HOARE LEA

Stag Brewery, Mortlake

Energy Strategy

For Reselton Properties

March 2022

Former Stag Brewery.
London.
Reselton Properties Limited.

SUSTAINABILITY
ENERGY STRATEGY

REVISION 00 – 11 MARCH 2022

Audit sheet.

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00	11/03/2022	For submission	J. Young	E. Jolly	G. Jones

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Contents.

Executive summary.

This Energy Strategy has been prepared by Hoare Lea on behalf of Reselton Properties Limited ("the Applicant") in support of two linked planning applications ("the Applications") for the comprehensive redevelopment of the former Stag Brewery Site in Mortlake ("the Site") within the London Borough of Richmond upon Thames (LBRuT).

The proposed new scheme.

This 3rd iteration of the scheme seeks to respond directly to the Mayors' reasons for refusal and in doing so also addresses a number of the concerns raised by the LBRuT.

The amendments can be summarised as follows:

- A revised energy strategy is proposed in order to address the London Plan (2021) requirements.
- Several residential blocks have been reduced in height to better respond to the listed buildings along the Thames riverfront and to respect the setting of the Maltings building, identified as a Building of Townscape Merit (BTM) by the LBRuT;
- Reconfiguration of layout of Buildings 20 and 21 has been undertaken to provide lower rise buildings to better respond to the listed buildings along the Thames riverfront; and
- Chalkers Corner light highways mitigation works.

The school proposals (submitted under 'Application B') are unchanged. The Applicant acknowledges LBRuT's identified need for a secondary school at the Site and the Applications continue to support the delivery of a school. It is expected that the principles to be agreed under the draft Community Use Agreement (CUA) will be the same as those associated with the refused school application (LBRuT ref: 18/0548/FUL, GLA ref: GLA/4172a/07).

Overall, it is considered that together, the Applications respond successfully to the concerns raised by the GLA which also reflect some of the concerns raised by stakeholders in respect of the previous schemes and during pre-application discussions on the revised Proposed Development. As a result, it is considered that the scheme now represents a balanced development that delivers the principle LBRuT objectives from the Site.

Policies & drivers.

This document summarises the pertinent policies and requirements applicable to the Proposed Development. Of these, the principal targets are summarised below as set out in the adopted London Plan (2021) and London Borough of Richmond upon Thames (LBRuT) Local Plan (2018):

- All major development will achieve net zero carbon compared to the Part L baseline, with a minimum of 35% reduction being met on site. Remaining emissions to be offset via carbon offset payment to the Local Authority.
- Non-regulated emissions should be calculated and minimised.
- Residential development should achieve at least a 10% carbon emission reduction at the Be Lean stage of the energy strategy.
- Non-residential development should achieve at least a 15% carbon emission reduction at the Be Lean stage of the energy strategy.
- Whole life-cycle carbon emissions should be calculated and demonstrate actions to reduce.
- Carbon emissions are calculated using proposed SAP10 carbon factors.
- Combined Heat and Power (CHP) engines can only be considered where there is a case to enable the delivery of an areas-wide heat network and meet the development's electricity demands and provide demand response to the local electricity network.

Approach

The residential elements of the Proposed Development have been assessed using Part L1A 2013 approved SAP v9.92 (2012) methodology. Non-residential spaces have been modelled using Part L2A compliant software or benchmarked using Part L 2013 compliant results from similar building types. This has provided the basis for the analysis of the designed building and services and the consideration of all applicable passive design, energy efficiency and Low or Zero Carbon (LZC) technologies.

The assessment makes use of the Mayor of London's Energy Hierarchy and the cooling hierarchy from the London Plan (2021).

Summary of changes in this Energy Strategy.

The Proposed Development has met the relevant planning policy targets set by the Greater London Authority (GLA) and London Borough of Richmond upon Thames (LBRuT) through energy efficient design, provision of a centralised energy strategy with all thermal demand met via Air Source Heat Pumps (ASHP), and consideration of roof top Photovoltaic (PV) panels across the site. Where the carbon emission target is not met on site, the shortfall will be offset by a single carbon offset payment to the local authority.

The key change to the energy strategy sees thermal demand met via on site, centralised ASHP which is considered a low carbon technology which allows the site to benefit from continuous decarbonisation of the national grid throughout its lifetime. The previous strategy included the installation of an energy centre which housed combined heat and power (CHP) plant to serve the thermal demand. CHP is a combustion technology that uses fossil fuel. This plant type no longer provides the carbon reductions previously anticipated due to decarbonisation of the grid and can have negative impacts on local air quality, therefore this approach was revised. Furthermore, this "all-electric" approach removes combustion plant on site which provides additional benefit to local air quality.

Be Lean - Passive design & energy efficiency measures.

Passive design measures to be implemented at the Proposed Development include:

1. Suitable glazing ratio and glass g-value (0.29) to balance heat losses, heat gains and daylight ingress.
2. Fabric insulation levels achieving improvements over Building Regulations Part L (2013) requirements of 25% - 100%.
3. Fabric air permeability achieving improvements over Building Regulations Part L (2013) requirements of 75% and 70% for dwellings and commercial spaces respectively.

Energy efficiency measures to be implemented at the Proposed Development include:

1. Efficient space heating systems with zonal, programmable and thermostatic controls, with separate programmer for hot water.
2. Efficient low-energy lighting throughout all dwellings. External and communal lighting will be coupled to daylight and presence detection sensors to minimise unnecessary use.
3. Efficient mechanical ventilation with heat recovery which will limit the need for space heating in winter months, aid the mitigation of high internal temperatures in summer months (where openable windows cannot be used due to ambient acoustic conditions), and maintain good indoor air quality.
4. Appropriately insulated pipework and ductwork (and air sealing to ductwork) to minimise losses and gains.
5. Variable speed pumps and fans to minimise energy consumption for distribution of services

The above measures have been applied within the Part L assessments carried out to support the detailed elements of the application. The above measures would also be considered for the areas within the outline application of the Proposed Development.

Application A – Whole site
It is anticipated that the areas within the of the Application A site will perform to a comparable level to the Part L calculations undertaken for Development Area 1.

Based on this level of performance the areas of the Proposed Development would be expected to achieve ~10% reduction in CO_2 emissions beyond the requirements of the SAP10 gas boiler 'baseline' on a site wide basis.

The Site Plan showing the Application and associated Development Areas are shown in Figure 1 within the Introduction.

Application A – Development area 1
Development Area 1 includes plots 1-12 and consists of mixed-use tenure which is residentially led. A proportion of the residential areas consist of the refurbishment of existing buildings. All other areas are new construction.

These measures are anticipated to achieve 12.06% reduction in regulated CO_2 emissions beyond the requirements of the Building Regulations SAP10 'baseline' for the areas within the application. When considering the residential elements alone, it is anticipated that a 12.33% reduction in CO_2 emissions beyond the requirements of the Building RegulationsSAP10 'baseline' will be achieved.

Furthermore, it has been calculated based on the parameters outlined within this report and the SAP calculations undertaken that the dwellings will improve upon the requirements of Target Fabric Energy Efficiency (TFEE) included in Part L1A 2013.

As a result, the Proposed Development will achieve compliance with the requirements of the Building Regulations Part L 2013 through passive design and energy efficiency measures alone.

Application A – Development area 2
Development Area 2 includes plots 13-21 and consists of solely of new construction residential development.

The passive design measures are capable of achieving a ~5% reduction in regulated CO_2 emissions to demonstrate compliance with the Building Regulations SAP10 'baseline' for the areas within the application at the Be Lean stage. Opportunities to implement passive design measures to achieve a reduction in CO_2 emissions at the Be Lean stage would be considered in detailed design.

As a result, the Proposed Development will be capable of compliance with the requirements of the Building Regulations Part L 2013 through passive design and energy efficiency measures.

Application B - School
These measures are anticipated to achieve ~15% reduction in regulated CO_2 emissions beyond the requirements of the SAP10 gas boiler 'baseline' for the school.

As a result, the Proposed Development will achieve compliance with the requirements of the Building Regulations Part L 2013 through passive design and energy efficiency measures.

Be Clean - Infrastructure and low-carbon supply of energy.

The Proposed Development is proposing a staggered approach across the two Development Areas of Application A. The overall emissions are calculated using the SAP 10 carbon factors (as per October 2020 GLA guidance). These are the carbon factors used in the submitted energy strategy.

The previous application sought to install an Energy Centre to house CHP and gas boilers to serve the thermal demand of the Proposed Development. However, following the discussions with the GLA, LBRuT and with consideration of the changing energy landscape, it is recognised that this strategy is no longer appropriate to minimise climate change impact and create neutral or positive impact on local air quality.

As such, the energy strategy produced to support this application seeks to utilise an all-electric strategy in the form of Air Source Heat Pumps, to meet thermal demand. Therefore, no additional savings are demonstrated at this stage of the hierarchy.

Be Green - On-site renewable energy generation.

The inclusion of on-site renewable energy generation has been assessed.

Application A – Whole site
It is anticipated that a PV array would be provided on the roof area of the Proposed Development. Suitable roof space has been identified for Development area 1 (see following section for full detail). Roof allocation for Development Area 2 will be determined during Reserved Matters Application. However, for the purpose of this submission, it is assumed that at least a similar area will be allocated. Therefore, the total assumed area for Application A is up to 3,760m^2. Based on the solar irradiance data for London, an array of this size could generate approximately 556,500kWh of electricity per annum, reducing CO_2 emissions by ~128 tonnes per annum. This is equivalent to a reduction in regulated CO_2 emissions of ~10% beyond the SAP10 gas boiler 'baseline' for the anticipated emissions of the Proposed Development (Application A). Further opportunities to increase the area of the PV array will be considered at the detailed design stage.

PV is therefore anticipated to be a suitable addition to the Proposed Development in pursuit of further reductions in regulated CO_2 emissions.

In response to the previous application, comments received from the GLA and LBRuT and the changing energy landscape, this energy strategy proposes the installation of community Air Source Heat Pumps (ASHP) to supply all thermal demand on site. At this stage of design, a target coefficient of performance (COP) for the heat pump of 3.0 has been used. The use of ASHP for the Proposed Development demonstrates a potential saving of ~882 tonnes of regulated carbon emissions per annum, equating to ~53% compared to the Part L(SAP10) gas boiler baseline.

Application A – Development area 1
Considering the available roof space of Development Area 1, and allowing for access and maintenance requirements, a total solar PV system size in the region of 1,855m^2 array area will be included in the Proposed Development as shown in Appendix D.

Based on the solar irradiance data for London, an array of this size would reduce CO_2 emissions by ~65tonnes per annum. This is equivalent to a reduction in regulated CO_2 emissions of ~6% beyond the Building Regulations Part L (SAP10) 'baseline' on the CO_2 emissions of Development Area 1.

PV is therefore deemed to be a suitable addition to the Proposed Development in pursuit of further reductions in regulated CO_2 emissions.

The use of ASHP for the Proposed Development demonstrates a potential saving of ~594 tonnes of regulated carbon emissions per annum, equating to ~53% compared to the Part L(SAP10) gas boiler baseline for the Development Area 1.

Application A – Development area 2
At the reserved matters submission, the available roof space of Development Area 2, for the installation of a solar PV system size will be considered. This has been agreed in a draft condition as agreed by LBRuT and the GLA on the Original Scheme, prior to the scheme's resolution at the LBRuT Planning Committee on 29 January 2020. The draft condition reads: "The Reserved Matters submission for the Outline proposals (Development Area 2) of Application A (ref. 18/0547/FULL) will include a review of suitable low and zero carbon technologies that could be incorporated to provide a carbon dioxide emissions reduction at least commensurate with the Energy Strategy submitted for Application A (Development Area 1 and Development Area 2). The review would be undertaken where feasible to do so in line with the energy policy in place at the time of submission of the Reserved Matters submission. The review shall be submitted to GLA for review and comment".

Using benchmark Part L data, the use of ASHP for the Proposed Development estimates a potential saving of ~285 tonnes of regulated carbon emissions per annum, equating to ~60% compared to the Part L(SAP10) gas boiler baseline for Development Area 2.

Application B – School

PV is not proposed to be located on the school building as the roof area is being used to provide a play area and is also allocated for plant.

The use of ASHP for the Proposed Development demonstrates a potential saving of ~52 tonnes of regulated carbon emissions per annum, equating to ~50% compared to the Part L(SAP10) gas boiler baseline for the School.

Overall carbon dioxide emissions reduction.

A summary of the anticipated CO_2 emissions and reduction at each step of the energy hierarchy is given in Table 1 below. This captures the CO_2 emissions that would be used to calculate a potential offset payment for the whole site including the areas associated with Application A and B. The calculation of the Carbon Offset payment needs to be dealt with on a bespoke basis for a mixed-use scheme of this scale.

Application A

Table 1: Summary of CO_2 emissions reductions – Application A.

Application A	Carbon Dioxide Emissions (tonnes CO_2 per annum)	
	(Regulated)	(Unregulated)
Part L Gas Boiler Baseline	1,590	485
Reduction from Be Lean	1,432	485
Reduction from Be Clean	1,432	485
Reduction from Be Green	424	485
	Regulated Carbon Dioxide Emission Savings	
	(tonnes/yr.)	(%)
Reduction from Be Lean	159	10%
Reduction from Be Clean	-	0%
Reduction from Be Green	1,008	63%
Total Reduction	1,166	73%
Dwelling Reduction	979	77%
Non-Dwelling Reduction	187	60%

Dwelling only summary

Table 2: Summary of CO_2 emissions reductions – Application A (Dwellings).

Application A - Dwellings	Carbon Dioxide Emissions (tonnes CO_2 per annum)	
	(Regulated)	(Unregulated)
Part L Gas Boiler Baseline	1,278	296
Reduction from Be Lean	1,155	296
Reduction from Be Clean	1,155	296
Reduction from Be Green	298	296
	Regulated Carbon Dioxide Emission Savings	
	(tonnes/yr)	(%)
Reduction from Be Lean	123	10%
Reduction from Be Clean	-	0%
Reduction from Be Green	857	67%
Total Reduction	980	77%
Total Target Reduction	1,278	100%
Annual Surplus / Shortfall	-298	-23%

Non-Dwellings

Table 3: Summary of CO_2 emissions reductions – Application A (non-dwellings).

Application A - Non-Dwellings	Carbon Dioxide Emissions (tonnes CO_2 per annum)	
	(Regulated)	(Unregulated)
Part L Gas Boiler Baseline	312	189
Reduction from Be Lean	277	189
Reduction from Be Clean	277	189
Reduction from Be Green	125	189
	Regulated Carbon Dioxide Emission Savings	
	(tonnes/yr)	(%)
Reduction from Be Lean	36	11%

Application A - Non-Dwellings	Carbon Dioxide Emissions (tonnes CO_2 per annum)	
	(Regulated)	(Unregulated)
Reduction from Be Clean	-	0%
Reduction from Be Green	151	48%
Total Reduction	187	60%
Total Target Reduction	312	100%
Annual Surplus / Shortfall	-125	-40%

Application A – Development area 1
A summary of the anticipated CO_2 emissions and reductions at each step of the energy hierarchy is given in Table 4 below. The Proposed Development achieves an overall **~71%** reduction in regulated CO_2 emissions when considering the Development Area 1 of Application A.

Table 4: Summary of CO_2 emissions reductions for Development Area 1.

Application A – DA1	Carbon Dioxide Emissions (tonnes CO_2 per annum)	
	(Regulated)	(Unregulated)
Part L Gas Boiler Baseline	1,119	244
Reduction from Be Lean	984	244
Reduction from Be Clean	984	244
Reduction from Be Green	325	244
	Regulated Carbon Dioxide Emission Savings	
	(tonnes/yr)	(%)
Reduction from Be Lean	135	12%
Reduction from Be Clean	-	0%
Reduction from Be Green	659	59%
Total Reduction	794	71%
Dwelling Reduction	606	75%
Non-Dwelling Reduction	187	60%

Application A – Development area 2
A summary of the anticipated CO_2 emissions and reductions at each step of the energy hierarchy is given in Table 5 below. The Proposed Development achieves an overall **~79%** reduction in regulated CO_2 emissions when considering the Development Area 2 of Application A.

Table 5: Summary of CO_2 emissions reductions for Development Area 1.

Application A – DA2	Carbon Dioxide Emissions (tonnes CO_2 per annum)	
	(Regulated)	(Unregulated)
Part L Gas Boiler Baseline	472	241
Reduction from Be Lean	448	241
Reduction from Be Clean	448	241
Reduction from Be Green	99	241
	Regulated Carbon Dioxide Emission Savings	
	(tonnes/yr)	(%)
Reduction from Be Lean	24	5.04%
Reduction from Be Clean	-	0.00%
Reduction from Be Green	349	73.94%
Total Reduction	372	79%
Dwelling Reduction	372	79%
Non-Dwelling Reduction	0	0.0%

Application B – The School
A summary of the anticipated CO_2 emissions and reduction at each step of the energy hierarchy is given in Table 6 below. The application for the School achieves an overall **~66%** reduction in regulated CO_2 emissions when considering the School.

Table 6: Summary of CO_2 emissions reductions for the School (Application B).

Application B – School	Carbon Dioxide Emissions (tonnes CO_2 per annum)	
	(Regulated)	(Unregulated)
Part L Gas Boiler Baseline	104	43
Reduction from Be Lean	88	43
Reduction from Be Clean	88	43
Reduction from Be Green	35	43
	Regulated Carbon Dioxide Emission Savings	
	(tonnes/yr)	(%)
Reduction from Be Lean	16	15%
Reduction from Be Clean	0	0%
Reduction from Be Green	53	51%
Total Reduction	69	66%
Total Target Reduction	104	100%
Annual Surplus / Shortfall	-35	-34%

Carbon offset.

Table 7 shows the anticipated CO_2 emissions that will be subject to a carbon offset charge to be agreed with LBRuT.

Table 7: Carbon Offset

Whole Site (Application A and B) Total		Carbon Offset (tonnes)	Cost (£)
Development Area 1	Annual Offset (Residential Areas)	199 tCO_2	£568,244
	Annual Offset (Non-residential Areas)	125 tCO_2	£357,596
Development Area 2	Annual Offset (Residential Areas)	99 tCO_2	£282,443
	Annual Offset (Non-residential Areas)	n/a	£0
Application B - School	Annual Offset (School)	35 tCO_2	£99,573
Total carbon offset		**459**	**£1,307,856**

Minimising cooling demand and limiting the effects of heat gains in summer months.

The Proposed Development has been designed in accordance with the cooling hierarchy to minimise cooling demand and limit the likelihood of high internal temperatures. Mitigation measures such as suitable glazing ratio and g-value, appropriate ventilation levels and minimisation of internal heat gains will be implemented. Through these measures, relevant areas of the Proposed Development will achieve compliance with Criterion 3 of the Building Regulations Part L (2013).

An overheating risk assessment has been carried out on the proposals for Development Area 1, in accordance with the London Plan 2021 GLA policy SI4 – Overheating and cooling, using the CIBSE TM59 methodology. A completed overheating checklist has also been provided in this report. Active cooling will not be provided for the residential areas of Development Area 1.

The following mitigation measures have been implemented in the design of the Proposed Development:

a. Energy efficient lighting (such as LED or compact fluorescent) with low heat output
b. Insulation to heating and hot water pipework and minimisation of dead-legs to avoid standing heat loss (from pipework to dwellings) including no-hot water storage in the dwellings
c. HIUs located away from main living spaces
d. Environmental controls within the common corridors to provide ventilation
e. Increased mechanical ventilation rates beyond minimum Building Regulations requirements.

The results show a hybrid ventilation strategy which enables 100% of living rooms, kitchens and bedrooms assessed to meet the CIBSE TM59 requirements of the first criteria of the adaptive thermal comfort model and 100% of bedrooms meet the second criteria.

All dwellings will be provided with opening windows and therefore the adaptive thermal comfort model has been used as the benchmark in this analysis. The ventilation design includes MVHR to all units to extract stale air and provide fresh background air, with enhanced ventilation rates to provide additional mechanical ventilation during periods of warmer ambient conditions.

As a result of the above considerations, the risk of high internal temperatures in summer has been minimised as far as practically possible from passive measures for the residential dwellings, within architectural and practical constraints, and this has been demonstrated via overheating calculations in compliance with current CIBSE guidance.

1. Introduction.

1.1 The Application.

This Energy Strategy has been prepared by Hoare Lea on behalf of Reselton Properties Limited ("the Applicant") in support of two linked planning applications ("the Applications") for the comprehensive redevelopment of the former Stag Brewery Site in Mortlake ("the Site") within the London Borough of Richmond upon Thames (LBRuT).

The Applications seek planning permission for:

Application A:
"Hybrid application to include the demolition of existing buildings to allow for comprehensive phased redevelopment of the site:

- Planning permission is sought in detail for works to the east side of Ship Lane which comprise:
  - Demolition of existing buildings (except the Maltings and the façade of the Bottling Plant and former Hotel), walls, associated structures, site clearance and groundworks
  - Alterations and extensions to existing buildings and erection of buildings varying in height from 3 to 9 storeys plus a basement of one to two storeys below ground
  - Residential apartments
  - Flexible use floorspace for:
    - Retail, financial and professional services, café/restaurant and drinking establishment uses
    - Offices
    - Non-residential institutions and community use
    - Boathouse
  - Hotel / public house with accommodation
  - Cinema
  - Offices
  - New pedestrian, vehicle and cycle accesses and internal routes, and associated highway works
  - Provision of on-site cycle, vehicle and servicing parking at surface and basement level
  - Provision of public open space, amenity and play space and landscaping
  - Flood defence and towpath works
  - Installation of plant and energy equipment
- Planning permission is also sought in outline with all matters reserved for works to the west of Ship Lane which comprise:
  - The erection of a single storey basement and buildings varying in height from 3 to 8 storeys
  - Residential development
  - Provision of on-site cycle, vehicle and servicing parking
  - Provision of public open space, amenity and play space and landscaping
  - New pedestrian, vehicle and cycle accesses and internal routes, and associated highways works"

Application B:

"Detailed planning permission for the erection of a three-storey building to provide a new secondary school with sixth form; sports pitch with floodlighting, external MUGA and play space; and associated external works including landscaping, car and cycle parking, new access routes and other associated works"

Together, Applications A and B described above comprise the 'Proposed Development'.

Background to Submission.
The Applications follow earlier planning applications which were refused by the Greater London Authority. The refused applications were for:

- a) Application A – hybrid planning application for comprehensive mixed use redevelopment of the former Stag Brewery site consisting of:
  - i. Land to the east of Ship Lane applied for in detail (referred to as 'Development Area 1' throughout); and
  - ii. Land to the west of Ship Lane (excluding the school) applied for in outline (referred to as 'Development Area 2' throughout).
    - Application B – detailed planning application for the school (on land to the west of Ship Lane).
    - Application C – detailed planning application for highways and landscape works at Chalkers Corner.

The LBRuT (the Council) originally resolved to grant planning permission for Applications A and B but refuse Application C.

Following the LBRuT's resolution to approve the applications A and B, the Mayor called-in the applications and became the determining authority. The Mayor's reasons for calling in the applications were set out in his Stage II letter (dated 4 May 2020) but specifically related to concerns regarding what he considered was a low percentage of affordable housing being proposed for the Site and the need to secure a highways solution for the scheme following the LBRuT's refusal of Application C.

Working with the Mayor's team, the Applicant sought to meaningfully respond to the Mayor's concerns on the applications. A summary of the revisions to the scheme made and submitted to the GLA in July 2020 is as follows:

- Increase in residential unit provision from up to 813 units to up to 1,250 units;
- Increase in affordable housing provision from (up to) 17%, to 30%;
- Increase in height for some buildings of up to three storeys;
- Change to the layout of Blocks 18 and 19, conversion of Block 20 from a terrace row of housing to two four storey buildings;
- Reduction in the size of the western basement, resulting in an overall car parking spaces reduction of 186 spaces and introduction of an additional basement storey under Block 1;
- Internal layout changes and removal of the nursing home and assisted living in Development Area 2;
- Landscaping amendments, including canopy removal of four trees on the north west corner of the Site; and
- Alternative options to Chalkers Corner in order to mitigate traffic impacts through works to highway land only and allow the withdrawal of Application C.

Application A was amended to reflect these changes.

Notwithstanding this, and despite GLA officers recommending approval, the Mayor refused the applications in August 2021.

The Mayor's reasons for refusal in respect of Application A were:

- height, bulk and mass, which would result in an unduly obtrusive and discordant form of development in this 'arcadian' setting which would be harmful to the townscape, character and appearance of the surrounding area;
- heritage impact. The proposals, by reason of its height, scale, bulk and massing would result in less than substantial harm to the significance of several listed buildings and conservation areas in the vicinity. The Mayor considered that the less than substantial harm was not clearly and convincingly outweighed by the public benefits, including Affordable Housing, that the proposals would deliver;
- neighbouring amenity issues. The proposal, by reason of the excessive bulk, scale and siting of Building 20 and 21 in close proximity to the rear of neighbouring residential properties in Parliament Mews and the rear gardens of properties on Thames Bank, would result in an unacceptable overbearing and unneighbourly impact, including direct overlooking of private amenity spaces. The measures in the Design Code would not sufficiently mitigate these impacts; and
- no section 106 agreement in place.

Application B was also refused because it is intrinsically linked with Application A and therefore could not be bought forward in isolation.

The proposed new scheme.
This 3rd iteration of the scheme seeks to respond directly to the Mayors' reasons for refusal and in doing so also addresses a number of the concerns raised by the LBRuT.

The amendments can be summarised as follows:

- A revised energy strategy is proposed in order to address the London Plan (2021) requirements.
- Several residential blocks have been reduced in height to better respond to the listed buildings along the Thames riverfront and to respect the setting of the Maltings building, identified as a Building of Townscape Merit (BTM) by the LBRuT;
- Reconfiguration of layout of Buildings 20 and 21 has been undertaken to provide lower rise buildings to better respond to the listed buildings along the Thames riverfront; and
- Chalkers Corner light highways mitigation works.

The school proposals (submitted under 'Application B') are unchanged. The Applicant acknowledges LBRuT's identified need for a secondary school at the Site and the Applications continue to support the delivery of a school. It is expected that the principles to be agreed under the draft Community Use Agreement (CUA) will be the same as those associated with the refused school application (LBRuT ref: 18/0548/FUL, GLA ref: GLA/4172a/07).

Overall, it is considered that together, the Applications respond successfully to the concerns raised by the GLA which also reflect some of the concerns raised by stakeholders in respect of the previous schemes and during pre-application discussions on the revised Proposed Development. As a result, it is considered that the scheme now represents a balanced development that delivers the principle LBRuT objectives from the Site.

1.2 Site context.

The site plan shows the former Stag Brewery Site is bounded by Lower Richmond Road to the south, the river Thames and the Thames Bank to the north, Williams Lane to the east and Bulls Alley (off Mortlake High Street) to the west. The Site is bisected by Ship Lane. The Site currently comprises a mixture of large-scale industrial brewing structures, large areas of hardstanding and playing fields.

Aim
The aim of this strategy is to detail a robust energy demand reduction and supply strategy to enable the Proposed Development to meet the targets set out in the LBRuT Local Plan (2018), and GLA London Plan (2021).

The Proposed Development includes multiple planning applications. This Energy Strategy reviews the whole site encompassing Application A and B.

Table 8 shows the area schedule for the Proposed Development, including those uses that will come forward as part of Development Area 1, and those which will follow in Development Area 2.

Table 8: Area schedule for the Proposed Development.

Space use		GIA (m^2)		
		Application A Development Area 1	Application A Development Area 2	Application B
Domestic	Private residential	55,877	34,439	-
	Affordable	4,841	20,523	-
Non-domestic	Flexible Use	4,840	-	-
	Office	4,547	-	-
	Cinema	1,606	-	-
	Hotel	1,765	-	-
	School	-	-	9,319

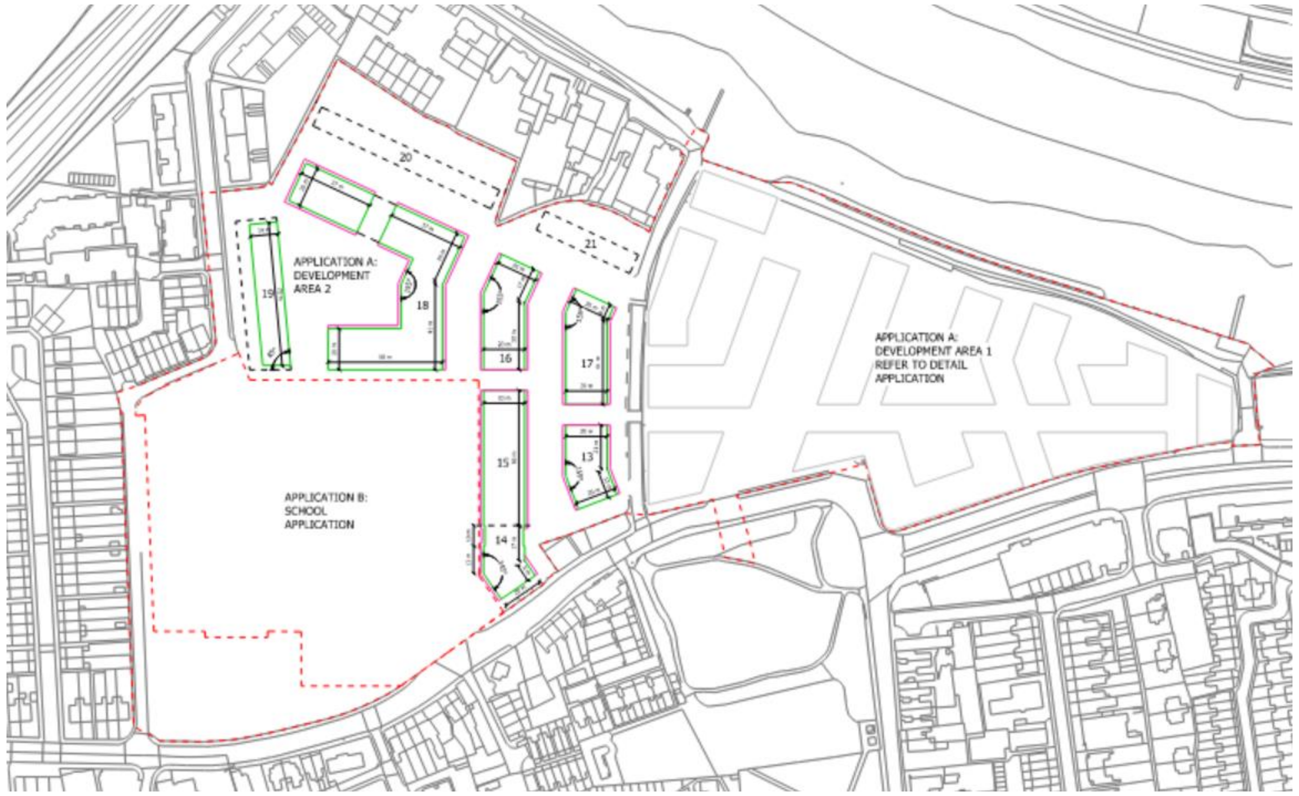


Figure 1: Site plan showing Development and Application areas (source: Squires & Partners).

2. Approach and methodology.

2.1 Definitions.

The following definitions should be understood throughout this strategy:

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

2.2 Limitations.

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

2.3 Approach.

This strategy outlines how the Proposed Development could have a reduced effect on climate change by reducing CO_2 emissions associated with energy use in buildings.

Figure 2 outlines the route followed by the Proposed Development when reducing CO_2 emissions and defines the structure of this statement.

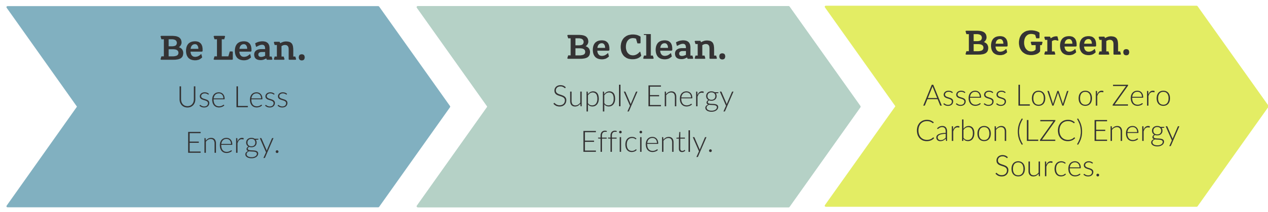


Figure 2: Energy Hierarchy

The strategic approach to the design of the proposed development has been to maximise the energy efficiency of the development through the incorporation of passive design led solutions during the construction process, with the integration of low carbon technology to maximise reduction of carbon emissions from the development.

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

After the inclusion of passive design and energy efficiency measures, various options have been investigated to reduce CO_2 emissions associated with energy supply. The feasibility of LZC technologies has been investigated in line with the policy aspirations.

2.4 Methodology.

The areas outlined in Table 9 have been used to undertake the appraisals described within this strategy as advised by the architect. Please note that these areas refer to conditioned spaces only and excludes the basement car park, energy centres and other non-conditioned spaces that are subject to the CO_2 emissions calculations of Part L of the building regulations.

It should be noted that some flexible commercial floor space is proposed as part of the scheme (Class E, F1 and Sui Generis). In the calculations the floor area has been allocated to these uses in the following order to generate a 'worst case' energy demand and CO_2 emissions:

1. Class E (Office), (as this category has a minimum floor area of 2000m^2)
2. Class E (Cafes and restaurants)
3. Class E (Retail)

This is not to be taken as a suggestion that these areas are set in the Proposed Development.

Flexible use spaces are set within the following maximum floor area per use with the maximum floor area for flexible uses at 4,839m^2.

Table 9: Flexible Use Maximum Areas

Use	Minimum cap for flexible floor space (m^2)	Maximum cap for flexible floor space (m^2)
Retail (Class E)	-	2,200
Financial and Professional services (Class E)	-	220
Cafes/restaurants ((Class E)	-	2,400
Drinking Establishments (Sui Generis)	-	1,800
Offices (Class E)	2,000	2,200
Community Use (Class F1)	-	1,300
Boathouse (Sui Generis)	-	380

From this proposal the areas used in the calculation of energy use and CO_2 emissions in this Energy Strategy are set out in the table below.

Table 10: Flexible use areas assigned in Energy Strategy

Use	Area used in energy strategy (m^2)
Retail (Class E)	618
Financial and Professional services (Class E)	0
Cafes/restaurants ((Class E)	2,453
Drinking Establishments (Sui Generis)	0
Offices (Class E)	2,056
Community Use (Class F1)	0

Use	Area used in energy strategy (m^2)
Boathouse (Sui Generis)	0

Whole site application

Calculations demonstrating the energy requirements and associated CO_2 emissions for the dwelling areas have been undertaken using SAP assessment results from the calculations undertaken for the full application of Development Area 1. Calculations for the commercial uses have been carried out using Part L2A modelling using NCM compliant software for the cinema and office areas. The flexible use areas have made use of benchmarks from similar Part L2A 2013 compliant buildings. The Whole Site (Applications A & B) calculations include all areas of the Proposed Development as set out in Table 8.

The following SAP10 compliant carbon factors in Table 11 were used to convert the energy consumption figures into CO_2 emissions for the Proposed Development.

Table 11: Building Regulations Part L 2013 CO_2 Emission Factors.

Fuel	Emission Factor ($kgCO_2/kWh$)
Gas	**0.210**
Electricity	**0.233**

3. Drivers.

This section summarises the pertinent policies and requirements applicable to the Proposed Development.

The policies considered when preparing this strategy are contained in the London Plan (Greater London Authorities (GLA), October 2021) and the Local Plan documents of LBRuT. These policies are reviewed in further detail in Appendix A and summarised below.

3.1 Building Regulations Part L 2013.

The assessment of the Proposed Development against policy targets has been carried out using Part L 2013 benchmarks.

Criterion One of the Building Regulations Part L (2013) requires that the building as designed is not anticipated to generate CO_2 emissions in excess of that set by a Target Emission Rate (TER) calculated in accordance with the approved National Calculation Methodology (NCM).

On aggregate, Part L 2013 requires the following CO_2 emissions reductions:

- 6% beyond the requirements of Part L 2010 for dwellings.
- 9% beyond the requirements of Part L 2010 for non-domestic buildings.

Criterion Two places upper limits on the efficiency of controlled fittings and services for example, an upper limit to an external wall U-value of $0.35W/m^2.K$ (new non-domestic buildings).

Criterion Three requires that spaces are not subject to excessive solar gains. This is demonstrated using the procedure given in the National Calculation Methodology.

3.2 London Plan (March 2021).

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

New London Plan Policy SI2 – "Minimising Greenhouse Gas Emissions" has set more stretching targets for carbon emissions for London developments, both overall, and at stipulated stages of the energy hierarchy, as seen in Table 12.

Table 12: Summary of London Plan policies for energy and CO_2 emissions.

Policy SI1	Improving air quality – Result in neutral or improvement on air quality as result of the proposed development.
Policy SI3	Energy infrastructure – Identify opportunities for energy infrastructure improvement. – Provide a communal low temperature heating system in accordance with the heating hierarchy. – CHP and ultra-low NOx gas boilers are designed in accordance with policy SI1.
Policy S12	Minimising Greenhouse Gas Emissions – Major development to be Net Zero Carbon (taken to mean a 100% reduction in regulated CO_2 emissions from the relevant Building Regulations baseline). – Minimum 35% on-site emissions reduction. – Minimum 15% (commercial)/10% (residential) reduction in regulated CO_2 through energy efficiency measures (Be Lean stage). – Demonstrate a pathway to Zero Carbon by 2050.

3.3 LBRuT Policy.

The pertinent targets of the LBRuT policies are:

London Borough Richmond upon Thames Local Plan, July 2018

The LBR Local Plan details local policies which are applicable to the proposed development.

Policy LP 22 states:

- "Development of 1 dwelling unit or more, or 100sqm or more of non-residential floor space (including extensions) will be required to complete the Sustainable Construction Checklist SPD. A completed Checklist has to be submitted as part of the planning application.
- Proposals for commercial areas greater than 100 sqm will be required to meet BREEAM New Construction 'Excellent' standard (where feasible).
- All new major residential developments (10 units or more) should achieve zero carbon standards in line with London Plan policy."

4. Cooling and overheating.

In tandem with the energy and CO_2 emissions appraisal, an assessment has been undertaken to determine the risk of summertime overheating and consider measures for the minimisation of cooling demand.

4.1 Cooling hierarchy.

The London Plan Policy SI4 (Managing Heat Risks) requests that developments should reduce potential overheating risk and reliance on air conditioning systems. A 'cooling hierarchy' is provided and the Proposed Development has sought to follow this hierarchy.

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

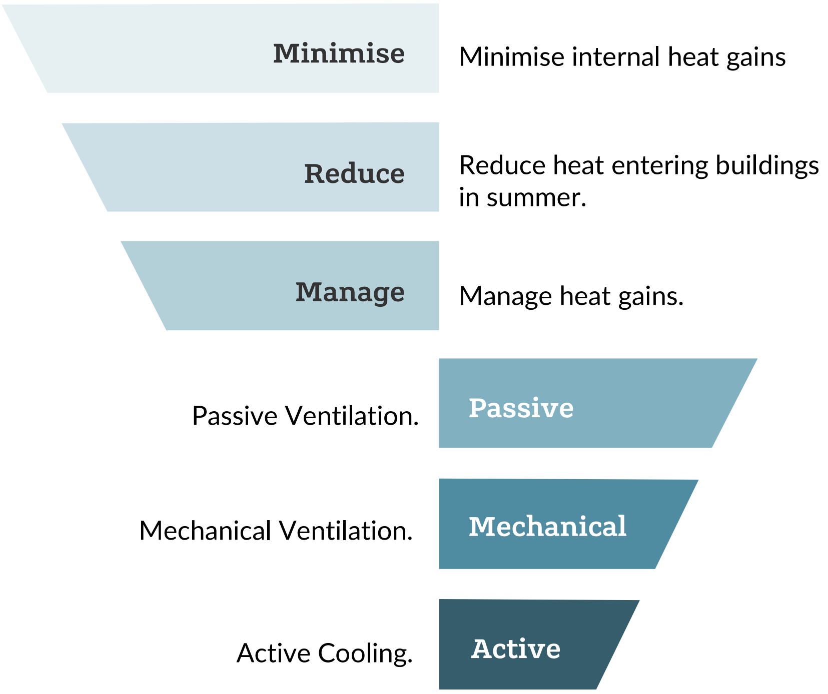


Figure 3: Cooling hierarchy.

4.2 Mitigation strategy.

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

Minimising internal heat generation through energy efficient design

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

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

Reducing the amount of heat entering the building in summer

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

- Suitable glazing ratio responding to orientation and space use
- Glazing with shading devices and suitable g-value to limit solar heat gains (where appropriate)
- High levels of insulation and low fabric air permeability which will retain cool air during summer months

Passive ventilation

The rooms will also benefit from passive solar heating and occupants will be able to adapt their internal environment via openable panels for natural ventilation.

Mechanical ventilation

All residential spaces, as a minimum will be provided with ventilation rate in accordance with Part F through Mechanical Ventilation with Heat Recovery (MVHR) or through central provision of ventilation also taking advantage of Heat Recovery.

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

4.3 Part L heat gain check.

It is anticipated that the Proposed Development will achieve compliance with the Building Regulations Part L 2013 Criterion 3 and limit the effects of heat gains in summer months and reduce the need for comfort cooling/air-conditioning.

4.4 Overheating risk assessment.

This provides a summary of overheating risk for the proposed Stag Brewery development.

The typical floor for Block 08 has been used as a best representation of apartments on the site. An assessment has been carried out using weather scenarios Design Summer Year (DSY) 1, 2 and 3 have been used for the appropriate location for completeness. Please refer to Appendix C for full detail of the weather scenarios applied.

Three scenarios have been included in the analysis:

- Natural ventilation only with blinds
- Natural ventilation with improved performance parameters and blinds
- Hybrid ventilation (i.e. openable windows and mechanical ventilation with heat recovery (MVHR)), improved performance parameters and blinds.

Please refer to Appendix B for key modelling input parameters.

The results for each summer year are included below and also in Appendix C.

Table 13 to Table 15 summarise the results of the overheating risk assessments. Results are presented in terms of the percentage of rooms that meet the adaptive comfort criteria.

This method of assessment has been advised by the GLA Energy Assessment Guidance (October 2020). Please refer to Appendix C for the results on a room by room basis.

DSY1

Based on the input parameters and methodology outlined in Appendix B & C, it has been demonstrated that all of the assessed dwellings can meet the CIBSE TM59 adaptive criteria for DSY1.

The following scenarios have been assessed as part of the analysis:

- Natural ventilation only, with blinds.
- Natural ventilation only with improved performance parameters (Table 13).
- Hybrid ventilation strategy where natural and mechanical ventilation is being used concurrently

It is important to note that where blinds have been used, for the natural ventilation strategy, a reduction in the achieved free area of the windows / opening doors has not been accounted for in the model.

Table 13: Summary of adaptive criteria results based on various ventilation scenarios – DSY1.

	% meeting adaptive comfort criteria		Corridors
	TM59 criterion 1 Kitchens, living rooms and bedrooms <3% occ. hours exceed comfort temp (May – Sept)	TM59 criterion 2 Bedrooms only <26°C for <1% occ. hours	28°C operative temperature target <3% of annual hours
Natural ventilation only with blinds	70% (30/43)	83% (25/30)	0% (0/2)
Natural ventilation with improved parameters (Table 37)	91% (39/43)	83% (25/30)	0% (0/2)
Improved parameters with hybrid ventilation	100% (43/43)	100% (30/30)	100% (2/2)

DSY2

In addition to the assessment using DSY1, the dwellings have also been assessed using the DSY2 summer year. Results are presented in the table below.

Table 14: Summary of adaptive criteria results based on various ventilation scenarios – DSY2.

	% meeting adaptive comfort criteria		Corridors
	TM59 criterion 1 Kitchens, living rooms and bedrooms <3% occ. hours exceed comfort temp (May – Sept)	TM59 criterion 2 Bedrooms only <26°C for <1% occ. hours	28°C operative temperature target <3% of annual hours
Natural ventilation only with blinds	65% (28/43)	83% (25/30)	0% (0/2)
Natural ventilation with improved parameters (Table 37)	70% (30/43)	83% (25/30)	0% (0/2)
Improved parameters with hybrid ventilation	72% (31/43)	83% (25/30)	100% (2/2)

DSY3.

A final model iteration was run using the DSY3 weather file.

Table 15: Summary of adaptive criteria results based on various ventilation scenarios – DSY3.

	% meeting adaptive comfort criteria		Corridors
	TM59 criterion 1 Kitchens, living rooms and bedrooms <3% occ. hours exceed comfort temp (May – Sept)	TM59 criterion 2 Bedrooms only <26°C for <1% occ. hours	28°C operative temperature target <3% of annual hours
Natural ventilation only with blinds	2% (1/43)	3% (1/30)	0% (0/2)
Natural ventilation with improved parameters (Table 37)	7% (3/43)	3% (1/30)	0% (0/2)
Improved parameters with hybrid ventilation	7% (3/43)	3% (1/30)	0% (0/2)

5. Be Lean.

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

Be Lean. Use less energy. | Be Clean. | Be Green.

5.1 Passive design and energy efficiency features.

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

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

Fabric performance
A 'fabric first' approach has been taken in order to reduce the energy demand and CO_2 emissions from the Proposed Development. The overriding objective for the façade design of the building will be to achieve the optimum balance between providing natural daylighting benefits to reduce the use of artificial lighting, the provision of passive solar heating to limit the need for space heating in winter and limiting summertime solar gains to reduce space cooling demands.

Thermal insulation
The Proposed Development will benefit from an efficient thermal envelope. Typically, demand for space heating and hot water demand can be dominant in residential accommodation, whilst space heating is less dominant in commercial spaces (lighting dominant). Heat losses and gains will be controlled by the optimisation of the fabric of each building, i.e. ensuring appropriate levels of glazing to control winter heat loss and summer heat gain. Reducing the thermal transmittance of the building envelope where appropriate will help to reduce both heating and cooling requirement and result in lower energy requirements.

Glazing energy and light transmittance
In designing the elevations with a moderate approach to fenestration, the design team has focused to ensure a balance between the benefits of passive solar heating in winter months whilst limiting the likelihood of high internal temperatures in summer.

Fabric air permeability
Fabric air permeability is a measure of the volume of air that can penetrate through the fabric of a building, leading to ventilation heat loss and gain. High air permeability can lead to uncomfortable drafts and dramatically increase the demand for space heating in winter, and space cooling in summer, when the airflow works in reverse i.e., cool air escaping from the building. The Proposed Development will target an air permeability of $3m^3/(m^2.h)$ at 50 Pa in line with the Part L notional building.

Space heating
At the Be Lean stage, space heating has been modelled to be provided by ultra-low NOx, high efficiency (91%) central gas-fired boilers and radiators as advised in the GLA guidance for energy statements (2020).

Space cooling
It is anticipated that the building will not require active cooling to manage overheating risk.

Through considered design of the building fabric and a combined natural and mechanical ventilation strategy, the risk of overheating has been demonstrated through an overheating risk assessment in line with CIBSE TM59 to be mitigated (refer to Appendix C for full detail).

Mechanical ventilation and heat recovery
All spaces, as a minimum will be provided with ventilation rate in accordance with Part F. The majority of spaces will be served by local MVHR units. All dwellings will have openable windows to provide natural ventilation.

Mechanical ventilation is an important addition to the building services strategy to maintain good indoor air quality, by providing fresh air to living rooms and bedrooms and extracting vitiated air from bathrooms and kitchens. Providing fresh air minimises the risk of stale and stagnant air and limits the risk of condensation and mould growth.

Coupled to a heat exchanger, the warmth in extracted air can be recovered and delivered to the supply air. In this mode, the MVHR reduces space heating demand. The heat recovery mechanism will be provided with a bypass to avoid returning hot air to the dwellings in summer months.

Domestic hot water (DHW) system
To limit the demand for hot water, all spaces, where part of the specification, will include the use of water-efficient fixtures and fittings including flow reducers in the taps of wash hand basins and aerated shower heads and also WCs with low flush volume to limit overall water consumption in line with Building Regulations Part G.

At the Be Lean stage, the Domestic Hot Water has been modelled to use a central gas boiler with 91% efficiency, in-line with the GLA guidance on preparing energy assessments.

Natural daylight and lighting strategy
The Proposed Development will be provided with low-energy, efficient light fittings throughout, External lighting for amenity and communal areas will also be low-energy efficient fittings and will be linked to daylight sensors and / or presence detectors to prevent unnecessary use.

It is anticipated that the Proposed Development will be supplied with efficient electric lighting that could include 'Compact Fluorescent Lamps' (CFL), 'Light Emitting Diodes' (LED) or similar low energy lamps. The lighting specification for the Proposed Development will be carried out in conjunction with lighting control systems incorporating daylight linkage and presence detection in suitable areas.

As well as reduced energy requirement that will be achieved by implementing these strategies, the contribution to the cooling requirements and internal heat gains will be reduced. This will further reduce the total energy requirements and CO_2 emissions of each building.

5.2 Be Lean results.

The results presented below are based on Building Regulations Part L1A 2013 compliance modelling carried out on the dwellings of Development Area 1 of Application A. The results have been applied to the residential areas of the whole 'Application A' site on an area weighted basis. The calculations demonstrating the energy requirements and associated CO_2 emissions for dwellings have been carried out using Building Regulations Part L1A approved SAP 2012 v9.92 methodology.

The following table sets out the dwelling units that SAP calculations were undertaken on to form the sample set used in the calculations in the submitted energy strategy to represent the dwellings throughout the development. The calculation has been undertaken on units within the typical floors provided by the architect. SAP Outputs of TER and DER are summarised in the table below.

Table 16: Summary of TER and DER Results

SAP Dwelling Reference	DER	TER
B08-TR-02 v1	14.19	14.91
B08-TY-03 v1	17.48	18.8
B08-TY-04 v1	9.84	11.62
B08-TY-05 v1	16.71	18.31
B08-TY-06 v1	14.63	15.43
B08-TY-07 v1	13.53	14.49
B08-TY-10 v1	14.05	15.3
B08-TY-11 v1	13.33	15.38
B08-TY-12 v1	11.46	13.92
B08-TY-13 v1	14.28	15.23
B06-TY-03_3 v1	15.21	14.74
B09-TY-01_3 v1	14.59	14.62
B09-TY-02_2 v1	15.66	15.09
B09-TY-03_3 v1	14.1	15.15
B09-TY-04_2 v1	14.87	14.93
B10-TY-03_3 v1	17.04	17.91

Calculations for the non-domestic uses have been carried out using software in compliance with Part L2A of the building regulations for school, office and cinema and for the remaining areas benchmarks from similar Part L2A 2013 compliant buildings have been used.

The results summarised overleaf demonstrate that prior to the implementation of any 'be clean' or 'be green' measures, on a site wide (Application A and B) basis the annual regulated energy requirement of the Proposed Development is anticipated to be approximately 7,116 MWh with associated regulated CO_2 emissions of 365 tonnes.

The majority of the regulated energy requirement, approximately 82%, is as a result of thermal energy requirements (domestic hot water and space heating), of which hot water is the most significant contributor. It is anticipated that the cooling requirement would be minimised through the implementation of passive design and energy efficiency measures and represent approximately 1% of the total regulated annual energy requirement.

It is anticipated that based on the calculations undertaken on a site wide (Application A and B) basis, ~10% reduction in annual regulated CO_2 emissions would be made beyond the requirements of the Building Regulations Part L (SAP10) with a Part L gas boiler baseline, through passive design and energy efficiency measures.

Therefore, the Proposed Development achieves Part L 2013 compliance via Be Lean measures, i.e. prior to the consideration of any LZC technologies.

When considering the residential uses in isolation, an anticipated annual regulated energy requirement of 5,434 MWh with associated CO_2 emissions of 1,155 tonnes has been calculated.

The majority of the regulated energy requirement (~88%) for the residential uses is associated with thermal energy requirements (domestic hot water and space heating). Consequently, thermal loads contribute most to regulated CO_2 emissions from the domestic uses (~71%).

It is anticipated that the residential use would achieve ~10% reduction in annual regulated CO_2 emissions beyond the requirements of the Building Regulations Part L (SAP10) through passive design and energy efficiency measures alone.

It can be demonstrated that on an area weighted basis, the dwellings fabric energy efficiency levels calculated alongside the CO_2 emissions calculation would improve upon the requirements of the Building Regulations Part L 2013.

When considering the non-domestic elements (excluding the school) in isolation, these spaces have been calculated to have an annual regulated energy requirement of 1,272 MWh with associated CO_2 emission of 277tonnes.

The majority of the regulated energy requirement (~63%) for the non-domestic uses is associated with thermal energy, i.e. space heating and hot water. However, non-thermal energy use contributes the greatest proportion of CO_2 emissions (~51%) due to the higher carbon intensity of electricity compared to mains gas (Part L SAP10 figures).

When considering the school in isolation, it has been calculated to have an annual regulated energy requirement of 409MWh with associated CO_2 emission of 88 tonnes.

The majority of the regulated energy requirement (~58%) for the school is associated with heating and hot water requirements. Heating and hot water also contribute the greatest proportion of CO_2 emissions (~66%).

5.2.1 Summary tables & charts.

The following tables and figures provide a summary of the anticipated the annual energy requirement and associated CO_2 emissions at the Proposed Development.

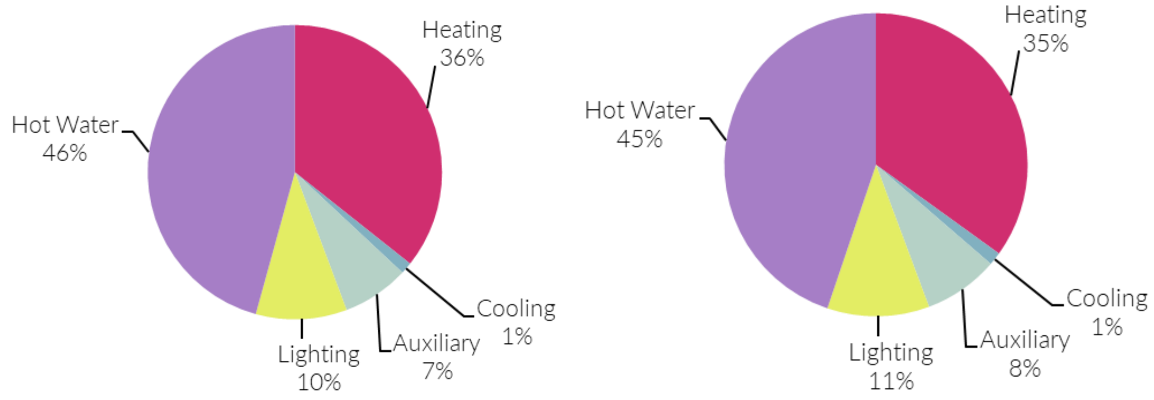


Figure 4: Summary of Regulated Energy Requirement (left) and CO_2 emissions (right) for the Whole Site, Application A and B.

5.3 Site-wide performance.

The anticipated regulated CO_2 emissions at the 'Be Lean' stage of the energy hierarchy are determined based on the performance parameters outlined within Appendix C. The results detailed below for the 'Be Lean' assessment demonstrate the percentage variance against Approved Document Part L1A and L2A for the Proposed Development.

Table 17: 'Be Lean' sitewide carbon performance.

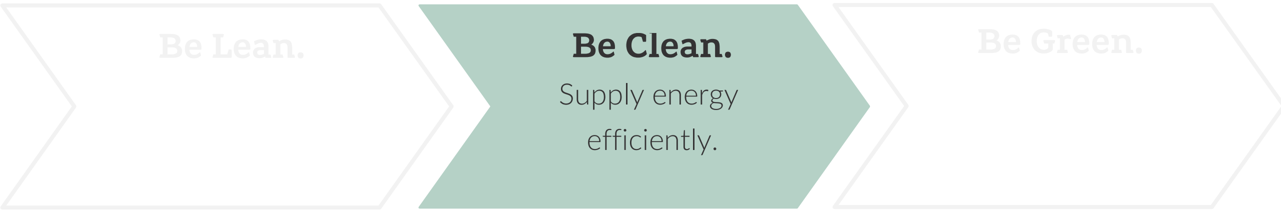
Stage	Energy Consumption		Regulated CO_2 Emissions	
	MWh/yr	% Reduction	tCO2/yr	% Reduction
Part L SAP10 baseline	7,956	-	1694	-
Be Lean	7,116	10.6%	1520	10.3%

5.4 Be Lean summary.

The results show that at this stage, the site-wide development demonstrates a ~10% reduction over the baseline carbon dioxide emissions.

6. Be Clean.

This' stage of the energy hierarchy refers to the use of heat networks or on-site Combined Heat and Power (CHP) in order to provide energy and reducing consumption from the national grid and gas networks, through the generation of electricity, heating and cooling on-site.



6.1 Development demand.

The Proposed Development's anticipated non-thermal energy demand has been calculated to be 19% compared to 81% for thermal demand.

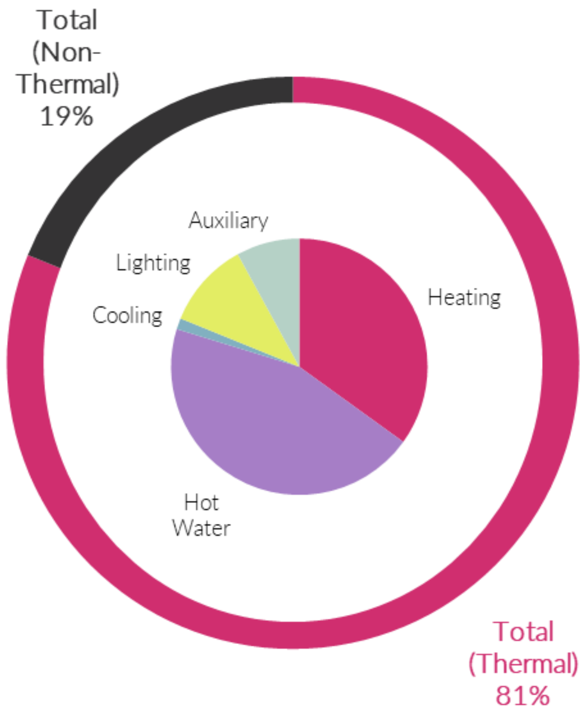


Figure 5: Thermal and non-thermal CO_2 emissions breakdown.

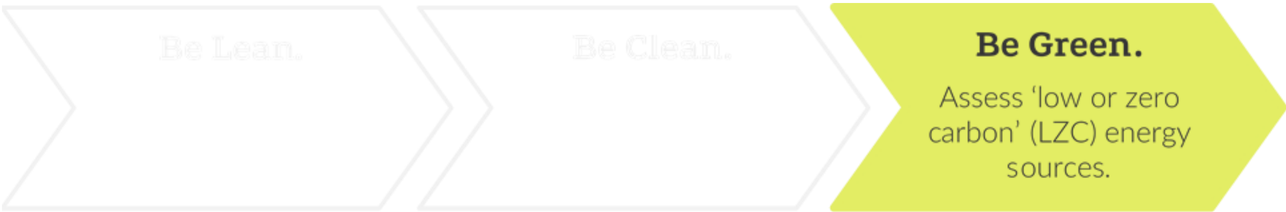
6.2 Be Clean: network and technologies.

In line with policy aspirations, the following sections summarise the considerations of the low-carbon energy supply measures that have been considered, and those which will be implemented at the Proposed Development.

	Decentralised Heat and Energy Networks Offsite heating/cooling network By reference to the London Heat Map (http://www.londonheatmap.org.uk), the proposed development is not in close proximity to an existing energy network, the closest being some 5.4miles away in Westminster. This is an unavailable connection, with no known plans to develop or extend as far as Richmond. There are opportunities for potential networks in the Hammersmith area although this remains at a distance that is beyond what could be considered reasonable to connect to at 2.3miles. Figure 4.10 shows the area of the site and the potential networks from the London Heat Map. From viewing the current London Heat Map data for the area, we understand that there are no current plans to create new or extend existing networks to the proximity of the site. Consideration has therefore be given for the Proposed Development to develop a heat network on the site with an energy centre housing Air Source Heat Pumps (ASHP) and ambient loop to enable energy sharing from waste heat from cooling for serviced commercial areas. Onsite heating/cooling network There is significant thermal demand across both Development Area 1 and Development Area 2 to allow cost-effective operation of the heat network, providing increased emissions reductions when using SAP 10 carbon factors. The intention would be that the site wide network would be provided when Development Area 2 is brought forward for development. However, given the technology proposed to supply the thermal demand and latest GLA guidance, the savings associated with this stage are incorporated within the Be Green stage of the hierarchy.
	Combined heat and power (CHP) Considering the high proportion of CO_2 emissions arising from thermal sources in particular with reference to the dwellings, a gas fired Combined Heat and Power (CHP) system could be suitable for the scheme. However, when considering the decarbonisation of the National Grid and proposed carbon factors in the emerging update to Part L (15th June 2022), a CHP system would result in an increase of on site emissions (approximately 15% addition to the SAP10 baseline). Furthermore, the presence of on site combustion plant could have a detrimental impact on local air quality as a result of the Proposed Development. Therefore, for the reasons detailed above, CHP has not been proposed for this energy strategy and no additional savings can be demonstrated at this stage of the energy hierarchy.

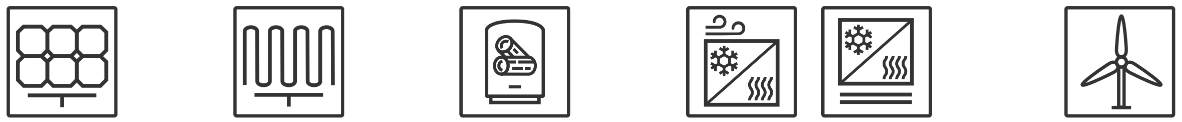
7. Be Green.

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



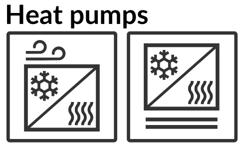
7.1 Low and zero carbon (LZC) technology assessment.

The following technologies have been considered as part of this Energy Strategy and assessed according to suitability by taking into account opportunities and constraints including the nature and location of the site.



Photovoltaics | Solar thermal panels | Biomass boilers | Heat pumps (closed and open loop ground-source/ air-source) | Wind turbines

Heat pumps



Air Source Heat Pumps (ASHP) and Ground Source Heat Pumps (GSHP) work to extract heat from the air or the ground. Generally, GSHPs are more efficient as the ground temperature is more stable over the course of the year relative to the air temperature.

GSHPs have three common varieties:

- horizontal, closed loop
- vertical, closed loop
- vertical, open loop

ASHPs have two common varieties:

- air to water
- air to air

Ground Source Heat Pumps (GSHP)

The performance characteristics and technical requirements of each vary. Typically, however, vertical open loop GSHP systems operate at the highest efficiencies and are capable of producing the most thermal output.

Open loop boreholes require an abstraction license from the Environment Agency. To gain a licence, a scheme is typically required to operate in balance such that over the year, the amount of heat extracted from the ground is equivalent to the amount of heat rejected to the ground.

Given the low amount of cooling at the Proposed Development (Application A and B) (approximately 1% of the overall regulated energy requirement), if a large amount of heat were to be extracted from the ground in winter there would be a large imbalance between amount of heat extracted and heat rejected to the ground over a yearly cycle, which could lead to permafrost, rendering the system unusable and potentially damaging nearby structures and local ecology.

Impacts to ground conditions are a valid consideration for all GSHP technologies, meaning a balanced heating and cooling strategy should be applied.

When assuming a GSHP could operate at Seasonal Energy Efficiency Ratio (SEER) of 5.0 (i.e. five units of useful heat or coolth for every unit of electricity consumed), to deliver 100% of space cooling and balanced to deliver an equivalent amount of heating and hot water (approx. 50% of requirement), it is estimated that a reduction in CO_2 emissions of ~489 tonnes per annum could be achieved.

This is equivalent to a reduction in regulated CO_2 emissions of ~29% beyond the Part L SAP10 gas boiler 'baseline'.

GSHP have the potential to provide additional reduction in on site emission. However, GSHP is unable to meet the thermal demand as a lone technology so would require additional sources for the remaining demand. Considering this and the associated infrastructure requirement and cost, this technology has not been proposed to the energy strategy at this time.

Air Source Heat Pumps (ASHP)

ASHP are a more flexible form of heat pump compared to GSHP as they comprise of localised units that do not require additional invasive infrastructure like GSHP or WSHP.

When assuming an ASHP could operate at Seasonal Energy Efficiency Ratio (SEER) of 4.0 (i.e. four units of useful heat for every unit of electricity consumed), to deliver 100% of space heating and hot water, and 100% of space cooling, it is estimated that a reduction in CO_2 emissions of ~931 tonnes per annum could be achieved.

This is equivalent to a reduction in regulated CO_2 emissions of ~55% beyond the Part L SAP10 gas boiler 'baseline'.

A suitable location has been identified within Development Area 1 that can house the ASHP plant to supply both Application A & B to ensure low carbon energy for heating and cooling demand can be met from day 1 of operation. This approach has enabled a centralised system to safeguard roof space for PV technology and biodiverse roof across the site. In addition, the connection to cooled areas via an ambient loop will allow energy sharing across the mixes of uses to further reduce energy demand in summer months.

Therefore, for the justification provided and additional benefit of ensuring and all electric strategy to enable ongoing decarbonisation of operational emissions, ASHP has been incorporated into the energy strategy at this stage.

Biomass heating

Biomass boilers burn wood fuel, or other bio-fuel sources, to generate heat. These boilers can operate at high efficiencies, comparable to condensing gas boilers. However, they require a large fuel store to maintain continuous operation during the winter months. As such, area take for such plant is high. Furthermore, fuel deliveries in city-centre locations can prove difficult and security of fuel supply is an important consideration.

Biomass boilers also result in higher emission of Nitrous Oxide (NOx) in comparison with gas boilers. This can have a negative impact on the local air quality. Policies in London seek to protect and enhance local air quality. Any proposal for biomass heating would be required to demonstrate the scheme would be 'air quality neutral'.

If a biomass boiler was to be implemented to provide 100% of the hot water demand, and 50% of the space heating demand, requiring a large fuel store, a reduction in CO_2 emissions of 768 tonnes per annum could be achieved. This is equivalent to a reduction in regulated CO_2 emissions of ~45% beyond the Part L SAP10 gas boiler 'baseline'.

However, due to the constraints of this site, the potential negative impact on air quality, and large store footprint of ~85m^2, biomass heating is not favoured for the Proposed Development.

Photovoltaic panels

An appraisal of the available roof space at the Proposed Development has been undertaken. The roof layouts have been designed in response to the need to balance many factors such as:

- area required for plant
- area required for access
- building heights in respect of the parameter plan thresholds
- potential area for PV arrays
- location of green and brown roofs

Considering the available roof space, and allowing for access and maintenance requirements, a total solar PV system size in the region of 1,855m^2 array area could be included on Development Area 1 at the Proposed Development. At reserved matters stage for the outline element of Application A consideration would be given to include a further area of PV to reduce CO_2 emissions for Development Area 2.

Assuming an equivalent area of PV could be identified for Development Area 2 from the proposed roof space, based on the solar irradiance data for London, an array of this size (up to 3,760m^2) would generate approximately ~564,000kWh of electricity per annum, reducing CO_2 emissions by ~131 tonnes per annum. This is equivalent to a reduction in regulated CO_2 emissions of ~8% beyond the Building Regulations Part L (SAP10) 'baseline'.

PV is therefore anticipated to be a suitable addition to the Proposed Development in pursuit of further reductions in regulated CO_2 emissions.

The school has limited roof space available for the installation of a PV array due to the location of plant, roof lights and the location of the play area on the roof. Therefore, PV is not currently proposed for the school application.

Solar thermal panels

The appraisal of solar thermal panels has been undertaken with the same approach as for PV.

Considering the available roof space, and allowing for access and maintenance requirements, a total solar thermal system size of ~1,880kWp could be installed at the Proposed Development.

Based on the solar irradiance data for London, an array of this size would generate approximately ~1,716,669kWh of heat per annum. This level of thermal generation is equivalent to 79% of the annual hot water demand, reducing CO_2 emissions by ~403 tonnes per annum. This is equivalent to a reduction in regulated CO_2 emissions of ~45% beyond the Part L (SAP10) gas boiler 'baseline'.

However, in operation, the stores required to house the heated water would be substantial and require top up to ensure desired temperatures in use could be achieved. Furthermore, the periods of the day where water would be heated by the technology is least likely to be when hot water is needed, this tends to be mornings and evenings. Therefore, this technology would require additional energy demand to ensure quality of use is maintained.

Furthermore, as the energy strategy is 'all electric' the generation of electricity that can be used to offset demand on site for all energy sources would be more beneficial.

As such, the use of solar thermal, does not out way the benefits of PV panel technology to warrant the roof allocation and is therefore not proposed for the energy strategy.

Micro wind turbines

The installation of micro wind turbines at the Proposed Development could generate useful electricity.

On the basis of providing 25No. 6kW vertical axis wind turbines, it is estimated that approximately 547,454kWh of electricity could be generated annually, reducing CO_2 emissions by ~128 tonnes per annum.

This is equivalent to a reduction in regulated CO_2 emissions of ~7% beyond the Part L SAP10 gas boiler 'baseline'.

Despite manufacturer claims that vertical axis wind turbines work well in city-centre locations, turbulent air flow patterns caused by the rough and irregular urban landscape are not conducive to high annual yields from wind turbines.

Moreover, mounting wind turbines on the roofs of the Proposed Development could result in unacceptable vibration and resonance being felt within top floor apartments. This scenario is likely to result in the turbines being switched off. As such, the use of micro wind turbines would not be implemented at the Proposed Development.

LZC review summary.

Table 18 provides a summary of the estimated emissions reductions for Application A and B associated with each of the suitable technologies identified above.

Based on the assessment conducted, it is proposed that ASHP will supply all thermal and cooling demand on site in addition to a solar PV array of 1,855m^2 for Development Area 1 and further array in Development Area 2, achieving a 9% and 61% reduction in regulated CO_2 emissions over the GLA gas boiler baseline respectively.

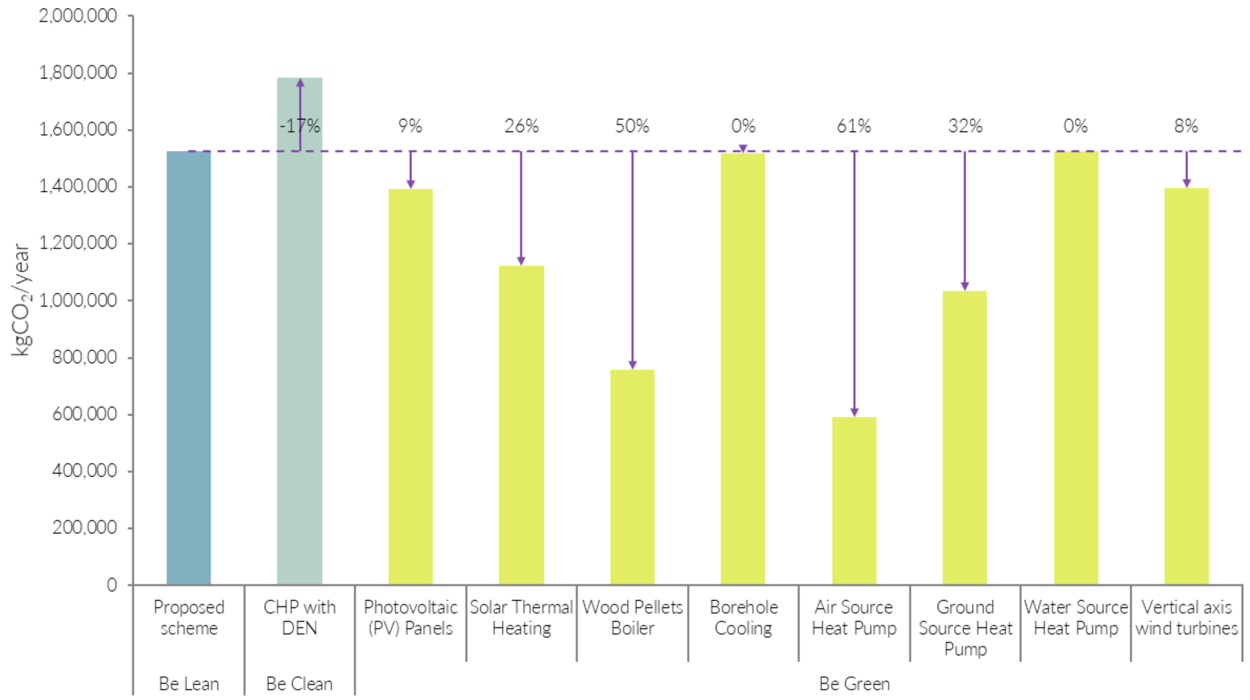


Table 18: Summary of LZC Technology Appraisal for Whole Site.

7.2 Be Green summary.

It is anticipated that the Proposed Development of Application A will achieve up to a 63% reduction in CO_2 emissions beyond the GLA gas boiler baseline factors through the implementation of low and zero carbon technologies specified.

Overall, the Proposed Development is anticipated to achieve up to a 73% reduction in CO_2 emissions beyond the GLA gas boiler baseline.

8. Be Seen.

The final section of the strategy considers additional measures that will be adopted during operation to ensure the risk of performance gap is reduced and high energy performance as designed is maintained throughout the Proposed Development's lifetime.

Figure 6: Be Seen.

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

8.1 Monitoring and Reporting.

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

8.2 Development Monitoring and Reporting Plan.

The developed strategy will allow for an exhaustive metering of all the various energy usage in the Proposed Development. Electrical meters will be provided on the main central Air Source Heat Pump(s), providing data on plant energy consumption throughout the year. Each area of high energy load will be sub-metered monitor energy consumption in greater granularity and facilitate reporting. All the main sub-systems (i.e. small power, lighting etc) will be separately monitored and their energy usage separately accounted. Energy intensity and carbon emissions will be monitored and reported annually. The Applicant will also complete the GLA's suggested "Be Seen" energy reporting protocols via the appropriate web portals, at the appropriate stage if required.

Table 19 includes a high-level summary of the reporting requirements for the three 'be seen' stages for all reportable units (RU) types. This table intends to capture the overarching similarities between various stages and RUs.

Table 19: Performance indicators for Be Seen.

Indicators	Planning stage	As-built stage	In-use stage
Contextual data	– Location Unique Property Reference Number (UPRN) or Address (if no UPRN available) – Site plan – Typology / Planning Use Class (all included) – GIA (m^2) for each Typology / Use Class – Anticipated target dates for each 'be seen' reporting stage (i.e. 'as-built' and 'in-use')	– Updates of contextual data provided at planning stage, if necessary – GIA (m^2) for each RU – Confirmation that a verified metering plan is in place	– GIA (m^2) update for each RU, if necessary

Indicators	Planning stage	As-built stage	In-use stage
Building energy use	– Grid electricity consumption (kWh) – Gas consumption (kWh) – Other fuels consumption (kWh) – District heating/cooling consumption (kWh) (if applicable)	(SAME AS PLANNING STAGE plus) – *Predicted* DEC grade and rating (for non-residential RUs only)	(SAME AS PLANNING STAGE plus) – *Measured* DEC grade and rating (for non-residential RUs only)
Renewable energy use	– Energy generation (kWh)	– Renewable electricity generation (gross) (kWh) – Solar thermal heat generation (kWh)	(SAME AS AS-BUILT STAGE plus) – Renewable electricity exported (kWh) – Renewable energy used on site (kWh)
Energy storage		– Net electricity flow to EVs (kWh) – Battery storage capacity (kWh)	
Plant parameters		Energy centres: – Grid electricity, Gas and/or other fuel consumption – Delivered efficiency of each heating/ cooling) generation plant (%) – % of heat supplied from each heating/ cooling generation plant – Predicted losses from heat/cooling distribution pipework (kWh) – District heating/cooling energy import/export (kWh) Residential and non-residential: – District heating energy exported (kWh) – District cooling energy exported (kWh)	Energy centres: (SAME AS AS-BUILT STAGE plus) – Energy input/output to/from each heating/ cooling energy conversion plant (kWh) – Total district heating/ cooling output from production centre (kWh) – Total district heating/ cooling supplied to customers (kWh) Residential and non-residential: (SAME AS AS-BUILT STAGE)

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

8.3 Operational cost: space heating and DHW.

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

This section provides an appraisal of potential end user costs for both boiler-led communal heating, and communal heat-pump strategies. A summary of the appraisal is shown in Table 20.

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

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

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

Table 20: Operational Cost Appraisal Summary

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

It is expected that the actual running cost for the DHW system will fall between the two estimated costs calculated in Table 20, provided the Renewable Heat Incentive is still available to the scheme at the time of project completion.

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

Table 21: Cost Assessment Global Inputs. Unit cost source: BEIS (September 2021).

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

9. Anticipated CO_2 emissions reduction.

9.1 Domestic uses (Application A).

Table 22 shows the equivalent reductions in regulated CO_2 emissions when considering the domestic uses alone for the whole site. These results account for the benefit of connecting to the on-site CHP, and the PV array.

When considering the domestic uses alone, an overall reduction of ~10% beyond the Part L gas boiler 'baseline' can be achieved through passive design and energy efficiency measures. The CO_2 emission savings for the domestic uses are represented graphically in Figure 7. CO_2 emissions reductions are represented cumulatively in the graph.

Table 22: CO_2 Emissions after Each Stage of the Energy Hierarchy for the **Domestic Uses.**

Application A - Dwellings	Carbon Dioxide Emissions (tonnes CO_2 per annum)	
	(Regulated)	(Unregulated)
SAP10 Gas Boiler Baseline	1,278	296
Reduction from Be Lean	1,155	296
Reduction from Be Clean	1,155	296
Reduction from Be Green	298	296
	Regulated Carbon Dioxide Emission Savings	
	(tonnes/yr)	(%)
Reduction from Be Lean	123	10%
Reduction from Be Clean	-	0%
Reduction from Be Green	856	67%
Total Reduction	979	77%
Total Target Reduction	1,278	100%
Annual Shortfall	298	23%

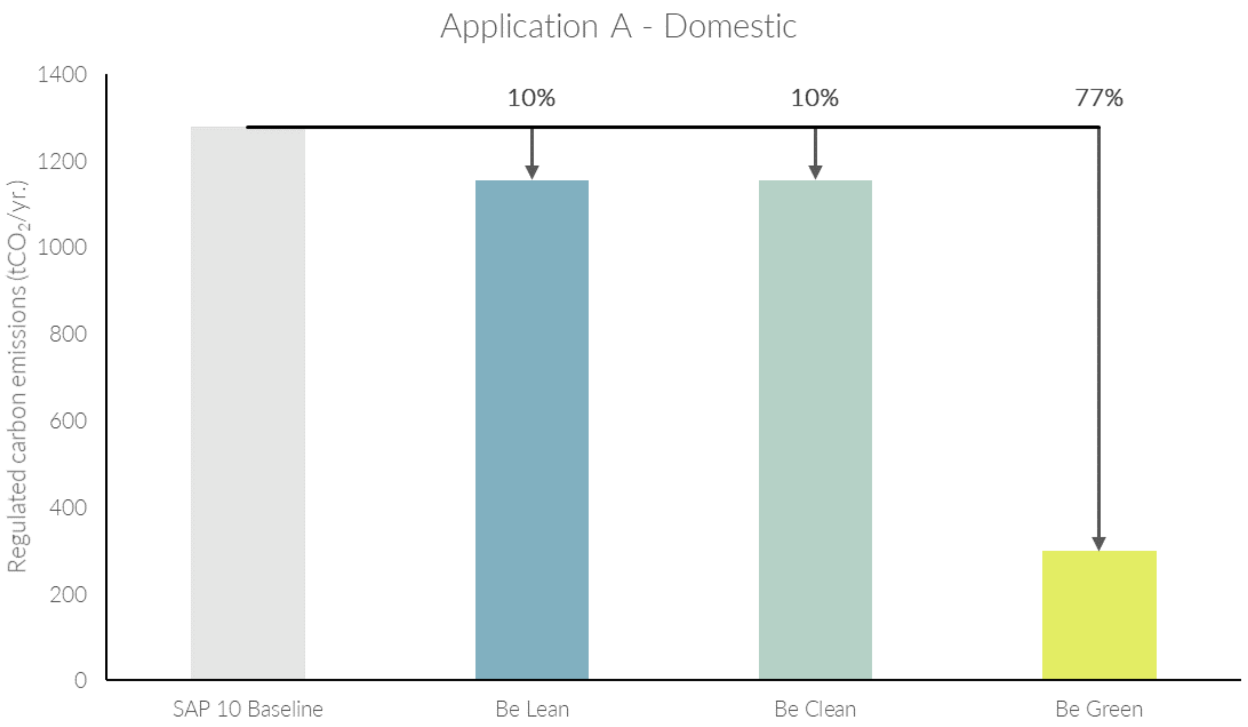


Figure 7: Cumulative regulated carbon savings – Application A (Domestic).

9.2 Non-Domestic uses (Application A).

Table 23 shows the equivalent reductions in regulated CO_2 emissions when considering the non-residential uses alone.

When considering the non-domestic uses alone, an overall reduction of ~11% beyond the Building Regulations Part L (SAP10) 'baseline' can be achieved through passive design and energy efficiency measures. The CO_2 emission savings for the non-domestic uses are represented graphically in Figure 8. CO_2 emissions reductions are represented cumulatively in the graph.

Table 23: CO_2 Emissions after Each Stage of the Energy Hierarchy for the Non-residential areas.

Application A - Non-Dwellings	Carbon Dioxide Emissions (tonnes CO_2 per annum)	
	(Regulated)	(Unregulated)
SAP10 Gas Boiler Baseline	312	189
Reduction from Be Lean	277	189
Reduction from Be Clean	277	189
Reduction from Be Green	125	189
	Regulated Carbon Dioxide Emission Savings	
	(tonnes/yr)	(%)
Reduction from Be Lean	36	11%
Reduction from Be Clean	-	0%
Reduction from Be Green	151	48%
Total Reduction	187	60%
Total Target Reduction	312	100%
Annual Shortfall	125	40%

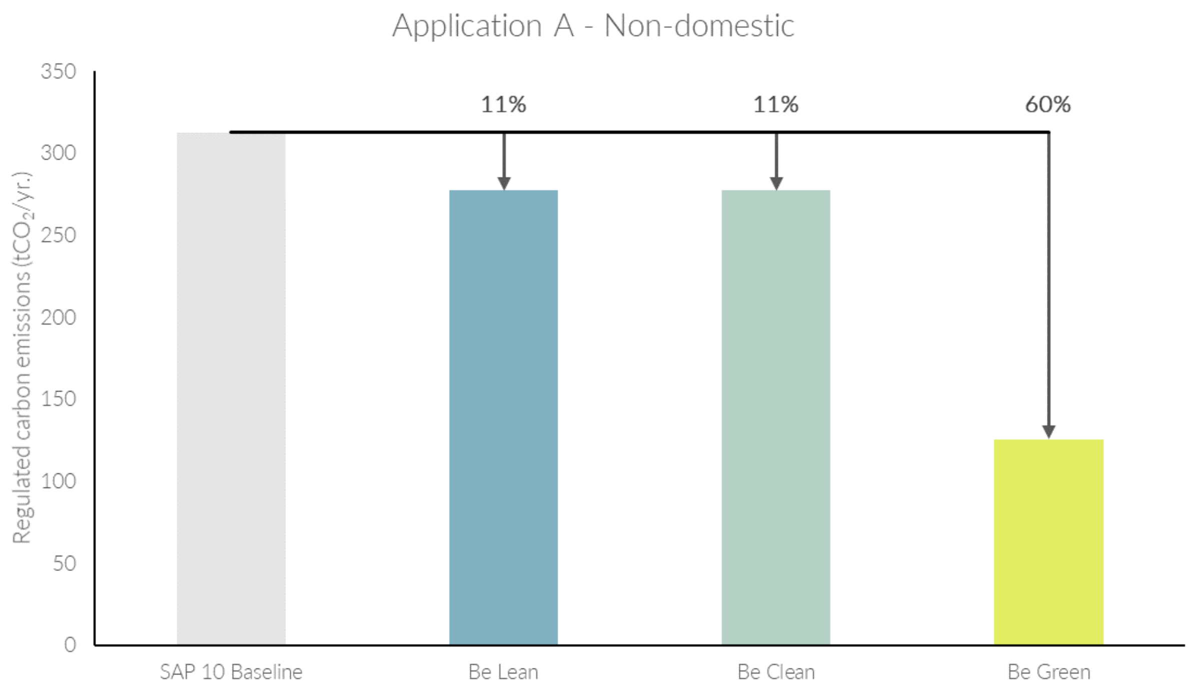


Figure 8: Cumulative regulated carbon savings – Application A (Non-domestic).

9.3 Non-Domestic Uses – School (Application B).

Table 24 shows the equivalent reductions in regulated CO_2 emissions when considering the school use alone. These results account for the benefit of connecting to the proposed on-site CHP.

When considering the school alone, an overall reduction of 15% beyond the Building Regulations Part L (SAP10) 'baseline' can be achieved through passive design and energy efficiency measures. The CO_2 emission savings for the non-domestic uses are represented graphically in Figure 9. CO_2 emissions reductions are represented cumulatively in the graph.

Table 24: CO_2 Emissions after Each Stage of the Energy Hierarchy for the school.

Application B - School	Carbon Dioxide Emissions (tonnes CO_2 per annum)	
	(Regulated)	(Unregulated)
Part L Gas Boiler Baseline	104	43
Reduction from Be Lean	88	43
Reduction from Be Clean	88	43
Reduction from Be Green	35	43
Non-Dwellings	Regulated Carbon Dioxide Emission Savings	
	(tonnes/yr)	(%)
Reduction from Be Lean	16	15%
Reduction from Be Clean	0	0%
Reduction from Be Green	53	51%
Total Reduction	69	66%
Total Target Reduction	104	100%
Annual Surplus / Shortfall	35	34%

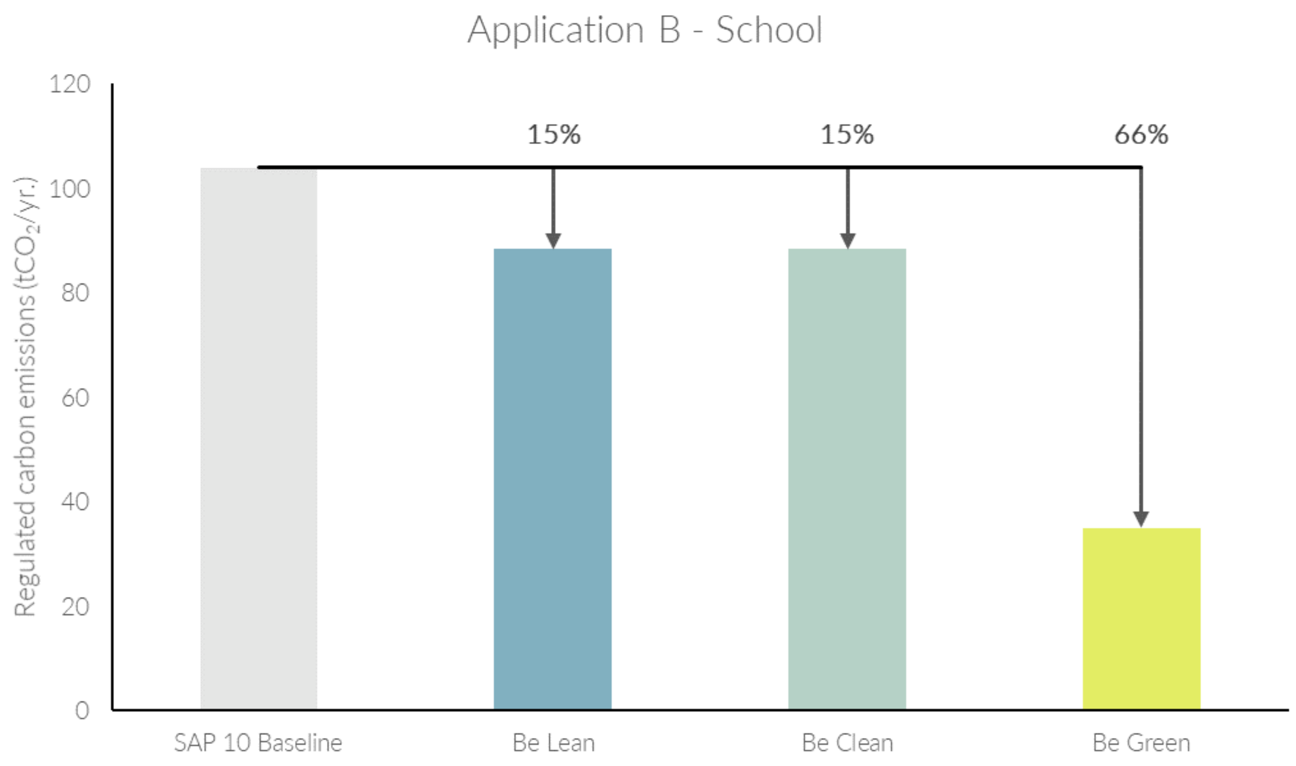


Figure 9: Summary of Regulated CO_2 Emissions Reduction for the school (Application B).

9.4 Whole site total (Application A and B).

Following the energy hierarchy, reductions in regulated energy requirements and associated CO_2 emissions have been made at each stage as demonstrated by Table 25.

When considering the whole site, it is anticipated that a ~73% overall reduction in CO_2 emissions beyond the Building Regulations Part L 2013 'baseline' can be achieved.

The CO_2 emissions savings for the whole site are represented cumulatively in Table 25.

Table 25: CO_2 Emissions after Each Stage of the Energy Hierarchy for the whole site.

Whole site (Application A & B)	Carbon Dioxide Emissions (tonnes CO_2 per annum)	
	(Regulated)	(Unregulated)
Part L Gas Boiler Baseline	1694	528
Reduction from Be Lean	1520	528
Reduction from Be Clean	1520	528
Reduction from Be Green	459	528
	Regulated Carbon Dioxide Emission Savings	
	(tonnes/yr.)	(%)
Reduction from Be Lean	174	10%
Reduction from Be Clean	0	0%
Reduction from Be Green	1061	63%
Total Reduction	1235	73%
Dwelling Reduction	979	77%
Non-Dwelling Reduction	256	61%

9.5 Carbon offset payment.

The Proposed Development is anticipated to require to offset the remaining 462 tonnes for 30 years. The GLA has set the price for Carbon Offset at £95 per tonne per year.

Table 26: CO_2 Emissions Offset for the **Whole Site**

Whole Site (Application A and B) Total		Carbon Offset (tonnes)	Cost (£)
Development Area 1	Annual Offset (Residential Areas)	199	£568,244
	Annual Offset (Non-residential Areas)	125	£357,596
Development Area 2	Annual Offset (Residential Areas)	99	£282,443
	Annual Offset (Non-residential Areas)	N/A	£0
School	Annual Offset (School)	35	£99,573
Total carbon offset		459	£1,307,856

10. Conclusion.

This document has been prepared on behalf of Reselton Properties Ltd to support of the application for planning permission for the Proposed Development of the former Stag Brewery.

This Energy Strategy summarises the pertinent regulatory and planning policies applicable to the Proposed Development and sets out how the Proposed Development addresses the relevant policy requirements.

10.1 The energy strategy.

The strategy has been developed using the 'Be Lean, Clean and Green' energy hierarchy which utilises a fabric first approach to maximise reduction in energy through passive design measures.

The following table provides a summary of the energy strategy for the Proposed Development for both the dwelling and site wide scale.

Table 27: Energy strategy summary.

Be Lean	~10% sitewide betterment achieved against GLA gas boiler baseline. Highly energy efficient building fabric and building services have been utilised to reduce carbon emissions and energy demand through good practice passive measures.
Be Clean	No additional savings at the Be Clean stage An centralised approach to energy supply will be available via an ambient loop using heat pump technology. As no connection to an existing DHN or installation of CHP is proposed, no additional savings can be demonstrated at this stage.
Be Green	A further ~63% sitewide betterment achieved through LZC technologies. Thermal and cooling demand supplied via on site centralised ASHP and the incorporation of a photovoltaic array further reduces and offsets the proposed development's carbon emissions respectively .

Results

Table 29 summarises the emissions reductions for the Proposed Development using the Part L SAP10 carbon factors, as required by the updated GLA guidance.

Through the measures outlined in the energy strategy, it is anticipated that overall up to a 73% reduction in CO_2 emissions can be achieved beyond the Part L SAP10 gas boiler baseline, inclusive of all measures.

10.2 Proposed site-wide energy strategy.

A fabric first approach utilising high performance building fabric and efficient systems. Heating and hot water to be provided by a site wide heat network fed by a ASHP via ambient loop. Finally, a solar PV array will be provided on the available roof areas.

Carbon dioxide emissions after each stage of the energy hierarchy

Table 28: Carbon emissions after each stage of energy hierarchy.

	Dwellings		Non-Dwellings	
	Regulated Tonnes CO_2/year	Unregulated Tonnes CO_2/year	Regulated Tonnes CO_2/year	Unregulated Tonnes CO_2/year
Part L 2013 baseline	1278	296	416	232
Be Lean.	1155	296	365	232
Be Clean.	1155	296	365	232
Be Green.	298	296	160	232

Table 29: Carbon reduction breakdown for Application A & B.

	Domestic		Non-Domestic	
	Tonnes CO_2/year	Percentage	Tonnes CO_2/year	Percentage
Savings from Be lean.	123	10%	51	12%
Savings from Be clean.	0	0%	0	0%
Savings from Be green.	856	67%	205	49%
Total reduction:	979	77%	256	61%
Target reduction:	1278	100%	416	100%
Annual shortfall	298	23%	160	39%

10.3 Carbon offset payments.

Table 30 shows a summary of the emissions reductions at each stage of the hierarchy, as well as the carbon offset contribution required to meet the London Plan 100% emissions reduction target for dwellings and non-dwellings.

Table 30: Summary of the regulated CO_2 emissions reductions for the Proposed Development at each stage of the Energy Hierarchy.

Whole Site (Application A and B) Total		Carbon Offset (tonnes)	Cost (£)
Development Area 1	Annual Offset (Residential Areas)	199	£568,244
	Annual Offset (Non-residential Areas)	125	£357,596
Development Area 2	Annual Offset (Residential Areas)	99	£282,443
	Annual Offset (Non-residential Areas)	0	£0
School	Annual Offset (School)	35	£99,573
Total carbon offset		459	£1,307,856

Appendix A - Planning policies.

Current policy framework.

The policies considered when preparing this strategy are contained in the London Plan (GLA, 2021) and the local planning policy of London Borough of Richmond upon Thames.

The Proposed Development constitutes a 'major development' (>10 dwellings and/or >1,000m^2 of non-residential floor space) and is therefore subject to the policies of the GLA, contained within the London Plan.

National.

Approved Document Part L
Part L of the Building Regulations is the mechanism by which government is driving reductions in the regulated CO_2 emissions from new buildings.

Current requirements: Part L 2013
Part L has five key criteria which must be satisfied as follows:

a. Criterion 1 - Achieving the Target Emission Rate (TER)

b. Criterion 2 - Limits on design flexibility

c. Criterion 3 - Limiting the effects of solar gains in summer

d. Criterion 4 - Building performance consistent with the Building Emission Rate (BER)

e. Criterion 5 - Provision for energy efficient operation of the building

Criterion one requires that the building as designed is not predicted to generate CO_2 emissions in excess of that set by the Target Emission Rate (TER) calculated in accordance with the approved Standard Assessment Procedure (SAP) 2012. Part L (2013) requires the following reductions:

a. A 6% aggregate reduction in CO_2 emissions beyond the requirements of Part L 2010 for dwellings; and

b. A 9% aggregate reduction in CO_2 emissions beyond the requirements of Part L 2010 for non-domestic buildings.

Criterion two places upper limits on the efficiency of controlled fittings and services for example, an upper limit to an external wall U-value of 0.35W/m^2.K (non-domestic buildings).

A Fabric Energy Efficiency Standard (FEES) has been introduced for new buildings although no definitive targets have been set in this regard. Part L 2013 requires the following Fabric Energy Efficiency performance targets to be met:

- Target Fabric Energy Efficiency (TFEE). The TFEE is calculated for the building, based upon an elemental recipe of efficiency parameters, applied to the geometry of the building in question. This would generate a notional value which would then be relaxed by 15% to generate the TFEE

Criterion three requires that zones in non-residential buildings are not subject to excessive solar gains. This is demonstrated using the Simplified Building Energy Model (SBEM) or Dynamic Simulation Method (DSM) for non-residential buildings.

Proposed changes to Part L.
Part L 2021 changes will be regulated for in December 2021 and come into effect in June 2022. Transitional arrangements will apply from June 2022 and June 2023. Transitional arrangement are put in place to define when a construction site should use the latest version, and when the previous regulations can be kept.

Transitional metrics for developments will apply to individual buildings, rather than an entire development, and the transitional period will be one year. Any buildings not started beyond that point will be subject to the most up to date Building Regulations.

For buildings to remain under current regulation or for transitional arrangements to apply to an individual building, developers will be required to:

- Submit a building / initial notice or deposited plans by June 2022, and
- Commence work on each individual building by June 2023.

Any notices/plans submitted after June 2022, Part L 2021 regulation will apply. Likewise, if plans are submitted yet work is not commenced on an individual building by June 2023, then Part L 2021 applies.

Commencement activities include:

- Excavation for strip or trench foundations or for pad footings.
- Digging out and preparation of ground for raft foundations.
- Vibro-floatation (stone columns) piling, boring for piles or pile driving.
- Drainage work specific to the building(s) concerned.

A new non-domestic Future Buildings Standard is expected to be implemented in 2025, alongside a Future Homes Standard. It is intended that aligning to the Future Buildings Standard will make non-domestic buildings zero carbon ready by 2025.

Non-domestic
A 22% or 27% reduction in regulated carbon emissions is proposed over the Part L 2013 baseline for non-domestic buildings, with the preferred option being a 27% reduction.

Proposed metrics for the revised Part L 2021 for non-domestic buildings include:

- Primary energy metric
- CO_2 emission target

Changes are proposed for minimum fabric and fixed services standards, as well as the National Calculation Methodology that underpins the Part L assessment. Part L 2021 updates also propose a 74% reduction in electricity carbon factor from current regulations. This makes electric servicing strategies significantly more desirable from a carbon perspective.

Carbon factors for natural gas and grid supplied electricity will be revised in new Part L 2021 and likely to follow SAP 10.1 figures noted in the table below, i.e. aligned to the carbon factors to be used in emissions calculations for dwellings.

Table 31: Current, SAP10 and proposed carbon factors for natural gas and grid supplied electricity.

Fuel	Part L 2013 Carbon Factor ($kgCO_2$/kWh)	SAP10 Carbon Factor ($kgCO_2$/kWh) (aligned with GLA guidance)	Proposed SAP10.1 Carbon Factor ($kgCO_2$/kWh)
Mains Gas	0.216	0.216	0.210
Electricity (average)	0.519	0.233	0.136

It is recommended that the project building control officer or approved inspector is consulted to confirm expectations in relation to future regulation.

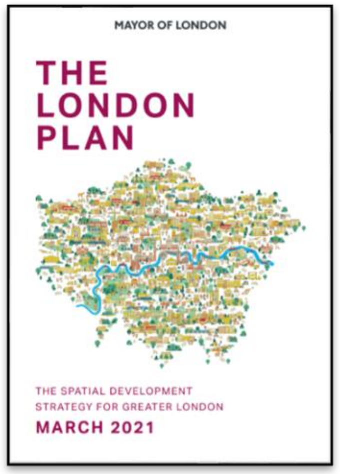
Regional

This section summarises key regional and local planning policy relating to energy and wider sustainability considerations. The following documents have been reviewed.

- The London Plan 2021
- LBRuT Local Plan 2018

Greater London Authority – London Plan (2021).

The London Plan was updated and adopted in March 2021. Key policy targets as follows:



- Major development to be Net Zero Carbon (i.e. 100% reduction in regulated CO_2 emissions from the relevant Building Regulations baseline).
- Minimum 35% on-site emissions reduction.
- Minimum 15% (non-residential) reduction in regulated CO_2 through energy efficiency measures.
- Commitment to energy monitoring and reporting in the first 5 years of building occupation
- Revised Proposed Developments to demonstrate a pathway to zero carbon on-site by 2050, with any short fall to the net-zero target covered by either.
- Cash in lieu payments to the borough's carbon offset fund, or
- Off-site (offsetting) provided that an alternative proposal is identified, and delivery is certain.

The plan also sets targets and policies for further sustainability measures such as:

- Improving Air Quality
- Energy infrastructure
- Managing heat risk
- Water infrastructure
- Reducing waste
- Aggregates

Additional supporting guidance from the GLA includes:

- Energy Assessment Guidance
- Whole Life Carbon
- Circular Economy Statement
- Be Seen guidance

London Borough of Richmond upon Thames (LBRuT).

Policy Local Plan 10: Local Environmental Impacts, Pollution and Land Contamination

The Council will seek to ensure that local environmental impacts of all development proposals do not lead to detrimental effects on the health, safety and the amenity of existing and new users or occupiers of the development site, or the surrounding land. These potential impacts can include, but are not limited to, air pollution, noise and vibration, light pollution, odours and fumes, solar glare and solar dazzle as well as land contamination.

Developers should follow any guidance provided by the Council on local environmental impacts and pollution as well as on noise generating and noise sensitive development. Where necessary, the Council will set planning conditions to reduce local environmental impacts on adjacent land uses to acceptable levels.

Air Quality

The Council promotes good air quality design and new technologies. Developers should secure at least 'Emissions Neutral' development. To consider the impact of introducing new developments in areas already subject to poor air quality, the following will be required:

- an air quality impact assessment, including where necessary, modelled data;
- mitigation measures to reduce the development's impact upon air quality, including the type of equipment installed, thermal insulation and ducting abatement technology;
- measures to protect the occupiers of new developments from existing sources;
- strict mitigation for developments to be used by sensitive receptors such as schools, hospitals and care homes in areas of existing poor air quality; this also applies to proposals close to developments used by sensitive receptors.

Noise and Vibration

The Council encourages good acoustic design to ensure occupiers of new and existing noise sensitive buildings are protected. The following will be required, where necessary:

- a noise assessment of any new plant and equipment and its impact upon both receptors and the general background noise levels;
- mitigation measures where noise needs to be controlled and managed;
- time limits and restrictions for activities where noise cannot be sufficiently mitigated;
- promotion of good acoustic design and use of new technologies;
- measures to protect the occupiers of new developments from existing sources.

Light Pollution

The Council will seek to ensure that artificial lighting in new developments does not lead to unacceptable impacts by requiring the following, where necessary:

- an assessment of any new lighting and its impact upon any receptors;
- mitigation measures, including the type and positioning of light sources;
- promotion of good lighting design and use of new technologies.

Odours and Fume Control

The Council will seek to ensure that any potential impacts relating to odour and fumes from commercial activities are adequately mitigated by requiring the following:

- an impact assessment where necessary;
- the type and nature of filtration to be used;
- the height and position of any chimney or outlet;
- promotion and use of new abatement technologies;

Policy LP 20: Climate Change Adaption

The Council will promote and encourage development to be fully resilient to the future impacts of climate change in order to minimise vulnerability of people and property.

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

- minimise internal heat generation through energy efficient design

- reduce the amount of heat entering a building in summer through shading, reducing solar reflectance, fenestration, insulation and green roofs and walls
- manage the heat within the building through exposed internal thermal mass and high ceilings
- passive ventilation
- mechanical ventilation
- active cooling systems (ensuring they are the lowest carbon options).

Opportunities to adapt existing buildings, places and spaces to the likely effects of climate change should be maximised and will be supported.

Policy LP 22: Sustainable Design and Construction
Developments will be required to achieve the highest standards of sustainable design and construction to mitigate the likely effects of climate change. Applicants will be required to complete the following:

- Development of 1 dwelling unit or more, or 100sqm or more of non-residential floor space (including extensions) will be required to complete the Sustainable Construction Checklist SPD. A completed Checklist has to be submitted as part of the planning application.
- Development that results in a new residential dwelling, including conversions, change of use, and extensions that result in a new dwelling unit, will be required to incorporate water conservation measures to achieve maximum water consumption of 110 litres per person per day for homes (including an allowance of 5 litres or less per person per day for external water consumption).
- New non-residential buildings over 100sqm will be required to meet BREEAM 'Excellent' standard.
- Proposals for change of use to residential will be required to meet BREEAM Domestic Refurbishment 'Excellent' standard (where feasible).

Reducing Carbon Dioxide Emissions

Developers are required to incorporate measures to improve energy conservation and efficiency as well as contributions to renewable and low carbon energy generation. Proposed developments are required to meet the following minimum reductions in carbon dioxide emissions:

- All new major residential developments (10 units or more) should achieve zero carbon standards in line with London Plan policy.
- All other new residential buildings should achieve a 35% reduction.
- All non-residential buildings over 100sqm should achieve a 35% reduction. From 2019 all major non-residential buildings should achieve zero carbon standards in line with London Plan policy.

Targets are expressed as a percentage improvement over the target emission rate (TER) based on Part L of the 2013 Building Regulations.

This should be achieved by following the Energy Hierarchy:

- Be lean: use less energy
- Be clean: supply energy efficiently
- Be green: use renewable energy

Decentralised Energy Networks

The Council requires developments to contribute towards the Mayor of London target of 25% of heat and power to be generated through localised decentralised energy (DE) systems by 2025. The following will be required:

- All new development will be required to connect to existing DE networks where feasible. This also applies where a DE network is planned and expected to be operational within 5 years of the development being completed.
- Development proposals of 50 units or more, or new non-residential development of 1000sqm or more, will need to provide an assessment of the provision of on-site decentralised energy (DE) networks and combined heat and power (CHP).
- Where feasible, new development of 50 units or more, or new non-residential development of 1000sqm or more, as well as schemes for the Proposal Sites identified in this Plan, will need to provide on-site DE and CHP; this is particularly necessary within the clusters identified for DE opportunities in the borough-wide Heat Mapping Study. Where on-site provision is not feasible, provision should be made for future connection to a local DE network should one become available.

Applicants are required to consider the installation of low, or preferably ultra-low, NOx boilers to reduce the amount of NOx emitted in the borough.

Local opportunities to contribute towards decentralised energy supply from renewable and low-carbon technologies will be encouraged where appropriate.

Appendix B - Technical parameters.

Compliance software and procedure.

The Proposed Development has been assessed using The National Calculation Methodology for demonstrating compliance with Approved Document Part L.

Part L1A compliance

In order to assess the residential aspects of the Proposed Developments, the methodology detailed in the Standard Assessment Procedure (SAP) 2012 was used. Calculations used compliant modelling software were conducted for the Be Lean stage of the energy hierarchy.

Assumed building fabric and services performance are detailed in the 'calculation parameters' section.

Part L2A compliance

A dynamic simulation model was created to assess the design of the non-dwelling areas, cinema, office and school.

Integrated Environmental Solutions Virtual Environment (IES VE) is a Dynamic Simulations Modelling (DSM) software package which has the capabilities of enabling the user to create a virtual representation of a building. The results presented in this report were calculated using the approved compliance software IES VE 2019.

The IES model for the Proposed Development was drawn to geometry received from Squire and Partners.

IES modelling disclaimer

The calculations produced by Hoare Lea have been carried out with the information provided by Squire and Partners to determine whether the Proposed Development can achieve compliance with Approved Document Part L2A of the Building Regulations.

It should be noted that the data generated by this work is obtained using computer simulations. These simulations are the best means of predicting the performance of the building at this stage. Full certainty can only be achieved by measuring the performance of the building and associated systems after a period of use.

The actual energy usage for the building once occupied may vary from the calculated values submitted to Building Control. These differences will occur due to a number of variable parameters between the modelled building and the actual building. Such differences will include the hours, levels of occupancy, how the plant is used and the design criteria with regards to how the rooms are environmentally controlled.

Whilst the simulations have been undertaken in good faith using reasonable skill and care, Hoare Lea can take no responsibility for differences between the computer simulations and the actual performance of the completed building due to the inherent complexity and variability of the physics in a building and its environment.

Calculation parameters.

The following tables give the parameters used to conduct the Part L compliant modelling for the Proposed Development.

Fabric parameters

The fabric performance parameters used to model the Proposed Development are as follows.

Table 32: Target building fabric performance parameters.

Parameter	Dwellings	Non-dwellings
Exposed Floor U-value (W/m^2K)	0.15	0.20
External Wall U-value (W/m^2K)	0.12	0.18 – 0.20
Roof U-value (W/m^2K)	0.15	0.15 - 0.20
Glazing U-value (W/m^2K)	1.20 (g value: 0.29)	1.30 – 1.60
Roof Light Glazing U-value (W/m^2K)	N/A	0.40
Air Permeability ($m^3/h.m^2$) @ 50Pa	3.00	5.00

System parameters

The systems performance parameters used to model the Proposed Development are as follows.

Table 33: System parameters per space type.

	Dwelling Areas	Non-dwellings
Space Heating & Cooling	Centralised Air Source Heat Pump (ASHP) (300% efficiency) with Heat Interface Units (HIU) per dwelling coupled to hot water systems and fan coil units / underfloor heating.	Centralised Air Source Heat Pump (ASHP) (300% efficiency) with heat exchangers and Fan Coil Units.
Domestic Hot Water	Water efficient fixtures and fittings to minimise water demand. HIU with minimal heat loss	
Cooling	No cooling.	High-efficiency chillers with an SEER of 5.0.
Ventilation	MVHR with specific fan power 0.4-0.53 with Heat Recovery of 91-94%	Target SFP of 1.6W/l/s and HR of 75%
Lighting	High efficiency lighting. Daylight and presence detection in common areas / roof terraces.	Target efficacy of >70 luminaire lumens per circuit Watt.

Appendix C - Overheating analysis.

The GLA domestic overheating checklist is provided below for reference. A TM59 analysis of the dwellings and residential accommodation was also undertaken to assess the risk of overheating.

Table 34: GLA domestic overheating checklist

Section 1 – Site Features Affecting Vulnerability to Overheating		Yes or No?
Site Location	Urban – within central London or high density conurbation	No
	Peri-urban – on the suburban fringes of London	Yes - Richmond
Air Quality and/or Noise sensitivity – are any of the following in the vicinity of the building	Busy roads / A roads	Yes
	Railways / Overground / DLR	No
	Airport / Flight Path	Yes
	Industrial uses / waste facility	No
Proposed Building Uses	Will any buildings be occupied by vulnerable people (e.g. elderly, disabled, young children)?	Yes
	Are residents likely to be at home during the day (e.g. students)?	No.
Dwelling Aspect	Are there any single aspect units?	Yes
Glazing ratio	Is the glazing ratio (glazing: internal floor area) greater than 25%?	Yes
	If yes, is this to allow acceptable levels of daylighting?	Yes
Security – Are there any security issues that could limit opening of windows for ventilation?	Single storey ground floor units	Yes
	Vulnerable areas identified by the Police Architectural Liaison Officer	TBC
	Other	No
Section 2 – Design Features Implemented to Mitigate Overheating Risk		Please Respond
Landscaping	Will deciduous trees be provided for summer shading (to windows and pedestrian routes)?	Yes
	Will green roofs be provided?	Yes
	Will other green or blue infrastructure be provided around buildings for evaporative cooling?	Yes
Materials	Have high albedo (light colour) materials been specified?	Yes – preference of material selection with high albedo
Dwelling Aspect	% of total units that are single aspect	Refer to architect's drawings and DAS.
	% of single aspect with N/NE/NW orientation	
	% single aspect with E orientation	
	% single aspect with S/SE/SW orientation	
	% single aspect with W orientation	
	N/NE/NW	

Section 1 – Site Features Affecting Vulnerability to Overheating		Yes or No?
Glazing Ratio – What is the glazing ratio (glazing – internal floor area) on each façade?	E	Refer to architect's drawings and DAS.
	S/SE/SW	
	W	
Daylighting Window Opening	What is the average daylight factor range	Refer to architect's drawings and DAS.
	Are windows openable?	Yes
	What is the average percentage of openable area for the windows?	90% - accounting for frame factor
Window Opening – what is the extent of the opening?	Fully openable	Yes - sliding doors and french doors
	Limited (e.g. for security, safety, wind loading reasons)	Yes - restrictions on top hung and side hung windows of 300mm opening.
Security	Where there are security issues (e.g. ground floor flats) has an alternative night time natural ventilation method been provided (e.g. ventilation grates)?	No – MVHR provides ventilation
Shading	Is there any external shading?	Yes – accounted in the massing e.g. balconies
	Is there any internal shading?	Yes – Blinds to be included in the base build.
Glazing Specification	Is there any solar control glazing?	Glazing with g-value of 0.35 will be specified.
Ventilation – what is the ventilation strategy?	Natural - background	Yes – openable windows
	Natural – purge	Yes – openable windows
	Mechanical – background (e.g. MVHR)	Yes - MVHR
	Mechanical – purge	Yes –boost via MVHR and mechanical extract fans
	Average Design ACH	Up to 4 ACH
Heating System	Is communal heating present?	Yes – connections via HIU
	What is the flow/return temperature?	Subject to detailed design
	Have horizontal pipe runs been minimized?	Yes
	Do the specifications include insulation levels in line with the London Heat Network Manual?	Yes

The typical floor for Block 08 has been used as a best representation of apartments on the site. An assessment has been carried out using weather scenarios Design Summer Year (DSY) 1, 2 and 3 have been used for the appropriate location for completeness.

The model used for the basis of the assessment is outlined in Figure 10.

Residential buildings that overheat cause significant discomfort and stress to their occupants and reduce sleep quality. There are several reasons for the increase in overheating risk in residential buildings. Contributing factors include the increase in single aspect building forms (that don't allow sufficient cross-flow ventilation), the trend towards larger areas of glazing, climate change, the urban heat island effect and inadequate means of ventilation.

It has also become increasingly evident that the limitations of how overheating risk is assessed within Building Regulations Criterion 3 are not always completely understood or fully communicated to project stakeholders.

CIBSE have published guidance documents which present methodologies for assessing overheating risk based on dynamic thermal simulation of buildings. The CIBSE guidance also references BS EN 15251 which is the applicable standard. The most recent guidance (TM59 - 2017) includes a standardised methodology for thermal modelling of residential buildings during design, which specifies occupancy densities, occupancy profiles and internal heat gains to be used within the assessment. It also clarifies the criteria which apply, based on the predominant ventilation method (i.e. natural or mechanical ventilation).

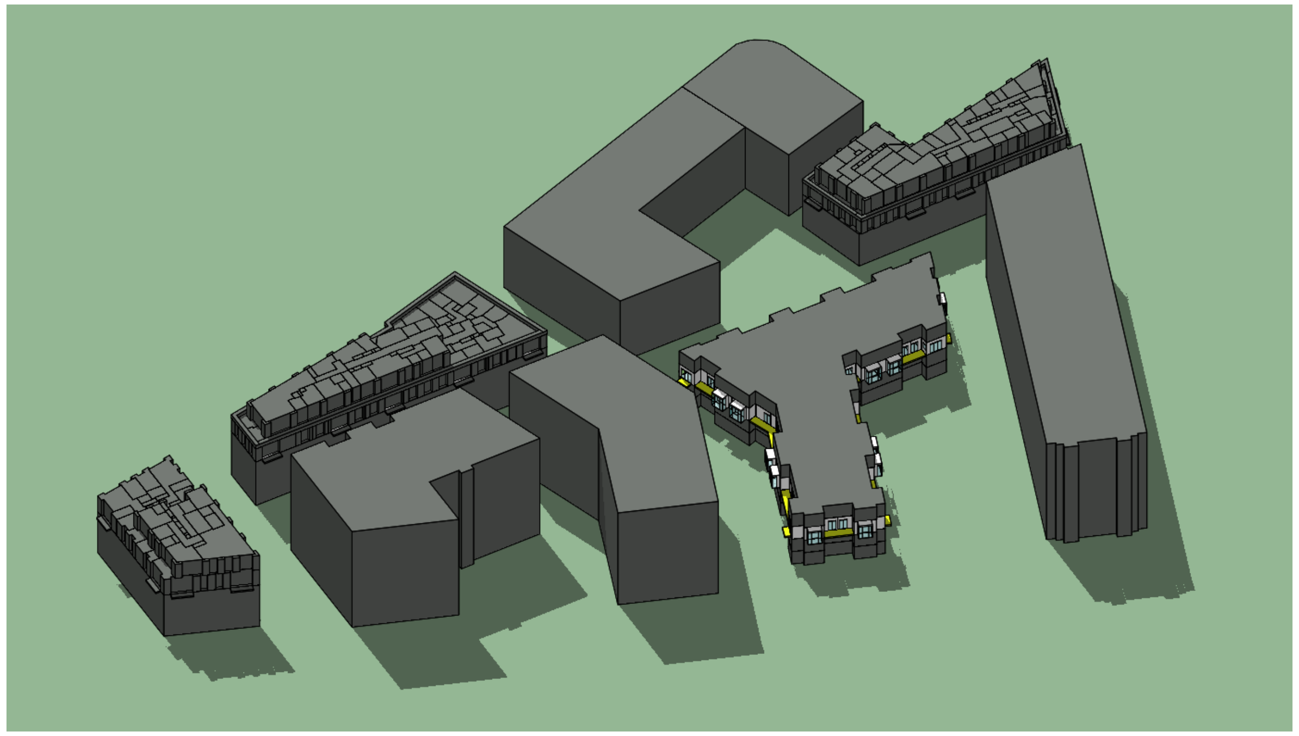


Figure 10: IES model used for the assessment.

Assessment criteria.

CIBSE TM59.
CIBSE TM59:2017 is a guidance document for assessing overheating risk in residential buildings. The guidance builds upon the requirements outlined in CIBSE TM52: 2013 Limits of thermal comfort: avoiding overheating in European Buildings (2013) and CIBSE Guide A 2015: Environmental Design.

CIBSE TM59 provides a standardised methodology for assessing and reporting overheating risk in new and refurbished homes and is now the industry standard for assessing overheating risk in residential projects.

The guidance includes a set of prescriptive internal gains and their associated timed profiles that represent reasonable usage patterns for a home suitable for evaluating overheating risk.

Risk assessment criteria

TM59 provides a standardised methodology for assessing and reporting overheating risk in new and refurbished homes.

Table 35 provides a summary of the overheating risk criteria.

Table 35: Summary of TM59 Assessment Criteria.

CIBSE Residential Overheating Criteria	
Adaptive Criteria:	For living rooms, kitchens and bedrooms: Internal temperatures should not exceed a threshold (linked to outside air temperature) for more than 3% of occupied hours (May – Sept). Additionally, for bedrooms only: At night (22:00-07:00hrs) internal temperatures should not exceed 26°C for more than 1% of occupied hours (Jan – Dec).
Communal Corridors	
Recommended test to ensure that corridors do not exceed operative temperature of 28°C for more than 3% of total annual hours (262 hours or less).	

Methodology.

Initial input parameters.
The following table provides an overview of the input parameters and modelling assumptions used to carry out the preliminary analysis.

Table 36: Modelling inputs.

Software	IES 2018.2.0.0	Wall U-value	0.12 W/m^2.K
Weather Data	Design Summer Year (DSY1) LHR_DSY1_2020High50	Window U-value	1.40 W/m^2.K
Assessment Criteria	CIBSE TM59	Window g-value	0.4
Assessment Season	Non-heating season (1st May-30th September)	Roof U-value	0.15 W/m^2.K
Occupancy	Bedrooms: 24/7 Communal living/kitchen: 9am-10pm	Floor U-value	0.15 W/m^2.K
Max Occupancy	Single bedroom – 1 person Double bedroom – 2 person Living / dining: – 1 bedroom – 1 person – 2 bedroom – 2 people – 3 bedroom – 3 people – 4 bedroom – 4 people	Window covering (SF = shading factor)	Blinds – shading coefficient 0.4 (black out)
Occupancy Heat Gains	75W / person (Sensible) 55W / person (Latent)	Infiltration	0.15 ACH

Software	IES 2018.2.0.0	Wall U-value	0.12 W/m^2.K
Communal Corridor and Riser Internal Gains	8 W/m flow and return	Lighting gains	2 W/m^2 (All areas)
Max equipment gains – Kitchen and living	Kitchen – 300W peak Living – 150W peak	Max equipment gains – bedroom	80 W (as per CIBSE TM59)
Domestic hot water storage losses	Heat interface unit heat loss: – 78W	MVHR ventilation rate and pick up (°C)	Please refer to Table 38. 1°C pick up assumed. (Used in Iteration 3 only)

Improved parameters.
The following table provides an overview of the improved parameters and modelling assumptions that were used to demonstrate a route to meet compliance with TM59 for the assessed dwellings.

Table 37: Modelling inputs (improved).

Parameter	Improved performance
Communal corridor and riser internal gains	7 W/m flow and return
Window g-value	0.29
Window covering (SF = Shading factor)	Blinds – shading Coefficient 0.1 (black out)

Sample spaces.
A typical floor of Block 08 has been assessed which is considered representative of the dwellings at the Proposed Development. The floor consists of thirteen apartments in total. The sample dwellings account for changes in orientation, glazing ratio, internal layouts and external environmental conditions.

Figure 11 shows the floor plan for Typical Floor Block 08 which has been used in this assessment.

Weather files.
The results for the Dynamic Simulation Modelling (DSM) presented in this report have been based on the following weather files appropriate to the location:

1. Design Summer Year 1 (DSY1) – London_LHR_DSY1_2020High50
2. Design Summer Year 2 (DSY2) – London_LHR_DSY2_2020High50
3. Design Summer Year 3 (DSY3) – London_LHR_DSY3_2020High50

Reporting criteria.
As per the results submitted as part of the planning application, the building has been assessed in accordance with the adaptive comfort criteria as listed in Table 35.

Ventilation.

Mechanical
Mechanical ventilation rates assumed for the model are as follows.

Table 38: Mechanical ventilation rates.

Unit type	Total flow rate (l/s)	Flow rate to living, kitchen, diner (l/s)	Flow rate to bedrooms (l/s)
One-bedroom unit	200	120	80
Two-bedroom unit	280	120	80
Three-bedroom unit	360	120	80
Four-bedroom unit	440	120	80

Natural – window openings
Windows have been assumed to be open 24 hours.

Table 39: Summary of window opening type.

Opening type	Restriction	Degree of opening (°)	Equivalent free area (%)
Top hung No.1	300mm restriction	13° – 21°	45-65%
Sliding Juliet balcony	No restriction	N/A	100%
Balcony door	No restriction	90°	100%

Blinds.
Dark coloured/black out internal blinds included in all iterations. It is important to note that where blinds have been used, for the natural ventilation strategy, a reduction in the achieved free area of the windows / opening doors has not been accounted for in the model.

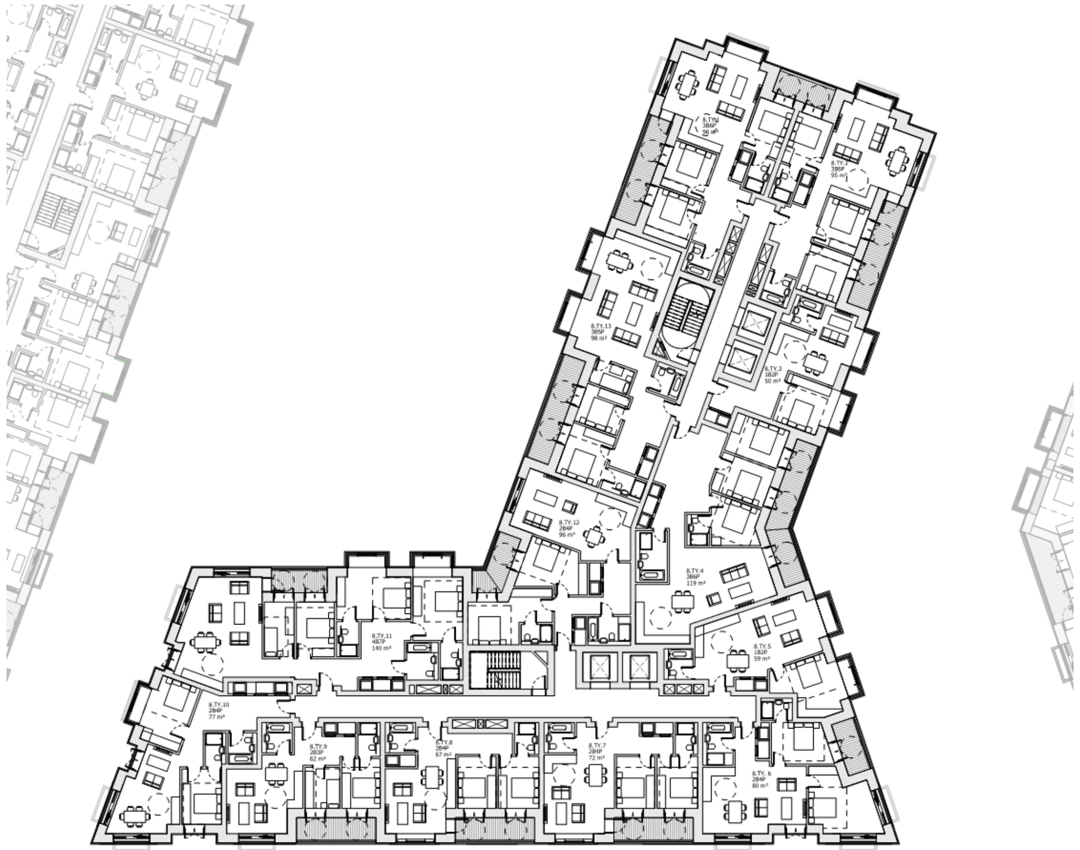


Figure 11: Dwellings assessed.

Results.

DSY1.

Based on the input parameters and methodology outlined in section 3.0, it has been demonstrated that the majority of assessed dwellings can meet the CIBSE TM59 adaptive criteria for DSY1.

The following scenarios have been assessed as part of the analysis:

- Natural ventilation only, with blinds.
- Natural ventilation only with improved performance parameters (Table 37).
- Hybrid ventilation strategy where natural and mechanical ventilation is being used concurrently

It is important to note that where blinds have been used, for the natural ventilation strategy, a reduction in the achieved free area of the windows / opening doors has not been accounted for in the model.

Table 40: Summary of adaptive criteria results based on various ventilation scenarios – DSY1.

	% meeting adaptive comfort criteria		Corridors
	TM59 criterion 1 Kitchens, living rooms and bedrooms <3% occ. hours exceed comfort temp (May – Sept)	TM59 criterion 2 Bedrooms only <26°C for <1% occ. hours	28°C operative temperature target <3% of annual hours
Natural ventilation only with blinds	70% (30/43)	83% (25/30)	0% (0/2)
Natural ventilation with improved parameters (Table 37)	93% (40/43)	83% (25/30)	0% (0/2)
Improved parameters with hybrid ventilation	100% (43/43)	100% (30/30)	100% (2/2)

DSY2.

In addition to the assessment using DSY1, the dwellings have also been assessed using the DSY2 summer year. Results are presented in the table below.

Table 41: Summary of adaptive criteria results based on various ventilation scenarios – DSY2.

	% meeting adaptive comfort criteria		Corridors
	TM59 criterion 1 Kitchens, living rooms and bedrooms <3% occ. hours exceed comfort temp (May – Sept)	TM59 criterion 2 Bedrooms only <26°C for <1% occ. hours	28°C operative temperature target <3% of annual hours
Natural ventilation only with blinds	65% (28/43)	83% (25/30)	0% (0/2)
Natural ventilation with improved parameters (Table 37)	70% (30/43)	83% (25/30)	0% (0/2)
Improved parameters with hybrid ventilation	72% (31/43)	83% (25/30)	100% (2/2)

DSY3.
A final model iteration was run using the DSY3 weather file.

Table 42: Summary of adaptive criteria results based on various ventilation scenarios – DSY3.

	% meeting adaptive comfort criteria		Corridors
	TM59 criterion 1 Kitchens, living rooms and bedrooms <3% occ. hours exceed comfort temp (May – Sept)	TM59 criterion 2 Bedrooms only <26°C for <1% occ. hours	28°C operative temperature target <3% of annual hours
Natural ventilation only with blinds	2% (1/43)	3% (1/30)	0% (0/2)
Natural ventilation with improved parameters (Table 37)	7% (3/43)	3% (1/30)	0% (0/2)
Improved parameters with hybrid ventilation	7% (3/43)	3% (1/30)	0% (0/2)

Conclusion.
This document has presented the results of an updated overheating assessment on a sample of dwellings at the Stag Brewery development.

This Energy Strategy summarises the results of additional risk assessments undertaken following the amendments of the development design and layouts. The typical floor for Block 08 has been used as a best representation of apartments on the site. An assessment has been carried out using weather scenarios Design Summer Year (DSY) 1, 2 and 3 have been used for the appropriate location for completeness.

Three scenarios have been included in the analysis:

- Natural ventilation only with blinds
- Natural ventilation with improved performance parameters and blinds
- Hybrid ventilation (i.e. openable windows and mechanical ventilation with heat recovery (MVHR)), improved performance parameters and blinds.

The results demonstrate that based on the updated design and parameters used within this report, the majority all assessed dwellings are able to meet the TM59 criteria for DSY1 climate based on a hybrid ventilation strategy and 'black out' blinds.

In regard to the communal corridors, as they are internal to the core of the building (i.e. no windows) they will rely on mechanical ventilation to meet the criteria. If this is provided, the criteria can be met.

Appendix D – CIBSE TM59 results on a room by room basis.

DSY 1.

Iteration 1 – Natural ventilation only

Table 43: Iteration 1 - Overheating risk results on a room by room basis (DSY1).

Room Name	TM52 Criterion 1	% Hours >26°C (bedrooms only)	Result
B08 8.TY.10 2B () Bedroom 2	1.91%	0.64%	Risk criteria met
B08 8.TY.9 2B Bedroom 2	2.18%	0.67%	Risk criteria met
B08 8.TY.9 2B Bedroom 1	2.23%	0.64%	Risk criteria met
B08 8.TY.8 2B Bedroom 1	2.07%	0.64%	Risk criteria met
B08 8.TY.8 2B Bedroom 2	1.96%	0.64%	Risk criteria met
B08 8.TY.7 2B Bedroom 2	2.04%	0.64%	Risk criteria met
B08 8.TY.7 2B Bedroom 1	2.07%	0.64%	Risk criteria met
B08 8.TY.6 2B Bedroom	1.99%	0.46%	Risk criteria met
B08 8.TY.6 2B Bedroom2	1.85%	0.67%	Risk criteria met
B08 8.TY.11 4B Bedroom 4	1.96%	0.49%	Risk criteria met
B08 8.TY.11 4B Bedroom 3	1.77%	0.61%	Risk criteria met
B08 8.TY.12 2B Bedroom 1	1.20%	0.61%	Risk criteria met
B08 8.TY.12 2B Bedroom 2	1.55%	0.67%	Risk criteria met
B08 8.TY.13 3B Bedroom	1.77%	0.64%	Risk criteria met
B08 8.TY.13 3B Bedroom 2	2.02%	0.64%	Risk criteria met
B08 8.TY.13 3B Bedroom 3	2.29%	0.61%	Risk criteria met
B08 8.TY.4 3B Bedroom 3	1.85%	0.64%	Risk criteria met
B08 8.TY.4 3B Bedroom 2	1.82%	0.64%	Risk criteria met
B08 8.TY.4 3B Bedroom 1	1.66%	0.64%	Risk criteria met
B08 8.TY.2 3B Bedroom 2	1.91%	0.64%	Risk criteria met
B08 8.TY.2 3B Bedroom 1	1.72%	0.64%	Risk criteria met
B08 8.TY.1 3B Bedroom 3	1.91%	0.64%	Risk criteria met
B08 8.TY.1 3B Bedroom 2	1.93%	0.64%	Risk criteria met
B08 8.TY.1 3B Bedroom 1	1.93%	0.64%	Risk criteria met
B08 8.TY.5 1B Bedroom	2.45%	1.92%	Risk criteria not met
B08 8.TY.3 1B Bedroom	3.46%	1.70%	Risk criteria not met
B08 8.TY.11 4B Bedroom	1.47%	1.31%	Risk criteria not met
B08 8.TY.11 4B Bedroom	1.74%	1.37%	Risk criteria not met

Room Name	TM52 Criterion 1	% Hours >26°C (bedrooms only)	Result
B08 8.TY.10 2B Bedroom	2.29%	1.34%	Risk criteria not met
B08 8.TY.2 3B Bedroom	1.93%	0.64%	Risk criteria met
B08 8.TY.10 2B () Living Area	3.52%		Risk criteria not met
B08 8.TY.9 2B Living Area	3.97%		Risk criteria not met
B08 8.TY.8 2B Living Area	5.13%		Risk criteria not met
B08 8.TY.7 2B Living Area	4.37%		Risk criteria not met
B08 8.TY.6 2B Living Area	4.22%		Risk criteria not met
B08 8.TY.11 4B () Living Area	3.17%		Risk criteria not met
B08 8.TY.12 2B Living Area	3.17%		Risk criteria not met
B08 8.TY.4 3B Living Area	1.66%		Risk criteria met
B08 8.TY.3 1B living Area	3.22%		Risk criteria not met
B08 8.TY.1 3B Living Area	3.57%		Risk criteria not met
B08 8.TY.13 Living Area	3.27%		Risk criteria not met
B08 8.TY.5 1B living Area	3.67%		Risk criteria not met
B08 8.TY.2 3B Living Area	3.12%		Risk criteria not met

Iteration 2 – Natural ventilation with improved parameters

Table 44: Iteration 2 - Overheating risk results on a room by room basis (DSY1).

Room Name	TM52 Criterion 1	% Hours >26°C (bedrooms only)	Result
B08 8.TY.10 2B () Bedroom 2	1.72%	0.61%	Risk criteria met
B08 8.TY.9 2B Bedroom 2	1.93%	0.64%	Risk criteria met
B08 8.TY.9 2B Bedroom 1	1.96%	0.64%	Risk criteria met
B08 8.TY.8 2B Bedroom 1	1.93%	0.64%	Risk criteria met
B08 8.TY.8 2B Bedroom 2	1.82%	0.64%	Risk criteria met
B08 8.TY.7 2B Bedroom 2	1.85%	0.64%	Risk criteria met
B08 8.TY.7 2B Bedroom 1	1.88%	0.64%	Risk criteria met
B08 8.TY.6 2B Bedroom	1.80%	0.43%	Risk criteria met
B08 8.TY.6 2B Bedroom2	1.58%	0.64%	Risk criteria met
B08 8.TY.11 4B Bedroom 4	1.91%	0.49%	Risk criteria met
B08 8.TY.11 4B Bedroom 3	1.61%	0.58%	Risk criteria met
B08 8.TY.12 2B Bedroom 1	1.12%	0.61%	Risk criteria met
B08 8.TY.12 2B Bedroom 2	1.42%	0.64%	Risk criteria met

Room Name	TM52 Criterion 1	% Hours >26°C (bedrooms only)	Result
B08 8.TY.13 3B Bedroom	1.58%	0.61%	Risk criteria met
B08 8.TY.13 3B Bedroom 2	1.85%	0.58%	Risk criteria met
B08 8.TY.13 3B Bedroom 3	2.04%	0.58%	Risk criteria met
B08 8.TY.4 3B Bedroom 3	1.55%	0.64%	Risk criteria met
B08 8.TY.4 3B Bedroom 2	1.63%	0.61%	Risk criteria met
B08 8.TY.4 3B Bedroom 1	1.53%	0.61%	Risk criteria met
B08 8.TY.2 3B Bedroom 2	1.66%	0.61%	Risk criteria met
B08 8.TY.2 3B Bedroom 1	1.53%	0.58%	Risk criteria met
B08 8.TY.1 3B Bedroom 3	1.63%	0.61%	Risk criteria met
B08 8.TY.1 3B Bedroom 2	1.74%	0.64%	Risk criteria met
B08 8.TY.1 3B Bedroom 1	1.66%	0.61%	Risk criteria met
B08 8.TY.5 1B Bedroom	1.12%	1.64%	Risk criteria not met
B08 8.TY.3 1B Bedroom	1.53%	1.34%	Risk criteria not met
B08 8.TY.11 4B Bedroom	0.71%	1.10%	Risk criteria not met
B08 8.TY.11 4B Bedroom	0.79%	1.22%	Risk criteria not met
B08 8.TY.10 2B Bedroom	1.36%	1.28%	Risk criteria not met
B08 8.TY.2 3B Bedroom	1.63%	0.61%	Risk criteria met
B08 8.TY.10 2B () Living Area	3.07%		Risk criteria not met
B08 8.TY.9 2B Living Area	2.82%		Risk criteria met
B08 8.TY.8 2B Living Area	3.92%		Risk criteria not met
B08 8.TY.7 2B Living Area	3.07%		Risk criteria not met
B08 8.TY.6 2B Living Area	3.67%		Risk criteria not met
B08 8.TY.11 4B () Living Area	2.77%		Risk criteria met
B08 8.TY.12 2B Living Area	2.41%		Risk criteria met
B08 8.TY.4 3B Living Area	1.46%		Risk criteria met
B08 8.TY.3 1B living Area	1.56%		Risk criteria met
B08 8.TY.1 3B Living Area	2.61%		Risk criteria met
B08 8.TY.13 Living Area	2.16%		Risk criteria met
B08 8.TY.5 1B living Area	2.11%		Risk criteria met
B08 8.TY.2 3B Living Area	2.46%		Risk criteria met

Iteration 3 – Hybrid ventilation with improved parameters

Table 45: Iteration 3 - Overheating risk results on a room by room basis (DSY1).

Room Name	TM52 Criterion 1	% Hours >26°C (bedrooms only)	Result
B08 8.TY.10 2B () Bedroom 2	1.85%	0.58%	Risk criteria met
B08 8.TY.9 2B Bedroom 2	1.93%	0.61%	Risk criteria met
B08 8.TY.9 2B Bedroom 1	1.96%	0.55%	Risk criteria met
B08 8.TY.8 2B Bedroom 1	1.93%	0.58%	Risk criteria met
B08 8.TY.8 2B Bedroom 2	1.88%	0.58%	Risk criteria met
B08 8.TY.7 2B Bedroom 2	1.91%	0.61%	Risk criteria met
B08 8.TY.7 2B Bedroom 1	1.93%	0.58%	Risk criteria met
B08 8.TY.6 2B Bedroom	1.82%	0.43%	Risk criteria met
B08 8.TY.6 2B Bedroom2	1.77%	0.61%	Risk criteria met
B08 8.TY.11 4B Bedroom 4	1.96%	0.49%	Risk criteria met
B08 8.TY.11 4B Bedroom 3	1.82%	0.55%	Risk criteria met
B08 8.TY.12 2B Bedroom 1	1.17%	0.58%	Risk criteria met
B08 8.TY.12 2B Bedroom 2	1.44%	0.61%	Risk criteria met
B08 8.TY.13 3B Bedroom	1.74%	0.58%	Risk criteria met
B08 8.TY.13 3B Bedroom 2	1.99%	0.55%	Risk criteria met
B08 8.TY.13 3B Bedroom 3	2.10%	0.55%	Risk criteria met
B08 8.TY.4 3B Bedroom 3	1.80%	0.58%	Risk criteria met
B08 8.TY.4 3B Bedroom 2	1.88%	0.55%	Risk criteria met
B08 8.TY.4 3B Bedroom 1	1.66%	0.58%	Risk criteria met
B08 8.TY.2 3B Bedroom 2	1.85%	0.58%	Risk criteria met
B08 8.TY.2 3B Bedroom 1	1.63%	0.58%	Risk criteria met
B08 8.TY.1 3B Bedroom 3	1.88%	0.58%	Risk criteria met
B08 8.TY.1 3B Bedroom 2	1.91%	0.58%	Risk criteria met
B08 8.TY.1 3B Bedroom 1	1.85%	0.58%	Risk criteria met
B08 8.TY.5 1B Bedroom	1.17%	0.88%	Risk criteria met
B08 8.TY.3 1B Bedroom	1.61%	0.88%	Risk criteria met
B08 8.TY.11 4B Bedroom	0.98%	0.82%	Risk criteria met
B08 8.TY.11 4B Bedroom	1.20%	0.85%	Risk criteria met
B08 8.TY.10 2B Bedroom	1.61%	0.88%	Risk criteria met
B08 8.TY.2 3B Bedroom	1.82%	0.58%	Risk criteria met
B08 8.TY.10 2B () Living Area	2.92%		Risk criteria met

Room Name	TM52 Criterion 1	% Hours >26°C (bedrooms only)	Result
B08 8.TY.9 2B Living Area	2.21%		Risk criteria met
B08 8.TY.8 2B Living Area	2.71%		Risk criteria met
B08 8.TY.7 2B Living Area	2.26%		Risk criteria met
B08 8.TY.6 2B Living Area	2.97%		Risk criteria met
B08 8.TY.11 4B () Living Area	2.56%		Risk criteria met
B08 8.TY.12 2B Living Area	2.11%		Risk criteria met
B08 8.TY.4 3B Living Area	1.11%		Risk criteria met
B08 8.TY.3 1B living Area	1.31%		Risk criteria met
B08 8.TY.1 3B Living Area	2.41%		Risk criteria met
B08 8.TY.13 Living Area	1.86%		Risk criteria met
B08 8.TY.5 1B living Area	1.46%		Risk criteria met
B08 8.TY.2 3B Living Area	2.26%		Risk criteria met

DSY 2.

Iteration 1 – Natural ventilation only

Table 46: Iteration 1 - Overheating risk results on a room by room basis (DSY2).

Room Name	TM52 Criterion 1	% Hours >26°C (bedrooms only)	Result
B08 8.TY.10 2B () Bedroom 2	2.53%	0.91%	Risk criteria met
B08 8.TY.9 2B Bedroom 2	2.72%	0.91%	Risk criteria met
B08 8.TY.9 2B Bedroom 1	2.72%	0.79%	Risk criteria met
B08 8.TY.8 2B Bedroom 1	2.67%	0.88%	Risk criteria met
B08 8.TY.8 2B Bedroom 2	2.64%	0.91%	Risk criteria met
B08 8.TY.7 2B Bedroom 2	2.67%	0.91%	Risk criteria met
B08 8.TY.7 2B Bedroom 1	2.61%	0.88%	Risk criteria met
B08 8.TY.6 2B Bedroom	2.53%	0.67%	Risk criteria met
B08 8.TY.6 2B Bedroom2	2.34%	0.91%	Risk criteria met
B08 8.TY.11 4B Bedroom 4	2.40%	0.73%	Risk criteria met
B08 8.TY.11 4B Bedroom 3	2.29%	0.76%	Risk criteria met
B08 8.TY.12 2B Bedroom 1	1.85%	0.91%	Risk criteria met
B08 8.TY.12 2B Bedroom 2	2.23%	0.97%	Risk criteria met
B08 8.TY.13 3B Bedroom	2.34%	0.88%	Risk criteria met
B08 8.TY.13 3B Bedroom 2	2.53%	0.76%	Risk criteria met
B08 8.TY.13 3B Bedroom 3	2.75%	0.73%	Risk criteria met
B08 8.TY.4 3B Bedroom 3	2.37%	0.91%	Risk criteria met
B08 8.TY.4 3B Bedroom 2	2.34%	0.76%	Risk criteria met
B08 8.TY.4 3B Bedroom 1	2.29%	0.85%	Risk criteria met
B08 8.TY.2 3B Bedroom 2	2.34%	0.76%	Risk criteria met
B08 8.TY.2 3B Bedroom 1	2.29%	0.79%	Risk criteria met
B08 8.TY.1 3B Bedroom 3	2.34%	0.79%	Risk criteria met
B08 8.TY.1 3B Bedroom 2	2.37%	0.76%	Risk criteria met
B08 8.TY.1 3B Bedroom 1	2.34%	0.79%	Risk criteria met
B08 8.TY.5 1B Bedroom	3.08%	2.62%	Risk criteria not met
B08 8.TY.3 1B Bedroom	3.92%	2.19%	Risk criteria not met
B08 8.TY.11 4B Bedroom	2.31%	1.95%	Risk criteria not met
B08 8.TY.11 4B Bedroom	2.53%	2.04%	Risk criteria not met
B08 8.TY.10 2B Bedroom	2.94%	2.13%	Risk criteria not met
B08 8.TY.2 3B Bedroom	2.34%	0.82%	Risk criteria met

Room Name	TM52 Criterion 1	% Hours >26°C (bedrooms only)	Result
B08 8.TY.10 2B () Living Area	4.58%		Risk criteria not met
B08 8.TY.9 2B Living Area	5.08%		Risk criteria not met
B08 8.TY.8 2B Living Area	6.18%		Risk criteria not met
B08 8.TY.7 2B Living Area	5.93%		Risk criteria not met
B08 8.TY.6 2B Living Area	5.33%		Risk criteria not met
B08 8.TY.11 4B () Living Area	4.12%		Risk criteria not met
B08 8.TY.12 2B Living Area	4.27%		Risk criteria not met
B08 8.TY.4 3B Living Area	3.52%		Risk criteria not met
B08 8.TY.3 1B living Area	4.78%		Risk criteria not met
B08 8.TY.1 3B Living Area	4.42%		Risk criteria not met
B08 8.TY.13 Living Area	4.63%		Risk criteria not met
B08 8.TY.5 1B living Area	5.43%		Risk criteria not met
B08 8.TY.2 3B Living Area	4.42%		Risk criteria not met

Iteration 2 – Natural ventilation with improved parameters

Table 47: Iteration 2 - Overheating risk results on a room by room basis (DSY2).

Room Name	TM52 Criterion 1	% Hours >26°C (bedrooms only)	Result
B08 8.TY.10 2B () Bedroom 2	2.26%	0.85%	Risk criteria met
B08 8.TY.9 2B Bedroom 2	2.42%	0.91%	Risk criteria met
B08 8.TY.9 2B Bedroom 1	2.40%	0.79%	Risk criteria met
B08 8.TY.8 2B Bedroom 1	2.37%	0.82%	Risk criteria met
B08 8.TY.8 2B Bedroom 2	2.34%	0.82%	Risk criteria met
B08 8.TY.7 2B Bedroom 2	2.37%	0.88%	Risk criteria met
B08 8.TY.7 2B Bedroom 1	2.37%	0.82%	Risk criteria met
B08 8.TY.6 2B Bedroom	2.29%	0.67%	Risk criteria met
B08 8.TY.6 2B Bedroom2	2.26%	0.91%	Risk criteria met
B08 8.TY.11 4B Bedroom 4	2.34%	0.70%	Risk criteria met
B08 8.TY.11 4B Bedroom 3	2.21%	0.76%	Risk criteria met
B08 8.TY.12 2B Bedroom 1	1.80%	0.91%	Risk criteria met
B08 8.TY.12 2B Bedroom 2	2.02%	0.91%	Risk criteria met
B08 8.TY.13 3B Bedroom	2.21%	0.79%	Risk criteria met
B08 8.TY.13 3B Bedroom 2	2.31%	0.73%	Risk criteria met
B08 8.TY.13 3B Bedroom 3	2.51%	0.70%	Risk criteria met
B08 8.TY.4 3B Bedroom 3	2.18%	0.79%	Risk criteria met
B08 8.TY.4 3B Bedroom 2	2.21%	0.76%	Risk criteria met
B08 8.TY.4 3B Bedroom 1	2.15%	0.79%	Risk criteria met
B08 8.TY.2 3B Bedroom 2	2.23%	0.76%	Risk criteria met
B08 8.TY.2 3B Bedroom 1	2.15%	0.76%	Risk criteria met
B08 8.TY.1 3B Bedroom 3	2.26%	0.76%	Risk criteria met
B08 8.TY.1 3B Bedroom 2	2.31%	0.76%	Risk criteria met
B08 8.TY.1 3B Bedroom 1	2.21%	0.76%	Risk criteria met
B08 8.TY.5 1B Bedroom	2.18%	2.13%	Risk criteria not met
B08 8.TY.3 1B Bedroom	2.42%	1.98%	Risk criteria not met
B08 8.TY.11 4B Bedroom	1.58%	1.83%	Risk criteria not met
B08 8.TY.11 4B Bedroom	1.74%	1.95%	Risk criteria not met
B08 8.TY.10 2B Bedroom	2.12%	2.01%	Risk criteria not met
B08 8.TY.2 3B Bedroom	2.23%	0.76%	Risk criteria met
B08 8.TY.10 2B () Living Area	4.22%		Risk criteria not met
B08 8.TY.9 2B Living Area	4.12%		Risk criteria not met
B08 8.TY.8 2B Living Area	4.93%		Risk criteria not met
B08 8.TY.7 2B Living Area	4.58%		Risk criteria not met
B08 8.TY.6 2B Living Area	4.42%		Risk criteria not met
B08 8.TY.11 4B () Living Area	3.82%		Risk criteria not met
B08 8.TY.12 2B Living Area	3.87%		Risk criteria not met
B08 8.TY.4 3B Living Area	3.12%		Risk criteria not met
B08 8.TY.3 1B living Area	3.22%		Risk criteria not met
B08 8.TY.1 3B Living Area	3.72%		Risk criteria not met
B08 8.TY.13 Living Area	3.57%		Risk criteria not met
B08 8.TY.5 1B living Area	3.72%		Risk criteria not met
B08 8.TY.2 3B Living Area	3.67%		Risk criteria not met

Iteration 3 – Hybrid ventilation with improved parameters

Table 48: Iteration 3 - Overheating risk results on a room by room basis (DSY2).

Room Name	TM52 Criterion 1	% Hours >26°C (bedrooms only)	Result
B08 8.TY.10 2B () Bedroom 2	2.37%	0.76%	Risk criteria met
B08 8.TY.9 2B Bedroom 2	2.40%	0.79%	Risk criteria met
B08 8.TY.9 2B Bedroom 1	2.51%	0.79%	Risk criteria met
B08 8.TY.8 2B Bedroom 1	2.40%	0.79%	Risk criteria met
B08 8.TY.8 2B Bedroom 2	2.37%	0.76%	Risk criteria met
B08 8.TY.7 2B Bedroom 2	2.40%	0.79%	Risk criteria met
B08 8.TY.7 2B Bedroom 1	2.40%	0.79%	Risk criteria met
B08 8.TY.6 2B Bedroom	2.31%	0.67%	Risk criteria met
B08 8.TY.6 2B Bedroom2	2.31%	0.88%	Risk criteria met
B08 8.TY.11 4B Bedroom 4	2.37%	0.70%	Risk criteria met
B08 8.TY.11 4B Bedroom 3	2.29%	0.76%	Risk criteria met
B08 8.TY.12 2B Bedroom 1	1.88%	0.91%	Risk criteria met
B08 8.TY.12 2B Bedroom 2	2.18%	0.88%	Risk criteria met
B08 8.TY.13 3B Bedroom	2.26%	0.76%	Risk criteria met
B08 8.TY.13 3B Bedroom 2	2.37%	0.73%	Risk criteria met
B08 8.TY.13 3B Bedroom 3	2.61%	0.70%	Risk criteria met
B08 8.TY.4 3B Bedroom 3	2.31%	0.76%	Risk criteria met
B08 8.TY.4 3B Bedroom 2	2.34%	0.76%	Risk criteria met
B08 8.TY.4 3B Bedroom 1	2.29%	0.76%	Risk criteria met
B08 8.TY.2 3B Bedroom 2	2.34%	0.76%	Risk criteria met
B08 8.TY.2 3B Bedroom 1	2.23%	0.76%	Risk criteria met
B08 8.TY.1 3B Bedroom 3	2.31%	0.76%	Risk criteria met
B08 8.TY.1 3B Bedroom 2	2.37%	0.76%	Risk criteria met
B08 8.TY.1 3B Bedroom 1	2.29%	0.76%	Risk criteria met
B08 8.TY.5 1B Bedroom	2.10%	1.61%	Risk criteria not met
B08 8.TY.3 1B Bedroom	2.42%	1.37%	Risk criteria not met
B08 8.TY.11 4B Bedroom	1.91%	1.43%	Risk criteria not met
B08 8.TY.11 4B Bedroom	1.99%	1.46%	Risk criteria not met
B08 8.TY.10 2B Bedroom	2.26%	1.43%	Risk criteria not met
B08 8.TY.2 3B Bedroom	2.34%	0.76%	Risk criteria met
B08 8.TY.10 2B () Living Area	4.02%		Risk criteria not met

Room Name	TM52 Criterion 1	% Hours >26°C (bedrooms only)	Result
B08 8.TY.9 2B Living Area	3.92%		Risk criteria not met
B08 8.TY.8 2B Living Area	4.22%		Risk criteria not met
B08 8.TY.7 2B Living Area	4.22%		Risk criteria not met
B08 8.TY.6 2B Living Area	4.12%		Risk criteria not met
B08 8.TY.11 4B () Living Area	3.82%		Risk criteria not met
B08 8.TY.12 2B Living Area	3.62%		Risk criteria not met
B08 8.TY.4 3B Living Area	2.92%		Risk criteria met
B08 8.TY.3 1B living Area	3.07%		Risk criteria not met
B08 8.TY.1 3B Living Area	3.77%		Risk criteria not met
B08 8.TY.13 Living Area	3.47%		Risk criteria not met
B08 8.TY.5 1B living Area	3.22%		Risk criteria not met
B08 8.TY.2 3B Living Area	3.62%		Risk criteria not met

DSY 3.

Iteration 1 – Natural ventilation only

Table 49: Iteration 1 - Overheating risk results on a room by room basis (DSY3).

Room Name	TM52 Criterion 1	% Hours >26°C (bedrooms only)	Result
B08 8.TY.10 2B () Bedroom 2	3.92%	1.37%	Risk criteria not met
B08 8.TY.9 2B Bedroom 2	4.11%	1.37%	Risk criteria not met
B08 8.TY.9 2B Bedroom 1	4.14%	1.28%	Risk criteria not met
B08 8.TY.8 2B Bedroom 1	4.03%	1.31%	Risk criteria not met
B08 8.TY.8 2B Bedroom 2	3.95%	1.34%	Risk criteria not met
B08 8.TY.7 2B Bedroom 2	4.06%	1.34%	Risk criteria not met
B08 8.TY.7 2B Bedroom 1	3.98%	1.31%	Risk criteria not met
B08 8.TY.6 2B Bedroom	3.87%	0.97%	Risk criteria not met
B08 8.TY.6 2B Bedroom2	3.81%	1.34%	Risk criteria not met
B08 8.TY.11 4B Bedroom 4	3.65%	1.22%	Risk criteria not met
B08 8.TY.11 4B Bedroom 3	3.57%	1.28%	Risk criteria not met
B08 8.TY.12 2B Bedroom 1	3.00%	1.43%	Risk criteria not met
B08 8.TY.12 2B Bedroom 2	3.51%	1.40%	Risk criteria not met
B08 8.TY.13 3B Bedroom	3.73%	1.34%	Risk criteria not met
B08 8.TY.13 3B Bedroom 2	3.89%	1.25%	Risk criteria not met
B08 8.TY.13 3B Bedroom 3	4.22%	1.16%	Risk criteria not met
B08 8.TY.4 3B Bedroom 3	3.79%	1.34%	Risk criteria not met
B08 8.TY.4 3B Bedroom 2	3.65%	1.25%	Risk criteria not met
B08 8.TY.4 3B Bedroom 1	3.62%	1.34%	Risk criteria not met
B08 8.TY.2 3B Bedroom 2	3.79%	1.31%	Risk criteria not met
B08 8.TY.2 3B Bedroom 1	3.59%	1.31%	Risk criteria not met
B08 8.TY.1 3B Bedroom 3	3.73%	1.31%	Risk criteria not met
B08 8.TY.1 3B Bedroom 2	3.87%	1.31%	Risk criteria not met
B08 8.TY.1 3B Bedroom 1	3.79%	1.31%	Risk criteria not met
B08 8.TY.5 1B Bedroom	4.98%	3.44%	Risk criteria not met
B08 8.TY.3 1B Bedroom	5.56%	3.17%	Risk criteria not met
B08 8.TY.11 4B Bedroom	3.65%	2.89%	Risk criteria not met
B08 8.TY.11 4B Bedroom	3.79%	2.95%	Risk criteria not met
B08 8.TY.10 2B Bedroom	4.52%	2.98%	Risk criteria not met
B08 8.TY.2 3B Bedroom	3.73%	1.31%	Risk criteria not met
B08 8.TY.10 2B () Living Area	6.89%		Risk criteria not met
B08 8.TY.9 2B Living Area	7.94%		Risk criteria not met
B08 8.TY.8 2B Living Area	8.90%		Risk criteria not met
B08 8.TY.7 2B Living Area	8.25%		Risk criteria not met
B08 8.TY.6 2B Living Area	7.64%		Risk criteria not met
B08 8.TY.11 4B () Living Area	6.59%		Risk criteria not met
B08 8.TY.12 2B Living Area	6.84%		Risk criteria not met
B08 8.TY.4 3B Living Area	5.98%		Risk criteria not met
B08 8.TY.3 1B living Area	8.14%		Risk criteria not met
B08 8.TY.1 3B Living Area	7.24%		Risk criteria not met
B08 8.TY.13 Living Area	7.29%		Risk criteria not met
B08 8.TY.5 1B living Area	8.60%		Risk criteria not met
B08 8.TY.2 3B Living Area	6.94%		Risk criteria not met

Iteration 2 – Natural ventilation with improved parameters

Table 50: Iteration 2 - Overheating risk results on a room by room basis (DSY3).

Room Name	TM52 Criterion 1	% Hours >26°C (bedrooms only)	Result
B08 8.TY.10 2B () Bedroom 2	3.54%	1.31%	Risk criteria not met
B08 8.TY.9 2B Bedroom 2	3.79%	1.34%	Risk criteria not met
B08 8.TY.9 2B Bedroom 1	3.81%	1.25%	Risk criteria not met
B08 8.TY.8 2B Bedroom 1	3.76%	1.31%	Risk criteria not met
B08 8.TY.8 2B Bedroom 2	3.57%	1.31%	Risk criteria not met
B08 8.TY.7 2B Bedroom 2	3.65%	1.31%	Risk criteria not met
B08 8.TY.7 2B Bedroom 1	3.70%	1.28%	Risk criteria not met
B08 8.TY.6 2B Bedroom	3.43%	0.94%	Risk criteria not met
B08 8.TY.6 2B Bedroom2	3.49%	1.34%	Risk criteria not met
B08 8.TY.11 4B Bedroom 4	3.62%	1.19%	Risk criteria not met
B08 8.TY.11 4B Bedroom 3	3.40%	1.25%	Risk criteria not met
B08 8.TY.12 2B Bedroom 1	2.86%	1.37%	Risk criteria not met
B08 8.TY.12 2B Bedroom 2	3.27%	1.37%	Risk criteria not met
B08 8.TY.13 3B Bedroom	3.43%	1.31%	Risk criteria not met
B08 8.TY.13 3B Bedroom 2	3.68%	1.22%	Risk criteria not met

Room Name	TM52 Criterion 1	% Hours >26°C (bedrooms only)	Result
B08 8.TY.13 3B Bedroom 3	3.92%	1.16%	Risk criteria not met
B08 8.TY.4 3B Bedroom 3	3.46%	1.34%	Risk criteria not met
B08 8.TY.4 3B Bedroom 2	3.46%	1.25%	Risk criteria not met
B08 8.TY.4 3B Bedroom 1	3.46%	1.31%	Risk criteria not met
B08 8.TY.2 3B Bedroom 2	3.49%	1.28%	Risk criteria not met
B08 8.TY.2 3B Bedroom 1	3.40%	1.28%	Risk criteria not met
B08 8.TY.1 3B Bedroom 3	3.43%	1.28%	Risk criteria not met
B08 8.TY.1 3B Bedroom 2	3.59%	1.28%	Risk criteria not met
B08 8.TY.1 3B Bedroom 1	3.46%	1.28%	Risk criteria not met
B08 8.TY.5 1B Bedroom	3.30%	3.11%	Risk criteria not met
B08 8.TY.3 1B Bedroom	3.59%	2.83%	Risk criteria not met
B08 8.TY.11 4B Bedroom	2.59%	2.59%	Risk criteria not met
B08 8.TY.11 4B Bedroom	2.75%	2.80%	Risk criteria not met
B08 8.TY.10 2B Bedroom	3.30%	2.80%	Risk criteria not met
B08 8.TY.2 3B Bedroom	3.46%	1.28%	Risk criteria not met
B08 8.TY.10 2B () Living Area	6.59%		Risk criteria not met
B08 8.TY.9 2B Living Area	6.54%		Risk criteria not met
B08 8.TY.8 2B Living Area	7.09%		Risk criteria not met
B08 8.TY.7 2B Living Area	6.69%		Risk criteria not met
B08 8.TY.6 2B Living Area	6.89%		Risk criteria not met
B08 8.TY.11 4B () Living Area	5.98%		Risk criteria not met
B08 8.TY.12 2B Living Area	5.98%		Risk criteria not met
B08 8.TY.4 3B Living Area	5.33%		Risk criteria not met
B08 8.TY.3 1B living Area	4.98%		Risk criteria not met
B08 8.TY.1 3B Living Area	6.08%		Risk criteria not met
B08 8.TY.13 Living Area	5.68%		Risk criteria not met
B08 8.TY.5 1B living Area	6.28%		Risk criteria not met
B08 8.TY.2 3B Living Area	5.83%		Risk criteria not met

Iteration 3 – Hybrid ventilation with improved parameters

Table 51: Iteration 3 - Overheating risk results on a room by room basis (DSY3).

Room Name	TM52 Criterion 1	% Hours >26°C (bedrooms only)	Result
B08 8.TY.10 2B () Bedroom 2	3.65%	1.28%	Risk criteria not met
B08 8.TY.9 2B Bedroom 2	3.73%	1.28%	Risk criteria not met
B08 8.TY.9 2B Bedroom 1	3.98%	1.19%	Risk criteria not met
B08 8.TY.8 2B Bedroom 1	3.81%	1.22%	Risk criteria not met
B08 8.TY.8 2B Bedroom 2	3.65%	1.25%	Risk criteria not met
B08 8.TY.7 2B Bedroom 2	3.73%	1.25%	Risk criteria not met
B08 8.TY.7 2B Bedroom 1	3.79%	1.22%	Risk criteria not met
B08 8.TY.6 2B Bedroom	3.49%	0.94%	Risk criteria not met
B08 8.TY.6 2B Bedroom2	3.62%	1.31%	Risk criteria not met
B08 8.TY.11 4B Bedroom 4	3.68%	1.10%	Risk criteria not met
B08 8.TY.11 4B Bedroom 3	3.57%	1.22%	Risk criteria not met
B08 8.TY.12 2B Bedroom 1	2.97%	1.34%	Risk criteria not met
B08 8.TY.12 2B Bedroom 2	3.43%	1.31%	Risk criteria not met
B08 8.TY.13 3B Bedroom	3.62%	1.28%	Risk criteria not met
B08 8.TY.13 3B Bedroom 2	3.76%	1.16%	Risk criteria not met
B08 8.TY.13 3B Bedroom 3	4.11%	1.16%	Risk criteria not met
B08 8.TY.4 3B Bedroom 3	3.62%	1.25%	Risk criteria not met
B08 8.TY.4 3B Bedroom 2	3.65%	1.22%	Risk criteria not met
B08 8.TY.4 3B Bedroom 1	3.51%	1.25%	Risk criteria not met
B08 8.TY.2 3B Bedroom 2	3.68%	1.25%	Risk criteria not met
B08 8.TY.2 3B Bedroom 1	3.46%	1.22%	Risk criteria not met
B08 8.TY.1 3B Bedroom 3	3.65%	1.25%	Risk criteria not met
B08 8.TY.1 3B Bedroom 2	3.70%	1.25%	Risk criteria not met
B08 8.TY.1 3B Bedroom 1	3.59%	1.25%	Risk criteria not met
B08 8.TY.5 1B Bedroom	3.19%	2.19%	Risk criteria not met
B08 8.TY.3 1B Bedroom	3.76%	2.01%	Risk criteria not met
B08 8.TY.11 4B Bedroom	2.89%	2.01%	Risk criteria not met
B08 8.TY.11 4B Bedroom	3.00%	2.13%	Risk criteria not met
B08 8.TY.10 2B Bedroom	3.57%	2.07%	Risk criteria not met
B08 8.TY.2 3B Bedroom	3.65%	1.25%	Risk criteria not met
B08 8.TY.10 2B () Living Area	6.18%		Risk criteria not met

Room Name	TM52 Criterion 1	% Hours >26°C (bedrooms only)	Result
B08 8.TY.9 2B Living Area	5.78%		Risk criteria not met
B08 8.TY.8 2B Living Area	6.18%		Risk criteria not met
B08 8.TY.7 2B Living Area	6.08%		Risk criteria not met
B08 8.TY.6 2B Living Area	6.44%		Risk criteria not met
B08 8.TY.11 4B () Living Area	5.78%		Risk criteria not met
B08 8.TY.12 2B Living Area	5.63%		Risk criteria not met
B08 8.TY.4 3B Living Area	4.07%		Risk criteria not met
B08 8.TY.3 1B living Area	4.63%		Risk criteria not met
B08 8.TY.1 3B Living Area	5.83%		Risk criteria not met
B08 8.TY.13 Living Area	5.18%		Risk criteria not met
B08 8.TY.5 1B living Area	5.03%		Risk criteria not met
B08 8.TY.2 3B Living Area	5.53%		Risk criteria not met

Appendix E - Indicative Roof areas suitable for PV.

Figure 12: Suitable roof allocation (DA1).

Appendix F - BRUKL and SAP Output documents.

Provided in separate attachment.

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