5907.7691 (338)



----------------------------------------------------------------------------------------------------
12b. Carbon dioxide emissions - Community heating scheme
----------------------------------------------------------------------------------------------------
                                                                                              Energy       Emission factor             Emissions
                                                                                            kWh/year            kg CO2/kWh           kg CO2/year
Efficiency of heat source Heat pump                                                                                                     378.0000 (367a)
Space heating from Heat pump                                                                730.9454                0.5190              379.3607 (367)
Efficiency of heat source Heat pump                                                                                                     206.0000 (367a)
Space heating from Heat pump                                                               1358.0296                0.5190              704.8174 (367)
Electrical energy for heat distribution (space)                                              27.6297                0.5190               14.3398 (372)
Electrical energy for heat distribution (water)                                              27.9754                0.5190               14.5192 (372)
Total CO2 associated with community systems                                                                                            1113.0371 (373)
 (negative value allowed since DFEE <= TFEE)
Space and water heating                                                                                                                1113.0371 (376)
Pumps and fans                                                                              184.5829                0.5190               95.7985 (378)
Energy for lighting                                                                         314.6687                0.5190              163.3131 (379)

 Energy saving/generation technologies
PV Unit                                                                                    -151.9971                0.5190              -78.8865 (380)
Total CO2, kg/year                                                                                                                     1293.2622 (383)
Dwelling Carbon Dioxide Emission Rate (DER)                                                                                              18.2200 (384)


16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES
DER                                                                                                                                      18.2200 ZC1
Total Floor Area                                                                                                                 TFA     70.9900
Assumed number of occupants                                                                                                         N     2.2699
CO2 emission factor in Table 12 for electricity displaced from grid                                                                EF     0.5190
CO2 emissions from appliances, equation (L14)                                                                                            16.6610 ZC2
CO2 emissions from cooking, equation (L16)                                                                                                2.4437 ZC3
Total CO2 emissions                                                                                                                      37.3247 ZC4
Residual CO2 emissions offset from biofuel CHP                                                                                            0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year                                                                                  0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation                                                           0.0000 ZC7
Net CO2 emissions                                                                                                                        37.3247 ZC8


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BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Holloway Prison - Retail Unit (Be Green) As designed

Date: Thu Sep 23 08:51:31 2021

Administrative information

Building Details

Address: London,

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.13

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.13

BRUKL compliance check version: v5.6.b.0

Certifier details

Name: Hoare Lea

Telephone number: 01202 654600

Address: Enterprise House, Old School Cl, Ferndown,
Bournemouth, BH22 9UN

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	33.4
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	33.4
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	29.6
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	0.13	0.13	L0000064:Surf[2]
Floor	0.25	0.1	0.1	L0000064:Surf[20]
Roof	0.25	-	-	UNKNOWN
Windows***, roof windows, and rooflights	2.2	1.2	1.2	L0000064:Surf[1]
Personnel doors	2.2	-	-	No Personnel doors in building
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

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	>0.95

1- HP - VRF + AHU

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	4.2	3.5	0	0	0.9
Standard value	2.5*	2.6	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

1- HP - DHW

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	2.3	-
Standard value	1	N/A

Local mechanical ventilation, exhaust, and terminal units

ID	**System type in Non-domestic Building Services Compliance Guide**
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	**SFP [W/(l/s)]**									**HR efficiency**	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
B1-Flexible Commercial	-	-	-	1.4	-	-	-	-	-	-	N/A

General lighting and display lighting

Zone name	**Luminous efficacy [lm/W]**			
	Luminaire	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
B1-Flexible Commercial	-	100	40	1316

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	**Solar gain limit exceeded? (%)**	**Internal blinds used?**
B1-Flexible Commercial	NO (-78.4%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	145.8	145.8
External area [m²]	222.5	222.5
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	5
Average conductance [W/K]	57.18	93.14
Average U-value [W/m²K]	0.26	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
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	0.93	1.85
Cooling	8.21	8.95
Auxiliary	6.57	3.06
Lighting	41.98	51.58
Hot water	0.8	0.63
Equipment*	20.26	20.26
TOTAL**	**58.5**	**66.06**

* 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]	101.24	139.1
Primary energy* [kWh/m²]	175.09	197.74
Total emissions [kg/m²]	29.6	33.4

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	13.1	88.2	0.9	8.2	6.6	3.91	2.98	4.2	4.2
	Notional	17	122.1	1.8	8.9	3.1	2.56	3.79	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

Key to terms

Heat dem [MJ/m2] = Heating energy demand
Cool dem [MJ/m2] = Cooling energy demand
Heat con [kWh/m2] = Heating energy consumption
Cool con [kWh/m2] = Cooling energy consumption
Aux con [kWh/m2] = Auxiliary energy consumption
Heat SSEFF = Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER = Cooling system seasonal energy efficiency ratio
Heat gen SSEFF = Heating generator seasonal efficiency
Cool gen SSEER = Cooling generator seasonal energy efficiency ratio
ST = System type
HS = Heat source
HFT = Heating fuel type
CFT = Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	**$U_{i\text{-}Typ}$**	**$U_{i\text{-}Min}$**	**Surface where the minimum value occurs***
Wall	0.23	0.13	L0000064:Surf[2]
Floor	0.2	0.1	L0000064:Surf[20]
Roof	0.15	-	UNKNOWN
Windows, roof windows, and rooflights	1.5	1.2	L0000064:Surf[0]
Personnel doors	1.5	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)]

$U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	**Typical value**	**This building**
$m^3/(h.m^2)$ at 50 Pa	5	3

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Holloway Prison - Womens' centre (Be Green)

As designed

Date: Thu Sep 23 08:39:35 2021

Administrative information

Building Details

Address: London,

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.13

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.13

BRUKL compliance check version: v5.6.b.0

Certifier details

Name: Hoare Lea

Telephone number: 01202 654600

Address: Enterprise House, Old School Cl, Ferndown,
Bournemouth, BH22 9UN

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	20
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	20
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	18
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	0.13	0.13	L0000026:Surf[5]
Floor	0.25	0.1	0.1	L0000016:Surf[0]
Roof	0.25	0.12	0.12	L0000069:Surf[1]
Windows***, roof windows, and rooflights	2.2	1.2	1.2	L0000026:Surf[2]
Personnel doors	2.2	-	-	No Personnel doors in building
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

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	>0.95

1- HP - Radiators (no vent)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.78	-	0	0	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	NO				

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.

2- HP - Radiators + AHU

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.78	-	0	0	0.9
Standard value	2.5*	N/A	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	NO				

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.

3- HP - VRF + AHU

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.2	3.5	0	0	0.9
Standard value	2.5*	2.6	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	NO				

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.

4- HP - kitchen system

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.78	-	-	1.2	0.7
Standard value	2.5*	N/A	N/A	1.1^	0.45
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	NO				

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

1- HP - DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	2.3	-
Standard value	1	N/A

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
B1-Acc WC	-	-	0.3	-	-	-	-	-	-	-	N/A
B1-WC 1	-	-	0.3	-	-	-	-	-	-	-	N/A
B1-WC 2	-	-	0.3	-	-	-	-	-	-	-	N/A
B1-WC 3	-	-	0.3	-	-	-	-	-	-	-	N/A
B1-WC 4	-	-	0.3	-	-	-	-	-	-	-	N/A
L00-Acc WC 1	-	-	0.3	-	-	-	-	-	-	-	N/A
L00-Acc WC 2	-	-	0.3	-	-	-	-	-	-	-	N/A
L00-Acc WC 3	-	-	0.3	-	-	-	-	-	-	-	N/A
L00-WC 1	-	-	0.3	-	-	-	-	-	-	-	N/A
L00-WC 10	-	-	0.3	-	-	-	-	-	-	-	N/A
L00-WC 11	-	-	0.3	-	-	-	-	-	-	-	N/A
L00-WC 2	-	-	0.3	-	-	-	-	-	-	-	N/A
L00-WC 3	-	-	0.3	-	-	-	-	-	-	-	N/A
L00-WC 4	-	-	0.3	-	-	-	-	-	-	-	N/A
L00-WC 5	-	-	0.3	-	-	-	-	-	-	-	N/A
L00-WC 6	-	-	0.3	-	-	-	-	-	-	-	N/A
L00-WC 7	-	-	0.3	-	-	-	-	-	-	-	N/A
L00-WC 8	-	-	0.3	-	-	-	-	-	-	-	N/A
L00-WC 9	-	-	0.3	-	-	-	-	-	-	-	N/A
B1-Shower/Changing 1	-	-	-	1.4	-	-	-	-	-	-	N/A
B1-Shower/Changing 2	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Acc Shower	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Shower/Changing	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Creche 1	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Creche 2	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Creche 3	-	-	-	1.4	-	-	-	-	-	-	N/A
B1-Multipurpose Hall 1	-	-	-	1.4	-	-	-	-	-	-	N/A
B1-Multipurpose Hall 2	-	-	-	1.4	-	-	-	-	-	-	N/A
B1-Multipurpose Hall 3	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Multipurpose Room 1	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Multipurpose Room 10	-	-	-	1.4	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
L00-Multipurpose Room 11	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Multipurpose Room 12	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Multipurpose Room 13	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Multipurpose Room 14	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Multipurpose Room 15	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Multipurpose Room 16	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Multipurpose Room 17	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Multipurpose Room 18	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Multipurpose Room 19	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Multipurpose Room 2	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Multipurpose Room 3	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Multipurpose Room 4	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Multipurpose Room 5	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Multipurpose Room 6	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Multipurpose Room 7	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Multipurpose Room 8	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Multipurpose Room 9	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Kitchen	-	-	-	-	-	1	-	-	1	-	N/A
L00-Cafe	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Staff Room	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Reception	-	-	-	1.4	-	-	-	-	-	-	N/A
B1-Tea Point / Waiting	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Tea Point/Waiting	-	-	-	1.4	-	-	-	-	-	-	N/A
L00-Meditation/Prayer Room	-	-	-	1.4	-	-	-	-	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
B1-Acc WC	-	100	-	27
B1-WC 1	-	100	-	26
B1-WC 2	-	100	-	25
B1-WC 3	-	100	-	25
B1-WC 4	-	100	-	25
L00-Acc WC 1	-	100	-	36
L00-Acc WC 2	-	100	-	36
L00-Acc WC 3	-	100	-	34
L00-WC 1	-	100	-	15
L00-WC 10	-	100	-	27
L00-WC 11	-	100	-	27
L00-WC 2	-	100	-	14
L00-WC 3	-	100	-	15
L00-WC 4	-	100	-	14
L00-WC 5	-	100	-	25

General lighting and display lighting	**Luminous efficacy [lm/W]**			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
L00-WC 6	-	100	-	26
L00-WC 7	-	100	-	24
L00-WC 8	-	100	-	24
L00-WC 9	-	100	-	28
B1-Shower/Changing 1	-	100	-	13
B1-Shower/Changing 2	-	100	-	13
L00-Acc Shower	-	100	-	23
L00-Shower/Changing	-	100	-	14
B1-Circulation 1	-	95	-	208
B1-WC Lobby 1	-	114	-	57
B1-WC Lobby 2	-	205	-	10
L00-Circulation 1	-	141	-	161
L00-Circulation 2	-	131	-	173
L00-Circulation 3	-	102	-	277
L00-Circulation 4	-	119	-	243
L00-Circulation 5	-	124	-	244
L00-Entrance Lobby	-	71	-	82
L00-Shower/Changing Lobby	-	141	-	47
L00-WC Lobby 1	-	205	-	15
L00-WC Lobby 2	-	205	-	15
L00-WC Lobby 3	-	153	-	37
L00-WC Lobby 4	-	205	-	14
B1-Stair 3	-	108	-	45
L00-Stairs 3	-	157	-	40
B1-Cleaner's Cupboard	103	-	-	7
B1-Refuse Store 1	95	-	-	25
B1-Refuse Store 3	95	-	-	25
B1-Store	77	-	-	11
L00-Buggy/Cloak Area	101	-	-	6
L00-Creche Store	117	-	-	12
L00-Laundry/Cleaner's Cupboard	120	-	-	7
L00-Store 1	108	-	-	10
L00-Store 2	120	-	-	7
L00-Store 3	120	-	-	11
L00-Creche 1	100	-	-	164
L00-Creche 2	100	-	-	145
L00-Creche 3	100	-	-	164
B1-Multipurpose Hall 1	100	-	-	330
B1-Multipurpose Hall 2	100	-	-	343
B1-Multipurpose Hall 3	100	-	-	262
L00-Multipurpose Room 1	106	-	-	314
L00-Multipurpose Room 10	134	-	-	184
L00-Multipurpose Room 11	128	-	-	200

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
L00-Multipurpose Room 12	130	-	-	187
L00-Multipurpose Room 13	126	-	-	218
L00-Multipurpose Room 14	179	-	-	81
L00-Multipurpose Room 15	178	-	-	82
L00-Multipurpose Room 16	181	-	-	83
L00-Multipurpose Room 17	180	-	-	84
L00-Multipurpose Room 18	179	-	-	85
L00-Multipurpose Room 19	178	-	-	86
L00-Multipurpose Room 2	94	-	-	438
L00-Multipurpose Room 3	101	-	-	373
L00-Multipurpose Room 4	141	-	-	144
L00-Multipurpose Room 5	130	-	-	187
L00-Multipurpose Room 6	168	-	-	99
L00-Multipurpose Room 7	135	-	-	182
L00-Multipurpose Room 8	182	-	-	81
L00-Multipurpose Room 9	182	-	-	81
L00-Kitchen	-	100	-	252
L00-Cafe	-	100	-	220
L00-Staff Room	119	-	-	290
L00-Reception	-	63	40	724
B1-Tea Point / Waiting	100	-	-	106
L00-Tea Point/Waiting	100	-	-	112
L00-Meditation/Prayer Room	100	-	-	130

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
L00-Creche 1	NO (-84.3%)	NO
L00-Creche 2	NO (-82.5%)	NO
L00-Creche 3	NO (-91.1%)	NO
B1-Multipurpose Hall 1	NO (-49.3%)	NO
B1-Multipurpose Hall 2	NO (-27.6%)	NO
B1-Multipurpose Hall 3	NO (-73%)	NO
L00-Multipurpose Room 1	NO (-74.7%)	NO
L00-Multipurpose Room 10	NO (-84.2%)	NO
L00-Multipurpose Room 11	NO (-66.9%)	NO
L00-Multipurpose Room 12	NO (-71.9%)	NO
L00-Multipurpose Room 13	NO (-77.3%)	NO
L00-Multipurpose Room 14	N/A	N/A
L00-Multipurpose Room 15	N/A	N/A
L00-Multipurpose Room 16	N/A	N/A
L00-Multipurpose Room 17	N/A	N/A
L00-Multipurpose Room 18	N/A	N/A
L00-Multipurpose Room 19	N/A	N/A

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
L00-Multipurpose Room 2	NO (-64.8%)	NO
L00-Multipurpose Room 3	NO (-69.6%)	NO
L00-Multipurpose Room 4	NO (-81%)	NO
L00-Multipurpose Room 5	NO (-84%)	NO
L00-Multipurpose Room 6	NO (-71%)	NO
L00-Multipurpose Room 7	NO (-86%)	NO
L00-Multipurpose Room 8	NO (-80.4%)	NO
L00-Multipurpose Room 9	NO (-79.1%)	NO
L00-Cafe	NO (-62.2%)	NO
L00-Staff Room	NO (-99.3%)	NO
L00-Reception	NO (-71%)	NO
B1-Tea Point / Waiting	NO (-79.3%)	NO
L00-Tea Point/Waiting	NO (-74.7%)	NO
L00-Meditation/Prayer Room	NO (-78.1%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	1480.3	1480.3
External area [m²]	1798.3	1798.3
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	583.55	843.57
Average U-value [W/m²K]	0.32	0.47
Alpha value* [%]	10.02	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
82	**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
13	**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
5	**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	3.86	5.63
Cooling	2.67	3.84
Auxiliary	8.33	4.3
Lighting	12.62	19.33
Hot water	8.1	6.35
Equipment*	23.83	23.83
TOTAL**	**35.59**	**39.44**

* 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]	78.81	104.17
Primary energy* [kWh/m²]	106.51	118.05
Total emissions [kg/m²]	18	20

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

HVAC Systems Performance

System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity									
Actual	39.3	48.4	2.8	4.5	6.9	3.91	2.98	4.2	4.2
Notional	45.4	88.3	4.9	6.5	2.6	2.56	3.79	----	----
[ST] Central heating using water: radiators, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity									
Actual	47.1	0	3.9	0	6.8	3.37	0	3.78	0
Notional	60.2	0	6.5	0	3.2	2.56	0	----	----
[ST] Central heating using air distribution, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity									
Actual	0	0	0	0	209.4	3.26	0	3.78	0
Notional	0.3	0	0	0	122.6	2.56	0	----	----
[ST] Central heating using water: radiators, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity									
Actual	87	0	7.2	0	1.9	3.37	0	3.78	0
Notional	79.3	0	8.6	0	2.1	2.56	0	----	----
[ST] No Heating or Cooling									
Actual	0	0	0	0	0	0	0	0	0
Notional	0	0	0	0	0	0	0	----	----

Key to terms

Heat dem [MJ/m2] = Heating energy demand
Cool dem [MJ/m2] = Cooling energy demand
Heat con [kWh/m2] = Heating energy consumption
Cool con [kWh/m2] = Cooling energy consumption
Aux con [kWh/m2] = Auxiliary energy consumption
Heat SSEFF = Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER = Cooling system seasonal energy efficiency ratio
Heat gen SSEFF = Heating generator seasonal efficiency
Cool gen SSEER = Cooling generator seasonal energy efficiency ratio
ST = System type
HS = Heat source
HFT = Heating fuel type
CFT = Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	**$U_{i\text{-}Typ}$**	**$U_{i\text{-}Min}$**	**Surface where the minimum value occurs***
Wall	0.23	0.13	L0000026:Surf[5]
Floor	0.2	0.1	L0000071:Surf[0]
Roof	0.15	0.12	L0000069:Surf[1]
Windows, roof windows, and rooflights	1.5	1.2	L0000026:Surf[1]
Personnel doors	1.5	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)]

$U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	**Typical value**	**This building**
$m^3/(h.m^2)$ at 50 Pa	5	3

Appendix I: Net Zero Carbon Feasibility.

HOARE LEA

Holloway.
Islington, London.
Peabody.

SUSTAINABILITY
NET ZERO CARBON FEASIBILITY STUDY

REVISION 02 – 29 OCTOBER 2021

STAGE 2

Audit sheet.

Rev.	Date	Description of change / purpose of issue	Prepared	Reviewed	Authorised
01	18/10/2021	Draft Issue for comment	A Bryant/ L. Holden	J. Drane	R. Evans
02	29/10/2021	Issue for final planning application	A Bryant	L. Holden	R. Evans

This document has been prepared for Peabody only and solely for the purposes expressly defined herein. We owe no duty of care to any third parties in respect of its content. Therefore, unless expressly agreed by us in signed writing, we hereby exclude all liability to third parties, including liability for negligence, save only for liabilities that cannot be so excluded by operation of applicable law. The consequences of climate change and the effects of future changes in climatic conditions cannot be accurately predicted. This report has been based solely on the specific design assumptions and criteria stated herein.

Project number: 23/24131
Document reference: REP-2324131-20211029-Stg 2 NZC Holloway Rev 2.docx

Contents.

Executive Summary.

This report summarises the early-stage Net Zero Carbon Feasibility Study of Plot C of the proposed development at Holloway Prison. The assessment has been undertaken with the design team as part of the planning submission, in coordination with the Energy Officers at the London Borough of Islington (LBI).

Plot C has been selected due to the fact that it proposed to be 100% social rent and contains the Women's Centre. It is also proposed to be in the first phase of the build, so will offer the most value to occupants and being in the first phase will offer lessons learned around the materials and construction process.

UK Green Building Council Net Zero Carbon

As a response to mainstream scientific consensus on the urgent need to reduce carbon emissions, the UK Government has legislated to achieve Net Zero carbon by 2050. As part of the definition of Net Zero, the UK Green Building Council (UKGBC) has developed a Framework Definition that includes embodied carbon emissions and this definition is widely being used to develop a roadmap to the 2050 Net Zero target. This project will use the UKGBC's definition of Net Zero.

Embodied Carbon Results

Following the review of all of the materials and construction approaches for Plot C, the anticipated Upfront Carbon for Plot C is anticipated to be: ~ 650 $kgCO_2e/m^2$.

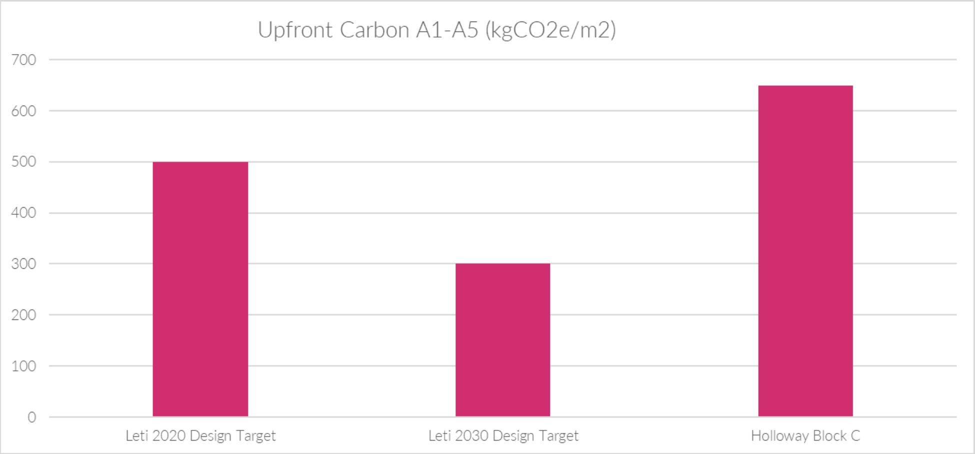


Figure 1 Final Upfront Embodied Carbon Results in comparison against the LETI Benchmarks

The anticipated total Embodied Carbon for Plot C is anticipated to be: ~ 935 $kgCO_2e/m^2$.

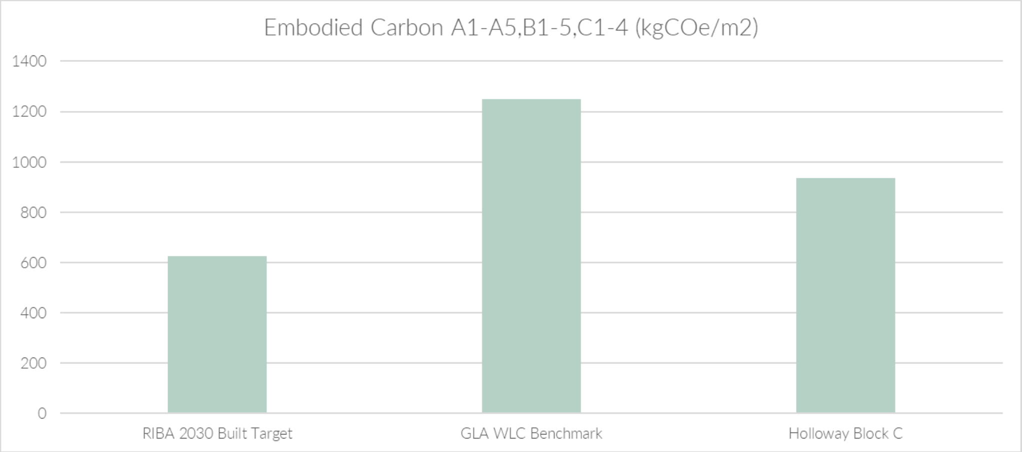
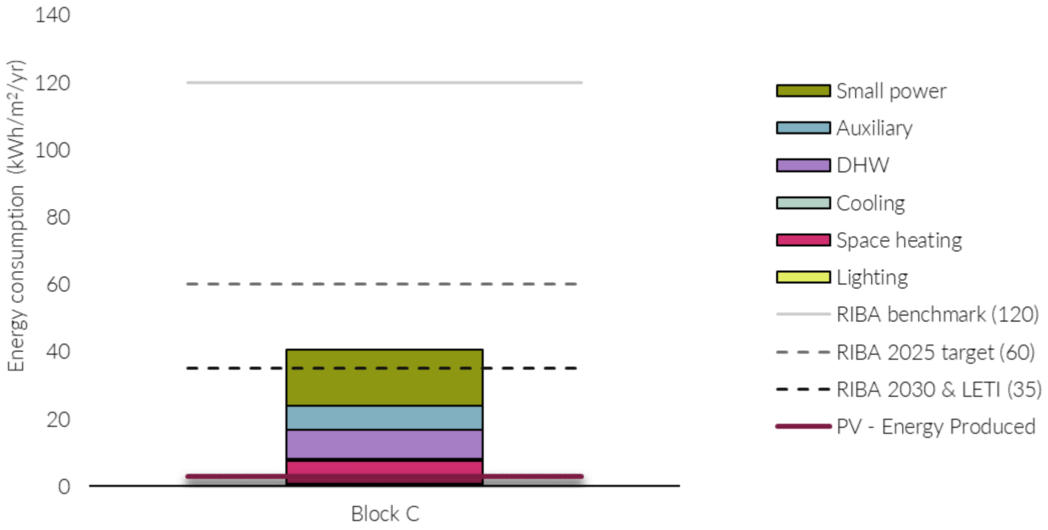


Figure 2 Final Total Embodied Carbon Results in comparison with the RIBA & GLA Benchmarks.

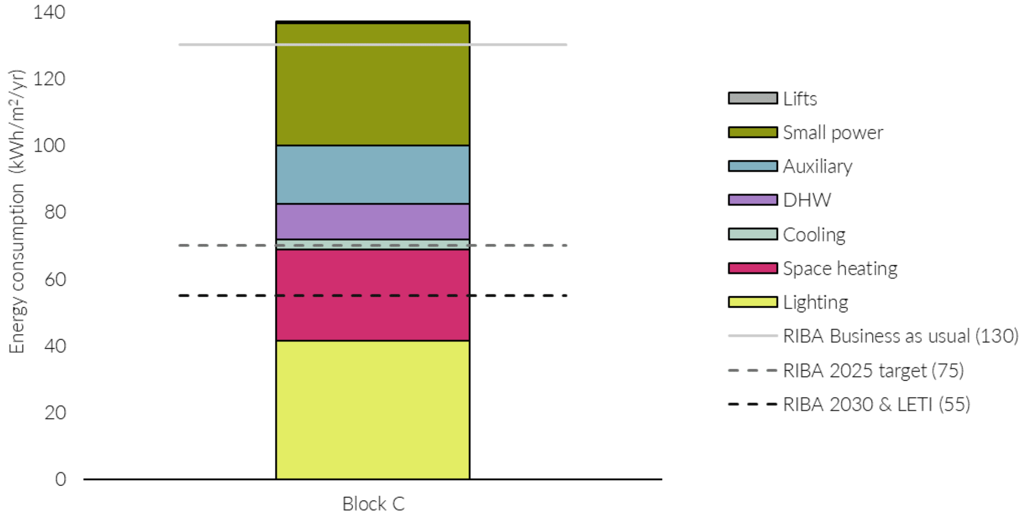
Although the embodied carbon results do not meet the LETI or RIBA 2030 targets, the performance of Plot C has made a positive step from the Business-as-Usual performance towards the 2030 targets. Further detail around the material quantities and EPDs will be progressed during the design stage to look to further reduce carbon emissions where feasible.

Operational Carbon Results

Following the operational energy investigations, the total energy consumption for the domestic element of Plot C achieved 41 kWh/m²/yr.



The non-domestic element of Plot C achieved 137 kWh/m²/yr.



The operational energy performance of the domestic element of Plot C has been reduced considerably through the improvement of the façade performance and system efficiencies. This area has been a key focus for the team in delivering value for the occupants of the social rent units.

More detailed analysis will be outlined within the Green Performance Plan which secures all relevant and necessary performance targets and accompanies the planning application.

1. Introduction

1.1 Purpose of this report.

Hoare Lea have been appointed to undertake a Net Zero Carbon Feasibility assessment on the Holloway Prison development in order to drive down Operational and Embodied carbon emissions on site and in support of the planning submission.

The assessment of the carbon emissions associated with the development will consider the anticipated operational energy consumption (and associated carbon emissions) as well as the project's embodied emissions (Lifecycle Module A1 – A5).

1.2 The Proposed Development.

The proposed development consists of the phased comprehensive redevelopment including demolition of existing structures; site preparation and enabling works; and the construction of 985 residential homes including 60 extra care homes (Use Class C3), a Women's centre (Use Class F.2) and flexible commercial floorspace (Use Class E) in buildings of up to 14 storeys in height; highways/access works; landscaping; pedestrian and cycle connections, publicly accessible park; car (blue badge) and cycle parking; and other associated works.

A CGI image of the scheme is shown in Figure 2.

Figure 2: Site Image (Credit: AHMM)

1.3 Assessment Area

The Net Zero Assessment will be undertaken in detail on Plot C. This building has been selected due to the fact that it proposed to be 100% social rent and contains the Women's Building. It is also proposed to be in the first phase of the build, so will offer the most value to occupants and being in the first phase will offer lessons learned around the materials and construction process.

The output and design implications from the detailed study of Plot C will be shared across the areas of the development, where appropriate, to enable maximum benefit from the study. A CGI of Plot C is shown in Figure 3.

Figure 3: Plot C (Credit: AHMM)

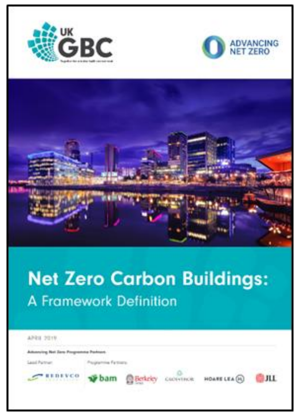
2. Industry Energy and Carbon Benchmarks.

2.1 UKGBC Net Zero framework

The UKGBC for net zero carbon was released in April 2019 and sets principles and definitions for the term zero carbon, each having equal importance. These are as follows:

Net Zero Carbon – Construction (1.1)
When the carbon emissions associated with a building's product and construction stages up to practical completion is zero or negative, through the use of offsets or the net export of on-site renewable energy.

Net Zero Carbon – Operational Energy (1.2)
When the amount of carbon emissions associated with the building's operational energy on an annual basis is zero or negative. A net zero carbon building is highly



UK GBC

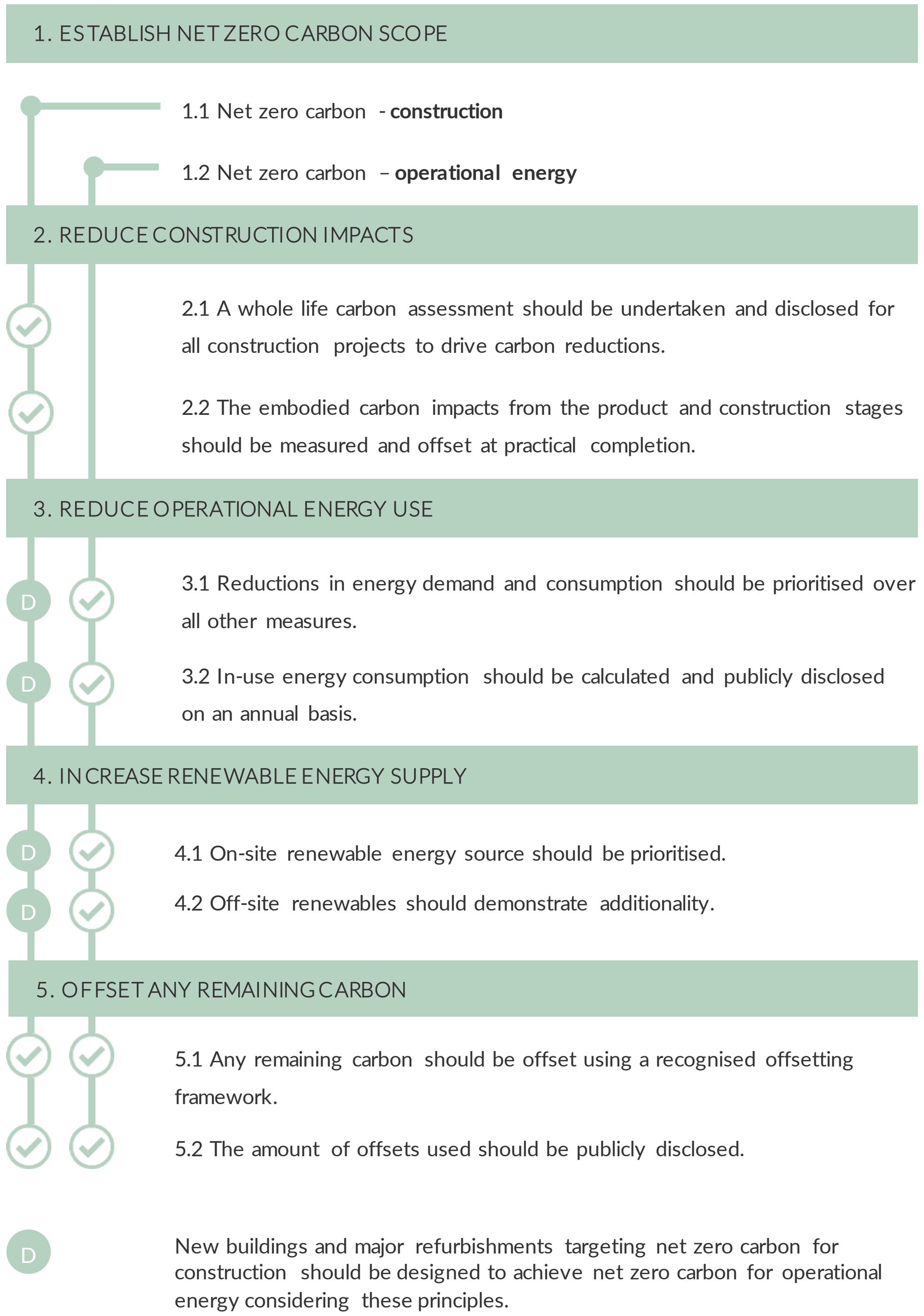
ADVANCING NET ZERO

Net Zero Carbon Buildings:
A Framework Definition

energy efficient and powered from on-site and/or off-site renewable energy sources, with any remaining carbon balance offset.

Developers aiming for net zero carbon in construction should design the building to enable net zero carbon for operational energy, and where possible this should be achieved annually in-use. Net zero carbon for both construction and operation represents the greatest level of commitment to the framework.

The framework for achieving net zero carbon in construction and operation is shown in Figure 4.



1. ESTABLISH NET ZERO CARBON SCOPE

1.1 Net zero carbon - **construction**

1.2 Net zero carbon – **operational energy**

2. REDUCE CONSTRUCTION IMPACTS

2.1 A whole life carbon assessment should be undertaken and disclosed for all construction projects to drive carbon reductions.

2.2 The embodied carbon impacts from the product and construction stages should be measured and offset at practical completion.

3. REDUCE OPERATIONAL ENERGY USE

3.1 Reductions in energy demand and consumption should be prioritised over all other measures.

3.2 In-use energy consumption should be calculated and publicly disclosed on an annual basis.

4. INCREASE RENEWABLE ENERGY SUPPLY

4.1 On-site renewable energy source should be prioritised.

4.2 Off-site renewables should demonstrate additionality.

5. OFFSET ANY REMAINING CARBON

5.1 Any remaining carbon should be offset using a recognised offsetting framework.

5.2 The amount of offsets used should be publicly disclosed.

D New buildings and major refurbishments targeting net zero carbon for construction should be designed to achieve net zero carbon for operational energy considering these principles.

Figure 4: UKGBC net zero carbon framework (Source: adapted from UKGBC).

2.2 RIBA 2030 Climate Challenge

RIBA 2030 CLIMATE CHALLENGE

Sign up to take the RIBA 2030 Climate Challenge at www.architecture.com/2030challenge

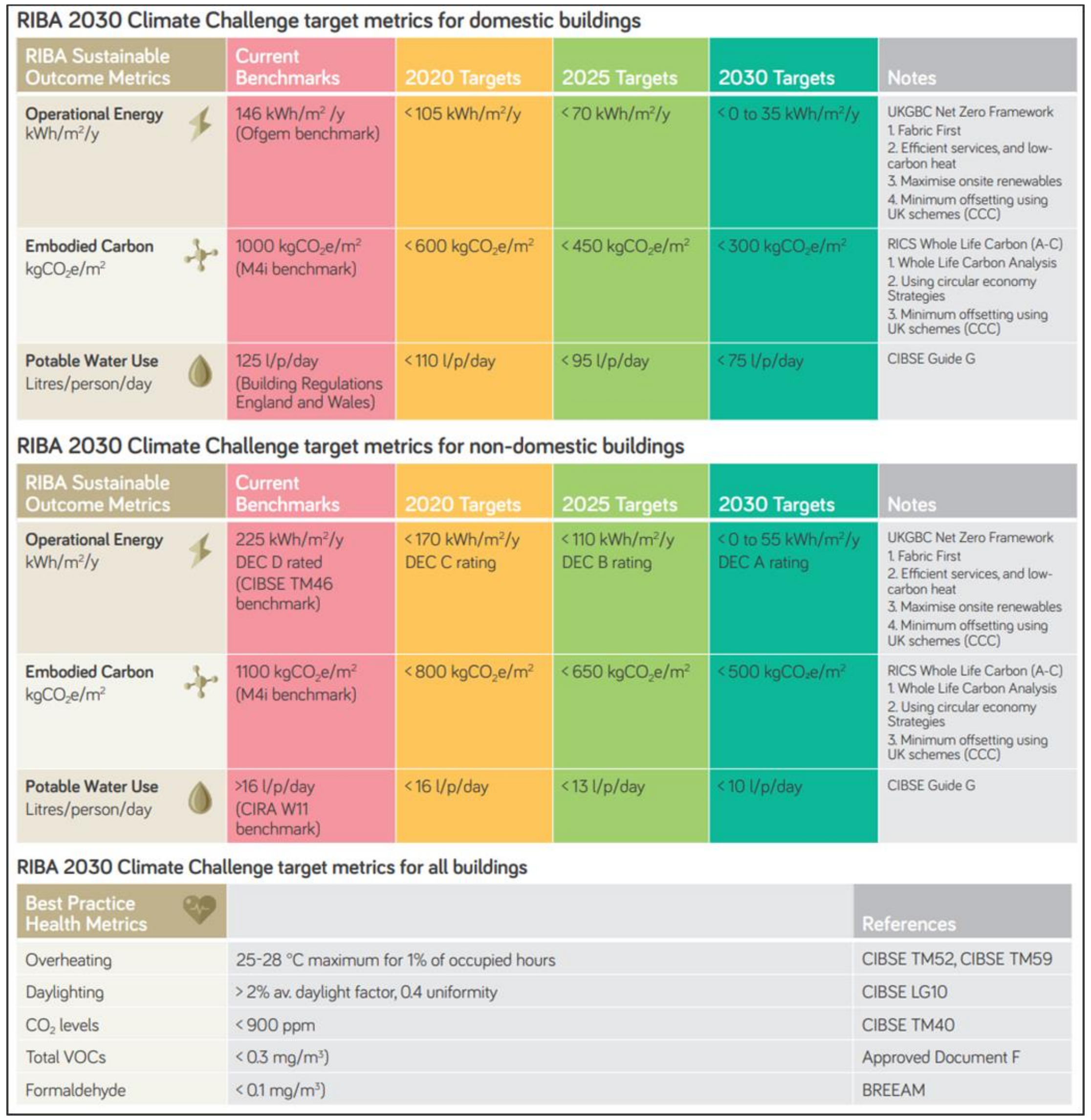
RIBA Architecture.com

According to RIBA, "RIBA has developed the 2030 Climate Challenge to help architects meet net zero (or better) whole life carbon for new and retrofitted buildings by 2030. It sets a series of targets for practices to adopt to reduce operational energy, embodied carbon and potable water."

RIBA provides current benchmarks and targets for 3 future time horizons: 2020, 2025, and 2030, with a view to providing an incremental path to the net zero target required by 2030.

This includes targets for both operational energy consumption and embodied carbon, both of which must be addressed for the built sector to mitigate its contribution to man-made climate change.

Also included are recommendations on overheating assessment and mitigation and potable water consumption, in recognition of the wider impacts a changing climate will have; notably significantly warmer, dryer summers.



RIBA 2030 Climate Challenge target metrics for domestic buildings

RIBA Sustainable Outcome Metrics	Current Benchmarks	2020 Targets	2025 Targets	2030 Targets	Notes
Operational Energy kWh/m²/y	146 kWh/m² /y (Ofgem benchmark)	< 105 kWh/m²/y	< 70 kWh/m²/y	< 0 to 35 kWh/m²/y	UKGBC Net Zero Framework 1. Fabric First 2. Efficient services, and low-carbon heat 3. Maximise onsite renewables 4. Minimum offsetting using UK schemes (CCC)
Embodied Carbon $kgCO_2e/m^2$	1000 $kgCO_2e/m^2$ (M4i benchmark)	< 600 $kgCO_2e/m^2$	< 450 $kgCO_2e/m^2$	< 300 $kgCO_2e/m^2$	RICS Whole Life Carbon (A-C) 1. Whole Life Carbon Analysis 2. Using circular economy Strategies 3. Minimum offsetting using UK schemes (CCC)
Potable Water Use Litres/person/day	125 l/p/day (Building Regulations England and Wales)	< 110 l/p/day	< 95 l/p/day	< 75 l/p/day	CIBSE Guide G

RIBA 2030 Climate Challenge target metrics for non-domestic buildings

RIBA Sustainable Outcome Metrics	Current Benchmarks	2020 Targets	2025 Targets	2030 Targets	Notes
Operational Energy kWh/m²/y	225 kWh/m²/y DEC D rated (CIBSE TM46 benchmark)	< 170 kWh/m²/y DEC C rating	< 110 kWh/m²/y DEC B rating	< 0 to 55 kWh/m²/y DEC A rating	UKGBC Net Zero Framework 1. Fabric First 2. Efficient services, and low-carbon heat 3. Maximise onsite renewables 4. Minimum offsetting using UK schemes (CCC)
Embodied Carbon $kgCO_2e/m^2$	1100 $kgCO_2e/m^2$ (M4i benchmark)	< 800 $kgCO_2e/m^2$	< 650 $kgCO_2e/m^2$	< 500 $kgCO_2e/m^2$	RICS Whole Life Carbon (A-C) 1. Whole Life Carbon Analysis 2. Using circular economy Strategies 3. Minimum offsetting using UK schemes (CCC)
Potable Water Use Litres/person/day	>16 l/p/day (CIRA W11 benchmark)	< 16 l/p/day	< 13 l/p/day	< 10 l/p/day	CIBSE Guide G

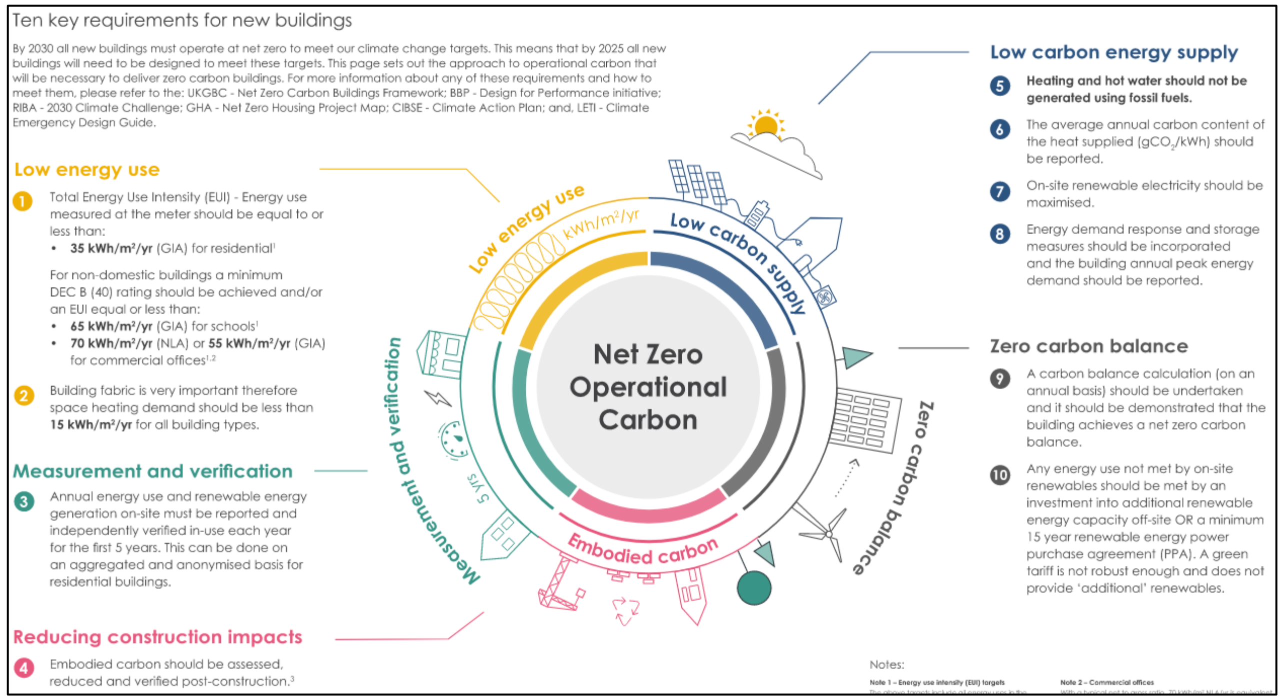
RIBA 2030 Climate Challenge target metrics for all buildings

Best Practice Health Metrics		References
Overheating	25-28 °C maximum for 1% of occupied hours	CIBSE TM52, CIBSE TM59
Daylighting	> 2% av. daylight factor, 0.4 uniformity	CIBSE LG10
CO_2 levels	< 900 ppm	CIBSE TM40
Total VOCs	< 0.3 mg/m³)	Approved Document F
Formaldehyde	< 0.1 mg/m³)	BREEAM

Figure 5: RIBA Climate Challenge targets.

2.3 LETI guidance for Net Zero Operational Carbon

The London Energy Transformation Initiative (LETI) have released guidance on achieving net zero operational carbon. Although this initiative began in London, it has now expanded to become U.K. wide. LETI focusses first on reducing the consumption of energy as far as possible, with targets set for different use types. Space heating demand in line with Passivhaus requirements (15kWh/sqm/yr.) is also recommended. There is a focus on measurement and verification, to ensure the building is performing as design and to minimise the performance gap. The need to assess embodied carbon is noted but not a focus for the guidance, which is concerned with operational carbon emissions. The guidance is shown below.



Ten key requirements for new buildings

By 2030 all new buildings must operate at net zero to meet our climate change targets. This means that by 2025 all new buildings will need to be designed to meet these targets. This page sets out the approach to operational carbon that will be necessary to deliver zero carbon buildings. For more information about any of these requirements and how to meet them, please refer to the: UKGBC - Net Zero Carbon Buildings Framework; BBP - Design for Performance initiative; RIBA - 2030 Climate Challenge; GHA - Net Zero Housing Project Map; CIBSE - Climate Action Plan; and, LETI - Climate Emergency Design Guide.

Low energy use

① Total Energy Use Intensity (EUI) - Energy use measured at the meter should be equal to or less than:
- **35 kWh/m²/yr** (GIA) for residential[1]

For non-domestic buildings a minimum DEC B (40) rating should be achieved and/or an EUI equal or less than:
- **65 kWh/m²/yr** (GIA) for schools[1]
- **70 kWh/m²/yr** (NLA) or **55 kWh/m²/yr** (GIA) for commercial offices[1,2]

② Building fabric is very important therefore space heating demand should be less than **15 kWh/m²/yr** for all building types.

Measurement and verification

③ Annual energy use and renewable energy generation on-site must be reported and independently verified in-use each year for the first 5 years. This can be done on an aggregated and anonymised basis for residential buildings.

Reducing construction impacts

④ Embodied carbon should be assessed, reduced and verified post-construction.[3]

Low carbon energy supply

⑤ **Heating and hot water should not be generated using fossil fuels.**

⑥ The average annual carbon content of the heat supplied (gCO_2/kWh) should be reported.

⑦ On-site renewable electricity should be maximised.

⑧ Energy demand response and storage measures should be incorporated and the building annual peak energy demand should be reported.

Zero carbon balance

⑨ A carbon balance calculation (on an annual basis) should be undertaken and it should be demonstrated that the building achieves a net zero carbon balance.

⑩ Any energy use not met by on-site renewables should be met by an investment into additional renewable energy capacity off-site OR a minimum 15 year renewable energy power purchase agreement (PPA). A green tariff is not robust enough and does not provide 'additional' renewables.

Notes:

Note 1 – Energy use intensity (EUI) targets

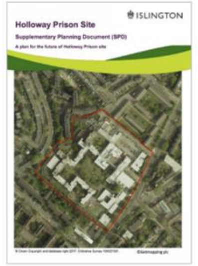
Note 2 – Commercial offices

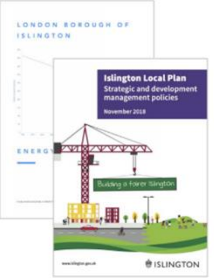
Figure 6: LETI guidance on Net Zero Operational Carbon.

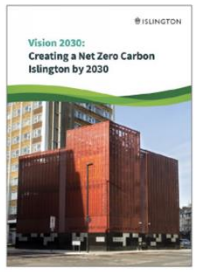
2.4 Islington's 2030 Vision

In order to create a net zero carbon Islington, the council, borough partners, residents, and community organisations, supported by regional and national government, will need to ensure:

- Residents, people who work in Islington and local business owners know the part they need to play to achieve net zero and are empowered to do so.
- Emissions from gas boilers and vehicles are eliminated.
- Buildings in the borough are made as energy efficient as possible.
- Renewable heat and power generation in the borough is maximised.
- Any remaining electricity needs are sourced from certified renewable or zero carbon sources.
- The planning system only allows fossil-fuel free buildings to be built.
- Circular economy principles are embedded in local businesses and supply chains are sustainable.
- Tree cover is maximised, and local biodiversity protected.
- Any outstanding emissions are offset through carbon sequestration and other methods.







Reaching Net Zero Operational Carbon on new residential buildings is technically possible assuming that:

1. An exemplar level of energy efficiency is achieved,
2. A truly low carbon heating system is used (e.g., heat pumps)
3. Solar PVs are maximised on roofs.

It also requires a pragmatic and very collaborative approach within the project team.

Table 1 below sets out a number of Key Performance Indicators (KPIs) for Net Zero Carbon. Although compliance with these KPIs is not mandated by Islington, the advice that they have provided is that these KPI's are key to achieving Net Zero and should form the basis of any Net Zero Carbon Standard.

The KPIs highlight the importance of all elements below:

- Low energy use
- Low carbon energy supply (heat and electricity)
- Zero carbon balance
- Measurement and verification
- Embodied carbon

For full details on how the proposed development performs against the KPIs, please refer to Appendix A.

Table 1: LBI Net Zero Carbon Suggested KPIs

	Requirements for Net Zero Carbon
Feasibility	Carry out a Stage 2 Net Zero Carbon Feasibility Assessment
Reduce Operational Energy Consumption	Achieve an Energy Use Intensity of less than 35 kWh/m^2/yr.
	Achieve a space heating demand between 10 and 15 kWh/m^2/yr. Target a total hot water demand of less than 18 kWh/m^2/yr.
	Target an air permeability of less than 0.6 m^3/h/m^2 at 50 Pa
Reduce Embodied Carbon	Report embodied carbon for building life cycle stages A1-A5
	Compare to the benchmark value of 500 kg/CO$_2$/m^2/yr. for new multi-residential buildings report improvements achieved during design
Low Carbon heat Supply	No gas connection or fossil fuel consumption on site
	Estimate average heating costs per dwelling for a typical dwelling Including direct energy costs, standing charge, maintenance, and replacement cost per unit
	Report estimated distribution losses in kWh/unit as well as % of heating and hot water demand
	Report estimated carbon content of heat (kgCO$_2$/kWh $_{\text{heat delivered}}$)
Measurement and verification	Commitment to predict energy use and report at planning
	Commitment to predict energy use and report at tender
	Commitment to predict energy use and report at end of construction
Zero Operational Carbon Balance	Achieve a renewable electricity generation on-site of more than 100kWh/m^2 $_{\text{building footprint}}$/yr.)
	Report on-site renewable electricity generation in kWh/m^{2}GIA/yr.
	Report predicted annual energy balance for the whole development

	Requirements for Net Zero Carbon
	Energy Use Intensity (EUI) vs renewable electricity generation, both in kWh/m^2 $_{GIA}$/yr.
Overheating Risk	Clearly describe summer comfort strategy CIBSE TM59 Overheating risk assessment

Complying with the Passivhaus standard is not a mandatory requirement to achieve Net Zero Carbon. However, it provides a robust, tried, and tested method and standard to deliver the required level of energy efficiency while ensuring construction quality and minimising the performance gap (as the modelling and QA processes are more thorough).

3. Methodology.

The assessment of the carbon emissions associated with the development, will consider the anticipated operational energy consumption (and associated carbon emissions) as well as the project's embodied emissions (Lifecycle Module A1 – A5). Options for managing the carbon emissions apparent from the development will be considered and several next steps identified.

3.1 Embodied carbon

Refers to the carbon emissions associated with the extraction and processing of materials and the energy and water consumption used by the factory in producing products and constructing the building. It also includes the 'in-use' stage (maintenance, replacement, and emissions associated with refrigerant leakage) and 'end of life' stage (demolition, disassembly, and disposal of any parts of product or building) and any transportation relating to the above.

LETI/WLCN 2021 defines Embodied Carbon as: *'The GHG emissions and removals associated with materials and construction processes throughout the whole life cycle of an asset (Modules A1-A5, B1-B5, C1-C4).*

To assess the embodied carbon for the project, a Life Cycle Assessment (LCA) tool – One Click LCA – has been used to make allocations for the anticipated materials quantities in an inventory analysis. The materials are represented within the model by using materials with associated Environmental Product Declarations (EPDs). EPDs are produced by manufacturers and identify the carbon emissions of a product. By scheduling the materials proposed for the development, the overall carbon emissions can be approximated.

It should be noted here that the LCA tool has a limited database of materials. In the scenario where a specified material isn't included in the database, the most similar material in terms of material composition is selected instead.

In line with standard UK practice, the LCA process and results included by this report have been assessed in line with BS 15978:2011 and the RICS Professional Statement: Whole Life Carbon assessment for the built environment. All EPDs used have been produced in line with the requirements of BS EN 15804:2012. Hence, each material has been assessed against the following lifecycle stage:

- A1-A3: Product stage
- A4: Material transportation to site
- A5: On site construction
- B4-B5: Replacement and maintenance
- C1-C4: End of life

Together with these stages, the contribution of life cycle stage A5 has also been explored separately, giving an estimate of the emissions related to the construction. I.e., the electrical consumption and waste disposal.

In line with the draft GLA guidance, the assessment includes the following elements:

- Demolition
- Facilitating works
- Substructure
- Superstructure (frame, upper floors, roof, stairs and ramps, external walls, windows and external doors, internal walls and partitions, internal doors)
- Finishes
- Fittings, furnishings, and equipment
- Building services
- Prefabricated buildings and building units
- External works (hard and soft landscaping, fencing, fixtures, drainage, services)

3.2 Operational carbon

Refers to the collection CO_2 emissions associated with the operational phase of the building, including regulated emissions (space heating and cooling, lighting, hot water, and ventilation) and unregulated emissions (small plug-in equipment, IT, servers, process, and machinery associated with the use of the building).

The operational carbon emissions have been determined from a TM54 study of the Women's Building and a PHPP Assessment of the dwellings within Plot C.

4. Inputs.

This section sets out the inputs used in the Net Zero Carbon Feasibility Assessment.

4.1 Operational Carbon

The inputs for the Operational Carbon assessment were taken from the inputs outlined in the Energy Strategy (Hoare Lea October 2021), the planning drawings, discussions with the MEP Engineers and assumptions based on the usage of the spaces.

4.2 Embodied Carbon

The inputs for the Embodied Carbon assessment have been obtained from the London Squares' Bill of Quantities with accompanying design information from the team. The building elements covered by the assessment, in line with the Royal Institute of Chartered Surveyors (RICS) Professional Statement: *Whole Life Carbon assessment for the built environment* along with the lifecycle modules are provided in Appendix B.

4.3 Approach

A number of workshops were undertaken during the Net Zero Carbon Feasibility as per the schedule listed in Figure 6.

The workshops involved collaboration between the whole team, and then presentations to the LBI Planning Team and Energy Officers.

Details of those involved are listed in Table 2 below.

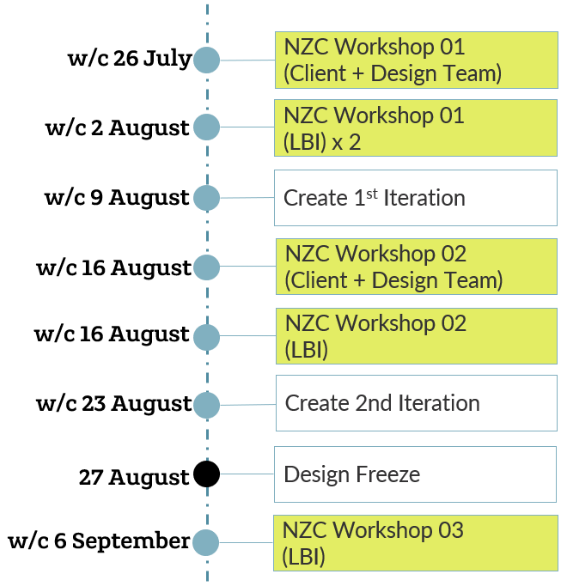


Figure 6 Net Zero Carbon Feasibility - Schedule.

Table 2: Holloway Project Team

Role	Holloway Consultant Team
Architects	AHMM
Structures	Watermans
MEP	Hoare Lea
Landscape Architect	Exterior Architecture
Acoustics	Max Fordham
Fire Consultant	FDS UK
Construction Partner	London Square
Client	Peabody

5. Embodied Carbon Results.

For Project Holloway the aim with the Plot C modelling was to seek and investigate alternative lower carbon design options. The workshops undertaken throughout this process ensured a collaborative effort throughout the entire design team, appraising different proposals from different disciplines, investigating not only how we could design for Net Zero, but also how we would practically deliver it.

5.1 Baseline - Embodied Carbon Assessment Results

To commence the assessment process, a baseline model of Plot C was created using the One Click LCA tool. The initial design was created in order to understand the preliminary results of the scheme, and how these compared to the LETI and RIBA benchmarks.

Due to the difference in approach taken by LETI and RIBA, in order to provide a cohesive assessment to the team, the results of the Embodied Carbon calculation were evaluated against the ‘Upfront Carbon’ (Modules A1-A5) in line with LETI residential benchmarks, and the ‘Embodied Carbon’ (Modules A1-A5, B1-5, C1-4) in line with RIBA 2030 built target, and GLA WLC benchmarks. Figure 7, 8 and 9 outline the baseline results.

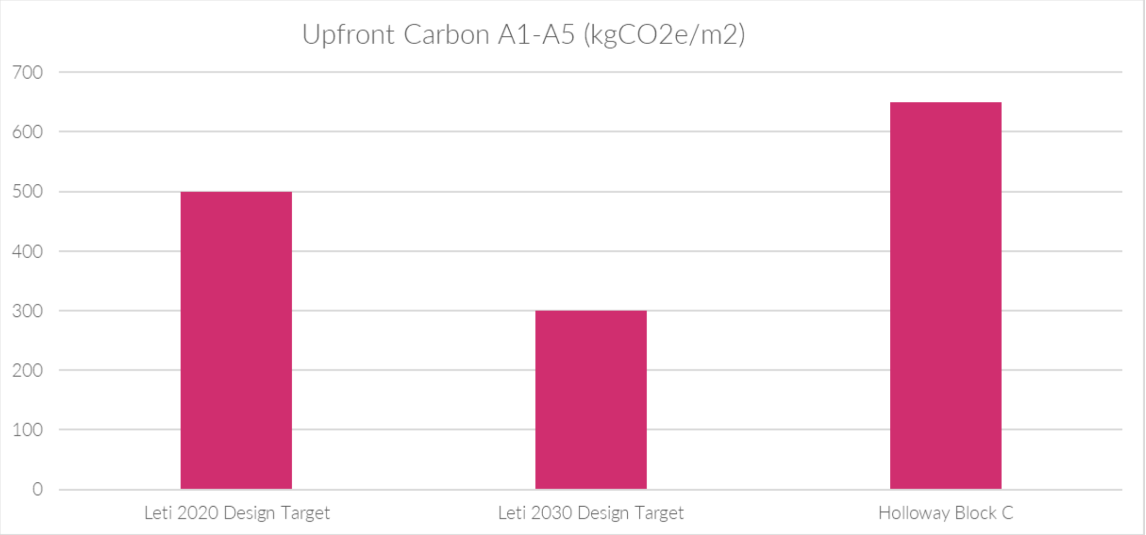


Figure 7 Upfront Carbon baseline result in comparison against the LETI design benchmarks.

The results demonstrated in comparison with the LETI benchmarks, the scheme was exceeding the targets (2020: 500 $\text{kgCO}_{2e}/\text{m}^{2.}$ and 2030: 300 $\text{kgCO}_{2e}/\text{m}^{2}$) by ~30%.

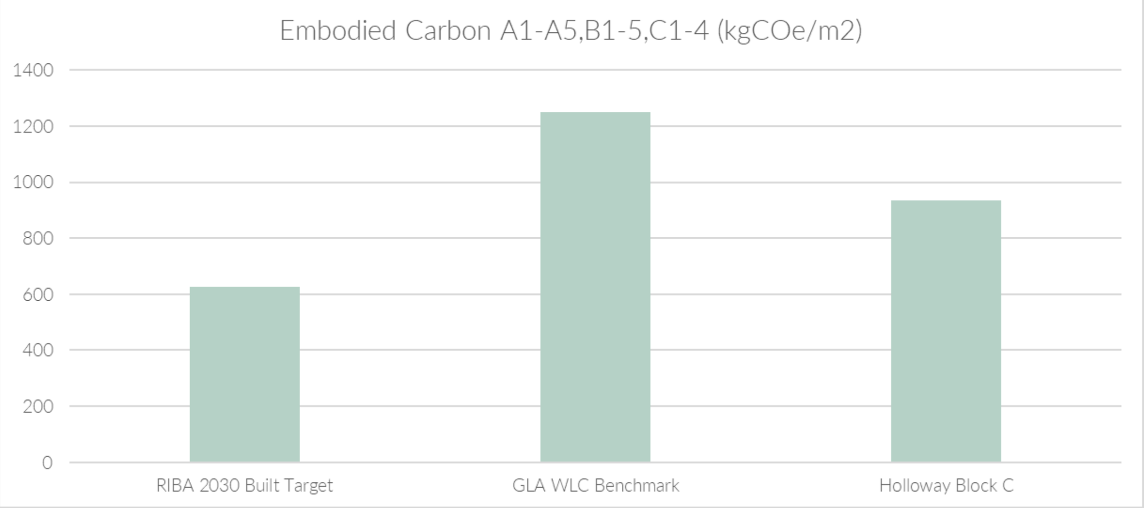


Figure 8 Embodied carbon baseline result in comparison to the RIBA 2030 built target, and GLA WLC benchmark

Comparatively, the Plot C baseline results exceeded RIBA 2030 target (625 $\text{kgCO}_{2e}/\text{m}^{2}$) by ~49%, however improving on GLA target (1050 – 1250 $\text{kgCO}_{2e}/\text{m}^{2}$) by 25% overall.

Figure 9 demonstrates that the main carbon hotspots within the design were Electricity (29%), Concrete frames (16%), and Floors (11%).

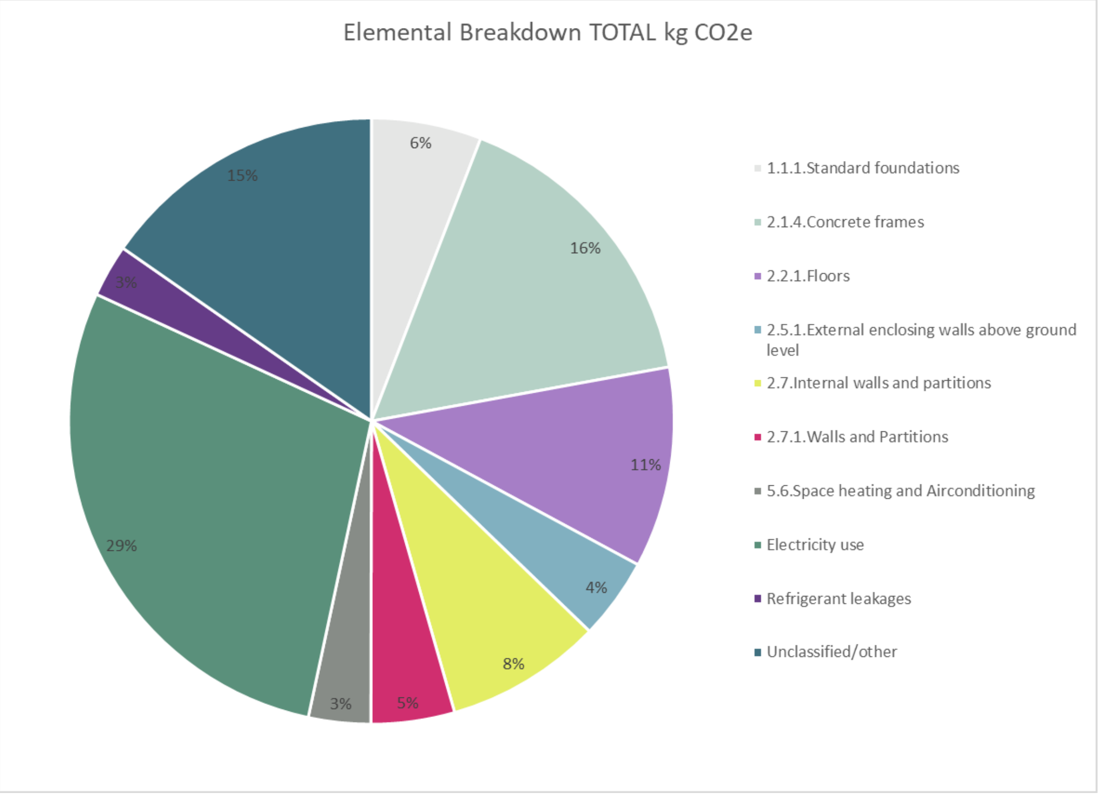


Figure 9 Elemental carbon comparison of the Plot C baseline.

5.1.1 Electricity Usage

For the baseline design a Passivhaus (PHPP) assessment was undertaken for the domestic areas and a TM54 Operational Energy Performance was completed assessing both the Domestic and Non-Domestic areas. Full details of the study are provided in Section 6 of the report.

The pie charts below show the electrical elemental breakdown following the separate domestic and non-domestic analysis. The results show small power as a total of 35.5% of the Domestic energy, and 36.5% for Non-Domestic. Small power accounts for the energy usage of a building which is not controlled i.e., energy consumption from systems in the building on which the Building Regulations do not impose a requirement. The results presented in the graph demonstrate worst case scenario usage for the yearly occupation, and base on initial assumptions from similar buildings and poor efficiency equipment.

Domestic Hot Water (DHW) was identified as the second largest contributor accounting for 16.6% of the Domestic energy usage, and 10.8% of the Non-domestic usage. Typically, higher in the domestic modelling due to the increased amount of water consumption in dwellings.

Lighting was the final large contributor to the scheme accounting for a total of 41.8% in the Non-Domestic, and 1.5% in the Domestic space. The Non-Domestic space requires higher lighting demand than the domestic spaces.

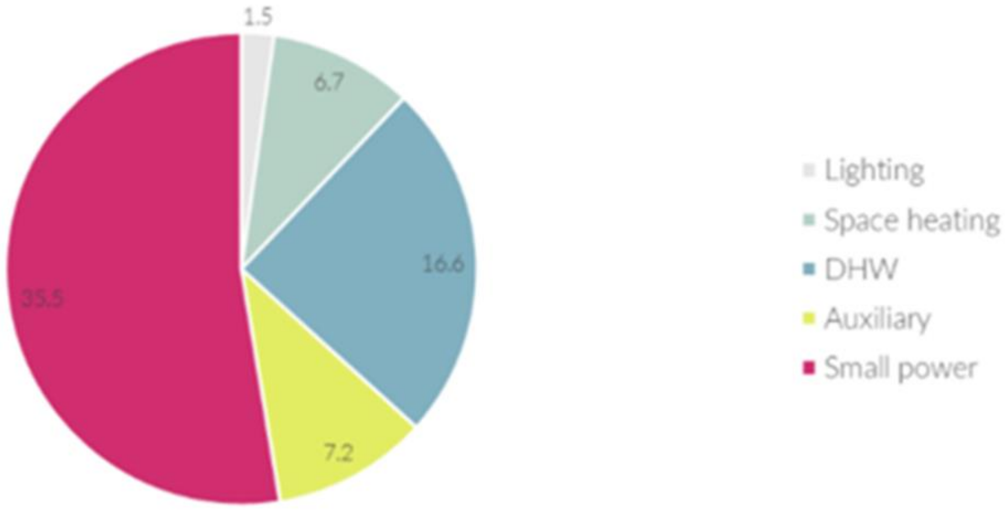


Figure 10 Operational Energy Demand – Domestic Figure 11 Operational Energy Demand - Non-Domestic

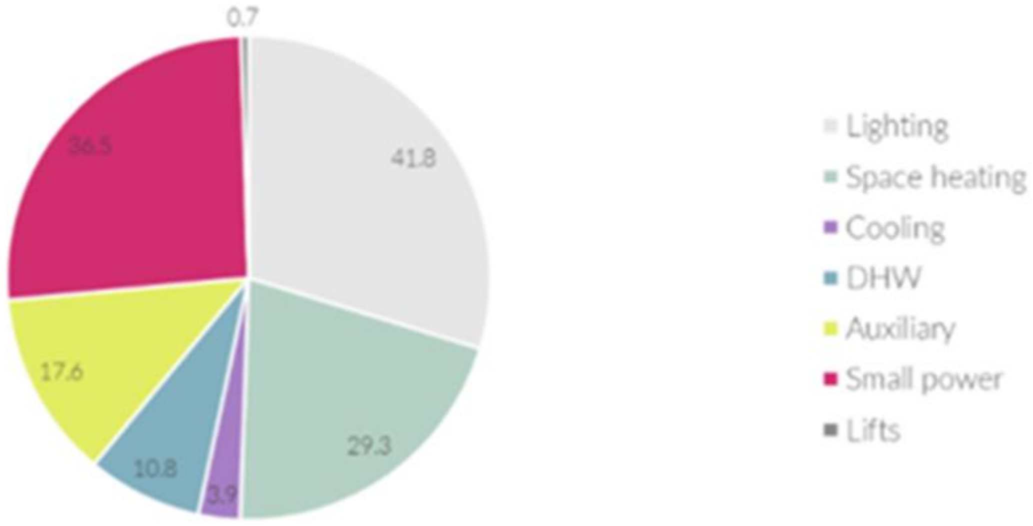


Figure 11 Operational Energy Demand - Non-Domestic

Following a review of the systems design and considering where the best benefits would be obtained, it was decided to review the following listed options were to be reviewed and captured in the TM54 analysis, and subsequently the WLC assessment.

- Update white goods spec in the PHPP based on the Peabody guidance
- Reduction in glazing
- Update the Glazing U-value to 1.20 W/m2 in line with the London Squares' Bill of Quantities
- Update and consideration of the lighting design
- Update the External Wall U-value to 0.13 W/m^2

5.1.2 Concrete Frames and Floors

The initial baseline design is comprised of a Reinforced Concrete (RC) Frame. Concrete was identified as the most suitable option for the scheme for the following motives:

- Elements of the RC Frame can be pre-cast (e.g., columns, walls, and stairs) and therefore reduce the amount of wastage (from formwork or materials) from in-situ construction; and
- Precast concrete suppliers, including manufacturers of pre-stressed elements, are required to be signatories to the British Precast Sustainability Charter, provide evidence that they have or are working towards BS EN ISO 14001 certification and be participating in the British Precast "Concrete Targets" health and safety improvement scheme.

Waterman specifications require all reinforcement to be sourced responsibly and sustainably by requiring the fabricator and mill supplying the reinforcement to be certified through either the "Eco- Reinforcement" scheme operated by BRE Global or the "Sustainable Reinforcing Steel" scheme operated by CARES or other third-party accredited scheme that follows the principles of BS 8902.

This material was initially established as the most suitable for the development due to the following details:

- The basement construction and foundation requirements (durability, robustness, resilience & water resistance) drive the need to use reinforced concrete below ground. Utilising other materials within this area of the design, could potentially compromise the initial structure risking higher maintenance requirements, and costs, and potential long-term damage to these areas.
- Secondly, due to the heights of the buildings, up to 13 storeys above a basement, alongside their proposed residential use mean that an RC Frame superstructure for the buildings is able to deliver an efficient solution using a Flat Slab Construction with RC Core Walls and Columns. However, in the limited situations where transfer structure is required, this can also be constructed as an integral part of the RC Frame.

- In addition to this, the flat slab solution provides an efficient design in terms of slab depths, formwork, and future flexibility.
- Concrete's role in delivering a sustainable built environment through the performance benefits of durability (long life), robustness (strength and low maintenance), fire resistance, thermal mass (energy efficiency), acoustic performance and climate change resilience (food and extreme weather) – together with design excellence (potential for a reduced need for applied finishes) – is increasingly recognised and utilised by design teams in the delivery of the most sustainable projects and infrastructure.
- Concrete is a versatile and natural material and designers can use it efficiently to deliver structure and other functions of integrated designs. Concrete and its constituents have other strong sustainability credentials; for example, they are local to the UK and most are certificated to the highest, most demanding responsible sourcing standards.

The design team fully understood that there are carbon disadvantages to using RC throughout the scheme, however the use of RC was also considered in terms of the building design, purpose, and life cycle, and thus its wider sustainability impact and benefit. Nevertheless, the team did request a review for a CLT structure to be undertaken, in order to understand the differences in carbon between the two structural options and how this will influence other elements within the design. This is discussed in later section of this report.

5.2 1st Iteration - Embodied Carbon Results

Following the review of the baseline results, in the initial Net Zero Carbon workshop and ongoing discussions within the team, it was agreed to the take forward multiple options in order to minimise the overall carbon for the scheme. The options outlined were recognised to have the largest proposed impact on the design, in terms of reducing carbon. Taking forward multiple options, as opposed to just one, would also ensure the design has the best chance of reducing carbon in line with the development Net Zero aspirations. The changes confirmed to be tested were as follows:

- Investigate alternative refrigerant options with lower GWP.
- Investigate options to reduce the distribution pipework
- Review the results of timber stud partitions.
- Reduce screed (slab thickness)
- Review Cross Laminated Timber (CLT) structure,
- Improvements in Operational Energy, and finally
- Exposed Ceilings.

5.2.1 MEP Distribution Pipework

Options to reduce the network pipe distribution were considered within the MEP team, however it was recognised due to the early-stage design, the full information of this aspect was not yet confirmed. Whilst the material had already been captured within the baseline LCA model, the quantity specified represents an indicative figure, based on previous similar developments of a similar nature and scale. It was agreed, once the distribution design was underway, the MEP team would review and revise options seeking to reduce the embodied carbon within the network design.

5.2.2 Cross Laminated Timber (CLT)

For CLT a comparable approach was taken regarding the feasibility of the scheme pursuing the option. The initial results confirmed CLT to demonstrate a 12.9% reduction in carbon against the baseline design. Whilst the benefits of utilising CLT throughout the scheme can be noted such as lower embodied carbon, reduced waste production, improved thermal performance and design versatility, the comparison in terms of cost against steel or concrete (production, construction and maintenance and repair), restrictions on timber building heights, fire safety and overarching design of the building, and expected usage, it was decided not to capture this within the updated baseline design moving forward.

5.2.3 Results

The following graphs demonstrate the results from the 1st iteration.

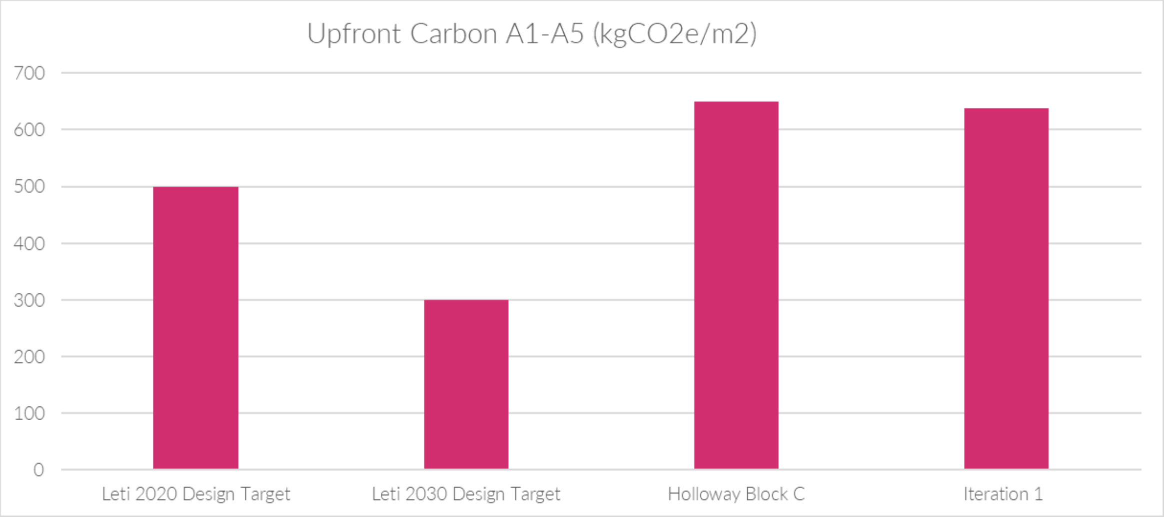


Figure 12 Iteration 1 results in comparison against the LETI and baseline benchmarks.

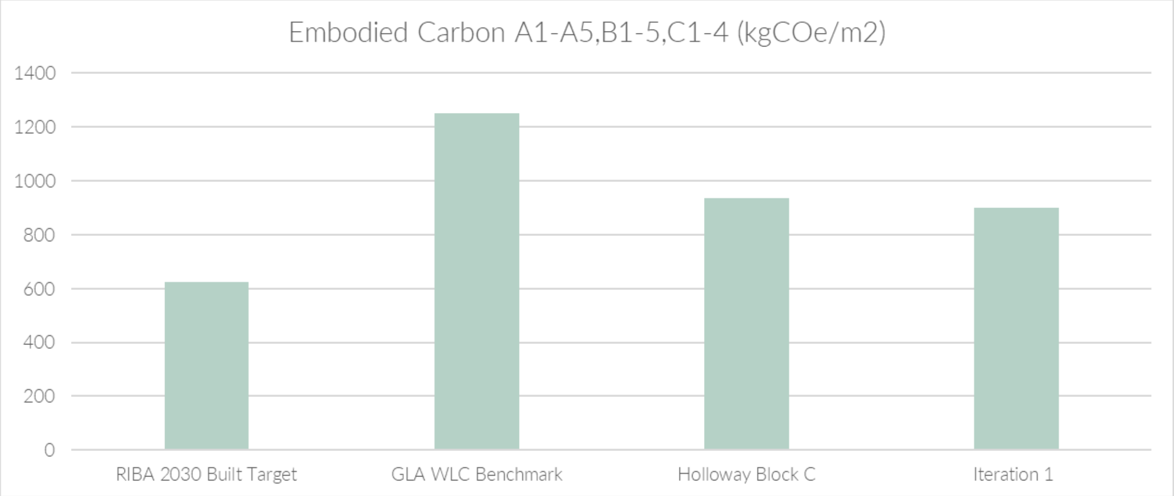


Figure 13 Iteration 1 results in comparison with RIBA and baseline benchmarks.

Independently, the results confirmed the following

- Architectural changes (timber stud partitions over steel studs): 1.4% reduction
- MEP changes (R410A to R454B refrigerant): 2.2% reduction.
- Operational energy: 9.3% reduction

Total reduction in carbon 12.9%.

Overall, the results presented demonstrated a 27% increase in comparison to the LETI 2020 Design Target, and 112% in comparison to the LETI 2030 Design Target. Whilst the results still exceed the LETI benchmarks, the changes incorporated, demonstrated overall a ~3% increase from the initial baseline results established improving on the Upfront Carbon with the scheme. Comparatively, the Embodied Carbon changes demonstrated the results to still be exceeding RIBA 2030 built target by 44%, however achieving the required GLA benchmark threshold by 26%.

5.3 2nd Iteration - Embodied Carbon Results

Further investigations were discussed with the team in the second workshop as to how to reduce the carbon further. Building upon the knowledge from the initial baseline results provided, the team considered the following options to incorporate into the design:

The 2nd update to the design accounted only for the following options:

- Screed board and exposure of concrete soffit; and
- Ceiling removal and gypsum plasterboard removal.

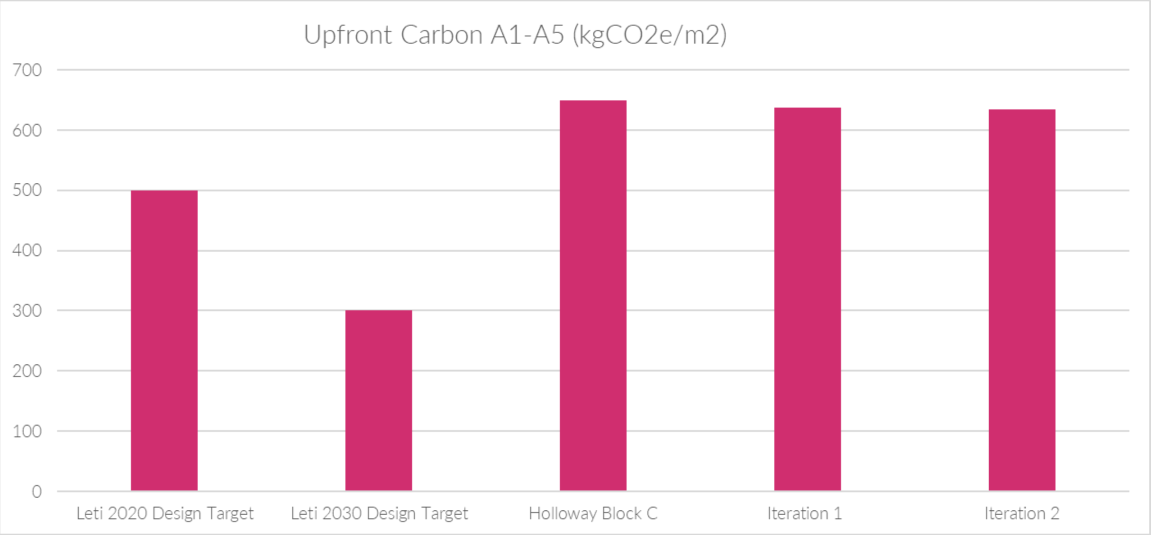


Figure 14 Iteration 2 results in comparison against the LETI and baseline benchmarks.

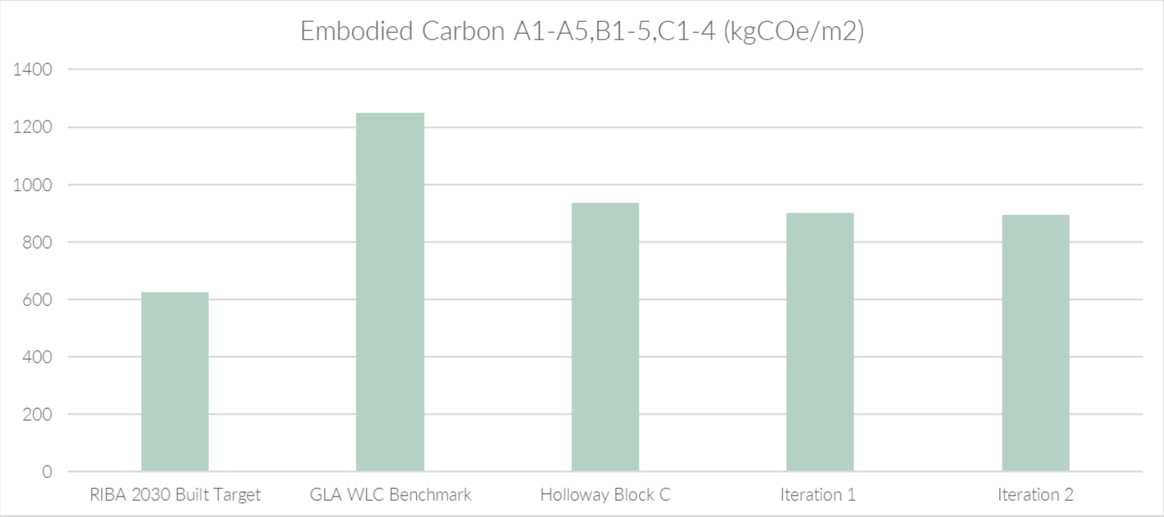


Figure 15 Iteration 2 results in comparison with RIBA and baseline benchmarks.

The results demonstrated the exposure of concrete soffits, and replacement of screed, with screed board instead, alongside ceiling removal and gypsum plasterboard removal would result in a further carbon reduction of 0.18-0.28% in comparison to the baseline design.

Overall, performance of the building was still exceeding against the LETI 2020 Design Target by 27%, and the LETI 2030 Design Target by 112%. Comparatively, for Embodied carbon the results demonstrated to still be exceed the RIBA 2030 Built target by 44%, however still complying with the GLA WLC benchmark by 28%.

5.4 Final Iteration - Embodied Carbon Results

Following the review of the 2nd iteration results, and a subsequent review of all of the materials and approaches from the team, the final approach was determined for Plot C. The results of the approach can be identified in Figure 16 and 17 below. The full material appraisal from the team is located in Table 3, page 14.

The anticipated Upfront Carbon for Plot C is anticipated to be: ~ 650 kgCO$_2$e/m^2.

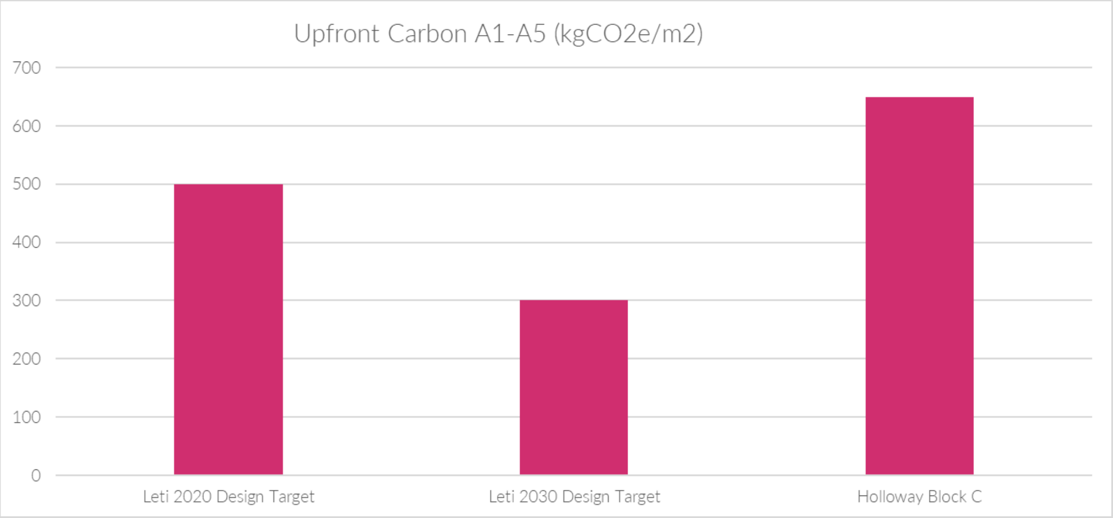


Figure 16 Final Upfront Embodied Carbon Results in comparison against the LETI Benchmarks

The anticipated total Embodied Carbon for Plot C is anticipated to be: ~ 935 kgCO$_2$e/m^2.

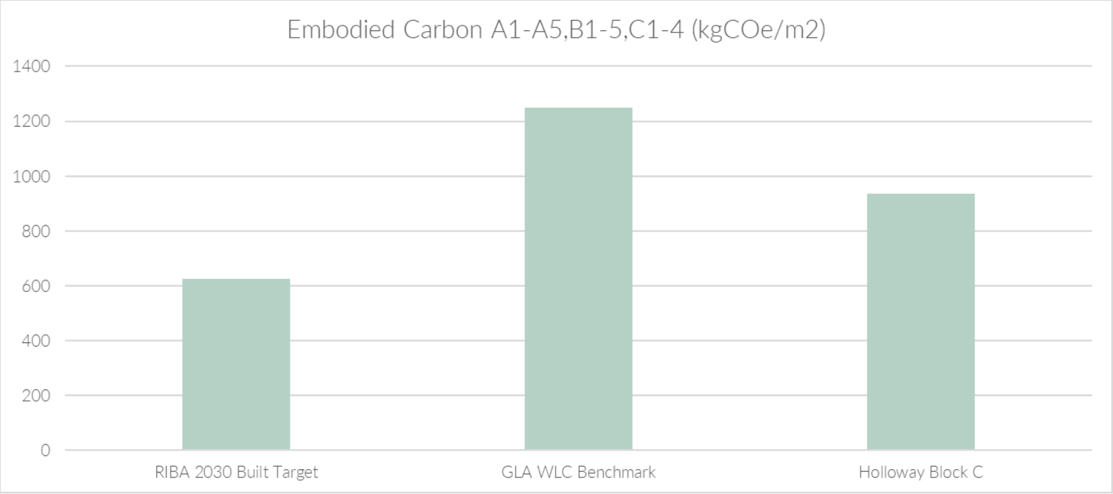


Figure 17 Final Total Embodied Carbon Results in comparison with the RIBA & GLA Benchmarks.

The results demonstrate, in comparison with the LETI benchmarks, that the scheme is expected to exceed the targets (2020: 500 kgCO2e/m2, and 2030: 300 kgCO2e/m2) by ~30-117%. In comparison, the Embodied Carbon results demonstrate the building is to exceed upon RIBA 2030 target (625 kgCO2e/m2) by ~50%, however maintaining improvement on the GLA target (1050 – 1250 kgCO2e/m2) by ~25%.

The reason for these differing comparisons is due to the different approach taken by the professional bodies in setting the target benchmarks. The LETI methodology only evaluates the amount of Upfront Carbon, which is generated, evaluating the Product Stage (A1-A3), and Construction Stage (A4-A5) appraising the sourcing, transportation of materials, and finally manufacturing and construction and the associated carbon emissions resulting from these processes. The RIBA and GLA benchmark targets assess all Upfront Carbon (A1-A5), In-use Carbon (B1-B5) including emissions associated with maintenance, repair, replacement of the components, and finally carbon emissions associated with the End-of-Life Stage (C1-C4) such as deconstruction and demolition, exporting the materials away, waste processing and disposal. Similar to the LETI benchmark, the RIBA benchmark outlines the target which buildings should be designed to in line with UK 2025 Climate Change targets.

In comparison to these targets, the GLA WLC target has been established based on verified project information of a similar building type using LCA tools such as Etool, OneClick as well as supporting design stage information. The information captured within these assessments follows the RICS Professional Statement (RICS PS) in terms of the scope of assessment, and material baseline assumptions and specifications.

The WLC results presented in our findings have provided an indicative result for the WLC emissions to be produced throughout Plot C life cycle. The assessment has been based upon the London Square Bill of Quantities, engagement throughout the NZC process with the design team and assessing different options, as well as the RICS PS. As the project continues, it anticipated the results confirmed in line with LETI, RIBA and GLA WLC benchmarks will improve due to the increased availability and accuracy of information becoming available, as well as a greater opportunity to influence where materials are sourced and procured from in line with Environmental Product Declarations and Responsible sourcing declarations. This knowledge and understanding will assist the design team in reducing the overall carbon emissions for the design, and therefore continue to strive towards work towards achieving and improving on the WLC benchmark targets for the future.

Table 3. Net Zero Carbon - Material Appraisal.

Element to Review	AHMM (Architectural)	Watermans (Structures)	Hoare Lea (MEP)	Acoustic (Max Fordham)	Peabody (Client)	LSQ (Cost) Comments	LSQ (Programme) Comments	Included into the scheme
Architectural changes (steel studs to timber)	Concealed element. No reservations from an architectural viewpoint. Inclusion will be driven by cost and programme.				This was worth exploring for wall internal partitions (not as part of the external wall (due to fire safety) to understand percentage reduction. On balance, the reduction does not outweigh additional waste, construction complexity, and risk of quality issues and potential future defects compounded by the split responsibility created by bringing in two separate trades, as outlined by LSQ.	This item not recommended by LSQ due to increased sub-contractor requirements. It would also result in extensive waste of materials, due to floor-to-floor heights and increased risk of ceiling head deflection issues	Considerations for separate trades coming on site and the coordination of them. When you place the metal stud and plasterboard with one dry liner contractor, they are responsible for the delivery, however if you have a timber stud and pick-ups are missed or things are out of position you have coordination issues surrounding bringing people back to check and re-do work. The carpentry subcontractor would need to come on board earlier than required which could add costs due to extended prelims for them being on site It has far more chance for delays and quality issues.	✗
Structural changes (concrete to CLT structure)				Internal sound insulation between dwellings is achievable with timber frame or CLT constructions but requires careful specification/design of isolated room linings - screeds/screed boards, facade linings, ceilings Internal sound insulation from non-residential to residential may be difficult to achieve as the scheme is subject to some significantly higher performance	Not considered appropriate by Peabody due to scale of development, and because of the fire safety issues identified by LSQ and acoustic challenges identified by Max Fordham.	We would need to allow for fire doors on closers fixed to every single apartment door and during construction along with each landing and stair core. We would also need to allow for significant amounts of fire board and mastic to seal any service holes between fire compartments and floors. For example, holes from corridors to flats for services, risers, soil vent hole locations.	CLT construction requires a longer lead in time and an early fixed design. All penetrations, risers, MEP positions, door locations, bathrooms etc all need to be fully coordinated and fixed prior to the CLT manufacturer commencing their design. Any changes could lead to impacts on structural integrity and fire compartmentalisation.	✗

Element to Review	AHMM (Architectural)	Watermans (Structures)	Hoare Lea (MEP)	Acoustic (Max Fordham)	Peabody (Client)	LSQ (Cost) Comments	LSQ (Programme) Comments	Included into the scheme
				requirements from some non-residential uses (multi-function spaces in the Woman's Building, Spin Studio, Cinema) Lightweight facades (if present) need to be acoustically robust towards Camden Road/Parkhurst Road More reliance on carefully specified AV mounts for rooftop plant (may require concrete inertia bases in addition to spring/elastomeric mounts).		This is to compartmentalise areas during construction for fire safety. Additional assistant site manager required to undertake constant checking of the sealing of compartments and to ensure fire doors are not wedged open by operatives.		
Glazing Reduction	Careful balance required between the daylighting requirements, the overheating requirements, and the heating/ cooling impacts							✓
Screed Reduction* *To be reviewed and calculated later on in the project programme.	Acoustic treatment required in either ceiling or floor when screed reduced. Overall reduced floor build up would mean localised structural solutions required for accessible apartment level access showers.	Sand Cement Screeds can be reduced/removed by the use of alternative products (with a reduced thickness) or by installing a timber floating floor. The removal of screeds will reduce the overall dead weight of a building and hence provide efficiency savings in the RC Frame Design (reduced reinforcement densities to address long-term deflection requirements). The reduced overall weight will also reduce the foundation loads and can be used to shorten the required foundation				.		✓

Element to Review	AHMM (Architectural)	Watermans (Structures)	Hoare Lea (MEP)	Acoustic (Max Fordham)	Peabody (Client)	LSQ (Cost) Comments	LSQ (Programme) Comments	Included into the scheme
		pile lengths or numbers under the buildings.						
Exposed ceilings (bin and bike stores, plant rooms and communal staircases) * *To be reviewed and calculated later on in the project programme.	Beneficial to thermal mass. Requires careful coordination of exposed services.							✓
MEP changes (refrigerant use)			The ASHP units we have incorporated into our design are actually going to be converted from R410a to R454B. R454B has a GWP of 466 which is 76% less than R410A & 34% less than R32 – the efficiencies etc remain as per our original design.					✓
Recycled Aggregate (20%) Assumed in concrete structure		Aggregates for concrete may contain up to 20% of recycled content, as permitted under BS 8500. As a general provision, maximum aggregate sizes below 10mm are not generally required, thus minimising embodied carbon where aggregates are crushed to achieve smaller sizes. Recycled Concrete Aggregate (RCA) is permitted for use in structural elements where the strength class is lower than C40/50 (generally slabs) and the environmental exposure class is determined to			Peabody would like to explore this as an option at the next design stage, noting that it is dependent on recycled material being available as advised by London Square.	This item is dependent on recycled material being available at the local Concrete Batching Plant. Further information will be required to price this item	If there are any delays in procuring recycled aggregate for the scheme, this will impact the overall construction programme.	~

Element to Review	AHMM (Architectural)	Watermans (Structures)	Hoare Lea (MEP)	Acoustic (Max Fordham)	Peabody (Client)	LSQ (Cost) Comments	LSQ (Programme) Comments	Included into the scheme
		be appropriate. Material obtained by crushing hardened concrete of known composition that has not been in use and not contaminated during storage and processing can be used in any strength class. Recycled Aggregate (RA) is generally obtained from demolition arisings and can be highly variable. Appropriate uses include landscape fill and mass concrete fill where there are no particular standards to be achieved for durability and strength class. RA is not recommended for use in structural concrete.						
Refrigerator and Freezer changed to Fridge-Freezer								✓
Tumble Dryer/ Washer Dryer					Where Peabody do install appliances, we will install washer dryers. Where Peabody does not install appliances, we will encourage residents to install washer dryers rather than tumble dryers.			✓
Glazing U-value changed from 1.00 to 1.20 W/m²K								✓

Element to Review	AHMM (Architectural)	Watermans (Structures)	Hoare Lea (MEP)	Acoustic (Max Fordham)	Peabody (Client)	LSQ (Cost) Comments	LSQ (Programme) Comments	Included into the scheme
External Wall U-value changed from 0.15 to 0.13 W/m²K								✓
Non-domestic g-value reduced from 0.50 to 0.30								✓

6. Operational Carbon.

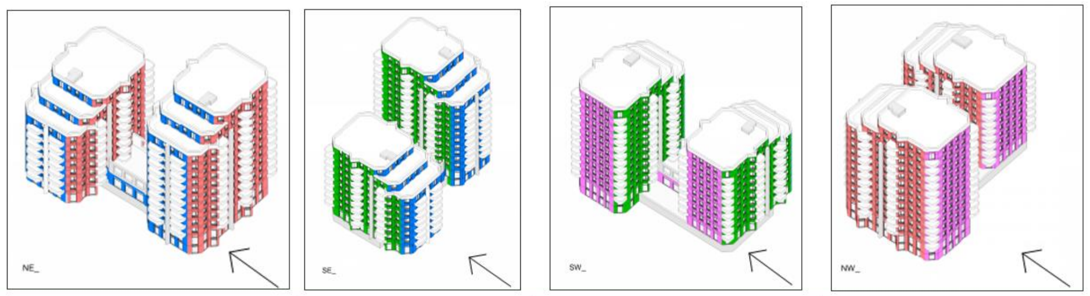
For the baseline design a Passivhaus (PHPP) assessment was undertaken for the domestic areas and a TM54 Operational Energy Performance was completed assessing the Non-Domestic areas. The aim of the study was to provide the building users with an understanding as to how much energy the expected design is to consume once in operation.

The studies consider the expected lighting, heating, ventilation and cooling and provision of hot water systems, as well as lifts and escalators, small power loads, catering, server rooms and other plant and equipment. The exercise provided the design team with an understanding as to how efficient the proposed systems are to work throughout the building once in operation, and similarly to the overall WLC assessment, identify areas where systems could be improved and enhanced in order to lower the overall carbon usage.

Prior to looking at the energy consumption in Plot C, the team worked on the building design, and in particular the façade to see how demand reduction could be designed in.

6.1 Glazing Ratio and Orientation

The glazing ratio for Plot C has been reduced in line with the limiting daylighting requirements, and ranges from between 29-31%.



	NE	SE	SW	NW
Wall Area	2727.18 m^2	1533.00 m^2	2655.36 m^2	2727.18 m^2
Glazing Area	801.04 m^2	486.73 m^2	822.62 m^2	801.04 m^2
Glazing Ratio	29%	32%	31%	29%

Figure 18: Holloway Plot C Glazing Ratio

6.2 Access for Daylighting and Ventilation

Careful consideration has been given in order to design the façade and glazing ratio to optimise the strategy to meet the LBI daylight/ sunlight criteria – this limited any significant glazing reductions across many of the Blocks across the proposed development.

Careful design consideration was also required to meet the acoustic and overheating criteria. Figure 19 below demonstrates comparison of the fabric performance criteria for Part L1A notional building and the Passivhaus standard.

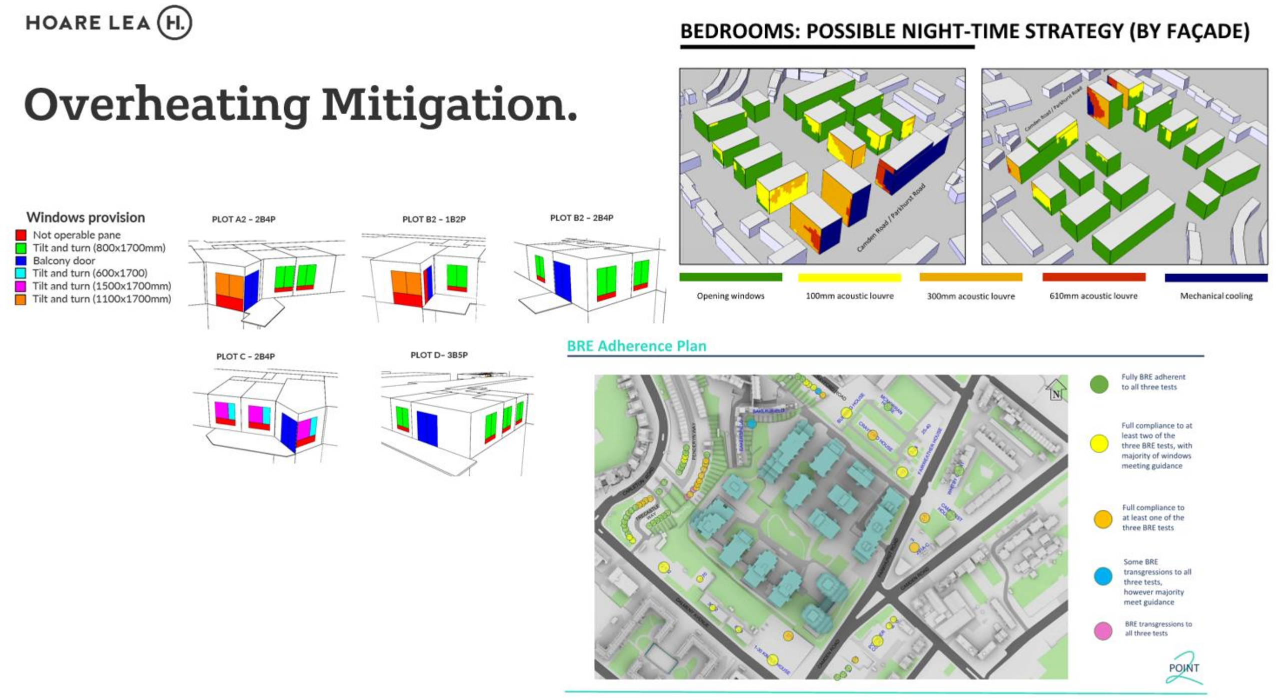


Figure 19: Comparison of the fabric performance criteria for Part L1A notional building and the Passivhaus standard.

6.3 Baseline - Domestic Operational Carbon Assessment Results (PHPP)

To begin with, a detailed model was completed in SketchUp. This incorporated all external elements of building C1 together with the internal floor layouts for the apartments and the communal corridors, in line with PHPP criteria.

The model was then completed using the PHPP planning tool. This incorporated all other elements including:

- Fabric parameters
- Ventilation
- Heating
- Cooling
- DHW & distribution
- PV
- Auxiliary energy
- Small power

As a result, the following graphs show the breakdown of results for the domestic operational energy. The RIBA benchmarks are also displayed. The total energy consumption of the baseline model was 67 kWh/m²/yr.

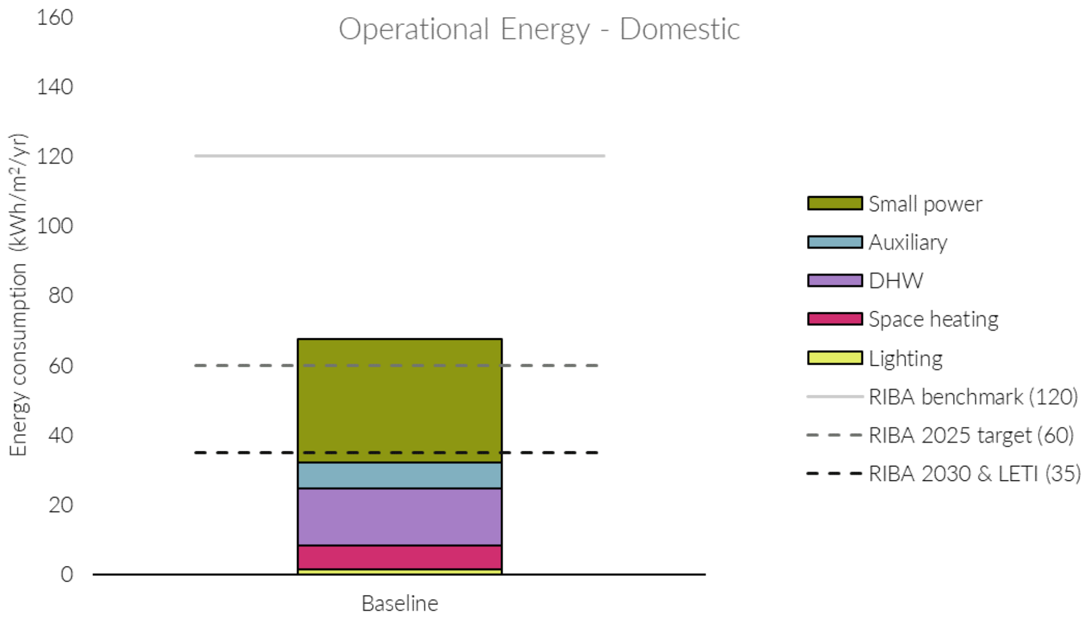


Figure 20: Holloway Plot C Domestic Operational Energy - Baseline

A breakdown of the operational energy shows that small power accounts for the majority of the energy consumption for the residential dwellings.

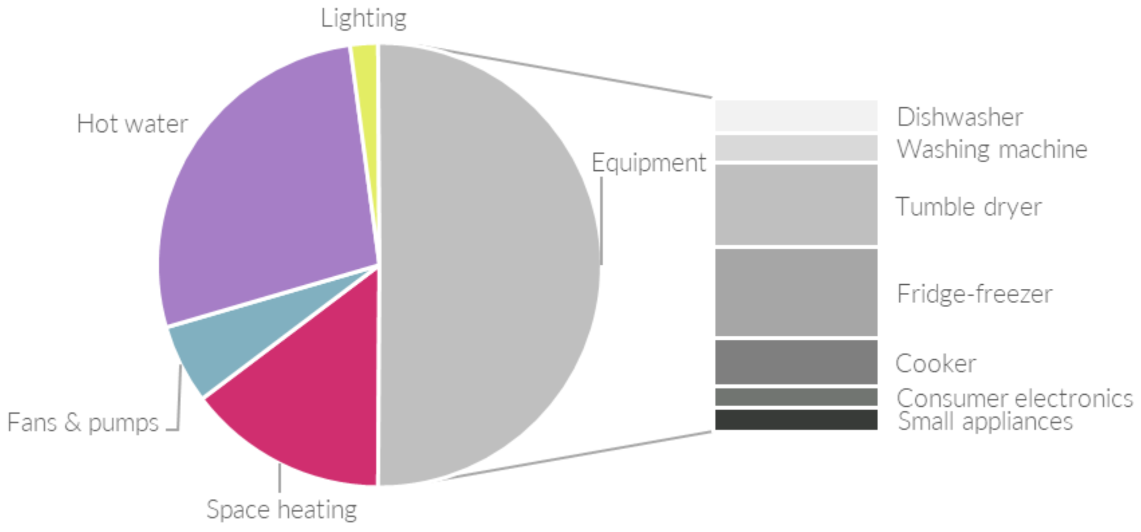


Figure 21: Holloway Plot C Domestic Operational Energy Breakdown - Baseline

The results were presented and workshopped with the team, including input from LBI Energy Officers, with the following further reductions to be investigated:

- More accurate estimate of residential occupancy
- Tumble dryer and dishwasher use
- Improved SCOP for ASHP
- Detailed PV output
- Improved lighting design
- Improved energy efficiency of equipment
- Reduce thermal bridges
- Improve window performance
- Reduced air permeability
- Enhanced external wall insulation

These suggested improvements were discussed with the design team as to the implications on the design and taken forward into the 1st iteration.

6.4 1st Iteration - Domestic Operational Carbon Assessment Results (PHPP)

For the 1st iteration, the following amendments were made to the model following discussions with the design team, including the client, architect, mechanical and electrical engineers:

- Residential occupancy amended to Passivhaus standard
- Dishwashers use only for 3B5P and above
- Refrigerator and Freezer changed to Fridge-Freezer
- 1,918 kWh PV added
- Glazing U-value changed from 1.00 to 1.20 W/m^{2}K
- External Wall U-value changed from 0.15 to 0.13 W/m^{2}K
- Roof and floor also amended (0.12 and 0.10 W/m^{2}K)

Following these amendments, the total energy consumption reduced from 67 kWh/m^2/yr. to 41 kWh/m^2/yr. The largest reduction was through the small power, reducing from 35.5 kWh/m^2/yr. to 16.8 kWh/m^2/yr., a reduction of 53%. The small change was the space heating which actually increased by 10% from 6.7 to 7.3 kWh/m^2/yr., predominantly due to the increase in glazing U-value which had a greater impact that the reductions in external wall, roof, and floor U-values. The figure below shows the reduction.

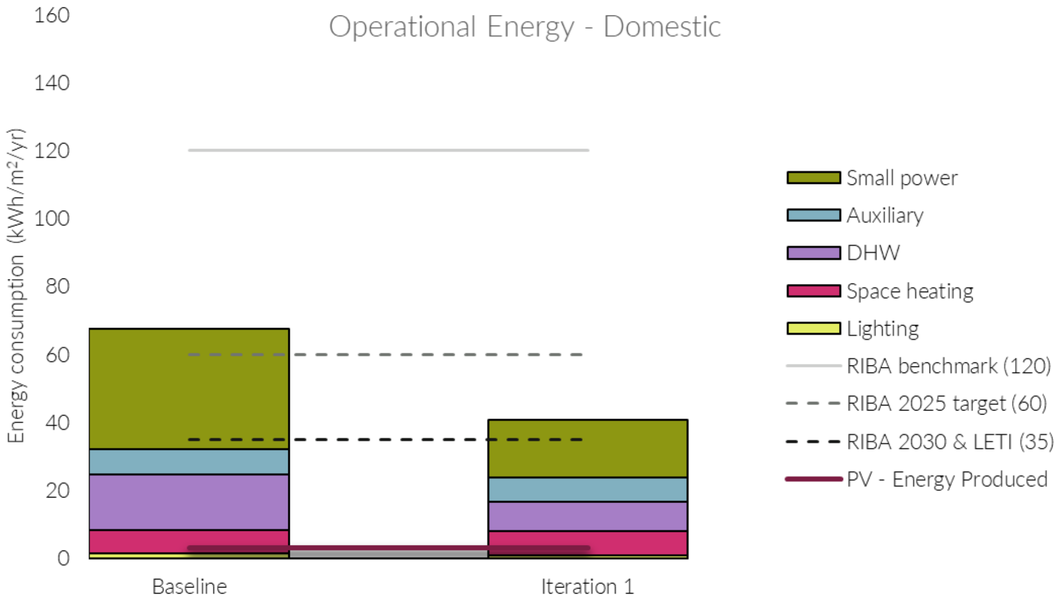


Figure 22: Holloway Plot C Domestic Operational Energy – 1st Iteration

Following these results, another Net Zero workshop with the design team took place and improvements discussed and then taken forward into the 2nd iteration.

6.5 2nd Iteration - Domestic Operational Carbon Assessment Results (PHPP)

For the 2nd iteration, the following further amendments were made to the model following the discussions with the design team:

- Glazing reductions
- MVHR with tempered air incorporated (cooling) – to align with the overheating strategy + acoustic requirements.

Detailed plans and elevations showing the glazing reductions were provided and updated in the PHPP model. This had a positive effect, reducing the space heating consumption. However, due to the incorporation of a small amount of cooling from the MVHR with tempered air units, the total energy consumption remained at 41 kWh/m²/yr.

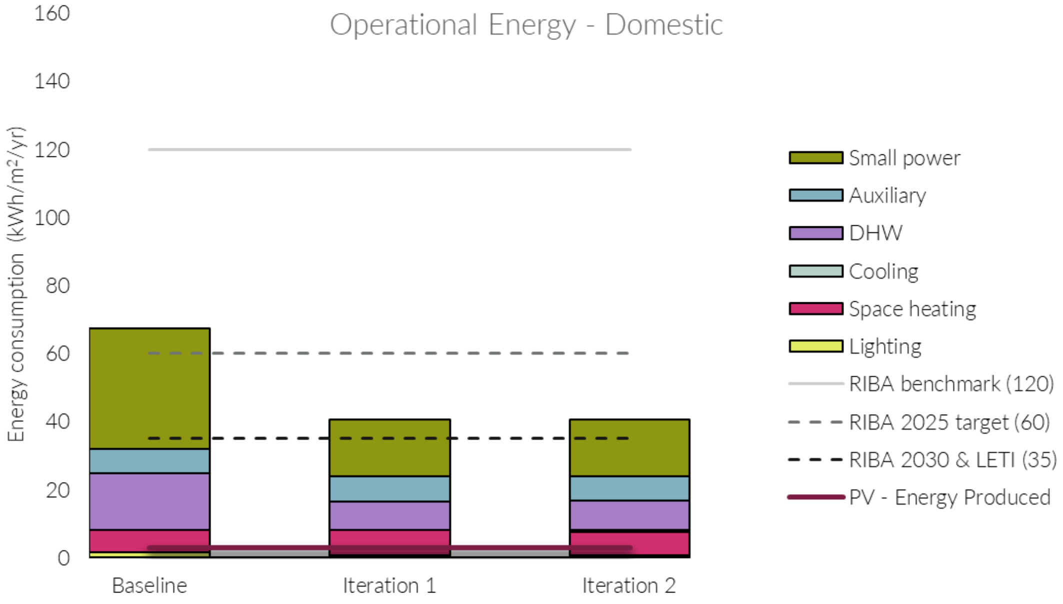


Figure 23: Holloway Plot C Domestic Operational Energy – 2nd Iteration

6.6 Baseline – Non-Domestic Operational carbon assessment results (TM54)

To begin with, a detailed model was completed in IES. This incorporated all internal and external elements of the women's building and also the following systems and parameters, in line with the TM54 methodology:

- Fabric parameters
- Heating including coefficient of performances of plant
- Cooling including seasonal efficiencies of plant
- Ventilation and auxiliary energy including specific fan powers
- DHW & distribution
- Unregulated loads

As a result, the following graphs show the breakdown of results for the non-domestic operational energy. The RIBA benchmarks are also displayed. The total energy consumption for the baseline model was 141 kWh/m²/yr.

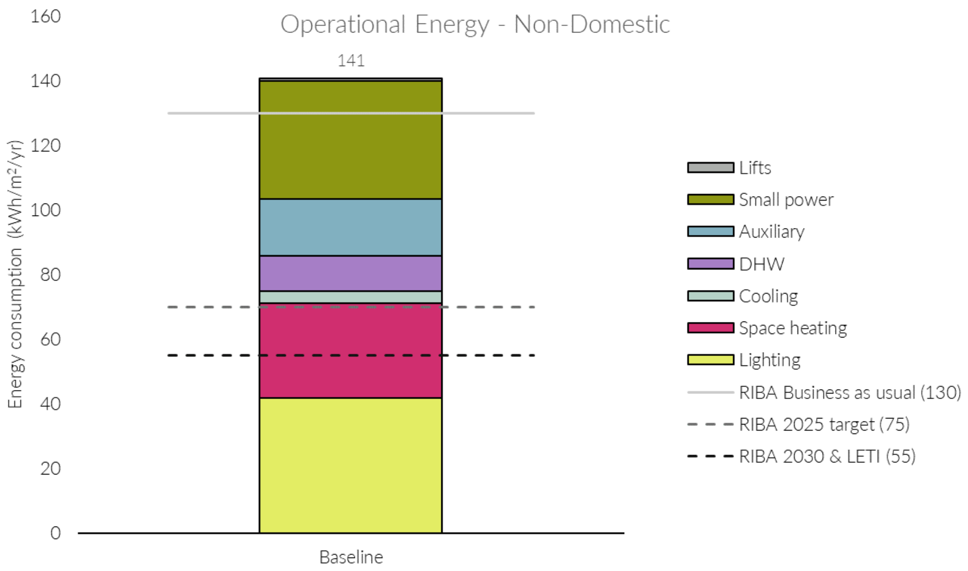


Figure 24: Holloway Plot C Non-Domestic Operational Energy - Baseline

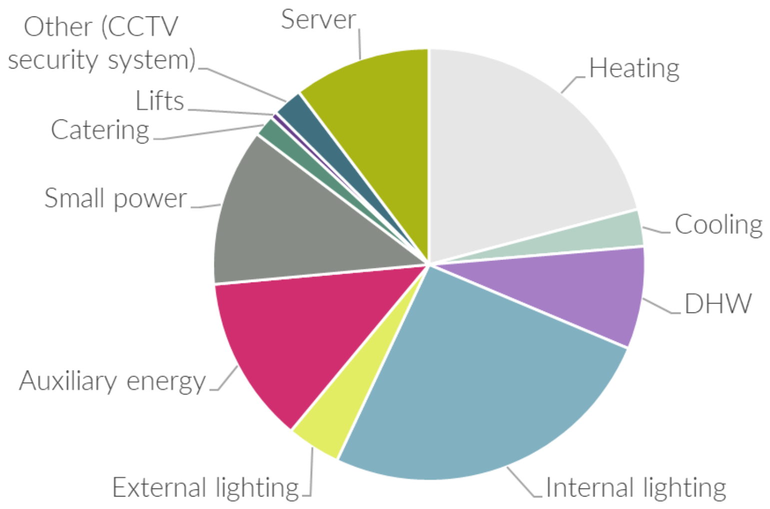


Figure 25: Holloway Plot C Non-Domestic Operational Energy Breakdown - Baseline

Improvements were discussed with the design team in a Net Zero workshop and taken forward into the 1st iteration. These were predominantly services parameters.

6.7 1st Iteration – Non-Domestic Operational Energy Breakdown

For the 1st iteration, the following amendments were made to the model following discussions with the design team, including the client, architect, mechanical and electrical engineers:

- Non-domestic g-value reduced from 0.50 to 0.30
- Storage lighting density and usage reduced
- ASHP SCOP improved

Following these amendments, the total energy consumption reduced from 141 kWh/m²/yr. to 137 kWh/m²/yr. The largest reduction was through the cooling, with a 27% reduction, followed by the space heating with a 6% reduction. Figure 24 below shows the reduction.

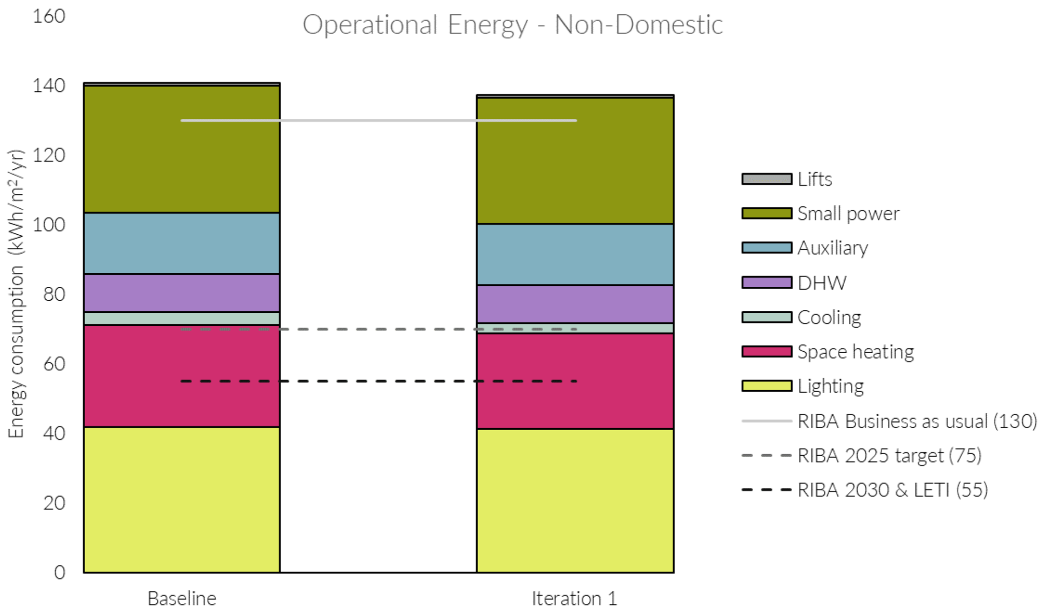


Figure 26: Holloway Plot C Non-Domestic Operational Energy – 1st Iteration

Whilst the results have demonstrated improvements have been achieved, no further iteration was undertaken following the first set of changes. This was due to the non-domestic spaces only being designed to a shell and core fit out, as well as only accounting for a total of 4% of the areas being assessed. It was recognised that greater value was to be provided for the scheme for the areas where the opportunity to influence the design was within the design team scope. The results presented in Figure 26 provide an indicative figure on the expected energy usage within this area, considering the listed changes as well as best practise assumptions for the components where no information has been confirmed e.g., small power, lighting, and space heating.

It is expected that as the design progresses, further information and understanding on how the expected non-domestic areas are to operate will be provided. This information will therefore inform the assessment on the expected energy usage to greater accuracy, resulting in a greater understanding on expected energy demand and how the design team can influence, manage, and mitigate this for the future.

7. Conclusion.

Following the Net Zero Carbon feasibility study that was undertaken with the internal design team, with input and commentary from LBI's Energy Officers on Plot C of the proposed development, the below targets have been set for the building.

Although the embodied carbon results do not meet the LETI or RIBA 2030 targets, the performance of Plot C has made a positive step from the Business-as-Usual performance towards the 2030 targets. As the project progresses, further opportunities in regard to reducing the buildings embodied carbon will become available such as further detail around the material quantities and selection of EPDs. These processes combined, will collectively work towards informing the design team on the expected carbon emissions associated with each material and building element assess, and ensure informed choices and design considerations are incorporated for the future, and reducing carbon emissions.

Table 4: Holloway Plot C Embodied Carbon Results

Embodied Carbon	
Upfront Carbon	~ 650 kgCO$_2$e/m^2.
Total Embodied Carbon	~ 935 kgCO$_2$e/m^2

The operational energy performance of the domestic element of Plot C has been reduced considerably through the improvement of the façade performance and system efficiencies. This area has been a key focus for the team in delivering value for the occupants of the social rent units.

More detailed analysis will be included within the Green Performance Plan which secures all relevant and necessary performance targets and accompanies the planning application.

Table 5: Holloway Plot C Operational Carbon Results

Operational Carbon	
Domestic	~ 41 kWh/m²/yr.
Non-Domestic	~ 137 kWh/m²/yr.

Appendix A: London Borough of Islington NZC KPIs.

Holloway Prison.
Net Zero Carbon KPIs.

	Requirements for Net Zero Carbon	Holloway
Feasibility	Carry out a Stage 2 Net Zero Carbon Feasibility Assessment	Yes
Reduce Operational Energy Consumption	Achieve an Energy Use Intensity of less than 35 kWh/m^2/yr.	~41 kWh/m^2 /yr. (Residential) ~137 kWh/m^2/yr. (Non-residential)
	Achieve a space heating demand between 10 and 15 kWh/m^2/yr. Target a total hot water demand of less than 18 kWh/m^2/yr.	~26.2 kWh/m^2/yr. ~16 kWh/m^2/yr.
	Target an air permeability of less than 0.6 m^3/h/m^2 at 50 Pa	3.00 m^3/h/m^2
Reduce Embodied Carbon	Report embodied carbon for building life cycle stages A1-A5	Yes
	Compare to the benchmark value of 500 kg/CO$_2$/m^2/yr. for new multi-residential buildings report improvements achieved during design	Yes ~650 kgCO$_2$e/m^2
Low Carbon heat Supply	No gas connection or fossil fuel consumption on site	Yes
	Estimate average heating costs per dwelling for a typical dwelling Including direct energy costs, standing charge, maintenance, and replacement cost per unit	£272.00
	Report estimated distribution losses in kWh/unit as well as % of heating and hot water demand	10.95 kW 29%
	Report estimated carbon content of heat (kgCO$_2$/kWh$_{\text{heat delivered}}$)	~0.136 kgCO$_2$/kWh
Measurement and verification	Commitment to predict energy use and report at planning	Yes
	Commitment to predict energy use and report at tender	Yes
	Commitment to predict energy use and report at end of construction	Yes
Zero Operational Carbon Balance	Achieve a renewable electricity generation on-site of more than 100kWh/m$^2_{\text{building footprint}}$/yr.)	No ~62kWh/m^2/year
	Report on-site renewable electricity generation in kWh/m^{2}GIA/yr.	~1.64kWh/m2/year
	Report predicted annual energy balance for the whole development Energy Use Intensity (EUI) vs renewable electricity generation, both in kWh/m$^2_{\text{GIA}}$/yr.	~41 kWh/m^2 /yr. (Residential) ~137 kWh/m^2/yr. (Non-residential)
Overheating Risk	Clearly describe summer comfort strategy CIBSE TM59 Overheating risk assessment	Please refer to TM59 Overheating risk assessment for full detail.

Appendix B: Embodied Carbon Inputs.

Holloway.
NZC: Embodied Carbon Inputs.

Building element group	Building element (NRM level 2)	Basis for information
Demolition	0.1 Toxic/hazardous/contaminated material treatment	An allowance for contaminated land removal and treatment has not been provided for the Proposed Development.
	0.2 Major demolition works	An allowance for site excavation and demolition works was included in the assessment and used the average intensity of 1.39 kg CO2e / m3 cleared debris, as developed by OneClick LCA software.
0 Facilitating works	0.3 & 0.5 Temporary/enabling works	Due to the early stage of the design (RIBA Stage 2) this information is not yet available and as such has not been included in the assessment.
	0.4 Specialist groundworks	No specialist ground works were included separately. The individual ground works were accounted for in the relevant sub structure / external landscaping sections
1 substructure	1.1 Substructure	The foundations materials were drawn from the London Square Jan 2021 Cost Plan's description of needed material quantity and composition
2. Superstructure	2.1 Frame	The frame materials were drawn from the London Square Jan 2021 Cost Plan's description of needed material quantity and composition
	2.2 Upper floors incl. balconies	The upper floor and balconies materials were drawn from the London Square Jan 2021 Cost Plan's description of needed material quantity and composition
	2.3 Roof	The roof materials were drawn from the London Square Jan 2021 Cost Plan's description of needed material quantity and composition
	2.4 Stairs and ramps	The information from the London Square Jan 2021 Cost Plan did not provide suitable information about the Stairs and ramps
	2.5 External walls	The external wall materials were drawn from the London Square Jan 2021 Cost Plan's description of needed material quantity and composition
	2.6 Windows and external doors	The window and external door materials were drawn from the London Square Jan 2021 Cost Plan description of needed material quantity and composition
	2.7 Internal walls and partitions	The internal partition materials were drawn from the London Square Jan 2021 Cost Plan's description of needed material quantity and composition
	2.8 Internal doors	The information from the London Square Jan 2021 Cost Plan did not provide suitable information about the internal doors
3 Finishes	3.1 Wall finishes	The wall, floor and ceiling finishes areas were gathered from the London Square Jan 2021 Cost Plan
	3.2 Floor finishes	
	3.3 Ceiling finishes	
4 Fittings, furnishings, and equipment (FF&E)	4.1 Fittings, furnishings & equipment incl. building-related* and non-building-related**	The quantum of FFE for the residential apartments are gathered from the London Square Jan 2021 Cost Plan, and uses benchmark data from previous comparable assessments for any missing information.
5 Building services/MEP	5.1–5.14 Services incl. building-related* and nonbuilding-related**	The quantum of sanitaryware were calculated based on the area schedule and occupancy, with EPD's matched to the fittings proposed to be installed.
6 Prefabricated Buildings and Building Units	6.1 Prefabricated buildings and building units	FF&E is not applicable to the non-residential uses as these are being built out to a shell-only speculative standard and the detailed use types are unknown.
7 Work to Existing Building	7.1 Minor demolition and alteration works	Building services data uses data provided from the Building Services engineers which align with the proposed services strategy for the project. The lengths of duct's, electrical distribution and water distribution were calculated on a m2 GIA basis using in-built EPD within OneClick LCA.
8 External works	8.1 Site preparation works	No prefabricated elements are applicable.
	8.2 Roads, paths, paving and surfacing	No minor works were applicable.
	8.3 Soft landscaping, planting, and irrigation systems	Due to the early stage of the design (RIBA Stage 2) this information is not yet available and as such has not been included in the assessment.
	8.4 Fencing, railings, and walls	Data for roads, paths, paving, and surfacing is based on details provided from the London Square Jan 2021 Cost Plan.
	8.5 External fixtures	Data for Soft landscaping, planting and irrigation systems is based on details provided from the London Square Jan 2021 Cost Plan where the external materials have been listed.
	8.6 External drainage	Due to the early stage of the design (RIBA Stage 2) this information is not yet available and as such has not been included in the assessment.
	8.7 External services	Due to the early stage of the design (RIBA Stage 2) this information is not yet available and as such has not been included in the assessment.
	8.8 Minor building works and ancillary buildings	Due to the early stage of the design (RIBA Stage 2) this information is not yet available and as such has not been included in the assessment.

The Life Cycle Modules included in the assessment and commentary on the data source.

Module	Description	Commentary of Data Source
A1-A3 Construction Materials	Raw material supply (A1) includes emissions generated when raw materials are taken from nature, transported to industrial units for processing and processed. Loss of raw material and energy are also taken into account. Transport impacts (A2) include exhaust emissions resulting from the transport of all raw materials from suppliers to the manufacturer's production plant as well as impacts of production of fuels. Production impacts (A3) cover the manufacturing of the production materials and fuels used by machines, as well as handling of waste formed in the production processes at the manufacturer's production plants until end-of-waste state.	Calculated using EPD's which align with the exact product (where known) or the most applicable similar product. The RICS guidance has also been used to ensure the most appropriate materials are used.
A4 Transportation to site	A4 includes exhaust emissions resulting from the transport of building products from manufacturer's production plant to building site as well as the environmental impacts of production of the used fuel.	The case specific transport distances were used when available. Other transport distances were estimated based on typical average transport distances based on material type & project location, provided by OneClick LCA. The RICS guidance has also been used to ensure the most appropriate materials transport methods are used.
A5 Construction/ installation process	A5 covers the exhaust emissions resulting from using energy during the site operations, the environmental impacts of production processes of fuel and energy and water as well as handling of waste until the end-of-waste state.	Due to lack of site-specific construction data, the climate zone average construction impact was used and sized based upon the scale of the development.
B1-B5 Maintenance and material replacement	The environmental impacts of maintenance and material replacements (B1-B5) include environmental impacts from replacing building products after they reach the end of their service life. The emissions cover impacts from raw material supply, transportation, and production of the replaced new material as well as the impacts from manufacturing the replaced material and handling of waste until the end-of-waste state.	Use (B1) include the impact of refrigerant leakage at leakage rate of 5% a year and 99% end of life recovery. Maintenance (B2) and Repair (B3) have not been considered due to accurate data being unavailable at this early stage. Replacement (B4) and Refurbishment (B5) account for the technical service life of the building components "BCIS Life expectancy of building components".
B6 Energy use	The considered use phase energy consumption (B6) impacts include exhaust emissions from any building level energy production as well as the environmental impacts of production processes of fuel and externally produced energy. Energy transmission losses are also taken into account.	Energy consumption taken from the TM54 Operational Energy assessment calculations for the project in line with GLA requirements. An area weighted average has been calculated for all domestic and non-domestic spaces.

Module	Description	Commentary of Data Source
B7 Water use	The considered use phase water consumption (B7) impacts include the environmental impacts of production processes of fresh water and the impacts from wastewater treatment.	Water consumption was obtained from the mechanical engineers, based on the CIBSE Guide G Public Health and Plumbing Engineering document.
C1-C4 Deconstruction	The impacts of deconstruction include impacts for processing recyclable construction waste flows for recycling (C3) until the end-of-waste stage or the impacts of pre-processing and landfilling for waste streams that cannot be recycled (C4) based on type of material. Additionally, deconstruction impacts include emissions caused by waste energy recovery.	C1 (Deconstruction/demolition) and C2 (Transport) are based on default values. C3 (Waste Processing) and C4 (Disposal) use OneClick LCA's default end of life scenarios, please refer to the appendix for further detail.
D External impacts/end-of-life benefits	External benefits for re-used or recycled material types include the positive impact of replacing virgin-based material with recycled material and the benefits of the energy which can be recovered from the materials.	D (End of Life) use OneClick LCA's default end of life scenarios, please refer to the appendix for further detail.

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Appendix J: Whole Life Cycle Carbon Assessment.

HOARE LEA

Holloway.
Islington, London.
Peabody.

SUSTAINABILITY
WHOLE LIFE CARBON ASSESSMENT

REVISION A – 29 OCTOBER 2021

Audit sheet.

Rev.	Date	Description of change / purpose of issue	Prepared	Reviewed	Authorised
A	29/10/2021	Final issue for planning submission	AB	GB	NB/RE

This document has been prepared for Peabody only and solely for the purposes expressly defined herein. We owe no duty of care to any third parties in respect of its content. Therefore, unless expressly agreed by us in signed writing, we hereby exclude all liability to third parties, including liability for negligence, save only for liabilities that cannot be so excluded by operation of applicable law. The consequences of climate change and the effects of future changes in climatic conditions cannot be accurately predicted. This report has been based solely on the specific design assumptions and criteria stated herein.

Project number: 23/24131
Document reference: REP-2324131-5A-AB-20211029-WLC-Rev A.docx

Contents.

Executive summary.

1.1 Scope.

This document has been prepared on behalf of Peabody (hereafter referred to as the ‘Applicant’) supporting the application for planning permission for the Proposed re-development of the former Holloway Prison.

This report constitutes a Whole Life Carbon (WLC) assessment for the former Holloway Prison development, situated in Islington, London. The assessment has been undertaken in line with the guidance given in the draft guidance provided by the Greater London Authority GLA in the *Whole Life-Cycle Carbon Assessments guidance Pre-consultation draft,* April 2020.

1.1 Development description.

The Proposed development will involve the ‘*Phased comprehensive redevelopment including demolition of existing structures; site preparation and enabling works; and the construction of 985 residential homes including 60 extra care homes (Use Class C3), a Women’s Building (Use Class F.2) and flexible commercial floorspace (Use Class E) in buildings of up to 14 stores in height; highways/access works; landscaping; pedestrian and cycle connection, publicly accessible park; car (blue badge) and cycle parking; and other associated works.’*

1.2 Summary of the approach to Whole Life Carbon

The Whole Life Carbon Assessment undertaken using the London Square Bill of Quantities (September 2021), Royal Institute of Charter Surveyors RICS Professional Statement (RICS PS) and OneClick Life Cycle Assessment (LCA) tool. This exercise informed the team on the expected Whole Life Carbon emissions for the entire development (Plots A-E) informing on key carbon hot spots, as well as expected operational energy and water usage. The results collated following this study can be identified in Table 1 below.

Estimated Whole Life Carbon emissions

Table 1: Summary of Whole Life Carbon emissions, using carbon factors from SAP10 and a decarbonised grid scenario.

Building Element	Plot A (SAP10) kgCO$_2$e)	Plot B (SAP10) kgCO$_2$e)	Plot C (SAP10) kgCO$_2$e)	Plot D (SAP10) kgCO$_2$e)	Plot E (SAP10) kgCO$_2$e)
1 Substructure	2448172	2985915.79	1735032.45	2,294,554	910068
2.1 Frame	212834	324185.25	162361.36	170,032	100798
2.2 Upper Floors	1441956	2074852.29	1156186.28	1,219,112	606791
2.3 Roof	153664	170667.53	85602.5	110,814	61905
2.4 Stairs & Ramps	-	-	-	-	-
2.5 Ext. Walls	201309	68044.36	27068.97	16,664	10895
2.6 Windows & Ext. Doors	406647	481568.36	237603.1	13,255	2396
2.7. Int. Walls & Partitions	1697557	2074292.97	1075242.68	1,302,349	495239
2.8 Int. Doors	-	-	-	-	-
3 Finishes	1821261	2673390.76	769209.84	1,934,613	562472
4 Fittings, furnishings & equipment’s	-	-	-	-	-
5 Services (MEP)	1420642B	22473771.08	12467351.52	14,396,630	6306315
External works	1922492	634638.6	1052196.36	1,108,833	659396
TOTAL kg CO2e	24512320	33961326.98	18767855.04	22,566,856	9716275

1.3 Actions taken to reduce whole life-cycle carbon emissions.

Energy strategy

The Energy Strategy for the project is a key mechanism for reducing Whole Life Carbon of the development. In addition to a passive design approach, a strategy has been proposed, which features highly efficient heat pumps to deliver heating and hot water throughout the development. In addition to heat pumps working at greater efficiency than gas boilers, the heat pumps can take advantage of the projected decarbonisation of the national grid.

Circular economy

The proposed development has taken care to consider Circular Economy in its design. A Circular Economy is defined in London Plan Policy SI7 ‘Reducing waste and supporting the Circular Economy’ as one where materials are retained in use at their highest value for as long as possible and are then reused or recycled, leaving a minimum of residual waste’. The aim of the Circular Economy approach is to retain the value of materials and resources indefinitely, with no residual waste at all. This is possible, requiring transformational change in the way that buildings are designed, built, operated, and deconstructed.

The supporting Circular Economy statement details the strategy for recovery of materials in line with the Circular Economy model.

Net Zero Carbon Feasibility Assessment– Plot C

Throughout the pre-planning process, an early-stage Net Zero Carbon Feasibility Study of Plot C was undertaken. The aim of the study was to assess the baseline carbon emissions for the plot and engage with the design team on suitable and realistic design changes to capture in order to reduce the anticipated carbon emissions. The overall approach was steered by leading Industry and Carbon benchmark targets from UK Green Building Council (UKGBC), Royal Institute of British Architects (RIBA) Climate Challenge, London Energy Transformation Initiative LETI Guidance for Net Zero Operational Carbon, and finally Islington’s 2030 vision. The exercise demonstrated the performance of Plot C has made a positive step towards the 2030 targets. As the project progresses, further opportunities in regard to reducing the buildings embodied carbon will become available such as further detail around the material quantities and selection of Environmental Product Declarations (EPDs). These processes combined, will collectively work towards inform the design team on the expected carbon emissions associated with each material and building element assess, and ensure informed choices and design considerations are incorporated for the future, and reducing carbon emissions.

For full review of the study undertaken, please refer to the Stage 2 Net Zero Carbon Feasibility Study for a full overview as to the investigation works completed.

1.4 Conclusion

This report follows the GLA Whole Life-Cycle Carbon Assessments, Pre-consultation draft guidance, 2020. Table 2 below summarises the Whole Life Carbon emissions expected to arise from the building throughout the expected building life cycle (60-year).

Table 2: Summary table of the Whole Life Carbon Emissions of the Proposed Development.

Whole Life Carbon scope	Whole Life Carbon emissions
Plot A Assessment 1: SAP10	24,512,320
Plot A Assessment 2: Decarbonisation projection	15,587,498
Plot B Assessment 1: SAP10	33,961,327
Plot B Assessment 2: Decarbonisation projection	26,072,495
Plot C Assessment 1: SAP10	18,767,855
Plot C Assessment 2: Decarbonisation projection	8,997,018
Plot D Assessment 1: SAP10	22,566,856
Plot D Assessment 2: Decarbonisation projection	13,471,925
Plot E Assessment 1: SAP10	9,716,275
Plot E Assessment 2: Decarbonisation projection	6,070,222

2. Introduction.

Hoare Lea have been appointed to undertake a Whole Life Carbon (WLC) Assessment for the Project Holloway development in Islington, London, hereafter referred to as the Proposed Development. This assessment is aligned to the planning application 'Stage 2' submission and has been carried out in line with draft guidance provided by the GLA in the *Whole Life-Cycle Carbon Assessments guidance Pre-consultation draft,* April 2020.

The aim of this assessment is to assess the WLC for the Proposed Developments, defined as 'those carbon emissions resulting from the construction and the use of a building over its entire life, including its demolition and disposal.' This assessment captures the operational carbon emissions for the Proposed Development from both regulated and unregulated energy use, as well as its embodied carbon emissions, i.e., those associated with raw material extraction, manufacture and transport of building materials, construction and the emissions associated with maintenance, repair, and replacement as well as dismantling, demolition, and eventual material disposal. The study also includes an assessment of the potential carbon emissions 'benefits' from the reuse or recycling of components after the end of a building's useful life.

This report should be read in conjunction with the 'GLA Whole Life Carbon Assessment Template' issued in Microsoft Excel Format.

2.1 Development description.

The Proposed Development is seeking full planning permission under the following description:

'Phased comprehensive redevelopment including demolition of existing structures; site preparation and enabling works; and the construction of 985 residential homes including 60 extra care homes (Use Class C3), a Women's Building (Use Class F.2) and flexible commercial floorspace (Use Class E) in buildings of up to 14 stores in height; highways/access works; landscaping; pedestrian and cycle connection, publicly accessible park; car (blue badge) and cycle parking; and other associated works.'

Figure 1: CGI concept of the Proposed development (Credit: AHMM).

2.2 Background to Whole Life Carbon assessments.

Global climate change is widely considered to be one of the most pressing challenges at a regional, national, and international level. Industrialisation has resulted in the use of refined and unrefined fossil fuels as an energy source and since the start of the industrial revolution, use of fossil fuels and their resultant release of carbon dioxide into the atmosphere has caused an exponential increase in the concentration of carbon dioxide and other pollutants that are generally agreed to result in increasing global average surface temperature.

It is outside the scope of this report to describe the wide-ranging impacts of climate change, the main aim is to quantify the immediate WLC carbon performance and identify key areas for reduction.

Carbon emissions from operational use of buildings has been the subject of regulation for some time and has historically been the primary focus of reducing the impact of built environment projects. More recently, this focus has been expanded to also include carbon emission associated with the building materials themselves.

Some studies have historically suggested that 10 – 20% of the total carbon emissions for buildings over their lifetime are due to embodied carbon. With increasing energy efficiency within buildings and an increasingly decarbonised electricity supply, building operational carbon emission are being acknowledged to be rapidly reducing. As this occurs, the significance of embodied carbon emissions increases and the potential for reduction of overall carbon emissions through structural design choice and material selection becomes greater.

2.3 RICS Whole Life Carbon.

The RICS professional statement: Whole Life Carbon Assessment (WLC) for the Build Environment, released in 2017, seeks to standardise WLC assessment and enhance consistency in outputs by providing guidance on implementing the broad appraisal methodology set out in EN 15978: Sustainability of Construction Works. The Greater London Authority have adopted the RICS WLC methodology in their guidance methodology for Whole Life Carbon assessment of referable planning applications.

RICS professional statement

RICS

RICS professional standards and guidance, UK

Whole life carbon
assessment for the
built environment

1st edition, November, 2017

rics.org/guidance

Figure 2: RICS Professional Statement: Whole Life Carbon Assessment for the Built Environment.

2.4 UK Green Building Council (UKGBC) net zero carbon.

As a response to mainstream scientific consensus on the urgent need to reduce carbon emissions, the UK Government has legislated to achieve Net Zero carbon by 2050. As part of the definition of Net Zero, the UK Green Building Council has developed a Framework Definition that includes embodied carbon emissions, and this definition is widely being used to develop a roadmap to the 2050 Net Zero target. It's worth noting that the UKGBC approach has not set out a methodology for the appraisal of Whole Life Carbon, which is still being developed.

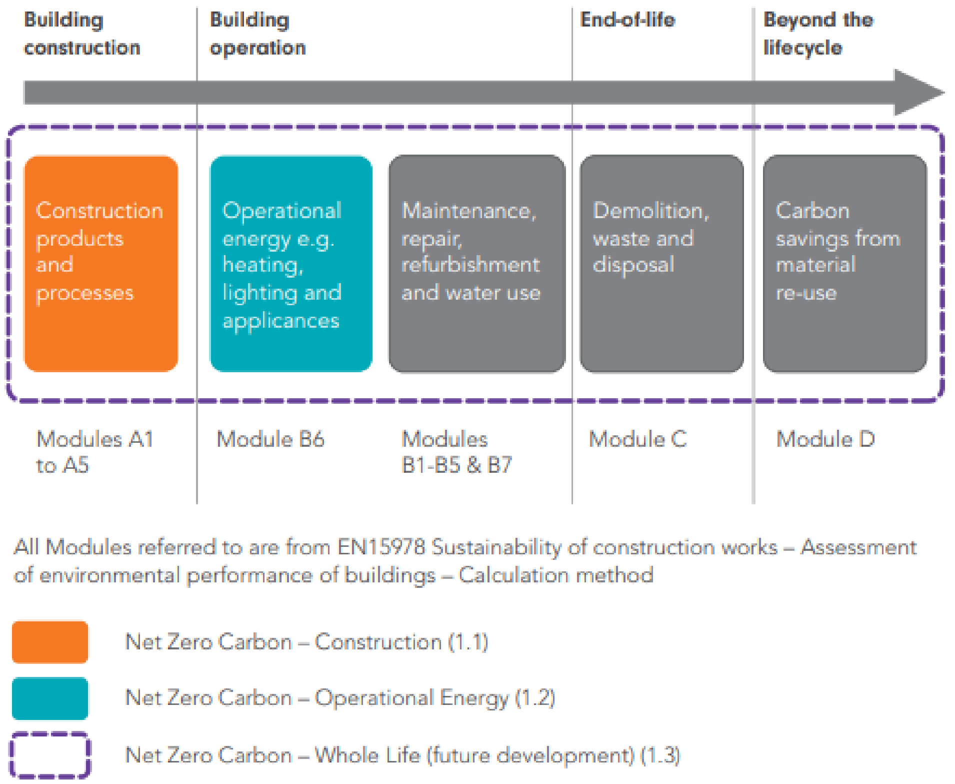


Figure 3: UKGBC Advancing Net Zero Carbon framework approach.

2.5 The Circular Economy.

The construction and operation of the built environment consumes 60% of all materials in the UK. At the end of life, materials are often diverted from landfill, but in reality, downcycled, reducing their value.

There is growing industry consensus that the way we design, build, operate and dispose of our buildings and associated facilities needs a major overhaul to obviate waste and increase efficiency. There is an incredible breadth of opportunity that this shift in approach will create across the entire supply chain.

Designing for longevity and adaptability and maximizing the use of recycled and renewable materials could reduce greenhouse gas emissions while increasing innovation opportunities and economic growth. Replacing finite and fossil-based materials with responsibly managed renewable materials can decrease carbon emissions whilst reducing dependency on finite resources.

By considering the carbon emissions of a development from a whole life perspective, design decisions can be made to not only minimize embodied carbon in construction, but it can assist to produce a development which reduces resource consumption throughout its use, extending life cycles of products, maximizing re-use of building components and ensuring that all components are considered as a 'product resource', rather than 'product waste'.

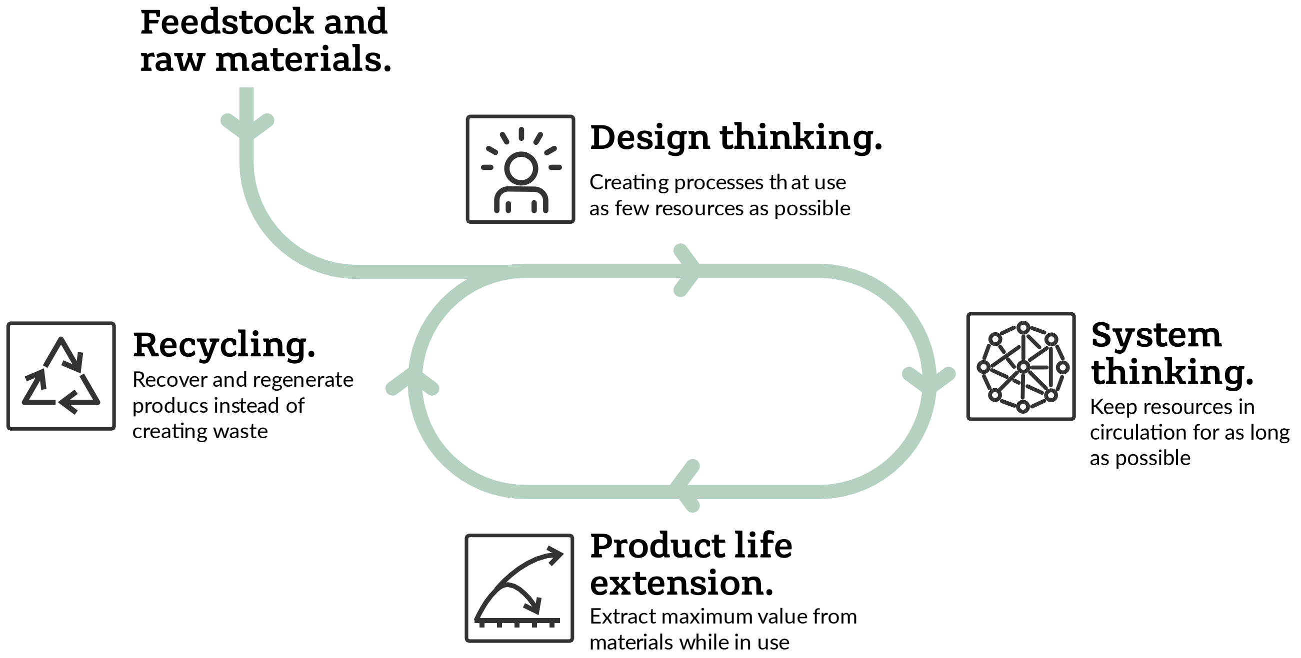


Figure 4: Simplified graphic of the Circular Economy highlighting the key components of the principle of circularity.

3. Methodology.

3.1 Assessment scope.

The assessment of Whole Life Carbon (WLC) emissions consists of the following sections: total operational carbon emissions (regulated plus unregulated); embodied carbon emissions; and any future potential carbon emissions 'benefits', post end-of-life, including benefits from reuse and recycling of building structure and materials.

This assessment has been undertaken in line with the draft GLA guidance for undertaking WLC Assessments and therefore in line with the RICS Professional Statement: Whole Life Carbon Assessment for the Built Environment.

Operational carbon emissions

The operational carbon emissions for the WLC assessment have been determined following the Passivhaus Planning Package (PHPP) assessment and TM54 modelling. The assessment and modelling process have provided a representative figure based on the Plot C development. In line with the early-stage Net Zero Carbon Feasibility Study, this Plot was identified as the most suitable to assess due to the multiple usages it is to include, as well as proposed to be built in the first phase of the development, so will offer the most value to occupants and being in the first phase will offer lessons learned around the materials and construction process.

An area weighted approach has been applied to each plot in order to provide an indicative figure. This encompasses carbon emissions related to both regulated and unregulated energy uses, accumulated over a 60-year study period.

Embodied carbon assessment and end-of-life emissions

To assess the embodied carbon for the project, a Life Cycle Assessment (LCA) tool – One Click LCA – has been used to make allocations for the anticipated materials quantities in an inventory analysis. The materials are represented within the model by using materials with associated Environmental Product Declarations (EPDs). EPDs are produced by manufacturers and identify the carbon emissions of a product. By scheduling the materials proposed for the development, the overall carbon emissions can be approximated.

It should be noted here that the LCA tool has a limited database of materials. In the scenario where a specified material isn't included in the database, the most similar material in terms of material composition is selected instead.

In line with standard UK practice, the LCA process and results included by this report have been assessed in line with BS 15978:2011 and the RICS Professional Statement: Whole Life Carbon assessment for the built environment. All EPDs used have been produced in line with the requirements of BS EN 15804:2012. Hence, each material has been assessed against the following lifecycle stage:

- A1-A3: Product stage
- A4: Material transportation to site
- A5: On site construction
- B4-B5: Replacement and maintenance
- C1-C4: End of life

Together with these stages, the contribution of life cycle stage A5 has also been explored separately, giving an estimate of the emissions related to the construction. I.e., the electrical consumption and waste disposal.

In line with the draft GLA guidance, the assessment includes the following elements:

- Demolition
- Facilitating works
- Substructure
- Superstructure (frame, upper floors, roof, stairs and ramps, external walls, windows and external doors, internal walls and partitions, internal doors)
- Finishes
- Fittings, furnishings, and equipment
- Building services
- Prefabricated buildings and building units
- Work to existing building
- External works (hard and soft landscaping, fencing, fixtures, drainage, services)

3.2 Life cycle assessment impacts.

A building Life Cycle Assessment considers a range of environmental indicators that assess the relevant overall impacts of the materials selections. Whilst ideally an LCA assessment would consider all environmental factors relevant to the product or material, due to lack of information in some cases, and lack of consensus in how to calculate Key Performance Indicators (KPIs) within the industry, not all environmental impacts can be considered.

Standard ratios are used to convert the various greenhouse gases into equivalent amounts of CO_2. These ratios are based on the global warming potential (GWP) of each gas. GWP is a relative measure of how much a given mass of greenhouse gas is estimated to contribute to global warming over a given time interval – usually 100 years. It is expressed relative to carbon dioxide which is set as the baseline which other emitters are compared against, and which therefore has a GWP of 1.

This assessment thus reports on the embodied carbon of the development as 'global warming potential' with the annotation 'CO_2 equivalent (CO_2e)'.

3.3 Data sources.

There are a number of approaches to complete a building specific life cycle assessment. In particular, a flexible approach is needed when utilising a dataset of product specific EPD's and more generic data calculated within the LCA tool.

Table 3: Types of data required for a WLC assessment.

Quantity Data	Material Data	Comments
Bill of Quantities	Bill of Quantities	Bill of Quantities can be useful for calculation of uncertain quantities which are not product specific, however often an allowance is made at early design stages which may reduce accuracy.
IES-VE Model	IES-VE Model	IES-VE model and the data export function can quickly determine the quantity of main building elements but there is limited functionality in calculating the volume of materials. The HL energy strategy has used IES to generate energy consumption data.
Architectural/Structural Drawings and Area schedule	Architectural Build-ups/Structural drawings	Information provided by design team has been used as reference where required.

The assessment has utilised multiple data sources described above and is based on the level of detail available at the current stage of design.

3.4 Current and future carbon emissions.

In line with the guidance given in the draft GLA guidance to Whole Life Carbon assessments, the assessment has been undertaken based on two sets of carbon emissions:

3.4.1 SAP 10

The first set of figures is based on the current status of the electricity grid and provides a point-in-time assessment. B4 emissions and D benefits beyond the system, SAP 10 emission factors are used in line with the GLA's Energy Assessment Guidance. Products sourced from outside the UK use data appropriate to the local energy grid at that location. This set of figures is used in the comparison to the WLC benchmarks.

3.4.2 Decarbonisation

The RICS WLC guidance (2017) refers to the use of the 'slow progression' scenario *from the latest Future Energy Scenarios* (FES) developed by the National Grid to demonstrate the continual effects of decarbonisation over the project's lifetime.

This progression has been revised each year, with the latest edition 2020 accounting for more recent developments in the future performance of the National Grid.

Therefore, for this Whole Life Carbon Assessment, the National Grid's 2020 edition of the 'Steady Progression' scenario was chosen as this more closely maps the departments of Business Energy and Industrial Strategy (BEIS) declared grid carbon projection.

Decarbonisation has also been applied to B4 emissions and D benefits beyond the system. It has been assumed that these values will decarbonise at the same rate as the FES progression. The decarbonisation of products not sourced in the UK may differ as various nation grids will decarbonise at different rates, the FES scenario has been applied to all elements.

3.4.3 Context of grid carbon projections

The FES document, produced by the National Grid, discusses how the UK's energy landscape is changing. FES 2020 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.

FES discusses these projections in one of four scenarios and Figure 5 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 all cases, the FES 2018 scenarios see the carbon factor of electricity fall below 100 gCO_2/kWh by 2035.

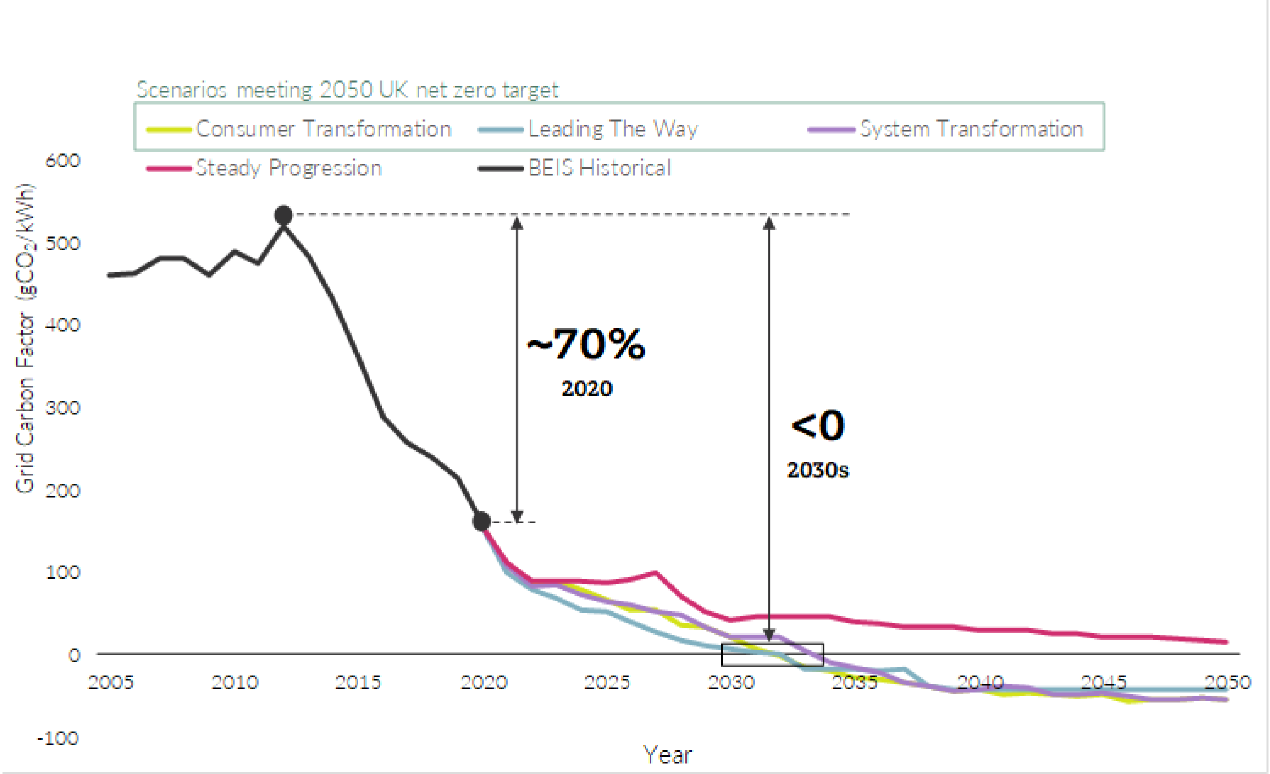


Figure 5: Historic and future projected carbon factor for the National Grid. Transmission and distribution losses are included. Sources: *BEIS Green Book* (historic carbon factors); *National Grid Future Energy Scenarios (FES) 2021*(future projected carbon factors).

3.4.4 Shifting focus

As the carbon emissions associated with the generation of electricity continue to reduce, the proportion of the UK's overall greenhouse gas emissions for which the electricity sector is responsible will fall. In fact, transport has now replaced energy supply as the greatest single contributor, responsible for 26% of national greenhouse gas emissions (BEIS).

The carbon factor of natural gas is likely to remain relatively static. With 85% of homes in the UK relying on gas to supply their heating and hot water, as well as a significant proportion of commercial buildings, heating buildings and industry represents an ever-greater proportion of UK emissions – 32% in 2015 (BEIS). In order for the UK to maintain a trajectory sufficient to meet the 2050 decarbonisation target, focus must necessarily shift to other contributors.

The BEIS Clean Growth Strategy provides an indication of the direction the UK's energy policy is likely to take and "...sets out [the government's] proposals for decarbonising all sectors of the UK economy through the 2020s." This includes investing in infrastructure and mechanisms to facilitate a transition to low emission vehicles and strengthening the energy performance requirements of new and existing buildings.

4. Inputs.

This section sets out the inputs used in the Whole Life Carbon assessment.

4.1 Operational carbon assessment.

The following table documents the Operational Carbon emissions are estimated as part of the Hoare Lea Energy Strategy.

Table 4: HL operational energy estimation.

		Regulated and Unregulated kWh (annual) (60-year)
Plot A	Residential	55,669,600
	Non-residential	0
Plot B	Residential	72,686,112
	Non-residential	13,700,274
Plot C	Residential	37,279,578
	Non-residential	13,507,926
Plot D	Residential	44,855,640
	Non-residential	10,965,480
Plot E	Residential	22,132,251
	Non-residential	0

Water consumption has been confirmed by the Mechanical engineer as being based upon CIBSE Guide G (based upon litres/per day per number of bedrooms) and has estimated the following breakdown:

- Plot A – 31,000 litres/day (l/d)
- Plot B – 41,000 litres/day (l/d)
- Plot C – 21,000 litres/day (l/d)
- Plot D – 24,000 litres/day (l/d)
- Plot E – 11,000 litres/day (l/d)

4.2 Embodied carbon and end-of-life assessment.

Table 5 lists the building elements covered by the assessment, in line with the Royal Institute of Chartered Surveyors (RICS) Professional Statement: *Whole Life Carbon assessment for the built environment.*

Where detailed information was available for the designed elements of the scheme the Stage 2 cost plan and architectural drawings have been used to inform this study. For the project elements that are in the outline stage, no cost plan data was available. In this case, the Carbon Designer tool to estimate the quantities of materials based on the floor area and the material types and quantities have been adjusted to reflect the same construction as detailed in the fully designed elements. This is the best-informed estimate that can be made at this stage of the design process.

4.2.1 Building elements

Table 5: Data used in the embodied carbon assessment.

Building element group	Building element (NRM level 2)	Basis for information
Demolition	0.1 Toxic/hazardous/contaminated material treatment	An allowance for contaminated land removal and treatment has not been provided for the Proposed Development.
	0.2 Major demolition works	An allowance for site excavation and demolition works was included in the assessment and used the average intensity of 1.39 kg CO2e / m3 cleared debris, as developed by OneClick LCA software.
0 Facilitating works	0.3 & 0.5 Temporary/enabling works	Due to the early stage of the design (RIBA Stage 2) this information is not yet available and as such has not been included in the assessment.
	0.4 Specialist groundworks	No specialist ground works were included separately. The individual ground works were accounted for in the relevant sub structure / external landscaping sections
1 Substructure	1.1 Substructure	The foundations materials were drawn from the London Square Sept 2021 Cost Plan’s description of needed material quantity and composition
2 Superstructure	2.1 Frame	The frame materials were drawn from the London Square Sept 2021 Cost Plan’s description of needed material quantity and composition
	2.2 Upper floors incl. balconies	The upper floor and balconies materials were drawn from the London Square Sept 2021 Cost Plan’s description of needed material quantity and composition
	2.3 Roof	The roof materials were drawn from the London Square Sept 2021 Cost Plan’s description of needed material quantity and composition
	2.4 Stairs and ramps	The information from the London Square Sept 2021 Cost Plan did not provide suitable information about the Stairs and ramps
	2.5 External walls	The external wall materials were drawn from the London Square Sept 2021 Cost Plan’s description of needed material quantity and composition
	2.6 Windows and external doors	The window and external door materials were drawn from the London Square Sept 2021 Cost Plan description of needed material quantity and composition
	2.7 Internal walls and partitions	The internal partition materials were drawn from the London Square Sept 2021 Cost Plan’s description of needed material quantity and composition
	2.8 Internal doors	The information from the London Square Sept 2021 Cost Plan did not provide suitable information about the internal doors
3 Finishes	3.1 Wall finishes	The wall, floor and ceiling finishes areas were gathered from the London Square Sept 2021 Cost Plan.
	3.2 Floor finishes	

Building element group	Building element (NRM level 2)	Basis for information
	3.3 Ceiling finishes	
4 Fittings, furnishings, and equipment (FF&E)	4.1 Fittings, furnishings & equipment incl. building-related* and non-building-related**	The quantum of FFE for the residential apartments are gathered from the London Square Sept 2021 Cost Plan and uses benchmark data from previous comparable assessments for any missing information.
5 Building services/MEP	5.1–5.14 Services incl. building-related* and nonbuilding-related**	The quantum of sanitaryware were calculated based on the area schedule and occupancy, with EPD's matched to the fittings proposed to be installed.
6 Prefabricated Buildings and Building Units	6.1 Prefabricated buildings and building units	FF&E is not applicable to the non-residential uses as these are being built out to a shell-only speculative standard and the detailed use types are unknown.
7 Work to Existing Building	7.1 Minor demolition and alteration works	Building services data uses data provided from the Building Services engineers which align with the proposed services strategy for the project. The lengths of duct's, electrical distribution and water distribution were calculated on a m2 GIA basis using in-built EPD within OneClick LCA.
8 External works	8.1 Site preparation works	No prefabricated elements are applicable.
	8.2 Roads, paths, paving and surfacing	No minor works were applicable.
	8.3 Soft landscaping, planting, and irrigation systems	Due to the early stage of the design (RIBA Stage 2) this information is not yet available and as such has not been included in the assessment.
	8.4 Fencing, railings, and walls	Data for roads, paths, paving, and surfacing is based on details provided from the London Square Sept 2021 Cost Plan.
	8.5 External fixtures	Data for Soft landscaping, planting and irrigation systems is based on details provided from the London Square Sept 2021 Cost Plan where the external materials have been listed.
	8.6 External drainage	Due to the early stage of the design (RIBA Stage 2) this information is not yet available and as such has not been included in the assessment.
	8.7 External services	Due to the early stage of the design (RIBA Stage 2) this information is not yet available and as such has not been included in the assessment.
	8.8 Minor building works and ancillary buildings	Due to the early stage of the design (RIBA Stage 2) this information is not yet available and as such has not been included in the assessment.

A full list of product declarations used is given in the Appendix C.

4.2.2 Life-cycle modules

Table 6: The Life Cycle Modules included in the assessment and commentary on the data source.

Module	Description	Commentary of Data Source
A1-A3 Construction Materials	Raw material supply (A1) includes emissions generated when raw materials are taken from nature, transported to industrial units for processing and processed. Loss of raw material and energy are also taken into account. Transport impacts (A2) include exhaust emissions resulting from the transport of all raw materials from suppliers to the manufacturer's production plant as well as impacts of production of fuels. Production impacts (A3) cover the manufacturing of the production materials and fuels used by machines, as well as handling of waste formed in the production processes at the manufacturer's production plants until end-of-waste state.	Calculated using EPD's which align with the exact product (where known) or the most applicable similar product.
A4 Transportation to site	A4 includes exhaust emissions resulting from the transport of building products from manufacturer's production plant to building site as well as the environmental impacts of production of the used fuel.	The case specific transport distances were used when available. Other transport distances were estimated based on typical average transport distances based on material type & project location, provided by OneClick LCA.
A5 Construction/ installation process	A5 covers the exhaust emissions resulting from using energy during the site operations, the environmental impacts of production processes of fuel and energy and water as well as handling of waste until the end-of-waste state.	Due to lack of site-specific construction data, the climate zone average construction impact was used and sized based upon the scale of the development.
B1-B5 Maintenance and material replacement	The environmental impacts of maintenance and material replacements (B1-B5) include environmental impacts from replacing building products after they reach the end of their service life. The emissions cover impacts from raw material supply, transportation, and production of the replaced new material as well as the impacts from manufacturing the replaced material and handling of waste until the end-of-waste state.	Use (B1) include the impact of refrigerant leakage at leakage rate of 5% a year and 99% end of life recovery. Maintenance (B2) and Repair (B3) have not been considered due to accurate data being unavailable at this early stage. Replacement (B4) and Refurbishment (B5) account for the technical service life of the building components "BCIS Life expectancy of building components".
B6 Energy use	The considered use phase energy consumption (B6) impacts include exhaust emissions from any building level energy production as well as the environmental impacts of production processes of fuel and externally produced energy. Energy transmission losses are also considered.	Energy consumption taken from the Part L Energy assessment calculations for the project, in line with GLA requirements.

Module	Description	Commentary of Data Source
B7 Water use	The considered use phase water consumption (B7) impacts include the environmental impacts of production processes of fresh water and the impacts from wastewater treatment.	Water consumption has been based on the CIBSE Guide G estimated water consumptions (liters/day per number of bedrooms).
C1-C4 Deconstruction	The impacts of deconstruction include impacts for processing recyclable construction waste flows for recycling (C3) until the end-of-waste stage or the impacts of pre-processing and landfilling for waste streams that cannot be recycled (C4) based on type of material. Additionally, deconstruction impacts include emissions caused by waste energy recovery.	C1 (Deconstruction/demolition) and C2 (Transport) are based on default values. C3 (Waste Processing) and C4 (Disposal) use OneClick LCA's default end of life scenarios, please refer to the appendix for further detail.
D External impacts/end-of-life benefits	External benefits for re-used or recycled material types include the positive impact of replacing virgin-based material with recycled material and the benefits of the energy which can be recovered from the materials.	D (End of Life) use OneClick LCA's default end of life scenarios, please refer to the appendix for further detail.

5. Results.

5.1 Operational carbon emissions.

The total operational carbon emissions have been calculated over a 60-year study period based on two sets of carbon factors, in line with the GLA guidance. The data used to inform these calculations has been provided from the PHPP assessment and TM54 modelling. The total operational carbon emissions (total estimated emissions from regulated and unregulated energy uses) have been estimated to be:

- 54,373,560 $kgCO_2$ based on SAP10 carbon factors – (Residential),
- 8,894,460 $kgCO_2$ based on SAP10 carbon factors – (Non-residential).

Total carbon emissions: 63,268,020 $kgCO_2$ based on SAP10 carbon factors.

5.2 Estimated Whole Life Carbon emissions.

The total WLC emissions for the development can be identified in Tables 7-11 below demonstrating the baseline results, and tables 12-16 demonstrating the results following decarbonisation. The results shown provide an indicative result as to the expected carbon emissions to be emitted by the building based on the following information:

- London Square Bill of Quantities (September 2021)
- RICS PS
- OneClick data sets
- PHPP Assessment; and finally
- TM54 modelling report.

5.3 Estimated Whole Life Carbon (WLC) emissions.

Table 7: WLC emissions for each lifecycle module, using the SAP 10 Carbon factor for module B6 Operational Energy use.

Plot A

Result category	Biogenic carbon (kg CO_{2e})	A1-A3 Product Stage	A4 Transportation to site	A5 Site operations	B1 Use Phase	B2-B3	B4-B5 Material replacement and refurbishment	B6 Operational Energy use - Regulated	B6 Operational Energy use - Unregulated	B7 Operational Water use	C1-C4 End of Life stage	TOTAL kg CO_{2e}	D External impacts (not included in totals)
1 Substructure	−3 617	2 205 630	45 388	165 751		0					35 020	2 448 172	−507 296
2.1 Frame	−2 006	185 351	13 591	8 186		0					7 712	212 834	−57 146
2.2 Upper Floors	−9 050	913 625	66 911	47 883		0	386 462				36 125	1 441 956	−295 453
2.3 Roof	−1 448	133 822	9 812	5 910		0					5 568	153 664	−41 259
2.4 Stairs & Ramps													
2.5 Ext. Walls	−945	145 794	6 893	7 415		0	37 440				4 712	201 309	−35 310
2.6 Windows & Ext. Doors	0	402 760	1 261	25		0	2 508				93	406 647	−198 314
2.7. Int. Walls & Partitions	−150 275	750 942	68 803	107 392		0	751 475				169 220	1 697 557	−2 236
2.8 Int. Doors													
3 Finishes	−375 518	565 534	10 954	94 300		0	965 434				560 555	1 821 261	−628 062
4 Fittings, furnishings & equipment's													
5 Services (MEP)	0	414 622	9 983	3 579		0	529 878	13 042 420		203 670	2 276	14 206 428	−301 670
6 Prefabricated													
7 Existing bldg.													
8 Ext. works	−105 836	541 495	93 810	21 798		0	75 369				115 749	742 384	−276 475
Unclassified / Other				469 644	710 464							1 180 107	
TOTAL kg CO_{2e}	−648 694	6 259 574	327 405	931 884	710 464	0	2 748 566	13 042 420		203 670	937 032	24 512 320	−2 343 223

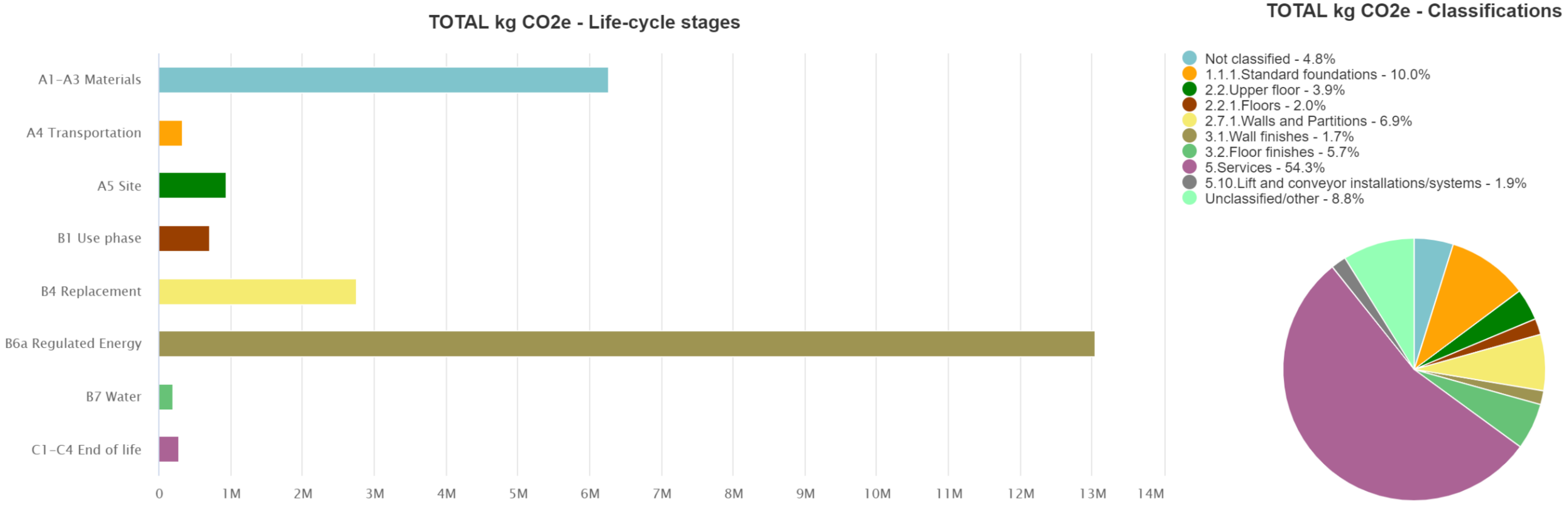


Figure 6: WLC per lifecycle stage (left), WLC per RICS category (right) - Plot A

Plot B

Table 8. WLC emissions for each lifecycle module, using the SAP 10 Carbon factor for module B6 Operational Energy use.

Result category	Biogenic carbon (kg CO_{2e})	A1-A3 Product Stage	A4 Transportation to site	A5 Site operations	B1 Use Phase	B2-B3	B4-B5 Material replacement and refurbishment	B6 Operational Energy use - Regulated	B6 Operational Energy use - Unregulated	B7 Operational Water use	C1-C4 End of Life stage	TOTAL kg CO_{2e}	D External impacts (not included in totals)
1 Substructure	−4 427	2 699 731	44 980	207 217		0					38 415	2 985 916	−628 082
2.1 Frame	−3 055	282 323	20 701	12 469		0					11 747	324 185	−87 044
2.2 Upper Floors	−13 553	1 354 722	99 228	69 788		0	510 797				53 871	2 074 852	−435 880
2.3 Roof	−1 608	148 629	10 898	6 564		0					6 184	170 668	−45 825
2.4 Stairs & Ramps													
2.5 Ext. Walls	−385	59 867	2 784	3 471		0	138				2 170	68 044	−15 388
2.6 Windows & Ext. Doors	0	476 294	677	45		0	4 440				113	481 568	−233 791
2.7. Int. Walls & Partitions	−193 088	917 727	83 387	131 319		0	918 664				216 283	2 074 293	−3 931
2.8 Int. Doors													
3 Finishes	−744 448	899 310	15 109	150 538		0	1 333 051				1 019 831	2 673 391	−968 754
4 Fittings, furnishings & equipment's													
5 Services (MEP)	0	538 287	12 881	3 604	710 464	0	673 678	19 910 745		621 688	2 425	22 473 771	−361 012
6 Prefabricated													
7 Existing bldg.													
8 Ext. works													
Unclassified / Other				634 639								634 639	
TOTAL kg CO_{2e}	−960 564	7 376 890	290 645	1 219 653	710 464	0	3 440 767	19 910 745		621 688	1 351 039	33 961 327	−2 779 708

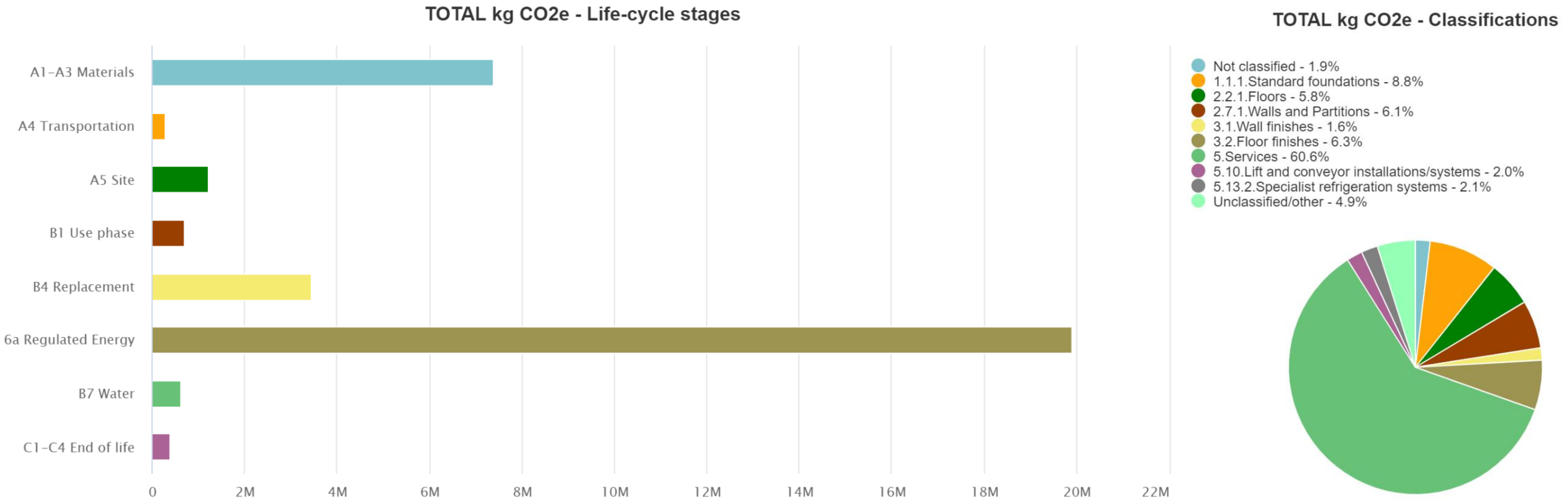


Figure 7: WLC per lifecycle stage (left), WLC per RICS category (right) - Plot B

Plot C

Table 9. WLC emissions for each lifecycle module, using the SAP 10 Carbon factor for module B6 Operational Energy use.

Result category	Biogenic carbon (kg CO_{2e})	A1-A3 Product Stage	A4 Transportation to site	A5 Site operations	B1 Use Phase	B2-B3	B4-B5 Material replacement and refurbishment	B6 Operational Energy use - Regulated	B6 Operational Energy use - Unregulated	B7 Operational Water use	C1-C4 End of Life stage	TOTAL kg CO_{2e}	D External impacts (not included in totals)
1 Substructure	−1 837	1 571 510	26 385	111 892			0				27 082	1 735 032	−378 962
2.1 Frame	−1 530	141 396	10 368	6 245			0				5 883	162 361	−43 594
2.2 Upper Floors	−7 527	752 945	55 149	38 845			0	286 847	0		29 927	1 156 186	−242 364
2.3 Roof	−807	74 549	5 466	3 292		0					3 102	85 602	−22 984
2.4 Stairs & Ramps													
2.5 Ext. Walls	−152	23 820	1 098	1 385		0	56				862	27 069	−6 105
2.6 Windows & Ext. Doors	0	236 821	731	0		0					51	237 603	−117 338
2.7. Int. Walls & Partitions	0	474 619	46 399	66 676		0	475 113				12 435	1 075 243	−2 073
2.8 Int. Doors													
3 Finishes	0	194 073	5 762	31 117		0	466 982				71 276	769 210	−201 162
4 Fittings, furnishings & equipment’s													
5 Services (MEP)	0	254 053	5 783	3 091		0	318 348	11 746 033		137 970	2 073	12 467 352	−190 605
6 Prefabricated													
7 Existing bldg.													
8 Ext. works													
Unclassified / Other				341 733	710 464							1 052 196	
TOTAL kg CO_{2e}	−11 851	3 723 785	157 142	604 276	710 464	0	1 547 345	11 746 033		137 970	152 692	18 767 855	−1 205 187

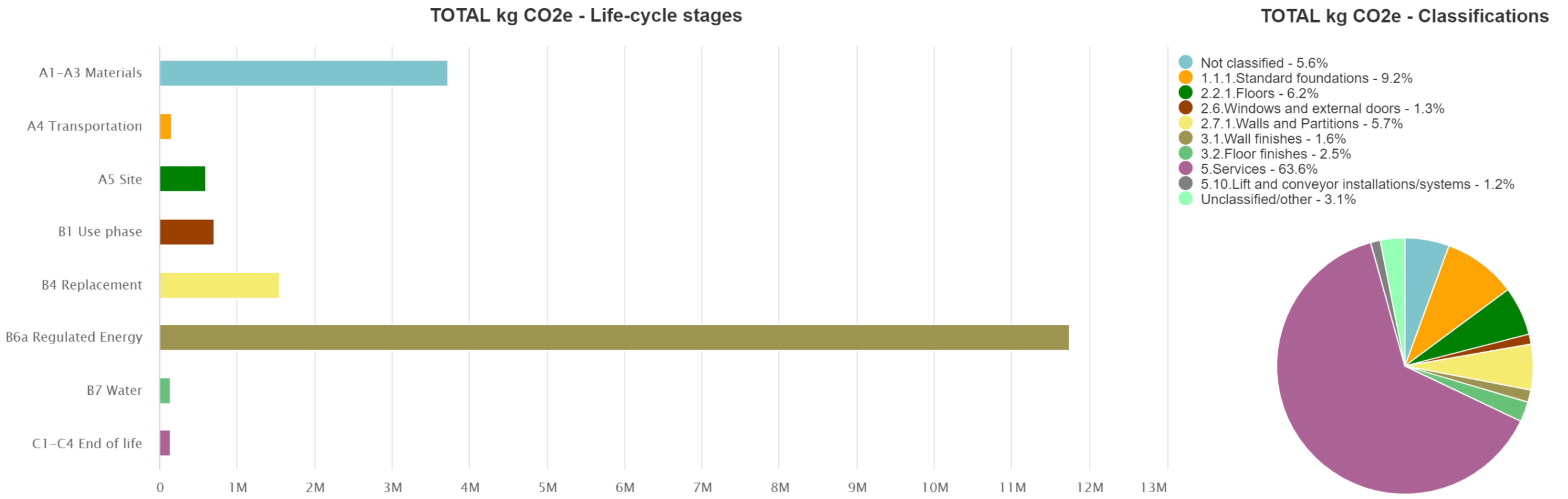


Figure 8: WLC per lifecycle stage (left), WLC per RICS category (right) - Plot C

Plot D

Table 10. WLC emissions for each lifecycle module, using the SAP 10 Carbon factor for module B6 Operational Energy use.

Result category	Biogenic carbon (kg CO_{2e})	A1-A3 Product Stage	A4 Transportation to site	A5 Site operations	B1 Use Phase	B2-B3	B4-B5 Material replacement and refurbishment	B6 Operational Energy use - Regulated	B6 Operational Energy use - Unregulated	B7 Operational Water use	C1-C4 End of Life stage	TOTAL kg CO_{2e}	D External impacts (not included in totals)
1 Substructure	−3 421	2 083 058	37 650	143 266			0				34 001	2 294 554	−499 521
2.1 Frame	−1 602	148 076	10 858	6 540			0				6 161	170 032	−45 654
2.2 Upper Floors	−8 154	810 352	59 359	41 323		0	283 902				32 330	1 219 112	−259 958
2.3 Roof	−1 044	96 505	7 076	4 262		0					4 015	110 814	−29 754
2.4 Stairs & Ramps													
2.5 Ext. Walls	0	14 887	108	1 161		0	84				423	16 664	−2 716
2.6 Windows & Ext. Doors	0	6 552	68	66		0	6 552				16	13 255	
2.7. Int. Walls & Partitions	−115 541	576 035	52 773	82 378		0	576 644				130 060	1 302 349	−2 555
2.8 Int. Doors													
3 Finishes	−567 887	646 253	10 105	109 561		0	959 341				777 240	1 934 613	−755 365
4 Fittings, furnishings & equipment's													
5 Services (MEP)	0	507 674	12 114	3 288		0	615 848	12 891 597		363 915	2 194	14 396 630	−311 681
6 Prefabricated													
7 Existing bldg.													
8 Ext. works													
Unclassified / Other				398 370	710 464							1 108 833	
TOTAL kg CO_{2e}	−697 649	4 889 392	190 111	790 214	710 464	0	2 442 372	12 891 597		363 915	986 440	22 566 856	−1 907 204

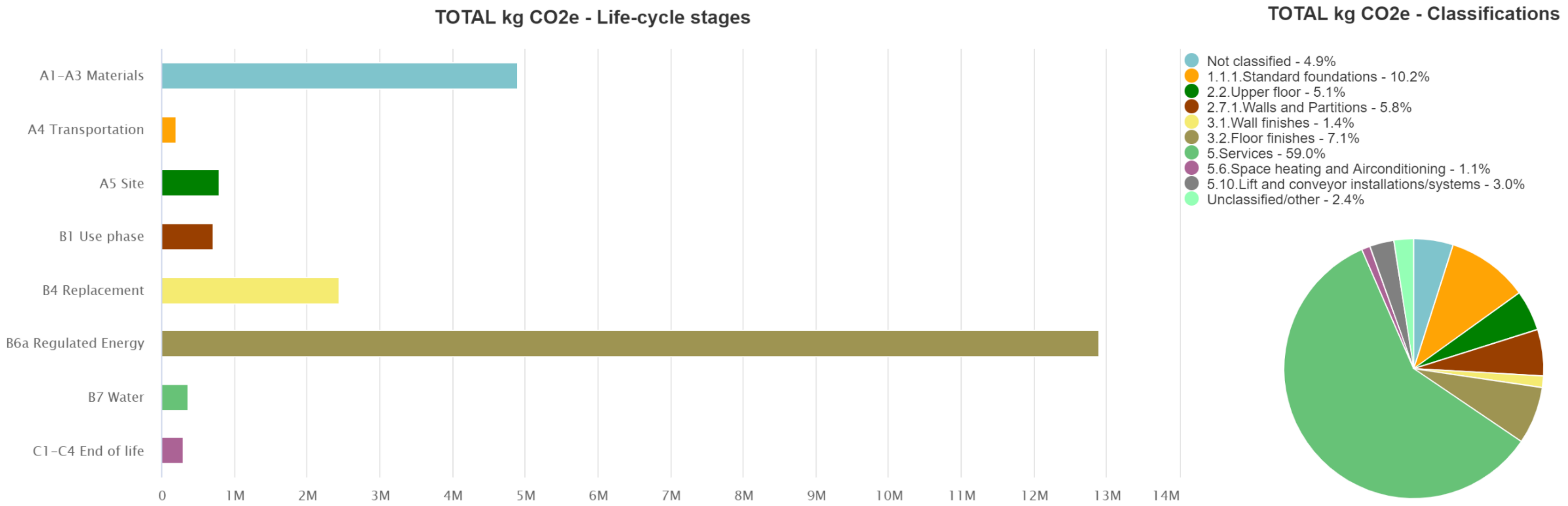
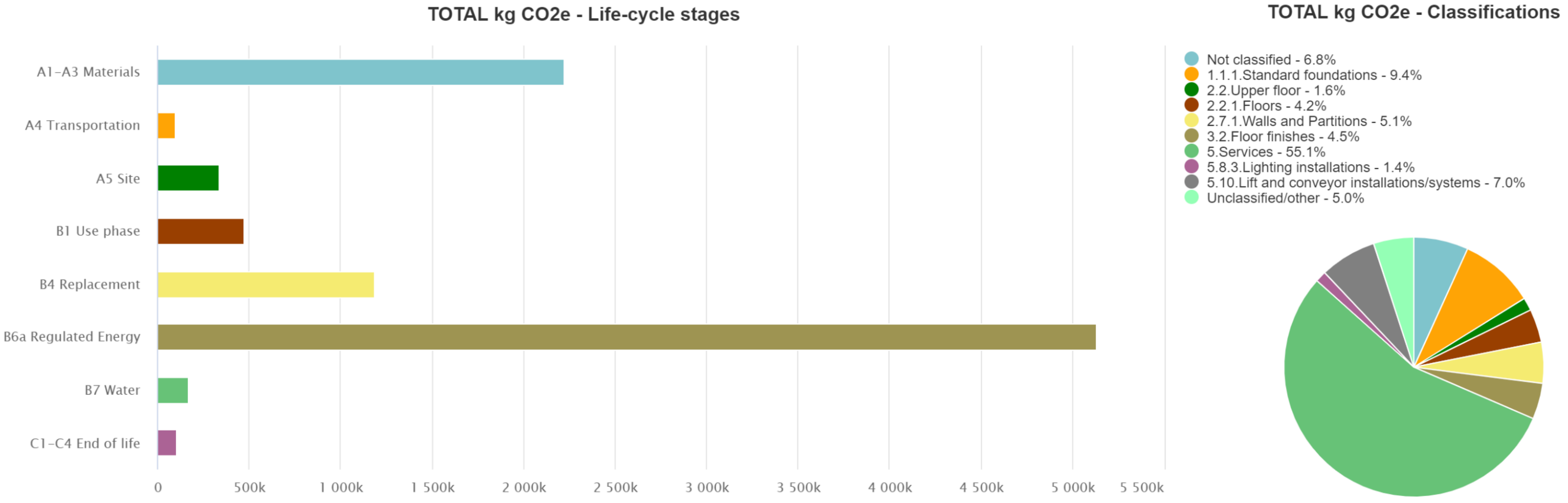


Figure 9: WLC per lifecycle stage (left), WLC per RICS category (right) - Plot D

Plot E

Table 11. WLC emissions for each lifecycle module, using the SAP 10 Carbon factor for module B6 Operational Energy use.

Result category	Biogenic carbon (kg CO_{2e})	A1-A3 Product Stage	A4 Transportation to site	A5 Site operations	B1 Use Phase	B2-B3	B4-B5 Material replacement and refurbishment	B6 Operational Energy use - Regulated	B6 Operational Energy use - Unregulated	B7 Operational Water use	C1-C4 End of Life stage	TOTAL kg CO_{2e}	D External impacts (not included in totals)
1 Substructure	−1 488	805 706	22 893	59 022		0					23 934	910 068	−189 659
2.1 Frame	−950	87 782	6 437	3 877		0					3 652	100 798	−27 064
2.2 Upper Floors	−4 243	417 262	30 569	20 876		0	125 578				16 748	606 791	−133 122
2.3 Roof	−583	53 912	3 953	2 381		0					2 243	61 905	−16 622
2.4 Stairs & Ramps													
2.5 Ext. Walls	0	9 732	71	760		0	55				276	10 895	−1 771
2.6 Windows & Ext. Doors	0	1 184	12	12		0	1 184				3	2 396	
2.7. Int. Walls & Partitions	−47 141	218 925	20 085	31 381		0	219 208				52 780	495 239	−1 191
2.8 Int. Doors													
3 Finishes	−97 382	164 642	3 303	27 496		0	309 912				154 501	562 472	−193 678
4 Fittings, furnishings & equipment's													
5 Services (MEP)	0	462 571	10 617	2 820		0	527 905	5 133 574		166 794	2 035	6 306 315	−242 352
6 Prefabricated													
7 Existing bldg.													
8 Ext. works													
Unclassified / Other				185 754	473 642							659 396	
TOTAL kg CO_{2e}	−151 788	2 221 716	97 940	334 380	473 642	0	1 183 843	5 133 574		166 794	256 173	9 716 275	−805 459



TOTAL kg CO2e - Life-cycle stages

TOTAL kg CO2e - Classifications

Figure 10: WLC per lifecycle stage (left), WLC per RICS category (right) - Plot E

5.4 Estimated Whole Life Carbon (WLC) emissions (decarbonisation).

Plot A

Table 12: WLC emissions for each lifecycle module, using the FES 2020 Carbon factor for modules B4. B6, and D.

Result category	Biogenic carbon (kg CO_{2e})	A1-A3 Product Stage	A4 Transportation to site	A5 Site operations	B1 Use Phase	B2-B3	B4-B5 Material replacement and refurbishment	B6 Operational Energy use - Regulated	B6 Operational Energy use - Unregulated	B7 Operational Water use	C1-C4 End of Life stage	TOTAL kg CO_{2e}	D External impacts (not included in totals)
1 Substructure	−3 617	2 205 630	45 388	165 751		0					35 020	2 448 172	−507 296
2.1 Frame	−2 006	185 351	13 591	8 186		0					7 712	212 834	−57 146
2.2 Upper Floors	−9 050	913 625	66 911	47 883		0	386 462				36 125	1 441 956	−295 453
2.3 Roof	−1 448	133 822	9 812	5 910		0					5 568	153 664	−41 259
2.4 Stairs & Ramps													
2.5 Ext. Walls	−945	145 794	6 893	7 415		0	37 440				4 712	201 309	−35 310
2.6 Windows & Ext. Doors	0	402 760	1 261	25		0	2 508				93	406 647	−198 314
2.7. Int. Walls & Partitions	−150 275	750 942	68 803	107 392		0	751 475				169 220	1 697 557	−2 236
2.8 Int. Doors													
3 Finishes	−375 518	565 534	10 954	94 300		0	965 434				560 555	1 821 261	−628 062
4 Fittings, furnishings & equipment's													
5 Services (MEP)	0	414 622	9 983	3 579		0	529 878	4 117 598		203 670	2 276	5 281 607	−301 670
6 Prefabricated													
7 Existing bldg.													
8 Ext. works	−105 836	541 495	93 810	21 798		0	75 369				115 749	742 384	−276 475
Unclassified / Other				469 644	710 464							1 180 107	
TOTAL kg CO_{2e}	−648 694	6 259 574	327 405	931 884	710 464	0	2 748 566	4 117 598		203 670	937 032	15 587 498	−2 343 223

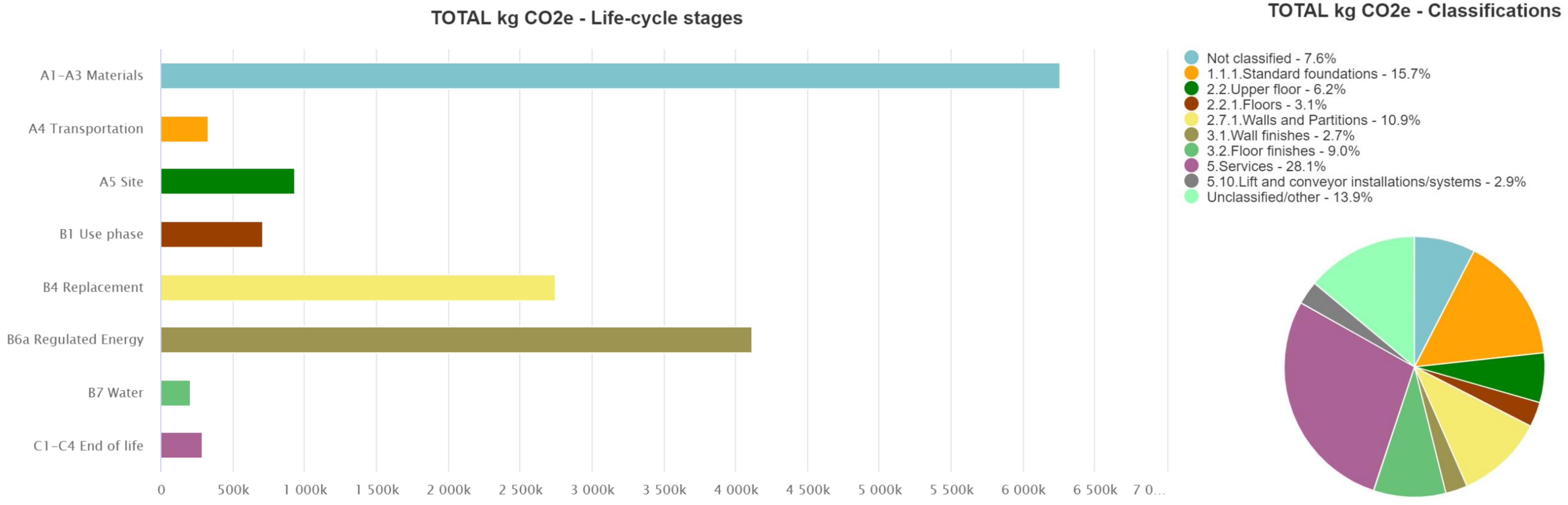


Figure 11: WLC per lifecycle stage (left), WLC per RICS category (right) - Plot A

Plot B

Table 13: WLC emissions for each lifecycle module, using the FES 2020 Carbon factor for modules B4. B6, and D.

Result category	Biogenic carbon (kg CO_{2e})	A1-A3 Product Stage	A4 Transportation to site	A5 Site operations	B1 Use Phase	B2-B3	B4-B5 Material replacement and refurbishment	B6 Operational Energy use - Regulated	B6 Operational Energy use - Unregulated	B7 Operational Water use	C1-C4 End of Life stage	TOTAL kg CO_{2e}	D External impacts (not included in totals)
1 Substructure	−4 427	2 699 731	44 980	207 217		0					38 415	2 985 916	−628 082
2.1 Frame	−3 055	282 323	20 701	12 469		0					11 747	324 185	−87 044
2.2 Upper Floors	−13 553	1 354 722	99 228	69 788		0	510 797				53 871	2 074 852	−435 880
2.3 Roof	−1 608	148 629	10 898	6 564		0					6 184	170 668	−45 825
2.4 Stairs & Ramps													
2.5 Ext. Walls	−385	59 867	2 784	3 471		0	138				2 170	68 044	−15 388
2.6 Windows & Ext. Doors	0	476 294	677	45		0	4 440				113	481 568	−233 791
2.7. Int. Walls & Partitions	−193 088	917 727	83 387	131 319		0	918 664				216 283	2 074 293	−3 931
2.8 Int. Doors													
3 Finishes	−744 448	899 310	15 109	150 538		0	1 333 051				1 019 831	2 673 391	−968 754
4 Fittings, furnishings & equipment’s													
5 Services (MEP)	0	538 287	12 881	3 604	710 464	0	673 678	6 285 985		621 688	2 425	8 849 011	−361 012
6 Prefabricated													
7 Existing bldg.													
8 Ext. works													
Unclassified / Other				634 639								634 639	
TOTAL kg CO_{2e}	−960 564	7 376 890	290 645	1 219 653	710 464	0	3 440 767	6 285 985		621 688	1 351 039	20 336 567	−2 779 708

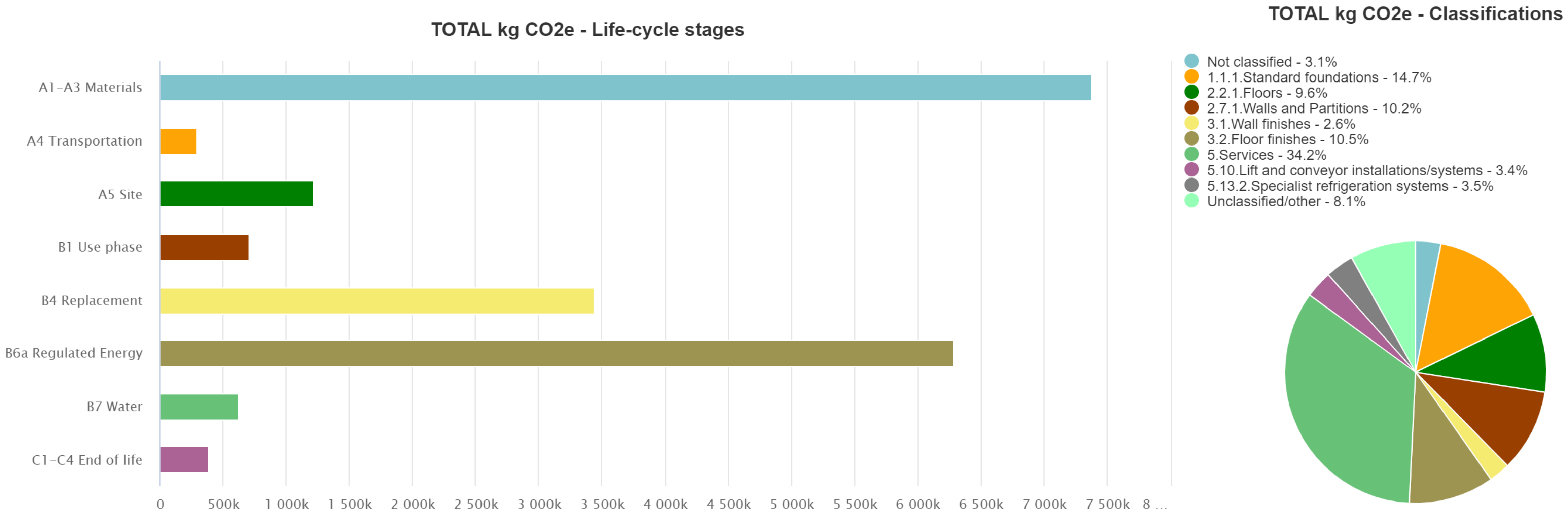


Figure 12: WLC per lifecycle stage (left), WLC per RICS category (right) - Plot B

Plot C

Table 14: WLC emissions for each lifecycle module, using the FES 2020 Carbon factor for modules B4. B6, and D.

Result category	Biogenic carbon (kg CO_{2e})	A1-A3 Product Stage	A4 Transportation to site	A5 Site operations	B1 Use Phase	B2-B3	B4-B5 Material replacement and refurbishment	B6 Operational Energy use - Regulated	B6 Operational Energy use - Unregulated	B7 Operational Water use	C1-C4 End of Life stage	TOTAL kg CO_{2e}	D External impacts (not included in totals)
1 Substructure	−1 837	1 837	0	73		0					1 837	1 910	0
2.1 Frame	−1 530	141 396	10 368	6 245		0					5 883	162 361	−43 594
2.2 Upper Floors	−7 527	752 945	55 149	38 845		0	286 847				29 927	1 156 186	−242 364
2.3 Roof	−807	74 549	5 466	3 292		0					3 102	85 602	−22 984
2.4 Stairs & Ramps													
2.5 Ext. Walls	−152	23 820	1 098	1 385		0	56				862	27 069	−6 105
2.6 Windows & Ext. Doors	0	236 821	731	0		0					51	237 603	−117 338
2.7. Int. Walls & Partitions	0	474 619	46 399	66 676		0	475 113				12 435	1 075 243	−2 073
2.8 Int. Doors													
3 Finishes	0	194 073	5 762	31 117		0	466 982				71 276	769 210	−201 162
4 Fittings, furnishings & equipment’s													
5 Services (MEP)	0	254 053	5 783	3 091		0	318 348	3 708 318		137 970	2 073	4 429 637	−190 605
6 Prefabricated													
7 Existing bldg.													
8 Ext. works													
Unclassified / Other				341 733	710 464							1 052 196	
TOTAL kg CO_{2e}	−11 851	2 154 112	130 757	492 457	710 464	0	1 547 345	3 708 318		137 970	127 446	8 997 018	−826 225

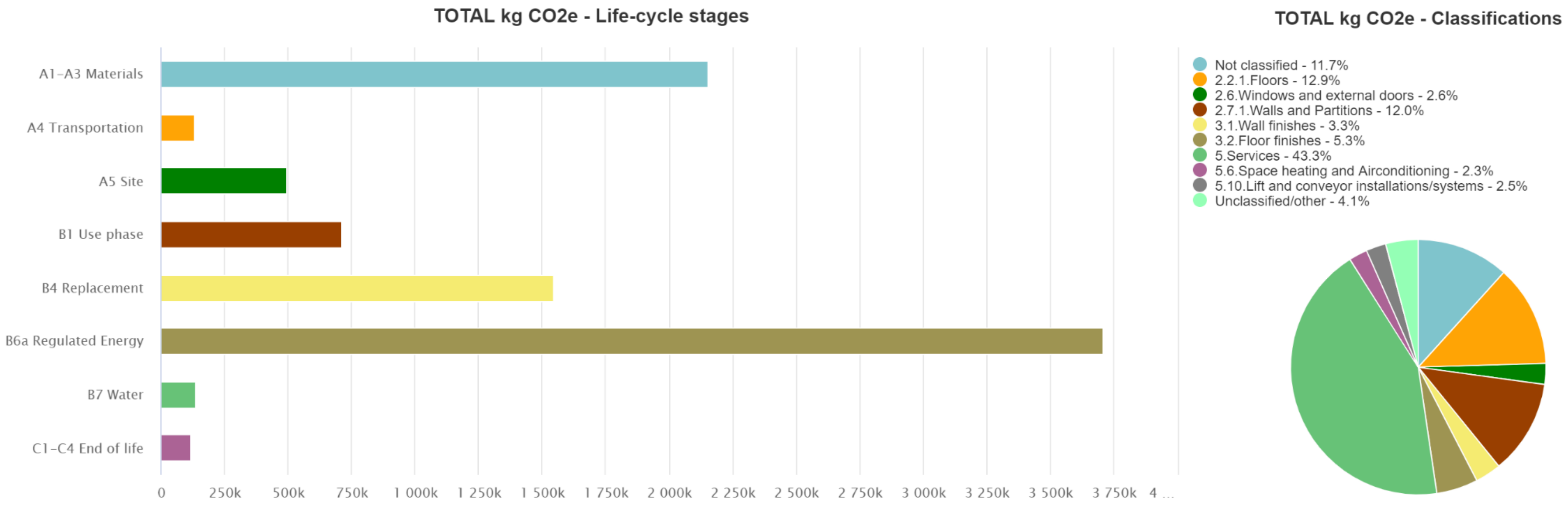


Figure 13: WLC per lifecycle stage (left), WLC per RICS category (right) - Plot C

Plot D

Table 15: WLC emissions for each lifecycle module, using the FES 2020 Carbon factor for modules B4. B6, and D.

Result category	Biogenic carbon (kg CO_{2e})	A1-A3 Product Stage	A4 Transportation to site	A5 Site operations	B1 Use Phase	B2-B3	B4-B5 Material replacement and refurbishment	B6 Operational Energy use - Regulated	B6 Operational Energy use - Unregulated	B7 Operational Water use	C1-C4 End of Life stage	TOTAL kg CO_{2e}	D External impacts (not included in totals)
1 Substructure	−3 421	2 083 058	37 650	143 266		0					34 001	2 294 554	−444 472
2.1 Frame	−1 602	148 076	10 858	6 540		0					6 161	170 032	−40 526
2.2 Upper Floors	−8 154	810 352	59 359	41 323		0	253 582				32 330	1 188 792	−230 927
2.3 Roof	−1 044	96 505	7 076	4 262		0					4 015	110 814	−26 412
2.4 Stairs & Ramps													
2.5 Ext. Walls	0	14 887	108	1 161		0	74				423	16 654	−2 421
2.6 Windows & Ext. Doors	0	6 552	68	66		0	5 787				16	12 490	
2.7. Int. Walls & Partitions	−115 541	576 035	52 773	82 378		0	509 284				130 060	1 234 990	−2 283
2.8 Int. Doors													
3 Finishes	−567 887	646 253	10 105	109 561		0	854 264				777 240	1 829 535	−676 240
4 Fittings, furnishings & equipment's													
5 Services (MEP)	0	507 674	12 114	3 288		0	546 064	4 069 982		363 915	2 194	5 505 231	−276 235
6 Prefabricated													
7 Existing bldg.													
8 Ext. works													
Unclassified / Other				398 370	710 464							1 108 833	
TOTAL kg CO_{2e}	−697 649	4 889 392	190 111	790 214	710 464	0	2 169 056	4 069 982		363 915	986 440	13 471 925	−1 699 514

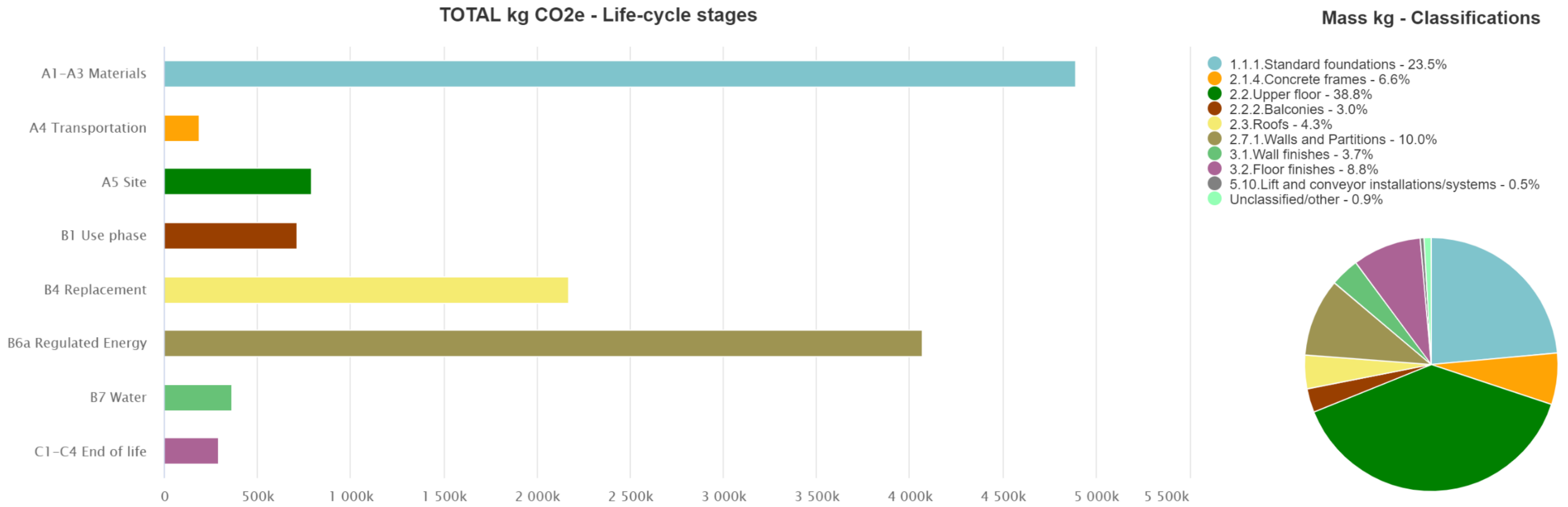


Figure 14: WLC per lifecycle stage (left), WLC per RICS category (right) - Plot D

Plot E

Table 16: WLC emissions for each lifecycle module, using the FES 2020 Carbon factor for modules B4. B6, and D.

Result category	Biogenic carbon (kg CO_{2e})	A1-A3 Product Stage	A4 Transportation to site	A5 Site operations	B1 Use Phase	B2-B3	B4-B5 Material replacement and refurbishment	B6 Operational Energy use - Regulated	B6 Operational Energy use - Unregulated	B7 Operational Water use	C1-C4 End of Life stage	TOTAL kg CO_{2e}	D External impacts (not included in totals)
1 Substructure	−1 488	805 706	22 893	59 022		0					23 934	910 068	−168 847
2.1 Frame	−950	87 782	6 437	3 877		0					3 652	100 798	−24 024
2.2 Upper Floors	−4 243	417 262	30 569	20 876		0	112 167				16 748	593 379	−118 244
2.3 Roof	−583	53 912	3 953	2 381		0					2 243	61 905	−14 755
2.4 Stairs & Ramps													
2.5 Ext. Walls	0	9 732	71	760		0	49				276	10 889	−1 579
2.6 Windows & Ext. Doors	0	1 184	12	12		0	1 046				3	2 257	
2.7. Int. Walls & Partitions	−47 141	218 925	20 085	31 381		0	193 603				52 780	469 633	−1 064
2.8 Int. Doors													
3 Finishes	−97 382	164 642	3 303	27 496		0	276 055				154 501	528 614	−173 266
4 Fittings, furnishings & equipment's													
5 Services (MEP)	0	462 571	10 617	2 820		0	467 733	1 620 711		166 794	2 035	2 733 282	−214 624
6 Prefabricated													
7 Existing bldg.													
8 Ext. works													
Unclassified / Other				185 754	473 642							659 396	
TOTAL kg CO_{2e}	−151 788	2 221 716	97 940	334 380	473 642	0	1 050 652	1 620 711		166 794	256 173	6 070 222	−716 402

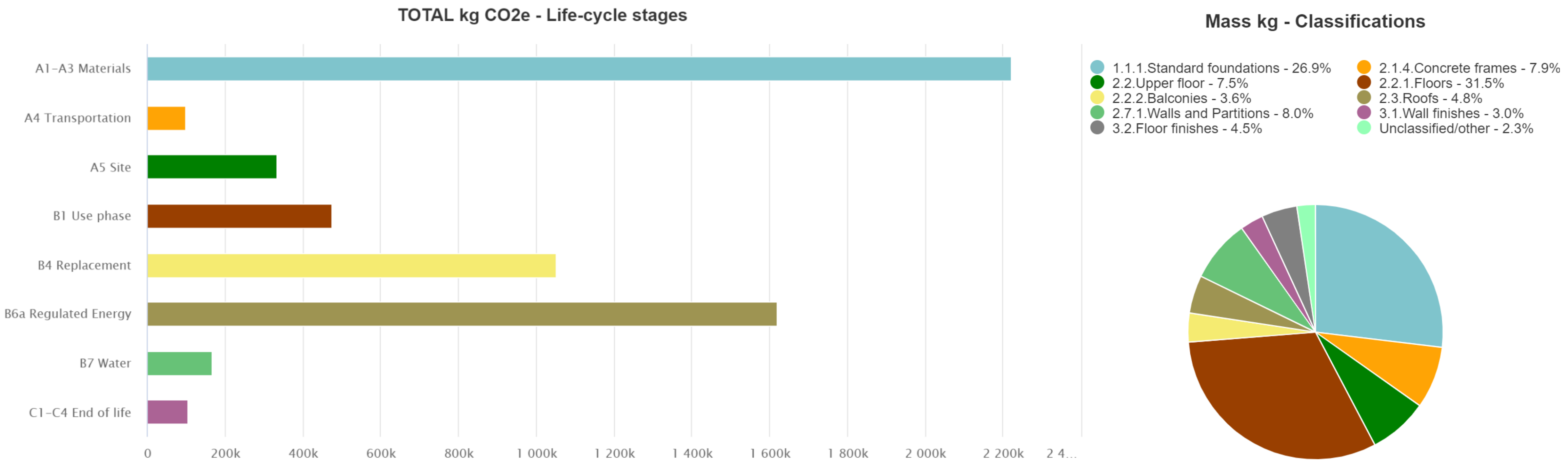


Figure 15: WLC per lifecycle stage (left), WLC per RICS category (right) - Plot E

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6. Opportunities for reducing WLC.

6.1 Maximise recycled content.

By specifying products with high contents of recycled material, the product life cycle emissions can be significantly reduced, compared to products procured with virgin material. Noting the relationships confirmed in EPD data displayed in Figure 16, Figure 17 and Figure 18, embodied carbon can be reduced at the technical design stage.

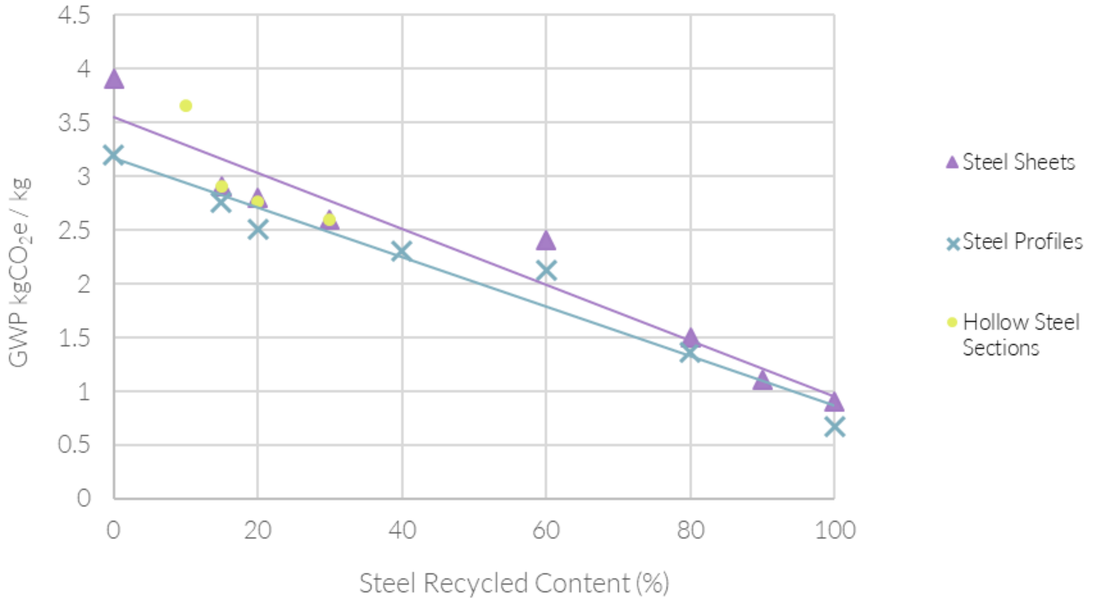

Figure 16: Product life cycle emissions (A1-A3) of construction grade steel and reporting the impact of recycled content.

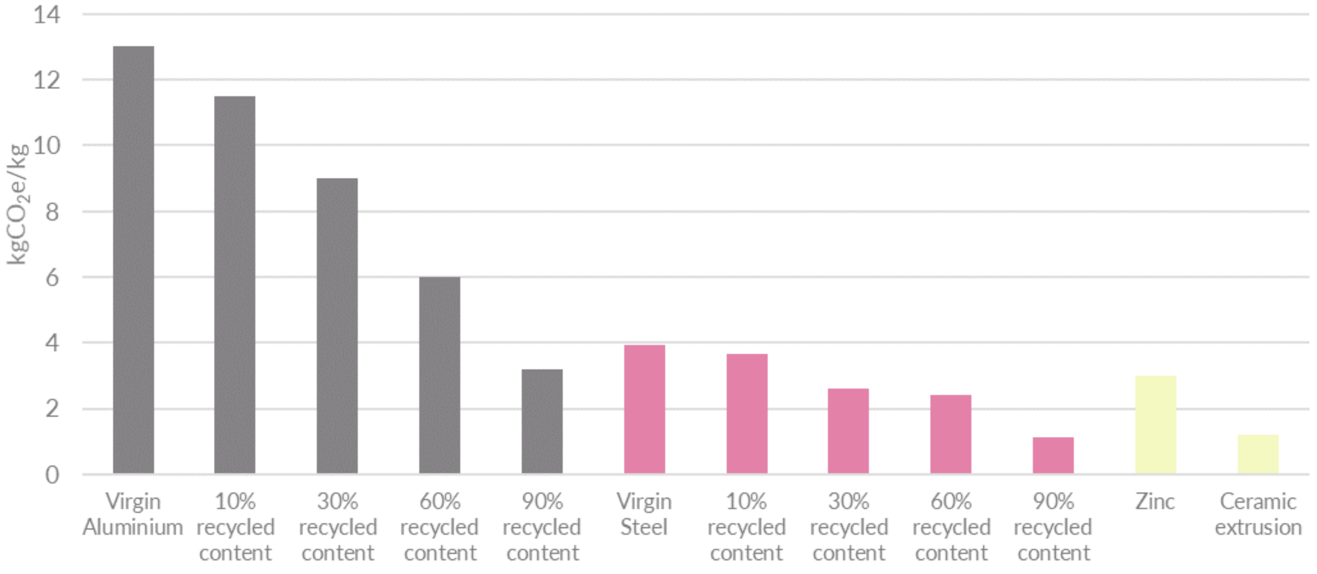

Figure 17: Product life cycle emissions (A1-A3) of aluminium, steel, zinc and ceramic and the impact of including recycled content.

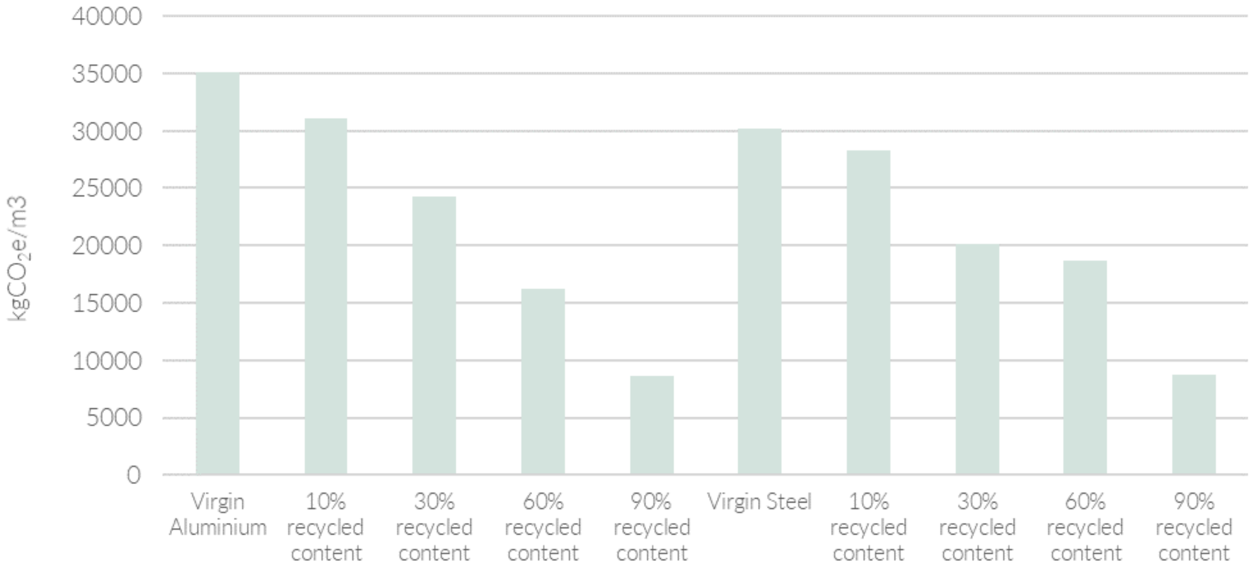

Figure 18: Product life cycle emissions (A1-A3) of aluminium and steel by volume, confirming that the quantum of material contained within a product is just as important as the material itself.

6.2 Influence of product specification.

The specific requirements of a product can significantly impact the carbon emissions at the product stage, often due the components of the product requiring more carbon intensive treatment and subsequent transportation prior to fabrication.

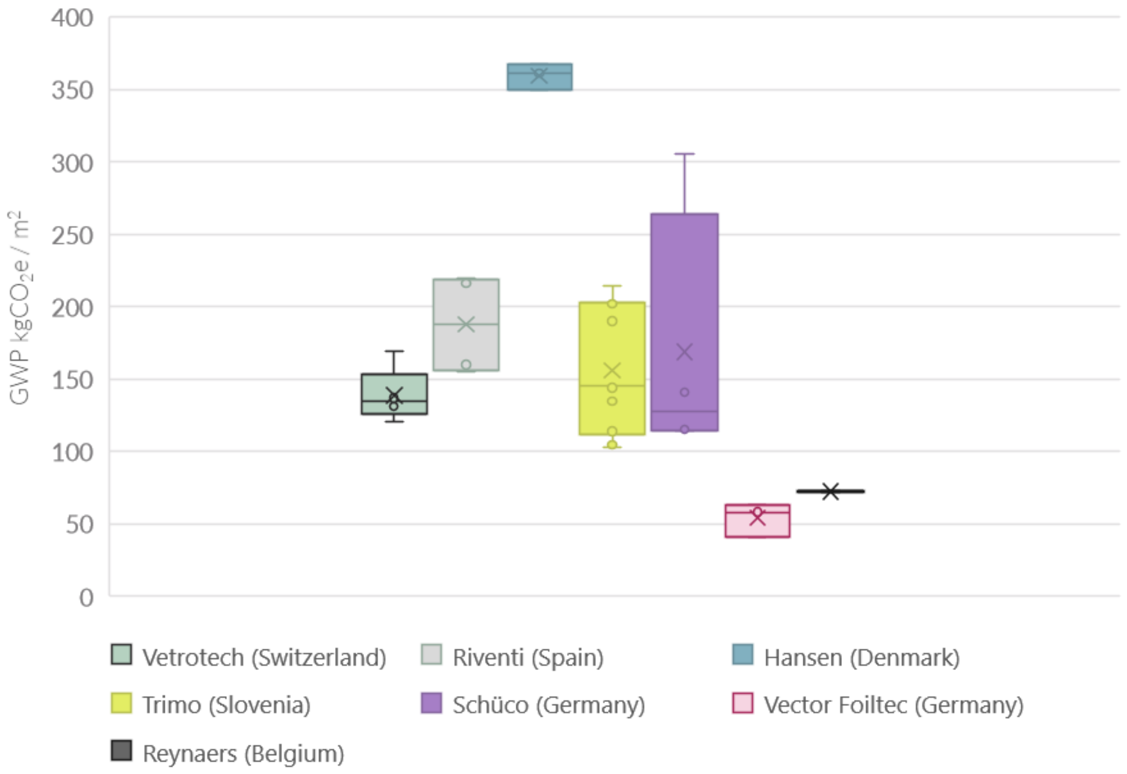

Figure 19: Comparison of Environmental Product Declarations (EPDs) of leading façade fabricators.

6.3 Actions taken to reduce whole life-cycle carbon emissions.

6.3.1 Energy strategy

Primarily, the energy strategy for the project is a key mechanism for reducing Whole Life Carbon of the development.

In addition to a passive design approach, an 'electric led' energy strategy has been proposed, which features highly efficient heat pumps to deliver heating and hot water throughout the development. In addition to heat pumps working at greater efficiency than gas boilers, the heat pumps can take advantage of the projected decarbonisation of the national grid (previously discussed), and therefore is expected to be lower in Whole Life Carbon terms than traditional gas boiler servicing strategy.

Table 17: Reduction in WLC due to energy strategy.

Energy scenario	Electricity emissions (tonnes CO_{2e} 60 year)
Proposed regulated baseline	69,540
Proposed regulated "Be Green" design	33,300
Change over lifetime	36,340

This equates to a reduction of 2006 kg CO_{2e} /m^2.

6.3.2 The Circular Economy

The supporting Circular Economy statement details the approach to Circular Economy taken by the design in line with Peabody aspirations as well as the GLA Circular Economy Statement Guidance, and Policy SI7 Reducing waste and supporting the Circular Economy. The key aims of the Circular Economy is to encourage applicants to:

- Consider strategies to facilitate the transition towards a circular built environment.
- Report against numerical targets that will facilitate monitoring of waste and recycling; and finally
- Recognise opportunities to benefit from greater efficiencies that can help to save resources, materials, and money.

Following co-operative engagement with the team, the following early-stage key commitments for the development have been confirmed in Table 18 below. In line with the Circular Economy methodology, the approach it is expected to be further developed through a collaborative and cross-disciplinary process throughout the project programme. The interventions proposed address Peabody's desire to embed sustainable practice, waste reduction and circular economy principles within the built environment and throughout their organisational activities. The approach covers a wide range of interventions in developing a design that prioritises Circular Economy principles and will help to reduce the material impact and waste generated by the built environment.

For a full review of the Circular Economy Statement and approach, the ideas considered for the please refer to the supporting Circular Economy Statement.

Table 18 Summary of the Key Commitments set in line with Circular Economy Statement Guidance.

	Summary of Approach
Section A: Conserve Resources	
Minimising the quantities of materials used	The scheme will look at adopting efficient design, demolitions, construction, and operation of the building life cycle. Key considerations will be made throughout each of the different layers regarding minimising quantities of materials required as far as possible.
Minimising the quantities of other resources used (energy, water, land)	All aspects of the building will ensure quantities of materials are reduced as far as possible, without compromising the design. As a result of minimising the overall quantity of materials used on site, less resourcing. water, energy will be required for the scheme.
Specifying and sourcing materials responsibly and sustainably	Responsibly sourced materials will be given priority over materials not obtaining certification.
Section B: Design to Eliminate Waste (And for Ease of Maintenance)	
Designing for reusability / recoverability / longevity / adaptability / flexibility	All commercial and residential spaces throughout the development will be designed with reusability / recoverability / longevity / adaptability / flexibility principles in mind. The scheme will look to create a space flexible and accommodating to all needs of the building users and tenants ensuring an inclusive development is delivered for the community.
Designing out construction, demolition, excavation, industrial and municipal waste arising	Efficient waste reduction practices will be incorporated where practical throughout all stages of the design, demolition, excavation, construction, and municipal waste stages.
Section C: Manage Waste	
Demolition waste (how waste from demolition of the layers will be managed)	Potential challenges are reusing materials within the scheme, without compromising integrity of the design or building elements.
Excavation waste (how waste from excavation will be managed)	Excavation waste could be of poor quality, therefore making it impractical to incorporate within the design of the scheme/and or potentially compromise the design.
Construction waste (how waste arising from construction of the layers will be reused or recycled)	New techniques and strategies with potential cost implications to be considered in order to ensure the waste targets are achieved.
Municipal and industrial waste (how the design will support operational waste management)	Space requirements for the waste storage facility potential challenge for the team to incorporate within the base build.

6.3.3 The Net Zero Carbon Feasibility assessment – Plot C.

Throughout the pre-planning process, an early-stage Net Zero Carbon Feasibility Study of Plot C was undertaken. The aim of the study was to assess the baseline carbon emissions for the plot and engage with the design team on suitable and realistic iterations to capture in order to reduce the anticipated carbon emissions. Plot C was selected as the key design to assess due to the fact that it is proposed to be 100% social rent and contains the Women's Centre. It is also proposed to be in the first phase of the build, so will offer the most value to occupants and being in the first phase will offer lessons learned around the materials and construction process.

The overall approach was steered by leading Industry and Carbon benchmark targets from UKGBC, RIBA 2030 Climate Challenge, LETI Guidance for Net Zero Operational Carbon, and finally Islington's 2030 vision.

Concluding the feasibility study, the team confirmed the following design changes would be captured within the final design:

- Glazing Reduction
- MEP Refrigerant changes
- Refrigerator and Freezer changed to Fridge-Freezer
- Tumble Dryer/ Washer Dryer
- Glazing U-value changed from 1.00 to 1.20 W/m²K
- External Wall U-value changed from 0.15 to 0.13 W/m²K
- Non-domestic g-value reduced from 0.50 to 0.30

Following the inclusion of these changes, the exercise confirmed the performance of Plot C has made a positive step towards the 2030 targets. As the project progresses, further opportunities in regard to reducing the buildings embodied carbon will become available, such as further detail around the material quantities and selection of EPDs. These processes combined, will collectively work towards informing the design team on the expected carbon emissions associated with each material and building element assess, and ensure informed choices and design considerations are incorporated for the future, and reducing carbon emissions.

For full review of the study undertaken, please refer to the Stage 2 Net Zero Carbon Feasibility Study for a full understanding as to the investigation works completed, and associated results concluded.

7. Conclusion.

This report has set out the indicative results to the Whole Life Carbon emissions estimated for Project Holloway, completed following the GLA Whole Life-Cycle Carbon Assessment - Pre-consultation draft guidance. Assessment 2 forms the basis of this Whole Life Carbon Assessment as it accounts for future decarbonisation of the UK's electrical grid.

The results for the assessment are as summarised below.

Table 19: Summary table of the Whole Life Carbon Emissions of the Proposed Development.

Whole Life Carbon scope	Whole Life Carbon emissions
Plot A Assessment 1: SAP10	24,512,320
Plot A Assessment 2: Decarbonisation projection	15,587,498
Plot B Assessment 1: SAP10	33,961,327
Plot B Assessment 2: Decarbonisation projection	26,072,495
Plot C Assessment 1: SAP10	18,767,855
Plot C Assessment 2: Decarbonisation projection	8,997,018
Plot D Assessment 1: SAP10	22,566,856
Plot D Assessment 2: Decarbonisation projection	13,471,925
Plot E Assessment 1: SAP10	9,716,275
Plot E Assessment 2: Decarbonisation projection	6,070,222

Appendix A – Principles for reducing WLC emissions.

No.	Principle	Description Relevant life-cycle modules	Relevant life-cycle modules
1	Reuse and retrofit of existing built structures	Before embarking on the design of a new structure or building, the retrofit or reuse of any existing built structures, in part or as a whole, should be a priority consideration as this is typically the lowest carbon option. Significant retention and reuse of structures also reduces construction costs and can contribute to a smoother planning process.	A1-A5, B1-B6, C1-C4, D
2	Use recycled or repurposed materials	Using recycled or repurposed materials, as opposed to newly sourced raw materials, typically reduces the carbon emissions from constructing a new building and reduces waste. This process would start by reviewing the materials already on site for their potential for inclusion into the proposed scheme. Many of the currently available standard products already include a degree of recycled content. Applicants should obtain this information from the supply chain, preferably in the form of an EPD.	A1-A5, B1-B5, C1-C4, D
3	Material selection	This is the most important issue affecting the WLC 'cost' of a new building. Appropriate low carbon material choices are key to carbon reduction. Ensuring that there is synchronicity between materials selected and planned life expectancy of the building reduces waste and the need for replacement, thus reducing in-use costs. EPDs should be referenced. It is important to note that the overall life-time carbon footprint of a product can be as much down to its durability as to what it is made of. For example, bricks may have a high carbon cost in terms of their manufacture, however they have an exceptionally long and durable life expectancy. The selection of reused or recycled materials and products, plus products made from renewable sources, such as timber, will also help reduce the carbon footprint of a project.	A1-A5, B1-B5, C1-C4, D
4	Minimise operational energy use	A 'fabric first' approach should be prioritised to minimise the heating and cooling requirement of a building. Naturally ventilated buildings avoid the initial carbon and financial costs of a ventilation system installation, and the repeat carbon and financial costs of its regular replacement.	A1-A5, B1-B4, B6
5	Minimise operational water use	Carbon emissions from water use are largely due to the materials and systems used for its storage and distribution, the energy required to transfer it around the building, and the energy required to treat any wastewater. The choice of materials used and the durability of the systems, which help avoid leakage and resulting damage to building fabric, are therefore key aspects of reducing the carbon cost of water use. On-site water collection, recycling and treatment, and storage can have additional positive environmental impacts as well as reducing in-use costs.	A1-A5, B1-B5, B7, C1-C4, D
6	Disassembly and reuse	Designing for future disassembly ensures that products do not become future waste and that they maintain their environmental and economic value. A simple example is using lime rather than cement mortar; the former being removable at the end of a building's life, the latter not. This enables the building's components (e.g., bricks) to have a future economic value as they can be reused for their original purpose rather than becoming waste or recycled at a lower level (e.g., hardcore in foundations). Designing building systems (e.g., cladding or structure) for disassembly and dismantling has similar and even broader benefits. Ease of disassembly facilitates easy access for maintenance and replacement leading to reduced maintenance carbon emissions and reduced material waste during the 'in-use' and 'end of life' phases. This leads to the potential for material and product reuse which also reduces waste and contributes to the circular economy principle.	A1-A5, B1-B5, C1-C4, D
7	Building shape and form	Compact efficient shapes help minimise both operational and embodied carbon emissions from repair and replacement for a given floor area. This leads to a more efficient building overall, resulting in lower construction and in-use costs. A complex building shape with a large external surface area in relation to the floor area requires a larger envelope than a more compact building. This measure of efficiency can be referred to as the 'wall to floor ratio', or the 'heat loss form factor'. This requires a greater use of materials to create the envelope, and a potentially greater heating and/or cooling load to manage the internal environment.	A1, B1, D
8	Regenerative design	Removing CO_2 from the atmosphere through materials and systems absorbing it makes a direct contribution to carbon reduction. Examples include unfinished concrete, some carpet products and maximising the amount of vegetation.	A1, B1, D
9	Designing for durability and flexibility	Durability means that repair and replacement is reduced which in turn helps reduce lifetime building costs. A building designed for flexibility can respond with minimum environmental impact to future changing requirements and a changing climate, thus avoiding obsolescence which also underwrites future building value. Buildings designed with this principle in mind will be less likely to be demolished at the 'end of life' as they lend themselves to future refurbishment. Examples include buildings being designed with 'soft spots' in floors to allow for future modification and design as well as non-structural internal partitions to allow layout change.	A1-A5, B1-B5, C1-C4, D
10	Optimisation of the relationship between operational and embodied carbon	Optimising the relationship between operational and embodied emissions contributes directly to resource efficiency and overall cost reduction. For example, the use of insulation has a clear carbon benefit whereas its fabrication has a carbon cost. This means that it is important to look not only at the U-value of	A1-A5, B1-B6

No.	Principle	Description Relevant life-cycle modules	Relevant life-cycle modules
		insulation, but also the carbon cost of the manufacture and installation of different product options. Avoiding fully glazed façades will reduce cooling demand and limits the need for high-carbon materials (glass units, metal frame, shading device etc) both at the construction stage, and the 'in use' stage through wholesale replacements.	
11	Building life expectancy	Defining building life expectancy gives guidance to project teams as to the most efficient life expectancy choices for materials and products. This aids overall resource efficiency, including cost efficiency and helps future proof asset value	A1-A5, B1-B5, C1-C4, D
12	Local sourcing	Sourcing local materials reduces transport distances and therefore supply chain lengths and has associated local social and economic benefits e.g., employment opportunities. It also has benefits for occupiers as replacement materials are easier to source. Transport type is also highly relevant. A product transported by ship will have a significantly lower carbon cost per mile than one sent by HGV. A close understanding of the supply chain and its transport processes is therefore essential when selecting materials and products.	A1-A5, B3- B4
13	Minimising waste	Waste represents an unnecessary and avoidable carbon cost. Buildings should be designed to minimise fabrication and construction waste, and to ease repair and replacement with minimum waste, which helps reduce initial and in-use costs. This can be achieved through the use of standard sizes of components and specification and by using modern methods of construction. Where waste is unavoidable, the designers should establish the suppliers' processes for disposal or preferably reuse of waste.	A1-A5, B1-B7, C1-C4, D
14	Efficient fabrication	Efficient construction methods (e.g., modular systems, precision manufacturing and modern methods of construction) can contribute to better build quality, reduce construction phase waste, and reduce the need for repairs in the post completion and defects period (snagging). Such methods can also enable future disassembly and reuse with attendant future carbon benefits.	A1-A5, B1-B7, C1-C4, D
15	Lightweight construction	Lightweight construction uses less material which reduces the carbon footprint of the building as there is less material to source, fabricate and deliver to site. Foundations can then also be reduced with parallel savings. Lightweight construction can also be easier to design for future disassembly and reuse. The benefits of lighter construction should be seen in the context of other principles such as durability.	A1-A5, C1-C4, D
16	Circular economy	The circular economy principle focusses on a more efficient use of materials which in turn leads to financial efficiency. Optimising recycled content, reuse and retrofit of existing buildings, and designing new buildings for easy disassembly, reuse and retrofit, and recycling as equivalent components for future reuse is essential. The use of composite materials and products can make future recycling difficult. Where such products are proposed, the supplier should be asked for a method statement for future disposal and recycling.	C1-C4, D

Appendix B – End of life scenarios.

Table 20: One Click LCA's default end of life scenarios.

Material group	End of life scenario	Materials included	C3 – C4, waste processing and landfilling	D, recycling benefits
Mineral building materials	Recycling for ground works	Concrete*, Cement*, Bricks, Porcelain, Plaster, Clay products, Stone, Ceramics, Asphalt	C3: Construction waste preparation for recycling	Recycling benefit from replacing the primary gravel
Metals	Metal preparation and recycling**	Aluminium, Steel, Stainless steel, Galvanized steel, Copper coated, Copper uncoated, Brass, Zinc, Lead	C3: Metal waste preparation	Recycling benefits for replacing virgin metal
Biobased materials with heating value	Incineration and energy recovery	Wood, Wood products	C3: Construction waste incineration for energy recovery	Recovered energy
Other materials with heating value	Incineration and energy recovery	Plastics	C3: Construction waste incineration for energy recovery	Recovered energy
Other materials that can be landfilled in construction waste site	Disposal / landfilling of inert material	Coatings, Synthetic materials, Panels, and boards***, Insulating materials***, Glass, Window, and façade components***	Disposal of inert construction waste	-

* Taking into account concrete carbonization

** Recycling potential can only be reported for metals with shares of primary manufacturing, i.e., if a product is made of recycled material, it no longer has recycling potential. 5% of losses is assumed for recycling (the remaining 95% are recycled).

*** When not included to above groups

Appendix C – OneClick LCA information export and EPDs.

Here the OneClick tool exports are shown for the baseline case.

Resource Name	Technical Specification	Product	Manufacturer	EPD Program	EPD Number	Environment Data Source	Standard	Verification	Year	Country	Upstream Database	Density	Product Category Rules (PCR)	Notes About PCR
Acrylic bathtub	170x75 cm		IDÉAL STANDARD	INIES	INIES_CFDE20141218_151217, 4107	FDES	EN15804+A1	Third-party verified (as per ISO 14025)	2014	france	ecoinvent		EN15804+A1	EN15804+A1
Aluminium composite panels for ventilated façade cassettes for window openings	5 mm (panel), 0.5 mm (aluminium layer), 9.95 kg/m2	FR plus 5x0.5	Alcotek LLC	International EPD System	S-P-01480	EPD Aluminium composite panels	EN15804+A1	Third-party verified (as per ISO 14025)	2020	Russia	ecoinvent		PCR 2012:01 Construction products and construction services, version 2.33.	Only with EN15804
Aluminium door frame, per unit	1000 mm x 2000mm, 20.05 kg/unit		Kawneer	-	-	EPD Aluminium Door Systems	EN15804+A1	Third-party verified (as per ISO 14025)	2015	United Kingdom	ecoinvent		-	-
Aluminium frame window, double glazed	32.259 kg/m2, 1.23 x 1.48 m	Masterline 8 Standard	Reynaers Aluminium	B-EPD	2000058-001-EN	EPD Reynaers Aluminium window Masterline 8 Standard	EN15804+A1	Third-party verified (as per ISO 14025)	2020	Belgium	ecoinvent		PCR NBN DTD B 08-001	Only with EN15804
Aluminium handrails	5.51 kg/m	HR-6CN/HRO-6, HR-8CN, HR-6CRBN, HR-6CNSS, HR-6CRBNSS, HRO-6RBN, HRO-6CN, HRO-6CRBN	Construction Specialties (CS)	NSF	EPD10491	EPD HR/HRO Handrails	ISO14040	Third-party verified (as per ISO 14025)	2020	Pennsylvania, USA	GaBi		PCR Part A: Life Cycle Assessment Calculation Rules and Report Requirements, Version 3.2, 2018 Part B: Wall and Door Protection EPD Requirements, Version 1.0, 2019	Only with EN15804 (TRACI 2.1 units only)
Brass fixtures, shower heads	1.96 kg/piece	080st – chromed brass	VOLA	EPD Danmark	MD-18008-EN	EPD VOLA A/S	EN15804+A1	Third-party verified (as per ISO 14025)	2018	Denmark	GaBi		EN15804+A1	-

Resource Name	Technical Specification	Product	Manufacturer	EPD Program	EPD Number	Environment Data Source	Standard	Verification	Year	Country	Upstream Database	Density	Product Category Rules (PCR)	Notes About PCR
Brass tap	0.3kg	Donnee par default	MDEGD	INIES	INIES_DROB20200319_144702, 16276	MDEGD_FDES	EN15804+A1	Third-party verified (as per ISO 14025)	2020	France	ecoinvent		EN15804+A1	EN15804+A1
Carpet in rolls	width: 2.00 m, 0.978 kg/m2	Forbo Flooring Systems: Tenor, Granit, Showtime, Akzent, Markant, TotemTecsom: Tapisom 600, Tapisom 600D Fabricants concernés: FORBO FLOORING SYSTEMS	KALEI	INIES	INIES_CREV20190114_091734, 11038	FDES	EN15804+A1	Third-party verified (as per ISO 14025)	2018	France	ecoinvent		EN15804+A1	EN15804+A1
Carpet tiles	4.462 kg/m2	Taskworx	Shaw Europe	International EPD System	S-P-01240	EPD Taskworx	EN15804+A1	Third-party verified (as per ISO 14025)	2018	United Kingdom	ecoinvent		PCR 2012:01 Construction products and Construction services, ver. 2.2, 03/05/2017	Only with EN15804
Ceramic floor tile	10 mm, average density 2000 kg/m3		Mosa	MRPI	11.1.0001.004	EPD Vloertegelcollectie Koninklijke Mosa	EN15804+A1	Third-party verified (as per ISO 14025)	2013	United Kingdom	ecoinvent	2000.0	EN15804+A1	-
Ceramic shower tray, French average		Donnee par default	MDEGD	INIES	INIES_DREC20170317_174250, 6399	MDEGD_FDES	EN15804+A1	Third-party verified (as per ISO 14025)	2017	France	ecoinvent		EN15804+A1	EN15804+A1
Ceramic sink, French average		Donnee par default	MDEGD	INIES	INIES_DEVI20170317_174255, 6401	MDEGD_FDES	EN15804+A1	Third-party verified (as per ISO 14025)	2017	France	ecoinvent		EN15804+A1	EN15804+A1
Ceramic tiles, glazed	10/10.5 x 300 - 600 x 600 - 1200 mm, 24.7 kg/m2		Marazzi Group	IBU	EPD-MAR-20160004-IBC2-EN	EPD	EN15804+A1	Third-party verified (as per ISO 14025)	2016	Italy	GaBi	2470.0	PCR Ceramic tiles and panels 2014	Only with EN15804

Resource Name	Technical Specification	Product	Manufacturer	EPD Program	EPD Number	Environment Data Source	Standard	Verification	Year	Country	Upstream Database	Density	Product Category Rules (PCR)	Notes About PCR
Ceramic toilet, French average		Donnee par default	MDEGD	INIES	INIES_DWC20170317_174246, 6397	MDEGD_FDES	EN15804+A1	Third-party verified (as per ISO 14025)	2017	France	ecoinvent		EN15804+A1	EN15804+A1
Curtain wall with steel frame	54.64kg/m2, Uw<2.8W/m2. K		UNION DES METALLIERS	INIES	INIES_CFAÇ20191210_140842, 12996	FDES	EN15804+A1	Third-party verified (as per ISO 14025)	2019	France	ecoinvent		EN15804+A1	EN15804+A1
Electric elevator elements dependent of the number of floors (cabin and others)	max. transported gross weight 1000kg	Donnee par default	MDEGD	INIES	INIES_DELÉ20180427_112853, 8222	MDEGD_FDES	EN15804+A1		2018	France	ecoinvent		EN15804+A1	EN15804+A1
Emulsion for exterior masonry	0.269 kg/m2, 10 m2/l, 1.346 kg/l	Dulux Trade Weather shield Smooth Masonry Paint Pure Brilliant White, Dulux Trade Weather shield Smooth Masonry Paint Light Base, Dulux Trade Weather shield Smooth Masonry Paint Medium Base, Dulux Trade Weather shield Smooth Masonry Paint Extra Deep Base, Dulux Trade Weather shield Smooth Masonry Paint Magnolia, Dulux Trade Weather shield Smooth Masonry Paint Black, Dulux	AkzoNobel	MRPI	1.1.00010.2017	EPD Dulux Trade Weather shield Smooth Masonry	EN15804+A1	Third-party verified (as per ISO 14025)	2017	United Kingdom	ecoinvent		EN15804+A1	-

Resource Name	Technical Specification	Product	Manufacturer	EPD Program	EPD Number	Environment Data Source	Standard	Verification	Year	Country	Upstream Database	Density	Product Category Rules (PCR)	Notes About PCR
		Trade Weather shield Smooth Masonry Paint Gardenia, Dulux Trade Weather shield Smooth Masonry Paint Sandstone, Dulux Trade Weather shield Smooth Masonry Paint County cream, Dulux Trade Weather shield Smooth Masonry Paint Buttermilk												
Emulsion paint for all-round interior use	Pigment: Lightfast Pigments, binder: Acrylic Copolymer Dispersion, solvent: Water, 1.444 kg/l, 17 m2/l, 0.17 kg/m2	Vinyl Matt White	Dulux Trade	MRPI	1.1.00001.2017	EPD Dulux Trade Vinyl Matt	EN15804+A1	Third-party verified (as per ISO 14025)	2017	United Kingdom	ecoinvent		EN15804+A1	-
Expanded polystyrene insulation (EPS)	L=0.033 W/mK, 100 mm, 23.5 kg/m3, Lambda=0.033 W/ (m.K)	ECO-DUR ZETA	Isolconfort	EPD Italy	EPDITALY0114	EPD ECO-DUR ZETA Stabilimenti di Cologna Veneta (VR) e Pozzolo Formigaro (AL)	EN15804+A1	Third-party verified (as per ISO 14025)	2020	Italy	GaBi	23.5	PCR ICMQ-001/15 – rev2.1	Only with EN15804
Exterior façade mineral plastering mortar coating, French average		Donnee par default	MDEGD	INIES	INIES_DREV20170317_174052, 26026	MDEGD_FDES	EN15804+A1	Third-party verified (as per ISO 14025)	2021	France	ecoinvent		EN15804+A1	EN15804+A1

Resource Name	Technical Specification	Product	Manufacturer	EPD Program	EPD Number	Environment Data Source	Standard	Verification	Year	Country	Upstream Database	Density	Product Category Rules (PCR)	Notes About PCR
Exterior wooden door and windows, with aluminium elements	137mm, U = 0.65W/m2. K	LUMIA	MINCO	INIES	INIES_IFEN20190725_070639, 11039	FDES	EN15804+A1	Third-party verified (as per ISO 14025)	2018	France	ecoinvent		EN15804+A1	EN15804+A1
Flooring screed	C20/25 - XC1 - S3 - 20 CEM I, 50mm, 116.8kg/m2, 2336 kg/m3		SNBPE	INIES	INIES_CCHA20181217_151718, 10267	FDES	EN15804+A1	Third-party verified (as per ISO 14025)	2018	France	ecoinvent		EN15804+A1	EN15804+A1
Glass wool insulation panels, unfaced, generic	L = 0.031 W/mK, R = 3.23 m2K/W (18 ft2°Fh/BTU), 25 kg/m3 (1.56 lbs/ft3), (applicable for densities: 0-25 kg/m3 (0-1.56 lbs/ft3)), Lambda=0.031 W/ (m.K)			One Click LCA	-	One Click LCA	EN15804+A1	Internally verified	2018	LOCAL	ecoinvent	25.0	EN15804+A1	-
Granular surfacing ø 8...20 mm, 35 kg/m²				One Click LCA	-	LCA of crushed stone, OneClickLCA 2016	ISO14040	Internally verified	2016	LOCAL	ecoinvent	1700.0	-	Only with EN15804
Gravel for roads and sidewalks, with hydraulic binder stabilizer	100 mm, 230 kg/m2	Donnee par default	MDEGD	INIES	-	MDEGD_FDES	EN15804+A1	Third-party verified (as per ISO 14025)	2019	France	ecoinvent		EN15804+A1	EN15804+A1
Gypsum plaster board, regular, generic	6.5-25 mm (0.25-0.98 in), 10.725 kg/m2 (2.20 lbs/ft2) (for 12.5 mm/0.49 in), 858 kg/m3 (53.6 lbs/ft3)			One Click LCA	-	One Click LCA	EN15804+A1	Internally verified	2018	LOCAL	ecoinvent	858.0280607132333	EN15804+A1	-
Gypsum plasterboard	12.5 mm, 8.985 kg/m2 (average		Etex Building Performance	BRE	BREG EN EPD 000204	EPD GTEC Plasterboard	EN15804+A1	Third-party verified (as	2018	United Kingdom	ecoinvent	718.8	EN15804+A1	-

Resource Name	Technical Specification	Product	Manufacturer	EPD Program	EPD Number	Environment Data Source	Standard	Verification	Year	Country	Upstream Database	Density	Product Category Rules (PCR)	Notes About PCR
	product weight)							per ISO 14025)						
Gypsum plasterboard for suspended ceiling systems	12.5 mm, 9 kg/m2, 720 kg/m3			INSIDE/INSIDE	NIBE283	NIBE2899	EN15804+A1	Third-party verified (as per ISO 14025)	2020	Netherlands	ecoinvent	720.0	EN15804+A1	-
Kitchen cabinet door, melamine faced chipboard	5.5 kg/unit	Harmoni White	Ballingslöv	International EPD System	S-P-02127	EPD Painted Plain MFC Kitchen Door	EN15804+A1	Third-party verified (as per ISO 14025)	2020	Sweden	ecoinvent		PCR Furniture, Except seats and mattresses 2012:19 version 2.01 valid until 2023-06-17	Only with EN15804
Lightweight concrete masonry units (CMU) with stone wool insulation	0.08 W/mK, 450-600 kg/m3	Kalopor	KLB KlimaleichtPlot	IBU	EPD-KLB-20180129-IAA2-DE	EPD Plan-Blöcke mit integrierter Dämmung - KLB Kalopor	EN15804+A1	Third-party verified (as per ISO 14025)	2019	Germany	GaBi	600.0	PCR Leichtbeton, 07/2014	Only with EN15804
Luxury vinyl floor tiles	2.5 mm, 3.472 kg/m2	Amtico Form	Amtico	BRE	BREG EN EPD 000227	EPD Amtico Form (Artisan Wood and Contemporary Ceramic Emboss) Luxury Vinyl Floor Tiles	EN15804+A1	Third-party verified (as per ISO 14025)	2018	United Kingdom	ecoinvent		EN15804+A1	-
Mirror	ép. 8 mm	Donnee par default	MDEGD	INIES	INIES_DPOR20181005_154952, 8584	MDEGD_FDES	EN15804+A1	Third-party verified (as per ISO 14025)	2018	France	ecoinvent		EN15804+A1	EN15804+A1
Natural stone quartzite schist, naturally cleft surface, with sawn edges	30 - mm, 2700 kg/m3		Minera Skifer	EPD Norge	NEPD-315-192-EN	NEPD-315-192-EN Natural stone quartzite schist, natural cleft surface, with broken or sawn edges, Minera	EN15804+A1	Third-party verified (as per ISO 14025)	2015	Norway	ecoinvent	2700.0	IBU PCR Requirements on the EPD for Dimension stone for roof, wall, and floor applications	Only with EN15804

Resource Name	Technical Specification	Product	Manufacturer	EPD Program	EPD Number	Environment Data Source	Standard	Verification	Year	Country	Upstream Database	Density	Product Category Rules (PCR)	Notes About PCR
Plinth from solid wood	haut. 7 à 10 cm, ép. 1.4cm, biogenic CO2 not subtracted (for CML)	Donnee par default	MDEGD	INIES	INIES_DPLI20200120_154240, 14005	MDEGD_FDES	EN15804+A1	Third-party verified (as per ISO 14025)	2020	France	ecoinvent		EN15804+A1	EN15804+A1
Precast concrete part, staircase	1,1 m wide, 9 steps each 16 cm, 1965 kg/unit			OKOBAUDAT	-	Oekobau.dat 2020-II	EN15804+A1	Third-party verified (as per ISO 14025)	2020	Germany	GaBi		EN15804+A1	-
Ready-mix concrete, high-strength, generic	C50/55 (7300/7800 PSI), 20% recycled binders in cement (440 kg/m3 / 27.47 lbs/ft3)			One Click LCA	-	One Click LCA	EN15804+A1	Internally verified	2018	LOCAL	ecoinvent	2400.0	EN15804+A1	-
Ready-mix concrete, high-strength, generic	C60/75 (8700/10900 PSI), 20% recycled binders in cement (500 kg/m3 / 31.21 lbs/ft3)			One Click LCA	-	One Click LCA	EN15804+A1	Internally verified	2018	LOCAL	ecoinvent	2400.0	EN15804+A1	-
Ready-mix concrete, normal-strength, generic	C40/50 (5800/7300 PSI), 20% recycled binders in cement (400 kg/m3 / 24.97 lbs/ft3)			One Click LCA	-	One Click LCA	EN15804+A1	Internally verified	2018	LOCAL	ecoinvent	2400.0	EN15804+A1	-
Reinforcement steel (rebar), generic	97% recycled content (typical), A615			One Click LCA	-	One Click LCA	EN15804+A1	Internally verified	2018	LOCAL	ecoinvent	7850.0	EN15804+A1	-
Removable/mobile partitions with aluminium frame, glazed	38.02 kg/m2		Organisation professionnelle représentative des concepteurs, fabricants et installateurs	INIES	INIES_CCLO20181003_101314, 8666	FDES	EN15804+A1	Third-party verified (as per ISO 14025)	2018	France	ecoinvent		EN15804+A1	EN15804+A1

Resource Name	Technical Specification	Product	Manufacturer	EPD Program	EPD Number	Environment Data Source	Standard	Verification	Year	Country	Upstream Database	Density	Product Category Rules (PCR)	Notes About PCR
			de menuiseries extérieures en profilés aluminium											
Sewage water drainage piping network, per m2 GIFA (residential buildings)				One Click LCA	-	One Click LCA	EN15804	Internally verified	2019	LOCAL	ecoinvent		EN15804	-
Skirting board, plinthe, MDF, French average	haut. 7cm et ép. 1cm	Donnee par default	MDEGD	INIES	INIES_DPLI20161116_164652, 5760	MDEGD_FDES	EN15804+A1		2016	France	ecoinvent		EN15804+A1	EN15804+A1
Steel faced, fireproof, sandwich panels with stone wool core	25 kg/m2, 200 mm	AST T/AST L	Paroc	EPD Norge	NEPD-404-283-EN	NEPD-404-283-EN Paroc AST T and AST L fireproof panels	EN15804+A1	Third-party verified (as per ISO 14025)	2016	Finland	ecoinvent		NPCR 010 Building boards, rev1	Only with EN15804
Steel hollow door frames, per unit	3 x 7 x 0.53 ft., 16.64 kg/unit	Standard Hollow Frame	Assa Abloy	UL Environment	478714321.121.1	EPD ASSA ABLOY Standard Hollow Frame	EN15804+A1	Third-party verified (as per ISO 14025)	2016	iowa, USA	GaBi		UL PCR for Commercial Steel Doors and/or Frames 9005 (2015)	Only with EN15804
Steel mesh ceiling tile system	from 1200 x 300mm to 3000 x 600mm, 4.42 kg/m2	SAS 330	SAS International	BRE	BREG EN EPD000217	EPD SAS 330 Metal Mesh Ceiling Tile	EN15804+A1	Third-party verified (as per ISO 14025)	2018	United Kingdom	ecoinvent		EN15804+A1	-
Steel stud internal wall assembly, 100 mm, incl. mineral wool insulation	Steel stud wall 100 mm, incl. mineral wool insulation 100 mm and plasterboard 13 mm on both sides			One Click LCA		One Click LCA generic construction definitions				Europe	Other			
Structural steel profiles, generic	60% recycled content, I, H, U, L, and T			One Click LCA	-	One Click LCA	EN15804+A1	Internally verified	2018	LOCAL	ecoinvent	7850.0	EN15804+A1	-

Resource Name	Technical Specification	Product	Manufacturer	EPD Program	EPD Number	Environment Data Source	Standard	Verification	Year	Country	Upstream Database	Density	Product Category Rules (PCR)	Notes About PCR
	sections, S235, S275 and S355													
Synthetic membrane for waterproofing of underground walls and foundations, French average	ép. 2mm	Donnee par default	MDEGD	INIES	INIES_DMEM 20161116_164605, 5719	MDEGD_FDES	EN15804+A1		2016	France	ecoinvent	980.0	EN15804+A1	EN15804+A1
Terracotta clay tiles, interlocking	45.4 kg/m2	Tuiles de terre cuite produites par les fabricants de tuiles de terre cuite françaises ressortissants du CTMNC.	CENTRE TECHNIQUE DE MATÉRIAUX NATURELS DE CONSTRUCTION	INIES	INIES_CTUI20200319_142141, 16435	FDES	EN15804+A1	Third-party verified (as per ISO 14025)	2020	France	ecoinvent		EN15804+A1	EN15804+A1
Water-borne interior paints	1.36 kg/L, average coverage 8-10 m2/L	Biora, Ekora, Kolibri Sand, Paneelikattomaali, Ranch, Superlateksi, Tapettipohjamaali, Teknospro, Tela, Timantti, Trend	Teknos	RTS	RTS_14_18	EPD RTS EPD, Water-borne interior paints	EN15804+A1	Third-party verified (as per ISO 14025)	2018	Finland, OCLEPD	ecoinvent	1360.0	RTS PCR protocol: EPDs published by the Building Information Foundation RTS sr (2016)	Only with EN15804
Waterproofing membrane, single component, cold applied, from PU	1.5 mm, 1.98 kg/m2	Sikalastic-625	Sika	BRE	BREG EN EPD0000111	BREGENEPD000111	EN15804+A1	Third-party verified (as per ISO 14025)	2016	United Kingdom	GaBi	1320.0	EN15804+A1	-

Name	Technical Specification	Product	Manufacturer	EPD Program	EPD Number	Environment Data Source	Standard	Verification	Year	Country	Upstream Database	Density	Product Category Rules (Pcr)	Notes About Pcr
Air-to-air heat pump, external unit	heating (26.9 kW) and cooling (25.1 kW)	DAIKIN: RXYQ8T - MITSUBISHI ELECTRIC: PUHYP250YKB - YACK & MITSUBISHI HEAVY INDUSTRIES: FDC224KXE6	Uniclima	INIES	UNIC-00019-V01.01-FR, 9176	PEP	EN15804+A1	Third-party verified (as per ISO 14025)	2019	france	ecoinvent		PEP-PCR-ed3-FR-2015 04 02	ISO 14025
Circulating pump	250-1000W/unit			OKOBAUDAT	-	Oekobau.dat 2020-II	EN15804+A1	Third-party verified (as per ISO 14025)	2020	Germany	GaBi		EN15804+A1	-
Drinking water supply piping network, per m2 GIFA (office buildings)				One Click LCA	-	One Click LCA	EN15804	Internally verified	2019	LOCAL	ecoinvent		EN15804	-
Drinking water supply piping network, per m2 GIFA (residential buildings)				One Click LCA	-	One Click LCA	EN15804	Internally verified	2019	LOCAL	ecoinvent		EN15804	-
Electricity distribution system, cabling and central, for all building types	per m2 GFA			One Click LCA	-	One Click LCA	EN15804	Internally verified	2019	LOCAL	ecoinvent		EN15804	-
Ethernet wall outlet	RJ 45, LAN	AP-C45 - Data	Hager Iboco	INIES	HAGE-00027-V01.01-FR, 5407	PEP	PEP	Third-party verified (as per ISO 14025)	2016	Germany	ecoinvent		EN15804+A1	-
Expansion tank/vessel	V = 200L	Donnee par default	MDEGD	INIES	INIES_DVAS20190821_152747, 11170	MDEGD_FDES	EN15804+A1	Third-party verified (as per ISO 14025)	2019	france	ecoinvent		EN15804+A1	EN15804+A1
Heat distribution				One Click LCA	-	One Click LCA	EN15804	Internally verified	2019	LOCAL	ecoinvent		EN15804	-

Name	Technical Specification	Product	Manufacturer	EPD Program	EPD Number	Environment Data Source	Standard	Verification	Year	Country	Upstream Database	Density	Product Category Rules (Pcr)	Notes About Pcr
piping network, per m2 heated area, all building types														
LED lighting	P = 40W	Donnee par default	MDEGD	INIES	INIES_DRÉG20191220_143840, 13721	MDEGD_FDES	EN15804+A1	Third-party verified (as per ISO 14025)	2019	france	ecoinvent		EN15804+A1	EN15804+A1
Plate heat exchanger	P = 150kW	Donnee par default	MDEGD	INIES	INIES_DECH20190710_161707, 10888	MDEGD_FDES	EN15804+A1	Third-party verified (as per ISO 14025)	2019	france	ecoinvent		EN15804+A1	EN15804+A1
Power outlet, low current		Donnee par default	MDEGD	INIES	INIES_DPRI20190819_150144, 11128	MDEGD_FDES	EN15804+A1	Third-party verified (as per ISO 14025)	2019	france	ecoinvent		EN15804+A1	EN15804+A1
Sewage water drainage piping network, per m2 GIFA (office buildings)				One Click LCA	-	One Click LCA	EN15804	Internally verified	2019	LOCAL	ecoinvent		EN15804	-
Sewage water drainage piping network, per m2 GIFA (residential buildings)				One Click LCA	-	One Click LCA	EN15804	Internally verified	2019	LOCAL	ecoinvent		EN15804	-
Thermostat, French average	up to 63A	Donnee par default	MDEGD	INIES	INIES_DTHE20170113_152829, 5914	MDEGD_FDES	EN15804+A1	Third-party verified (as per ISO 14025)	2017	france	ecoinvent, ELCD		EN15804+A1	EN15804+A1
Ventilation system for educational or commercial building	per m2 GFA			One Click LCA	-	One Click LCA	EN15804	Internally verified	2019	LOCAL	ecoinvent		EN15804	-
Ventilation system for residential building	per m2 GFA			One Click LCA	-	One Click LCA	EN15804	Internally verified	2019	LOCAL, Paraguay	ecoinvent		EN15804	-

Name	Technical Specification	Product	Manufacturer	EPD Program	EPD Number	Environment Data Source	Standard	Verification	Year	Country	Upstream Database	Density	Product Category Rules (Pcr)	Notes About Pcr
Ventilator for decentralized ventilation with heat recovery (wall, ceiling mounted)	60 m3/h, 3.7 kg/unit			OKOBAUDAT	-	Oekobau.dat 2020-II	EN15804+A1	Third-party verified (as per ISO 14025)	2020	Germany	GaBi		EN15804+A1	-

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Appendix K: Green Performance Plan.

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Holloway Prison.
Islington, London.
Peabody.

SUSTAINABILITY
GREEN PERFORMANCE PLAN

REVISION 1 – 29 OCTOBER 2021

Audit sheet.

Rev.	Date	Description of change / purpose of issue	Prepared	Reviewed	Authorised
0	14/10/2021	Draft issue for comments	C. Mooney/ L. Holden	J. Drane	G. Jones
1	29/10/2021	Issue for planning submission	L. Holden	A. Bryant	G. Jones

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Contents.

1. Introduction.

1.1 Overview

This draft Green Performance Plan (GPP) is submitted in support of a new planning application for the proposed new build development at the former the Holloway Prison site in the London Borough of Islington, London.

1.2 Purpose of this document

This draft Green Performance Plan aims to set initial key performance indicators for the Proposed Development to monitor and manage once complete. This is to better understand and mitigate against potential shortfalls in the performance of the building, with particular focus on energy consumption, carbon emissions, water consumption and user satisfaction. Please refer to Policy S4 of the LBI Draft Local Plan for detailed requirements.

The Green Performance Plan will set out:

- Measurable performance targets and indicators
- Arrangements for management and monitoring of the plan covering the first two years of operation
- Arrangement for addressing performance in the event that the agreed objectives are not met after the monitoring period has ended.

1.3 Site

The proposed development consists of the phased comprehensive redevelopment including demolition of existing structures; site preparation and enabling works; and the construction of 985 residential homes including 60 extra care homes (Use Class C3), a Women's Building (Use Class F.2) and flexible commercial floorspace (Use Class E) in buildings of up to 14 storeys in height; highways/access works; landscaping; pedestrian and cycle connection, publicly accessible park; car (blue badge) and cycle parking; and other associated works.

The NIA of the residential spaces is 69,511m^2 while the gross non-residential space (GIA) adds up to 4,644m^2.

Figure 1: Site location and surrounding context

1.4 Proposed Works

The proposed new build is in response to a changing need in accommodation and commercial spaces, but it also presents an opportunity to support the LB of Islington's carbon reduction and sustainability ambitions and climate change policies. As part of the proposed works, the following measures will be implemented to ensure the development results in a better performing and more sustainable building:

- 60% affordable housing
  - 70% 'social rent'
  - 30% 'London Shared Ownership'
- 120 wheelchair accessible homes
- Air Source Heat Pump ('ASHP') with Photovoltaic ('PV') Provision to serve the entire Development
- Provision of a Women's Building
- Provide a site wide communal low-temperature heat network
- BREEAM 'Excellent' rating targeted for the proposed development to ensure sustainability overall

1.5 Energy and Sustainability Strategy Overview

The Energy and Sustainability Strategy for the Proposed Development is focused on energy saving and sustainability measures that are achievable within the scope of the construction works. The proposed measures will be implemented throughout design and construction stage and continue to influence the development at operational stage.

Table 1: Summary of energy and sustainability measures

A-G	**Energy Consumption and Carbon Reduction** Photovoltaics The roof level of every plot has been utilised to provide green and brown roof, photovoltaics, ASHP and areas of resident amenity space. The scheme has sought to maximise the provision of photovoltaics and provides approximately 1500m^2 of PV panels. Air source heat pumps 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.
	Fabric performance A 'fabric first' approach will be taken in order to reduce the energy demand and CO$_2$ emissions from the Proposed Development. The overriding objective for the façade design of each building will be to achieve the optimum balance between providing natural daylighting benefits to reduce the use of artificial lighting, the provision of passive solar heating to limit the need for space heating in winter and limiting summertime solar gains to reduce space cooling demands. Thermal Insulation The Proposed Development will seek to utilise efficient thermal envelopes. 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 and cooling requirement and result in lower energy requirements.

	Glazing Energy & Light Transmittance Elevations 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.
	Mechanical ventilation It is anticipated that high-efficiency mechanical ventilation with heat recovery will be adopted for all building areas. 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 and cooling demand. To reduce the electrical energy associated with fan usage, plant and systems will be optimised to achieve low specific fan powers.
	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. Water consumption requirements in environmental assessment methods such as BREEAM will be considered further during detailed design stages.
	Operational Energy (Metering Strategy) Operational energy is also a key concern; meters will be included in the design to meter power and lighting on each level and tenant occupancy. This will aid energy monitoring and minimise the performance gap during operational phase.
	Natural daylight and lighting strategy In the context of the Women's Building and flexible commercial space, lighting tends to provide a significant contribution to regulated CO_2 emissions. As such, the implementation of energy efficiency lighting design is paramount to reducing overall emissions for these spaces. Therefore, it is anticipated that the Proposed Development will be supplied with high efficiency lighting installations representing best practise. Full lighting control systems including daylight linkage and presence detection will also be incorporated. As well as reduced energy requirement that will be achieved by implementing these strategies, the contribution to the cooling requirements and internal heat gains will be reduced. This will further reduce the total energy requirements and CO_2 emissions of each building.
	Efficient Lighting LED lights are to be installed and the lighting control strategy incorporates occupancy sensing and daylight linking technologies, further enhancing energy efficiency.
	Responsible Sourcing of Materials The environmental impact of materials used on site will be minimised by specifying locally supplied, sustainably sourced, low-impact and recycled material where feasible in line with BREEAM guidelines.

	Waste Reduction The construction of the proposed development will seek to minimise waste generated by targeting 50% of credits from BREEAM Wst 01. Key KPI targets will be outlined to the Contractor, informing the team of the appropriate reuse. Recycling and recovery targets to be met in line with both GLA and BREEAM guidance. In regard to managing waste sustainably, will ensure key materials available for reuse and recovery are identified and managed in accordance with best waste practises. In addition to construction waste, municipal waste on the scheme will also be well thought out. The team will be sure to comply with local, and recommended waste legislation, accounting for the different waste streams, estimated waste amounts to be generated as well as encourager residents and building occupied to reduce their waste as far as possible also.

Reference Documents

This report should be read alongside the following documents:

- BREEAM UK New Construction 2018 (Issue 3.0) Shell Only manual
- Holloway – Sustainable Design and Construction Statement
- LBI emerging local plan, Energy Policies (Chapter 6 Sustainable Design).

2. Performance Targets and Indicators.

The proposed indicators to be monitored in the Proposed Development are set out in Table 2. The table also sets out the suggested source of the data.

The proposed regulated and unregulated energy and emissions targets are based upon industry benchmarks from RICS, RIBA and/or LETI.

Greenhouse gas conversion factors
Carbon factors[1] at the time of writing this report:

Gas: 0.210 $kgCO_2/kWh$

Electricity: 0.233 $kgCO_2/kWh$

Performance targets and indicators
As the scheme develops, the industry benchmarks will be used as the indicators for the Proposed Development.

Table 2: Performance targets and indicators

	Indicator	Source for performance benchmarks	Data source during building operation	Industry benchmarks		Units
Energy	Annual energy consumption by end use	Derived from RICS, RIBA, and/or LETI carbon targets	BMS/ SCADA data	Gas	None	$kWh/m^2/yr$
				Electricity	**Residential:** Business as usual = 120 RIBA 2030 & LETI = 35 **Non-residential:** Business as usual = 130 RIBA 2030 & LETI = 55	
	Total annual energy consumption			Total	35-55	$kWh/m^2/yr$
Carbon Emissions	Annual CO_2 emissions by end use	Derived from the above energy targets using the latest DECC carbon factors	BMS/ SCADA data with the latest DECC carbon conversion factors	Gas	None	$kgCO_2/m^2/yr$
				Electricity	**Residential:** Business as usual = 28.0 RIBA 2030 & LETI = 8.2 **Non-residential:** Business as usual = 30.3 RIBA 2030 & LETI = 12.8	
	Annual CO_2 emissions related to construction	Derived from RICS, RIBA, and/or LETI carbon targets	RICS, RIBA, LETI modelling on building embodied performance	Lifecycle stages A1-5	500	$kgCO_2/m^2$
Air Permeability	Exchange of air in the blocks	BREEAM target	Air permeability test carried out post construction	3.0 at 50 Pa		$m^3/h/m^2$
Water	Total annual water consumption	Part G Building Regulations & BREEAM Excellent	BMS/ SCADA data	Part G Building Regulations (Residential) BREEAM Excellent (non-residential)		$m^3/m^2/yr$

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[1] The Government's Standard Assessment, Procedure for Energy Rating of Dwellings Version 10.0; Conversion Factors Table 12 https://www.benuk.net/pdf/SAP-10.0_24-07-2018.pdf

2.1 Industry energy and carbon benchmarks.

UKGBC Net Zero framework
The UKGBC for net zero carbon was released in April 2019 and sets principles and definitions for the term zero carbon, each having equal importance. These are as follows:

Net Zero Carbon – Construction (1.1)
When the carbon emissions associated with a building's product and construction stages up to practical completion is zero or negative, through the use of offsets or the net export of on-site renewable energy.

Net Zero Carbon – Operational Energy (1.2)
When the amount of carbon emissions associated with the building's operational energy on an annual basis is zero or negative. A net zero carbon building is highly energy efficient and powered from on-site and/or off-site renewable energy sources, with any remaining carbon balance offset.

Developers aiming for net zero carbon in construction should design the building to enable net zero carbon for operational energy, and where possible this should be achieved annually in-use. Net zero carbon for both construction and operation represents the greatest level of commitment to the framework (see Appendix A: UKGBC Framework.).

2.2 RIBA 2030 Climate Challenge

According to RIBA, "RIBA has developed the 2030 Climate Challenge to help architects meet net zero (or better) whole life carbon for new and retrofitted buildings by 2030. It sets a series of targets for practices to adopt to reduce operational energy, embodied carbon and potable water."

RIBA provides current benchmarks and targets (see Appendix B: RIBA Targets.) for 3 future time horizons: 2020, 2025, and 2030, with a view to providing an incremental path to the net zero target required by 2030.

This includes targets for both operational energy consumption and embodied carbon, both of which must be addressed for the built sector to mitigate its contribution to man-made climate change.

Also included are recommendations on overheating assessment and mitigation and potable water consumption, in recognition of the wider impacts a changing climate will have; notably significantly warmer, dryer summers.

2.3 LETI guidance for Net Zero Operational Carbon

The London Energy Transformation Initiative (LETI) have released guidance on achieving net zero operational carbon. Although this initiative began in London, it has now expanded to become U.K. wide. LETI focusses first on reducing the consumption of energy as far as possible, with targets set for different use types. Space heating demand in line with Passivhaus requirements (15kWh/sqm/yr) is also recommended. There is a focus on measurement and verification, to ensure the building is performing as design and to minimise the performance gap. The need to assess embodied carbon is noted but not a focus for the guidance, which is concerned with operational carbon emissions.

2.4 Islington's 2030 Vision

In order to create a net zero carbon Islington, the council, borough partners, residents, and community organisations, supported by regional and national government, will need to ensure:

- Residents, people who work in Islington and local business owners know the part they need to play to achieve net zero and are empowered to do so.
- Emissions from gas boilers and vehicles are eliminated.
- Buildings in the borough are made as energy efficient as possible.
- Renewable heat and power generation in the borough is maximised.
- Any remaining electricity needs are sourced from certified renewable or zero carbon sources.
- The planning system only allows fossil-fuel free buildings to be built.
- Circular economy principles are embedded in local businesses and supply chains are sustainable.
- Tree cover is maximised and local biodiversity protected.
- Any outstanding emissions are offset through carbon sequestration and other methods.

Reaching Net Zero Operational Carbon on new residential buildings is technically possible assuming that:

1. An exemplar level of energy efficiency is achieved,
2. A truly low carbon heating system is used (e.g. heat pumps)
3. Solar PVs are maximised on roofs.

It also requires a pragmatic and very collaborative approach within the project team.

Table 2 above sets out a number of Key Performance Indicators (KPIs) designed to help enable the development to become 'greener'. Although compliance with these KPIs is not mandated by Islington, the advice that they have provided is that these KPI's are key to achieving Net Zero and should form the basis of any Net Zero Carbon Standard.

The KPIs highlight the importance of all elements below:

- Low energy use
- Low carbon energy supply (heat and electricity)
- Zero carbon balance
- Measurement and verification
- Embodied carbon

Complying with the Passivhaus standard is not a mandatory requirement to achieve Net Zero Carbon. However, it provides a robust, tried and tested method and standard to deliver the required level of energy efficiency while ensuring construction quality and minimising the performance gap (as the modelling and QA processes are more thorough).

3. Data Collection, Analysis, and Reporting.

As the Proposed Development is a new build construction, it is proposed that the data collection, analysis and reporting will be integrated into the newly installed metering and monitoring infrastructure.

3.1 Energy

The MEP engineers have proposed energy meters to be installed for lighting, power, and additional meters for specific high energy use areas. The metering strategy should also be integrated into the Development's Supervisory Control and Data Acquisition (SCADA) system and will also connect to the Building Management System (BMS).

3.2 Carbon Emissions

3.2.1 Embodied Carbon

Typically referred to as the 'upfront' emissions associated with building construction, including extraction and processing of materials and the energy and water consumption in the production, assembly and construction of a building.

They will also include embodied carbon from the in-use stage (replacement, repair, refurbishment, maintenance (of the product during its life in/on the building) and the 'end of life' stage (demolition, dis-assembly and disposal of any parts of products or buildings).

To assess the embodied carbon for the project, a Life Cycle Assessment (LCA) tool – One Click LCA – has been used to make allocations for the anticipated materials quantities in an inventory analysis. The materials are represented within the model by using materials with associated Environmental Product Declarations (EPDs). By scheduling the materials proposed for the development, the overall carbon emissions can be approximated. Where a specified material isn't included in the database, the most similar material in terms of material composition is selected instead.

3.2.2 Operational Carbon

This refers to the emissions associated with the operational phase of the building, including regulated emissions (space heating and cooling, lighting, hot water and ventilation) and unregulated emissions (small plug in equipment, IT, servers, process and machinery associated with the use of the building).

The initial operational carbon emissions have been determined from a TM54 study of the Women's Building and a PHPP Assessment of the dwellings within Block C.

3.2.3 Whole life carbon

Both the developments' operational and embodied carbon emissions will be calculated using the designed/recorded energy and lifecycle carbon consumption data. Updated carbon factors which align with DEFRA carbon data as well as the Development's carbon reporting protocol should be used.

3.2.4 Grid Decarbonisation

Recent progress in the energy sector has seen emissions associated with electricity consumption reduce drastically, however this is not reflected in the current Building Regulations which were last updated in 2013. Building Regulations are unlikely to be updated before the end of 2021, increasing the gap between compliance and reality.

The carbon factor for grid-supplied electricity in the current Building Regulations (2013) is 0.519kgCO2/kWh; as can be seen in the graph below, this is a fair reflection of the performance of the grid at that time. However, in response to legally binding targets established in line with the Paris Agreement, significant progress has been made in decarbonising the electricity grid over the past six years.

At the end of 2020, the Department for Business, Energy, and Industrial Strategy (BEIS) reported the carbon factor of electricity as having fallen to 0.159kgCO2/kWh; a 69% reduction compared to that in Part L, 2013. The consequence of this is a discrepancy between emissions calculated using current building regulations methodology from electrical plant and any technologies which offset grid electricity (such as solar PV) compared to the reality of their performance. This leads to the risk that buildings could be specified with technologies with the objective of reducing CO2 emissions which, in fact, may not offer any real benefit in practice.

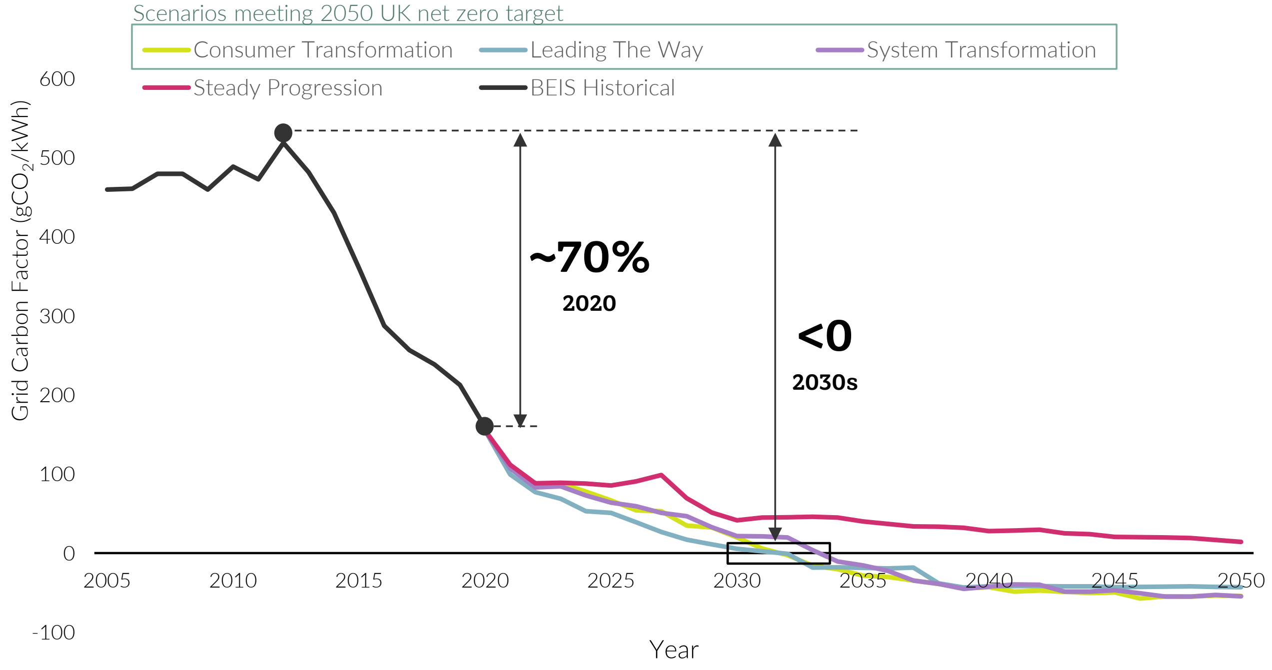


Figure 2: Historic and future projected carbon factor for the National Grid.

3.2.5 Shifting focus

As the carbon emissions associated with the generation of electricity continue to reduce, the proportion of the UK's overall greenhouse gas emissions for which the electricity sector is responsible will fall. Therefore, the focus on meeting the UK's climate targets must be on investing in energy infrastructure and strengthening the energy performance requirements of new and existing buildings.

3.3 Water

The water consumption data will be automatically recorded via water meters and connected to the BMS system. Water monitoring equipment such as easily accessible sub-meters and/or integral to the plant space, will also be incorporated into the design ensuring building occupants can easily access and monitor overall water usage throughout the building operation. Submeters will be installed and connected to a leak detection system to limit water loss during leakages.

As the proposed development's meters will be connected to the BMS/ SCADA system, the water consumption of the new buildings could be automatically recorded and, over 5 years, uploaded to GLA and/or *CarbonBuzz* online platforms. Uploading to Low Energy Building Database will also be considered.

The proposed strategy is that the Site Sustainability lead for the development will receive and record the data, monitoring water consumption on a monthly basis and formally reported on a yearly basis.

4. Management and Monitoring.

A monitoring and management strategy is required to be set up in order to deliver the aims of the Green Performance Plan.

Monitoring and reviewing the performance of the installed systems will be required after the building is occupied. It is suggested that the first reporting of the performance targets is completed after the first 6 months after first occupation of the scheme with a frequency of being updated every 6 months.

It is important that the monitoring period accounts for the commissioning of the building services as it is likely that the commissioning engineer will make alterations when the services are under full load and part load conditions.

The site Sustainability lead is responsible for managing the data collection, analysis, and maximising the performance of the Proposed Development in line with the targets of the Green Performance plan. There may be a different sustainability lead for each tenancy where reporting should be produced against proportional targets.

The Sustainability lead of the principal contractor will be the Green Performance Plan coordinator for the project throughout the construction stage and will liaise with the identified sustainability lead post constriction to ensure the appropriate adoption of the Green Performance Plan.

It is envisaged that the Green Performance Plan will be managed by the Sustainability lead of the principle contractor up until handover, and the monitoring and reporting requirements will be communicated to the tenant sustainability lead, as part of the operational handover process.

Table 3: Proposed timeline for the first year of GPP Reporting.

Building Occupation						GPP Report No. 1						GPP Report No. 2
Month 0	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12

A provisional timetable is required to be set out for the reporting of the performance targets and indicators within the first full year after the building is intended to be occupied.

Analysis of the energy and carbon emissions data and comparison against the proposed targets should be assessed after a complete calendar year, with the performance target benchmarks adjusted to the experienced heating and cooling degree days.

In addition, Peabody will carry out a resident survey after 8 weeks benchmarked against the G15 survey and Peabody will carry out a 12 months building survey which is likely to be replaced by the Building Use Studies methodology after it has been successfully trialled and/or mandated by the Greater London Authority.

5. Arrangement of Addressing Performance.

It is suggested that prior to comparing the actual performance of the building against the benchmark performance targets, the energy model should be revised to include the 'as installed' heating, cooling and ventilation plant and should be compared against the systems specified at the design stage, in order to account for any increase/decrease in system performance and delivery efficiency.

Additionally, the actual operating hours of the building should be determined and included in the revised performance targets.

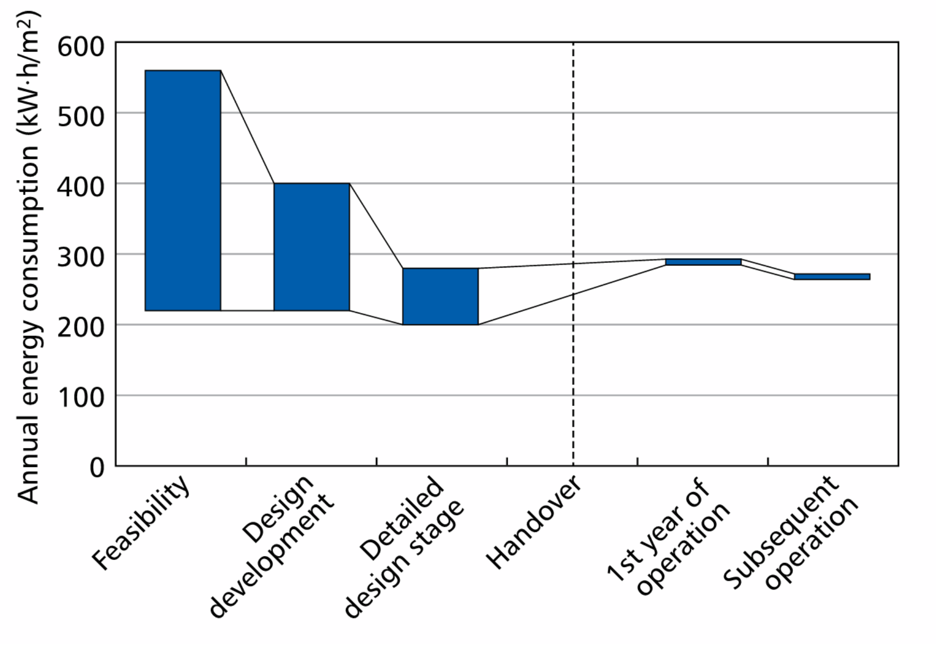


Figure 3: Extract from the CIBSE TM54 – Evaluating operational energy performance of buildings at the design stage.

The extract from TM54 above explains the inherent uncertainty in predicting the performance of the building at each stage of the design. A key objective of the Green Performance Plan is to maximise the performance of the building as far as practicable and this is represented in Figure 3 by the decrease in annual energy consumption after the first year of operation.

A number of strategies exist which can assist to maximise the performance of the building:

- Review the user guide documentation and operation and maintenance manuals for the facilities management staff
- Assess the heat and electricity meters to ensure they are installed correctly
- Building Management System (BMS) demonstration and settings adjustment
- Review behaviour of the building users and their interaction with the building
- Implement a communication strategy to increase more energy efficient management

Following any significant remedial action, further data collection and analysis should be completed to produce a revised baseline performance of the building, as this will allow any future deviation from the performance to be appropriately investigated.

Appendix A: UKGBC Framework.

The framework for achieving net zero carbon in construction and operation:

1. ESTABLISH NET ZERO CARBON SCOPE

1.1 Net zero carbon - **construction**

1.2 Net zero carbon – **operational energy**

2. REDUCE CONSTRUCTION IMPACTS

✓ 2.1 A whole life carbon assessment should be undertaken and disclosed for all construction projects to drive carbon reductions.

✓ 2.2 The embodied carbon impacts from the product and construction stages should be measured and offset at practical completion.

3. REDUCE OPERATIONAL ENERGY USE

D ✓ 3.1 Reductions in energy demand and consumption should be prioritised over all other measures.

D ✓ 3.2 In-use energy consumption should be calculated and publicly disclosed on an annual basis.

4. INCREASE RENEWABLE ENERGY SUPPLY

D ✓ 4.1 On-site renewable energy source should be prioritised.

D ✓ 4.2 Off-site renewables should demonstrate additionality.

5. OFFSET ANY REMAINING CARBON

✓ ✓ 5.1 Any remaining carbon should be offset using a recognised offsetting framework.

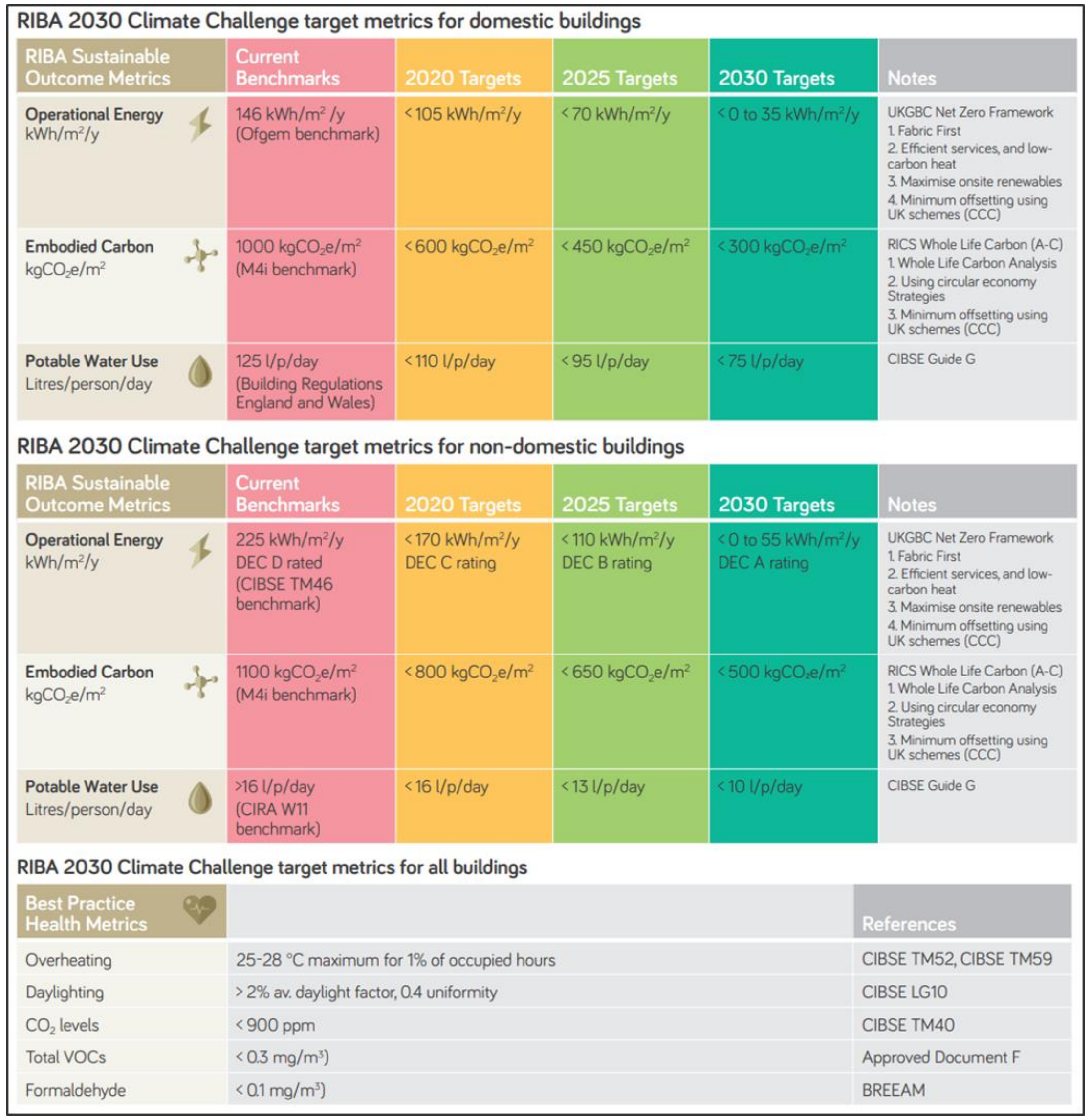
✓ ✓ 5.2 The amount of offsets used should be publicly disclosed.

D New buildings and major refurbishments targeting net zero carbon for construction should be designed to achieve net zero carbon for operational energy considering these principles.

Figure 4: UKGBC net zero carbon framework (Source: adapted from UKGBC).

Appendix B: RIBA Targets.

RIBA Climate Challenge targets.



RIBA 2030 Climate Challenge target metrics for domestic buildings

RIBA Sustainable Outcome Metrics	Current Benchmarks	2020 Targets	2025 Targets	2030 Targets	Notes
Operational Energy kWh/m²/y	146 kWh/m² /y (Ofgem benchmark)	< 105 kWh/m²/y	< 70 kWh/m²/y	< 0 to 35 kWh/m²/y	UKGBC Net Zero Framework 1. Fabric First 2. Efficient services, and low-carbon heat 3. Maximise onsite renewables 4. Minimum offsetting using UK schemes (CCC)
Embodied Carbon $kgCO_2e/m^2$	1000 $kgCO_2e/m^2$ (M4i benchmark)	< 600 $kgCO_2e/m^2$	< 450 $kgCO_2e/m^2$	< 300 $kgCO_2e/m^2$	RICS Whole Life Carbon (A-C) 1. Whole Life Carbon Analysis 2. Using circular economy Strategies 3. Minimum offsetting using UK schemes (CCC)
Potable Water Use Litres/person/day	125 l/p/day (Building Regulations England and Wales)	< 110 l/p/day	< 95 l/p/day	< 75 l/p/day	CIBSE Guide G

RIBA 2030 Climate Challenge target metrics for non-domestic buildings

RIBA Sustainable Outcome Metrics	Current Benchmarks	2020 Targets	2025 Targets	2030 Targets	Notes
Operational Energy kWh/m²/y	225 kWh/m²/y DEC D rated (CIBSE TM46 benchmark)	< 170 kWh/m²/y DEC C rating	< 110 kWh/m²/y DEC B rating	< 0 to 55 kWh/m²/y DEC A rating	UKGBC Net Zero Framework 1. Fabric First 2. Efficient services, and low-carbon heat 3. Maximise onsite renewables 4. Minimum offsetting using UK schemes (CCC)
Embodied Carbon $kgCO_2e/m^2$	1100 $kgCO_2e/m^2$ (M4i benchmark)	< 800 $kgCO_2e/m^2$	< 650 $kgCO_2e/m^2$	< 500 $kgCO_2e/m^2$	RICS Whole Life Carbon (A-C) 1. Whole Life Carbon Analysis 2. Using circular economy Strategies 3. Minimum offsetting using UK schemes (CCC)
Potable Water Use Litres/person/day	>16 l/p/day (CIRA W11 benchmark)	< 16 l/p/day	< 13 l/p/day	< 10 l/p/day	CIBSE Guide G

RIBA 2030 Climate Challenge target metrics for all buildings

Best Practice Health Metrics		References
Overheating	25-28 °C maximum for 1% of occupied hours	CIBSE TM52, CIBSE TM59
Daylighting	> 2% av. daylight factor, 0.4 uniformity	CIBSE LG10
CO_2 levels	< 900 ppm	CIBSE TM40
Total VOCs	< 0.3 mg/m³)	Approved Document F
Formaldehyde	< 0.1 mg/m³)	BREEAM

Figure 5: RIBA Climate Challenge targets.

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