

April 2025

The Aylesham Centre, Peckham

Energy Statement and Overheating Assessment

Document reference: AC07C

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Executive Summary

This updated Energy Strategy and Overheating Assessment is prepared for Berkeley Homes (Capital) Plc and submitted in support of the planning application (ref. 24/AP/2074) which seeks permission for the comprehensive redevelopment of the Aylesham Centre and associated car park and petrol filling station at Hanover Park, London SE15 5EW ('the Site'). This updated Energy Statement and Overheating Assessment supersedes the July 2024 Energy Statement and Overheating Assessment (document ref. AC07).

The updated Energy Statement and Overheating Assessment reflects the design changes as set out within the updated Design and Access Statement (document ref AC02A).

The conclusions are unchanged from those as set out within the July 2024 Energy Statement and Overheating Assessment (document ref. AC07).

This report is intended to present the obligations with regards to Energy Modelling and compliance with the Building Regulations Part L and the sustainability targets of the project. Additionally, the Energy Modelling Inputs used to date are detailed within this report. All information herein is current at time of issuing and is subject to change pending final fabric thermal performance calculations, mechanical and electrical equipment selections, and additional design calculations.

The energy strategy for this development focuses on delivering high-quality residential and commercial spaces with minimal energy consumption and carbon emissions, aligned with the Greater London Authority's energy hierarchy: 'Lean, Clean, and Green.', striving to meet the following goals:

- **Reduce regulated CO₂ emissions** below the levels permitted by Part L 2021 of the Building Regulations through energy efficiency measures (Be Lean).
- **Achieve a 35% on-site CO₂ reduction** for non-residential developments, exceeding Part L 2021 requirements.
- **Attain zero carbon for residential developments**, achieving at least a 35% on-site reduction beyond Part L 2021 and offsetting remaining emissions to reach zero carbon status if necessary.

This report outlines the proposed strategies for both residential and non-residential areas of the development. The strategy prioritizes reducing energy demand, aiming for energy-efficient (i.e., 'lean') buildings without heavy reliance on complex systems or carbon offsetting technologies. The building design, mechanical, electrical, and plumbing (MEP) systems, and sustainability features have been optimized to reduce energy demand. The adopted servicing strategy includes maximizing the efficiency of regulated loads.

Key Features and Measures

- **Building Design and Fabric:** High insulation levels and double glazing with low-emissivity coatings reduce heating and cooling requirements.
- **Servicing Strategy:** High-efficiency mechanical ventilation with heat recovery systems (MVHR) and VRF systems for cooling, incorporating low-energy lighting fixtures and efficient controls.
- **Renewable Energy:** Installing photovoltaic panels (PV) on roofs to reduce electricity demand.
- **Heat Networks:** A study of the London Heat Networks database identified two potential heat networks near the project: Southwark-Peckham Heat Network (nearest to the project site), and SELCHP Heat Network (relatively near to the project site). The strategy includes centralized heating generation with provisions for future connection to these heat networks. The Be Clean will be considered as the local heat network for each block presented in the Be Green stage where the heating is provided via Air Source Heat Pump.
- **Sub Metering:** The sub metering will be essential for effective measurement and monitoring of the project energy performance which can be used to identify the potentials of carbon reduction opportunities related to incorporating rising technologies.

The development has been modelled using approved software packages Elmhurst Design SAP and IES VE. SAP calculations have been performed for all residential units; two scenarios were considered for the Be Lean stage: one with a low carbon system and one without a low carbon system. SBEM calculations have been conducted for communal and amenities areas and Morrisons. The Notional building of the Be Lean stage is the baseline against which the carbon reduction will be measured. Final BRUKL and SAP calculations should account for the final selected equipment and building construction details. The methodology employed and the outcomes of the assessment are outlined in this document.

Energy Assessment Conclusions

- The energy demand assessment for the residential areas indicates that the carbon-saving measures in the energy strategy achieve an on-site reduction of 62% for the Be Green scenario. Additionally, the energy demand assessment for the non-residential areas shows that the carbon-saving measures outlined in the energy strategy provide an overall on-site reduction of 36.7 % for commercial areas, with a 37.5% reduction for communal corridors compared to Building Regulations Part L. This achieves a cumulative on-site Non-residential reduction of 37 % and exceeds the minimum 35% target for the Be Green scenario.

Overheating Assessment

A comprehensive analysis was conducted to evaluate and implement optimal measures for preventing overheating throughout the project's lifetime. This analysis followed the guidelines of Building Regulations Part O and CIBSE TM59. Building Regulations Part O provides methodologies to minimise overheating risks in new dwellings, including compliance through dynamic thermal modelling as specified in CIBSE TM59.

- The dynamic simulation indicates that in units with unrestricted or minimally restricted window openings, natural ventilation will mitigate overheating for most of the year. However, in scenarios with low wind speeds or wind directions that do not facilitate adequate airflow through the windows due to their location, MVHR will provide the necessary additional mitigation. This ensures that the units remain cool in most wind flow scenarios and are adaptable to heatwaves and climate change.
- For units with restricted window openings due to acoustic concerns, natural ventilation is not an effective method for mitigating heat. According to the analysis, a mechanical system utilising MVHR will be required to reduce the risk of overheating.

Current Weather file

- Mixed Mode Ventilation (Mechanical + Natural)

The results show MVHR 1.5 ACH (Overheating Mode) + 0.46 m² openable window for all floors where windows are allowed to open, will comply with TM59 Criteria. The below table shows the average frequency of opening the windows per façade.

Table 1 Average number of hours when windows required to open for overheating mitigation.

Orientation	Average number of hours when windows required to open for overheating mitigation
North	70 hrs*
East	110 hrs
West	110 hrs
South	210 hrs

*No Hours at night-time for Bedrooms needed for overheating mitigation.

For spaces where windows cannot be opened due to acoustic considerations, the overheating results demonstrate that all spaces for all buildings will meet the necessary overheating assessment requirements by installing MVHR systems with a 2.5 ACH (overheating mode).

The overheating analysis shows that the current strategy results in compliance for DSY1 for apartments spaces.

DSY2, DSY3 and Future Weather File Scenario

The results demonstrate that the current strategy meets the compliance for majority of the apartments and has only slight limited exceedance for some apartments for DSY2 and 3 files. Although it is not mandatory to comply with future weather files such as DSY2050, it is recommended to consider them for future-proofing the development. While some apartments show marginal exceedance of TM59 thermal comfort criteria under future weather conditions, the overall strategy remains effective.

Communal Corridors

The inclusion of corridors in the overheating analysis is mandatory where community heating pipework runs through them. The overheating test for corridors should be based on the number of annual hours for which an operative temperature of 28 °C is exceeded. If an operative temperature of 28 °C is exceeded for more than 3% of the total annual hours, then this should be identified as a significant risk within the report.

Based on the current stage level of details the corridors have low risk of overheating. The design therefore complies with the requirements of TM59 criteria. This is to be further verified as more details regarding heating pipes routing and insulation become available.

1 Introduction

1.1 Scope

ME Engineers Ltd has been appointed by Berkeley Homes (Capital) Plc (the 'Applicant') to prepare an Energy Statement and Overheating Assessment to accompany an application for full planning permission being submitted by the Applicant to the London Borough of Southwark (LBS) for the proposed development at Aylesham Centre Peckham, located in Hanover Park, London SE15 5EW.

The Proposed Development is for the demolition of existing buildings and phased redevelopment to provide a replacement supermarket and associated service yard and car parking (Use Class E(a)); flexible retail, leisure (including drinking establishment), and commercial accommodation (Use Class E/Sui Generis); dwellings (Use Class C3); landscaping; and associated works.

1.2 Purpose of Report

This updated Energy Strategy and Overheating Assessment is prepared for Berkeley Homes (Capital) Plc and submitted in support of the planning application (ref. 24/AP/2074) which seeks permission for the comprehensive redevelopment of the Aylesham Centre and associated car park and petrol filling station at Hanover Park, London SE15 5EW ('the Site'). This updated Energy Statement and Overheating Assessment supersedes the July 2024 Energy Statement and Overheating Assessment (document ref. AC07).

The updated Energy Statement and Overheating Assessment reflects the design changes as set out within the updated Design and Access Statement (document ref AC02A).

The conclusions are unchanged from those as set out within the July 2024 Energy Statement and Overheating Assessment (document ref. AC07).

The project particularly focuses on carbon emissions reduction in line with the current London Plan guidance and Energy Assessment Guidance with the "Lean-Clean-Green" approach. The environmental strategy approach targets to first minimize the energy demand and subsequently apply energy efficient systems. The energy demand has been minimized by implementing passive envelope design strategies, ensuring that whole-house ventilation with minimum fresh air and high heat recovery efficiency can meet most of the buildings' energy needs and reduce dependency on active cooling for summer comfort.

As a third step, ME Engineers recommends to first consider renewables (due to their effectiveness in reducing emissions) prior to relying on other alternatives. The environmental approach adopted is therefore in line with the London Plan Energy Hierarchy: reduce demand, supply energy efficiently and use renewables.

Subsequently, the energy strategy considers connection to the existing heat network to meet the space heating and domestic hot water demand of the development. The Be Clean will be considered as the local heat network within the site for each block presented in the Be Green stage where the heating is provided via Air Source Heat Pump. Photovoltaics were determined to be the most suitable renewable technology for the project.

SAP calculations have been performed for all residential units, while SBEM calculations have been conducted for communal and amenities areas and Morrisons. Final BRUKL and SAP calculations should account for the final selected equipment and building construction details. A comprehensive overheating analysis to evaluate the optimum measures to overcome the potential of overheating throughout the lifetime of the project. The methodology employed and the outcomes of the assessment are outlined in this document.

1.3 The Site and Location

The Site is located within Peckham town centre within the administrative boundary of the London Borough of Southwark ('LBS') (the Local Planning Authority ('LPA')) Rye Lane bounds the Site to the west, Hanover Park to the south and Mckerrell Road to the east as shown in Figure 1.

The site area is 2.7 ha, and it accommodates the Aylesham Centre alongside an associated surface car park, service yard, and petrol filling station. The Aylesham Centre comprises retail units fronting on to Rye Lane with additional retail units within a covered mall, including a Morrison supermarket. The proposed development, Aylesham Centre, comprises residential and non-residential units distributed across 16 buildings, as shown in Figure 2.

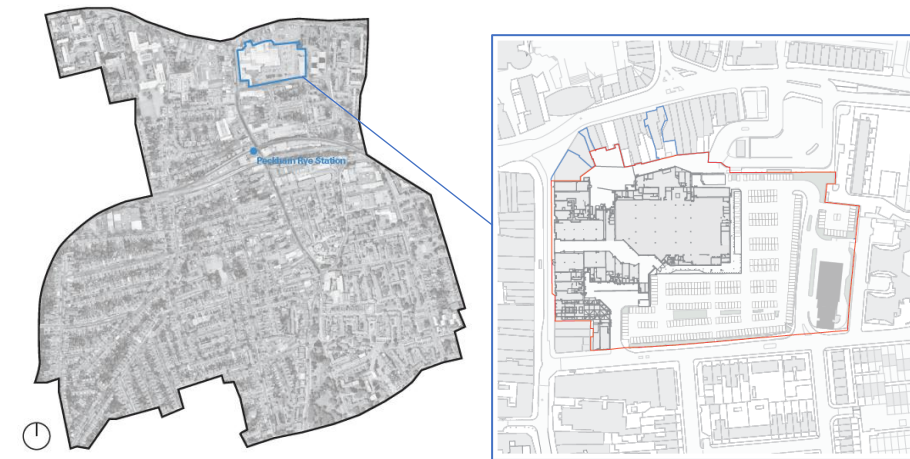


Figure 1 The Site



Figure 2 GA Plan shows the proposed development site

1.4 Software and Modelling Information

The development has been modelled using an approved software package as follows:

- **For residential spaces,** the Standard Assessment Procedure (SAP) for energy ratings was used, specifically Elmhurst Design SAP 10.2, including the assessment of Code for Sustainable Homes (CfSH) energy credits.
- **For non-residential spaces,** the National Calculation Methodology (NCM) was applied through the Simplified Building Energy Model (SBEM) using IES VE 2023 (Integrated Environmental Solutions Virtual Environment).

A full IES model has been constructed for the project, following the CIBSE AM11 guidelines. The model reflects the latest received architectural drawings from dRMM Architects. The thermal templates reflect the design criteria for each space that follows CIBSE Guide A- 2019 and CIBSE AM11 guidelines.

To demonstrating Building Regulations Part L (BRUKL) compliance, each building has been modelled as one development with different uses. NCM room activities were selected in each case as appropriate to the room function. The following images show the IES model used for the calculations and thermal template model.

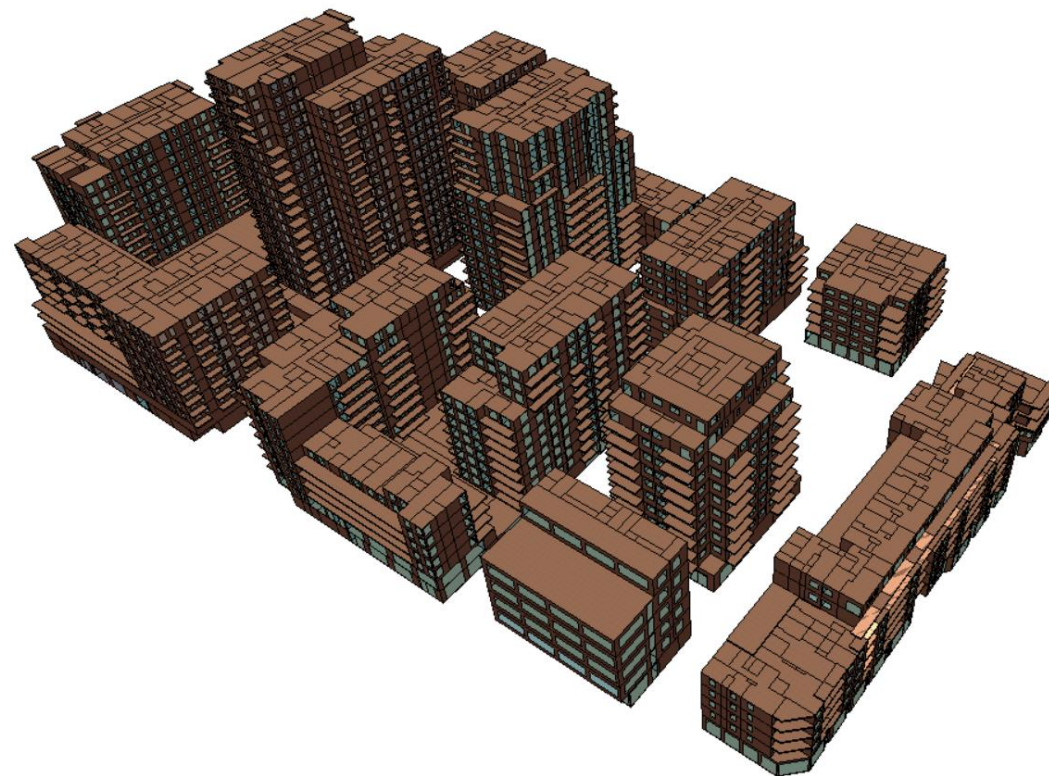


Figure 3 Aylesham Centre IES Model

Room Group	
00)	Non-resi - Lift
01)	Non-resi - Stair
02)	Resi - Toilet
03)	Resi - Bed Room
04)	Resi - Living Room
05)	Resi - Storage
06)	Non-resi - Plant
07)	Non-resi - Retail
08)	Non-resi - Office
09)	Non-resi - WC
10)	Resi - Corridor
11)	Non-resi - Lobby
12)	Non-resi - Store
13)	Resi-Plant
14)	Resi-Lift
15)	Resi-Stair
16)	Resi-Riser
17)	Morrisons PQL
18)	Non-resi Cycle store

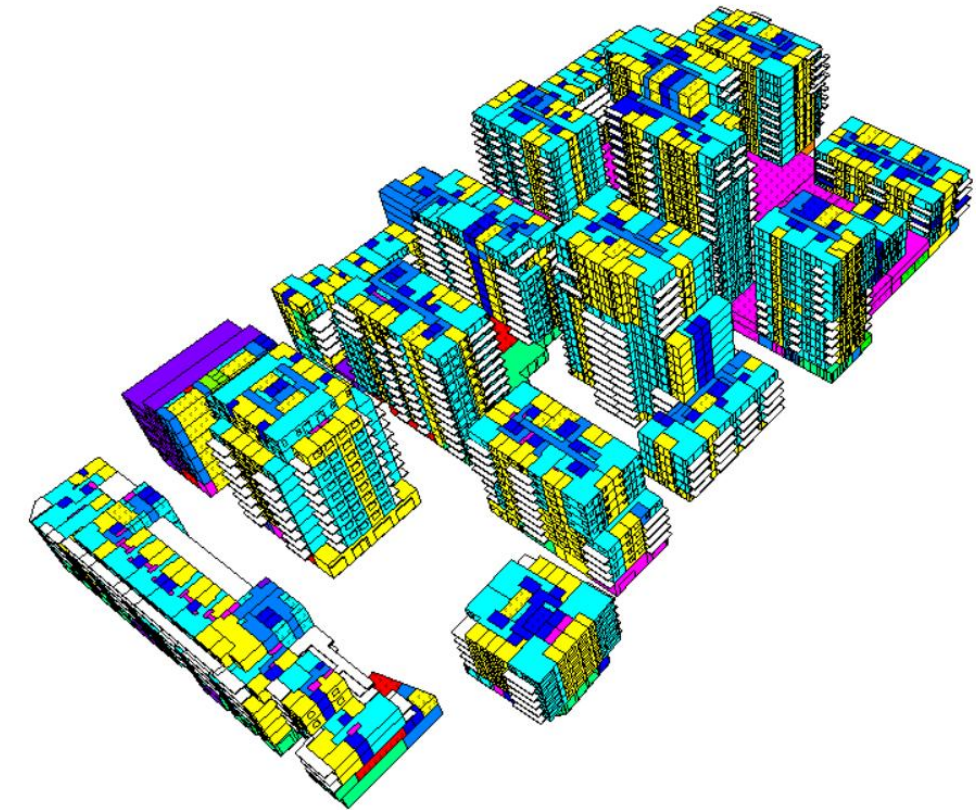


Figure 4 Aylesham Centre IES Model Thermal Template

2 Sustainability Drivers

Sustainability in urban development aims to mitigate environmental impact, enhance energy efficiency, and promote ecological balance. Regulatory initiatives focus on reducing carbon emissions, increasing the use of renewable energy, and improving building design and operation to achieve economic and social benefits, such as reduced operational costs and improved quality of life. The proposed development has considered the following adopted and emerging sustainability policies and documents. This ensures compliance with relevant requirements and identifies viable environmental design opportunities.

2.1 National Planning Policy Framework (2023)

The National Planning Policy Framework (NPPF) is a land-use planning policy in England. The NPPF sets out the government's planning policies for England. It covers a wide range of topics, including sustainable development, plan-making, decision-making, housing, economy, transport, environment, and heritage. The latest version of the NPPF was published in December 2023. It serves as a framework for producing Local Plans for housing and other development, which in turn inform decisions on planning permission applications.

2.2 London Plan Policies

The current London Plan March 2021 (LP2021) is adopted and is a material consideration in planning decisions. The following policies govern the sustainable delivery of the proposed development, which should be addressed by the proposed development.

- Policy SI 1: Improving Air Quality
- Policy SI 2: Minimising Greenhouse Gas Emissions
- Policy SI 3: Energy Infrastructure
- Policy SI 4: Managing Heat Risk
- Policy SI 5: Water Infrastructure
- Policy SI 7 Reducing waste and supporting the circular economy
- Policy SI 12: Flood Risk Management
- Policy SI 13: Sustainable Drainage
- T 5 Cycling
- T6 Car Parking

2.3 London Borough of Southwark Local Plan 2022

The current London Borough of Southwark Local Plan 2022 (LBS 2022) serves as a material consideration in planning decisions. The following policies govern the sustainable delivery of the proposed development and should be addressed accordingly.

- P16 Designing out Crime
- P56 Protection of amenity
- P59 Green Infrastructure
- P60 Biodiversity
- P61 Trees
- P62 Reducing waste
- P64 Contaminated land and hazardous substances
- P65 Improving air quality
- P66 Reducing noise pollution and enhancing soundscapes
- P67 Reducing water use
- P68 Reducing flood risk
- P69 Sustainability standards
- P70 Energy

2.3.1 London Plan Policy SI 2 Minimising Greenhouse Gas Emissions

The primary drivers for the project's energy strategy are complying with local guidelines, including the GLA Energy Plan 2022, and the national requirement of Part L compliance. In line with the London Plan, major developments are expected to be net zero carbon by incorporating measures outlined in the London Energy Hierarchy.

- **Be Lean:** use less energy and manage demand during operation through fabric and servicing improvements and the incorporation of flexibility measures.
- **Be Clean:** exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly by connecting to district heating networks.
- **Be Green:** maximise opportunities for renewable energy by producing, storing, and using renewable energy on-site.
- **Be seen monitor:** verify and report on energy performance through the mayor's post construction monitoring platform.

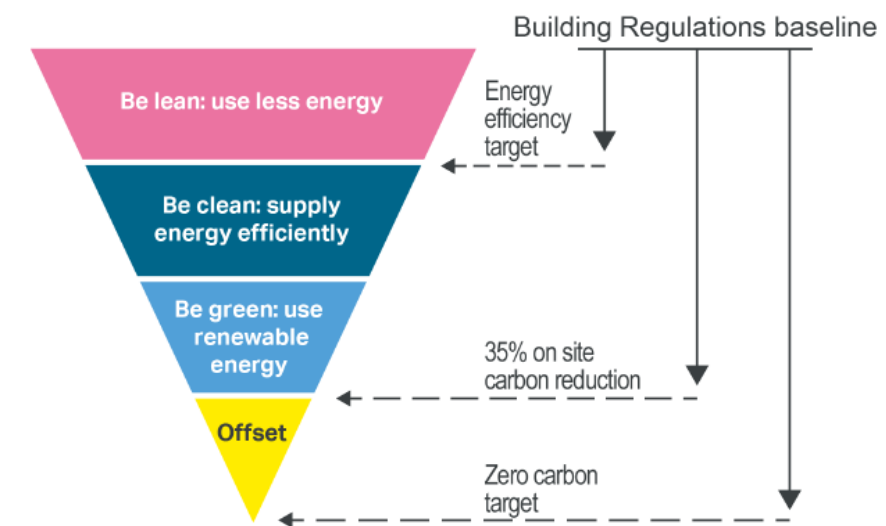


Figure 5 Energy Hierarchy

Major developments must reduce on-site emissions by at least 35% beyond Building Regulations. Residential projects should achieve 10% and non-residential projects 15% through energy efficiency measures. If the zero-carbon target cannot be fully met on-site, the shortfall should be addressed by either:

- A cash in lieu contribution to the borough's carbon offset fund, or
- An off-site solution, provided it is clearly identified and guaranteed to be delivered.

2.4 Building Regulations Part L

To meet the newly introduced Part L 2022 compliance for dwellings, the following three criteria must be met for the entire development:

1. The Dwelling Emissions Rate (DER) must not exceed the Target Emissions Rate (TER).
2. The Dwelling Fabric Energy Efficiency (DFEE) Rate must not exceed the Target Fabric Energy Efficiency (TFEE) Rate.
3. The Dwelling Primary Energy Rate (DPER) must not exceed the Target Primary Energy Rate (TPER).

One of the key changes from previous legislation is the introduction of the TPER, which directly limits the energy consumption of a dwelling, along with efficiency improvements to the target dwelling.

3 Be Lean

This section shows how CO2 emissions are reduced through energy demand reduction measures. The design for Aylesham Centre focused on reducing energy demand first, prioritizing the optimization of the building's fabric performance to minimize the need for heating, cooling, and lighting. The goal was to maximize efficiency ('lean') and avoid depending on complex mechanical systems to achieve low carbon performance. The energy efficiency measures undertaken include passive and active design measures.

The scenarios considered are:

For residential buildings:

- Be Lean – Gas Boiler

For non-residential areas:

- Be Lean - with a low carbon system

Part L1

The Part L1 2021 baseline will ordinarily include a gas boiler as the heating source for the notional building (see SAP 10.2, Appendix A). If low carbon or renewable heating systems are proposed applicants should match the notional building assumptions when reporting CO2 emission performance under the 'Be Lean' stage of the energy hierarchy. For example, if the final proposed building specification includes heat pumps, then the 'Be lean' DER should include the gas boiler in line with the notional performance values. Please note that for Part L1 the notional building is not always a gas boiler e.g. for developments connecting to an existing heat network. In this case the 'Be Lean' performance for the heating system should assume the same system and performance values as the existing heat network that will be included in the Part L 2021 baseline.

Additional exercise has been conducted to quantify the extra energy savings from the proposed HVAC system design, efficiency, and other on-site renewable sources compared to the baseline system efficiencies per SAP 10.2 Part L. This is to quantify the additional Be Green savings compared to a low carbon baseline using the Part L 2 methodology. The emphasis is on the development and innovation aimed at further reducing operational energy consumption and carbon emissions, which are currently not adequately represented by the Part L 1 non-low carbon baseline.

Part L2

The Part L2 2021 baseline will change depending on the actual heating system proposed. Tables 7 - 10 of the NCM Modelling Guide (2021 Edition) explains the systems and performance values that will be used in the Part L 2021 baseline. For example, under Part L 2021 for a non-residential building proposing heat pumps, the TER for the Part L 2021 baseline would include heat pumps with notional performance values of 2.86 seasonal generator efficiency for hot water and 2.64 seasonal system coefficient of performance for space heating. Where heat pumps are proposed, applicants are required to match the notional building heating type and performance values for heat pumps in the 'Be Lean' case.

Heating and hot water assumptions

It is expected that, through following the heat hierarchy, the final proposed heating strategy will include low carbon and/or renewable technologies. The CO2 emission improvements from these technologies are to be accounted for in the 'be clean' and 'be green' stages of the energy hierarchy. For the purposes of demonstrating CO2 emission improvements in the 'be lean' stage of the energy hierarchy, applicants should use the notional building system type and performance values specified in the Part L 2021 baseline as determined by the final proposed building specifications. In this way CO2 emission improvements from the proposed space heating and

hot water demand reduction measures can be compared against the Part L 2021 baseline, for example through improvements in performance of building fabric, heat recovery or water efficient fittings.

3.1 Passive Design Measures

The following 'passive' design measures implemented in the project to reduce energy requirements:

- Enhanced the building fabric's thermal performance beyond the standard Part L notional values.
- Double-glazed windows.
- Low-emissivity coated glass with a low G value to reduce undesirable solar heat gain.
- Enhanced air permeability.
- Maximized potential for passive ventilation in residential areas.

3.1.1 Building Fabric

The table below summarises the proposed and target fabric performance for the residential and non-residential areas of the development used in the assessment. For each element, a note has been added to show how each element has been modelled and whether it has been adopted in the design as proposed.

Table 2 Proposed Design performance for the development

Element or System	U Value	Notes
External walls including semi exposed walls	0.15 W/m²K	All Envelope parameters have been modelled as proposed
Partition walls between Lift Shafts (Untreated) and Dwellings	0.2-0.25 W/m²K	
Partition walls between services risers (Untreated) and Dwellings	0.2-0.23 W/m²K	
Party walls	0	
Ground Floors	0.11 W/m²K	
Intermediate floor	1 W/m²K	
Roofs	0.11 W/m²K	
Windows and glazed doors with >60% glazed area	Windows U Value = 1.3 W/m²K Frame factor = 0.7 Light transmittance = 0.70 G-Value <=0.4 Glazed Doors U Value =1.3 W/m²K Frame factor = 0.7 Light transmittance = 0.70	
Thermal mass	As Designed	
Allowance for thermal bridging	0.1 Y value with thermal bridging calculation to be considered at later stages.	
Air permeability	3 m³/h·m² at 50 Pa	Note that as part of the future building consultation, it will be required that all dwellings need to have an air permeability test. Provisions of such requirement shall be considered in the cost plan. Moreover, such requirement will ensure that each dwelling will have its actual air permeability performance without applying any penalty values because of not being tested.

Table 3 Criterion 3 - Limiting Solar Gain

Building	Internal Blinds
ABC	NO
D	YES
E	YES
F	NO
G	YES
H	NO
J1J2	NO
K	YES
L	NO
M	NO
N	NO
P	NO
Q	NO
Morrisons	NO

*The internal blinds have only been included in offices.

3.2 Active Design Measures

Following from passive measures that balance fabric losses and gains, active energy efficiency measures have been proposed to further enhance energy efficiency and reduce energy consumption. These measures are divided into regulated and unregulated loads. Regulated loads involve critical systems like space heating, cooling, hot water, internal lighting, etc., which we aim to optimize for efficiency. Unregulated loads, like plug-in devices and equipment used by building occupants, require collaboration with end users to refine assumptions and select energy-efficient equipment for minimal energy use.

The Notional building at the Be Lean stage serves as the baseline against which carbon reduction will be measured.

To maximize the efficiency of regulated loads in the Be Lean stage, the following approach is proposed:

- For residential units, a gas boiler with an 89.5% efficiency.
- For non-residential units, an ASHP with a Seasonal Coefficient of Performance (SCOP) of 3 has been used in the low carbon system Be Lean scenario, providing efficient, low-carbon heating by transferring heat from outside air to inside spaces. Using a high-efficiency ASHP system with performance higher than the Be Lean scenario will be reported as part of the Be Green level.
- High efficiency mechanical ventilation with heat recovery (MVHR) systems, have been applied to the systems where appropriate.
- Cooling is provided via VRF system with heat recovery to various terminal system types for retails and offices spaces due to its energy efficiency, individual zoning, eco-friendliness, low noise levels.
- Direct Electric Heaters for corridors.
- Efficient fans and pumps with variable speed control, along with inverter-driven pumps combined with differential pressure sensors to optimize system efficiency.
- Heat Interface Unit (HIU).
- Artificial lighting incorporates low-energy light fixtures and efficient lighting controls, such as presence/absence detection and daylight-linked dimming, when suitable.

Tables 4 and 5 detail the building system properties for the residential and non-residential units.

Table 4 Building System Properties – Residential Units

Be Lean	Energy	Source	Contribution (%)	Efficiency (%)
Non-Low Carbon Baseline	Heating	Boiler	100	89.5

Table 5 Building System Properties – Non-Residential Units

System Type	Specification	Notes
MVHR	SFP = 1.5 W/(l/s) Heat Recovery Efficiency = 80% Variable speed controller	-
VRF	SCOP = 2.64 SEER = 6	-
DHW - ASHP	SCOP = 2.86	-
Low energy light	Luminaire Efficacy = 120 lm/W Display Light Source Efficacy = 85 lm/W	-

3.3 Be Lean Energy Assessment Results

3.3.1 Residential

Detailed SAP calculations have been conducted for all-residential units in each tower based on Be Lean parameters with the below results:

3.3.1.1 Be Lean Results

Table 6 Residential Be Lean SAP calculations levels

Building	Area (m ²)	DER (kgCO ₂ /yr/m ²)	TER (kgCO ₂ /yr/m ²)	Savings (%)	DFEE (kWh/m ² /yr)	TFEE (kWh/m ² /yr)	Savings (%)	DPER (kWh/m ² /yr)	TPER (kWh/m ² /yr)	Savings (%)
ABC	4581	12.18	13.49	9.71%	34.45	31.18	-10.49%	71.87	72.56	0.95%
E	4643	12.22	14.08	13.21%	30.4	28.63	-6.18%	73.13	76.65	4.59%
F	1704	10.69	11.99	10.84%	31.97	28.94	-10.47%	63.53	64.02	0.77%
G	4811	11.43	13.16	13.15%	30.9	28.72	-7.59%	68.14	71.64	4.89%
H	3451	10.48	12.19	14.03%	29.5	26.64	-10.74%	62.7	65.92	4.88%
J1J2	8851	10.68	12.64	15.51%	26.29	24.64	-6.70%	64.46	69.08	6.69%
K	5897	10.64	12.39	14.12%	27.22	25.07	-8.58%	64.01	67.28	4.86%
L	5675	10.55	12.46	15.33%	25.06	24.43	-2.58%	63.61	67.53	5.80%
M	10790	10.35	12.88	19.64%	26.69	26.37	-1.21%	62.37	70.78	11.88%
N	3632	12.1	13.63	11.23%	27.07	24.65	-9.82%	72.67	74.59	2.57%
P	4362	9.73	11.6	16.12%	28.33	25.48	-11.19%	58.36	63.03	7.41%
Q	2056	10.92	12.22	10.64%	29.97	26.83	-11.70%	65.33	65.46	0.20%
Total	60453	10.91	12.78	14.66%	28.30	26.47	-6.92%	65.44	69.56	5.92%

As required by the GLA Carbon emission reporting template, the energy saving/generation technologies have been included in the DER of the Be Lean Stage emissions. The values of PV have been calculated based on data extracted from Section 12a of each assessment for the DER/TER report for every flat across the masterplan development.

Table 7: Residential Be Lean Sap Calculation Levels (PV Included) (Column F GLA Form)

Building	PV (kgCO ₂ e)
ABC	-4446.11
E	-2721.09
F	-1807.78
G	-2611.41
H	-2436.85
J1J2	-4353.10
K	-3705.50
L	-3353.99
M	-3319.61
N	-1771.89
P	-2319.19
Q	-2156.20

The calculations were originally based on the following SAP 10.2 methodology formula:

For flats and maisonettes kWp = 40% of dwelling floor area / (6.5 x number of storeys in block)

The average carbon factor has been calculated based on the average of the PV energy use in the dwelling and PV exported to the grid calculated from multiple of samples of DER/TER calculations (0.12993 kgCO₂e/kWh). However, to remove uncertainty and take advantage that all dwelling have been assessed and simulated the exact energy saving/generation technology from renewables (i.e. PV) has been extracted from each DER/TER report and summed for each block and inserted accordingly in Column F of the GLA Carbon Emissions Reporting template. Noting that the deviation between both approaches was within 0.74%.

The DER (PV included) is the reported value compared to the Be Green TER that is used to calculate the emissions savings. Please refer to Appendix P for the detailed assessment of the energy saving/generation technologies applied to each of the assessments.

3.3.2 Non-Residential

The non-residential energy assessment has considered the commercial areas, Morrisons, and any associated areas as separate spaces, while spaces like stores are unheated and therefore excluded in Part L. The tables below summarise the BRUKL output for non-domestic areas based on Be Lean parameters.

Table 8 BRUKLs Summary for Commercial areas - Be Lean

Building	Area [m ²]	Heating + Cooling Demand [MJ/m ² /annum]		Primary Energy [kWh/m ² /annum]		Total Emissions [KgCO ₂ /m ² /annum]		
ABC	1245.20	152.84	159.44	47.67	58.97	4.4	5.42	18.82%
D	2725.30	96.57	108.65	30.53	37.44	2.82	3.42	17.54%
E	341.00	329.65	282.65	98.31	122.78	9.11	11.28	19.24%
F	208.20	190.28	208.32	89.58	114.33	8.24	10.46	21.22%
G	276.20	271.93	252.39	92.92	114.48	8.49	10.48	18.99%
H	244.20	302.5	296.91	116.67	142.49	10.73	13.06	17.61%
J1J2	125.30	308.94	207.46	53.82	63.9	4.94	5.89	16.13%
K	1259.40	116.09	127.19	42.81	52.22	3.95	4.78	17.36%
L	16.50	310.51	228.22	59.21	71.35	5.46	6.61	17.40%
N	97.40	226.11	166.76	48.14	60.7	4.36	5.55	21.44%
Morrisons	2252.92	141.8	111.32	45.94	54.23	4.18	4.94	15.38%
Site Wide	8791.62	146.3	140.3	47.6	58.1	4.4	5.3	17.62%

Table 9: BRUKLs Summary for Communal Corridors - Be Lean

Buildings	Area [m ²]	Heating + Cooling Demand [MJ/m ² /annum]		Primary Energy [kWh/m ² /annum]		Total Emissions [KgCO ₂ /m ² /annum]				
		Actual	Notional	Actual	Notional	Actual	PV	Be Lean (PV Removed)	Notional	Savings
ABC	371	16.43	26.82	14.69	12.39	1.41	0.61	0.80	1.24	23.58%
D	153	39.11	62.92	28.09	25.29	2.72	0.85	1.87	2.53	19.46%
E	593.1	0.93	1.36	9.9	8.63	0.91	0.42	0.49	0.81	26.23%
F	244.6	6.82	7.46	10.62	5.92	1	0.71	0.29	0.6	23.40%
G	858	9.95	17.91	11.53	12.54	1.1	0.35	0.75	1.22	30.06%
H	582.2	4.85	13.18	10.45	11.16	0.98	0.47	0.51	1.08	36.82%
J1J2	1196.3	2.59	3.53	10.54	10.11	0.98	0.25	0.73	0.95	18.32%
K	1120.8	4.97	12.5	9.59	10.35	0.9	0.42	0.48	1	36.78%
L	874.1	2.21	11.8	9.04	9.54	0.84	0.38	0.46	0.93	36.12%
M	2207.5	0.16	0.59	8.53	8.78	0.78	0.20	0.58	0.82	23.69%
N	797.5	20.31	35.72	17.12	17.85	1.66	0.33	1.33	1.75	20.03%
P	891.2	5.99	13.43	11.37	11.01	1.07	0.35	0.72	1.06	24.26%
Q	453.3	13.1	23.8	14.13	10.35	1.35	0.71	0.64	1.05	23.10%
Site Wide	10342.6	6.20	12.22	11.07	10.87	1.04	0.37	0.67	1.05	26.53%

4 Be Clean

In this step, the project investigates the potential of connection to local energy resources (such as heat networks) and supply energy efficiently and cleanly to reduce CO₂. There is no currently existing heat network directly within the vicinity of the Proposed Development that can be feasibly used to supply heating and cooling energy.

The site for the proposed development is defined within a current Heat Network priority area as shown below:

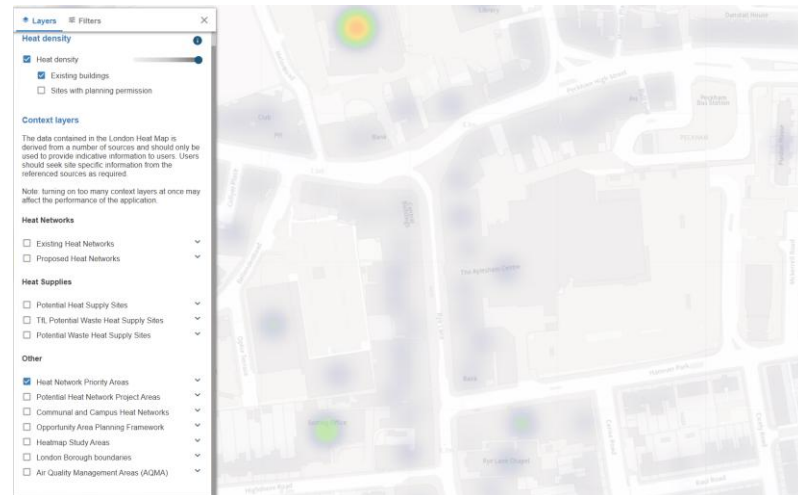


Figure 6: London Heat Map - Heat Network Priority Areas

Current Heat Network Priority areas are defined in the London Heat Map maps as areas in London where a heat network provides a financially competitive solution for supplying heat to buildings and consumers. This was last updated 23/04/2023.

Potential Heat Priority area is defined by the Centre For Sustainable Energy's (CSE's) cost optimisation and heat network model that indicate areas where heat networks may be a highly viable approach for the decarbonisation of heat in the area and it would be worth investigating these heat network project areas further. London Heat network maps shows Only limited parts of the North East side of the plot is within the potential priority heat network area

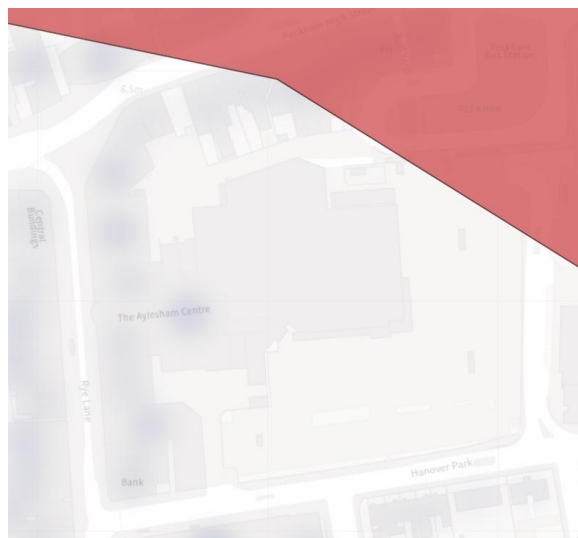


Figure 7: Potential Heat Network Priority Area

As indicated by the London Heat Map networks database, the proposed (potential) main heat network near the project site is the Southeast London Combined Heat and Power (SELCHP) facility. Based on the available data from the SELCHP heat network provider and the London Heat Map data, there is currently no direct connection of this heat network to the proposed development site.

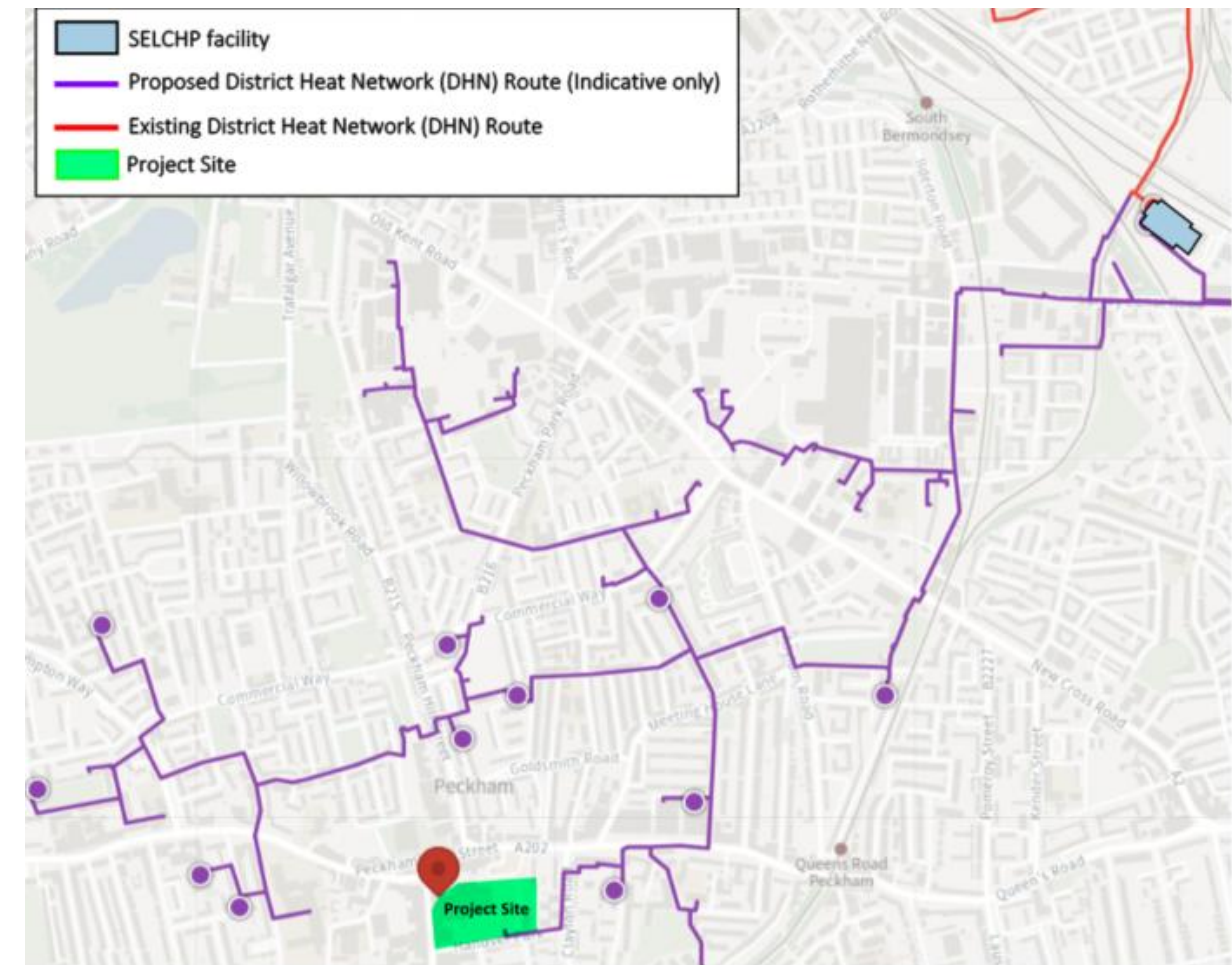


Figure 8 SELCHP Proposed Extension of the SELCHP Heat network

The London Heat Maps shows that the SELCHP is proposed to be extended to the site as part of future works. This is confirmed by the heat network operator, however, there is currently no data on the start and expected completion date for the proposed heat network extension at the time of enquiry and the proposed routes indicated in the proposed Local Development Area (LDO) area are still evolving and are subject to change.

For this energy strategy the Be Clean approach is considered as the local heat network within the site for each block where the heating is provided via Air Source Heat Pump. The proposed energy infrastructure for the site ensures appropriate systems are in place to facilitate the potential connection to district heating networks should this become a viable option for the site in the future.

Communication with Veolia, the service provider, has been initiated from the early stages of the project to establish the potential timeline for the availability of the heat network near the site for connection (details of this communication are included in Appendix I). Based on these discussions, the provision for a future connection to the SELCHP heat network has been incorporated into the energy centre planning for each phase.

An updated correspondence has been provided to clarify the comment requirements and to indicate the candidate connection points (Wood's Road connection (to be confirmed) and Lisford Road connection) that will be eligible to provide a heat network connection to the site.

Per the operator feedback, these connections are expected to be available prior to the site's heat-on date. Based on confirmation from the heat network provider, the network will have an interrupted capacity (i.e. no backup), but it is expected to be capable of fulfilling the site's base heating demand. The recommendation is to utilise the local sitewide heat network, which will be implemented within the site and funded by the developer, along with future connection to SELCHP heat network. This future hybrid arrangement presents a more optimal solution by offering the required backup and peaking capacity.

Furthermore, the updated correspondence confirms that there is no objection to having three connections to the heat network, provided that the primary network route within the site remains accessible 24/7. This accessibility will be maintained throughout the development of the heat network connection.

Two updated layout drawings have been submitted to illustrate the proposed connection routes, ensuring continuous access. These layouts are based on the proposed connection points suggested by the heat network operator. The connection from Wood's Road is yet to be confirmed but is identified as a suitable option for serving the Phase 1 energy centre. This connection could be extended to also serve the Phase 2 energy centres, or alternatively, a separate connection could be made directly from Lisford Street to serve Phase 2. A third option, presented in a previous submission, proposes a single connection from Lisford Street for both phases. However, Options 1 and 2 are preferable due to improved accessibility to the primary pipework.

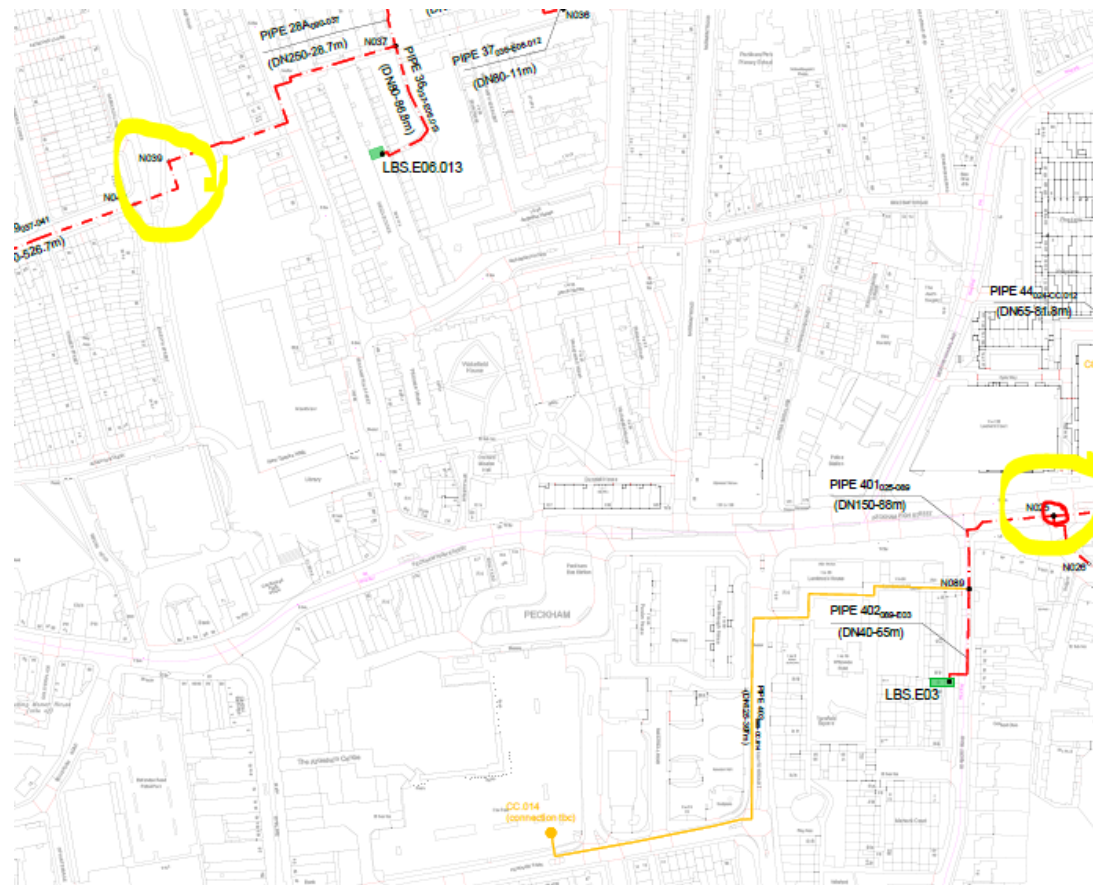


Figure 9: SELCHP Potential connection points to the Aylesham Redevelopment site

The following figures present the location where future connection to SELCHP heat network can be integrated in the site heating system (See also Appendix K).



Figure 10: Potential Connection of Project Site to District Heating Network based on proposed LDO route (Indicative Only – Option 1)



Figure 11: Potential Connection of Project Site to District Heating Network based on proposed LDO route (Indicative Only – Option 2)



Figure 12: Potential Connection of Project Site to District Heating Network based on proposed LDO route (Indicative Only – Option 3)

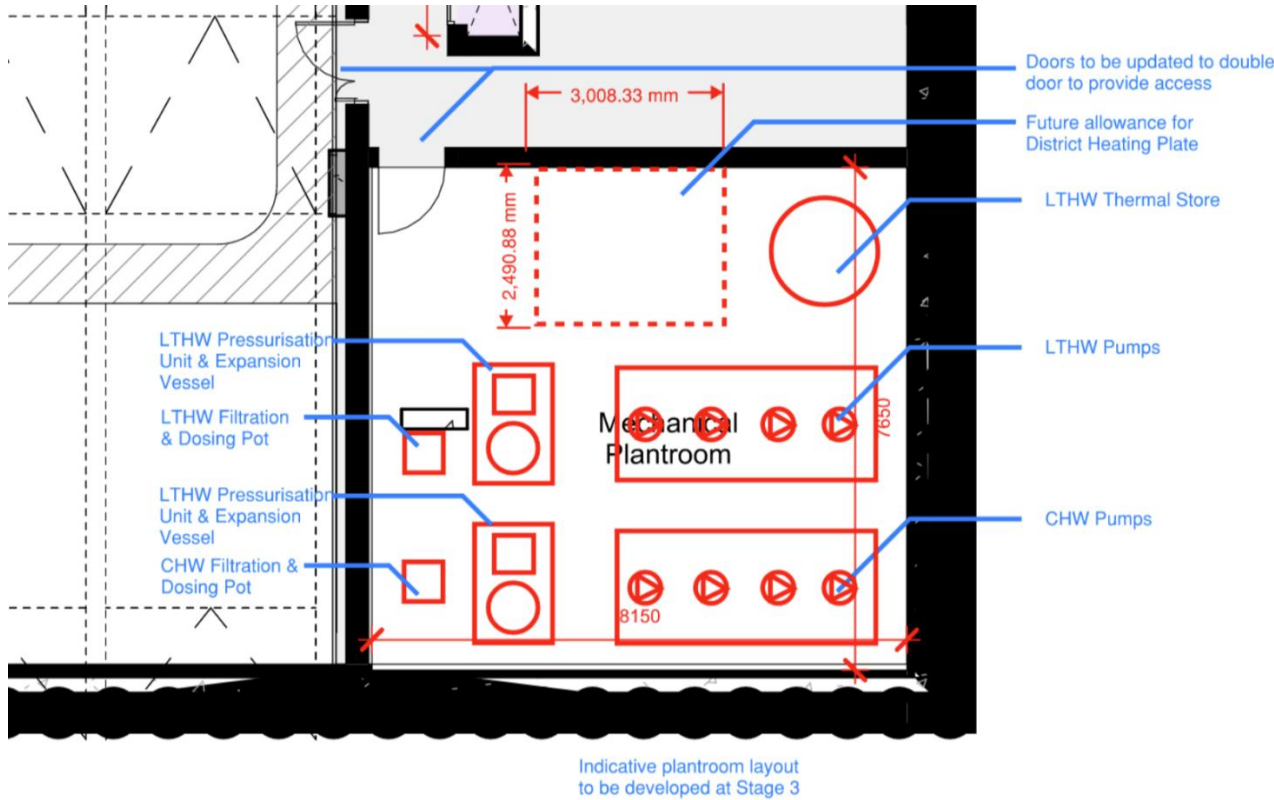


Figure 13: Proposed Layout of Energy Centre

4.1 Be Clean Energy Assessment Results

As requested by the GLA, the carbon emissions from the portions of the plot that will benefit from a future connection to the SELCHP heat network have been estimated. These portions are the Residential .

SELCHP is an energy-from-waste incineration plant located in Bermondsey, London. The facility is designed to generate both heat and electricity by incinerating municipal solid waste. SELCHP is a partnership between the public and private sectors, involving local authorities and specialist companies. The plant plays a crucial role in waste management for several London boroughs, providing a sustainable solution by converting waste into energy.

The calculation have been based on the data received from SELCHP service Provider as shown below:

Table 03 - DHN Bespoke modelling

Ref	Description	Current System		Future Potential System		Units	Method
		SAP 2012	SAP 10.1	SAP 2012	SAP 10.1		
Ref	Heat Delivered						
(1)	Heat Delivered to HIU (within the dwelling)	1000	1000	1000	1000	kWh	HIU
	Losses						
(2)	SAP Distribution Loss factor (As per CP1)	1.05	1.30	1.05	1.30	-	SAP
	Heat Generated						
(3)	Heat Generated at SELCHP (96.5% fraction)	1013.25	1300.00	1050.00	1300.00	kWh	(1) x (2) x 96.5%
(4)	Heat produced by backup boilers (fraction 3.5% @85% eff.)	43.24	53.53	43.24	53.53	kWh	(1)x(3.5%)/(85%) x(2)
(5)	Total heat generated	1056.49	1353.53	1093.24	1353.53	kWh	(3) + (4)
	SELCHP Ratio						
(6)	Z Factor	10.00	10.00	5.80	5.80	-	Operations
	Efficiencies						
(7)	Overall power efficiency (Heat & Electricity)	0.25	0.25	0.39	0.39	%	Operations
	Electricity Losses						
(8)	Total waste heat recovered at SELCHP eligible for carbon intensity	101.33	130.00	181.03	224.14	kWh	(3) / (6)
(9)	Electricity loss for pumping (parasitic load)	10.56	13.54	10.93	13.54	kWh	(5) x 1%
	Emission Factors						
(10)	heat from boilers - mains gas	0.216	0.210	0.216	0.210	kgCO2/kWh	SAP
(11)	electricity displaced from grid	0.519	0.136	0.519	0.136	kgCO2/kWh	SAP
	Overall carbon intensity factor for SELCHP DHN						
(12)	Backup boilers	9.34	11.24	9.34	11.24	kgCO2	(10) x (4)
(13)	SELCHP eligible heat	58.07	19.52	99.63	32.32	kgCO2	(11) x (8+9)
(14)	Total emissions per annum	67.41	30.76	108.97	43.56	kgCO2	(12) + (13)
(15)	Carbon Intensity Factor per kWh delivered	0.067	0.031	0.109	0.044	kgCO2/kWh	(14) / (1)

Figure 14: SELCHP Data extract

The current carbon factor of SELCHP is 0.031 KgCO₂/kWh(Heat). The current carbon factor for the heat network with Aylsham site is circa 0.0136/SCOP = 0.136/2.5 = 0.0544 KgCO₂/kWh(Heat). the below figure shows that connecting to potential SELCHP heat network will result in 8% reduction compared to the current carbon factors.



Figure 15: Be Clean Scenario reduction savings

However, The Heat Network within the site which is totally electrified will continuously decarbonise. The below figure shows the expected decarbonisation rate. It is predicted that by date of starting project the carbon factor will be 0.0408 kgCP₂/kWh(thermal). By 2032 the carbon factor of the local heat network will equalize of SELCHP and continuous to decrease until reaching net zero as the grid completely decarbonise.

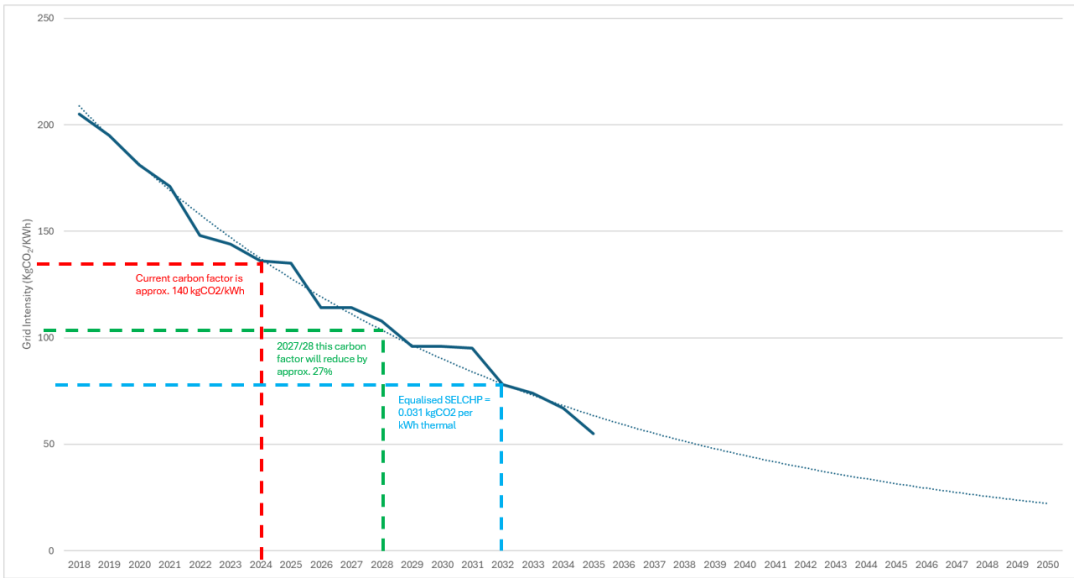


Figure 16: BEIS Grid Carbon intensity factor

5 Be Green

5.1 Residential

The residential apartments are supplied with hot water from **three energy centres for each phase**, where heat pumps are used for water heating. Based on manufacturer specifications, the heat pumps, operating at the required capacities for this project, will achieve a **Seasonal Coefficient of Performance (SCOP) of 2.5**, as summarized in the table below:

Table 10 Building System Properties - Residential

Energy	Source	Contribution (%)	Efficiency (%)
Heating	Heat Pumps	100	250

Communal Corridors will be heated via direct electric heaters

5.2 Non-Domestic

In line with Policy 5.7 of the London Plan on renewable energy technologies, the final stage of the Energy Hierarchy emphasizes the use of low and zero carbon energy technologies. Low and Zero Carbon (LZC) Feasibility studies offer an in-depth examination of appropriate renewable energy technologies for prospective projects. As attention to operational expenses and related CO₂ emissions continues to increase, integrating LZC technologies is crucial in any design plan. From a technical standpoint, two main LZC technologies are feasible to be applied for the project:

- 1. Use of high-performance heat pumps for non-domestic areas: Decentralized Heat pumps are a highly efficient method for producing hot water and heating, significantly contributing to the carbon savings for the commercial units in the Proposed Development.

Table 11 Building System Properties – Non-Residential

System Type	Specification
MVHR	SFP = 1.5 W/(l/s) Heat Recovery Efficiency = 80% Variable speed controller
VRF	SCOP = 5* SEER = 6*
DHW - ASHP	SCOP = 3 **
Low energy light	Luminaire Efficacy = 120 lm/W Display Light Source Efficacy = 85 lm/W

*Based on Manufacturer data for high efficiency VRF units part L efficiencies

**Based on Manufacturer data for Air to water heat pumps

- 2. PV panels along with applying heat pump systems for the non-domestic spaces: In addition to incorporating heat pumps as a LZC technology, the proposal includes PV panels to further reduce site CO₂ emissions. PV panels offset the higher electrical demands of heat pumps and are cost-effective, typically paying for themselves within 10 years. Additionally, they would reduce the annual carbon offset payments for 30 years post-completion. The energy assessment confirms these measures effectively lower energy consumption and carbon emissions.

5.3 Photovoltaics

Figure 8 shows the incident solar radiation on the blocks, and Figure 9 shows incident solar radiation on buildings' roofs and the required PVs areas for each building. For detailed Plan, please refer to Appendix J.

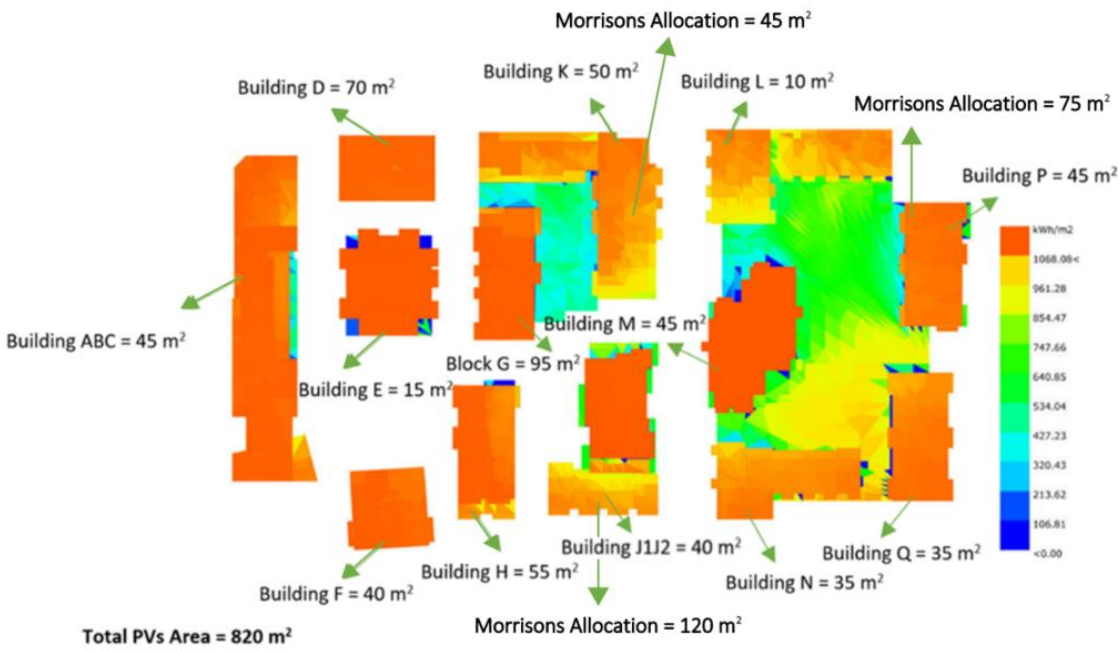


Figure 17 The incident solar radiation on the buildings' roofs and the required PVs areas for each building

The table below summarises an initial estimation of the area of PVs required for communal corridors, commercial areas, and Morrisons.

Table 12 Communal Corridors, commercial areas and Morrisons PVs

Building	Communal Corridors PVs (m²)	Commercial Areas and Morisons PVs (m²)	Total PVs Area (m²)
ABC	20	25	45
D	25	45	70
E	15	-	15
F	15	25	40
G	45	50	95
H	25	30	55
J1J2	30	10	40
K	25	25	50
L	10	-	10
M	45	-	45
N	30	5	35
P	45	-	45
Q	35	-	35
Morrisons	-	240	240
Total	365 m²	455 m²	820 m²

The following figure presents the current roof allocations throughout the masterplan:



Figure 18: Aylesham Centre Redevelopment Site-Wide PV Layouts including plant, access/maintenance and terrace allocations

The PV areas calculated occupy maximum available roof space with current allocations for MEP plant, the access and maintenance strategy and, proposed roof terraced areas. Refer to Appendix K for detailed drawings. The following figures present the proposed PV roof level layouts across the proposed development.

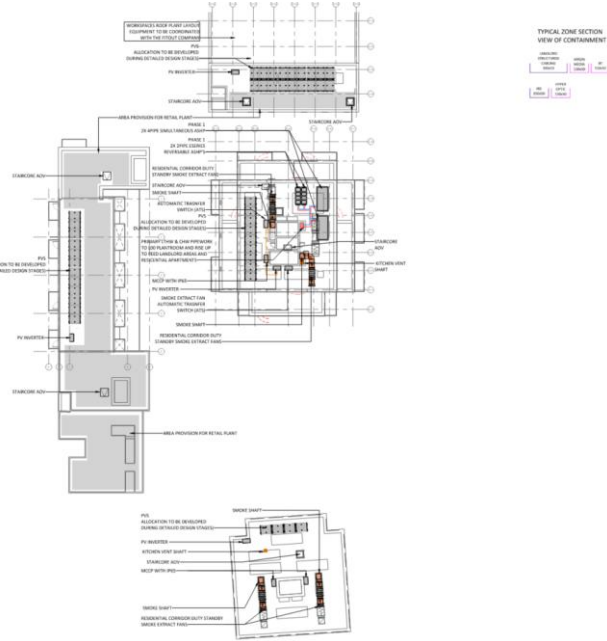


Figure 19: MEP Services Aylesham – Combined Services Roof Level MEP Layout

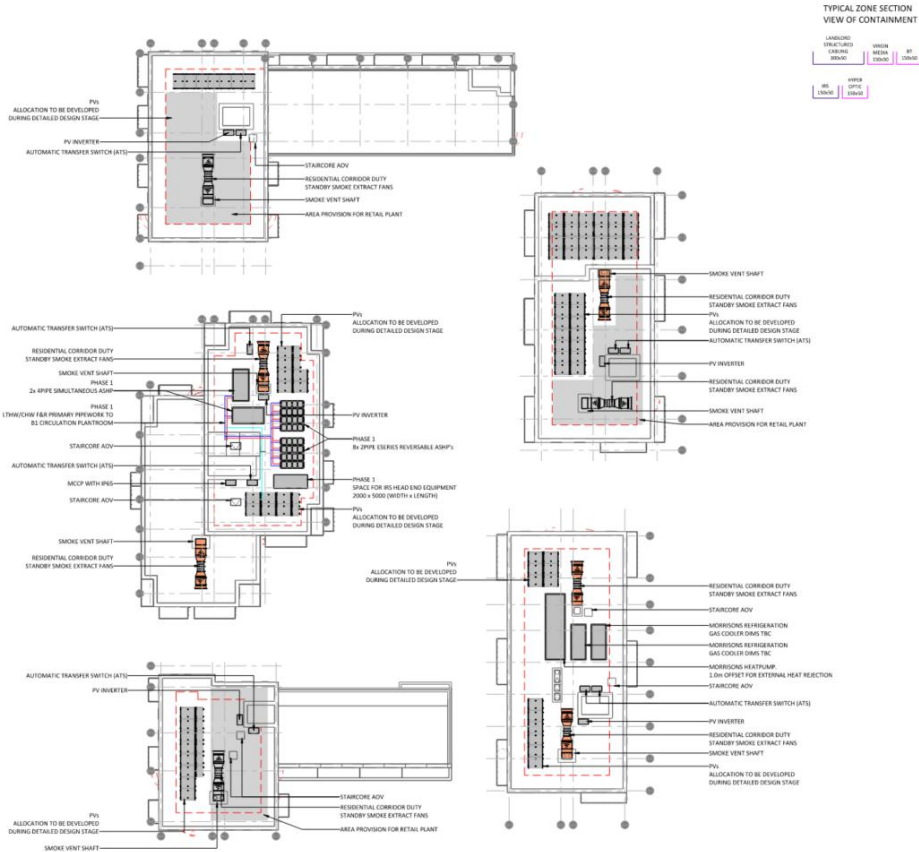


Figure 20: MEP Services Aylesham – Combined Services Roof Level MEP Layout



Figure 21: MEP Services Aylesham - Combined Services Roof Level MEP Layout

5.4 Be Green Energy Assessment Results

5.4.1 Residential

Detailed SAP calculations have been conducted for all residential units in each tower based on Be Lean parameters. Overall, the scheme will achieve on-site savings of 63.03%. The table below summarises the Be Green results.

Table 13 Residential Be Green SAP calculations levels

Building	Area (m ²)	DER (kgCO ₂ /yr/m ²)	TER (kgCO ₂ /yr/m ²)	Savings (%)	DFEE (kWh/m ² /yr)	TFEE (kWh/m ² /yr)	Savings (%)	DPER (kWh/m ² /yr)	TPER (kWh/m ² /yr)	Savings (%)
ABC	4581	5.14	13.13	60.85%	34.43	31.41	-9.61%	54.52	70.65	22.83%
E	4643	5.13	13.74	62.66%	30.2	28.55	-5.78%	54.69	74.83	26.91%
F	1704	4.39	11.58	62.09%	31.97	28.94	-10.47%	46.47	61.83	24.84%
G	4811	4.94	12.84	61.53%	30.9	28.72	-7.59%	52.62	69.89	24.71%
H	3451	4.53	11.78	61.54%	29.47	26.63	-10.66%	47.97	63.68	24.67%
J1J2	8851	4.56	12.32	62.99%	26.03	24.64	-5.64%	48.77	67.36	27.60%
K	5897	4.56	12.06	62.19%	26.91	25.07	-7.34%	48.67	65.48	25.67%
L	5675	4.6	12.25	62.45%	25.52	24.43	-4.46%	49.15	66.71	26.32%
M	10790	4.54	12.53	63.77%	26.91	26.48	-1.62%	48.51	68.86	29.55%
N	3632	5.37	13.52	60.28%	27.69	25.09	-10.36%	57.33	73.98	22.51%
P	4362	4.07	11.22	63.73%	28.33	25.48	-11.19%	43.39	61.01	28.88%
Q	2056	4.74	11.8	59.83%	29.71	26.83	-10.73%	50.49	63.19	20.10%
Total	60453	4.69	12.46	62.35%	28.32	26.53	-6.78%	50.02	67.84	26.27%

5.4.2 Non-Residential

The non-residential energy assessment has considered the supermarket, commercial units, communal corridors and any associated areas as separate spaces, while spaces which are unheated (e.g. stores) are excluded in Part L.

The scheme will achieve an overall on-site reduction of 36.96 % for commercial areas and 35.02% for Morrisons, with a 36.75% reduction for communal corridors compared to Building Regulations Part L. The tables below summarise the BRUKL output based on Be Green parameters.

Table 14 BRUKLs Summary for Commercial Units - Be Green

Building	Area [m ²]	Heating + Cooling Demand		Primary Energy		Total Emissions		
		[MJ/m ² /annum]		[kWh/m ² /annum]		[KgCO ₂ /m ² /annum]		
ABC	1245.2	152.84	159.44	37.88	58.97	3.5	5.42	35.42%
D	2725.3	96.57	108.65	23.95	37.44	2.21	3.42	35.38%
E	341	329.65	282.65	75.06	122.78	6.96	11.28	38.30%
F	208.2	190.28	208.32	52.64	114.33	4.99	10.46	52.29%
G	276.2	271.93	252.39	70.53	114.48	6.5	10.48	37.98%
H	244.2	302.5	296.91	86.06	142.49	7.97	13.06	38.97%
J1J2	125.3	308.94	207.46	38.55	63.9	3.51	5.89	40.41%
K	1259.4	117	127.19	33.46	52.22	3.09	4.78	35.36%
L	16.5	310.51	228.22	40.28	71.35	3.7	6.61	44.02%
N	97.4	226.11	166.76	36.74	60.7	3.34	5.55	39.82%
Morrisons	2252.92	141.8	111.32	34.82	54.23	3.2	4.94	35.22%
Site Wide	8791.62	146.41	140.31	36.30	58.08	3.35	5.31	36.93%

Table 15 BRUKLs Summary for Communal Corridors - Be Green

Building	Area [m ²]	Heating + Cooling Demand		Primary Energy		Total Emissions		
		[MJ/m ² /annum]		[kWh/m ² /annum]		[KgCO ₂ /m ² /annum]		
		Actual	Notional	Actual	Notional	Actual	Notional	Savings
ABC	371	15.84	26.82	7.7	12.39	0.8	1.24	35.48%
D	153	39.11	62.92	15.46	25.29	1.64	2.53	35.18%
E	593.1	0.93	1.36	5.36	8.63	0.52	0.81	35.80%
F	244.6	6.82	7.42	3.41	5.92	0.38	0.60	36.67%
G	858	9.95	17.91	7.91	12.54	0.79	1.22	35.25%
H	582.2	4.85	13.18	6.76	11.16	0.66	1.08	38.89%
J1J2	1196.3	2.59	3.53	6.15	10.11	0.60	0.95	36.84%
K	1120.8	4.96	12.48	6.66	10.34	0.64	1.00	36.00%
L	874.1	2.21	11.8	5.91	9.54	0.56	0.93	39.78%
M	2207.5	0.16	0.59	5.43	8.78	0.51	0.82	37.80%
N	797.5	20.31	35.72	10.26	17.85	1.06	1.75	39.43%
P	891.2	6.34	13.78	6.64	11.12	0.66	1.06	38.32%
Q	453.3	13.1	23.8	5.96	10.35	0.63	1.05	40.00%
Site Wide	10342.6	6.20	12.24	6.65	10.88	0.66	1.05	37.54%

5.4.3 Cooling Demand

Space cooling is provided within the each of the commercial units throughout the masterplan site. The actual and notional values (MJ/m²) have been extracted from the BRUKL reports and are summarised as follows:

Building	Area [m ²]	Actual (MJ/m ²)	Notional (MJ/m ²)	Actual (MJ)	Notional (MJ)
ABC	1245.20	71	108.8	88409.20	135477.76
D	2725.3	60	88.9	163518.00	242279.17
E	341	182.5	213.6	62232.50	72837.60
F	208.2	101.4	165.1	21111.48	34373.82
G	276.2	233	219.5	64354.60	60625.90
H	244.2	202.8	238.8	49523.76	58314.96
J1J2	125.3	210.1	118.4	26325.53	14835.52
K	1259.4	68	102.7	85639.20	129340.38
L	16.5	186.4	112.6	3075.60	1857.90
N	97.4	189.4	131.5	18447.56	12808.10
Morrisons	2252.92	140.4	109	316309.97	245568.28
Site Wide	8791.62			898947.4	1008319
				102.25 MJ / m ²	114.69 MJ / m ²

The overall results confirm that the actual cooling demand for the overall non-residential areas is less than the notional.

Block ABC

HVAC Systems Performance			
System Type	Heat dem MJ/m2	Cool dem MJ/m2	[ST] Variable refrigerant flow, [HS] ASHRAE 90.1-2010
Actual	81.9	71	4
Notional	50.7	108.8	5

Block H

HVAC Systems Performance			
System Type	Heat dem MJ/m2	Cool dem MJ/m2	[ST] Variable refrigerant flow, [HS] ASHRAE 90.1-2010
Actual	99.7	202.8	5
Notional	58.1	238.8	6

Block D

HVAC Systems Performance			
System Type	Heat dem MJ/m2	Cool dem MJ/m2	[ST] Variable refrigerant flow, [HS] ASHRAE 90.1-2010
Actual	36.6	60	2
Notional	19.7	88.9	2

Block J1J2

HVAC Systems Performance			
System Type	Heat dem MJ/m2	Cool dem MJ/m2	[ST] Variable refrigerant flow, [HS] ASHRAE 90.1-2010
Actual	98.8	210.1	5
Notional	89	118.4	5

Block E

HVAC Systems Performance			
System Type	Heat dem MJ/m2	Cool dem MJ/m2	[ST] Variable refrigerant flow, [HS] ASHRAE 90.1-2010
Actual	147.2	182.5	8
Notional	69	213.6	7

Block K

HVAC Systems Performance			
System Type	Heat dem MJ/m2	Cool dem MJ/m2	[ST] Variable refrigerant flow, [HS] ASHRAE 90.1-2010
Actual	49	68	2
Notional	24.5	102.7	2

Block F

HVAC Systems Performance			
System Type	Heat dem MJ/m2	Cool dem MJ/m2	[ST] Variable refrigerant flow, [HS] ASHRAE 90.1-2010
Actual	88.9	101.4	
Notional	43.2	165.1	

Block L

HVAC Systems Performance			
System Type	Heat dem MJ/m2	Cool dem MJ/m2	[ST] Variable refrigerant flow, [HS] ASHRAE 90.1-2010
Actual	124.1	186.4	6
Notional	115.6	112.6	1

Block G

HVAC Systems Performance			
System Type	Heat dem MJ/m2	Cool dem MJ/m2	[ST] Variable refrigerant flow, [HS] ASHRAE 90.1-2010
Actual	38.9	233	2
Notional	32.9	219.5	3

Block N

HVAC Systems Performance			
System Type	Heat dem MJ/m2	Cool dem MJ/m2	[ST] Variable refrigerant flow, [HS] ASHRAE 90.1-2010
Actual	36.7	189.4	2
Notional	35.2	131.5	3

Morrisons

HVAC Systems Performance			
System Type	Heat dem MJ/m2	Cool dem MJ/m2	[ST] Variable refrigerant flow, [HS] ASHRAE 90.1-2010
Actual	1.4	140.4	6
Notional	2.3	109	6

Figure 22: BRUKL cooling demand extracted figures

6 Be Seen

In order to effectively contribute to the “reduce” stage within the carbon hierarchy throughout the project lifetime, there shall be a measurement and monitoring framework to identify the potentials of carbon reduction opportunities related to incorporating rising technologies.

This is a crucial measure where smart metering can be integrated in BMS will facilitate:

- A. Benchmark its operational carbon footprint
- B. Identify operational opportunities to reduce carbon footprint
- C. Assist in transparent carbon footprint reporting as part of offsetting framework to achieve carbon neutrality

This data can be essential in the Journey towards net zero where various operational and maintenance decisions can be taken to reduce the operational carbon emissions of the buildings. The data can be used in simulation models where cutting-edge technologies can be studied as they become available in the market to evaluate its sustainability benefits.

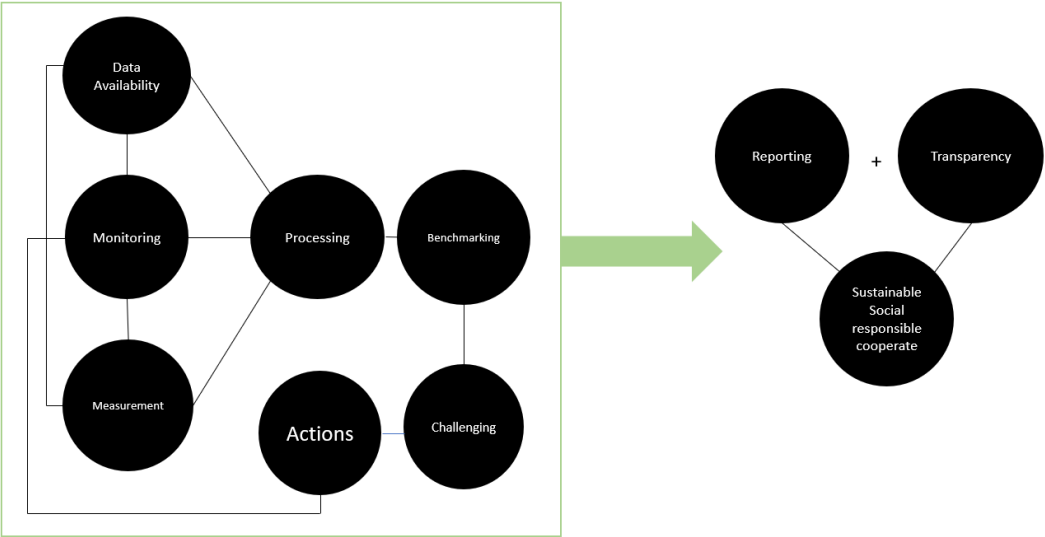


Figure 23 Metering and Monitoring role in Carbon footprint reporting

7 Quality Assurance

The development’s energy strategy will incorporate various quality assurance mechanisms to safeguard consumers against high prices, in line with the **GLA Energy Assessment Guidance (June 2022)**. These measures include:

- Designing and installing the system in compliance with the **CIBSE Code of Practice (CP1)**, where applicable.
- Ensuring **transparent billing**, with a clear distinction between ongoing maintenance costs and capital replacement charges in the standing fee.
- Providing **accessible customer service facilities** to support vulnerable tenants, including individuals with physical or mental health conditions, disabilities, additional communication needs, financial insecurity, low income, or those experiencing bereavement. This includes:

- Ensuring fair treatment of all customers.
- Offering alternative heating sources to vulnerable tenants during supply interruptions as part of the aftercare process.
- Preventing the suspension of heating for vulnerable tenants during winter.
- Providing assistance to help tenants understand their bills and statements.
- **Registering the heat network** with the relevant regulatory authority.
- **Integrating renewable energy generation** as part of the development's energy strategy.

Predicted Energy Costs

Energy cost estimations for occupants have been calculated with the goal of protecting consumers from high prices. Reducing energy demand for residents has been a priority, as demonstrated by the measures implemented at the Be Lean stage, which focuses on enhancing the building fabric throughout the development.

In addition to the use of high-performance building fabric with improved U-values, the development benefits from self-shading features provided by apartment balconies with relatively low glazing g-value.

At the Be Seen stage, energy monitoring measures help further reduce costs for occupants. Each apartment is equipped with energy meters, allowing residents to track and manage their daily energy consumption. Additionally, occupants have the freedom to choose their energy provider, enabling them to opt for more competitive tariffs.

The estimated annual energy cost for a typical apartment within the development is £1,100 for 1B apartment and 1,400 for 2B Apartment. This figure is based on SAP calculation data. The total energy consumption for each of these units is derived by summing usage from:

- Space and water heating
- Space cooling
- Pumps and fans
- Electric keep-hot functions
- Lighting
- Additionally, approximations for cooking and appliance energy use are included in the calculation.

The total annual energy consumption is then multiplied by the current quarter's electricity rate of 26.2p/kWh.

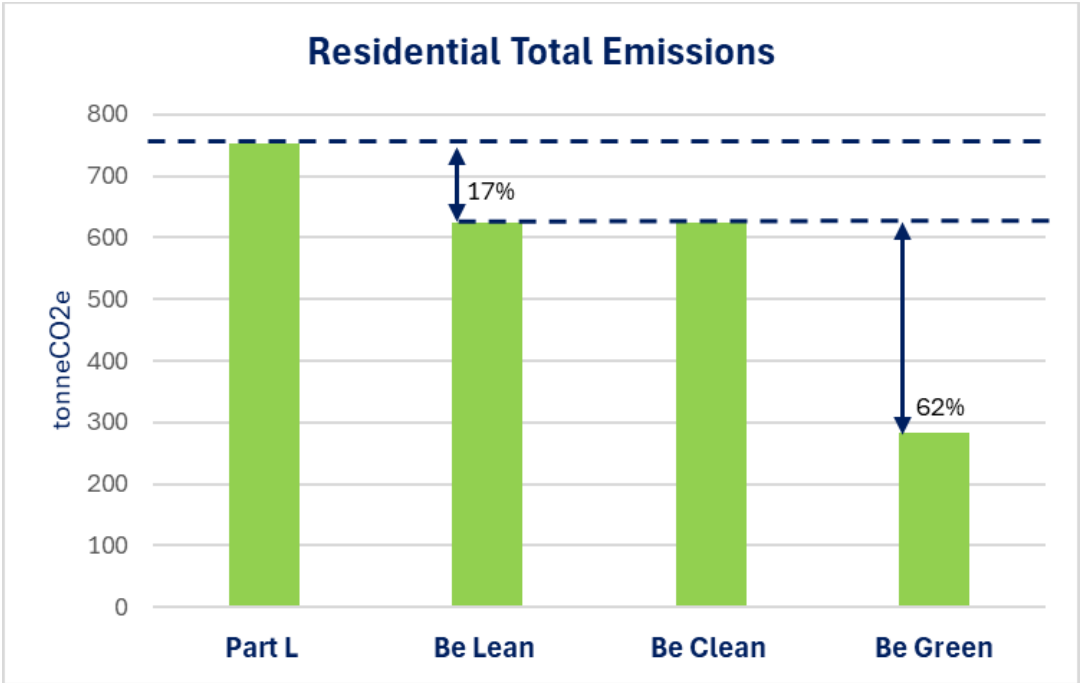
This estimate excludes service and maintenance costs.

8 Summary of Results
8.1 Residential Summary Results

Table 16 Residential CO2 Emissions

Residential			
CO ₂ Emissions after each stage of the Energy Hierarchy			
	(Tonnes CO ₂ / year)	Cumulative Savings (%)	(Tonnes CO ₂ / year)
	Regulated CO ₂ Emissions		Unregulated CO ₂ Emissions
Part L	753.2884		-
Be Lean	624.5648	17%	-
Be Clean	624.5648	17%	-
Be Green	283.59	62%	268.64

Additional exercise has been conducted to quantify the extra energy savings from the proposed HVAC system design, efficiency, and other on-site renewable sources compared to the baseline system efficiencies per SAP 10.2 Part L. This is to quantify the additional Be Green savings compared to a low carbon baseline using the Part L 2 methodology. The emphasis is on the development and innovation aimed at further reducing operational energy consumption and carbon emissions, which are currently not adequately represented by the Part L 1 non-low carbon baseline.



*Currently there is no potential for a heat network to be connected to the site – See Section 4.1

Figure 24 Energy Hierarchy - Residential – Emissions Rate

8.2 Non-Residential Summary Results

The non-residential elements of the Aylesham Centre have been assessed in accordance with the Energy Hierarchy. The following figures and table present the savings achieved by the commercial units and communal areas at each stage of the Energy Hierarchy approach.

Table 17 Commercial CO2 Emissions - Cumulative Savings

Commercial			
CO ₂ Emissions after each stage of the Energy Hierarchy			
	(Tonnes CO ₂ / year)	Cumulative Savings (%)	(Tonnes CO ₂ / year)
	Regulated CO ₂ Emissions		Unregulated CO ₂ Emissions
Part L	46.71	-	-
Be Lean	38.48	17.6%	41.04
Be Clean	38.48	17.6%	41.04
Be Green	29.46	36.93%	41.04

Table 18 Communal Corridors CO2 Emissions - Cumulative Savings

Communal Areas			
CO ₂ Emissions after each stage of the Energy Hierarchy			
	(Tonnes CO ₂ / year)	Cumulative Savings (%)	(Tonnes CO ₂ / year)
	Regulated CO ₂ Emissions		Unregulated CO ₂ Emissions
Part L	10.85	-	-
Be Lean	6.96	35.84%	18.47
Be Clean	6.96	35.84%	18.47
Be Green	6.78	37.48%	18.47

Table 19 Communal Corridors CO2 Emissions - Cumulative Savings

Commercial & Communal Corridor Savings – GLA Template			
CO ₂ Emissions after each stage of the Energy Hierarchy			
	(Tonnes CO ₂ / year)	Cumulative Savings (%)	(Tonnes CO ₂ / year)
	Regulated CO ₂ Emissions		Unregulated CO ₂ Emissions
Part L	57.56	-	-
Be Lean	45.44	21.0%	13.58
Be Clean	45.44	21.0%	13.58
Be Green	36.24	37.0%	13.58

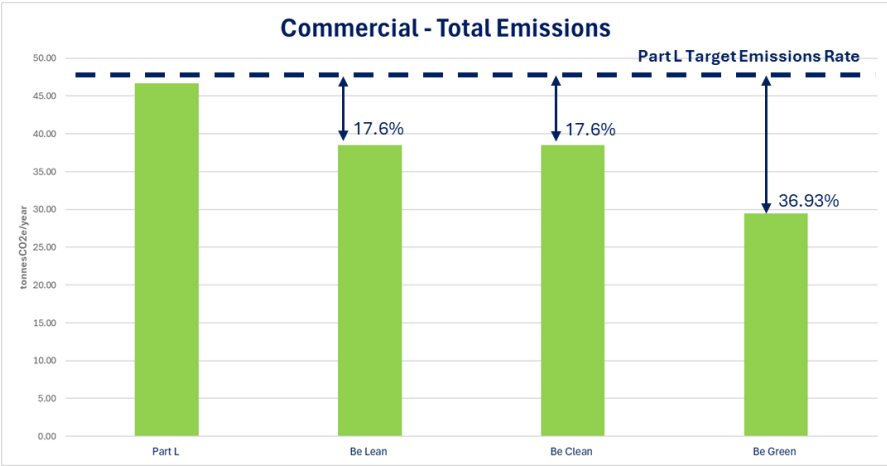


Figure 25: Commercial - Total Emissions

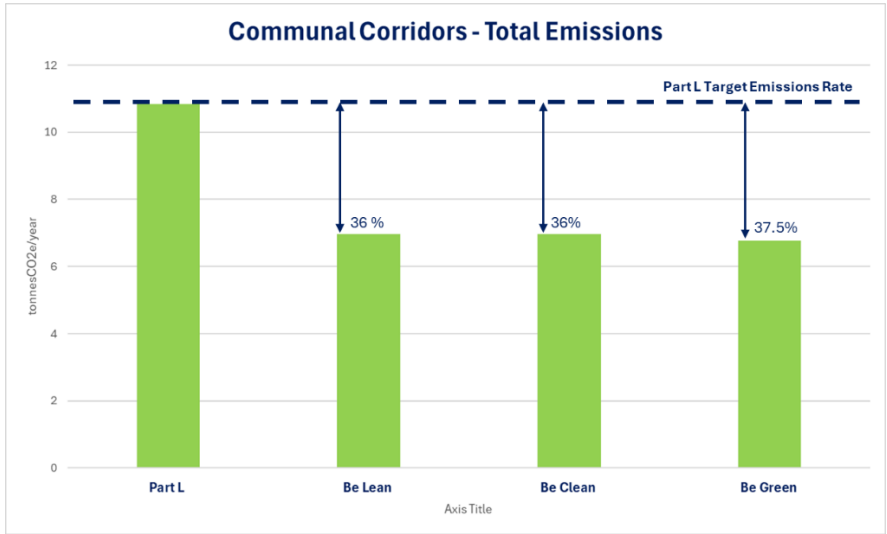


Figure 26: Communal - Total Emissions

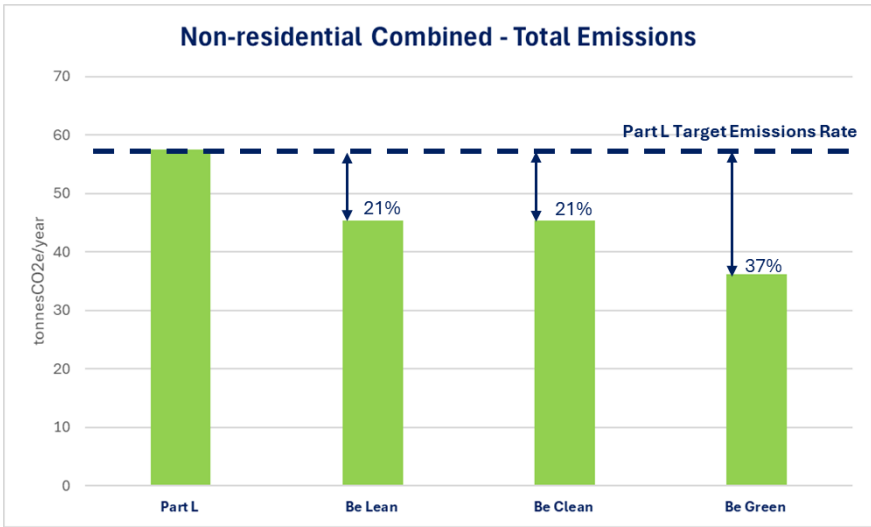


Figure 27: Non-residential Total Emissions

9 Electrification of energy sources and operational air quality enhancement

Electrification refers to the process of replacing technologies that use fossil fuels (coal, oil, and natural gas) with technologies that use electricity as a source of energy. Depending on the resources used to generate electricity, electrification can potentially reduce carbon dioxide (CO₂) emissions from the transportation and building sectors. Addressing emissions from these sectors is critical to decarbonizing the economy and, ultimately, mitigating the impacts of climate change as highlighted in the future building regulations.

With continuous decarbonization of the grid which increasingly relies on emission less energy sources as nuclear power and off and on shore renewable energy sources, technologies that use electricity as a fuel source result in lower carbon dioxide emissions on average than those that use fossil fuels directly. Additionally, the electricity grid is expected to become even cleaner over time as the aim is to increase the amount of electricity generated by zero-carbon sources. Therefore, the benefits associated with electrification will likely grow in the future as electricity generation becomes less carbon intensive.

Additionally, switching to electric heating and cooking technologies can have substantial air quality benefits. Some electric appliances can be better for indoor air quality than their fossil fuel-based counterparts—natural gas cooking stoves, for example, release carbon monoxide, nitrogen dioxide, and other harmful pollutants when in use.

As one of the expected major energy ends uses for development, Hot water generation resembled for long time a challenge to be electrified since gas boiler provided unchallenged convenient and reliable source of hot water generation. Other electric sources were burdened by the hefty bills of using such solutions where ASHP usually backed up with electric immersion heaters or even other gas boiler to reach the required hot water supply temperature which compromises the overall gained efficiency of such system. However, multiple technologies nowadays resolved this dilemma with ASHP systems capable to generate hot water at the required supply temperature without the need of the backup heaters, keeping the efficiency advantage and providing a precritical solution to achieve full electrification of the built energy sources.

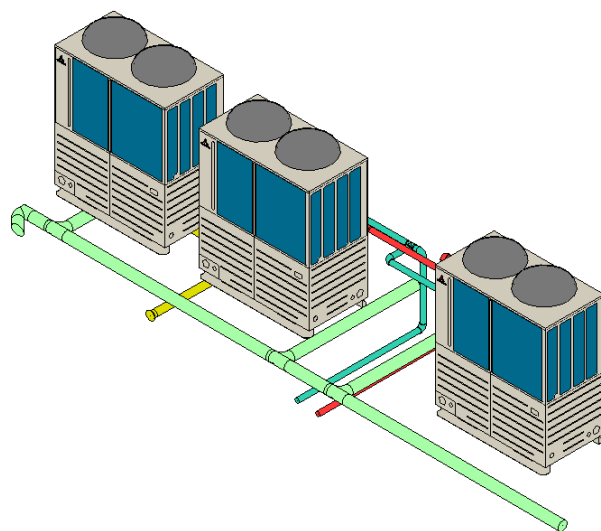


Figure 28 ASHP for hot water generation

10 Other Low and Zero Carbon Technologies

10.1 Wind Power

To evaluate the suitability for wind power generation it is necessary to undertake a full survey and analysis of the site to ascertain the likely wind speeds available to support the viability of wind generation.

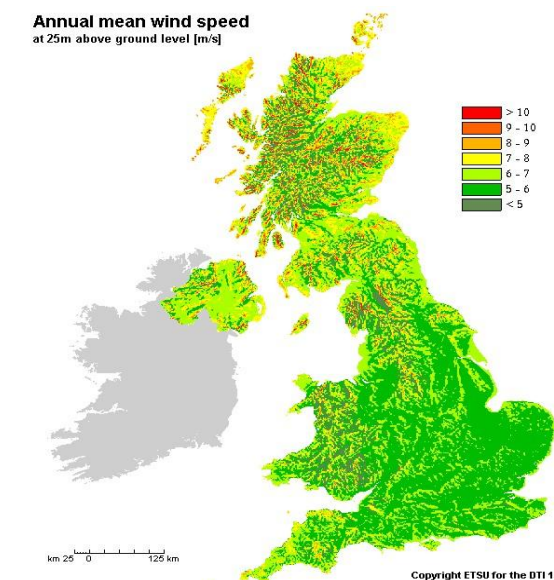


Figure 29 Annual mean wind speed

British Wind Energy Association (BWEA) wind data base suggests that wind speed at the site would be around 4-6m/s at 25m could support small wind turbine, however, annual load generation will be relatively low. Based on Wind analysis section, the wind speed in the stadium area will not support wind turbine as effective renewable energy source.

Installation of wind turbines would have a negative effect on the architectural character of the building. This issue aside, wind turbines can have a detrimental effect on telecommunications in the vicinity of their location. Given the surroundings of the stadium in the middle of urban residential areas which puts a limiting factor on location of the wind turbine installation. Wind patterns in urban areas can be very turbulent and are not the best conditions to yield a good output from small scale wind turbines.

In addition, planning requirements from the local authority regarding potential noise from the wind generators would have to be considered. It is likely that during the day sound levels would not be noticeable but at night with lower background levels this could be invasive to the buildings.

Based on the above information, it would be reasonable to conclude that, even without a technical review of the installation costs, the requirements for maintenance and the installation restraints are unlikely to support the installation of electrical wind generation for this development. Therefore, this option is excluded.

10.2 Hydrogen Fuel Cells

Hydrogen fuel cells have been considered for use within the building but have been discounted due to the current lack of a commercially viable source of hydrogen. Many current installations are known to be running on natural gas to generate the Hydrogen fuel until the hydrogen becomes available from sustainable non-fossil fuel-based source. Utilization of organic food decomposition and anaerobic digestion process to generate Biogas which can be used in generating Hydrogen fuel is other more environmentally friendly emission less process, however, the area footprint of such system is huge and will require specialist operation to maintain the process flow with expected complicated maintenance for such multiprocessor system.

10.3 Ground Source Heat Pump

Ground source systems provide the opportunity to obtain both heating and cooling via water to water or water to refrigerant heat pumps. This technology can reduce the demand for conventional energy and thus reduce overall CO₂ emissions. They do however have limited effect in reducing CO₂ emission levels compared to the other renewable energy technologies.

Geothermal technology can be utilised virtually anywhere in the UK and be installed under landscape areas and car parks. A more efficient and less expensive option is to utilise a nearby body of water for heat extraction/rejection. Geothermal systems provide the opportunity to connect to water-to-water heat pump units for heat rejection and to VRF heat pump units for cooling and heating.

VRF system heat pumps using inverter controls on the compressors can provide improved energy efficient operation, where the heating and cooling input are mixed so that the actual load is limited to the resultant difference thereby further reducing the energy input.

Installing a ground source system will require approval from the environment agency to pump heat in and out of the ground. As a large system would be required for the project, it is not known how the ground conditions will react to such a large system, and there are risks associated with ecology that will affect the size of system that will be possible. The area requirements for the blow grade pipe work will be constrained by the surrounding infrastructures for the surrounding residential area

It has been concluded that a GSHP is not viable due to ecological implications and Impracticality for the project.

10.4 Biomass Boilers

Biomass technology could be installed as part of the central heating provision. The most economical option and the best for reducing CO₂ emission levels would normally be to install Biomass Boilers to act as the lead boiler to cater for the base hot water heating load with the remaining gas fuelled boilers sized to meet the total heating load and to form a standby facility.

The Bio-energy boiler system would require the installation of additional components for the storage of the wood chips or pellets used as fuel, along with the necessary transportation components to link between the storage hoppers and the boiler.

Wood chips or pellets would need to be stored in external or internal hoppers. The amount of wood chips or pellets stored will affect the choice of the silo or bunker storage types. Storage systems require sufficient space for large delivery vehicle to 'shoot' the wood fuel directly into the storage facility.

The wood chips or pellets are transferred from the storage facility by screw or similar transportation system linking between the wood hoppers and the boiler house.



The waste combustion products from the boilers (in the form of ash) can either be removed manually or automatically using screw feed units direct to a collection skip. This plant ash is an inert ash and can be used as fertiliser assuming that the wood is obtained from clean sources (i.e., nonindustrial, and not contaminated with plastics). The use of automatic removal of the plant ash will reduce maintenance costs but increase the initial capital installation costs.

Wood burning boilers have comparable combustion efficiencies as basic gas fired systems. The fluing requirements for modern wood fired boilers are comparable with those of gas fired systems and the emissions are like that of gas fired units. Where the heat output to water is above 300kW (400kW input) there is a requirement under the clean air regulations when using waste wood to install continuous flue monitoring of the waste gas products. These systems are relatively expensive to install and maintain.

Biomass Boilers can also operate on a modulating basis to vary the heat output. Boilers can operate as low as 30% of their maximum load they do, however require additional plant room area then the standard models.

The installation of Biomass Boiler with pellet storage as the main heating boiler is not a viable option when CHP plant is proposed, as the majority of the base heating would be provided by CHP. Biomass boilers also cause other issues such as fuel storage, which need to be maintained in a dry storage area. With space being at a high premium in the project, it is not anticipated that biomass fuel store will be a provision that is easy to make.

Biomass boilers will require the associated flues to terminate above the highest point of the building presenting obvious issues in this high-rise development. This will mean that the architectural character of the building will be fundamentally changed to these flue requirements.

Biomass is therefore discounted as a feasible and viable option for the project.

10.5 Solar Thermal, Hot Water Generation

The use of solar heating for hot water generation would require the installation of solar panels at roof level. Ideally the panels should be aligned in a southerly direction with a tilt of between 30° and 40°.

Solar thermal panels will also require to be mounted in areas that are unshaded. The potential, therefore, of incorporating solar thermal is limited as it would compete for roof space with the PVs system that would feed ASHP How water system generating 4 W of hot water for each W of generated electrical energy while Solar hot water system ideally generates 1 W for every 1 W of absorbed Solar energy. With minimum 4 to 1 advantage for ASHP hot water generation, expansion of electricity generating PVs is always superior to solar hot water solutions.

10.6 Combined heat and Power generation (CHP)

Micro CHP system is one of the low carbon technology options. However, it is one of the systems that is fed by mains gas to have both thermal and electrical power output. This one of low carbon technologies which are not encouraged to be adopted as preferred design option in built environment as it still uses main gas as its fuel source.

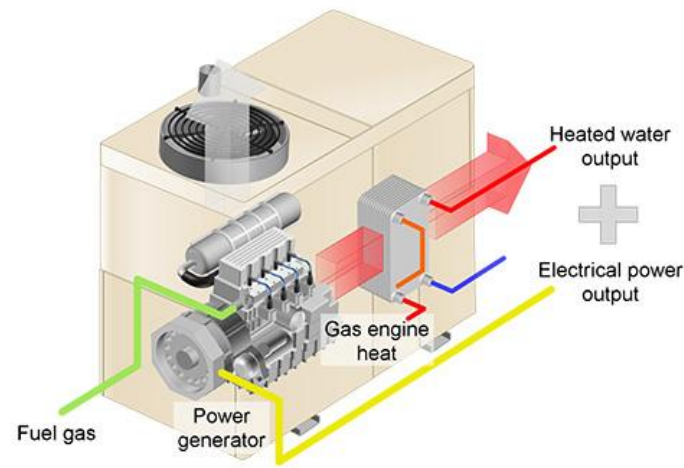


Figure 30 Micro CHP system

11 Overheating Assessment

11.1 CIBSE TM 59 Compliance

TM59 methodology recommends a full written report that documents the following details for the assessment: dynamic thermal analysis software name and version used for the assessment, which must comply with the requirements of CIBSE AM11: Building performance modelling (2015b)

- Site location and orientation
- Images of the model indicating the sample units selected and the basis for selection.
- Images showing the internal layouts for the sample units.
- Information on the construction type with layers of construction (used to determine U-values and g-values) for all external and internal building elements, plus any additional shading features (including any blinds, and demonstrating that the blinds do not clash with opening windows if blinds are used to contribute to a pass)
- Thermal mass, with a written explanation of where the thermal mass is incorporated in the construction.
- The ventilation strategy modelled, including details of window opening assumptions, free areas calculated, infiltration rates assumed and any mechanical supply/extract flow rates.
- The weather file(s) used for the assessment. Noting that London DSY 2020 weather files have been used in the assessment.

Due to acoustics constraints, the apartments are proposed to adopt either mixed mode or fully mechanical ventilation strategies. Per CIBSE TM59, for homes which are predominantly mechanically ventilated, the CIBSE fixed temperature test must be followed, i.e., all occupied rooms should not exceed an operative temperature of 26 °C for more than 3% of the annual occupied hours (CIBSE Guide A (2015a))

Reliance on the Natural ventilation has also been assessed as part of the study.

Design summer years (DSY) should always be used for analysis of overheating, and it is good practice to take into account future weather files.

However, a minimum requirement for passing the test is proposed here by using a single DSY (DSY1), with the use of additional weather files recommended to explore performance where there is particular concern (e.g., the presence of vulnerable occupants) and/or demonstrating mitigation options under more extreme events (e.g. heatwaves). The analysis based on additional weather files can be used to develop a heatwave plan. As part of this study is Future weather files assessment.

Accordingly, additional assessments based on DSY 2 and 3 and future weather file based on London DSY H 2050 has been completed and provided as part of this assessment.

CIBSE TM59 provides a complete set of Occupancy and internal gains profile which has been accounted for in the simulations. From Behaviour perspective it is assumed for the sake of this analysis, that heating system operation is linked to occupancy such that during unoccupied hours the occupants will switch off heating.

The following figures show the profiles for each type as detailed in CIBSE TM59.

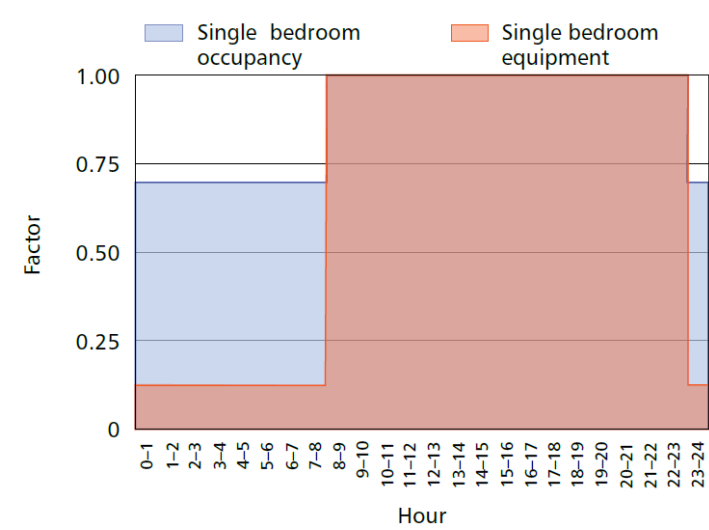


Figure 31 Single Bedroom Profiles

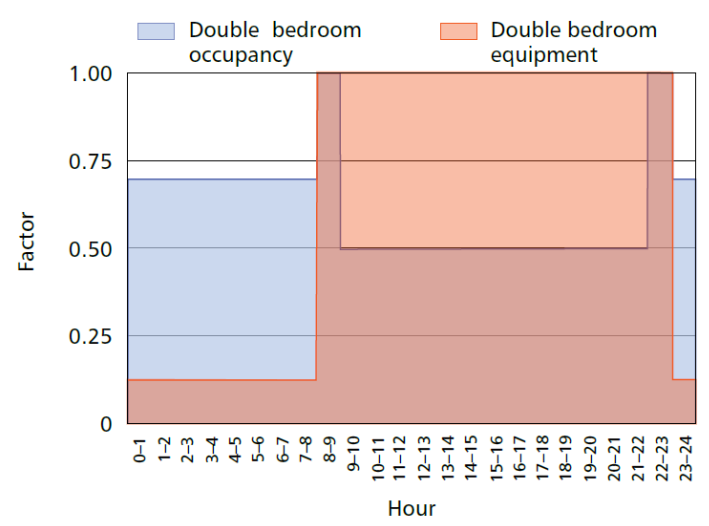


Figure 32 Double Bedroom Profiles

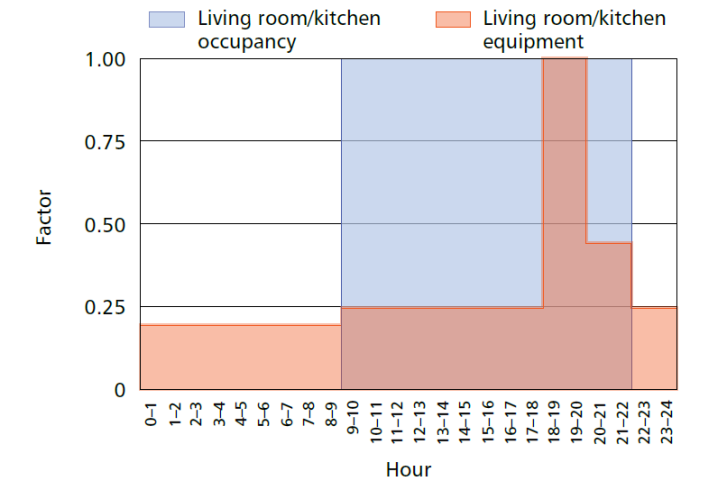


Figure 33 Combined Living/Kitchen Profiles

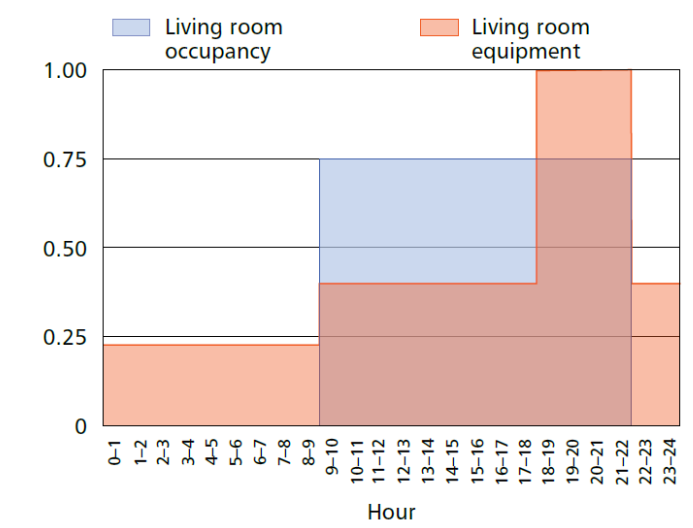


Figure 34 Living room profile

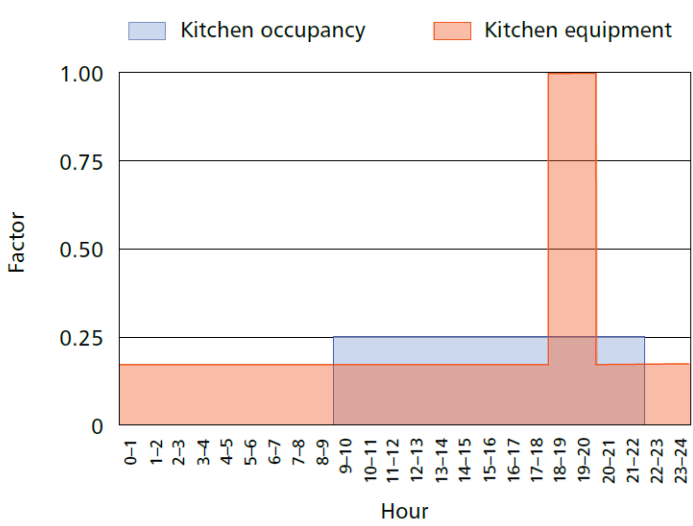


Figure 35 Kitchen Profiles

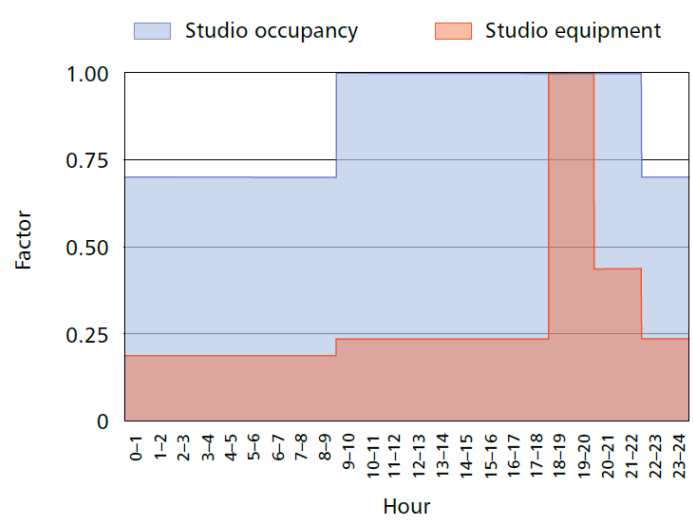


Figure 36 Studio Profiles

11.2 Approved Document Part O

To demonstrate compliance using the dynamic thermal modelling method, all of the following guidance should be followed.

CIBSE's TM59 methodology for predicting overheating risk.

- The limits on the use of CIBSE's TM59 methodology
- The acceptable strategies for reducing overheating risk within Part O
- The building control body should be provided with a report that demonstrates that the residential building passes CIBSE's TM59 assessment of overheating.

Limits on CIBSE's TM59 modelling

CIBSE's TM59 method requires the modeller to make choices. These limits should be applied when following the guidance in CIBSE's TM59.

When a room is occupied during the day (8am to 11pm), openings should be modelled to do all of the following.

- Start to open when the internal temperature exceeds 22°C.
- Be fully open when the internal temperature exceeds 26°C.
- Start to close when the internal temperature falls below 26°C.
- Be fully closed when the internal temperature falls below 22°C.

At night (11pm to 8am), openings should be modelled as fully open if both of the following apply.

- The opening is on the first floor or above and not easily accessible.
- The internal temperature exceeds 23°C at 11pm.

When a ground floor or easily accessible room is unoccupied, both of the following apply.

In the day, windows, patio doors and balcony doors should be modelled as open, if this can be done securely, following the guidance below.

- At night, windows, patio doors and balcony doors should be modelled as closed.
- An entrance door should be included, which should be shut all the time.

Acceptable strategies for reducing overheating risk.

Solar gains in summer should be limited by any of the following means.

- Fixed shading devices, comprising any of the following.
 - Shutters.
 - External blinds.
 - Overhangs.
 - Awnings.
- Glazing design, involving any of the following solutions.
 - Size.
 - Orientation.
 - g-value.
 - Depth of the window reveal.
 - Building design – for example, the placement of balconies.

Shading provided by adjacent permanent buildings, structures, or landscaping.

Although internal blinds and curtains provide some reduction in solar gains, they should not be taken into account when considering whether requirement O1 has been met.

Foliage, such as tree cover, can provide some reduction in solar gains. However, it should not be taken into account when considering whether requirement O1 has been met.

Removing excess heat

Excess heat should be removed from the residential building by any of the following means.

- Opening windows (the effectiveness of this method is improved by cross-ventilation).
- Ventilation louvres in external walls.
- A mechanical ventilation system.
- A mechanical cooling system

The building should be constructed to meet requirement O1 using passive means as far as reasonably practicable. It should be demonstrated to the building control body that all practicable passive means of limiting unwanted solar gains and removing excess heat have been used first before adopting mechanical cooling. Any mechanical cooling (air-conditioning) is expected to be used only where requirement O1 cannot be met using openings.

NOTE: Any method to reduce overheating risk in residential buildings must comply with all other parts of the Building Regulations. Particular attention should be paid to the requirements of Part F and the guidance in Approved Document F, Volume 1: *Dwellings* on noise and maintenance.

NOTE: A system for purge ventilation should be provided in each habitable room to demonstrate compliance with Part F of the Building Regulations. The guidance in Section 1 of Approved Document F, Volume 1: *Dwellings* should be followed for the minimum standards for purge ventilation. A larger amount of purge ventilation may be required than that in Approved Document F, Volume 1: *Dwellings* in order to satisfy requirement O1 on providing an adequate means to remove excess heat from the indoor environment.

Based on the below London Overheating risk map extracted from Part O, Aylesham centre is within high overheating risk area.

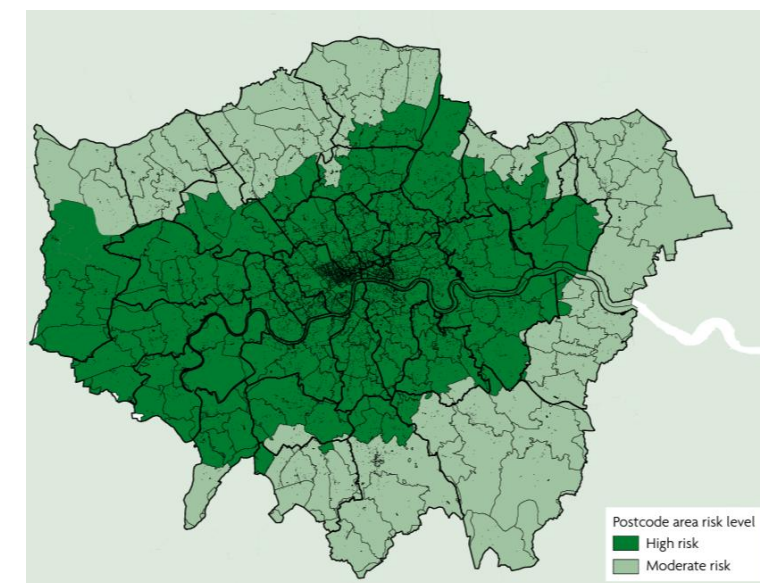


Figure 37: Overheating risk at postcode area level in the high-risk part of London.

This has been verified via the Good Homes Alliance Early Stage Overheating Risk Tool presented below (the tool has been prepared with the worst case scenario). The overall score exceeds 12 and accordingly, a detailed assessment via dynamic thermal modelling using CIBSE TM59 methodology has been completed with the mitigation measures defined as need for each area within the site.

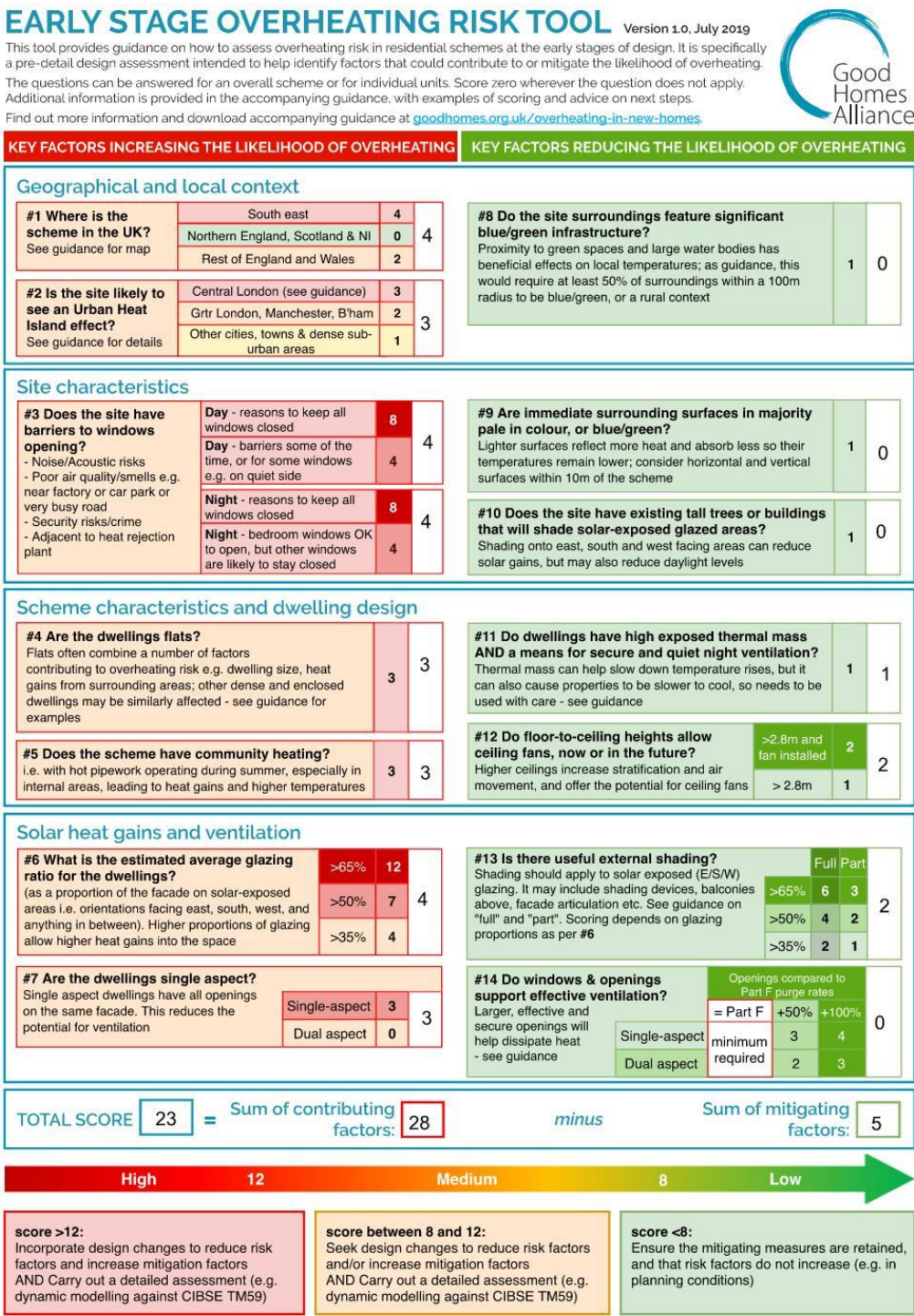


Figure 38: Good Homes Alliance Early Stage Overheating Risk Tool

11.3 IES Modelling

A Full IES model has been constructed for the project. The modelling approach followed CIBSE AM11 guidelines. The model reflects the latest received architectural plans and layouts.

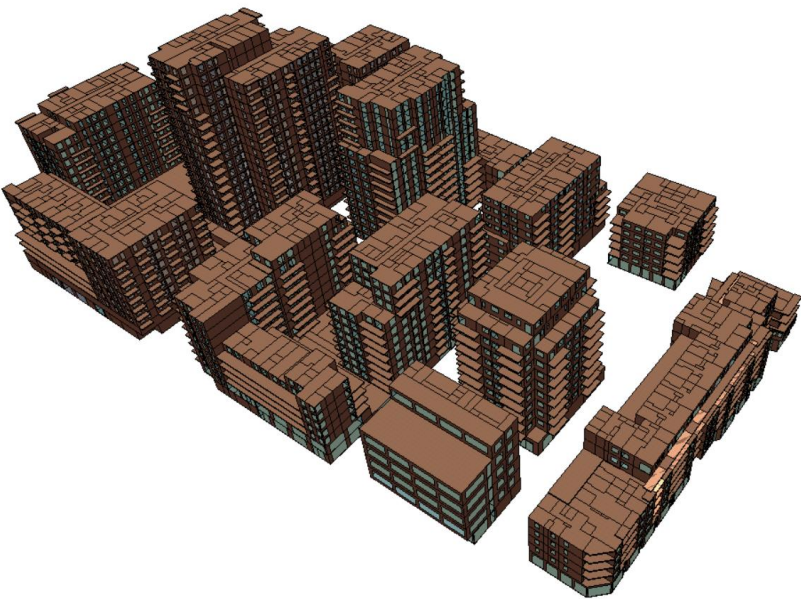


Figure 39: IES Model -Aylesham Centre

The thermal templates reflect the design criteria for each space that follows CIBSE Guide A- 2019 and CIBSE AM11 guidelines.

- Room Group
- 00) Non-resi -Lift
- 01) Non-resi -Stair
- 02) Resi - Toilet
- 03) Resi - Bed Room
- 04) Resi - Living Room
- 05) Resi - Storage
- 06) Non-resi - Plant
- 07) Non-resi - Retail
- 08) Non-resi - Office
- 09) Non-resi - WC
- 10) Resi - Corridor
- 11) Non-resi - Lobby
- 12) Non-resi - Store
- 13) Resi-Plant
- 14) Resi-Lift
- 15) Resi-Stair
- 16) Resi-Riser
- 17) Morrisons PQL
- 18) Non-resi Cycle store

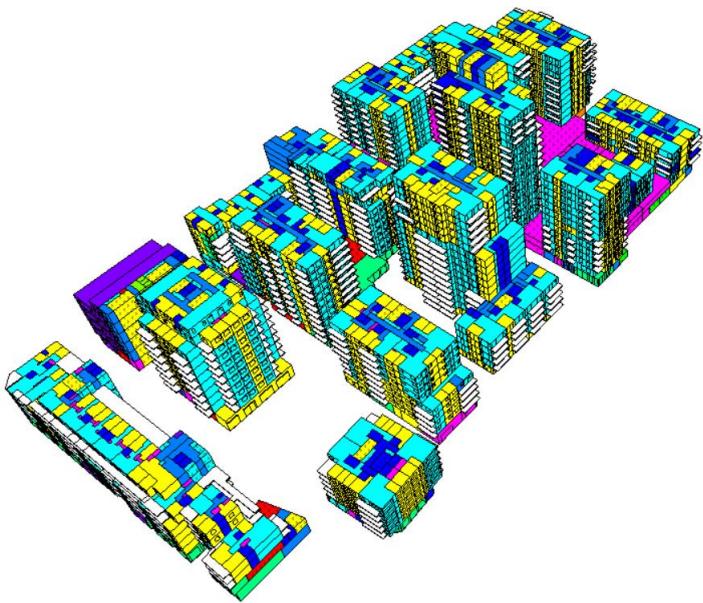


Figure 40: Thermal Templates

11.4Basis of Design

11.4.1Residential units

The below table summarises the design parameters for the dwellings used in the assessment. For each system and element, a note has been added to show how each element has been modelled and whether it has been adopted in the design as proposed.

Element or System	Value
External walls including semi exposed walls	U = 0.15 W/m²K
Partition walls between Lift Shafts (Untreated) and Dwellings	U-Value = 0.2-0.25 W/m²K ^[1]
Partition walls between services risers (Untreated) and Dwellings	U-Value = 0.2-0.23 W/m²K ^[1]
Party walls ^[2]	-
Ground Floors	U = 0.11 W/m²K
Roofs	U = 0.11 W/m²K
Windows and glazed doors with >60% glazed area	U = 1.3 W/m²K
	Frame factor = 0.7
	Light transmittance = 0.70
	G-Value = 0.4
Thermal mass	Same as actual dwelling
Allowance for thermal bridging	At the current design stage Default value of adopted as basis of assessment. For later stages when more details available for the envelope structures, thermal bridging shall be calculated to have the actual thermal bridging effect for the building with aim to reach the thermal bridging values for different assemblies included in SAP 10.2
Air permeability ^[3]	3 m³/h·m² at 50 Pa
Main heating fuel (space and water)	Electrical
Mechanically ventilated zones	Heat Recovery 75 % (Plate heat exchanger)
	Max SFP 1.5 W/l/s
Heating system controls	1. For a single storey dwelling in which the living area is greater than 70% of total floor area, programmer, and room thermostat. 2. For any other dwelling, time, and temperature zone control, TRVs; And in all cases: Boiler interlock ErP Class V
Water use limited to 125 liters per person per day	Yes

Low energy light fittings	Fixed lighting capacity (lm) = 185 x TFA Efficacy of all fixed lighting = 100 lm/W
PV System	As designed

*Glazing g-value of less than or equal 0.4 is crucial to limit the requirements of overheating risk mitigation.

Table 20:Proposed Design performance for dwellings

11.5 Microclimate

11.5.1 Current Weather file – DYS1

The current weather file is set as London DSY-1. The below charts show the Dry-Bulb and Wet-bulb temperature variation for London DSY -1 weather file with peak dry-bulb temperature of 33.6 °C.

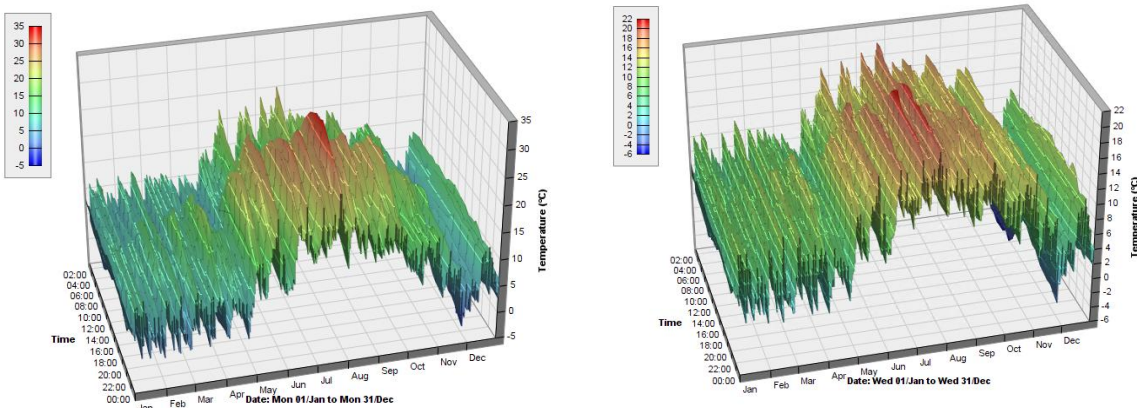


Figure 41: London DSY 2020 High dry-bulb and wet bulb temperatures profile.

The number of hours per year where the temperature higher than 26 °C is 179 hours.

Dry-bulb temperature (°C) - hours in range
> 26.00
179

Table 21: Temperature ranges London DSY weather file

11.5.2 Current Weather file – DYS2

The current weather file is set as London DSY-2. The below charts show the Dry-Bulb and Wet-bulb temperature variation for London DSY -2 weather file with peak dry-bulb temperature of 37.3°C. The development is compliant with DSY2 with marginal deviations from DSY3.

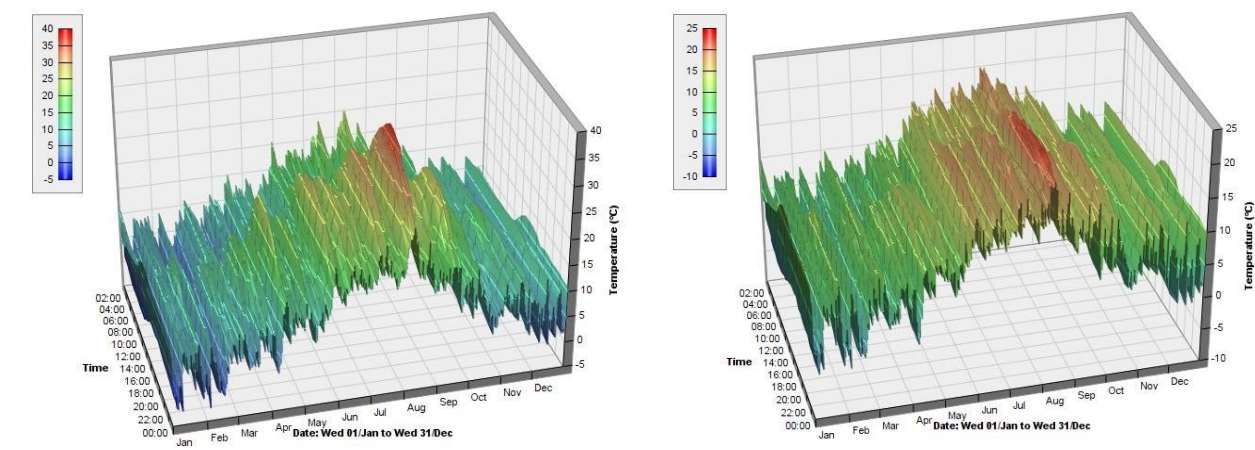


Figure 42: London DSY 2020 High dry-bulb and wet bulb temperatures profile.

The number of hours per year where the temperature higher than 26 °C is 180 hours.

Dry-bulb temperature (°C) - hours in range
> 26.00
180

Table 22: Temperature ranges London DSY weather file

11.5.3 Current Weather file – DYS3

The current weather file is set as London DSY-3. The below charts show the Dry-Bulb and Wet-bulb temperature variation for London DSY-3 weather file with peak dry-bulb temperature of 34 °C. The development is compliant with DSY2 with marginal deviations from DSY3.

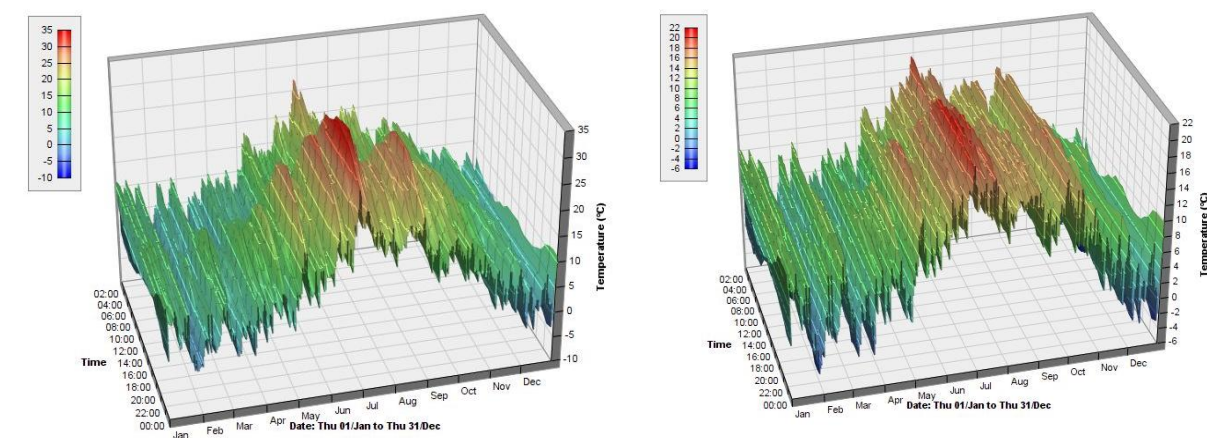


Figure 43: London DSY 2020 High dry-bulb and wet bulb temperatures profile.

The number of hours per year where the temperature higher than 26 °C is 259 hours.

Dry-bulb temperature (°C) - hours in range
> 26.00
259

Table 23: Temperature ranges London DSY weather file

11.5.4 Future weather files

Generally, there is an inherent uncertainty with respect to future climate conditions, there is no way to know which of the files will most closely match actual climate conditions during the specified period so a risk management approach to cooling, overheating, and heating system design is appropriate. In most cases, this will entail making use of more than one set of files. The uncertainty has three main sources. The first is that there is no way of knowing what future emissions of Greenhouse gases (GHG) will be. Second is the variation of the climatic prediction models and the unexpected factors that can arise in the future changing the models' predictions.

As a result of natural variability, there would be a substantial range in possible future climate conditions even if we knew precisely what future emissions would be and if we had a perfect model of the climate. This is the reason that we use multiple projections from multiple climate models, referred to as a multimodal ensemble, to explore the range of future possibilities.

The choice of future time period should be based on the design life of the building in question. For buildings with a design life of 25 years or less, obtaining a set of files for the time period closest to the end of that interval is recommended. For buildings with a design life greater than 25 years, obtaining a set of files for the time period closest to the end of that interval for low and high conditions recommended, since the difference between projections for the two becomes increasingly greater over time.

For overheating systems, running simulations at DSY high future weather file provide insight into system performance for both midpoint and upper tail warming based on the higher future emissions it assumes.

Future weather file is set as London DSY 2050 High for summer.

The below charts show the Dry-Bulb and Wet-bulb temperature variation for London DSY 2050 high weather file with peak dry-bulb temperature of 37.3 °C.

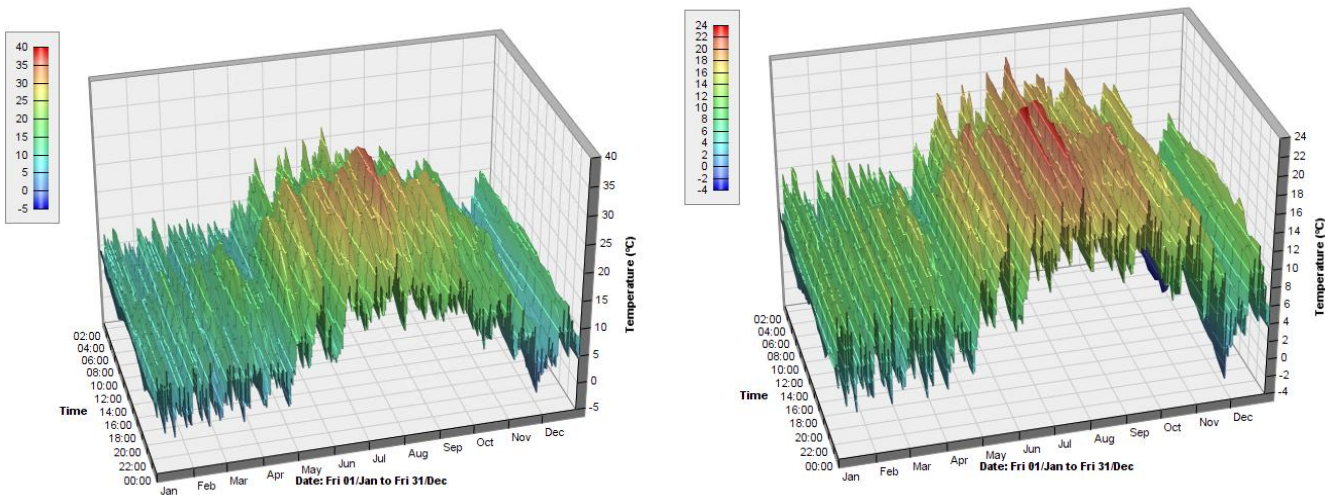


Figure 44: London DSY 2050 High dry-bulb and wet bulb temperatures profile.

11.6 Solar Exposure analysis

A solar analysis has been conducted to identify the locations where the façade solar exposure has the dominant effect annually. This establishes the design cases where the MVHR capacities are expected to be the highest.

The annual incident solar radiation on Horizontal surface is 1070 kWh/m²/year.

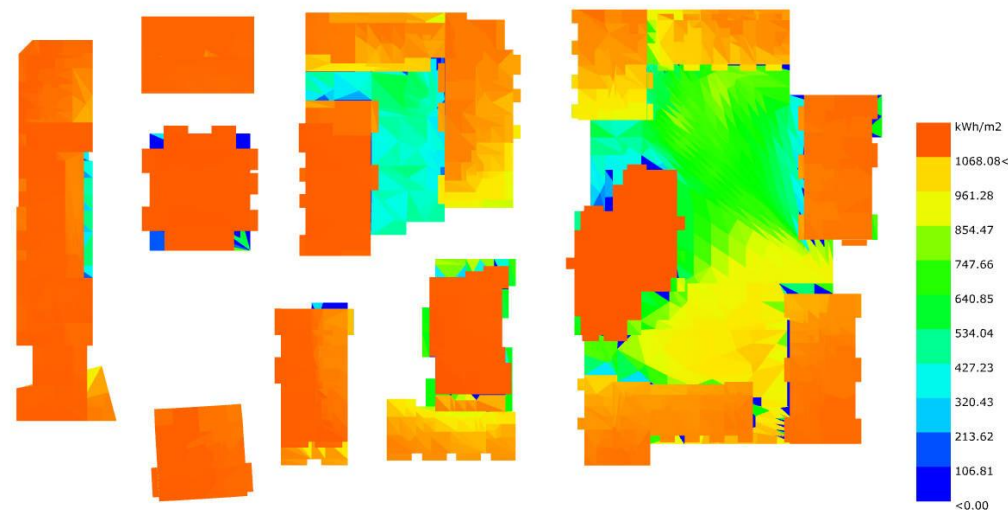


Figure 45: Solar Exposure Top View

The below figure shows the Eastern façade solar exposure with annual incident solar energy of 650 kWh/m². The Bedrooms glazing has a medium risk of overheating with low g-value glazing will assist in reducing the overheating risks.

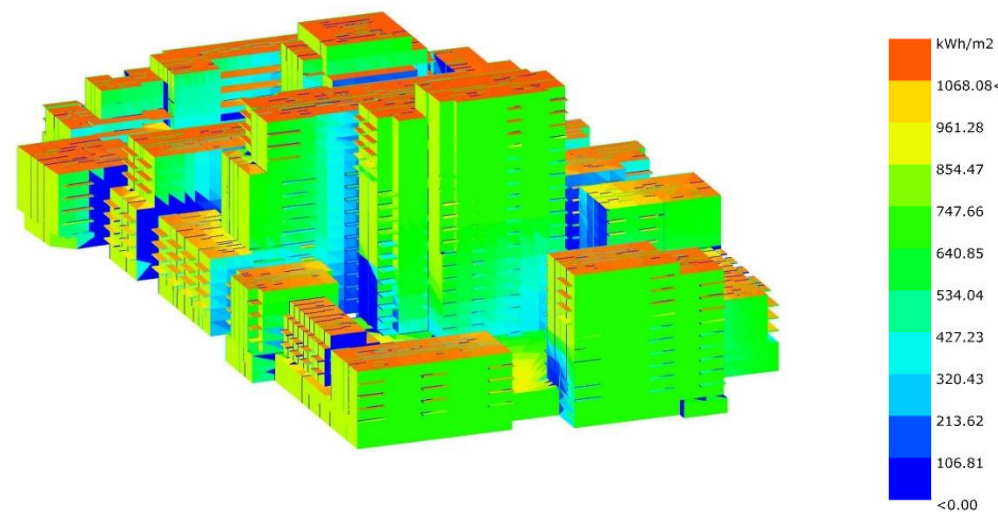


Figure 46: Eastern facade solar Exposure (kWh/m²)

The southern façade is exposed to annual solar radiation of 840 kWh/m² making the rooms on this façade subject to high overheating risks low g-value glazing or external shading structure including the balcony's shading effect is crucial to reduce the requirements of the heat removal to overcome overheating risks.

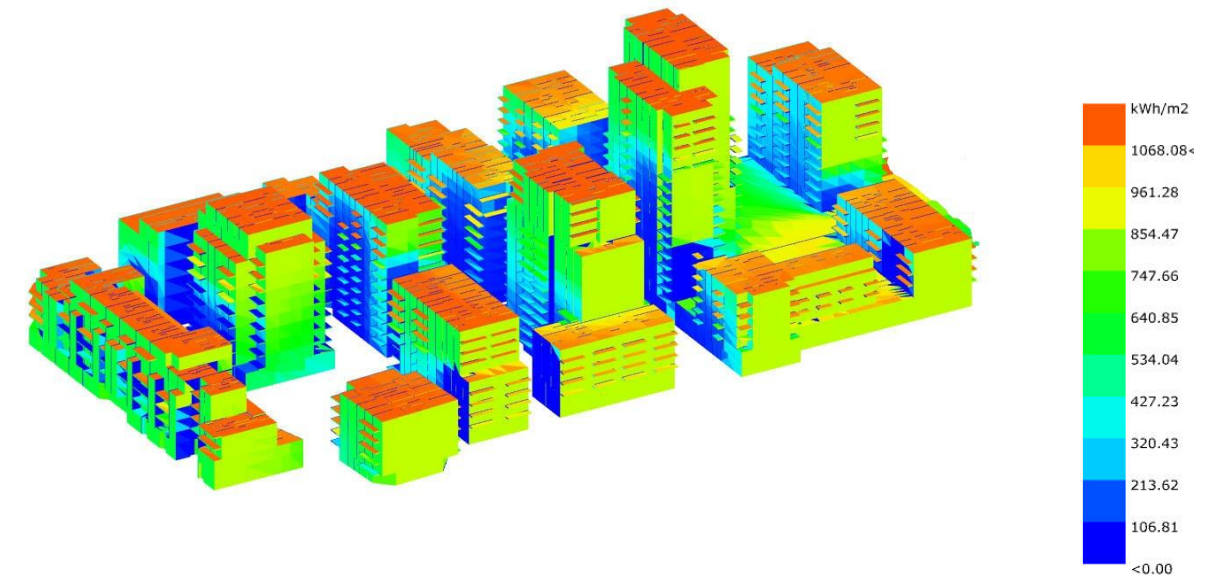


Figure 47: Southern facade solar Exposure (Hours)

The northern façade has low annual solar exposure of 330 kWh/m². G-value can be relaxed for this façade.

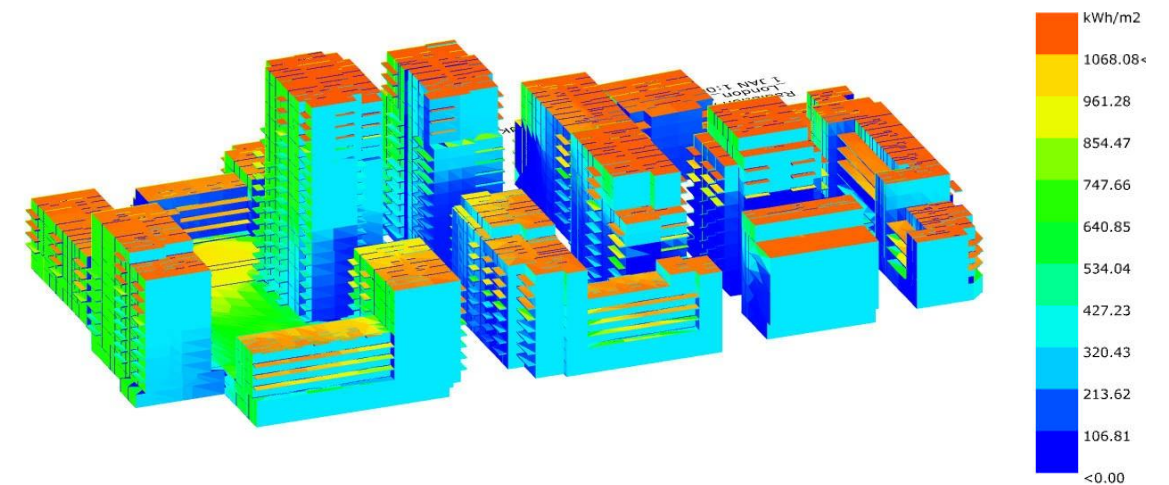


Figure 48: Northern facade solar Exposure (kWh/m²)

The western façade is partially shaded by the adjacent developments where overheating risks are expected to be less for the lower half of the building. While the floors within the upper half with experience the same annual solar exposure as eastern façade with similar overheating risks.

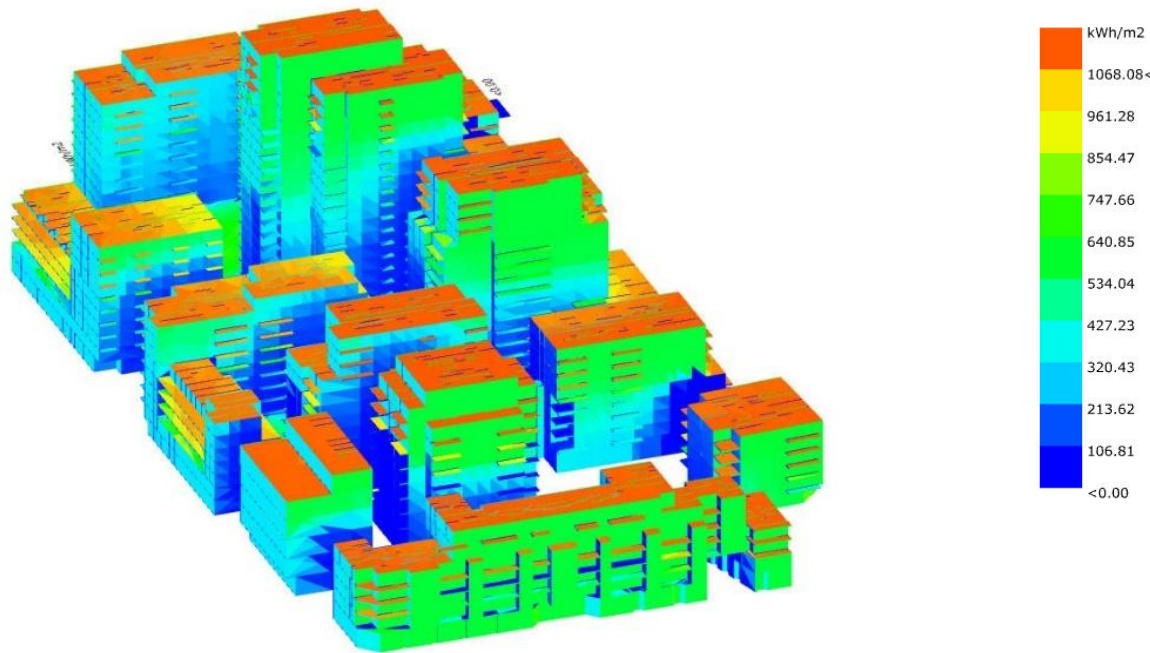


Figure 49: Western facade solar Exposure (kWh/m²)

11.7 Wind Analysis

Wind Analysis has been conducted to assess the buildings that will benefit the most from consistent flow of natural ventilation. The below figures show the wind rose for Aylesham Centre development.

The annual prevalent wind direction is Southwest with average wind speed of 3 m/s. The Summer season shows the same pattern with average wind speed of 2.82 m/s.

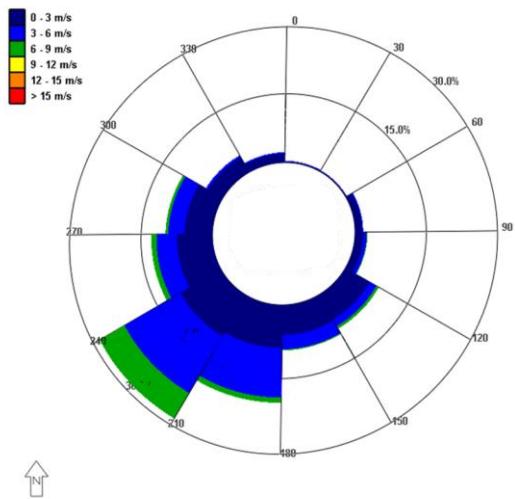


Figure 50: Winter Wind Rose

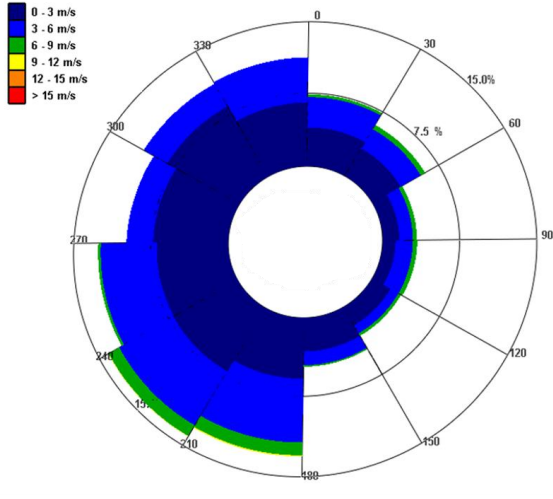


Figure 51: Summer Wind rose

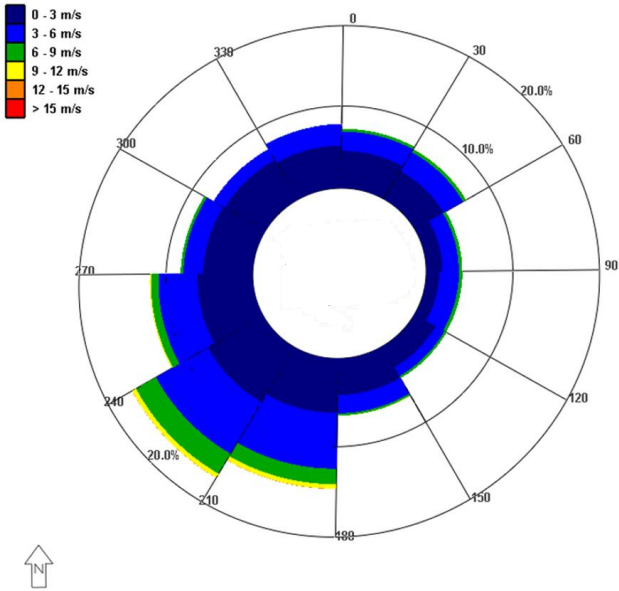


Figure 52: Annual Wind rose.

The figure below shows the wind pattern around the buildings at prevalent wind direction and speed. In a worst-case scenario, buildings upstream will have lower wind velocities, resulting in less potential for effective natural ventilation in buildings downstream (crossflow facades). The Southwestern façade will have higher rates of natural ventilation.

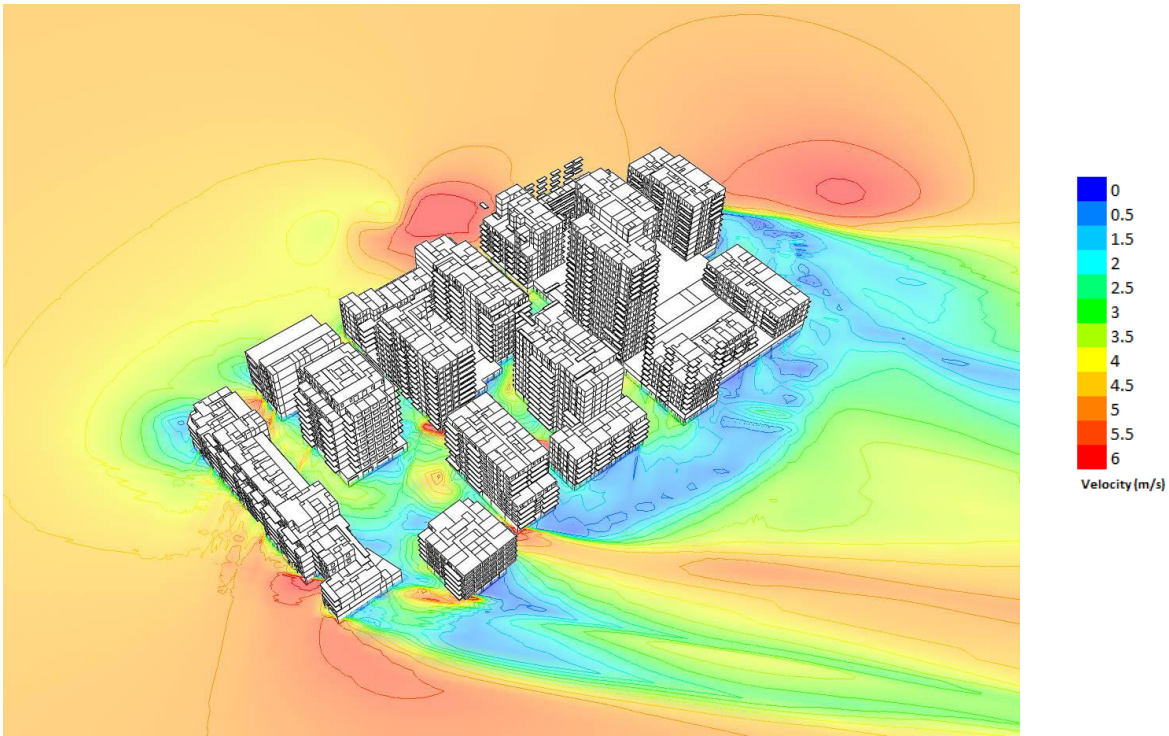


Figure 53: Air velocity contours at 2.5 m above Ground floor level.

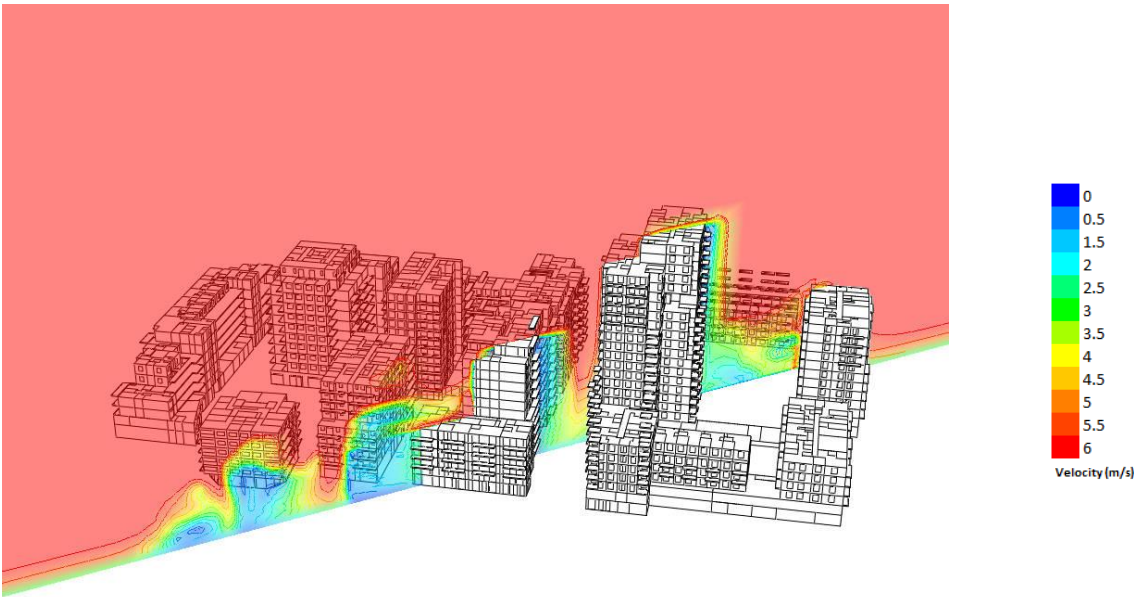


Figure 54: Wind Flow Vertical Section - Block M

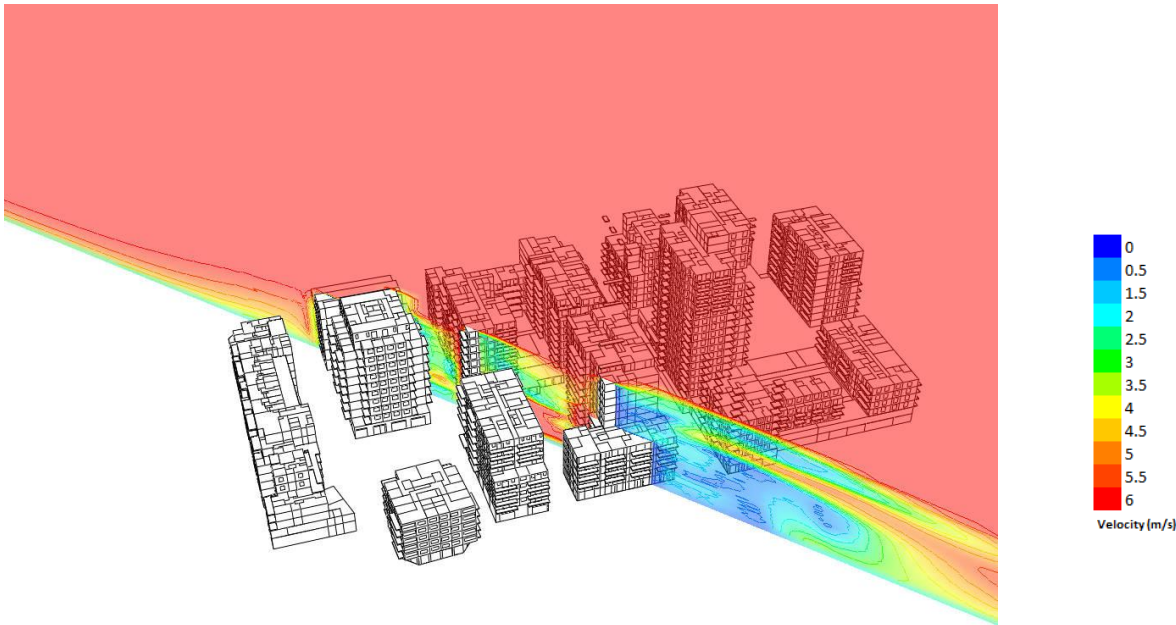


Figure 55: Wind Flow Vertical section - Block E

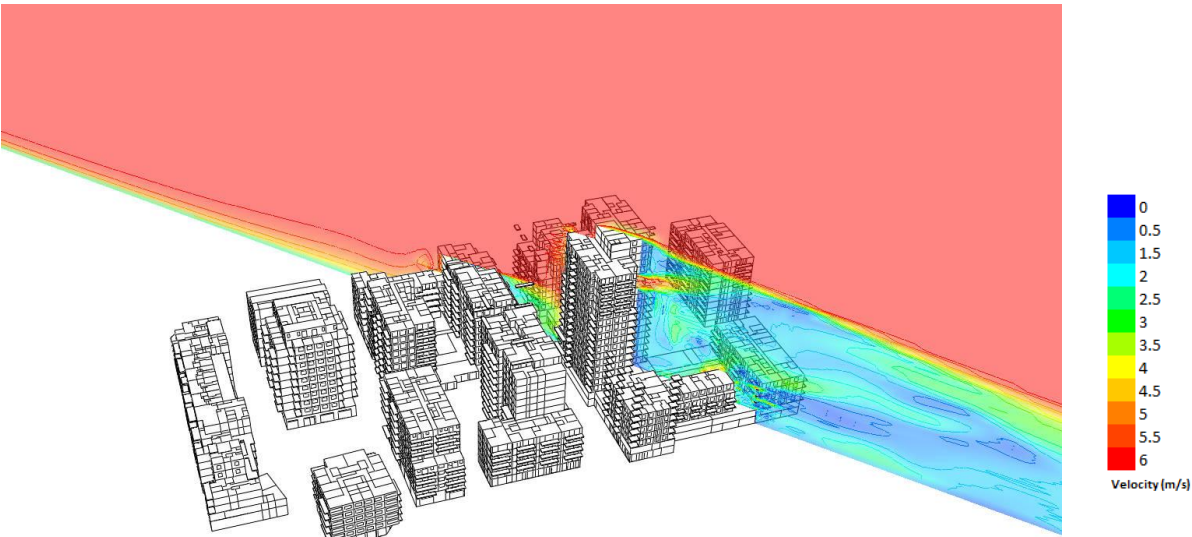


Figure 56: Wind Flow Vertical Section - Block N

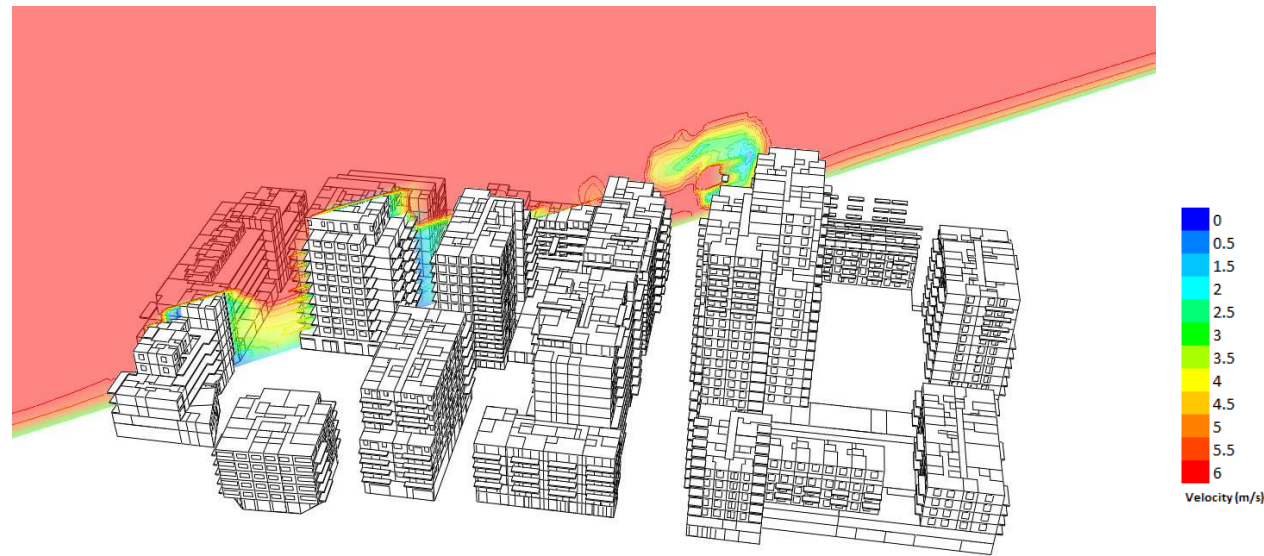


Figure 57: Wind Flow Vertical Section-Block ABC

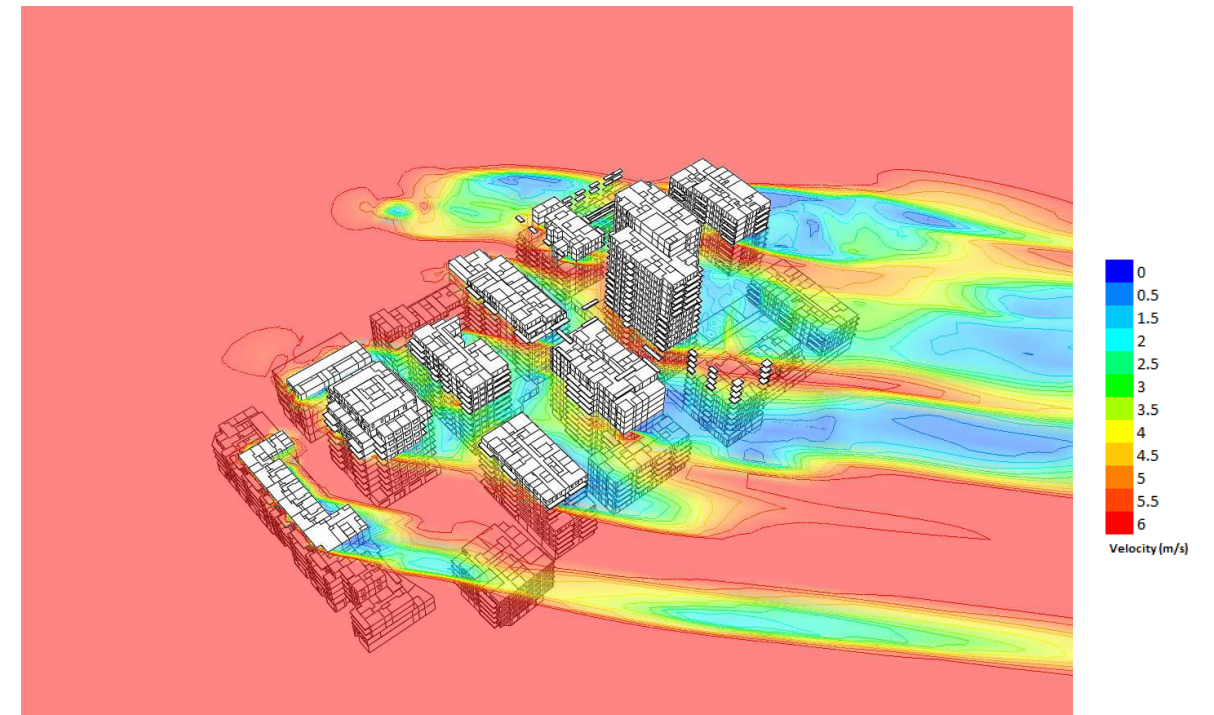


Figure 59: Wind Flow at 25 m from ground.

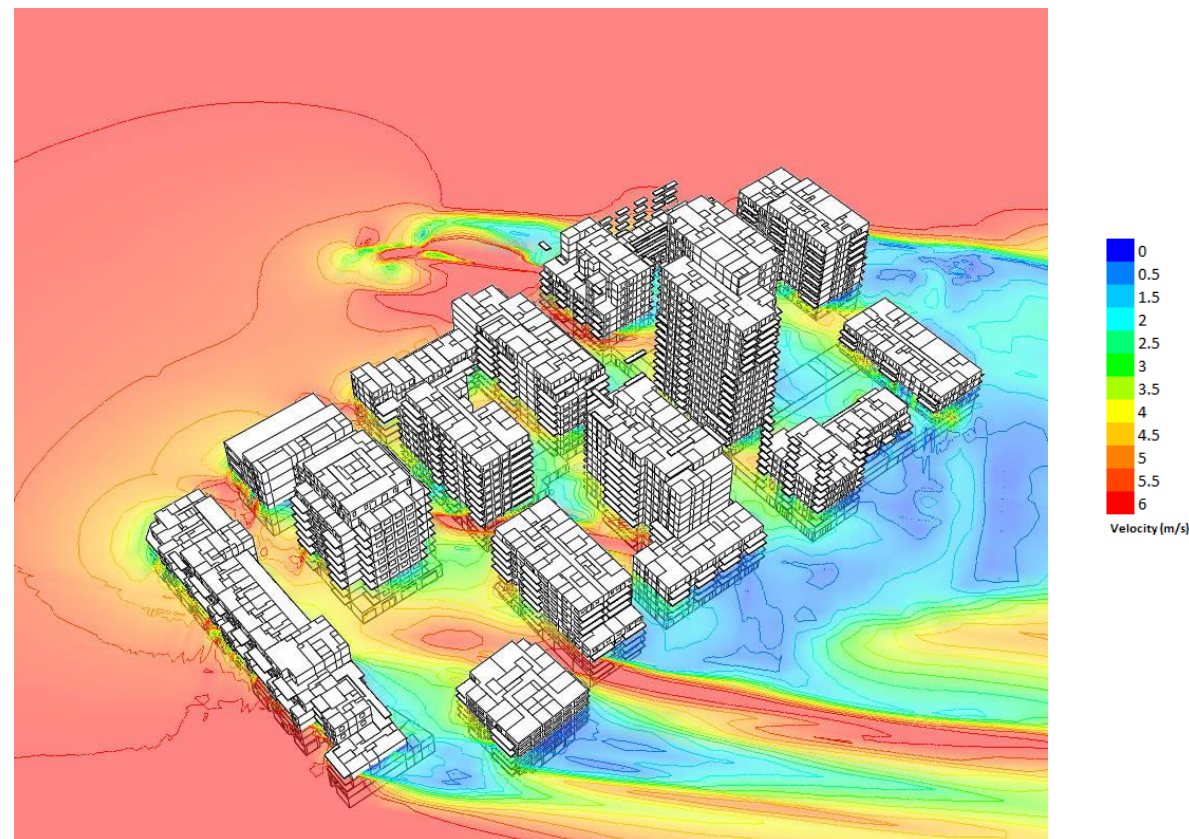


Figure 58: Wind Flow at 11.5 m from ground.

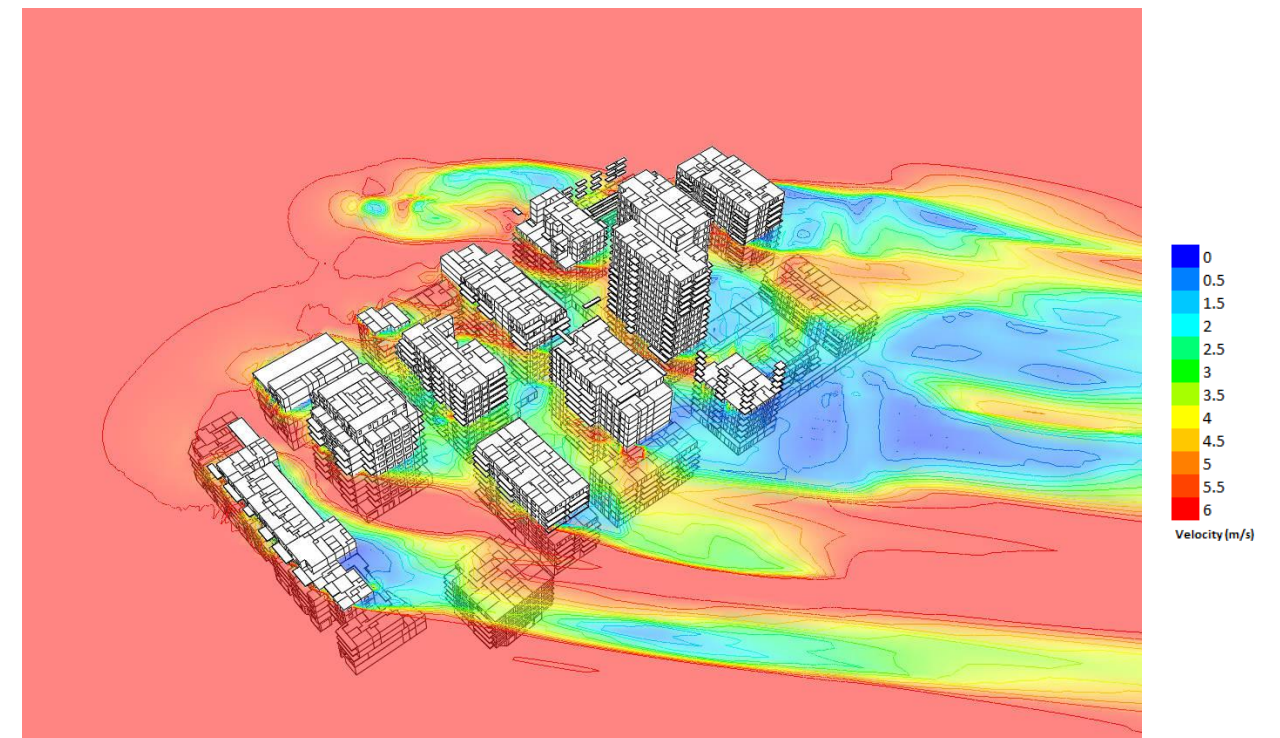


Figure 60: Wind Flow at 20.2 m from ground.

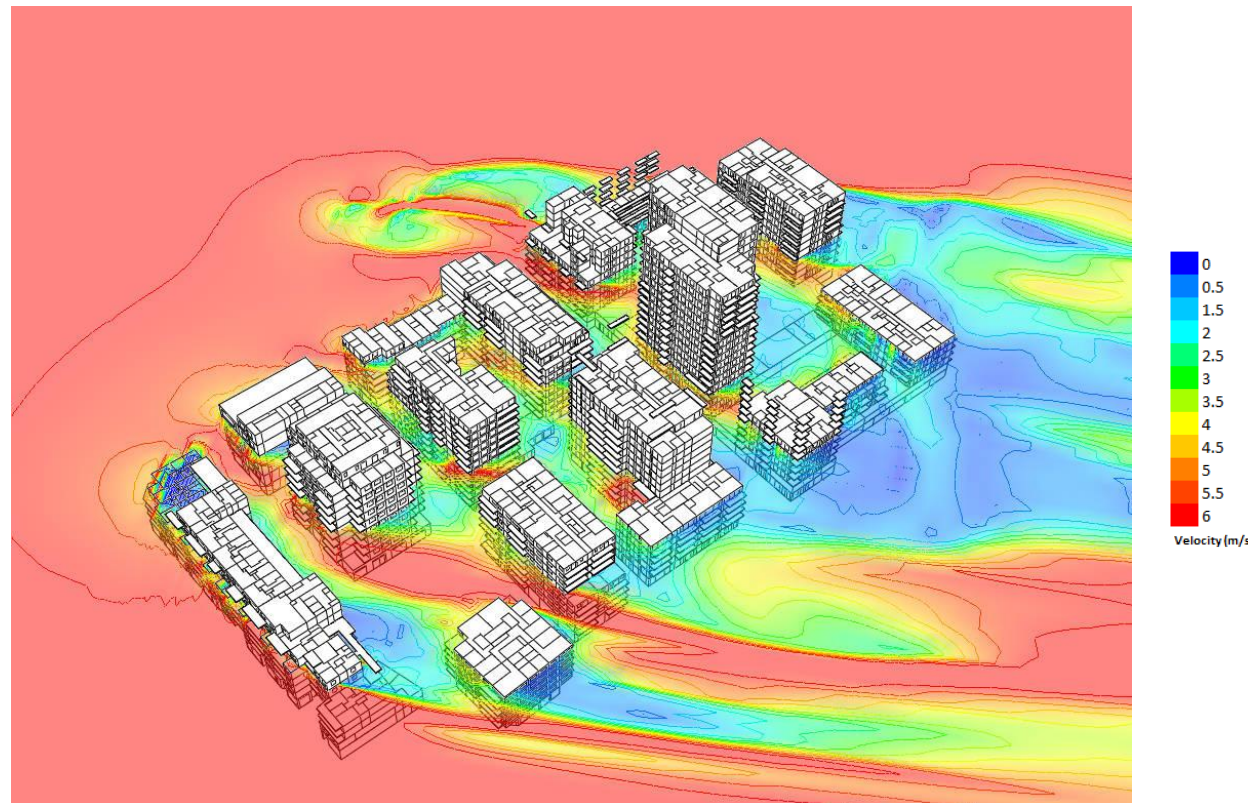


Figure 61: Wind Flow at 17.5 m from ground.

11.8 Window opening Case scenarios

The Windows effective opening area depends on the window type:

- 1- Hinged Window
- 2- Sliding (Upward -Side Ward)

The required opening width for sliding windows is straight forward as it directly equals to the linear length of the window opening. For Hinged windows, the effective area of the window opening relies on the angle of window opening, the below figure shows the received architectural concept for the windows dimensions.

Approved Document Part O, Appendix D includes a geometrical methodology to calculate the equivalent free area for hinged (Pivoted) windows noting that for Centre pivot windows, each of the two sections of the centrally hinged window should be assessed as a single side, bottom, or top hung window.

the below figures show curves that describes the relation between the angle of window opening and the effective window opening as extracted from part of data for the design window dimensions.

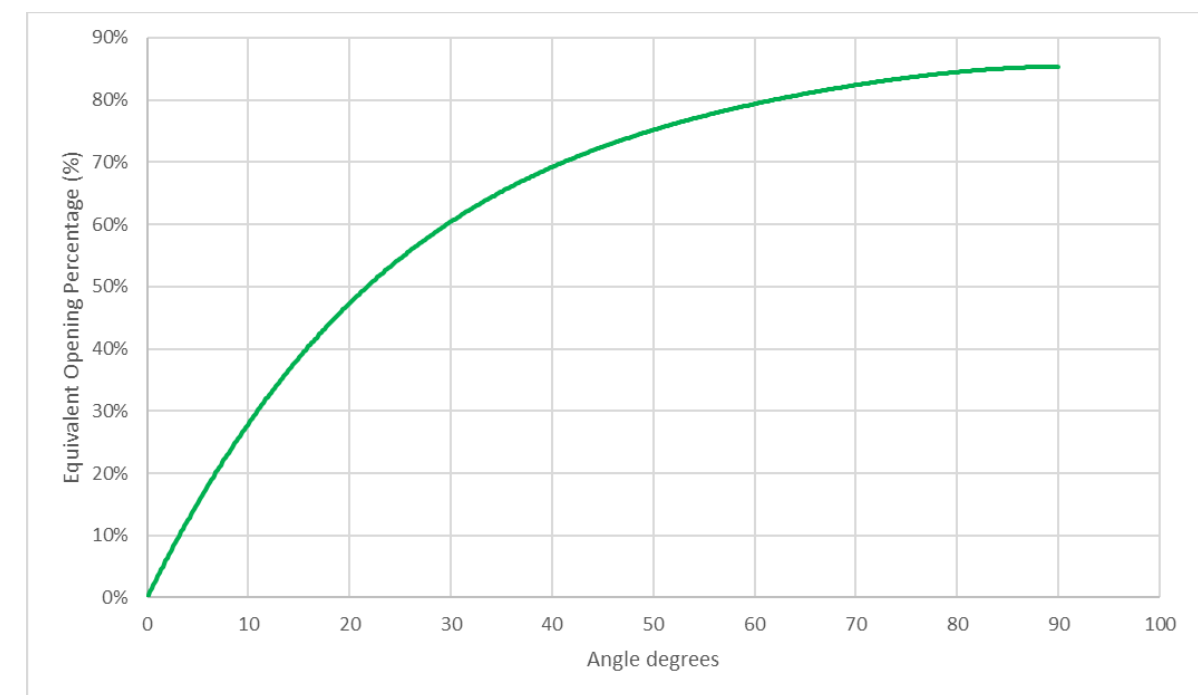


Figure 62: Opening angle and effective open area.

The modelling of the openable area in the IES is based on the effective open area as shown in the below figure. This is because the prevailing wind direction will have dominant influence on the natural ventilation efficiency through the windows. Thus, the efficiency of the natural ventilation will depend on the direction of the window opening.

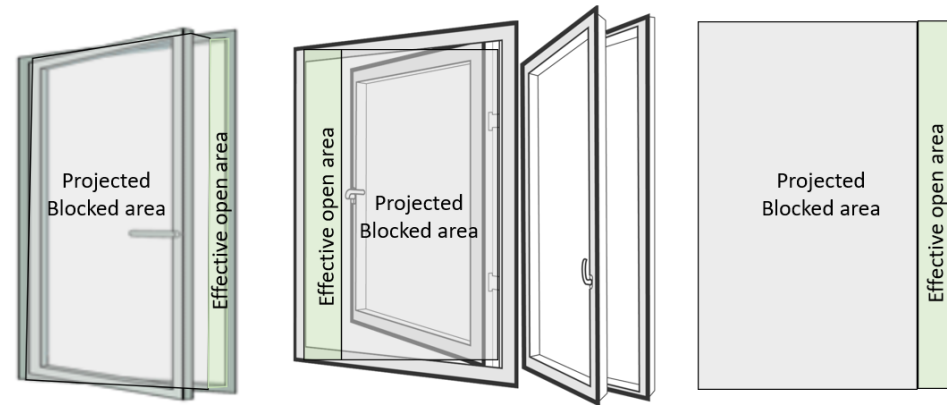


Figure 63: Effective Open area.

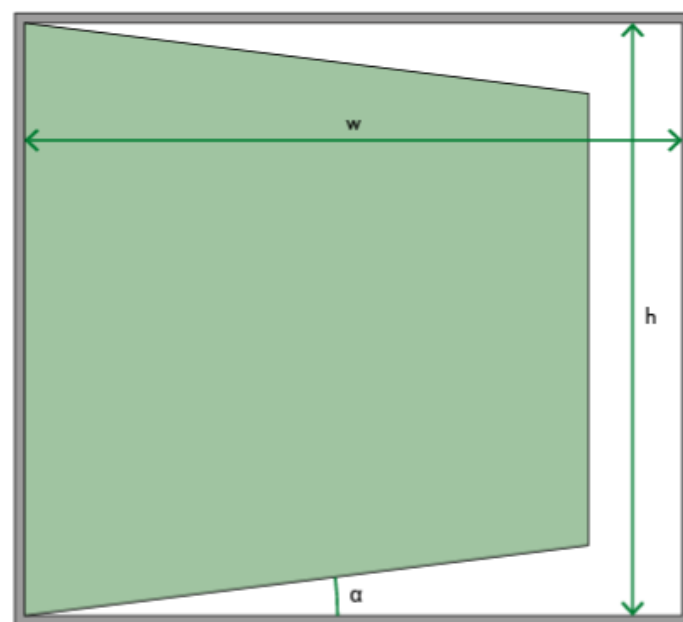


Figure 64: Window Opening dimensions.

At these angles, the natural ventilation assists through mixed ventilation model (Mechanical (MVHR) and Natural) to avoid overheating inside the apartments while effectively reducing the required maximum MVHR capacity to 1.5 Air change at current weather file as will be shown in the results section.

The MVHR cooling effect lies on the heat exchange between the hot outdoor air and the relatively cooler indoor air, resulting in 3 °C reduction in the ventilation air temperature as shown in figure 6. For future weather files, the limited window opening assists increasing the ventilation inside the spaces decreasing heat accumulation without compromising the MVHR cooling effect as will be discussed in the results section.

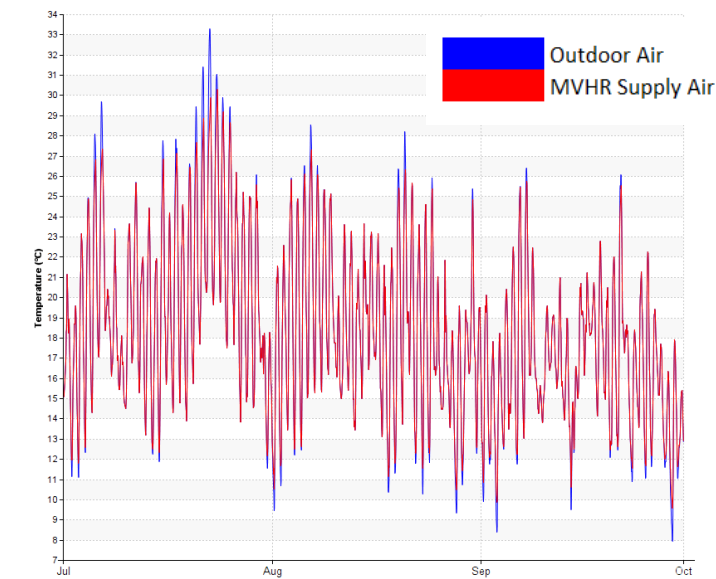


Figure 65: MVHR Cooling effect.

11.9 Acoustic Considerations

According to “29263-PTM2-Rev0-KFD Detailed Overheating and Noise - Part O” Project Technical Memorandum Aylesham centre development detailed overheating and noise – Part O – Residential Design Guide (AVO) with respect to the proposed development issued by Hann Tucker associates, high noise risks façades have been identified for Aylesham Centre as shown in the below extracts.



Façade Zones – Detailed ADO Assessment

Façade Zone	Predicted Maximum Acoustic Open Area of Bedroom Window (m²)
Zone A (Purple)	0.010
Zone B (Red)	0.010
Zone C (Orange)	0.095
Zone D (Green)	0.460

Figure 66: Project Technical Memorandum (AVO) with respect to the proposed development issued by Hann Tucker Associates-North facades.

The dynamic simulation indicates that in units with unrestricted or minimally restricted window openings, natural ventilation will mitigate overheating for most of the year. However, in scenarios with low wind speeds or wind directions that do not facilitate adequate airflow through the windows due to their location, MVHR will provide the necessary additional mitigation. This ensures that the units remain cool in most wind flow scenarios and are adaptable to heatwaves and climate change.

For units with restricted window openings due to acoustic concerns, natural ventilation is not an effective method for mitigating heat. According to the analysis, a mechanical system utilizing MVHR will be required to reduce the risk of overheating.

Figure 53 highlights apartments that should have an MVHR capacity of 2.5 ACH and those that can have a reduced MVHR capacity of 1.5 ACH with an openable window area of 0.46 m².



Figure 67 Apartments MVHR capacities

11.10 MVHR Selection

The following provides a high-level selection of MVHR units, as requested by the GLA, to verify that the required flow rates for each flat can be achieved using commercially available residential MVHR systems. At the concept stage, MVHR sizes have been coordinated with the Architect, including expected duct sizes, and this has been confirmed at the current Stage 2. During the Schematic and Detailed Design stages, further refinements will be made, with final selections expected by the end of Stage 4.

A total of 76% flats will require MVHR units with a maximum capacity of 120 l/s, while only 24% will need higher capacities. In the next design phase, apartments requiring MVHR capacities greater than 120 l/s—typically those with three or more bedrooms—can be served by either a single large unit or two smaller units. The final configuration will be determined during the schematic design stage.

The MVHR units will operate in three modes: normal ventilation, boost ventilation, and maximum mode for overheating conditions. Occupants will have the ability to set the MVHR parameters based on different ambient conditions, with controls to activate the maximum overheating flowrate on warm or hot days. This will help minimize heat accumulation, enhance air circulation within the apartment, and mitigate overheating risks.

MVHR SELECTIONS							
Block	Flat Type		Qty	Max Area without toilets (m2)	MVHR capacity	Maximum Flowrate at highest speed (l/s)	MVHR Selection Type
ABC	B	1B2P	16	50	2.5	93.75	Nuaire 95 l/s
	D	2B4P	39	64	2.5	120	Nuaire 120 l/s
	E	3B5P	10	85	2.5	159.375	FlaktGroup EIS 230
E	A	1B1P	16	35	1.5	39.375	Nuaire 40 l/s
	B	1B2P	40	50	1.5	56.25	Nuaire 60 l/s
	D	2B4P	20	58	1.5	65.25	Nuaire 70 l/s
	E	3B5P	2	75	1.5	84.375	Nuaire 85 l/s
	F	3B6P	1	100	1.5	112.5	Nuaire 115 l/s

F	E	3B5P	20	78	2.5	146.25	FlaktGroup EIS 230
	A	1B1P	11	35	1.5	39.375	Nuaire 40 l/s
	B	1B2P	23	45	1.5	50.625	Nuaire 60 l/s
	D	2B4P	23	65	1.5	73.125	Nuaire 75 l/s
	F	3B6P	14	95	1.5	106.875	Nuaire 110 l/s
G	C	2B3P	4	53	2.5	99.375	Nuaire 100 l/s
	D	2B4P	31	62	2.5	116.25	Nuaire 120 l/s
	E	3B5P	7	64	2.5	120	Nuaire 120 l/s
	F	3B6P	1	80	2.5	150	FlaktGroup EIS 230
H	C	2B3P	4	53	2.5	99.375	Nuaire 100 l/s
	D	2B4P	31	62	2.5	116.25	Nuaire 120 l/s
	E	3B5P	7	64	2.5	120	Nuaire 120 l/s
	F	3B6P	1	80	2.5	150	FlaktGroup EIS 230
J1J2	A	1B1P	16	40	2.5	75	Nuaire 75 l/s
	B	1B2P	36	50	2.5	93.75	Nuaire 95 l/s
	C	2B3P	20	60	2.5	112.5	Nuaire 115 l/s
	D	2B4P	34	64	2.5	120	Nuaire 120 l/s
	F	3B6P	23	90	2.5	168.75	FlaktGroup EIS 230
	G	2B3P Duplex L00		48	2.5	90	Nuaire 90 l/s
		2B3P Duplex L01		35	2.5	65.625	Nuaire 70 l/s
	H	2B4P Duplex L00		45	2.5	84.375	Nuaire 85 l/s
		2B4P Duplex L01		40	2.5	75	Nuaire 75 l/s
	I	3B5P Duplex L00		55	2.5	103.125	Nuaire 105 l/s
		3B5P Duplex L01		50	2.5	93.75	Nuaire 95 l/s
	J	3B6P Duplex L00		55	2.5	103.125	Nuaire 105 l/s
		3B6P Duplex L01		64	2.5	120	Nuaire 120 l/s
	K	ACC 1B1P		64	2.5	120	Nuaire 120 l/s
K	A	1B1P	8	35	2.5	65.625	Nuaire 70 l/s
	B	1B2P	36	55	2.5	103.125	Nuaire 105 l/s
	C	2B3P	8	60	2.5	112.5	Nuaire 115 l/s
	D	2B4P	15	64	2.5	120	Nuaire 120 l/s
	E	3B5P	2	85	2.5	159.375	FlaktGroup EIS 230
	F	3B6P	16	90	2.5	168.75	FlaktGroup EIS 230
	G	2B3P Duplex L00		40	2.5	75	Nuaire 75 l/s
		2B3P Duplex L01		45	2.5	84.375	Nuaire 85 l/s
	H	2B4P Duplex L00		40	2.5	75	Nuaire 75 l/s
		2B4P Duplex L01		45	2.5	84.375	Nuaire 85 l/s
	I	3B5P Duplex L00		55	2.5	103.125	Nuaire 105 l/s
		3B5P Duplex L01		55	2.5	103.125	Nuaire 105 l/s
	J	3B6P Duplex L00		60	2.5	112.5	Nuaire 115 l/s
		3B6P Duplex L01		55	2.5	103.125	Nuaire 105 l/s
	L	ACC 2B4P		85	2.5	159.375	FlaktGroup EIS 230
L	A	1B1P	30	35	2.5	65.625	Nuaire 70 l/s
	C	2B3P	4	60	2.5	112.5	Nuaire 115 l/s
	D	2B4P	42	60	2.5	112.5	Nuaire 115 l/s
	E	3B5P	2	80	2.5	150	FlaktGroup EIS 230
	F	3B6P	7	90	2.5	168.75	FlaktGroup EIS 230
M	A	1B1P	15	35	2.5	65.625	Nuaire 70 l/s
	B	1B2P	33	50	2.5	93.75	Nuaire 95 l/s
	C	2B3P	27	55	2.5	103.125	Nuaire 105 l/s

	D	2B4P	35	64	2.5	120	Nuaire 120 l/s
	E	3B5P		75	2.5	140.625	FlaktGroup EIS 230
	F	3B6P	39	95	2.5	178.125	FlaktGroup EIS 230
N	A	1B1P	6	35	2.5	65.625	Nuaire 70 l/s
	B	1B2P	53	45	2.5	84.375	Nuaire 85 l/s
	C	2B3P		55	2.5	103.125	Nuaire 105 l/s
	D	2B4P	5	75	2.5	140.625	FlaktGroup EIS 230
	E	3B5P		80	2.5	150	FlaktGroup EIS 230
P	E	3B5P	33	85	2.5	159.375	FlaktGroup EIS 230
	M	4B6P	17	105	2.5	196.875	FlaktGroup EIS 230
	L	ACC 2B4P		85	2.5	159.375	FlaktGroup EIS 230
Q	B	1B2P	4	45	2.5	84.375	Nuaire 85 l/s
	D	2B4P	21	60	2.5	112.5	Nuaire 115 l/s
	F	3B6P	2	75	2.5	140.625	FlaktGroup EIS 230

Refer to Appendix for the selected MVHR datasheets.

11.11 TM59 Overheating analysis Results

a. Natural Ventilation

Compliance for predominately naturally ventilated spaces is based on passing both of the following two criteria:

- a) For living rooms, kitchens, 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 per cent of occupied hours. (CIBSE TM52 Criterion 1: Hours of exceedance).
- b) For bedrooms only: to guarantee comfort during the sleeping hours the operative temperature in the g bedroom from 10 pm to 7 am 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, so 33 or more hours above 26 °C will be recorded as a failure).

The Dynamic simulation shows that all spaces for all buildings fails CIBSE TM 59 Criteria for naturally ventilated spaces for the current weather file based on the restriction of window opening as noted in the acoustic consideration section.

b. Current Weather file

- i. Mixed Mode Ventilation (Mechanical + Natural)

The results show MVHR 1.5 ACH (Overheating Mode) + 0.46 m² openable window for all floors where windows are allowed to open, will comply with TM 59 Criteria. The below table shows the average frequency of opening the windows per façade which is reported as the annual occupied hours per TM59.

Orientation	Average number of hours when windows required to open for overheating mitigation
North	70 hrs*
East	110 hrs
West	110 hrs
South	210 hrs

Table 24: Average number of hours when windows required to open for overheating mitigation.

*No. of Hours at night-time for Bedrooms needed for overheating mitigation.

For detailed results please refer to Appendix G

ii. Mechanical ventilation- MVHR 2.5 ACH (Overheating Mode) + closed window

For spaces where windows are not suitable to be opened for acoustic considerations, The results shows that all MVHR with 2.5 ACH (Overheating mode) is adequate to comply with TM 59 Criteria.

For detailed results please refer to Appendix G.

iii. Future Weather file

For future weather files and potential heatwaves based on London CIBSE DSY2, DSY3 and DSY2050 high weather files (25 Years), the results show that the current strategy results in compliance for DSY2 with limited instances of marginal non-compliance in DSY3 and marginal non-compliance for some of the apartments in the future weather file scenario. Noting that it is not mandatory to comply with future weather files cases, however, it is worth to study as part of potential future proofing option of the development.

For detailed results please refer to Appendix G.

iv. Communal Corridors

The inclusion of corridors in the overheating analysis is mandatory where community heating pipework runs through them. The overheating test for corridors should be based on the number of annual hours for which an operative temperature of 28 °C is exceeded. If an operative temperature of 28 °C is exceeded for more than 3% of the total annual hours, then this should be identified as a significant risk within the report.

Based on the current stage level of details the proposed corridors in all buildings have low risk of overheating complying with TM59 criteria. This is to be further verified as more details regarding heating pipes routing and insulation become available.

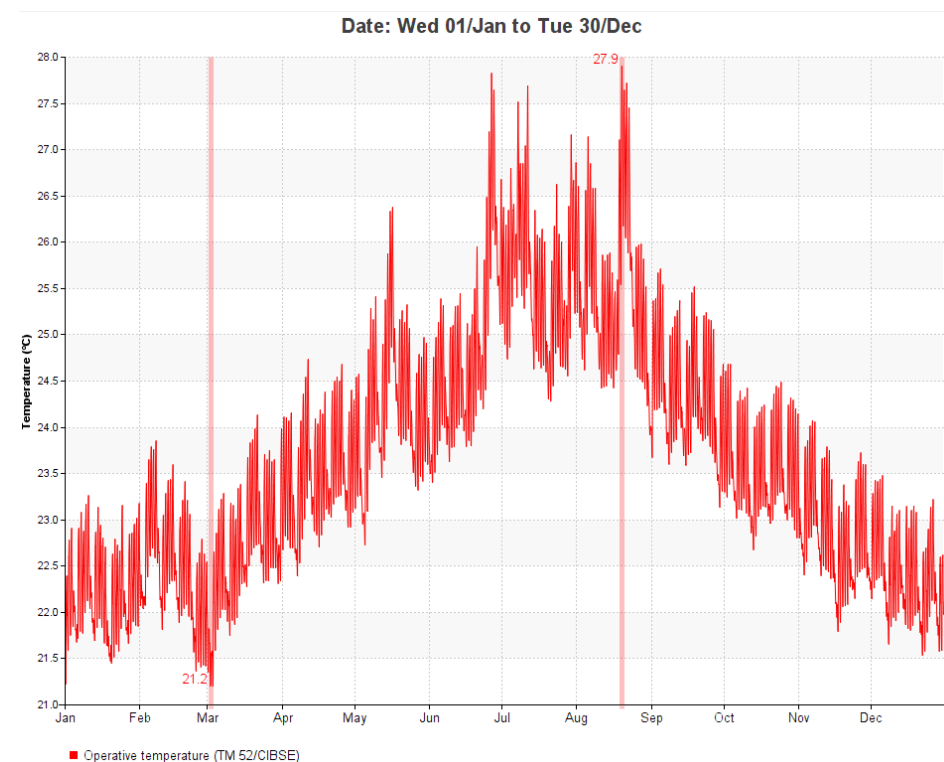


Figure 68: Corridors Operative temperature.

11.12 Future minimising future dwelling overheating risk

As part of the handover pack, occupants will receive guidance on minimizing future overheating risks in their dwelling. This guidance will help residents mitigate overheating during heat waves and future rising temperatures by following these recommendations that have been defined based on the cooling hierarchy:

1. Minimizing Internal Heat Gains

- Avoid prolonged use of heat-generating appliances such as ovens and stoves. Instead, opt for meals that require minimal cooking on particularly hot days.

2. Managing Sunlight and Heat Exposure

- Use internal blinds to reduce heat gain, especially when the property is unoccupied during midday hours.
- While blinds help in blocking solar heat, it is advisable to balance their use with reducing artificial lighting to maintain an optimal indoor environment.

3. Passive Ventilation Strategies

- For apartments where window opening is convenient, maximize natural ventilation by fully opening windows.
- In cases where external noise is a concern, occupants may still choose to open windows as needed. However, for apartments where noise levels are intolerable for the occupants, the mechanical ventilation system has been designed with a higher capacity to allow sufficient airflow while keeping windows closed.

4. Optimizing Mechanical Ventilation operation (MVHR)

- Operate the MVHR system at its maximum overheating mode (highest airflow rate) for an extended period before noon to prevent excessive heat buildup during peak temperature hours.
- During prolonged heat waves, keep the MVHR running at higher speeds, particularly at night, to take advantage of cooler nighttime temperatures and improve indoor air circulation for better thermal comfort.

This guidance will be continuously reviewed during the next design phases, ensuring that the final handover documentation provides comprehensive details on system operation and best practices for maintaining indoor comfort.

12 Conclusion

The energy strategy proposed for the Aylesham Centre development aligns with the stringent energy policies at national, regional, and local levels. By incorporating high levels of insulation, efficient systems, and renewable energy sources, the development significantly reduces energy demand and carbon emissions, along with provisions for future connections to local heat networks, further underscores the project's commitment to sustainability.

- The energy demand assessment for the residential areas indicates that the carbon-saving measures in the energy strategy achieve an on-site reduction of 62% for the Be Green scenario. Additionally, the energy demand assessment for the non-residential areas shows that the carbon-saving measures outlined in the energy strategy provide an overall on-site reduction of 36.9% for commercial areas and a 37.5% reduction for communal corridors compared to Building Regulations Part L. This exceeds the minimum 35% target for the Be Green scenario.

The Dynamic simulation shows that all spaces for all buildings fails CIBSE TM59 Criteria for naturally ventilated spaces for the current weather file based on the restriction of window opening as noted in the acoustic consideration section.

The Overheating results demonstrate MVHR 1.5 ACH (Overheating Mode) + 0.46 m² openable window for all floors where windows are allowed to open, will comply with TM 59 Criteria.

For spaces where windows cannot be opened due to acoustic considerations, the overheating results demonstrate that all spaces for all buildings will meet the necessary overheating assessment requirements by installing MVHR systems with a 2.5 ACH (overheating mode). The overheating analysis shows that the current strategy results in compliance for DSY1 for apartments spaces.

Based on the current stage level of details the corridors have low risk of overheating complying with TM 59 criteria. This is to be further verified as more details regarding heating pipes routing and insulation become available.

For future weather files and potential heatwaves based on London CIBSE DSY2, DSY3 and DSY2050 high weather files (25 Years), the overheating analysis shows limited instances of marginal exceedance in DSY 3 and 2 and marginal exceedance for some of the apartments in the future weather file scenario. Noting that it is not mandatory to comply with future weather files cases, however, it is worth to study as part of potential future proofing option of the development.

APPENDIX A SAPS Compliance Be Lean

12.1 Block ABC

Block Compliance



Block Reference	Block ABC_Be Lean 07042025	Issued on Date	07/04/2025
Block Name	Block ABC		
Calculation Type	New Build (As Designed)		
Assessor Details	Mr. Mohamed Mekkawy	Assessor ID	Q340-0001
Client	Berkeley Homes, Berkeley Homes, 21 Leman St, London , E1 8NZ		

Block Compliance Report - DER

Block Reference: Block ABC_Be Lean 07042025	Block Name: Block ABC			
Property-Assessment Reference	Floor area (m ²)	DER (kgCO ₂ /m ²)	TER (kgCO ₂ /m ²)	% DER/TER
27 BA-01-01_Copy_Copy_Copy - 00001_Copy_Copy_Copy_Copy	87.00	17.14	15.39	-11.37 %
27 BA-01-02_Copy_Copy_Copy - 00001_Copy_Copy_Copy	53.00	15.53	15.86	2.08 %
27 BA-02-01_Copy_Copy_Copy - 00001_Copy_Copy_Copy_Copy	87.00	14.31	13.86	-3.25 %
27 BA-02-02_Copy_Copy_Copy - 00001_Copy_Copy_Copy	53.00	12.91	14.35	10.03 %
27 BA-03-02_Copy_Copy_Copy - 00001_Copy_Copy_Copy	53.00	12.91	14.35	10.03 %
27 BA-04-02_Copy_Copy_Copy - 00001_Copy_Copy_Copy	53.00	12.91	14.35	10.03 %
27 BC-02-04_Copy_Copy_Copy - 00001_Copy_Copy_Copy_Copy	81.70	12.22	15.40	20.65 %
27 BC-03-04_Copy_Copy_Copy - 00001_Copy_Copy_Copy_Copy	81.70	9.71	13.88	30.04 %
A 27 BA-01-03_Copy_Copy_Copy - 00001_Copy_Copy_Copy	72.00	11.99	13.58	11.71 %
A 27 BA-02-03_Copy_Copy_Copy - 00001_Copy_Copy_Copy	72.10	9.48	11.98	20.87 %
A 27 BA-03-03_Copy_Copy_Copy - 00001_Copy_Copy_Copy	72.10	9.48	11.98	20.87 %
A 27 BA-04-03_Copy_Copy_Copy - 00001_Copy_Copy_Copy	72.10	9.48	11.98	20.87 %
A 27 BC-02-03_Copy_Copy_Copy - 00001_Copy_Copy_Copy	67.00	12.39	15.08	17.84 %
A 27 BC-03-03_Copy_Copy_Copy - 00001_Copy_Copy_Copy	67.00	10.08	13.57	25.72 %
B 27 BA-01-03_Copy_Copy_Copy - 00001_Copy_Copy_Copy	72.00	11.99	13.58	11.71 %
B 27 BA-02-03_Copy_Copy_Copy - 00001_Copy_Copy_Copy	72.10	9.48	11.98	20.87 %
B 27 BA-03-03_Copy_Copy_Copy - 00001_Copy_Copy_Copy	72.10	9.48	11.98	20.87 %
B 27 BA-04-03_Copy_Copy_Copy - 00001_Copy_Copy_Copy	72.10	9.48	11.98	20.87 %
B 27 BC-02-03_Copy_Copy_Copy - 00001_Copy_Copy_Copy	50.00	15.66	16.42	4.63 %
B 27 BC-03-03_Copy_Copy_Copy - 00001_Copy_Copy_Copy	50.00	13.27	14.94	11.18 %
BA-01-01_Copy_Copy_Copy - 00001_Copy_Copy_Copy	87.00	17.08	15.36	-11.20 %
BA-01-04_Copy_Copy_Copy - 00001_Copy_Copy_Copy	52.00	14.24	15.19	6.25 %