Pentavia, Mill Hill

London NW7 2ET

Energy Statement

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1 Executive Summary

This Energy Statement has been prepared by chapmanbdsp to support the planning application for the Pentavia, Mill Hill development in Barnet.

The energy strategy for this mixed-use development focuses on providing high quality dwellings and non-domestic spaces that are comfortable throughout the year, but with minimal energy consumption and carbon emissions. The design approach for Pentavia, Mill Hill follows the GLA energy hierarchy i.e. being 'lean, clean and green' to achieve the following targets:

- Reduce regulated CO_2 emissions below those of a development compliant with Part L 2013 of the Building Regulations through energy efficiency measures alone (be lean);
- An on-site reduction of 35% beyond Part L 2013 for non-residential development; and,
- Zero carbon target for residential developments, with at least a 35% on-site reduction beyond Part L 2013 and proposals for making up the shortfall to achieve zero carbon, where required.

As Pentavia, Mill Hill is comprised of both domestic and non-domestic uses, this report demonstrates that this target has been achieved for domestic and non-domestic uses separately. These targets are in line with the GLA's Sustainable Design and Construction SPG, Barnet's SPD on Sustainable Design and Construction, Barnet's Development Plan Document as well as the London Plan (March 2016) and the London Borough of Barnet Core Strategy.

The design approach targets demand reduction measures first, giving priority to optimization of building fabric to reduce the need for heating, cooling, and artificial lighting. The objective was to have buildings as energy efficient (i.e. 'lean') as possible without relying on overly complicated systems or technologies to deliver low carbon performance. The aim was to achieve a low-energy building without relying on carbon offsetting technologies only.

The design of the buildings, together with the MEP systems, and sustainability features have been optimized to minimize the energy demand. High level of envelope insulation and optimized glazing-to-solid ratios are applied to the façade design to ensure heating demand is minimized and in response to the site's surroundings; whilst window and door openings are provided for passive ventilation to reduce the need for cooling, wherever possible without compromising air quality. Efficient low energy lighting (with LED lighting where appropriate) and mechanical ventilation with high rate of heat recovery are implemented throughout to further reduce energy demand. Demand side response is also facilitated via smart meters and other technologies for control and diagnostics where applicable. These components also support the operational energy monitoring requirements.

In the absence of existing district energy networks in close proximity to the site, the energy centre also allows for a connection to a future district heating scheme by providing a space for the necessary equipment in the communal plantroom and a single capped off pipework connection point, should one become available.

The development will include a low carbon communal heating network serving all domestic and non-domestic areas. A single energy centre will include communal gas-fired CHP and gas fired boilers for space heating and domestic hot water. A PV array located on unshaded roofs will further reduce the scheme's electricity demand.

This strategy provides the following advantages:

- Future connection to area wide district heating scheme for energy sharing and network expansion; and
- Future installation of advanced technology heat generators towards achieving zero carbon.

With this design approach, the development achieves a 41.8% reduction in carbon emission against Part L 2013. Under the revised GLA guidance, we have also calculated the carbon emissions using SAP 10 carbon factors. These results are presented in section 11.9.

Domestic energy hierarchy

	Carbon dioxide emissions (Tonnes CO_2 per annum)		
	Regulated	Unregulated	Total
Part L 2013 compliant building	1014.4	1121.9	2136.3
Be Lean	978.1	1121.9	2100.0
Be Clean	615.2	1121.9	1737.1
Be Green	531.3	1121.9	1653.2

Table 1.1 - CO_2 emissions after each stage of the energy hierarchy for domestic buildings

		Carbon dioxide savings			
		(Tonnes CO_2 per annum)		%	
		Regulated	Total	Regulated	Total
Be Lean	Savings from demand reduction	36.3	36.3	3.6%	1.7%
Be Clean	Savings from CHP	362.9	362.9	35.8%	17.0%
Be Green	Savings from renewable energy	83.9	83.9	8.3%	3.9%
Total cumulative savings		483.1	483.1	47.6%	22.6%

Carbon shortfall	531.3
Cash-in-lieu contribution	£956,319

Table 1.2 - Regulated CO_2 savings from each stage of the energy hierarchy for domestic buildings

Figure 1.1 - Regulated CO_2 emissions after each stage of the energy hierarchy for domestic buildings

Non-domestic energy hierarchy

	Carbon dioxide emissions (Tonnes CO_2 per annum)		
	Regulated	Unregulated	Total
Part L 2013 compliant building	301.1	122.1	423.2
Be Lean	260.5	122.1	382.6
Be Clean	234.2	122.1	356.3
Be Green	234.2	122.1	356.3

Table 1.3 - CO_2 emissions after each stage of the energy hierarchy for non-domestic buildings

		Carbon dioxide savings (Tonnes CO_2 per annum)		Carbon dioxide savings %	
		Regulated	Total	Regulated	Total
Be Lean	Savings from demand reduction	40.6	40.6	13.5%	9.6%
Be Clean	Savings from CHP	26.3	26.3	8.7%	6.2%
Be Green	Savings from renewable energy	0.0	0.0	0.0%	0.0%
Total cumulative savings		66.9	66.9	22.2%	15.8%

Carbon shortfall	38.5
Cash-in-lieu contribution	£69,330

Table 1.4 - Regulated CO_2 savings from each stage of the energy hierarchy for non-domestic buildings

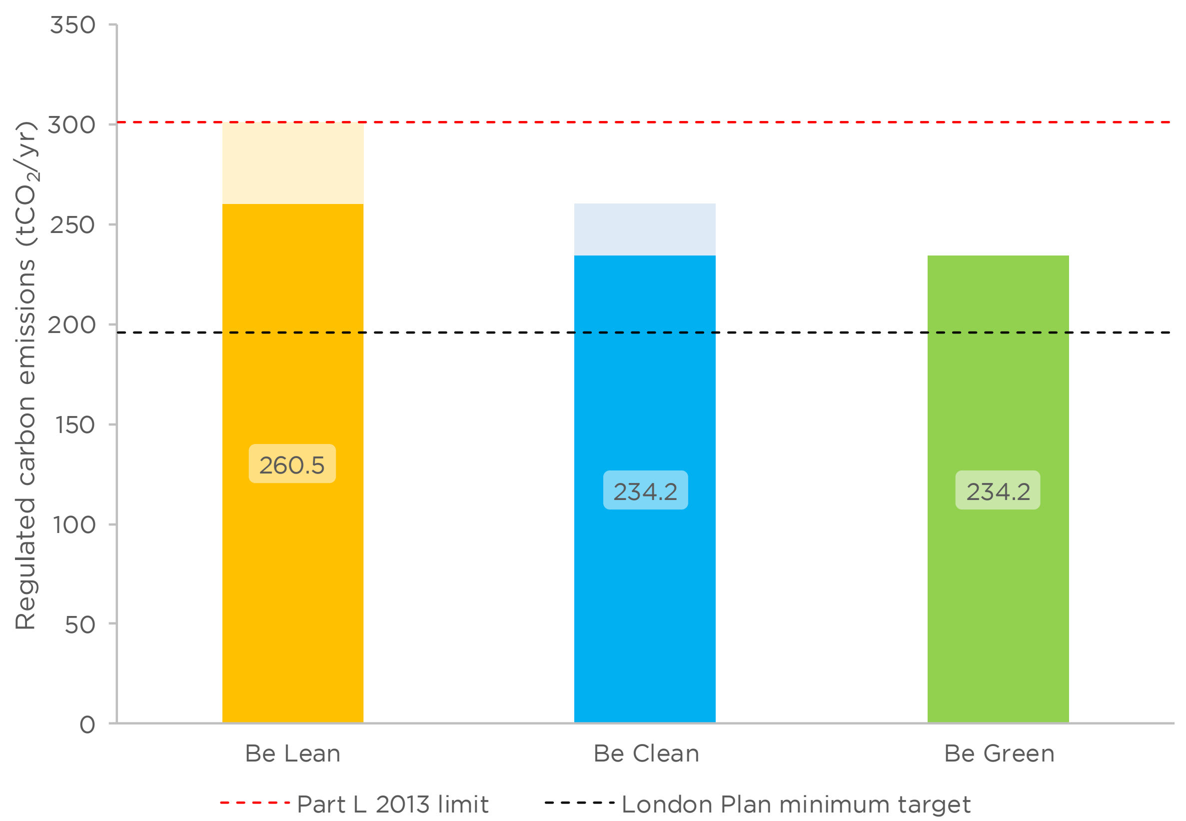

Figure 1.2 - Regulated CO_2 missions after each stage of the energy hierarchy for non-domestic buildings

Site-wide energy hierarchy

	Carbon dioxide emissions (Tonnes CO_2 per annum)		
	Regulated	Unregulated	Total
Part L 2013 compliant building	1315.5	1244.0	2559.5
Be Lean	1238.6	1244.0	2482.6
Be Clean	849.4	1244.0	2093.4
Be Green	765.5	1244.0	2009.5

Table 1.5 - CO_2 emissions after each stage of the energy hierarchy for the whole site

		Carbon dioxide savings (Tonnes CO_2 per annum)		Carbon dioxide savings %	
		Regulated	Total	Regulated	Total
Be Lean	Savings from demand reduction	76.9	76.9	5.8%	3.0%
Be Clean	Savings from CHP	389.2	389.2	29.6%	15.2%
Be Green	Savings from renewable energy	83.9	83.9	6.4%	3.3%
Total cumulative savings		550.0	550.0	41.8%	21.5%

Carbon shortfall	569.8
Cash-in-lieu contribution	£1,025,649

Table 1.6 - Regulated CO_2 savings from each stage of the energy hierarchy for the whole site

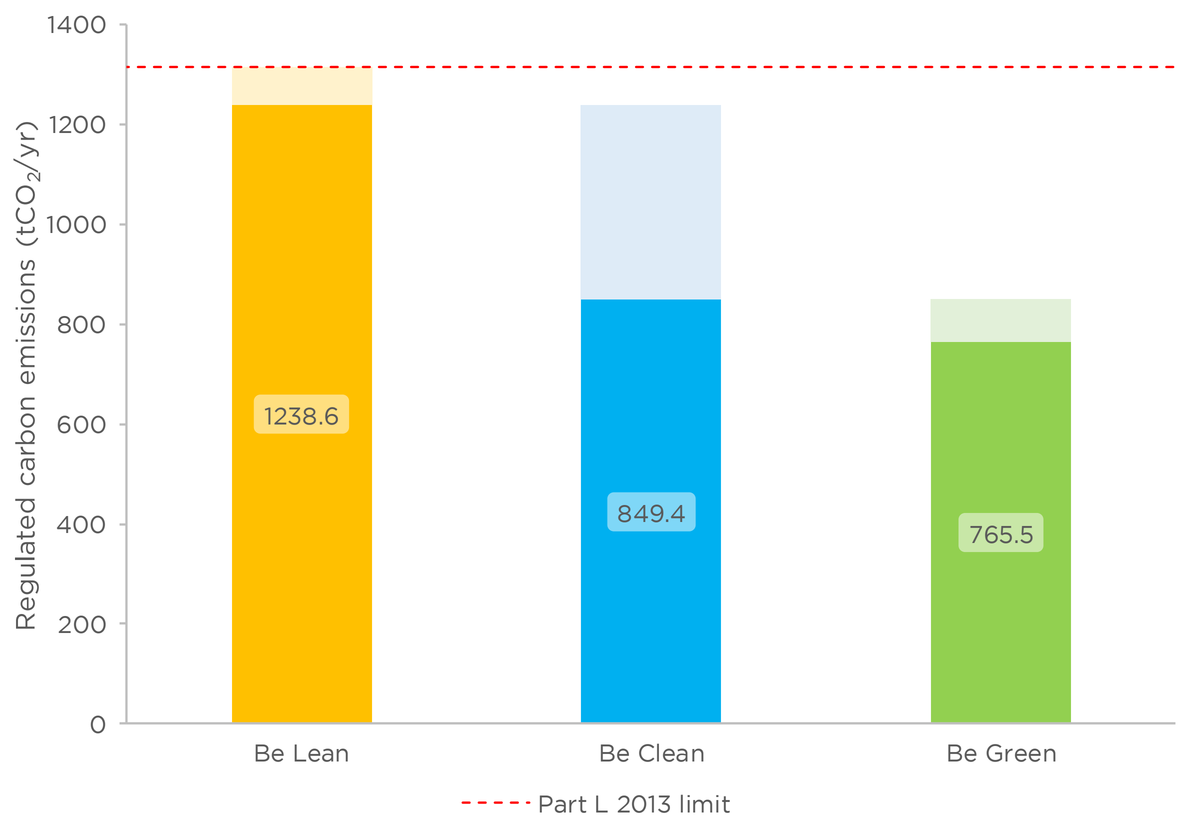

Figure 1.3 - Regulated CO_2 emissions after each stage of the energy hierarchy for the whole site

2 Introduction

This Energy Statement has been prepared by chapmanbdsp to support the detailed planning application for the Pentavia, Mill Hill development.

In line with the London Borough of Barnet Core Strategy, Pentavia, Mill Hill has adopted BREEAM New Construction 2018 Assessment tool and the London Borough of Barnet SPD – Sustainable Design and Construction as the framework to benchmark its wider sustainability performance. The project particularly focuses on carbon emissions reduction in line with the latest London Plan guidance and GLA's Energy Hierarchy with its "Lean-Clean-Green" approach.

Energy demand has been minimized by implementing passive envelope design strategies, including reduced glazing surface area that is optimized for the orientation of the individual facades; external solar shading provided by the balconies; highly insulated windows and walls combined with high level of air-tightness. This ensures that the whole-house ventilation with minimum fresh air and with high heat recovery rate can meet most of the dwellings' energy needs without the need for active cooling for summer comfort.

Low-carbon energy delivery systems have been chosen to further reduce energy demand. The dwellings are designed to provide effective natural ventilation for pollutants purge and passive cooling in summer, however comfort cooling will be provided to some uses of the non-domestic assets.

The adopted servicing strategy includes communal heating energy supply for space heating and domestic hot water from a gas-fired cogeneration scheme with back-up natural gas fired boilers. The current centralised water-based servicing strategy also allows for future connection to district heating scheme should one become available via heat exchanger and a single capped off pipe connection point. Cooling energy supply is from highly efficient air-cooled chillers in the basement to serve the requirements of the non-domestic assets. A PV array located in the unshaded roof is proposed to reduce the scheme's electrical consumption. Sub-metering will be provided for all major energy loads for each commercial unit.

2.1 Software and Modelling Information

The development has been modelled using an approved software package. Stroma FSAP 2012 was used to perform the analysis for the domestic assets and SBEM calculations for the non-domestic assets were carried out using EDSL Tas v9.4 and the UK Building Regulations 2013 Studio.

The calculations presented in this report are based on the carbon factors currently in use for Part L compliance. In addition to this report, we have included in the submission the GLA Carbon Emissions Reporting Spreadsheet v1.1 which has the revised tables for the updated SAP 10 carbon factors. This can be found in section 11.9.

2.2 Development Description

The Pentavia, Mill Hill site is located in the former Pentavia Retail Park which lies in the Mill Hill ward to the north of the London Borough of Barnet.

The proposal consists of redevelopment of site including the demolition of all existing buildings and construction of 844 new Build to Rent Class C3 residential units and 894 m^2 ancillary Class C3 Build to Rent facilities; 405 m^2 Class A1 Retail; 326 m^2 Class A3 and A4 food; and 297 m^2 Class D1 Community; new pedestrian access off Bunns Lane; open space, landscaping; car parking; and highway/pedestrian improvements.

The inclusion of a mixture of commercial spaces aims to make a better use of the existing Pentavia Retail Park, bringing benefits not only for the residents but also to the wider community.

The site is bounded to the southwest by the M1, to the east by Watford Way and to the north by Bunns Lane. Existing buildings on the site include the Pentavia Retail Park (Use Class A1) and a Together Plan (a charity occupying the former homebase unit).

Figure 2.1 - Location plan of the Pentavia, Mill Hill site

The 18 residential blocks will provide dwellings arranged around a communal space, protected visually and acoustically from the motorways that surround the site. The development will also provide D1 use, a fitness centre, security office, storage, dry cleaners, a coffee shop, a hair dresser, a work share hub, lower-ground level car park, a supermarket and a café.

3 Sustainability Drivers

This report identifies policies relevant for energy and carbon emissions elements of the London Plan, in particular, section 5 of the London Plan.

The Mayor's London Plan provides guidelines and targets to the 32 London boroughs and the Corporation of the City of London for the spatial development of London.

The London Plan was first published in 2004 with the current version released in March 2016, including revised energy performance targets in line with the 'zero carbon' target for residential development. Although the latest London Plan defines its targets against the 2010 Building Regulations, this Energy Statement reports the results for Pentavia Mill Hill against the 2013 Building Regulations, as defined in the Greater London Authority's (GLA) latest Energy Planning Guidance (March 2016); and also to ensure that the latest version of software (SAPs 2012 and SBEM 2013) is being used to provide as accurate results as possible.

Other key policies that are applicable to the scheme have been identified and are described in this section.

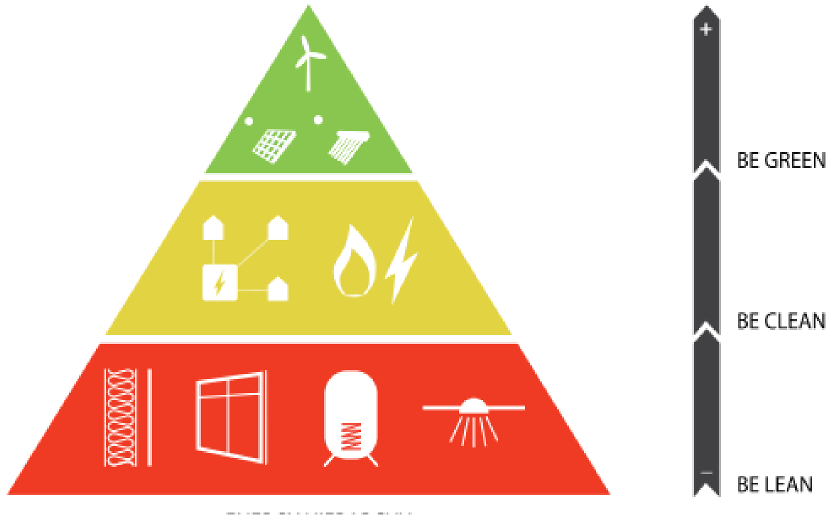

Figure 3.1 - Energy hierarchy

London Plan policies

This Spatial Development Strategy for Greater London includes objectives to reduce the capital's impact on, and exposure to, the effect of climate change. The most relevant policies for this Sustainability Statement are:

Policy 5.2 Minimising carbon dioxide emissions

The original London plan highlighted the need for the energy hierarchy to be in accordance with:

- Be Lean, use less energy
- Be clean, supply energy efficiently
- Be green: use renewable energy

The current London plan continues to pursue the requirement of this hierarchy and sets targets under policy 5.2 to target improvements over 2010 Building Regulations as follows:

Residential Developments:

- 2013-2016: 40 per cent
- 2016-2031: Zero carbon

Non-Residential developments:

- 2013-2016: 40 per cent
- 2016-2019: As per Building Regulations requirements
- 2019-2031: Zero carbon

As this Energy Statement is being assessed against the current 2013 Building Regulations, it is important to note that 40% over Building Regulations 2010 is equivalent to 35% over Building Regulations 2013.

Policy 5.3 Sustainable design and construction

The requirement for sustainable design and construction is split as follows:

At a strategic level it requires the highest standards of sustainable design and construction to be achieved to improve the environmental performance of new developments and to adapt to the effects of climate change over the buildings lifetime.

To demonstrate this, development proposals are required to demonstrate that sustainable design standards are integral to the building design, including its construction and operation, and ensure that sustainable measures are considered at the beginning of the design process in order for them to be fully integrated with the building and maximise every opportunity to meet the requirements.

Typical sustainability measures that should be considered are as follows:

- Minimising carbon dioxide emissions across the site, including the building and services (such as heating and cooling systems).
- Avoiding internal overheating and contributing to the urban heat island effect.
- Efficient use of natural resources (including water), including making the most of natural systems both within and around buildings.
- Minimising pollution (including noise, air and urban run-off).
- Minimising the generation of waste and maximising reuse or recycling.
- Avoiding impacts from natural hazards (including flooding).

Policy 5.6 Decentralised energy in development proposals

"Development proposals should evaluate the feasibility of Combined Heat and Power (CHP) systems, and where a new CHP system is appropriate also examine opportunities to extend the system beyond the site boundary to adjacent sites"

Policy 5.7 Renewable energy

The strategy of the London plan for application of renewable technology is to make use of the technology with a view to achieving the installed renewable energy capacity outlined in the 'Climate Change Mitigation and Energy Strategy'. The London plan does not however set mandatory targets, rather requiring the application to be implemented wherever feasible and with minimal impact on biodiversity and the natural environment.

Policy 5.9 Overheating and cooling

This policy is to address the impact of the urban heat island effect in London and encourages design to avoid overheating and excessive heat generation as well as reduce the effects of climate change on the urban heat island effect.

The policy defines a hierarchy for tackling the need for cooling in buildings as follows:

1. Minimise internal heat generation through energy efficient design
2. Reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls
3. Manage the heat within the building through exposed internal thermal mass and high ceilings
4. Passive ventilation
5. Mechanical ventilation
6. Active cooling system

Barnet Council Policies

Barnet's Local Plan – Core Strategy – Development Plan Document (2012)

Barnet's Local Plan embodies spatial planning – the practice of 'place shaping' to deliver positive social, economic and environmental outcomes and provide the overarching local policy framework for delivering sustainable development in Barnet.

Policy CS13

Ensuring the efficient use of natural resources – The London Borough of Barnet will:

- Promote the highest environmental standards for development and through our SPD, on Sustainable Design and Construction and Green Infrastructure we will continue working to deliver exemplary levels of sustainability throughout Barnet in order to mitigate and adapt to the effects of a changing climate;
- Expect all development to be energy efficient and seek to minimise any wasted heat or power;
- In line with London Plan Policy 5.2 Minimising carbon dioxide emissions, expect major development in accordance with the Mayor's energy hierarchy to reduce carbon dioxide emissions beyond the 2010 Building Regulations.
- Maximise opportunities for implementing new district-wide networks supplied by decentralised energy (including renewable generation) in partnership with key stakeholders in areas of major mixed use growth including town centres. Where feasible we will expect all development to contribute to new and existing frameworks;
- Make Barnet a water efficient borough and minimise the potential for fluvial and surface flooding by ensuring development does not cause harm to the water environment, water quality and drainage systems. Development should utilise Sustainable Urban Drainage Systems (SUDS) in order to reduce surface water run-off and ensure such run-off is managed as close to its source as possible subject to local geology and ground water levels;
- We will improve air and noise quality by requiring Air Quality Assessments and Noise Impact Assessments from development in line with Barnet's SPD on Sustainable Design and Construction.

Barnet – Development Management Plan (2012)

Barnet Development Management Plan forms part of Barnet's Local Plan and sets out the policy framework for decision making on planning applications.

Policy DM02

Development standards - Where appropriate, development will be expected to demonstrate compliance with the following national and London wide standards supported by the guidance set out in the Council's suite of Supplementary Planning Documents:

- BREEAM, the environmental assessment method for non-residential development;
- By Design, the CABE urban design principles;
- Lifetime Homes, the 16 design criteria required by the London Plan Policy 3.8;
- Wheelchair accessibility, the London Plan Policy 3.8;
- Minimum floor space, the London Plan Policy 3.5;
- Outdoor amenity space, the Sustainable Design and Construction SPD;
- Secured by Design, the National Police Initiative; and
- Play space, the London Plan Policy 3.6.

Barnet – Supplementary Planning Document – Sustainable Design and Construction (2016)

The London Borough of Barnet SPD on Sustainable Design and Construction sets out Barnet's technical requirements for environmental design and construction management. The SPD sets out requirements on air, noise, water, energy, water, waste and habitat quality in order to achieve protection and enhancement of the environment. The SPD requirements are linked to existing national standards and guidance.

The London Borough of Barnet SPD on Sustainable Design and Construction sets out Barnet's technical requirements for environmental design and construction management. The SPD sets out requirements on air, noise, water, energy, water, waste and habitat quality in order to achieve protection and enhancement of the environment.

The SPD requirements are linked to existing national standards and guidance:

- Minimum residential space standards;
- Internal layout and design;
- Outdoor amenity space;
- Daylight, privacy (minimum distance), outlook and light pollution;
- Microclimate – wind and thermal conditions;
- Accessible and adaptable dwellings;
- Wheelchair user dwellings;
- Energy use in new buildings;
- Decentralised energy;
- Retrofitting of existing buildings;
- Water efficiency;
- Waste strategy;
- Air quality;
- Noise quality;
- Flood risk, sustainable urban drainage systems and water quality;
- Biodiversity and habitat quality;
- Archaeological investigation;
- Pollution prevention, contaminated land remediation and construction management;
- BREEAM; and
- Considerate Constructors Scheme.

4 Establishing CO_2 Emissions

This section presents the baseline CO_2 emissions (TER – Target Emissions Rate) i.e. carbon emissions of the building regulations Part L compliant development. Regulated and unregulated CO_2 emissions were calculated using SAP 2012 for the domestic assets and SBEM for the non-domestic.

844 apartments are proposed at Pentavia, Mill Hill. 57 dwelling types were individually modelled using SAP 2012 and these were then extended to include for the dwellings with exposed surfaces (floors to ground or non-domestic assets and roofs), allowing for an accurate average performance to be calculated in accordance with building regulations Part L guidance. All non-domestic uses were modelled in EDSL Tas and with all proposed uses appropriately zoned with NCM internal conditions.

Baseline carbon emissions for the domestic and non-domestic assets of the building are summarised in Table 4.1 and Table 4.2 on the right. The BRUKL documents for the non-domestic part and the residential SAP compliance information can be found in section 11.1 and 11.2 respectively.

Domestic

	Carbon dioxide emissions (Tonnes CO_2 per annum)		
	Regulated	Unregulated	Total
Part L 2013 compliant building	1014.4	1121.9	2136.3
Be Lean	-	-	-
Be Clean	-	-	-
Be Green	-	-	-

Table 4.1 - Baseline CO_2 emissions for domestic buildings

Non-domestic

	Carbon dioxide emissions (Tonnes CO_2 per annum)		
	Regulated	Unregulated	Total
Part L 2013 compliant building	301.1	122.1	423.2
Be Lean	-	-	-
Be Clean	-	-	-
Be Green	-	-	-

Table 4.2 - Baseline CO_2 emissions for non-domestic buildings

5 Demand Reduction (Be Lean)

This section presents the reduction in CO_2 emissions achieved through the implementation of the energy demand reduction measures.

The design approach for Pentavia, Mill Hill has targeted demand reduction measures first, giving priority to the optimisation of the building fabric performance in order to reduce the need for heating, cooling and lighting. The objective was to maximise efficiency ('lean') as much as possible and avoid reliance on complex active/mechanical systems to deliver a low carbon performance. The focus was to achieve a low-energy building rather than just relying on carbon offsetting technologies. Studies were carried out at early design stages to inform the building envelope in terms of the envelope thermal performance with regards to air-tightness and levels of insulation.

5.1 Passive Design Measures

Passive measures to reduce energy demand incorporated in the project include:

- High levels of insulation for exposed solid envelope elements;
- Double glazing windows;
- Optimised glazing-to-wall ratio on the exposed facades based on solar gains for thermal comfort, daylighting for visual comfort and responding to surrounding issues, such as noise and air pollution;
- Improved airtightness;
- Maximised passive ventilation potential;
- External solar shading protecting glazed areas from unwanted solar gains.

5.1.1 Building Fabric

The proposed and target fabric performance for the domestic and non-domestic areas of the development is presented in the table below.

	Domestic		Non-domestic	
	Part L1A - TER	Pentavia, Mill Hill proposed - DER	Part L2A - BER	Pentavia, Mill Hill proposed - TER
External wall U-value	0.18	0.13	0.26	0.18
Exposed wall U-value (corridor/staircase)	n/a	0.16	N/A	N/A
Exposed floor U-value	0.13	0.12	0.22	0.16
Exposed roof U-value	0.13	0.13	0.18	0.20
Windows U-value	1.40	1.40	1.60	1.40
Windows g-value	0.63	0.55	0.40	0.45
y-value	0.05	0.15 (default)	N/A	N/A
Air permeability rate	5	3	5 if area <250m² 3 if area >250m²	3

Table 5.1 – Fabric performance of domestic and non-domestic areas of the development

5.2 Active Design Measures

Following from the passive measures that dealt with fabric losses and gains balance, energy efficiency (active) measures are also in place at Pentavia, Mill Hill to further reduce energy demand. All dwellings will be provided with a high efficiency whole-house mechanical ventilation with minimum fresh air and very high heat recovery rate. Artificial lighting uses low-energy light fittings and efficient lighting controls that include presence/absence detection and daylight linked dimming where appropriate. Supplementary heating will be provided via radiators whilst cooling for the non-domestic assets will be supplied from the efficient air cooled chillers in the basement.

	Domestic		Non-domestic	
	Part L1A - TER	Pentavia, Mill Hill proposed - DER	Part L2A - BER	Pentavia, Mill Hill proposed - TER
Ventilation system	Natural with Extract fans	Balanced with heat recovery	- Central ventilation sfp 0.3 - Terminal unit sfp 0.3 - Heat recovery efficiency 70% - Variable speed control of fans and pumps - Demand control via CO_2 sensors	- AHU SFP1.4 - Heat recovery efficiency 70% - Variable speed control of fans and pumps - Demand control via CO_2 sensors - Toilets extract fan SFP 0.8
Cooling	none	none	SEER 4.5	SEER 5.0
Lighting luminaire (lm/circuit watt)	N/A	N/A	60	80
Occupancy control	N/A	N/A	Yes	Yes
Low energy lights %	100	100	100	100

Table 5.2 – Systems performance for the domestic and non-domestic areas of the development

5.3 Demand Side Response

Advancement and commercialisation of smart technologies presents additional opportunities to manage and save energy. However, the rate of smart technology development means that specified equipment could be meaningfully improved by the time of procurement. Therefore, some scope flexibility is relevant at design stage in order to take advantage of this.

In this context, the following features will be included/considered during detailed design:

- Power, data and media infrastructure to deliver buildings which are smart-enabled for future connectivity by occupants.
- Smart utility meters provided for all residential units. Commercial units equipped with smart metering via base build or fit-out.
- Dwelling heat interface units enabled for connection via domestic smart control systems, such as Hive or Nest, for remote control, interrogation and diagnostics.
- Similarly, dwelling MVHR units enabled for connection to proprietary domestic smart control systems.
- An intelligent building level management strategy, employing big-data analytics for connecting and optimising systems, including; heat network; power; lighting; ventilation; life safety; vertical transportation and security. Provides other advanced features like remote maintenance and diagnostics; predictive tools; identifying inefficiencies, trends and synergies.
- These components also support the operational energy monitoring requirements.
- Thermal storage is proposed, which will permit the CHP to run for longer periods, increasing economic and carbon benefits.

5.4 'Be Lean' Results

The estimated energy demand reductions for the domestic and non-domestic elements of the development are shown in Table 5.3 and Table 5.4 below.

Domestic

	Carbon dioxide emissions (Tonnes CO_2 per annum)		
	Regulated	Unregulated	Total
Part L 2013 compliant building	1014.4	1121.9	2136.3
Be Lean	978.1	1121.9	2100.0
Be Clean	-	-	-
Be Green	-	-	-

Table 5.3 – Domestic CO_2 emissions after the lean stage of the energy hierarchy

Non-domestic

	Carbon dioxide emissions (Tonnes CO_2 per annum)		
	Regulated	Unregulated	Total
Part L 2013 compliant building	301.1	122.1	423.2
Be Lean	260.5	122.1	382.6
Be Clean	-	-	-
Be Green	-	-	-

Table 5.4 – Non-domestic CO_2 emissions after the lean stage of the energy hierarchy

5.5 Energy Demand

The total energy demand (MWh/year) for the domestic and the non-domestic areas of the development are presented in the table below.

	Energy demand following energy efficiency measures (MWh/year)						
Building use	Space heating	Hot water	Lighting	Auxiliary	Cooling	Unregulated electricity	Unregulated gas
Domestic	1313	1704	261	150	0	31.5	0
Non-domestic	96	58	352	25	254	234.3	0

Table 5.5 – Energy demand for the non-domestic areas of the development

5.6 Cooling Hierarchy

As part of the drive to reduce demand for energy highlighted by Mayor's Cooling Hierarchy set out in the London Plan, the design of Pentavia, Mill Hill has considered a number of passive and active measures that help reduce the need for cooling in the dwellings. The proposed approach is summarised in the table below.

London Plan Cooling Hierarchy	Pentavia, Mill Hill
Minimise internal heat generation through energy efficient design	Low energy lighting specified throughout; High efficiency appliances; Balconies provide solar shading to the floors below; Solar control glazing where required; Well insulated hot water systems.
Reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls	Building fabric has high levels of insulation; Good air-tightness (target air permeability of 3 $m^3/hr/m^2$ at 50 Pa); External solar shading provided by protuberating balconies; High-albedo facade and paving materials.
Passive ventilation	Natural daytime and night time ventilation enabled via openable windows and balcony doors; High thermal mass of the concrete structure stabilises daytime internal temperature fluctuations.
Mechanical ventilation	Efficient whole-house ventilation with heat recovery and boost purge fans will ensure adequate ventilation and acoustic comfort.

Table 5.6 - Cooling hierarchy at Pentavia Mill Hill

5.7 Overheating Risk Analysis

The well insulated envelope combined with openable windows facing the communal areas (residential areas) provide the potential for very effective daytime and night time natural ventilation with high level of occupant air flow control. This is complemented by a combination of MVHR and boost purge fans. All systems within the dwellings will be compliant with Building Regulations Part F and CIBSE guidelines. Residential ventilation is provided beyond Building Regulations standards in order to provide adequate ventilation despite the sealed windows to the main roads with the average design air change rate being 4 ACH.

The massing of the building blocks contributes to provide self-shading and minimise direct solar radiation. The balconies facing the communal spaces also contributes to prevent overheating, thermal and visual discomfort, such as glare.

Detailed overheating analysis has been carried out using EDLS TAS for the residential and commercial areas and these are detailed in the following sections.

5.8 Part L Criterion 3 of the Building Regulations

All non-domestic areas comply with Criterion 3 of the ADL2A:2013 – results can be found in section 11.1.

5.9 Domestic Overheating Checklist

The following checklists assisted the design team to identify potential overheating risk in the residential areas early in the design process and demonstrates the inclusion of passive measures within the building envelope and services design to mitigate overheating and reduce cooling demand in line with the London Plan policy.

Section 1 - Site features affecting vulnerability to overheating		Response
Site location	Urban – within central London or in a high-density conurbation	No
	Peri-urban – on the suburban fringes of London	Yes
Air quality and/or Noise sensitivity – are any of the following in the vicinity of buildings?	Busy roads / A roads	Yes
	Railways / Overground / DLR	Yes
	Airport / Flight path	No
	Industrial uses / waste facility	Yes
Proposed building use	Will any buildings be occupied by vulnerable people (e.g. elderly, disabled, young children)?	Possibly
	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%?	No, the overall glazing ratio is 15%
	If yes, is this to allow acceptable levels of daylighting?	N/A
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	No
	Other	No

Table 5.7 - Section 1 of GLA's Domestic Overheating Checklist

Section 2 - Design features implemented to mitigate overheating risk		Response
Landscaping	Will deciduous trees be provided for summer shading (to windows and pedestrian routes)?	Trees proposed at ground level – these may only provide shading to residential units located at lower levels and protect most pedestrian routes.
	Will green roofs be provided?	Yes, green roofs are proposed.
	Will other green or blue infrastructure be provided around buildings for evaporative cooling?	Yes, blue roofs are envisaged for the scheme.
Materials	Have high albedo (light colour) materials been specified?	The materials specified for the facade have relatively high albedo.
Dwelling aspect	% of total units that are single aspect	34%

Section 2 - Design features implemented to mitigate overheating risk		Response
	% single aspect with N / NE / NW orientation	72%
	% single aspect with E orientation	0%
	% single aspect with S / SE / SW orientation	28%
	% single aspect with W orientation	0%
Glazing ratio - What is the glazing ratio (glazing; internal floor area) on each facade?	N / NE / NW	15%
	E	15%
	S / SE / SW	15%
	W	15%
Daylighting	What is the average daylight factor range?	Target is 2% for occupied rooms.
Window opening	Are windows openable?	Yes, windows and doors facing the inner part of the scheme are openable.
	What is the average percentage of openable area for the windows?	50%
Window opening - What is the extent of the opening?	Fully openable	The opening is up to 50% of the total glazing area, but that area has no obstructions.
	Limited (e.g. for security, safety, wind loading reasons)	Windows are casement and around half the glazing area is openable and the doors are sliding, therefore the limitation is at 50%.
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)?	Windows with a secured limited aperture for ground floor.
Shading	Is there any external shading?	Yes, the recessed nature of the glazing and balconies will provide solar protection.
	Is there any internal shading?	Curtains and/or internal blinds.
Glazing specification	Is there any solar control glazing?	Glazing with a lower g-value has been specified.
Ventilation - What is the ventilation strategy?	Natural – background	Yes, windows facing the inner part of the scheme are openable in order to provide both background and purge ventilation.

Section 2 - Design features implemented to mitigate overheating risk		Response
		Windows facing outwards are sealed due to noise and air quality issues.
	Natural – purge	Yes, for the units with openable windows.
	Mechanical – background (e.g. MVHR)	Yes, MVHR units will provide both background and purge ventilation.
	Mechanical – purge	Yes
	What is the average design air change rate	4 ACH
Heating system	Is communal heating present?	Yes
	What is the flow/return temperature?	35 degrees
	Have horizontal pipe runs been minimised?	Yes
	Do the specifications include insulation levels in line with the London Heat Network Manual	Not applicable as the project is not connected to a Heat Network.
	Do the specifications include insulation levels in line with the London Heat Network Manual	Not applicable as the project is not connected to a Heat Network.

Table 5.8 - Section 2 of GLA's Domestic Overheating Checklist

5.10 Domestic and Non-domestic Overheating Modelling Assumptions

Overheating assessments have been carried out for the non-domestic and domestic areas using CIBSE Guide A and CIBSE TM59 criteria respectively. The following assumptions have been made.

- The analysis for the non-domestic and domestic areas has been carried out using Dynamic Thermal Modelling software; EDSL TAS version 9.4. This software tool is fully compliant with the CIBSE Applications Manual 11: Building Energy and Environment Modelling.
- Given the fixed location of the site and its proximity to the nearby road network (A1 & M1), opportunities to design different massing are limited.
- The building orientation is largely fixed by the constraints of the site and its proximity to the nearby road network. The surrounding buildings have not been modelled in order to represent the worst-case scenario for the proposed development. Trees are conventionally excluded from dynamic thermal models but could provide additional shading at lower levels.
- As per the CIBSE TM49: Design Summer Years for London (2014) guidance and to enable the urban heat island effect in the locality of the development to be taken into account, the most representative weather data set for the project location is London Heathrow airport. The assessments have been conducted using the DSY1 (Design Summer Year) weather year for the 2020s, high emissions, 50% percentile. Additional testing has been undertaken using the 2020 versions of the following two more extreme design weather years; DSY2 – 2003: a year with a very intense single warm spell; and DSY3 – 1976: a year with a prolonged period of sustained warmth.
- Occupancy patterns and internal gains for the domestic areas are prescribed by the CIBSE TM59 methodology. The occupancy patterns and internal gains specified in the Simplified Building Energy Model (SBEM) database as proposed by the Energy Performance of Buildings Directive (EPBD) 2002/91/EC of the European Parliament and Council are used for the non-domestic areas – 'A345 EatDrink' and 'D2 FitGym' thermostat changed from 25ºC to 23ºC.
- Thermal elements performance (U-values and glazing g-values), shading features (i.e. blinds, overhangs etc.) and thermal mass details can be found in section 5.1.1.
- Windows of the domestic areas from level 01 to the top facing the inner part of the development are openable by 50% throughout the day, while windows at ground floor are assumed to have a limiting openable area (10%) due to security issues. Windows of the domestic areas facing outwards are sealed due to noise and air quality issues – these rooms are assumed to have blinds installed. Windows of the non-domestic areas are fixed.
- A representative sample of apartments have been assessed in order to identify all the apartments that might be at risk of overheating. These were those with large glazing areas, having less shading, having large, sun-facing windows, having a single aspect and having limited opening windows. All occupied non-domestic areas of the development have been assessed.

5.11 Domestic Overheating Results for DSY1

Living rooms and bedrooms, as the main occupied zones in the apartments, have been assessed using the London Heathrow DSY1, 2020s, high emissions, 50% percentile weather data and the results are presented in the table below. Results for the London Heathrow DSY1 and DSY2, 2020s, high emissions, 50% percentile weather data are presented in section 11.3.

	Fail	Pass
Ground		
Bedrooms		
Inner	61%	39%
Outer	61%	39%
Living rooms/Kitchens		
Inner	11%	89%
Outer	11%	89%
Levels 01 to top		
Bedrooms		
Inner	19%	81%
Outer	83%	17%
Living rooms/Kitchens		
Inner	17%	83%
Outer	15%	85%
Total	**39%**	**61%**

Table 5.9 – Overheating results for the domestic areas using the DSY1 weather data

The inclusion of corridors in the overheating analysis is mandatory where community heating pipework runs through them. Space and water heating is provided in the development by a community heating system, and the Heat Interface Units (HIU) are located in the communal corridors, hence, the pipework connecting to the central system is permanently charged with hot water all year around to meet the hot water demand. Since this pipework is constantly emitting heat, even if well insulated, it can cause an increase in temperature in these spaces, therefore a communal corridor of block B is assessed for overheating.

The analysis includes the communal corridor heat gains from the water heating pipework and HIUs – losses from pipework are calculated using CIBSE Guide C guidance and standing gains from the HIUs are based on manufacturers' recommendations.

TM59 guidance requires that the overheating test for corridors should be based on the number of annual hours for which an operative temperature of 28°C is exceeded. Whilst there is no mandatory target to meet, if an operative temperature of 28°C is exceeded for more than 3% of the total annual hours, then this should be identified as a risk. When assessing the communal corridor of block B more than 3% of the total annual hours exceed an operative temperature of 28°C. Therefore, it is proposed to have mechanical ventilation in the corridors that utilises the staircase smoke ventilation system. The air supply volume will be based on a project specific average heat loss in order to mitigate the overheating risk.

5.12 Non-domestic Overheating Results for DSY1

An overheating assessment has been carried out for the non-domestic areas using CIBSE Guide A for free running buildings. In this case the buildings should be designed to limit the risk of overheating, in accordance with the adaptive comfort methodology outlined in CIBSE TM52: The limits of thermal comfort: avoiding overheating in European buildings. The results for this study are presented in the table below.

	Occupied Summer Hours	Max. Exceedable Hours	Criterion 1: #Hours Exceeding Comfort Range	Criterion 2: Peak Daily Weighted Exceedance	Criterion 3: #Hours Exceeding Absolute Limit	Result
Restaurant kitchen	2,448	73	2,448	0	2,448	Fail
Restaurant dining	2,754	82	2,754	0	2,754	Fail
Supermarket display	1,377	41	1,377	0	1,377	Fail
Nursery	814	24	801	14	726	Fail
Fitness centre	1,930	57	1,930	0	1,930	Fail
Coffee shop	2,601	78	2,601	0	2,601	Fail
Coffee shop kitchen	2,601	78	2,601	0	2,601	Fail
Residential meeting space	2,754	82	2,754	0	2,754	Fail
Residents' lounge	2,448	73	2,448	0	2,448	Fail
Coffee shop	2,448	73	2,448	0	2,448	Fail
Coffee shop food prep	2,754	82	2,754	0	2,754	Fail
Hair dresser	1,377	41	1,377	0	1,377	Fail
Dry cleaner	1,836	55	1,836	0	1,836	Fail
Workshare hub	1,377	41	1,377	0	1,377	Fail
Concierge	1,836	55	1,836	0	1,836	Fail
Maintenance office	2,601	78	2,601	0	2,601	Fail
Retail	1,377	41	1,377	0	1,377	Fail

Table 5.10 - Overheating results for the non-domestic areas using the DSY1 weather data for free running buildings

Due to the number of failings, cooling is proposed for the occupied non-domestic areas of the development. For air conditioned buildings, summer operative temperature ranges in occupied spaces are in accordance with the criteria set out in CIBSE Guide A Environmental design, Table 1.5. The results for this additional study are presented in the table below and the results for the London Heathrow DSY1 and DSY2, 2020s, high emissions, 50% percentile weather data are presented in section 11.3.

	Operative temperature >24	Operative temperature >25	Operative temperature >26	Operative temperature >27	Operative temperature >28	Result
Restaurant kitchen	0	0	0	0	0	Pass
Restaurant dining	0	0	0	0	0	Pass
Supermarket display	1,587	1,634	0	0	0	Pass
Nursery	91	0	0	0	0	Pass
Fitness centre	280	0	0	0	0	Pass
Coffee shop	1,190	0	0	0	0	Pass
Coffee shop kitchen	0	0	0	0	0	Pass
Residential meeting space	1,821	0	0	0	0	Pass
Residents' lounge	1,973	0	0	0	0	Pass
Coffee shop	2,292	387	0	0	0	Pass
Coffee shop food prep	0	0	0	0	0	Pass
Hair dresser	904	660	11	0	0	Pass
Dry cleaner	1,339	253	0	0	0	Pass
Workshare hub	1,553	606	0	0	0	Pass
Concierge	1,550	0	0	0	0	Pass
Maintenance office	1,202	901	0	0	0	Pass
Retail	927	389	0	0	0	Pass

Table 5.11 - Overheating results for the non-domestic areas using the DSY1 weather data for conditioned buildings

5.13 Active Cooling

No active cooling' is proposed for any of the residential areas of the development. As shown in section 5.12 natural ventilation is not enough to guarantee the occupant's comfort (in line with the cooling hierarchy set out in London Plan Policy 5.9) for the occupied non-domestic areas, therefore the cooling requirements of the different elements of the development are identified in the table below. A detailed breakdown of the cooling demand for all non-domestic areas of the development can be found in Appendix 11.4.

	Area weighted average non-domestic cooling demand (MJ/m^2)	Total area weighted non-domestic cooling demand (MJ/year)
Actual	45.1	917,371
Notional	42.3	858,847

Table 5.12 - Cooling demand for the non-domestic areas of the development

6 Heating Infrastructure (Be Clean)

6.1 Area-Wide Heat Network

At the time of writing, the London Heat Map shows that there are no existing area wide district heating networks within reasonable connection distance. The Heat Map does reveal that there is a proposed “Colindale CHP” future network on the other side of the M1 motorway.

Preliminary communications with London Borough of Barnet’s Energy Resource Manager (section 11.5) suggests that distance & the motorway could be prohibitive. Further feasibility investigations can be undertaken during design development because the magnitude of Pentavia’s heat load could be influential.

The Pentavia energy centre will be equipped with appropriate space to facilitate future connection.

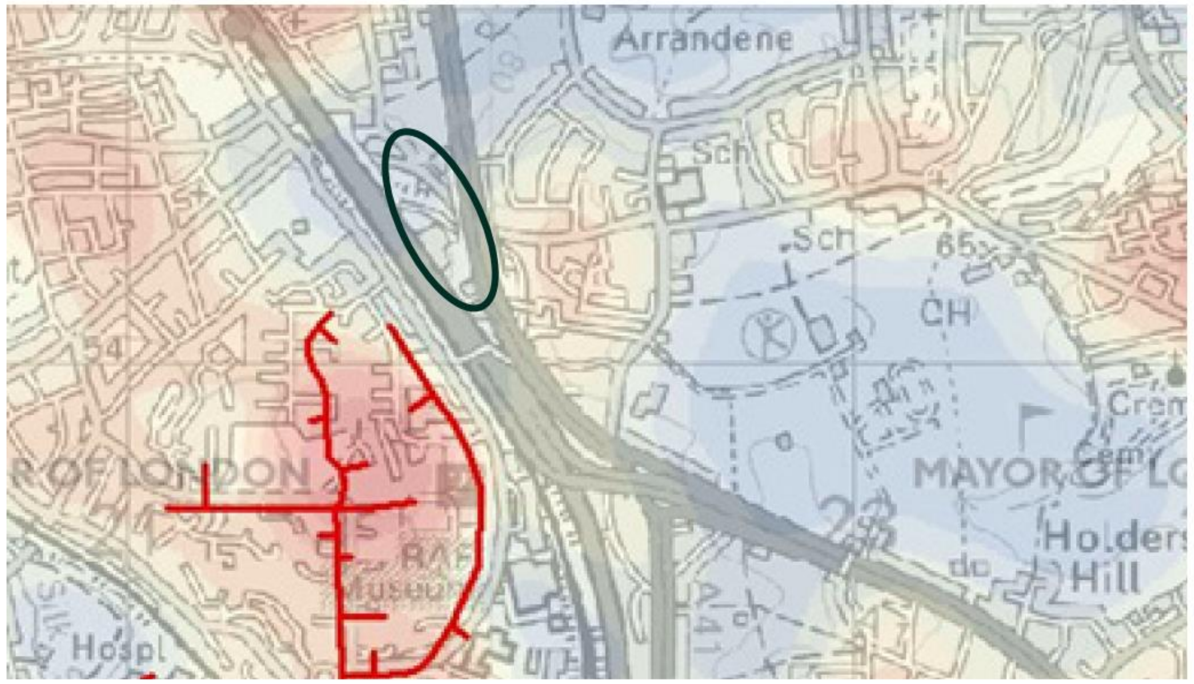

Figure 6.1 - Heat Map of Pentavia site (black circle)

6.2 Site-Wide Heat Network

Pentavia will be provided with a communal heat network served by a central energy centre which affords the following advantages:

- Future connection to area wide district heating scheme for energy sharing and network expansion.
- Future installation of advanced technology heat generators towards achieving zero carbon

CHP plant is proposed because of the magnitude of Pentavia’s heat demands, which may facilitate future network expansion and connection with “Colindale’s Area Action Plan”.

ESCOs will be engaged during detailed design to investigate systems, procurement, operating and funding options. ‘CIBSE Heat Networks: Code of Practice’ will be adopted throughout.

Further details on CHP and energy centre can be found in section 11.6.

At this concept stage, losses from distribution pipework can only be estimated at best and will be accurately calculated during detailed design.

Feasibility of bio-liquid CHP will be investigated during detailed design to further reduce emissions.

6.3 ‘Be Clean’ Results

Table 6.1 and Table 6.2 show the expected carbon emissions and reductions after the introduction of the CHP. The CHP emissions and preliminary demand profiles and a CHP assessment can be found in section 11.6.

Domestic

	Carbon dioxide emissions (Tonnes CO_2 per annum)		
	Regulated	Unregulated	Total
Part L 2013 compliant building	1014.4	1121.9	2136.3
Be Lean	978.1	1121.9	2100.0
Be Clean	615.2	1121.9	1737.1
Be Green	-	-	-

Table 6.1 - Domestic CO_2 emissions after the clean stage of the energy hierarchy

Non-domestic

	Carbon dioxide emissions (Tonnes CO_2 per annum)		
	Regulated	Unregulated	Total
Part L 2013 compliant building	301.1	122.1	423.2
Be Lean	260.5	122.1	382.6
Be Clean	234.2	122.1	356.3
Be Green	-	-	-

Table 6.2 - Non-domestic CO_2 emissions after the clean stage of the energy hierarchy

6.4 Air Quality

A comprehensive Air Quality Assessment has been undertaken by Mayer Brown, dated March 2019 and included in the planning submission.

The assessment of building emissions therefore demonstrates that on the worst-case assumption that the co-generation plant will have a NO_x emission of 50mg/Nm^3, the buildings emissions will not reach neutrality. However, it is understood that a Selective Catalytic Reduction System (SCR) which removes NOx from the plant exhaust will be utilised and this will significantly further reduce the Cogeneration Plant NOx emissions. Where an SCR system is applied, the Energy Centre will become air quality positive.

The predicted Total Transport Emissions associated with the Pentavia Development are expected to be higher than the benchmarked emissions. As noted, the GLA AQN Planning Support Update states that in circumstances where the benchmark is exceeded, mitigation measures to reduce emissions may be applied on site or offsite. In relation to this, the Pentavia Site offers a number of encouragements to model shift or ‘Active Travel’ as supported by Transport for London (TfL), to encourage residents and site users away from car use. These are set out in detail within the Framework Travel Plan submitted with the application

Energy Source	Total Fuel Consumption: Residential	Total Fuel Consumption: Non-Residential
Grid Electricity	411 MWh/year	430 MWh/year
Domestic/Communal Boilers	1,125 MWh/year	343 MWh/year
Gas CHP	4,615 MWh/year	n/a
Connection to existing DH network	n/a	n/a
Other Gas uses	n/a	n/a

Table 6.3 - GLA Reporting Template Table 14: Air Quality Impacts

6.5 Future Proofing

2050 is over 30 years away, during which time the energy landscape could evolve significantly, especially when the rates of change are considered.

The Government's 'Clean Growth Strategy' report, produced to support 'Climate Change Act' commitments, declares that technological breakthroughs that will help deliver the carbon budgets and targets cannot be exactly predicted. The 'pathways' illustrated in the strategy are based on current technologies. For buildings, the proposals include the following:

- Virtually zero carbon electricity grid by 2050
- Smart electricity grids
- Low carbon sources of heating through district heating
- Hydrogen fuel for heating

Advancements in existing and emerging technologies are accelerating, resulting in even further synergies and discoveries. The rate, as well as the nature and magnitude of change are expected to increase. Building level technologies which will be available to facilitate zero carbon operation cannot be exactly predicted now.

However, it is safe to speculate, that when the Government achieves these targets, then this development will be plugged into a zero-carbon infrastructure. It is envisaged that any residual carbon will be mitigated by the building level technology available at that time.

Proposals for this development include an energy centre with district heating network where zero carbon heat generators can be installed in future.

7 Renewable Energy (Be Green)

7.1 Low and Zero Carbon Technologies Study

Photovoltaic panels (PVs)

Photovoltaic panels convert sunlight into usable electricity, at relatively low efficiency of conversion at around 6-19% (depending on the technology) compared to solar thermal collectors (35-65%). Despite this low efficiency their advantage is low maintenance and zero-carbon electricity that offsets grid electricity and hence provides considerable carbon emission savings. Photovoltaic panels operate optimally when installed in a southerly orientation with inclination of 15-45 degrees.

PV technology is proposed for Pentavia, Mill Hill. Although the available unshaded roof area is relatively small when compared to the development's area and electricity requirements, the proposed PV array attempts to maximise the development's renewable energy generation capability.

7.2 'Be Green' Results

PV panels are proposed for Pentavia Mill Hill's energy strategy. A 246 kWp output array is envisaged, which provides a site-wide domestic carbon emission reduction of 6.4%. Drawings provided in the Design and Access Statement illustrate the provisional allocated roof spaces for the PV array.

Table 7.1 and Table 7.2 below show the expected carbon emissions at 'Be Green' stage for the domestic and non-domestic assets in Pentavia, Mill Hill.

Domestic

	Carbon dioxide emissions (Tonnes CO_2 per annum)		
	Regulated	Unregulated	Total
Part L 2013 compliant building	1014.4	1121.9	2136.3
Be Lean	978.1	1121.9	2100.0
Be Clean	615.2	1121.9	1737.1
Be Green	531.3	1121.9	1653.2

Table 7.1 – Domestic CO_2 emissions after the green stage of the energy hierarchy

Non-domestic

	Carbon dioxide emissions (Tonnes CO_2 per annum)		
	Regulated	Unregulated	Total
Part L 2013 compliant building	301.1	122.1	423.2
Be Lean	260.5	122.1	382.6
Be Clean	234.2	122.1	356.3
Be Green	234.2	122.1	356.3

Table 7.2 – Non-domestic CO_2 emissions after the green stage of the energy hierarchy

A roof plan showing the location of the PVs on each block can be seen in the figure on the right.

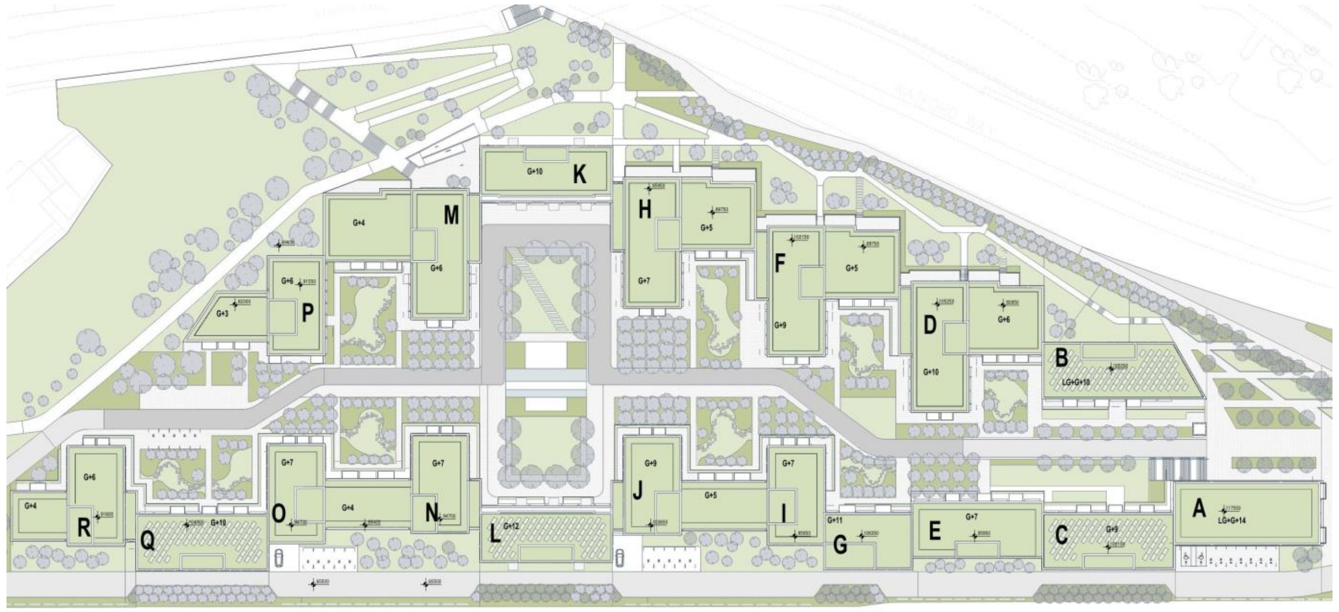

Figure 7.1 – Roof plan showing the PVs location on each block of the development

8 Carbon Offsetting

As part of the London Plan, developments are required to offset all remaining CO_2 emissions associated with the building through a financial contribution towards measures which reduce CO_2 emissions from the existing building stock.

Barnet SPD – Sustainable design and construction states that carbon offsetting will be considered in line with the Greater London Authority guidance and a figure of £60/tonne will be used over a 30 year period. London Plan Policy 5.2 sets out that where the required percentage improvements beyond Part L of the Building Regulations are not met on-site, any short fall should be provided off-site or through a cash-in-lieu contribution to the relevant borough. The benefit of the fund is in unlocking CO_2 saving measures with boroughs to identify suitable projects. Suitable projects will be identified on a site by site basis focusing on publicly owned buildings such as schools local to the development which can provide wider community benefits.

The CO_2 emissions offset cost is currently therefore set at £1,800/tCO_2.

8.1 Offset Payment

Following the implementation of the energy hierarchy, the estimated carbon shortfall is 569.8 tCO_2/year.

The estimated carbon offset payment for this development is £1,025,649.

9 Monitoring

Smart meters will generally be installed as described in section 5.3 and the *CIBSE Heat Networks: Code of Practice* guidance document.

10 Conclusion

The energy strategy for Pentavia, Mill Hill targeted demand reduction measures first, giving priority to optimization of building fabric to reduce the need for heating, cooling, and artificial lighting. The objective was to have buildings as energy efficient (i.e. 'lean') as possible without relying on overly complicated systems or technologies to deliver low carbon performance. The aim was to achieve a low-energy building without relying on carbon offsetting technologies only, committing to the priorities set in the London Plan and the Barnet Core Strategies.

The design team has put considerable effort in optimizing the fabric of the building envelope and in implementing other energy demand reduction measures so that the provision of a communal heating system connected to a CHP achieves a carbon emission reduction greater than the minimum target of the London Plan of 35%. Carbon emissions reduction goes beyond this target with the implementation of renewables, in this case PV panels.

The proposed development of Pentavia, Mill Hill achieves overall 41.8% reduction in regulated carbon emissions over the Part L 2013.

11 Appendices

11.1 BRUKLs

Be Lean

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Mill Hill As designed

Date: Wed Nov 22 10:29:26 2017

Administrative information

Building Details

Address: London,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.4.0"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.4.0

BRUKL compliance check version: v5.2.g.3

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name:

Telephone number:

Address: , ,

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

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	14.8
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	14.8
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	12.8
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

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

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

Building fabric

Element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	Surface where the maximum value occurs*
Wall**	0.35	0.24	0.61	spandrel
Floor	0.25	0.16	0.16	Exposed Floor
Roof	0.25	0.13	0.2	Exposed ceiling to resi
Windows***, roof windows, and rooflights	2.2	1.41	1.41	Curtain wall FX
Personnel doors	2.2	-	-	No personal doors in project
Vehicle access & similar large doors	1.5	-	-	No vehicle doors in project
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

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

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

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

Building services

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

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- Plant areas (19 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	-	1.1	0.7
Standard value	N/A	N/A	N/A	1.1^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

2- Food Prep Areas (3 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0	-	-	1	0.7
Standard value	N/A	N/A	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

3- Communal areas (39 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	-	1.5	0.7
Standard value	N/A	N/A	N/A	1.5^	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

4- Carpark (LG car park)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0	-	-	1.4	0.7
Standard value	N/A	N/A	N/A	N/A	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

5- Eat & drink (3 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	5	-	1.5	0.7
Standard value	N/A	2.6	N/A	1.6^	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

6- Retail (2 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	5	-	1.5	0.7
Standard value	N/A	2.6	N/A	1.6^	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

7- Creche (Core D G nursery)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	5	-	1.5	0.7
Standard value	N/A	2.6	N/A	1.6^	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

8- Fitness Centre (Core F G fitness centre)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0	5	-	1.5	0.7
Standard value	N/A	2.6	N/A	1.6^	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

9- Salon (Core K G hair dresser)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	5	-	1.5	0.7
Standard value	N/A	2.6	N/A	1.6^	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

10- Concierge (3 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	5	-	1.5	0.7
Standard value	N/A	2.6	N/A	1.6^	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

11- Office (2 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	5	-	1.5	0.7
Standard value	N/A	2.6	N/A	1.6^	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

12- Supermarket (2 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	5	-	1.5	0.7
Standard value	N/A	2.6	N/A	1.6^	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

13- Store

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	-	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

1- New HWS Circuit

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.91	0
Standard value	0.9*	N/A

* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.

"No zones in project where local mechanical ventilation, exhaust, or terminal unit is applicable"

General lighting and display lighting	**Luminous efficacy [lm/W]**			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Core A LG restaurant dining	-	80	22	610
Core A LG restarant kitchen	-	80	-	593
Core A LG circ	-	80	-	188
Core A LG stairs	-	80	-	84
Core A LG refuse	80	-	-	52
Core A LG store	80	-	-	40
Core A LG bike store	80	-	-	91
Core C LG energy centre	80	-	-	1008
Core C LG sprinkler tank room	80	-	-	133
Core C LG comm room	80	-	-	136
Core C LG boiler room	80	-	-	149
Core C LG flues	80	-	-	110
Core C LG LV switch room	80	-	-	206
Core C LG gas meter	80	-	-	120
Core C LG substation	80	-	-	142
Core C LG circ 1	-	80	-	130
Core C LG stairs	-	80	-	83
Core C LG circ 2	-	80	-	102
Core C LG refuse	80	-	-	49
Core E LG water store	80	-	-	115
Core E LG bike store	80	-	-	133
Core E LG circ1	-	80	-	166
Core E LG circ2	-	80	-	77
Core E LG stairs	-	80	-	86
Core E LG refuse	80	-	-	53
Core G LG stairs	-	80	-	76
Core G LG circ	-	80	-	150
Core G LG bike store	80	-	-	66
Core G LG refuse	80	-	-	43
Core I LG stairs	-	80	-	75

General lighting and display lighting

Zone name	Luminous efficacy [lm/W] Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
Core I LG circ	-	80	-	99
Core I LG bike store	80	-	-	81
Core I LG refuse	80	-	-	47
Core J LG stairs	-	80	-	64
Core J LG circ	-	80	-	156
Core J LG refuse	80	-	-	35
Core J LG bike store	80	-	-	89
Core L LG stairs	-	80	-	90
Core L LG refuse	80	-	-	45
Core L LG circ	-	80	-	157
Core L LG bike store	80	-	-	134
Core L LG LV switch room	80	-	-	252
Core L LG substation	80	-	-	188
Core N LG stairs	-	80	-	72
Core N LG circ	-	80	-	73
Core N LG bike store	80	-	-	64
Core N LG refuse	80	-	-	42
Core O LG stairs	-	80	-	61
Core O LG circ	-	80	-	61
Core O LG bike store	80	-	-	92
Core O LG refuse	80	-	-	32
Core Q LG stairs	-	80	-	84
Core Q LG circ	-	80	-	154
Core Q LG bike store	80	-	-	133
Core Q LG refuse	80	-	-	45
Core Q LG LV switch room	80	-	-	243
Core Q LG substation	80	-	-	187
Core R LG stairs	-	80	-	78
Core R LG circ	-	80	-	112
Core R LG bike store	80	-	-	73
Core R LG refuse	80	-	-	38
Core R LG LV switch room	80	-	-	260
Core R LG substation	80	-	-	153
Core B LG supermarket display	-	80	22	5386
Core B LG supermarket store	80	-	-	180
Core B LG stairs	-	80	-	88
Core B LG circ1	-	80	-	113
Core B LG circ2	-	80	-	61
Core B LG bike store	80	-	-	48
Core B LG refuse	80	-	-	36
Core D LG stairs	-	80	-	92
Core D LG circ	-	80	-	159
Core D LG refuse	80	-	-	37

General lighting and display lighting

Zone name	Luminous efficacy [lm/W] Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
Core D LG bike store	80	-	-	192
Core D LG LV switchroom	80	-	-	311
Core D LG substation	80	-	-	277
Core F LG stairs	-	80	-	93
Core F LG circ	-	80	-	153
Core F LG refuse	80	-	-	36
Core F LG bike store	80	-	-	91
Core F LG LV switchroom	80	-	-	276
Core F LG substation	80	-	-	152
Core H LG stairs	-	80	-	93
Core H LG circ	-	80	-	155
Core H LG refuse	80	-	-	35
Core H LG bike store	80	-	-	105
Core K LG stairs	-	80	-	89
Core K LG circ	-	80	-	143
Core K LG refuse	80	-	-	59
Core K LG bike store	80	-	-	59
Core M LG stairs	-	80	-	91
Core M LG circ	-	80	-	123
Core M LG refuse	80	-	-	46
Core M LG bike store	80	-	-	68
Core M LG water tank	80	-	-	137
Core P LG stairs	-	80	-	75
Core P LG circ	-	80	-	84
Core P LG refuse	80	-	-	70
Core P LG bike store	80	-	-	78
LG car park	-	80	-	24712
Core P G maintenance office	80	-	-	794
Core P G concierge	-	80	22	280
Core P G retail	-	80	22	847
Core M G workshare hub	80	-	-	1117
Core M G dry cleaner	-	80	22	2203
Core K G coffee shop	-	80	22	347
Core K G coffee shop food prep	-	80	-	332
Core K G hair dresser	-	80	22	1482
Core H G resindents lounge	-	80	22	296
Core H G resi meeting space	-	80	22	448
Core H G coffee shop kitchen	-	80	-	343
Core H G coffee shop	-	80	22	314
Core F G fitness centre	-	80	-	430
Core D G nursery	80	-	-	781

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Core A LG restaurant dining	N/A	N/A
Core B LG supermarket display	N/A	N/A
Core B LG supermarket store	N/A	N/A
Core P G maintenance office	NO (-60%)	YES
Core P G concierge	NO (-67%)	YES
Core P G retail	NO (-51%)	YES
Core M G workshare hub	NO (-73%)	YES
Core M G dry cleaner	NO (-49%)	YES
Core K G coffee shop	NO (-22%)	YES
Core K G hair dresser	NO (-37%)	YES
Core H G resindents lounge	NO (-57%)	YES
Core H G resi meeting space	NO (-73%)	YES
Core H G coffee shop	NO (-78%)	YES
Core F G fitness centre	NO (-78%)	YES
Core D G nursery	NO (-79%)	YES

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	20321	20321
External area [m²]	36219	36219
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	6333	8632
Average U-value [W/m²K]	0.17	0.24
Alpha value* [%]	4.55	4.55

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

Building Use

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

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	5.21	6.47
Cooling	2.51	3.1
Auxiliary	1.24	1.27
Lighting	17.42	20.81
Hot water	3.27	3.13
Equipment*	11.58	11.58
TOTAL**	**29.65**	**34.77**

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

Energy Production by Technology [kWh/m²]

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

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	62.21	62.35
Primary energy* [kWh/m²]	75.33	87.07
Total emissions [kg/m²]	12.8	14.8

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] No Heating or Cooling										
	Actual	13.1	0	4.2	0	1.7	0.86	0	0.91	0
	Notional	10.2	0	3.4	0	2.3	0.82	0	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	20.1	0	0	0	0
	Notional	0	0	0	0	22.4	0	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	19.5	0	6.3	0	3.5	0.86	0	0.91	0
	Notional	27.3	0	9.2	0	5.3	0.82	0	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	2.3	731.1	0.7	42.8	12.2	0.86	4.75	0.91	5
	Notional	17	682.4	5.8	52.7	10.6	0.82	3.6	----	----
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	2.4	230.4	0.8	13.5	4.4	0.86	4.75	0.91	5
	Notional	6.4	200	2.2	15.4	4.4	0.82	3.6	----	----
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	1.4	105.5	0.5	6.2	6.9	0.86	4.75	0.91	5
	Notional	8.7	102.5	2.9	7.9	6	0.82	3.6	----	----
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	0	81.8	0	4.8	28.9	0	4.75	0	5
	Notional	3	80.9	1	6.2	25.1	0.82	3.6	----	----
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	3	238.1	1	13.9	4.4	0.86	4.75	0.91	5
	Notional	8.7	175.3	3	13.5	3.8	0.82	3.6	----	----
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	0.1	297.5	0	17.4	6.8	0.86	4.75	0.91	5
	Notional	4.8	244.4	1.6	18.9	5.9	0.82	3.6	----	----
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	9.3	204.3	3	12	5	0.86	4.75	0.91	5
	Notional	26.5	156.8	9	12.1	4.4	0.82	3.6	----	----
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	12.1	528.1	3.9	30.9	4.3	0.86	4.75	0.91	5
	Notional	13.9	537.9	4.7	41.5	3.8	0.82	3.6	----	----
[ST] No Heating or Cooling										
	Actual	143.4	0	46.1	0	0	0.86	0	0.91	0
	Notional	161.7	0	54.8	0	0	0.82	0	----	----

Key to terms

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

Key Features

The BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

Element	U_{i-Typ}	U_{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.18	External Wall
Floor	0.2	0.16	Exposed Floor
Roof	0.15	0.13	Roof
Windows, roof windows, and rooflights	1.5	1.41	Curtain wall FX
Personnel doors	1.5	-	No personal doors in project
Vehicle access & similar large doors	1.5	-	No vehicle doors in project
High usage entrance doors	1.5	-	No high usage entrance doors in project

U_{i-Typ} = Typical individual element U-values [W/(m²K)]
U_{i-Min} = Minimum individual element U-values [W/(m²K)]
* There might be more than one surface where the minimum U-value occurs.

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	3

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Mill Hill

As designed

Date: Wed Nov 22 09:44:11 2017

Administrative information

Building Details

Address: London,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.4.0"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.4.0

BRUKL compliance check version: v5.2.g.3

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name:

Telephone number:

Address: , ,

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

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	14.8
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	14.8
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	11.5
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

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

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

Building fabric

Element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	Surface where the maximum value occurs*
Wall**	0.35	0.24	0.61	spandrel
Floor	0.25	0.16	0.16	Exposed Floor
Roof	0.25	0.13	0.2	Exposed ceiling to resi
Windows***, roof windows, and rooflights	2.2	1.41	1.41	Curtain wall FX
Personnel doors	2.2	-	-	No personal doors in project
Vehicle access & similar large doors	1.5	-	-	No vehicle doors in project
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]

U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]

U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

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

** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

*** Display windows and similar glazing are excluded from the U-value check.

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

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

Building services

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

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- Plant areas (19 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.45	-	-	1.1	0.7
Standard value	N/A	N/A	N/A	1.1^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

2- Food Prep Areas (3 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0	-	-	1	0.7
Standard value	N/A	N/A	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

3- Communal areas (39 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.45	-	-	1.5	0.7
Standard value	N/A	N/A	N/A	1.5^	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

4- Carpark (LG car park)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0	-	-	1.4	0.7
Standard value	N/A	N/A	N/A	N/A	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

5- Eat & drink (3 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.45	5	-	1.5	0.7
Standard value	N/A	2.6	N/A	1.6^	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

6- Retail (2 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.45	5	-	1.5	0.7
Standard value	N/A	2.6	N/A	1.6^	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

7- Creche (Core D G nursery)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.45	5	-	1.5	0.7
Standard value	N/A	2.6	N/A	1.6^	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
^ Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.					

8- Fitness Centre (Core F G fitness centre)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0	5	-	1.5	0.7
Standard value	N/A	2.6	N/A	1.6^	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
^ Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.					

9- Salon (Core K G hair dresser)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.45	5	-	1.5	0.7
Standard value	N/A	2.6	N/A	1.6^	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
^ Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.					

10- Concierge (3 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.45	5	-	1.5	0.7
Standard value	N/A	2.6	N/A	1.6^	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
^ Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.					

11- Office (2 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.45	5	-	1.5	0.7
Standard value	N/A	2.6	N/A	1.6^	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
^ Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.					

12- Supermarket (2 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.45	5	-	1.5	0.7
Standard value	N/A	2.6	N/A	1.6^	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
^ Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.					

13- Store

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.45	-	-	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

1- New HWS Circuit

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	Hot water provided by HVAC system	0
Standard value	N/A	N/A

1- New Heating Circuit

	CHPQA quality index	CHP electrical efficiency
This building	140	0.35
Standard value	105	0.2

Local mechanical ventilation, exhaust, and terminal units

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

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
Core A LG restaurant dining	-	-	-	1.5	-	-	-	-	-	-	N/A
Core A LG restarant kitchen	-	-	-	-	-	-	-	-	1	-	N/A
Core A LG circ	-	-	-	1.5	-	-	-	-	-	-	N/A
Core A LG stairs	-	-	-	1.5	-	-	-	-	-	-	N/A
Core C LG circ 1	-	-	-	1.5	-	-	-	-	-	-	N/A
Core C LG stairs	-	-	-	1.5	-	-	-	-	-	-	N/A
Core C LG circ 2	-	-	-	1.5	-	-	-	-	-	-	N/A
Core E LG circ1	-	-	-	1.5	-	-	-	-	-	-	N/A
Core E LG circ2	-	-	-	1.5	-	-	-	-	-	-	N/A
Core E LG stairs	-	-	-	1.5	-	-	-	-	-	-	N/A
Core G LG stairs	-	-	-	1.5	-	-	-	-	-	-	N/A
Core G LG circ	-	-	-	1.5	-	-	-	-	-	-	N/A
Core I LG stairs	-	-	-	1.5	-	-	-	-	-	-	N/A
Core I LG circ	-	-	-	1.5	-	-	-	-	-	-	N/A
Core J LG stairs	-	-	-	1.5	-	-	-	-	-	-	N/A
Core J LG circ	-	-	-	1.5	-	-	-	-	-	-	N/A
Core L LG stairs	-	-	-	1.5	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
Core L LG circ	-	-	-	1.5	-	-	-	-	-	-	N/A
Core N LG stairs	-	-	-	1.5	-	-	-	-	-	-	N/A
Core N LG circ	-	-	-	1.5	-	-	-	-	-	-	N/A
Core O LG stairs	-	-	-	1.5	-	-	-	-	-	-	N/A
Core O LG circ	-	-	-	1.5	-	-	-	-	-	-	N/A
Core Q LG stairs	-	-	-	1.5	-	-	-	-	-	-	N/A
Core Q LG circ	-	-	-	1.5	-	-	-	-	-	-	N/A
Core R LG stairs	-	-	-	1.5	-	-	-	-	-	-	N/A
Core R LG circ	-	-	-	1.5	-	-	-	-	-	-	N/A
Core B LG supermarket display	-	-	-	1.5	-	-	-	-	-	-	N/A
Core B LG supermarket store	-	-	-	1.5	-	-	-	-	-	-	N/A
Core B LG stairs	-	-	-	1.5	-	-	-	-	-	-	N/A
Core B LG circ1	-	-	-	1.5	-	-	-	-	-	-	N/A
Core B LG circ2	-	-	-	1.5	-	-	-	-	-	-	N/A
Core D LG stairs	-	-	-	1.5	-	-	-	-	-	-	N/A
Core D LG circ	-	-	-	1.5	-	-	-	-	-	-	N/A
Core F LG stairs	-	-	-	1.5	-	-	-	-	-	-	N/A
Core F LG circ	-	-	-	1.5	-	-	-	-	-	-	N/A
Core H LG stairs	-	-	-	1.5	-	-	-	-	-	-	N/A
Core H LG circ	-	-	-	1.5	-	-	-	-	-	-	N/A
Core K LG stairs	-	-	-	1.5	-	-	-	-	-	-	N/A
Core K LG circ	-	-	-	1.5	-	-	-	-	-	-	N/A
Core M LG stairs	-	-	-	1.5	-	-	-	-	-	-	N/A
Core M LG circ	-	-	-	1.5	-	-	-	-	-	-	N/A
Core P LG stairs	-	-	-	1.5	-	-	-	-	-	-	N/A
Core P LG circ	-	-	-	1.5	-	-	-	-	-	-	N/A
Core P G maintenance office	-	-	-	1.5	-	-	-	-	-	-	N/A
Core P G concierge	-	-	-	1.5	-	-	-	-	-	-	N/A
Core P G retail	-	-	-	1.5	-	-	-	-	-	-	N/A
Core M G workshare hub	-	-	-	1.5	-	-	-	-	-	-	N/A
Core M G dry cleaner	-	-	-	1.5	-	-	-	-	-	-	N/A
Core K G coffee shop	-	-	-	1.5	-	-	-	-	-	-	N/A
Core K G coffee shop food prep	-	-	-	-	-	-	-	-	1	-	N/A
Core K G hair dresser	-	-	-	1.5	-	-	-	-	-	-	N/A
Core H G resindents lounge	-	-	-	1.5	-	-	-	-	-	-	N/A
Core H G resi meeting space	-	-	-	1.5	-	-	-	-	-	-	N/A
Core H G coffee shop kitchen	-	-	-	-	-	-	-	-	1	-	N/A
Core H G coffee shop	-	-	-	1.5	-	-	-	-	-	-	N/A
Core F G fitness centre	-	-	-	1.5	-	-	-	-	-	-	N/A
Core D G nursery	-	-	-	1.5	-	-	-	-	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
Core A LG restaurant dining	-	80	22	610

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General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
Core A LG restarant kitchen	-	80	-	593
Core A LG circ	-	80	-	188
Core A LG stairs	-	80	-	84
Core A LG refuse	80	-	-	52
Core A LG store	80	-	-	40
Core A LG bike store	80	-	-	91
Core C LG energy centre	80	-	-	1008
Core C LG sprinkler tank room	80	-	-	133
Core C LG comm room	80	-	-	136
Core C LG boiler room	80	-	-	149
Core C LG flues	80	-	-	110
Core C LG LV switch room	80	-	-	206
Core C LG gas meter	80	-	-	120
Core C LG substation	80	-	-	142
Core C LG circ 1	-	80	-	130
Core C LG stairs	-	80	-	83
Core C LG circ 2	-	80	-	102
Core C LG refuse	80	-	-	49
Core E LG water store	80	-	-	115
Core E LG bike store	80	-	-	133
Core E LG circ1	-	80	-	166
Core E LG circ2	-	80	-	77
Core E LG stairs	-	80	-	86
Core E LG refuse	80	-	-	53
Core G LG stairs	-	80	-	76
Core G LG circ	-	80	-	150
Core G LG bike store	80	-	-	66
Core G LG refuse	80	-	-	43
Core I LG stairs	-	80	-	75
Core I LG circ	-	80	-	99
Core I LG bike store	80	-	-	81
Core I LG refuse	80	-	-	47
Core J LG stairs	-	80	-	64
Core J LG circ	-	80	-	156
Core J LG refuse	80	-	-	35
Core J LG bike store	80	-	-	89
Core L LG stairs	-	80	-	90
Core L LG refuse	80	-	-	45
Core L LG circ	-	80	-	157
Core L LG bike store	80	-	-	134
Core L LG LV switch room	80	-	-	252
Core L LG substation	80	-	-	188
Core N LG stairs	-	80	-	72

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General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
Core N LG circ	-	80	-	73
Core N LG bike store	80	-	-	64
Core N LG refuse	80	-	-	42
Core O LG stairs	-	80	-	61
Core O LG circ	-	80	-	61
Core O LG bike store	80	-	-	92
Core O LG refuse	80	-	-	32
Core Q LG stairs	-	80	-	84
Core Q LG circ	-	80	-	154
Core Q LG bike store	80	-	-	133
Core Q LG refuse	80	-	-	45
Core Q LG LV switch room	80	-	-	243
Core Q LG substation	80	-	-	187
Core R LG stairs	-	80	-	78
Core R LG circ	-	80	-	112
Core R LG bike store	80	-	-	73
Core R LG refuse	80	-	-	38
Core R LG LV switch room	80	-	-	260
Core R LG substation	80	-	-	153
Core B LG supermarket display	-	80	22	5386
Core B LG supermarket store	80	-	-	180
Core B LG stairs	-	80	-	88
Core B LG circ1	-	80	-	113
Core B LG circ2	-	80	-	61
Core B LG bike store	80	-	-	48
Core B LG refuse	80	-	-	36
Core D LG stairs	-	80	-	92
Core D LG circ	-	80	-	159
Core D LG refuse	80	-	-	37
Core D LG bike store	80	-	-	192
Core D LG LV switchroom	80	-	-	311
Core D LG substation	80	-	-	277
Core F LG stairs	-	80	-	93
Core F LG circ	-	80	-	153
Core F LG refuse	80	-	-	36
Core F LG bike store	80	-	-	91
Core F LG LV switchroom	80	-	-	276
Core F LG substation	80	-	-	152
Core H LG stairs	-	80	-	93
Core H LG circ	-	80	-	155
Core H LG refuse	80	-	-	35
Core H LG bike store	80	-	-	105
Core K LG stairs	-	80	-	89

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
Core K LG circ	-	80	-	143
Core K LG refuse	80	-	-	59
Core K LG bike store	80	-	-	59
Core M LG stairs	-	80	-	91
Core M LG circ	-	80	-	123
Core M LG refuse	80	-	-	46
Core M LG bike store	80	-	-	68
Core M LG water tank	80	-	-	137
Core P LG stairs	-	80	-	75
Core P LG circ	-	80	-	84
Core P LG refuse	80	-	-	70
Core P LG bike store	80	-	-	78
LG car park	-	80	-	24712
Core P G maintenance office	80	-	-	794
Core P G concierge	-	80	22	280
Core P G retail	-	80	22	847
Core M G workshare hub	80	-	-	1117
Core M G dry cleaner	-	80	22	2203
Core K G coffee shop	-	80	22	347
Core K G coffee shop food prep	-	80	-	332
Core K G hair dresser	-	80	22	1482
Core H G resindents lounge	-	80	22	296
Core H G resi meeting space	-	80	22	448
Core H G coffee shop kitchen	-	80	-	343
Core H G coffee shop	-	80	22	314
Core F G fitness centre	-	80	-	430
Core D G nursery	80	-	-	781

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Core A LG restaurant dining	N/A	N/A
Core B LG supermarket display	N/A	N/A
Core B LG supermarket store	N/A	N/A
Core P G maintenance office	NO (-60%)	YES
Core P G concierge	NO (-67%)	YES
Core P G retail	NO (-51%)	YES
Core M G workshare hub	NO (-73%)	YES
Core M G dry cleaner	NO (-49%)	YES
Core K G coffee shop	NO (-22%)	YES
Core K G hair dresser	NO (-37%)	YES
Core H G resindents lounge	NO (-57%)	YES
Core H G resi meeting space	NO (-73%)	YES
Core H G coffee shop	NO (-78%)	YES

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Core F G fitness centre	NO (-78%)	YES
Core D G nursery	NO (-79%)	YES

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	20321	20321
External area [m²]	36219	36219
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	6333	8632
Average U-value [W/m²K]	0.17	0.24
Alpha value* [%]	4.55	4.55

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

Building Use

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

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	10.54	6.47
Cooling	2.51	3.1
Auxiliary	1.24	1.27
Lighting	17.42	20.81
Hot water	6.32	3.13
Equipment*	11.58	11.58
TOTAL**	**32.05**	**34.77**

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

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	5.98	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	62.21	62.35
Primary energy* [kWh/m²]	67.21	87.07
Total emissions [kg/m²]	11.5	14.8

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] No Heating or Cooling										
	Actual	13.1	0	8.5	0	1.7	0.43	0	0.45	0
	Notional	10.2	0	3.4	0	2.3	0.82	0	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	20.1	0	0	0	0
	Notional	0	0	0	0	22.4	0	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	19.5	0	12.7	0	3.5	0.43	0	0.45	0
	Notional	27.3	0	9.2	0	5.3	0.82	0	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	2.3	731.1	1.5	42.8	12.2	0.43	4.75	0.45	5
	Notional	17	682.4	5.8	52.7	10.6	0.82	3.6	----	----
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	2.4	230.4	1.6	13.5	4.4	0.43	4.75	0.45	5
	Notional	6.4	200	2.2	15.4	4.4	0.82	3.6	----	----
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	1.4	105.5	0.9	6.2	6.9	0.43	4.75	0.45	5
	Notional	8.7	102.5	2.9	7.9	6	0.82	3.6	----	----
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	0	81.8	0	4.8	28.9	0	4.75	0	5
	Notional	3	80.9	1	6.2	25.1	0.82	3.6	----	----
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	3	238.1	1.9	13.9	4.4	0.43	4.75	0.45	5
	Notional	8.7	175.3	3	13.5	3.8	0.82	3.6	----	----
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	0.1	297.5	0.1	17.4	6.8	0.43	4.75	0.45	5
	Notional	4.8	244.4	1.6	18.9	5.9	0.82	3.6	----	----
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	9.3	204.3	6.1	12	5	0.43	4.75	0.45	5
	Notional	26.5	156.8	9	12.1	4.4	0.82	3.6	----	----
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	12.1	528.1	7.9	30.9	4.3	0.43	4.75	0.45	5
	Notional	13.9	537.9	4.7	41.5	3.8	0.82	3.6	----	----
[ST] No Heating or Cooling										
	Actual	143.4	0	93.2	0	0	0.43	0	0.45	0
	Notional	161.7	0	54.8	0	0	0.82	0	----	----

Key to terms

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

Key Features

The BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

Element	U_{i-Typ}	U_{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.18	External Wall
Floor	0.2	0.16	Exposed Floor
Roof	0.15	0.13	Roof
Windows, roof windows, and rooflights	1.5	1.41	Curtain wall FX
Personnel doors	1.5	-	No personal doors in project
Vehicle access & similar large doors	1.5	-	No vehicle doors in project
High usage entrance doors	1.5	-	No high usage entrance doors in project

U_{i-Typ} = Typical individual element U-values [W/(m²K)] U_{i-Min} = Minimum individual element U-values [W/(m²K)]

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

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	3

11.2 SAP Compliance Calculations

As a part of our BS EN ISO 14001 accreditation, we make a conscious effort to reduce the amount of printing and therefore reduce our carbon impact on the environment. For this reason, we have included a summary of all SAP results in this appendix. However, we are happy to provide all DER and TER worksheets as hard copies on request.

Dwelling		Lean			Clean		Green		Overheating compliance	FEE			Unregulated loads
Unit	Area	TER	DER	% variance	DER	% variance	DER	% variance		TFEE	DFEE	% variance	
1A1	87.5	18.8	20.1	6.8%	12.3	-34.8%	11.1	-40.8%	Y	58.9	63.4	7.6%	18.0
1A2	87.5	17.8	17.6	-1.1%	11.0	-38.3%	9.8	-44.7%	Y	52.0	52.3	0.6%	18.0
1B1	87.5	16.5	16.5	-0.2%	10.3	-37.4%	9.2	-44.2%	Y	47.2	49.3	4.4%	18.0
1B2	87.5	15.4	13.5	-12.1%	8.8	-42.9%	7.6	-50.2%	Y	39.7	36.2	-8.8%	18.0
1C1	87.5	18.8	20.2	7.5%	12.3	-34.4%	11.2	-40.4%	Y	58.9	63.9	8.5%	18.0
1C2	87.5	17.8	17.7	-0.2%	11.0	-37.9%	9.9	-44.2%	Y	52.0	52.9	1.7%	18.0
2A1	50.9	21.1	21.4	1.3%	13.0	-38.3%	11.1	-47.5%	Y	56.1	59.4	5.9%	20.6
2B1	50.9	18.7	17.4	-6.9%	10.9	-41.8%	9.0	-52.1%	Y	43.8	43.8	0.0%	20.6
2C1	50.9	21.1	21.6	2.0%	13.1	-37.9%	11.2	-47.1%	Y	56.1	60.0	7.0%	20.6
3A1	74.3	20.2	21.1	4.1%	12.8	-36.6%	11.5	-43.2%	Y	62.0	64.2	3.5%	18.9
3B1	74.3	17.9	17.1	-4.3%	10.7	-40.1%	9.4	-47.5%	Y	50.1	49.1	-2.0%	18.9
3C1	74.3	20.2	21.2	4.8%	12.9	-36.2%	11.6	-42.8%	Y	62.0	64.7	4.4%	18.9
4A1	56.6	20.0	21.1	5.3%	12.8	-35.8%	11.1	-44.5%	Y	53.4	60.0	12.4%	20.1
5A1	91.8	16.4	16.0	-2.2%	10.1	-38.2%	9.0	-44.7%	Y	45.6	47.2	3.5%	17.7
5B1	91.8	14.0	12.1	-13.4%	8.0	-42.5%	6.9	-50.2%	Y	33.4	31.3	-6.3%	17.7
5C1	91.8	16.4	16.1	-1.3%	10.2	-37.7%	9.1	-44.2%	Y	45.6	47.8	4.8%	17.7
6A1	87.3	18.2	18.0	-0.7%	11.2	-38.1%	10.1	-44.3%	Y	53.4	54.5	2.1%	18.0
7A1	72.2	18.8	21.4	13.8%	13.0	-30.8%	11.7	-38.0%	Y	54.1	68.6	26.8%	19.0
7A2	72.2	18.0	20.1	11.5%	12.3	-31.7%	10.9	-39.3%	Y	49.9	63.4	27.1%	19.0
7B1	72.2	16.5	18.2	10.3%	11.3	-31.5%	10.0	-39.8%	Y	42.4	56.3	32.8%	19.0
7B2	72.2	15.8	17.0	8.0%	10.7	-32.3%	9.3	-41.0%	Y	38.4	51.3	33.6%	19.0
7C1	72.2	18.8	21.5	14.5%	13.1	-30.4%	11.7	-37.7%	Y	54.1	69.1	27.7%	19.0
7C2	72.2	18.0	20.2	12.1%	12.4	-31.3%	11.0	-38.9%	Y	49.9	63.8	27.9%	19.0
8A1	51.1	20.1	20.0	-0.7%	12.3	-39.0%	10.3	-48.6%	Y	51.2	53.9	5.3%	20.6
8A2	51.1	22.0	22.8	3.5%	13.8	-37.4%	11.8	-46.2%	Y	60.8	64.7	6.4%	20.6
8B1	51.1	17.8	16.1	-9.1%	10.2	-42.5%	8.3	-53.3%	Y	39.0	38.4	-1.5%	20.6
8C1	51.1	20.1	20.1	0.0%	12.4	-38.6%	10.4	-48.2%	Y	51.2	54.5	6.4%	20.6
8C2	51.1	22.0	22.9	4.2%	13.9	-37.1%	11.9	-45.8%	Y	60.8	65.2	7.2%	20.6
9A1	87.8	18.1	18.7	3.0%	11.5	-36.5%	10.4	-42.7%	Y	55.7	57.5	3.2%	17.9
9B1	87.8	15.9	14.9	-6.4%	9.5	-40.4%	8.4	-47.4%	Y	44.2	42.6	-3.6%	17.9
9C1	87.8	18.1	18.8	3.7%	11.6	-36.1%	10.5	-42.3%	Y	55.7	58.0	4.1%	17.9
10A1	89.6	17.1	16.5	-3.6%	10.4	-39.2%	9.3	-45.6%	Y	48.5	48.7	0.4%	17.8
10B1	89.6	14.6	12.3	-15.5%	8.2	-44.0%	7.1	-51.5%	Y	35.8	32.2	-10.1%	17.8
10C1	89.6	17.1	16.7	-2.7%	10.5	-38.7%	9.4	-45.1%	Y	48.5	49.3	1.6%	17.8
11A1	67.0	19.9	19.9	0.1%	12.2	-38.6%	10.8	-46.0%	Y	56.3	57.6	2.3%	19.4
11B1	67.0	17.4	15.7	-9.9%	10.0	-42.8%	8.5	-51.3%	Y	43.7	41.2	-5.7%	19.4
11C1	67.0	19.9	20.1	0.9%	12.3	-38.2%	10.8	-45.6%	Y	56.3	58.2	3.4%	19.4
12A1	73.3	19.5	19.9	2.2%	12.2	-37.3%	10.9	-44.2%	Y	57.9	59.3	2.4%	19.0
12B1	73.3	17.2	16.1	-6.6%	10.2	-40.9%	8.8	-48.8%	Y	46.2	44.2	-4.3%	19.0
12C1	73.3	19.5	20.1	2.9%	12.3	-36.9%	11.0	-43.8%	Y	57.9	59.8	3.3%	19.0
13A1	90.6	18.4	18.7	1.7%	11.5	-37.4%	10.4	-43.3%	Y	57.5	58.0	0.9%	17.7
13B1	90.6	16.1	14.8	-8.1%	9.4	-41.4%	8.3	-48.2%	Y	45.7	42.8	-6.3%	17.7
13C1	90.6	18.4	18.8	2.5%	11.6	-36.9%	10.5	-42.9%	Y	57.5	58.6	1.9%	17.7
14A1	74.3	18.6	18.3	-1.5%	11.4	-38.9%	10.0	-46.0%	Y	53.5	53.7	0.4%	18.9
14B1	74.3	16.3	14.4	-11.6%	9.3	-43.1%	7.9	-51.3%	Y	41.5	38.1	-8.2%	18.9
14C1	74.3	18.6	18.5	-0.7%	11.4	-38.5%	10.1	-45.6%	Y	53.5	54.2	1.3%	18.9
15A1	65.8	20.1	20.3	0.9%	12.4	-38.3%	10.9	-45.8%	Y	58.2	59.4	2.1%	19.5
15B1	65.8	17.8	16.3	-8.4%	10.2	-42.3%	8.7	-50.7%	Y	46.1	43.6	-5.4%	19.5
16A1	103.4	18.0	18.1	0.4%	11.1	-38.1%	10.2	-43.4%	Y	57.9	58.4	0.9%	16.8
16B1	103.4	15.6	13.9	-10.7%	8.9	-42.8%	8.0	-48.9%	Y	45.7	42.4	-7.2%	16.8
17A1	61.5	19.9	19.8	-0.5%	12.2	-38.9%	10.6	-46.9%	Y	54.7	56.2	2.7%	19.8
17B1	61.5	17.5	15.7	-10.2%	10.0	-43.0%	8.4	-52.2%	Y	42.4	40.2	-5.2%	19.8
17C1	61.5	19.9	20.0	0.3%	12.3	-38.5%	10.7	-46.5%	Y	54.7	56.8	3.8%	19.8
18A1	98.9	18.2	19.2	5.4%	11.8	-35.5%	10.8	-40.9%	Y	58.8	62.0	5.4%	17.1
18B1	98.9	15.8	15.4	-2.5%	9.7	-38.5%	8.7	-44.8%	Y	46.9	47.4	1.1%	17.1
18C1	98.9	18.2	19.4	6.2%	11.8	-35.1%	10.8	-40.5%	Y	58.8	62.5	6.3%	17.1
19A1	59.3	18.8	18.3	-2.3%	11.4	-39.4%	9.7	-48.2%	Y	47.8	48.9	2.3%	19.9
19B1	59.3	16.5	14.6	-11.5%	9.4	-43.1%	7.7	-53.2%	Y	35.8	33.2	-7.3%	19.9
19C1	59.3	18.8	18.5	-1.5%	11.5	-38.9%	9.8	-47.8%	Y	47.8	49.5	3.6%	19.9
20A1	89.5	16.1	15.5	-3.9%	9.9	-38.8%	8.8	-45.6%	Y	43.5	44.8	3.0%	17.8
20B1	89.5	13.7	11.6	-15.1%	7.8	-43.0%	6.7	-51.0%	Y	31.1	28.6	-8.0%	17.8
20C1	89.5	16.1	15.6	-3.0%	10.0	-38.3%	8.9	-45.1%	Y	43.5	45.4	4.4%	17.8
21A1	46.2	21.8	22.0	1.1%	13.4	-38.5%	11.3	-48.3%	Y	55.1	58.7	6.5%	21.0
21B1	46.2	19.4	18.0	-7.1%	11.3	-41.9%	9.1	-52.9%	Y	43.0	42.9	-0.2%	21.0
21C1	46.2	21.8	22.1	1.8%	13.5	-38.1%	11.3	-47.9%	Y	55.1	59.2	7.4%	21.0
22A1	97.8	16.8	17.2	2.2%	10.7	-36.5%	9.7	-42.5%	Y	51.7	53.5	3.5%	17.2
22A2	97.8	16.4	16.4	0.0%	10.3	-37.5%	9.3	-43.6%	Y	49.6	50.2	1.2%	17.2
22B1	97.8	14.6	13.6	-6.4%	8.8	-39.7%	7.8	-46.7%	Y	40.2	39.3	-2.2%	17.2
22B2	97.8	14.2	12.7	-10.5%	8.3	-41.6%	7.2	-48.8%	Y	38.0	35.0	-7.9%	17.2
22C1	97.8	16.8	17.3	3.0%	10.8	-36.1%	9.7	-42.1%	Y	51.7	54.0	4.4%	17.2
22C2	97.8	16.4	16.6	0.9%	10.4	-37.0%	9.3	-43.1%	Y	49.6	50.8	2.4%	17.2
23B1	83.6	15.8	14.9	-5.6%	9.5	-39.8%	8.3	-47.3%	Y	42.3	42.1	-0.5%	18.2
24A1	117.1	17.6	19.3	9.6%	11.7	-33.3%	10.9	-38.1%	Y	59.5	66.0	10.9%	15.9

24B1	117.1	15.2	15.5	2.3%	9.7	-36.0%	8.9	-41.5%	Y	47.4	51.7	9.1%	15.9
24C1	117.1	17.6	19.4	10.4%	11.8	-32.9%	11.0	-37.7%	Y	59.5	66.6	11.9%	15.9
25A1	40.6	21.5	21.5	0.1%	13.1	-38.9%	10.7	-50.2%	Y	49.6	53.6	8.1%	21.8
25B1	40.6	19.3	18.1	-5.8%	11.3	-41.2%	8.9	-53.8%	Y	38.0	39.4	3.7%	21.8
25C1	40.6	21.5	21.6	0.7%	13.2	-38.6%	10.8	-49.9%	Y	49.6	54.1	9.1%	21.8
26B1	98.3	16.2	15.3	-5.3%	9.7	-40.2%	8.7	-46.4%	Y	48.5	45.9	-5.4%	17.2
26C1	98.3	18.4	19.3	4.7%	11.8	-36.0%	10.8	-41.4%	Y	60.1	61.3	2.0%	17.2
27C1	62.8	18.9	19.4	2.8%	11.9	-36.8%	10.4	-45.1%	Y	50.8	54.2	6.7%	19.7
27B1	62.8	16.7	15.8	-5.0%	10.0	-39.8%	8.5	-49.2%	Y	39.4	39.8	1.0%	19.7
28C1	67.6	17.4	17.4	-0.1%	10.8	-37.7%	9.4	-46.1%	Y	44.7	48.1	7.6%	19.3

11.3 Overheating Results

11.3.1 Detailed Domestic Overheating Results for DSY1

Zone Name	Room Use	Orientation	Max. Exceedable Hours	Criterion 1: #Hours Exceeding Comfort Range	Max Exceedable Night Hours	Criterion 2: Number of Night Hours Exceeding 26 °C for Bedrooms.	Result
Levels 01 to top							
A_BD_02 1	Bedroom	Inner	110	102	32	23	Pass
A_BD_02 2	Bedroom	Inner	110	99	32	17	Pass
A_BD_02 3	Bedroom	Inner	110	99	32	18	Pass
A_BD_02 4	Bedroom	Outer	110	623	32	111	Fail
A_BD_02 5	Bedroom	Outer	110	783	32	104	Fail
A_BD_02 6	Bedroom	Outer	110	677	32	138	Fail
A_BD_02 7	Bedroom	Outer	110	414	32	77	Fail
A_BD_02 8	Bedroom	Outer	110	325	32	63	Fail
A_BD_02 9	Bedroom	Outer	110	246	32	58	Fail
A_BS_02 1	Bedroom	Inner	110	100	32	23	Pass
A_LK1_02 1	Living Room / Kitchen	Inner	59	46	N/A	N/A	Pass
A_LK1_02 2	Living Room / Kitchen	Inner	59	48	N/A	N/A	Pass
A_LK2_02 1	Living Room / Kitchen	Inner	59	41	N/A	N/A	Pass
A_LK3_02 1	Living Room / Kitchen	Inner	59	128	N/A	N/A	Fail
A_LK3_02 2	Living Room / Kitchen	Outer	59	462	N/A	N/A	Fail
B_BD_02 1	Bedroom	Outer	110	33	32	45	Fail
B_BD_02 2	Bedroom	Outer	110	22	32	31	Pass
B_BD_02 3	Bedroom	Outer	110	36	32	38	Fail
B_BD_02 4	Bedroom	Outer	110	154	32	64	Fail
B_BD_02 5	Bedroom	Inner	110	131	32	10	Fail
B_BD_02 6	Bedroom	Inner	110	85	32	10	Pass
B_BD_02 7	Bedroom	Inner	110	86	32	7	Pass
B_BS_02 1	Bedroom	Inner	110	80	32	10	Pass
B_LK1_02 1	Living Room / Kitchen	Inner	59	37	N/A	N/A	Pass
B_LK1_02 2	Living Room / Kitchen	Inner	59	53	N/A	N/A	Pass
B_LK2_02 1	Living Room / Kitchen	Inner	59	116	N/A	N/A	Fail
B_LK2_02 2	Living Room / Kitchen	Inner	59	38	N/A	N/A	Pass
B_LK2_02 3	Living Room / Kitchen	Inner	59	114	N/A	N/A	Fail
C_BD_02 1	Bedroom	Inner	110	57	32	9	Pass
C_BD_02 2	Bedroom	Inner	110	43	32	12	Pass
C_BD_02 3	Bedroom	Inner	110	44	32	7	Pass
C_BD_02 4	Bedroom	Outer	110	51	32	47	Fail
C_BD_02 5	Bedroom	Outer	110	28	32	38	Fail
C_BD_02 6	Bedroom	Outer	110	22	32	31	Pass
C_BD_02 7	Bedroom	Outer	110	48	32	42	Fail
C_BS_02 1	Bedroom	Inner	110	41	32	10	Pass
C_LK1_02 1	Living Room / Kitchen	Inner	59	26	N/A	N/A	Pass
C_LK1_02 2	Living Room / Kitchen	Inner	59	25	N/A	N/A	Pass
C_LK2_02 1	Living Room / Kitchen	Inner	59	34	N/A	N/A	Pass
C_LK2_02 2	Living Room / Kitchen	Inner	59	26	N/A	N/A	Pass
C_LK2_02 3	Living Room / Kitchen	Inner	59	33	N/A	N/A	Pass
D_BD_02 1	Bedroom	Outer	110	24	32	35	Fail
D_BD_02 10	Bedroom	Inner	110	33	32	8	Pass
D_BD_02 11	Bedroom	Inner	110	169	32	9	Fail
D_BD_02 12	Bedroom	Inner	110	54	32	11	Pass
D_BD_02 13	Bedroom	Inner	110	76	32	9	Pass
D_BD_02 14	Bedroom	Inner	110	144	32	8	Fail
D_BD_02 2	Bedroom	Outer	110	24	32	36	Fail
D_BD_02 3	Bedroom	Outer	110	28	32	41	Fail
D_BD_02 4	Bedroom	Outer	110	18	32	29	Pass
D_BD_02 5	Bedroom	Outer	110	52	32	56	Fail
D_BD_02 6	Bedroom	Outer	110	44	32	50	Fail
D_BD_02 7	Bedroom	Inner	110	43	32	14	Pass
D_BD_02 8	Bedroom	Inner	110	127	32	16	Fail
D_BD_02 9	Bedroom	Inner	110	30	32	11	Pass
D_BS_02 1	Bedroom	Inner	110	138	32	14	Fail
D_LK1_02 1	Living Room / Kitchen	Outer	59	16	N/A	N/A	Pass
D_LK1_02 2	Living Room / Kitchen	Inner	59	46	N/A	N/A	Pass
D_LK1_02 3	Living Room / Kitchen	Inner	59	23	N/A	N/A	Pass
D_LK2_02 1	Living Room / Kitchen	Outer	59	29	N/A	N/A	Pass
D_LK2_02 2	Living Room / Kitchen	Inner	59	54	N/A	N/A	Pass
D_LK2_02 3	Living Room / Kitchen	Inner	59	51	N/A	N/A	Pass
D_LK3_02 1	Living Room / Kitchen	Outer	59	31	N/A	N/A	Pass
D_LK3_02 2	Living Room / Kitchen	Inner	59	44	N/A	N/A	Pass
E_BD_02 1	Bedroom	Inner	110	48	32	7	Pass
E_BD_02 2	Bedroom	Outer	110	47	32	43	Fail
E_BD_02 3	Bedroom	Outer	110	31	32	45	Fail
E_LK1_02 1	Living Room / Kitchen	Inner	59	27	N/A	N/A	Pass
E_LK2_02 1	Living Room / Kitchen	Inner	59	35	N/A	N/A	Pass
G_BD_02 1	Bedroom	Inner	110	31	32	8	Pass
G_BS_02 1	Bedroom	Inner	110	33	32	8	Pass
G_LK2_02 1	Living Room / Kitchen	Inner	59	16	N/A	N/A	Pass
I_BD_02 1	Bedroom	Inner	110	23	32	7	Pass
I_BD_02 2	Bedroom	Inner	110	30	32	10	Pass
I_BD_02 3	Bedroom	Inner	110	80	32	7	Pass
I_BD_02 4	Bedroom	Outer	110	79	32	37	Fail
I_BD_02 5	Bedroom	Outer	110	47	32	28	Pass
I_BD_02 6	Bedroom	Outer	110	29	32	25	Pass
I_BD_02 7	Bedroom	Outer	110	32	32	27	Pass
I_LK1_02 1	Living Room / Kitchen	Inner	59	73	N/A	N/A	Fail
I_LK2_02 1	Living Room / Kitchen	Inner	59	38	N/A	N/A	Pass
I_LK2_02 2	Living Room / Kitchen	Inner	59	26	N/A	N/A	Pass
I_LK2_02 3	Living Room / Kitchen	Inner	59	26	N/A	N/A	Pass
J_BD_02 1	Bedroom	Inner	110	70	32	7	Pass
J_BD_02 10	Bedroom	Outer	110	158	32	59	Fail
J_BD_02 11	Bedroom	Outer	110	74	32	39	Fail
J_BD_02 2	Bedroom	Inner	110	30	32	10	Pass
J_BD_02 3	Bedroom	Inner	110	46	32	8	Pass
J_BD_02 4	Bedroom	Inner	110	86	32	7	Pass
J_BD_02 5	Bedroom	Inner	110	42	32	11	Pass
J_BD_02 6	Bedroom	Outer	110	85	32	50	Fail
J_BD_02 7	Bedroom	Outer	110	116	32	57	Fail
J_BD_02 8	Bedroom	Outer	110	187	32	60	Fail
J_BD_02 9	Bedroom	Outer	110	67	32	58	Fail
J_LK1_02 1	Living Room / Kitchen	Inner	59	31	N/A	N/A	Pass
J_LK2_02 1	Living Room / Kitchen	Inner	59	25	N/A	N/A	Pass
J_LK2_02 2	Living Room / Kitchen	Inner	59	25	N/A	N/A	Pass
J_LK3_02 1	Living Room / Kitchen	Inner	59	52	N/A	N/A	Pass
J_LK3_02 2	Living Room / Kitchen	Inner	59	23	N/A	N/A	Pass
K_BD_02 1	Bedroom	Outer	110	518	32	142	Fail
K_BD_02 2	Bedroom	Outer	110	155	32	111	Fail
K_BD_02 3	Bedroom	Outer	110	229	32	132	Fail
K_BD_02 4	Bedroom	Outer	110	907	32	188	Fail
K_BD_02 5	Bedroom	Inner	110	138	32	9	Fail
K_BD_02 6	Bedroom	Inner	110	93	32	9	Pass
K_BD_02 7	Bedroom	Inner	110	187	32	9	Fail
K_BS_02 1	Bedroom	Inner	110	86	32	8	Pass
K_LK1_02 1	Living Room / Kitchen	Inner	59	58	N/A	N/A	Pass
K_LK1_02 2	Living Room / Kitchen	Inner	59	88	N/A	N/A	Fail
K_LK2_02 1	Living Room / Kitchen	Inner	59	72	N/A	N/A	Fail
K_LK2_02 2	Living Room / Kitchen	Inner	59	82	N/A	N/A	Fail
K_LK2_02 3	Living Room / Kitchen	Inner	59	132	N/A	N/A	Fail
L_BD_02 1	Bedroom	Outer	110	649	32	82	Fail
L_BD_02 2	Bedroom	Outer	110	303	32	75	Fail
L_BD_02 3	Bedroom	Outer	110	361	32	89	Fail
L_BD_02 4	Bedroom	Outer	110	863	32	99	Fail
L_LK2_02 1	Living Room / Kitchen	Inner	59	62	N/A	N/A	Fail
L_LK2_02 2	Living Room / Kitchen	Inner	59	58	N/A	N/A	Pass
M_BD_02 1	Bedroom	Outer	110	36	32	44	Fail
M_BD_02 10	Bedroom	Inner	110	104	32	16	Pass
M_BD_02 11	Bedroom	Inner	110	43	32	14	Pass
M_BD_02 12	Bedroom	Outer	110	18	32	29	Pass
M_BD_02 2	Bedroom	Outer	110	46	32	53	Fail
M_BD_02 3	Bedroom	Outer	110	45	32	53	Fail
M_BD_02 4	Bedroom	Outer	110	18	32	30	Pass
M_BD_02 5	Bedroom	Outer	110	34	32	45	Fail
M_BD_02 6	Bedroom	Outer	110	39	32	50	Fail
M_BD_02 7	Bedroom	Outer	110	38	32	48	Fail
M_BD_02 8	Bedroom	Inner	110	69	32	11	Pass
M_BD_02 9	Bedroom	Inner	110	43	32	11	Pass
M_LK1_02 1	Living Room / Kitchen	Outer	59	15	N/A	N/A	Pass
M_LK1_02 2	Living Room / Kitchen	Inner	59	36	N/A	N/A	Pass
M_LK1_02 3	Living Room / Kitchen	Inner	59	61	N/A	N/A	Fail
M_LK1_02 4	Living Room / Kitchen	Inner	59	82	N/A	N/A	Fail
M_LK2_02 1	Living Room / Kitchen	Inner	59	25	N/A	N/A	Pass
M_LK3_02 1	Living Room / Kitchen	Outer	59	30	N/A	N/A	Pass
M_LK3_02 2	Living Room / Kitchen	Inner	59	45	N/A	N/A	Pass
N_BD_02 1	Bedroom	Inner	110	72	32	7	Pass
N_BD_02 2	Bedroom	Inner	110	41	32	8	Pass
N_BD_02 3	Bedroom	Inner	110	34	32	10	Pass
N_BD_02 4	Bedroom	Inner	110	94	32	8	Pass
N_BD_02 5	Bedroom	Outer	110	117	32	49	Fail
N_BD_02 6	Bedroom	Outer	110	216	32	65	Fail
N_BD_02 7	Bedroom	Outer	110	92	32	60	Fail
N_LK2_02 1	Living Room / Kitchen	Inner	59	25	N/A	N/A	Pass
N_LK2_02 2	Living Room / Kitchen	Inner	59	47	N/A	N/A	Pass
N_LK3_02 1	Living Room / Kitchen	Inner	59	32	N/A	N/A	Pass
O_BD_02 1	Bedroom	Inner	110	73	32	7	Pass
O_BD_02 2	Bedroom	Inner	110	30	32	10	Pass
O_BD_02 3	Bedroom	Inner	110	23	32	7	Pass
O_BD_02 4	Bedroom	Outer	110	47	32	28	Pass
O_BD_02 5	Bedroom	Outer	110	45	32	29	Pass
O_LK1_02 1	Living Room / Kitchen	Inner	59	62	N/A	N/A	Fail
O_LK2_02 1	Living Room / Kitchen	Inner	59	23	N/A	N/A	Pass

O_LK2_02 2	Living Room / Kitchen	Inner	59	16	N/A	N/A	Pass
P_BD_02 1	Bedroom	Outer	110	24	32	20	Pass
P_BD_02 2	Bedroom	Outer	110	28	32	33	Fail
P_BD_02 3	Bedroom	Outer	110	55	32	15	Pass
P_BD_02 4	Bedroom	Inner	110	135	32	9	Fail
P_BD_02 5	Bedroom	Inner	110	63	32	8	Pass
P_BD_02 6	Bedroom	Inner	110	172	32	9	Fail
P_BD_02 7	Bedroom	Inner	110	80	32	8	Pass
P_BD_02 8	Bedroom	Outer	110	34	32	34	Fail
P_BD_02 9	Bedroom	Outer	110	9	32	14	Pass
P_LK1_02 1	Living Room / Kitchen	Outer	59	35	N/A	N/A	Pass
P_LK1_02 2	Living Room / Kitchen	Inner	59	57	N/A	N/A	Pass
P_LK2_02 1	Living Room / Kitchen	Inner	59	44	N/A	N/A	Pass
P_LK2_02 2	Living Room / Kitchen	Inner	59	44	N/A	N/A	Pass
P_LK3_02 1	Living Room / Kitchen	Inner	59	128	N/A	N/A	Fail
R_BD_02 1	Bedroom	Inner	110	72	32	7	Pass
R_BD_02 10	Bedroom	Outer	110	234	32	51	Fail
R_BD_02 11	Bedroom	Inner	110	68	32	9	Pass
R_BD_02 2	Bedroom	Inner	110	30	32	10	Pass
R_BD_02 3	Bedroom	Inner	110	73	32	9	Pass
R_BD_02 4	Bedroom	Inner	110	95	32	8	Pass
R_BD_02 5	Bedroom	Outer	110	56	32	47	Fail
R_BD_02 6	Bedroom	Outer	110	172	32	61	Fail
R_BD_02 7	Bedroom	Outer	110	99	32	68	Fail
R_BD_02 8	Bedroom	Outer	110	172	32	56	Fail
R_BD_02 9	Bedroom	Outer	110	209	32	57	Fail
R_LK1_02 1	Living Room / Kitchen	Inner	59	32	N/A	N/A	Pass
R_LK2_02 1	Living Room / Kitchen	Inner	59	24	N/A	N/A	Pass
R_LK2_02 2	Living Room / Kitchen	Inner	59	27	N/A	N/A	Pass
R_LK3_02 1	Living Room / Kitchen	Inner	59	26	N/A	N/A	Pass
R_LK3_02 2	Living Room / Kitchen	Inner	59	95	N/A	N/A	Fail
Ground							
A_BD_02 1	Bedroom	Inner	110	99	32	50	Fail
A_BD_02 2	Bedroom	Inner	110	104	32	50	Fail
A_BD_02 3	Bedroom	Inner	110	98	32	45	Fail
A_BD_02 4	Bedroom	Outer	110	621	32	110	Fail
A_BD_02 5	Bedroom	Outer	110	780	32	104	Fail
A_BD_02 6	Bedroom	Outer	110	675	32	137	Fail
A_BD_02 7	Bedroom	Outer	110	405	32	82	Fail
A_BD_02 8	Bedroom	Outer	110	319	32	63	Fail
A_BD_02 9	Bedroom	Outer	110	240	32	57	Fail
A_BS_02 1	Bedroom	Inner	110	105	32	56	Fail
A_LK1_02 1	Living Room / Kitchen	Inner	59	46	N/A	N/A	Pass
A_LK1_02 2	Living Room / Kitchen	Outer	59	49	N/A	N/A	Pass
A_LK2_02 1	Living Room / Kitchen	Outer	59	45	N/A	N/A	Pass
A_LK3_02 1	Living Room / Kitchen	Outer	59	120	N/A	N/A	Fail
A_LK3_02 2	Living Room / Kitchen	Outer	59	458	N/A	N/A	Fail
B_BD_02 1	Bedroom	Inner	110	34	32	45	Fail
B_BD_02 2	Bedroom	Inner	110	23	32	34	Fail
B_BD_02 3	Bedroom	Inner	110	36	32	40	Fail
B_BD_02 4	Bedroom	Inner	110	149	32	69	Fail
B_BD_02 5	Bedroom	Outer	110	123	32	23	Fail
B_BD_02 6	Bedroom	Outer	110	84	32	31	Pass
B_BD_02 7	Bedroom	Outer	110	80	32	26	Pass
B_BS_02 1	Bedroom	Outer	110	77	32	31	Pass
B_LK1_02 1	Living Room / Kitchen	Outer	59	39	N/A	N/A	Pass
B_LK1_02 2	Living Room / Kitchen	Outer	59	53	N/A	N/A	Pass
B_LK2_02 1	Living Room / Kitchen	Outer	59	108	N/A	N/A	Fail
B_LK2_02 2	Living Room / Kitchen	Inner	59	38	N/A	N/A	Pass
B_LK2_02 3	Living Room / Kitchen	Inner	59	111	N/A	N/A	Fail
C_BD_02 1	Bedroom	Outer	110	56	32	24	Pass
C_BD_02 2	Bedroom	Inner	110	44	32	31	Pass
C_BD_02 3	Bedroom	Inner	110	43	32	22	Pass
C_BD_02 4	Bedroom	Inner	110	51	32	48	Fail
C_BD_02 5	Bedroom	Inner	110	28	32	42	Fail
C_BD_02 6	Bedroom	Inner	110	22	32	33	Fail
C_BD_02 7	Bedroom	Inner	110	49	32	43	Fail
C_BS_02 1	Bedroom	Inner	110	43	32	27	Pass
C_LK1_02 1	Living Room / Kitchen	Outer	59	27	N/A	N/A	Pass
C_LK1_02 2	Living Room / Kitchen	Inner	59	29	N/A	N/A	Pass
C_LK2_02 1	Living Room / Kitchen	Inner	59	35	N/A	N/A	Pass
C_LK2_02 2	Living Room / Kitchen	Inner	59	28	N/A	N/A	Pass
C_LK2_02 3	Living Room / Kitchen	Inner	59	35	N/A	N/A	Pass
D_BD_02 1	Bedroom	Inner	110	24	32	35	Fail
D_BD_02 10	Bedroom	Inner	110	35	32	17	Pass
D_BD_02 11	Bedroom	Inner	110	157	32	24	Fail
D_BD_02 12	Bedroom	Inner	110	55	32	34	Fail
D_BD_02 13	Bedroom	Inner	110	74	32	26	Pass
D_BD_02 14	Bedroom	Inner	110	136	32	18	Fail
D_BD_02 2	Bedroom	Inner	110	24	32	37	Fail
D_BD_02 3	Bedroom	Inner	110	28	32	41	Fail
D_BD_02 4	Bedroom	Inner	110	18	32	29	Pass
D_BD_02 5	Bedroom	Inner	110	52	32	56	Fail
D_BD_02 6	Bedroom	Outer	110	44	32	50	Fail

D_BD_02 7	Bedroom	Outer	110	48	32	35	Fail
D_BD_02 8	Bedroom	Outer	110	125	32	45	Fail
D_BD_02 9	Bedroom	Outer	110	35	32	24	Pass
D_BS_02 1	Bedroom	Inner	110	139	32	40	Fail
D_LK1_02 1	Living Room / Kitchen	Outer	59	16	N/A	N/A	Pass
D_LK1_02 2	Living Room / Kitchen	Inner	59	46	N/A	N/A	Pass
D_LK1_02 3	Living Room / Kitchen	Inner	59	23	N/A	N/A	Pass
D_LK2_02 1	Living Room / Kitchen	Inner	59	31	N/A	N/A	Pass
D_LK2_02 2	Living Room / Kitchen	Inner	59	52	N/A	N/A	Pass
D_LK2_02 3	Living Room / Kitchen	Inner	59	51	N/A	N/A	Pass
D_LK3_02 1	Living Room / Kitchen	Outer	59	31	N/A	N/A	Pass
D_LK3_02 2	Living Room / Kitchen	Outer	59	46	N/A	N/A	Pass
E_BD_02 1	Bedroom	Outer	110	48	32	24	Pass
E_BD_02 2	Bedroom	Inner	110	46	32	44	Fail
E_BD_02 3	Bedroom	Inner	110	31	32	47	Fail
E_LK1_02 1	Living Room / Kitchen	Outer	59	31	N/A	N/A	Pass
E_LK2_02 1	Living Room / Kitchen	Inner	59	37	N/A	N/A	Pass
G_BD_02 1	Bedroom	Inner	110	36	32	23	Pass
G_BS_02 1	Bedroom	Inner	110	39	32	24	Pass
G_LK2_02 1	Living Room / Kitchen	Inner	59	19	N/A	N/A	Pass
I_BD_02 1	Bedroom	Inner	110	22	32	12	Pass
I_BD_02 2	Bedroom	Outer	110	37	32	29	Pass
I_BD_02 3	Bedroom	Outer	110	75	32	24	Pass
I_BD_02 4	Bedroom	Outer	110	77	32	39	Fail
I_BD_02 5	Bedroom	Outer	110	47	32	29	Pass
I_BD_02 6	Bedroom	Outer	110	30	32	27	Pass
I_BD_02 7	Bedroom	Inner	110	34	32	30	Pass
I_LK1_02 1	Living Room / Kitchen	Inner	59	69	N/A	N/A	Fail
I_LK2_02 1	Living Room / Kitchen	Inner	59	40	N/A	N/A	Pass
I_LK2_02 2	Living Room / Kitchen	Inner	59	27	N/A	N/A	Pass
I_LK2_02 3	Living Room / Kitchen	Inner	59	31	N/A	N/A	Pass
J_BD_02 1	Bedroom	Inner	110	68	32	16	Pass
J_BD_02 10	Bedroom	Outer	110	155	32	60	Fail
J_BD_02 11	Bedroom	Inner	110	73	32	42	Fail
J_BD_02 2	Bedroom	Inner	110	34	32	27	Pass
J_BD_02 3	Bedroom	Inner	110	45	32	28	Pass
J_BD_02 4	Bedroom	Outer	110	83	32	27	Pass
J_BD_02 5	Bedroom	Inner	110	47	32	34	Fail
J_BD_02 6	Bedroom	Inner	110	88	32	55	Fail
J_BD_02 7	Bedroom	Outer	110	114	32	61	Fail
J_BD_02 8	Bedroom	Inner	110	183	32	63	Fail
J_BD_02 9	Bedroom	Inner	110	69	32	59	Fail
J_LK1_02 1	Living Room / Kitchen	Outer	59	37	N/A	N/A	Pass
J_LK2_02 1	Living Room / Kitchen	Outer	59	25	N/A	N/A	Pass
J_LK2_02 2	Living Room / Kitchen	Inner	59	26	N/A	N/A	Pass
J_LK3_02 1	Living Room / Kitchen	Inner	59	55	N/A	N/A	Pass
J_LK3_02 2	Living Room / Kitchen	Inner	59	23	N/A	N/A	Pass
K_BD_02 1	Bedroom	Inner	110	512	32	144	Fail
K_BD_02 2	Bedroom	Outer	110	149	32	112	Fail
K_BD_02 3	Bedroom	Outer	110	229	32	135	Fail
K_BD_02 4	Bedroom	Inner	110	891	32	187	Fail
K_BD_02 5	Bedroom	Inner	110	132	32	24	Fail
K_BD_02 6	Bedroom	Inner	110	85	32	30	Pass
K_BD_02 7	Bedroom	Inner	110	176	32	23	Fail
K_BS_02 1	Bedroom	Inner	110	83	32	28	Pass
K_LK1_02 1	Living Room / Kitchen	Outer	59	55	N/A	N/A	Pass
K_LK1_02 2	Living Room / Kitchen	Outer	59	87	N/A	N/A	Fail
K_LK2_02 1	Living Room / Kitchen	Outer	59	74	N/A	N/A	Fail
K_LK2_02 2	Living Room / Kitchen	Inner	59	82	N/A	N/A	Fail
K_LK2_02 3	Living Room / Kitchen	Inner	59	126	N/A	N/A	Fail
L_BD_02 1	Bedroom	Inner	110	646	32	86	Fail
L_BD_02 2	Bedroom	Inner	110	300	32	77	Fail
L_BD_02 3	Bedroom	Inner	110	362	32	90	Fail
L_BD_02 4	Bedroom	Outer	110	856	32	104	Fail
L_LK2_02 1	Living Room / Kitchen	Inner	59	61	N/A	N/A	Fail
L_LK2_02 2	Living Room / Kitchen	Inner	59	60	N/A	N/A	Fail
M_BD_02 1	Bedroom	Outer	110	36	32	44	Fail
M_BD_02 10	Bedroom	Outer	110	104	32	43	Fail
M_BD_02 11	Bedroom	Inner	110	44	32	36	Fail
M_BD_02 12	Bedroom	Inner	110	20	32	33	Fail
M_BD_02 2	Bedroom	Outer	110	45	32	53	Fail
M_BD_02 3	Bedroom	Outer	110	45	32	53	Fail
M_BD_02 4	Bedroom	Inner	110	18	32	30	Pass
M_BD_02 5	Bedroom	Inner	110	34	32	45	Fail
M_BD_02 6	Bedroom	Inner	110	40	32	51	Fail
M_BD_02 7	Bedroom	Inner	110	40	32	49	Fail
M_BD_02 8	Bedroom	Inner	110	63	32	27	Pass
M_BD_02 9	Bedroom	Outer	110	45	32	26	Pass
M_LK1_02 1	Living Room / Kitchen	Outer	59	15	N/A	N/A	Pass
M_LK1_02 2	Living Room / Kitchen	Outer	59	37	N/A	N/A	Pass
M_LK1_02 3	Living Room / Kitchen	Outer	59	58	N/A	N/A	Pass
M_LK1_02 4	Living Room / Kitchen	Inner	59	81	N/A	N/A	Fail
M_LK2_02 1	Living Room / Kitchen	Inner	59	29	N/A	N/A	Pass
M_LK3_02 1	Living Room / Kitchen	Inner	59	29	N/A	N/A	Pass

M_LK3_02 2	Living Room / Kitchen	Inner	59	43	N/A	N/A	Pass
N_BD_02 1	Bedroom	Inner	110	68	32	16	Pass
N_BD_02 2	Bedroom	Inner	110	43	32	26	Pass
N_BD_02 3	Bedroom	Outer	110	39	32	34	Fail
N_BD_02 4	Bedroom	Outer	110	88	32	28	Pass
N_BD_02 5	Bedroom	Outer	110	117	32	53	Fail
N_BD_02 6	Bedroom	Outer	110	215	32	66	Fail
N_BD_02 7	Bedroom	Inner	110	91	32	60	Fail
N_LK2_02 1	Living Room / Kitchen	Inner	59	22	N/A	N/A	Pass
N_LK2_02 2	Living Room / Kitchen	Outer	59	43	N/A	N/A	Pass
N_LK3_02 1	Living Room / Kitchen	Inner	59	35	N/A	N/A	Pass
O_BD_02 1	Bedroom	Inner	110	70	32	16	Pass
O_BD_02 2	Bedroom	Inner	110	35	32	27	Pass
O_BD_02 3	Bedroom	Inner	110	25	32	15	Pass
O_BD_02 4	Bedroom	Inner	110	46	32	28	Pass
O_BD_02 5	Bedroom	Outer	110	44	32	31	Pass
O_LK1_02 1	Living Room / Kitchen	Inner	59	59	N/A	N/A	Pass
O_LK2_02 1	Living Room / Kitchen	Inner	59	23	N/A	N/A	Pass
O_LK2_02 2	Living Room / Kitchen	Inner	59	17	N/A	N/A	Pass
P_BD_02 1	Bedroom	Outer	110	23	32	21	Pass
P_BD_02 2	Bedroom	Outer	110	29	32	41	Fail
P_BD_02 3	Bedroom	Outer	110	58	32	33	Fail
P_BD_02 4	Bedroom	Inner	110	127	32	28	Fail
P_BD_02 5	Bedroom	Inner	110	61	32	24	Pass
P_BD_02 6	Bedroom	Inner	110	162	32	23	Fail
P_BD_02 7	Bedroom	Inner	110	78	32	24	Pass
P_BD_02 8	Bedroom	Inner	110	32	32	38	Fail
P_BD_02 9	Bedroom	Inner	110	10	32	16	Pass
P_LK1_02 1	Living Room / Kitchen	Outer	59	35	N/A	N/A	Pass
P_LK1_02 2	Living Room / Kitchen	Outer	59	54	N/A	N/A	Pass
P_LK2_02 1	Living Room / Kitchen	Outer	59	42	N/A	N/A	Pass
P_LK2_02 2	Living Room / Kitchen	Outer	59	46	N/A	N/A	Pass
P_LK3_02 1	Living Room / Kitchen	Outer	59	120	N/A	N/A	Fail
R_BD_02 1	Bedroom	Inner	110	69	32	17	Pass
R_BD_02 10	Bedroom	Outer	110	220	32	58	Fail
R_BD_02 11	Bedroom	Inner	110	65	32	27	Pass
R_BD_02 2	Bedroom	Inner	110	35	32	28	Pass
R_BD_02 3	Bedroom	Inner	110	71	32	39	Fail
R_BD_02 4	Bedroom	Outer	110	90	32	30	Pass
R_BD_02 5	Bedroom	Outer	110	56	32	49	Fail
R_BD_02 6	Bedroom	Outer	110	168	32	63	Fail
R_BD_02 7	Bedroom	Outer	110	99	32	69	Fail
R_BD_02 8	Bedroom	Inner	110	163	32	57	Fail
R_BD_02 9	Bedroom	Inner	110	194	32	58	Fail
R_LK1_02 1	Living Room / Kitchen	Inner	59	37	N/A	N/A	Pass
R_LK2_02 1	Living Room / Kitchen	Inner	59	21	N/A	N/A	Pass
R_LK2_02 2	Living Room / Kitchen	Inner	59	29	N/A	N/A	Pass
R_LK3_02 1	Living Room / Kitchen	Inner	59	28	N/A	N/A	Pass
R_LK3_02 2	Living Room / Kitchen	Inner	59	90	N/A	N/A	Fail

Table 11.1 – Detailed overheating results for the domestic areas using the DSY1 weather data

11.3.2 Domestic Overheating Results DSY2 & DSY3

The results for the overheating assessment of the domestic areas using the London Heathrow DSY2 and DSY3, 2020s, high emissions, 50% percentile weather file are presented in the tables below.

	DSY2		DSY3	
	Fail	Pass	Fail	Pass
Ground				
Bedrooms				
Inner	100%	0%	100%	0%
Outer	100%	0%	100%	0%
Living rooms/Kitchens				
Inner	90%	10%	100%	0%
Outer	77%	23%	100%	0%
Levels 01 to top				
Bedrooms				
Inner	54%	46%	98%	2%
Outer	100%	0%	100%	0%
Living rooms/Kitchens				
Inner	83%	17%	100%	0%
Outer	77%	23%	100%	0%
Total	**87%**	**13%**	**100%**	**0%**

Table 11.2 – Overheating results for domestic areas using the DSY2 & DSY3 weather data

DSY2							
Zone Name	Room Use	Orientatio n	Max. Exceedable Hours	Criterion 1: #Hours Exceeding Comfort Range	Max Exceedable Night Hours	Criterion 2: Number of Night Hours Exceeding 26 °C for Bedrooms.	Result
Levels 01 to top							
A_BD_02 1	Bedroom	Inner	110	132	32	51	Fail
A_BD_02 2	Bedroom	Inner	110	130	32	47	Fail
A_BD_02 3	Bedroom	Inner	110	126	32	50	Fail
A_BD_02 4	Bedroom	Outer	110	556	32	145	Fail
A_BD_02 5	Bedroom	Outer	110	709	32	137	Fail
A_BD_02 6	Bedroom	Outer	110	606	32	168	Fail
A_BD_02 7	Bedroom	Outer	110	354	32	123	Fail
A_BD_02 8	Bedroom	Outer	110	277	32	97	Fail
A_BD_02 9	Bedroom	Outer	110	234	32	94	Fail
A_BS_02 1	Bedroom	Inner	110	133	32	50	Fail
A_LK1_02 1	Living Room / Kitchen	Inner	59	93	N/A	N/A	Fail
A_LK1_02 2	Living Room / Kitchen	Inner	59	96	N/A	N/A	Fail
A_LK2_02 1	Living Room / Kitchen	Inner	59	86	N/A	N/A	Fail
A_LK3_02 1	Living Room / Kitchen	Inner	59	135	N/A	N/A	Fail
A_LK3_02 2	Living Room / Kitchen	Outer	59	400	N/A	N/A	Fail
B_BD_02 1	Bedroom	Outer	110	78	32	93	Fail
B_BD_02 2	Bedroom	Outer	110	60	32	79	Fail
B_BD_02 3	Bedroom	Outer	110	85	32	91	Fail
B_BD_02 4	Bedroom	Outer	110	199	32	109	Fail
B_BD_02 5	Bedroom	Inner	110	135	32	28	Fail
B_BD_02 6	Bedroom	Inner	110	104	32	33	Fail
B_BD_02 7	Bedroom	Inner	110	107	32	22	Pass
B_BS_02 1	Bedroom	Inner	110	100	32	32	Pass
B_LK1_02 1	Living Room / Kitchen	Inner	59	75	N/A	N/A	Fail
B_LK1_02 2	Living Room / Kitchen	Inner	59	85	N/A	N/A	Fail
B_LK2_02 1	Living Room / Kitchen	Inner	59	136	N/A	N/A	Fail
B_LK2_02 2	Living Room / Kitchen	Inner	59	75	N/A	N/A	Fail
B_LK2_02 3	Living Room / Kitchen	Inner	59	131	N/A	N/A	Fail
C_BD_02 1	Bedroom	Inner	110	87	32	20	Pass
C_BD_02 2	Bedroom	Inner	110	81	32	36	Fail
C_BD_02 3	Bedroom	Inner	110	79	32	22	Pass
C_BD_02 4	Bedroom	Outer	110	98	32	93	Fail
C_BD_02 5	Bedroom	Outer	110	66	32	83	Fail
C_BD_02 6	Bedroom	Outer	110	63	32	71	Fail
C_BD_02 7	Bedroom	Outer	110	92	32	90	Fail
C_BS_02 1	Bedroom	Inner	110	75	32	33	Fail
C_LK1_02 1	Living Room / Kitchen	Inner	59	58	N/A	N/A	Pass
C_LK1_02 2	Living Room / Kitchen	Inner	59	60	N/A	N/A	Fail
C_LK2_02 1	Living Room / Kitchen	Inner	59	77	N/A	N/A	Fail
C_LK2_02 2	Living Room / Kitchen	Inner	59	61	N/A	N/A	Fail
C_LK2_02 3	Living Room / Kitchen	Inner	59	76	N/A	N/A	Fail
D_BD_02 1	Bedroom	Outer	110	68	32	88	Fail
D_BD_02 10	Bedroom	Inner	110	67	32	26	Pass
D_BD_02 11	Bedroom	Inner	110	162	32	24	Fail
D_BD_02 12	Bedroom	Inner	110	87	32	39	Fail
D_BD_02 13	Bedroom	Inner	110	98	32	27	Pass
D_BD_02 14	Bedroom	Inner	110	141	32	18	Fail
D_BD_02 2	Bedroom	Outer	110	69	32	90	Fail
D_BD_02 3	Bedroom	Outer	110	73	32	89	Fail
D_BD_02 4	Bedroom	Outer	110	55	32	73	Fail
D_BD_02 5	Bedroom	Outer	110	118	32	108	Fail
D_BD_02 6	Bedroom	Outer	110	114	32	104	Fail
D_BD_02 7	Bedroom	Inner	110	81	32	38	Fail
D_BD_02 8	Bedroom	Inner	110	137	32	37	Fail
D_BD_02 9	Bedroom	Inner	110	72	32	29	Pass
D_BS_02 1	Bedroom	Inner	110	145	32	33	Fail
D_LK1_02 1	Living Room / Kitchen	Outer	59	49	N/A	N/A	Pass
D_LK1_02 2	Living Room / Kitchen	Inner	59	90	N/A	N/A	Fail
D_LK1_02 3	Living Room / Kitchen	Inner	59	55	N/A	N/A	Pass
D_LK2_02 1	Living Room / Kitchen	Outer	59	75	N/A	N/A	Fail
D_LK2_02 2	Living Room / Kitchen	Inner	59	96	N/A	N/A	Fail
D_LK2_02 3	Living Room / Kitchen	Inner	59	74	N/A	N/A	Fail
D_LK3_02 1	Living Room / Kitchen	Outer	59	73	N/A	N/A	Fail
D_LK3_02 2	Living Room / Kitchen	Inner	59	83	N/A	N/A	Fail
E_BD_02 1	Bedroom	Inner	110	83	32	22	Pass
E_BD_02 2	Bedroom	Outer	110	90	32	89	Fail
E_BD_02 3	Bedroom	Outer	110	79	32	89	Fail
E_LK1_02 1	Living Room / Kitchen	Inner	59	63	N/A	N/A	Fail
E_LK2_02 1	Living Room / Kitchen	Inner	59	78	N/A	N/A	Fail
G_BD_02 1	Bedroom	Inner	110	69	32	28	Pass
G_BS_02 1	Bedroom	Inner	110	69	32	28	Pass
G_LK2_02 1	Living Room / Kitchen	Inner	59	55	N/A	N/A	Pass
I_BD_02 1	Bedroom	Inner	110	54	32	14	Pass
I_BD_02 2	Bedroom	Inner	110	71	32	39	Fail
I_BD_02 3	Bedroom	Inner	110	105	32	21	Pass

I_BD_02 4	Bedroom	Outer	110	116	32	86	Fail
I_BD_02 5	Bedroom	Outer	110	90	32	66	Fail
I_BD_02 6	Bedroom	Outer	110	70	32	64	Fail
I_BD_02 7	Bedroom	Outer	110	74	32	65	Fail
I_LK1_02 1	Living Room / Kitchen	Inner	59	98	N/A	N/A	Fail
I_LK2_02 1	Living Room / Kitchen	Inner	59	83	N/A	N/A	Fail
I_LK2_02 2	Living Room / Kitchen	Inner	59	70	N/A	N/A	Fail
I_LK2_02 3	Living Room / Kitchen	Inner	59	65	N/A	N/A	Fail
J_BD_02 1	Bedroom	Inner	110	93	32	15	Pass
J_BD_02 10	Bedroom	Outer	110	168	32	102	Fail
J_BD_02 11	Bedroom	Outer	110	119	32	87	Fail
J_BD_02 2	Bedroom	Inner	110	63	32	36	Fail
J_BD_02 3	Bedroom	Inner	110	80	32	27	Pass
J_BD_02 4	Bedroom	Inner	110	110	32	20	Pass
J_BD_02 5	Bedroom	Inner	110	83	32	37	Fail
J_BD_02 6	Bedroom	Outer	110	124	32	94	Fail
J_BD_02 7	Bedroom	Outer	110	141	32	101	Fail
J_BD_02 8	Bedroom	Outer	110	173	32	104	Fail
J_BD_02 9	Bedroom	Outer	110	116	32	100	Fail
J_LK1_02 1	Living Room / Kitchen	Inner	59	70	N/A	N/A	Fail
J_LK2_02 1	Living Room / Kitchen	Inner	59	58	N/A	N/A	Pass
J_LK2_02 2	Living Room / Kitchen	Inner	59	70	N/A	N/A	Fail
J_LK3_02 1	Living Room / Kitchen	Inner	59	91	N/A	N/A	Fail
J_LK3_02 2	Living Room / Kitchen	Inner	59	61	N/A	N/A	Fail
K_BD_02 1	Bedroom	Outer	110	474	32	170	Fail
K_BD_02 2	Bedroom	Outer	110	182	32	139	Fail
K_BD_02 3	Bedroom	Outer	110	247	32	154	Fail
K_BD_02 4	Bedroom	Outer	110	769	32	203	Fail
K_BD_02 5	Bedroom	Inner	110	146	32	25	Fail
K_BD_02 6	Bedroom	Inner	110	110	32	28	Pass
K_BD_02 7	Bedroom	Inner	110	164	32	28	Fail
K_BS_02 1	Bedroom	Inner	110	108	32	26	Pass
K_LK1_02 1	Living Room / Kitchen	Inner	59	90	N/A	N/A	Fail
K_LK1_02 2	Living Room / Kitchen	Inner	59	112	N/A	N/A	Fail
K_LK2_02 1	Living Room / Kitchen	Inner	59	111	N/A	N/A	Fail
K_LK2_02 2	Living Room / Kitchen	Inner	59	104	N/A	N/A	Fail
K_LK2_02 3	Living Room / Kitchen	Inner	59	142	N/A	N/A	Fail
L_BD_02 1	Bedroom	Outer	110	582	32	120	Fail
L_BD_02 2	Bedroom	Outer	110	260	32	115	Fail
L_BD_02 3	Bedroom	Outer	110	319	32	129	Fail
L_BD_02 4	Bedroom	Outer	110	780	32	141	Fail
L_LK2_02 1	Living Room / Kitchen	Inner	59	96	N/A	N/A	Fail
L_LK2_02 2	Living Room / Kitchen	Inner	59	97	N/A	N/A	Fail
M_BD_02 1	Bedroom	Outer	110	81	32	90	Fail
M_BD_02 10	Bedroom	Inner	110	125	32	38	Fail
M_BD_02 11	Bedroom	Inner	110	89	32	36	Fail
M_BD_02 12	Bedroom	Outer	110	53	32	68	Fail
M_BD_02 2	Bedroom	Outer	110	100	32	103	Fail
M_BD_02 3	Bedroom	Outer	110	100	32	104	Fail
M_BD_02 4	Bedroom	Outer	110	59	32	76	Fail
M_BD_02 5	Bedroom	Outer	110	82	32	92	Fail
M_BD_02 6	Bedroom	Outer	110	96	32	101	Fail
M_BD_02 7	Bedroom	Outer	110	95	32	97	Fail
M_BD_02 8	Bedroom	Inner	110	109	32	32	Pass
M_BD_02 9	Bedroom	Inner	110	79	32	30	Pass
M_LK1_02 1	Living Room / Kitchen	Outer	59	48	N/A	N/A	Pass
M_LK1_02 2	Living Room / Kitchen	Inner	59	86	N/A	N/A	Fail
M_LK1_02 3	Living Room / Kitchen	Inner	59	97	N/A	N/A	Fail
M_LK1_02 4	Living Room / Kitchen	Inner	59	107	N/A	N/A	Fail
M_LK2_02 1	Living Room / Kitchen	Inner	59	68	N/A	N/A	Fail
M_LK3_02 1	Living Room / Kitchen	Outer	59	75	N/A	N/A	Fail
M_LK3_02 2	Living Room / Kitchen	Inner	59	102	N/A	N/A	Fail
N_BD_02 1	Bedroom	Inner	110	92	32	15	Pass
N_BD_02 2	Bedroom	Inner	110	76	32	27	Pass
N_BD_02 3	Bedroom	Inner	110	71	32	40	Fail
N_BD_02 4	Bedroom	Inner	110	113	32	22	Fail
N_BD_02 5	Bedroom	Outer	110	137	32	94	Fail
N_BD_02 6	Bedroom	Outer	110	204	32	104	Fail
N_BD_02 7	Bedroom	Outer	110	129	32	104	Fail
N_LK2_02 1	Living Room / Kitchen	Inner	59	57	N/A	N/A	Pass
N_LK2_02 2	Living Room / Kitchen	Inner	59	87	N/A	N/A	Fail
N_LK3_02 1	Living Room / Kitchen	Inner	59	80	N/A	N/A	Fail
O_BD_02 1	Bedroom	Inner	110	93	32	15	Pass
O_BD_02 2	Bedroom	Inner	110	66	32	36	Fail
O_BD_02 3	Bedroom	Inner	110	62	32	21	Pass
O_BD_02 4	Bedroom	Outer	110	88	32	67	Fail
O_BD_02 5	Bedroom	Outer	110	96	32	70	Fail
O_LK1_02 1	Living Room / Kitchen	Inner	59	97	N/A	N/A	Fail
O_LK2_02 1	Living Room / Kitchen	Inner	59	58	N/A	N/A	Pass
O_LK2_02 2	Living Room / Kitchen	Inner	59	50	N/A	N/A	Pass
P_BD_02 1	Bedroom	Outer	110	64	32	58	Fail
P_BD_02 2	Bedroom	Outer	110	73	32	83	Fail
P_BD_02 3	Bedroom	Outer	110	104	32	46	Fail
P_BD_02 4	Bedroom	Inner	110	139	32	24	Fail
P_BD_02 5	Bedroom	Inner	110	89	32	27	Pass
P_BD_02 6	Bedroom	Inner	110	156	32	27	Fail
P_BD_02 7	Bedroom	Inner	110	103	32	29	Pass
P_BD_02 8	Bedroom	Outer	110	80	32	82	Fail
P_BD_02 9	Bedroom	Outer	110	37	32	50	Fail
P_LK1_02 1	Living Room / Kitchen	Outer	59	85	N/A	N/A	Fail
P_LK1_02 2	Living Room / Kitchen	Inner	59	84	N/A	N/A	Fail
P_LK2_02 1	Living Room / Kitchen	Inner	59	101	N/A	N/A	Fail
P_LK2_02 2	Living Room / Kitchen	Inner	59	87	N/A	N/A	Fail
P_LK3_02 1	Living Room / Kitchen	Inner	59	137	N/A	N/A	Fail
R_BD_02 1	Bedroom	Inner	110	94	32	16	Pass
R_BD_02 10	Bedroom	Outer	110	193	32	93	Fail
R_BD_02 11	Bedroom	Inner	110	97	32	32	Pass
R_BD_02 2	Bedroom	Inner	110	67	32	38	Fail
R_BD_02 3	Bedroom	Inner	110	104	32	30	Pass
R_BD_02 4	Bedroom	Inner	110	114	32	23	Fail
R_BD_02 5	Bedroom	Outer	110	98	32	91	Fail
R_BD_02 6	Bedroom	Outer	110	171	32	105	Fail
R_BD_02 7	Bedroom	Outer	110	142	32	109	Fail
R_BD_02 8	Bedroom	Outer	110	162	32	98	Fail
R_BD_02 9	Bedroom	Outer	110	180	32	93	Fail
R_LK1_02 1	Living Room / Kitchen	Inner	59	70	N/A	N/A	Fail
R_LK2_02 1	Living Room / Kitchen	Inner	59	56	N/A	N/A	Pass
R_LK2_02 2	Living Room / Kitchen	Inner	59	70	N/A	N/A	Fail
R_LK3_02 1	Living Room / Kitchen	Inner	59	70	N/A	N/A	Fail
R_LK3_02 2	Living Room / Kitchen	Inner	59	108	N/A	N/A	Fail
Ground							
A_BD_02 1	Bedroom	Inner	110	145	32	98	Fail
A_BD_02 2	Bedroom	Inner	110	146	32	98	Fail
A_BD_02 3	Bedroom	Inner	110	133	32	96	Fail
A_BD_02 4	Bedroom	Outer	110	556	32	145	Fail
A_BD_02 5	Bedroom	Outer	110	707	32	137	Fail
A_BD_02 6	Bedroom	Outer	110	604	32	168	Fail
A_BD_02 7	Bedroom	Outer	110	344	32	122	Fail
A_BD_02 8	Bedroom	Outer	110	275	32	98	Fail
A_BD_02 9	Bedroom	Outer	110	223	32	94	Fail
A_BS_02 1	Bedroom	Inner	110	157	32	101	Fail
A_LK1_02 1	Living Room / Kitchen	Inner	59	101	N/A	N/A	Fail
A_LK1_02 2	Living Room / Kitchen	Inner	59	99	N/A	N/A	Fail
A_LK2_02 1	Living Room / Kitchen	Inner	59	90	N/A	N/A	Fail
A_LK3_02 1	Living Room / Kitchen	Inner	59	133	N/A	N/A	Fail
A_LK3_02 2	Living Room / Kitchen	Outer	59	400	N/A	N/A	Fail
B_BD_02 1	Bedroom	Outer	110	86	32	96	Fail
B_BD_02 2	Bedroom	Outer	110	62	32	82	Fail
B_BD_02 3	Bedroom	Outer	110	90	32	94	Fail
B_BD_02 4	Bedroom	Outer	110	207	32	109	Fail
B_BD_02 5	Bedroom	Inner	110	135	32	72	Fail
B_BD_02 6	Bedroom	Inner	110	109	32	77	Fail
B_BD_02 7	Bedroom	Inner	110	108	32	58	Fail
B_BS_02 1	Bedroom	Inner	110	107	32	77	Fail
B_LK1_02 1	Living Room / Kitchen	Inner	59	74	N/A	N/A	Fail
B_LK1_02 2	Living Room / Kitchen	Inner	59	91	N/A	N/A	Fail
B_LK2_02 1	Living Room / Kitchen	Inner	59	136	N/A	N/A	Fail
B_LK2_02 2	Living Room / Kitchen	Inner	59	76	N/A	N/A	Fail
B_LK2_02 3	Living Room / Kitchen	Inner	59	131	N/A	N/A	Fail
C_BD_02 1	Bedroom	Inner	110	92	32	49	Fail
C_BD_02 2	Bedroom	Inner	110	92	32	77	Fail
C_BD_02 3	Bedroom	Inner	110	79	32	53	Fail
C_BD_02 4	Bedroom	Outer	110	101	32	94	Fail
C_BD_02 5	Bedroom	Outer	110	69	32	86	Fail
C_BD_02 6	Bedroom	Outer	110	62	32	76	Fail
C_BD_02 7	Bedroom	Outer	110	93	32	93	Fail
C_BS_02 1	Bedroom	Inner	110	84	32	71	Fail
C_LK1_02 1	Living Room / Kitchen	Inner	59	64	N/A	N/A	Fail
C_LK1_02 2	Living Room / Kitchen	Inner	59	67	N/A	N/A	Fail
C_LK2_02 1	Living Room / Kitchen	Inner	59	81	N/A	N/A	Fail
C_LK2_02 2	Living Room / Kitchen	Inner	59	66	N/A	N/A	Fail
C_LK2_02 3	Living Room / Kitchen	Inner	59	79	N/A	N/A	Fail
D_BD_02 1	Bedroom	Outer	110	73	32	91	Fail
D_BD_02 10	Bedroom	Inner	110	72	32	53	Fail
D_BD_02 11	Bedroom	Inner	110	157	32	56	Fail
D_BD_02 12	Bedroom	Inner	110	89	32	81	Fail
D_BD_02 13	Bedroom	Inner	110	100	32	65	Fail
D_BD_02 14	Bedroom	Inner	110	138	32	44	Fail
D_BD_02 2	Bedroom	Outer	110	73	32	91	Fail
D_BD_02 3	Bedroom	Outer	110	73	32	89	Fail
D_BD_02 4	Bedroom	Outer	110	55	32	73	Fail
D_BD_02 5	Bedroom	Outer	110	119	32	108	Fail
D_BD_02 6	Bedroom	Outer	110	114	32	104	Fail
D_BD_02 7	Bedroom	Inner	110	92	32	81	Fail
D_BD_02 8	Bedroom	Inner	110	142	32	88	Fail
D_BD_02 9	Bedroom	Inner	110	77	32	64	Fail
D_BS_02 1	Bedroom	Inner	110	146	32	82	Fail
D_LK1_02 1	Living Room / Kitchen	Outer	59	49	N/A	N/A	Pass

D_LK1_02 2	Living Room / Kitchen	Inner	59	95	N/A	N/A	Fail
D_LK1_02 3	Living Room / Kitchen	Inner	59	55	N/A	N/A	Pass
D_LK2_02 1	Living Room / Kitchen	Outer	59	75	N/A	N/A	Fail
D_LK2_02 2	Living Room / Kitchen	Inner	59	93	N/A	N/A	Fail
D_LK2_02 3	Living Room / Kitchen	Inner	59	77	N/A	N/A	Fail
D_LK3_02 1	Living Room / Kitchen	Outer	59	75	N/A	N/A	Fail
D_LK3_02 2	Living Room / Kitchen	Inner	59	91	N/A	N/A	Fail
E_BD_02 1	Bedroom	Inner	110	86	32	53	Fail
E_BD_02 2	Bedroom	Outer	110	93	32	92	Fail
E_BD_02 3	Bedroom	Outer	110	84	32	93	Fail
E_LK1_02 1	Living Room / Kitchen	Inner	59	67	N/A	N/A	Fail
E_LK2_02 1	Living Room / Kitchen	Inner	59	82	N/A	N/A	Fail
G_BD_02 1	Bedroom	Inner	110	71	32	64	Fail
G_BS_02 1	Bedroom	Inner	110	75	32	67	Fail
G_LK2_02 1	Living Room / Kitchen	Inner	59	58	N/A	N/A	Pass
I_BD_02 1	Bedroom	Inner	110	58	32	35	Fail
I_BD_02 2	Bedroom	Inner	110	75	32	74	Fail
I_BD_02 3	Bedroom	Inner	110	107	32	50	Fail
I_BD_02 4	Bedroom	Outer	110	118	32	89	Fail
I_BD_02 5	Bedroom	Outer	110	89	32	70	Fail
I_BD_02 6	Bedroom	Outer	110	73	32	66	Fail
I_BD_02 7	Bedroom	Outer	110	76	32	67	Fail
I_LK1_02 1	Living Room / Kitchen	Inner	59	96	N/A	N/A	Fail
I_LK2_02 1	Living Room / Kitchen	Inner	59	85	N/A	N/A	Fail
I_LK2_02 2	Living Room / Kitchen	Inner	59	74	N/A	N/A	Fail
I_LK2_02 3	Living Room / Kitchen	Inner	59	70	N/A	N/A	Fail
J_BD_02 1	Bedroom	Inner	110	93	32	36	Fail
J_BD_02 10	Bedroom	Outer	110	170	32	102	Fail
J_BD_02 11	Bedroom	Outer	110	122	32	91	Fail
J_BD_02 2	Bedroom	Inner	110	68	32	69	Fail
J_BD_02 3	Bedroom	Inner	110	87	32	71	Fail
J_BD_02 4	Bedroom	Inner	110	115	32	51	Fail
J_BD_02 5	Bedroom	Inner	110	92	32	86	Fail
J_BD_02 6	Bedroom	Outer	110	123	32	98	Fail
J_BD_02 7	Bedroom	Outer	110	148	32	104	Fail
J_BD_02 8	Bedroom	Outer	110	177	32	108	Fail
J_BD_02 9	Bedroom	Outer	110	118	32	100	Fail
J_LK1_02 1	Living Room / Kitchen	Inner	59	80	N/A	N/A	Fail
J_LK2_02 1	Living Room / Kitchen	Inner	59	60	N/A	N/A	Fail
J_LK2_02 2	Living Room / Kitchen	Inner	59	75	N/A	N/A	Fail
J_LK3_02 1	Living Room / Kitchen	Inner	59	96	N/A	N/A	Fail
J_LK3_02 2	Living Room / Kitchen	Inner	59	63	N/A	N/A	Fail
K_BD_02 1	Bedroom	Outer	110	473	32	170	Fail
K_BD_02 2	Bedroom	Outer	110	190	32	140	Fail
K_BD_02 3	Bedroom	Outer	110	248	32	157	Fail
K_BD_02 4	Bedroom	Outer	110	760	32	201	Fail
K_BD_02 5	Bedroom	Inner	110	141	32	61	Fail
K_BD_02 6	Bedroom	Inner	110	114	32	68	Fail
K_BD_02 7	Bedroom	Inner	110	157	32	68	Fail
K_BS_02 1	Bedroom	Inner	110	110	32	65	Fail
K_LK1_02 1	Living Room / Kitchen	Inner	59	91	N/A	N/A	Fail
K_LK1_02 2	Living Room / Kitchen	Inner	59	106	N/A	N/A	Fail
K_LK2_02 1	Living Room / Kitchen	Inner	59	110	N/A	N/A	Fail
K_LK2_02 2	Living Room / Kitchen	Inner	59	103	N/A	N/A	Fail
K_LK2_02 3	Living Room / Kitchen	Inner	59	144	N/A	N/A	Fail
L_BD_02 1	Bedroom	Outer	110	581	32	123	Fail
L_BD_02 2	Bedroom	Outer	110	261	32	119	Fail
L_BD_02 3	Bedroom	Outer	110	323	32	135	Fail
L_BD_02 4	Bedroom	Outer	110	777	32	143	Fail
L_LK2_02 1	Living Room / Kitchen	Inner	59	102	N/A	N/A	Fail
L_LK2_02 2	Living Room / Kitchen	Inner	59	99	N/A	N/A	Fail
M_BD_02 1	Bedroom	Outer	110	83	32	90	Fail
M_BD_02 10	Bedroom	Inner	110	128	32	89	Fail
M_BD_02 11	Bedroom	Inner	110	96	32	83	Fail
M_BD_02 12	Bedroom	Outer	110	59	32	75	Fail
M_BD_02 2	Bedroom	Outer	110	101	32	103	Fail
M_BD_02 3	Bedroom	Outer	110	100	32	103	Fail
M_BD_02 4	Bedroom	Outer	110	59	32	76	Fail
M_BD_02 5	Bedroom	Outer	110	85	32	95	Fail
M_BD_02 6	Bedroom	Outer	110	99	32	103	Fail
M_BD_02 7	Bedroom	Outer	110	98	32	98	Fail
M_BD_02 8	Bedroom	Inner	110	117	32	73	Fail
M_BD_02 9	Bedroom	Inner	110	83	32	67	Fail
M_LK1_02 1	Living Room / Kitchen	Outer	59	48	N/A	N/A	Pass
M_LK1_02 2	Living Room / Kitchen	Inner	59	92	N/A	N/A	Fail
M_LK1_02 3	Living Room / Kitchen	Inner	59	101	N/A	N/A	Fail
M_LK1_02 4	Living Room / Kitchen	Inner	59	111	N/A	N/A	Fail
M_LK2_02 1	Living Room / Kitchen	Inner	59	73	N/A	N/A	Fail
M_LK3_02 1	Living Room / Kitchen	Outer	59	74	N/A	N/A	Fail
M_LK3_02 2	Living Room / Kitchen	Inner	59	103	N/A	N/A	Fail
N_BD_02 1	Bedroom	Inner	110	93	32	36	Fail
N_BD_02 2	Bedroom	Inner	110	79	32	60	Fail
N_BD_02 3	Bedroom	Inner	110	77	32	81	Fail
N_BD_02 4	Bedroom	Inner	110	118	32	52	Fail
N_BD_02 5	Bedroom	Outer	110	140	32	96	Fail
N_BD_02 6	Bedroom	Outer	110	205	32	107	Fail
N_BD_02 7	Bedroom	Outer	110	133	32	106	Fail
N_LK2_02 1	Living Room / Kitchen	Inner	59	58	N/A	N/A	Pass
N_LK2_02 2	Living Room / Kitchen	Inner	59	88	N/A	N/A	Fail
N_LK3_02 1	Living Room / Kitchen	Inner	59	83	N/A	N/A	Fail
O_BD_02 1	Bedroom	Inner	110	94	32	36	Fail
O_BD_02 2	Bedroom	Inner	110	70	32	70	Fail
O_BD_02 3	Bedroom	Inner	110	66	32	50	Fail
O_BD_02 4	Bedroom	Outer	110	88	32	68	Fail
O_BD_02 5	Bedroom	Outer	110	98	32	74	Fail
O_LK1_02 1	Living Room / Kitchen	Inner	59	97	N/A	N/A	Fail
O_LK2_02 1	Living Room / Kitchen	Inner	59	58	N/A	N/A	Pass
O_LK2_02 2	Living Room / Kitchen	Inner	59	52	N/A	N/A	Pass
P_BD_02 1	Bedroom	Outer	110	64	32	58	Fail
P_BD_02 2	Bedroom	Outer	110	76	32	88	Fail
P_BD_02 3	Bedroom	Outer	110	114	32	85	Fail
P_BD_02 4	Bedroom	Inner	110	135	32	61	Fail
P_BD_02 5	Bedroom	Inner	110	93	32	60	Fail
P_BD_02 6	Bedroom	Inner	110	154	32	70	Fail
P_BD_02 7	Bedroom	Inner	110	104	32	63	Fail
P_BD_02 8	Bedroom	Outer	110	80	32	87	Fail
P_BD_02 9	Bedroom	Outer	110	38	32	52	Fail
P_LK1_02 1	Living Room / Kitchen	Outer	59	84	N/A	N/A	Fail
P_LK1_02 2	Living Room / Kitchen	Inner	59	89	N/A	N/A	Fail
P_LK2_02 1	Living Room / Kitchen	Inner	59	104	N/A	N/A	Fail
P_LK2_02 2	Living Room / Kitchen	Inner	59	90	N/A	N/A	Fail
P_LK3_02 1	Living Room / Kitchen	Inner	59	128	N/A	N/A	Fail
R_BD_02 1	Bedroom	Inner	110	94	32	46	Fail
R_BD_02 10	Bedroom	Outer	110	193	32	95	Fail
R_BD_02 11	Bedroom	Inner	110	101	32	78	Fail
R_BD_02 2	Bedroom	Inner	110	71	32	81	Fail
R_BD_02 3	Bedroom	Inner	110	108	32	87	Fail
R_BD_02 4	Bedroom	Inner	110	119	32	58	Fail
R_BD_02 5	Bedroom	Outer	110	99	32	94	Fail
R_BD_02 6	Bedroom	Outer	110	174	32	106	Fail
R_BD_02 7	Bedroom	Outer	110	142	32	110	Fail
R_BD_02 8	Bedroom	Outer	110	157	32	98	Fail
R_BD_02 9	Bedroom	Outer	110	184	32	95	Fail
R_LK1_02 1	Living Room / Kitchen	Inner	59	81	N/A	N/A	Fail
R_LK2_02 1	Living Room / Kitchen	Inner	59	58	N/A	N/A	Pass
R_LK2_02 2	Living Room / Kitchen	Inner	59	76	N/A	N/A	Fail
R_LK3_02 1	Living Room / Kitchen	Inner	59	76	N/A	N/A	Fail
R_LK3_02 2	Living Room / Kitchen	Inner	59	107	N/A	N/A	Fail

Table 11.3 – Detailed overheating results for the domestic areas using the DSY2 weather data

DSY3							
Zone Name	Room Use	Orientation	Max. Exceedable Hours	Criterion 1: #Hours Exceeding Comfort Range	Max Exceedable Night Hours	Criterion 2: Number of Night Hours Exceeding 26 °C for Bedrooms.	Result
Levels 01 to top							
A_BD_02 1	Bedroom	13	110	194	32	75	Fail
A_BD_02 2	Bedroom	13	110	197	32	76	Fail
A_BD_02 3	Bedroom	13	110	186	32	80	Fail
A_BD_02 4	Bedroom	13	110	666	32	195	Fail
A_BD_02 5	Bedroom	13	110	809	32	195	Fail
A_BD_02 6	Bedroom	13	110	725	32	247	Fail
A_BD_02 7	Bedroom	13	110	438	32	170	Fail
A_BD_02 8	Bedroom	13	110	358	32	136	Fail
A_BD_02 9	Bedroom	13	110	299	32	125	Fail
A_BS_02 1	Bedroom	13	110	199	32	78	Fail
A_LK1_02 1	Living Room / Kitchen	13	59	141	N/A	N/A	Fail
A_LK1_02 2	Living Room / Kitchen	13	59	148	N/A	N/A	Fail
A_LK2_02 1	Living Room / Kitchen	13	59	138	N/A	N/A	Fail
A_LK3_02 1	Living Room / Kitchen	13	59	185	N/A	N/A	Fail
A_LK3_02 2	Living Room / Kitchen	13	59	520	N/A	N/A	Fail
B_BD_02 1	Bedroom	10	110	126	32	133	Fail
B_BD_02 2	Bedroom	10	110	96	32	122	Fail
B_BD_02 3	Bedroom	10	110	134	32	126	Fail
B_BD_02 4	Bedroom	10	110	292	32	147	Fail
B_BD_02 5	Bedroom	10	110	195	32	42	Fail
B_BD_02 6	Bedroom	10	110	158	32	45	Fail
B_BD_02 7	Bedroom	10	110	161	32	33	Fail
B_BS_02 1	Bedroom	10	110	154	32	44	Fail
B_LK1_02 1	Living Room / Kitchen	10	59	114	N/A	N/A	Fail
B_LK1_02 2	Living Room / Kitchen	10	59	138	N/A	N/A	Fail
B_LK2_02 1	Living Room / Kitchen	10	59	202	N/A	N/A	Fail
B_LK2_02 2	Living Room / Kitchen	10	59	113	N/A	N/A	Fail
B_LK2_02 3	Living Room / Kitchen	10	59	200	N/A	N/A	Fail

C_BD_02 1	Bedroom	37	110	126	32	35	Fail
C_BD_02 2	Bedroom	37	110	122	32	53	Fail
C_BD_02 3	Bedroom	41	110	116	32	40	Fail
C_BD_02 4	Bedroom	29	110	156	32	132	Fail
C_BD_02 5	Bedroom	29	110	108	32	122	Fail
C_BD_02 6	Bedroom	25	110	96	32	113	Fail
C_BD_02 7	Bedroom	25	110	152	32	130	Fail
C_BS_02 1	Bedroom	37	110	110	32	47	Fail
C_LK1_02 1	Living Room / Kitchen	37	59	83	N/A	N/A	Fail
C_LK1_02 2	Living Room / Kitchen	48	59	87	N/A	N/A	Fail
C_LK2_02 1	Living Room / Kitchen	25	59	124	N/A	N/A	Fail
C_LK2_02 2	Living Room / Kitchen	30	59	84	N/A	N/A	Fail
C_LK2_02 3	Living Room / Kitchen	29	59	114	N/A	N/A	Fail
D_BD_02 1	Bedroom	28	110	113	32	125	Fail
D_BD_02 10	Bedroom	28	110	117	32	39	Fail
D_BD_02 11	Bedroom	32	110	222	32	28	Fail
D_BD_02 12	Bedroom	32	110	132	32	47	Fail
D_BD_02 13	Bedroom	32	110	148	32	38	Fail
D_BD_02 14	Bedroom	32	110	206	32	29	Fail
D_BD_02 2	Bedroom	28	110	115	32	130	Fail
D_BD_02 3	Bedroom	16	110	132	32	137	Fail
D_BD_02 4	Bedroom	16	110	105	32	123	Fail
D_BD_02 5	Bedroom	16	110	202	32	149	Fail
D_BD_02 6	Bedroom	28	110	184	32	141	Fail
D_BD_02 7	Bedroom	16	110	136	32	55	Fail
D_BD_02 8	Bedroom	16	110	199	32	55	Fail
D_BD_02 9	Bedroom	16	110	109	32	44	Fail
D_BS_02 1	Bedroom	16	110	208	32	51	Fail
D_LK1_02 1	Living Room / Kitchen	16	59	90	N/A	N/A	Fail
D_LK1_02 2	Living Room / Kitchen	16	59	131	N/A	N/A	Fail
D_LK1_02 3	Living Room / Kitchen	28	59	86	N/A	N/A	Fail
D_LK2_02 1	Living Room / Kitchen	16	59	126	N/A	N/A	Fail
D_LK2_02 2	Living Room / Kitchen	32	59	140	N/A	N/A	Fail
D_LK2_02 3	Living Room / Kitchen	34	59	129	N/A	N/A	Fail
D_LK3_02 1	Living Room / Kitchen	28	59	116	N/A	N/A	Fail
D_LK3_02 2	Living Room / Kitchen	16	59	135	N/A	N/A	Fail
E_BD_02 1	Bedroom	7	110	118	32	40	Fail
E_BD_02 2	Bedroom	7	110	145	32	124	Fail
E_BD_02 3	Bedroom	7	110	118	32	129	Fail
E_LK1_02 1	Living Room / Kitchen	7	59	89	N/A	N/A	Fail
E_LK2_02 1	Living Room / Kitchen	7	59	127	N/A	N/A	Fail
G_BD_02 1	Bedroom	11	110	98	32	43	Fail
G_BS_02 1	Bedroom	11	110	100	32	43	Fail
G_LK2_02 1	Living Room / Kitchen	11	59	63	N/A	N/A	Fail
I_BD_02 1	Bedroom	7	110	77	32	24	Pass
I_BD_02 2	Bedroom	7	110	100	32	54	Fail
I_BD_02 3	Bedroom	7	110	158	32	35	Fail
I_BD_02 4	Bedroom	7	110	180	32	117	Fail
I_BD_02 5	Bedroom	7	110	148	32	110	Fail
I_BD_02 6	Bedroom	9	110	109	32	98	Fail
I_BD_02 7	Bedroom	9	110	121	32	101	Fail
I_LK1_02 1	Living Room / Kitchen	7	59	143	N/A	N/A	Fail
I_LK2_02 1	Living Room / Kitchen	7	59	119	N/A	N/A	Fail
I_LK2_02 2	Living Room / Kitchen	7	59	96	N/A	N/A	Fail
I_LK2_02 3	Living Room / Kitchen	9	59	95	N/A	N/A	Fail
J_BD_02 1	Bedroom	9	110	140	32	32	Fail
J_BD_02 10	Bedroom	9	110	249	32	140	Fail
J_BD_02 11	Bedroom	9	110	173	32	117	Fail
J_BD_02 2	Bedroom	9	110	93	32	52	Fail
J_BD_02 3	Bedroom	9	110	120	32	45	Fail
J_BD_02 4	Bedroom	9	110	167	32	36	Fail
J_BD_02 5	Bedroom	9	110	123	32	55	Fail
J_BD_02 6	Bedroom	9	110	185	32	127	Fail
J_BD_02 7	Bedroom	9	110	208	32	138	Fail
J_BD_02 8	Bedroom	9	110	263	32	147	Fail
J_BD_02 9	Bedroom	9	110	184	32	140	Fail
J_LK1_02 1	Living Room / Kitchen	9	59	103	N/A	N/A	Fail
J_LK2_02 1	Living Room / Kitchen	9	59	84	N/A	N/A	Fail
J_LK2_02 2	Living Room / Kitchen	9	59	93	N/A	N/A	Fail
J_LK3_02 1	Living Room / Kitchen	9	59	147	N/A	N/A	Fail
J_LK3_02 2	Living Room / Kitchen	9	59	79	N/A	N/A	Fail
K_BD_02 1	Bedroom	10	110	598	32	207	Fail
K_BD_02 2	Bedroom	10	110	287	32	183	Fail
K_BD_02 3	Bedroom	10	110	340	32	209	Fail
K_BD_02 4	Bedroom	10	110	938	32	246	Fail
K_BD_02 5	Bedroom	10	110	205	32	32	Fail
K_BD_02 6	Bedroom	10	110	164	32	38	Fail
K_BD_02 7	Bedroom	10	110	237	32	40	Fail
K_BS_02 1	Bedroom	10	110	163	32	36	Fail
K_LK1_02 1	Living Room / Kitchen	10	59	136	N/A	N/A	Fail
K_LK1_02 2	Living Room / Kitchen	10	59	159	N/A	N/A	Fail
K_LK2_02 1	Living Room / Kitchen	10	59	163	N/A	N/A	Fail
K_LK2_02 2	Living Room / Kitchen	10	59	156	N/A	N/A	Fail
K_LK2_02 3	Living Room / Kitchen	10	59	218	N/A	N/A	Fail

L_BD_02 1	Bedroom	12	110	689	32	165	Fail
L_BD_02 2	Bedroom	12	110	370	32	163	Fail
L_BD_02 3	Bedroom	12	110	418	32	182	Fail
L_BD_02 4	Bedroom	12	110	863	32	184	Fail
L_LK2_02 1	Living Room / Kitchen	12	59	160	N/A	N/A	Fail
L_LK2_02 2	Living Room / Kitchen	12	59	158	N/A	N/A	Fail
M_BD_02 1	Bedroom	4	110	143	32	135	Fail
M_BD_02 10	Bedroom	4	110	180	32	54	Fail
M_BD_02 11	Bedroom	4	110	132	32	54	Fail
M_BD_02 12	Bedroom	4	110	83	32	106	Fail
M_BD_02 2	Bedroom	4	110	167	32	143	Fail
M_BD_02 3	Bedroom	4	110	166	32	141	Fail
M_BD_02 4	Bedroom	4	110	108	32	126	Fail
M_BD_02 5	Bedroom	4	110	162	32	138	Fail
M_BD_02 6	Bedroom	4	110	159	32	138	Fail
M_BD_02 7	Bedroom	4	110	153	32	134	Fail
M_BD_02 8	Bedroom	4	110	164	32	49	Fail
M_BD_02 9	Bedroom	4	110	126	32	46	Fail
M_LK1_02 1	Living Room / Kitchen	4	59	88	N/A	N/A	Fail
M_LK1_02 2	Living Room / Kitchen	4	59	115	N/A	N/A	Fail
M_LK1_02 3	Living Room / Kitchen	4	59	152	N/A	N/A	Fail
M_LK1_02 4	Living Room / Kitchen	4	59	159	N/A	N/A	Fail
M_LK2_02 1	Living Room / Kitchen	4	59	98	N/A	N/A	Fail
M_LK3_02 1	Living Room / Kitchen	4	59	128	N/A	N/A	Fail
M_LK3_02 2	Living Room / Kitchen	4	59	147	N/A	N/A	Fail
N_BD_02 1	Bedroom	7	110	138	32	28	Fail
N_BD_02 2	Bedroom	7	110	111	32	43	Fail
N_BD_02 3	Bedroom	7	110	105	32	56	Fail
N_BD_02 4	Bedroom	7	110	172	32	43	Fail
N_BD_02 5	Bedroom	7	110	200	32	124	Fail
N_BD_02 6	Bedroom	7	110	298	32	148	Fail
N_BD_02 7	Bedroom	7	110	199	32	146	Fail
N_LK2_02 1	Living Room / Kitchen	7	59	78	N/A	N/A	Fail
N_LK2_02 2	Living Room / Kitchen	7	59	126	N/A	N/A	Fail
N_LK3_02 1	Living Room / Kitchen	7	59	108	N/A	N/A	Fail
O_BD_02 1	Bedroom	7	110	139	32	27	Fail
O_BD_02 2	Bedroom	7	110	96	32	49	Fail
O_BD_02 3	Bedroom	7	110	86	32	28	Pass
O_BD_02 4	Bedroom	7	110	143	32	107	Fail
O_BD_02 5	Bedroom	7	110	144	32	103	Fail
O_LK1_02 1	Living Room / Kitchen	7	59	139	N/A	N/A	Fail
O_LK2_02 1	Living Room / Kitchen	7	59	79	N/A	N/A	Fail
O_LK2_02 2	Living Room / Kitchen	7	59	63	N/A	N/A	Fail
P_BD_02 1	Bedroom	6	110	100	32	97	Fail
P_BD_02 2	Bedroom	6	110	110	32	127	Fail
P_BD_02 3	Bedroom	6	110	158	32	62	Fail
P_BD_02 4	Bedroom	6	110	205	32	29	Fail
P_BD_02 5	Bedroom	6	110	138	32	37	Fail
P_BD_02 6	Bedroom	3	110	229	32	41	Fail
P_BD_02 7	Bedroom	3	110	154	32	41	Fail
P_BD_02 8	Bedroom	3	110	128	32	119	Fail
P_BD_02 9	Bedroom	3	110	57	32	84	Fail
P_LK1_02 1	Living Room / Kitchen	6	59	143	N/A	N/A	Fail
P_LK1_02 2	Living Room / Kitchen	3	59	135	N/A	N/A	Fail
P_LK2_02 1	Living Room / Kitchen	6	59	149	N/A	N/A	Fail
P_LK2_02 2	Living Room / Kitchen	6	59	125	N/A	N/A	Fail
P_LK3_02 1	Living Room / Kitchen	3	59	198	N/A	N/A	Fail
R_BD_02 1	Bedroom	6	110	140	32	32	Fail
R_BD_02 10	Bedroom	4	110	290	32	125	Fail
R_BD_02 11	Bedroom	4	110	140	32	47	Fail
R_BD_02 2	Bedroom	6	110	97	32	56	Fail
R_BD_02 3	Bedroom	6	110	154	32	55	Fail
R_BD_02 4	Bedroom	6	110	173	32	45	Fail
R_BD_02 5	Bedroom	6	110	160	32	131	Fail
R_BD_02 6	Bedroom	6	110	261	32	146	Fail
R_BD_02 7	Bedroom	6	110	220	32	160	Fail
R_BD_02 8	Bedroom	4	110	247	32	139	Fail
R_BD_02 9	Bedroom	4	110	270	32	128	Fail
R_LK1_02 1	Living Room / Kitchen	4	59	105	N/A	N/A	Fail
R_LK2_02 1	Living Room / Kitchen	6	59	78	N/A	N/A	Fail
R_LK2_02 2	Living Room / Kitchen	6	59	95	N/A	N/A	Fail
R_LK3_02 1	Living Room / Kitchen	6	59	93	N/A	N/A	Fail
R_LK3_02 2	Living Room / Kitchen	4	59	164	N/A	N/A	Fail
Ground							
A_BD_02 1	Bedroom	13	110	221	32	117	Fail
A_BD_02 2	Bedroom	13	110	233	32	126	Fail
A_BD_02 3	Bedroom	13	110	222	32	126	Fail
A_BD_02 4	Bedroom	13	110	666	32	194	Fail
A_BD_02 5	Bedroom	13	110	808	32	195	Fail
A_BD_02 6	Bedroom	13	110	724	32	247	Fail
A_BD_02 7	Bedroom	13	110	427	32	171	Fail
A_BD_02 8	Bedroom	13	110	356	32	140	Fail
A_BD_02 9	Bedroom	13	110	294	32	131	Fail
A_BS_02 1	Bedroom	13	110	241	32	131	Fail

A_LK1_02 1	Living Room / Kitchen	13	59	159	N/A	N/A	Fail
A_LK1_02 2	Living Room / Kitchen	13	59	161	N/A	N/A	Fail
A_LK2_02 1	Living Room / Kitchen	13	59	155	N/A	N/A	Fail
A_LK3_02 1	Living Room / Kitchen	13	59	180	N/A	N/A	Fail
A_LK3_02 2	Living Room / Kitchen	13	59	517	N/A	N/A	Fail
B_BD_02 1	Bedroom	10	110	131	32	136	Fail
B_BD_02 2	Bedroom	10	110	101	32	128	Fail
B_BD_02 3	Bedroom	10	110	140	32	131	Fail
B_BD_02 4	Bedroom	10	110	295	32	147	Fail
B_BD_02 5	Bedroom	10	110	195	32	86	Fail
B_BD_02 6	Bedroom	10	110	162	32	95	Fail
B_BD_02 7	Bedroom	10	110	166	32	84	Fail
B_BS_02 1	Bedroom	10	110	158	32	99	Fail
B_LK1_02 1	Living Room / Kitchen	10	59	126	N/A	N/A	Fail
B_LK1_02 2	Living Room / Kitchen	10	59	143	N/A	N/A	Fail
B_LK2_02 1	Living Room / Kitchen	10	59	203	N/A	N/A	Fail
B_LK2_02 2	Living Room / Kitchen	10	59	127	N/A	N/A	Fail
B_LK2_02 3	Living Room / Kitchen	10	59	198	N/A	N/A	Fail
C_BD_02 1	Bedroom	37	110	135	32	67	Fail
C_BD_02 2	Bedroom	37	110	144	32	109	Fail
C_BD_02 3	Bedroom	41	110	127	32	86	Fail
C_BD_02 4	Bedroom	29	110	157	32	134	Fail
C_BD_02 5	Bedroom	29	110	114	32	126	Fail
C_BD_02 6	Bedroom	25	110	99	32	115	Fail
C_BD_02 7	Bedroom	25	110	154	32	133	Fail
C_BS_02 1	Bedroom	37	110	127	32	105	Fail
C_LK1_02 1	Living Room / Kitchen	37	59	93	N/A	N/A	Fail
C_LK1_02 2	Living Room / Kitchen	48	59	95	N/A	N/A	Fail
C_LK2_02 1	Living Room / Kitchen	25	59	132	N/A	N/A	Fail
C_LK2_02 2	Living Room / Kitchen	30	59	99	N/A	N/A	Fail
C_LK2_02 3	Living Room / Kitchen	29	59	120	N/A	N/A	Fail
D_BD_02 1	Bedroom	28	110	116	32	129	Fail
D_BD_02 10	Bedroom	28	110	126	32	77	Fail
D_BD_02 11	Bedroom	32	110	218	32	75	Fail
D_BD_02 12	Bedroom	32	110	141	32	101	Fail
D_BD_02 13	Bedroom	32	110	161	32	87	Fail
D_BD_02 14	Bedroom	32	110	200	32	65	Fail
D_BD_02 2	Bedroom	28	110	116	32	132	Fail
D_BD_02 3	Bedroom	16	110	138	32	137	Fail
D_BD_02 4	Bedroom	16	110	105	32	125	Fail
D_BD_02 5	Bedroom	16	110	202	32	151	Fail
D_BD_02 6	Bedroom	28	110	184	32	141	Fail
D_BD_02 7	Bedroom	16	110	148	32	113	Fail
D_BD_02 8	Bedroom	16	110	213	32	118	Fail
D_BD_02 9	Bedroom	16	110	126	32	85	Fail
D_BS_02 1	Bedroom	16	110	217	32	104	Fail
D_LK1_02 1	Living Room / Kitchen	16	59	91	N/A	N/A	Fail
D_LK1_02 2	Living Room / Kitchen	16	59	143	N/A	N/A	Fail
D_LK1_02 3	Living Room / Kitchen	28	59	90	N/A	N/A	Fail
D_LK2_02 1	Living Room / Kitchen	16	59	128	N/A	N/A	Fail
D_LK2_02 2	Living Room / Kitchen	32	59	144	N/A	N/A	Fail
D_LK2_02 3	Living Room / Kitchen	34	59	134	N/A	N/A	Fail
D_LK3_02 1	Living Room / Kitchen	28	59	123	N/A	N/A	Fail
D_LK3_02 2	Living Room / Kitchen	16	59	146	N/A	N/A	Fail
E_BD_02 1	Bedroom	7	110	133	32	88	Fail
E_BD_02 2	Bedroom	7	110	147	32	132	Fail
E_BD_02 3	Bedroom	7	110	121	32	135	Fail
E_LK1_02 1	Living Room / Kitchen	7	59	95	N/A	N/A	Fail
E_LK2_02 1	Living Room / Kitchen	7	59	138	N/A	N/A	Fail
G_BD_02 1	Bedroom	11	110	114	32	99	Fail
G_BS_02 1	Bedroom	11	110	120	32	101	Fail
G_LK2_02 1	Living Room / Kitchen	11	59	66	N/A	N/A	Fail
I_BD_02 1	Bedroom	7	110	79	32	58	Fail
I_BD_02 2	Bedroom	7	110	108	32	105	Fail
I_BD_02 3	Bedroom	7	110	169	32	77	Fail
I_BD_02 4	Bedroom	7	110	185	32	123	Fail
I_BD_02 5	Bedroom	7	110	147	32	111	Fail
I_BD_02 6	Bedroom	9	110	115	32	108	Fail
I_BD_02 7	Bedroom	9	110	125	32	111	Fail
I_LK1_02 1	Living Room / Kitchen	7	59	142	N/A	N/A	Fail
I_LK2_02 1	Living Room / Kitchen	7	59	122	N/A	N/A	Fail
I_LK2_02 2	Living Room / Kitchen	7	59	102	N/A	N/A	Fail
I_LK2_02 3	Living Room / Kitchen	9	59	109	N/A	N/A	Fail
J_BD_02 1	Bedroom	9	110	144	32	69	Fail
J_BD_02 10	Bedroom	9	110	252	32	142	Fail
J_BD_02 11	Bedroom	9	110	177	32	124	Fail
J_BD_02 2	Bedroom	9	110	104	32	105	Fail
J_BD_02 3	Bedroom	9	110	134	32	102	Fail
J_BD_02 4	Bedroom	9	110	178	32	80	Fail
J_BD_02 5	Bedroom	9	110	150	32	122	Fail
J_BD_02 6	Bedroom	9	110	197	32	137	Fail
J_BD_02 7	Bedroom	9	110	214	32	146	Fail
J_BD_02 8	Bedroom	9	110	266	32	157	Fail
J_BD_02 9	Bedroom	9	110	187	32	143	Fail
J_LK1_02 1	Living Room / Kitchen	9	59	124	N/A	N/A	Fail
J_LK2_02 1	Living Room / Kitchen	9	59	87	N/A	N/A	Fail
J_LK2_02 2	Living Room / Kitchen	9	59	102	N/A	N/A	Fail
J_LK3_02 1	Living Room / Kitchen	9	59	156	N/A	N/A	Fail
J_LK3_02 2	Living Room / Kitchen	9	59	85	N/A	N/A	Fail
K_BD_02 1	Bedroom	10	110	588	32	210	Fail
K_BD_02 2	Bedroom	10	110	294	32	183	Fail
K_BD_02 3	Bedroom	10	110	349	32	213	Fail
K_BD_02 4	Bedroom	10	110	925	32	249	Fail
K_BD_02 5	Bedroom	10	110	203	32	82	Fail
K_BD_02 6	Bedroom	10	110	168	32	90	Fail
K_BD_02 7	Bedroom	10	110	234	32	80	Fail
K_BS_02 1	Bedroom	10	110	169	32	87	Fail
K_LK1_02 1	Living Room / Kitchen	10	59	142	N/A	N/A	Fail
K_LK1_02 2	Living Room / Kitchen	10	59	164	N/A	N/A	Fail
K_LK2_02 1	Living Room / Kitchen	10	59	167	N/A	N/A	Fail
K_LK2_02 2	Living Room / Kitchen	10	59	162	N/A	N/A	Fail
K_LK2_02 3	Living Room / Kitchen	10	59	218	N/A	N/A	Fail
L_BD_02 1	Bedroom	12	110	686	32	168	Fail
L_BD_02 2	Bedroom	12	110	371	32	166	Fail
L_BD_02 3	Bedroom	12	110	421	32	188	Fail
L_BD_02 4	Bedroom	12	110	863	32	189	Fail
L_LK2_02 1	Living Room / Kitchen	12	59	163	N/A	N/A	Fail
L_LK2_02 2	Living Room / Kitchen	12	59	160	N/A	N/A	Fail
M_BD_02 1	Bedroom	4	110	143	32	135	Fail
M_BD_02 10	Bedroom	4	110	192	32	119	Fail
M_BD_02 11	Bedroom	4	110	147	32	114	Fail
M_BD_02 12	Bedroom	4	110	93	32	115	Fail
M_BD_02 2	Bedroom	4	110	167	32	143	Fail
M_BD_02 3	Bedroom	4	110	166	32	142	Fail
M_BD_02 4	Bedroom	4	110	108	32	126	Fail
M_BD_02 5	Bedroom	4	110	165	32	139	Fail
M_BD_02 6	Bedroom	4	110	165	32	139	Fail
M_BD_02 7	Bedroom	4	110	161	32	138	Fail
M_BD_02 8	Bedroom	4	110	178	32	89	Fail
M_BD_02 9	Bedroom	4	110	141	32	95	Fail
M_LK1_02 1	Living Room / Kitchen	4	59	91	N/A	N/A	Fail
M_LK1_02 2	Living Room / Kitchen	4	59	128	N/A	N/A	Fail
M_LK1_02 3	Living Room / Kitchen	4	59	158	N/A	N/A	Fail
M_LK1_02 4	Living Room / Kitchen	4	59	165	N/A	N/A	Fail
M_LK2_02 1	Living Room / Kitchen	4	59	119	N/A	N/A	Fail
M_LK3_02 1	Living Room / Kitchen	4	59	128	N/A	N/A	Fail
M_LK3_02 2	Living Room / Kitchen	4	59	154	N/A	N/A	Fail
N_BD_02 1	Bedroom	7	110	142	32	70	Fail
N_BD_02 2	Bedroom	7	110	124	32	96	Fail
N_BD_02 3	Bedroom	7	110	115	32	112	Fail
N_BD_02 4	Bedroom	7	110	180	32	79	Fail
N_BD_02 5	Bedroom	7	110	209	32	130	Fail
N_BD_02 6	Bedroom	7	110	299	32	152	Fail
N_BD_02 7	Bedroom	7	110	203	32	149	Fail
N_LK2_02 1	Living Room / Kitchen	7	59	77	N/A	N/A	Fail
N_LK2_02 2	Living Room / Kitchen	7	59	134	N/A	N/A	Fail
N_LK3_02 1	Living Room / Kitchen	7	59	121	N/A	N/A	Fail
O_BD_02 1	Bedroom	7	110	145	32	65	Fail
O_BD_02 2	Bedroom	7	110	106	32	102	Fail
O_BD_02 3	Bedroom	7	110	94	32	66	Fail
O_BD_02 4	Bedroom	7	110	145	32	108	Fail
O_BD_02 5	Bedroom	7	110	145	32	107	Fail
O_LK1_02 1	Living Room / Kitchen	7	59	145	N/A	N/A	Fail
O_LK2_02 1	Living Room / Kitchen	7	59	83	N/A	N/A	Fail
O_LK2_02 2	Living Room / Kitchen	7	59	67	N/A	N/A	Fail
P_BD_02 1	Bedroom	6	110	100	32	99	Fail
P_BD_02 2	Bedroom	6	110	118	32	131	Fail
P_BD_02 3	Bedroom	6	110	165	32	115	Fail
P_BD_02 4	Bedroom	6	110	201	32	79	Fail
P_BD_02 5	Bedroom	6	110	146	32	83	Fail
P_BD_02 6	Bedroom	3	110	229	32	85	Fail
P_BD_02 7	Bedroom	3	110	163	32	103	Fail
P_BD_02 8	Bedroom	3	110	128	32	125	Fail
P_BD_02 9	Bedroom	3	110	58	32	85	Fail
P_LK1_02 1	Living Room / Kitchen	6	59	143	N/A	N/A	Fail
P_LK1_02 2	Living Room / Kitchen	3	59	143	N/A	N/A	Fail
P_LK2_02 1	Living Room / Kitchen	6	59	154	N/A	N/A	Fail
P_LK2_02 2	Living Room / Kitchen	6	59	128	N/A	N/A	Fail
P_LK3_02 1	Living Room / Kitchen	3	59	190	N/A	N/A	Fail
R_BD_02 1	Bedroom	6	110	147	32	77	Fail
R_BD_02 10	Bedroom	4	110	288	32	129	Fail
R_BD_02 11	Bedroom	4	110	159	32	116	Fail
R_BD_02 2	Bedroom	6	110	107	32	114	Fail
R_BD_02 3	Bedroom	6	110	184	32	114	Fail
R_BD_02 4	Bedroom	6	110	181	32	87	Fail
R_BD_02 5	Bedroom	6	110	162	32	136	Fail
R_BD_02 6	Bedroom	6	110	263	32	149	Fail
R_BD_02 7	Bedroom	6	110	223	32	164	Fail

R_BD_02 8	Bedroom	4	110	244	32	141	Fail
R_BD_02 9	Bedroom	4	110	269	32	133	Fail
R_LK1_02 1	Living Room / Kitchen	4	59	127	N/A	N/A	Fail
R_LK2_02 1	Living Room / Kitchen	6	59	78	N/A	N/A	Fail
R_LK2_02 2	Living Room / Kitchen	6	59	100	N/A	N/A	Fail
R_LK3_02 1	Living Room / Kitchen	6	59	104	N/A	N/A	Fail
R_LK3_02 2	Living Room / Kitchen	4	59	166	N/A	N/A	Fail

Table 11.4 – Detailed overheating results for the domestic areas using the DSY3 weather data

11.3.3 Non-domestic Overheating Results DSY2 & DSY3

The results for the overheating assessment of the non-domestic areas using the London Heathrow DSY2 and DSY3, 2020s, high emissions, 50% percentile weather file are presented in the tables below.

DSY2						
	Operative temperature >24	Operative temperature >25	Operative temperature >26	Operative temperature >27	Operative temperature >28	Result
Restaurant kitchen	0	0	0	0	0	Pass
Restaurant dining	2	0	0	0	0	Pass
Supermarket display	1,572	1,374	10	0	0	Pass
Nursery	166	0	0	0	0	Pass
Fitness centre	342	0	0	0	0	Pass
Coffee shop	1,221	0	0	0	0	Pass
Coffee shop kitchen	0	0	0	0	0	Pass
Residential meeting space	1,792	0	0	0	0	Pass
Residents' lounge	1,959	0	0	0	0	Pass
Coffee shop	2,396	364	0	0	0	Pass
Coffee shop food prep	0	0	0	0	0	Pass
Hair dresser	882	598	21	0	0	Pass
Dry cleaner	1,221	263	0	0	0	Pass
Workshare hub	1,321	632	0	0	0	Pass
Concierge	1,569	0	0	0	0	Pass
Maintenance office	1,085	914	2	0	0	Pass
Retail	893	402	1	0	0	Pass

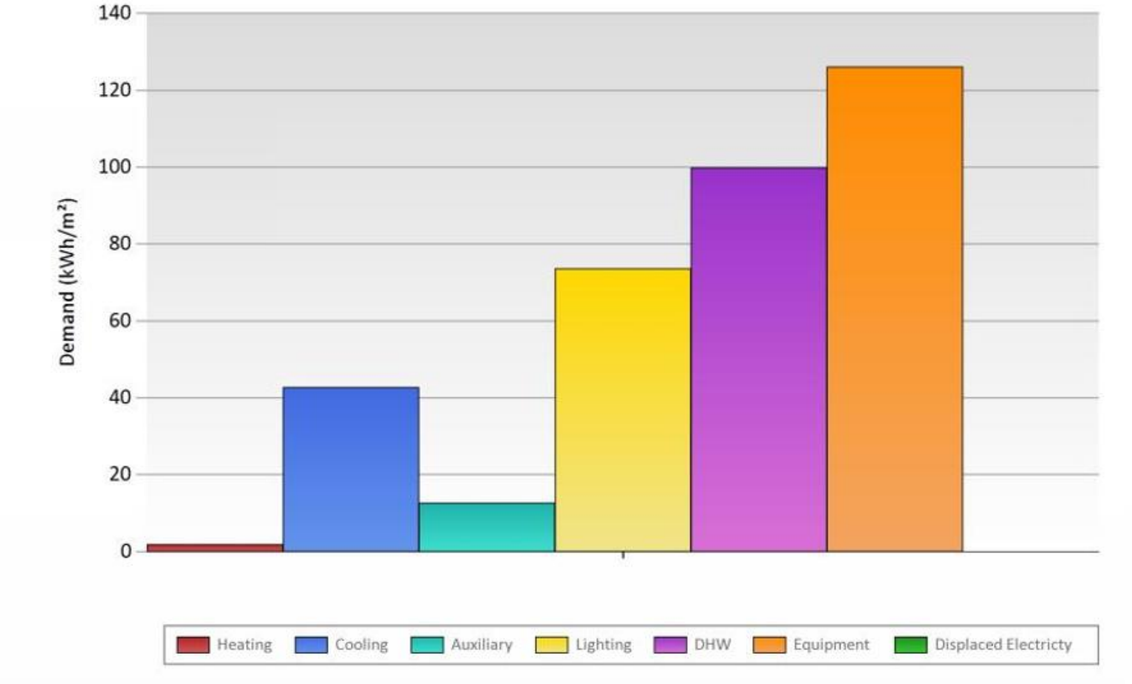
Table 11.5 - Overheating results for the non-domestic areas using the DSY2 weather data for conditioned buildings

DSY3						
	Operative temperature >24	Operative temperature >25	Operative temperature >26	Operative temperature >27	Operative temperature >28	Result
Restaurant kitchen	0	0	0	0	0	Pass
Restaurant dining	0	0	0	0	0	Pass
Supermarket display	1,468	1,447	0	0	0	Pass
Nursery	177	0	0	0	0	Pass
Fitness centre	441	0	0	0	0	Pass
Coffee shop	1,198	0	0	0	0	Pass
Coffee shop kitchen	0	0	0	0	0	Pass
Residential meeting space	1,634	0	0	0	0	Pass
Residents' lounge	1,908	0	0	0	0	Pass
Coffee shop	2,276	366	1	0	0	Pass
Coffee shop food prep	0	0	0	0	0	Pass
Hair dresser	817	673	15	0	0	Pass
Dry cleaner	1,067	421	0	0	0	Pass
Workshare hub	1,263	700	0	0	0	Pass
Concierge	1,487	0	0	0	0	Pass
Maintenance office	1,097	921	0	0	0	Pass
Retail	849	467	0	0	0	Pass

Table 11.6 - Overheating results for the non-domestic areas using the DSY2 weather data for conditioned buildings

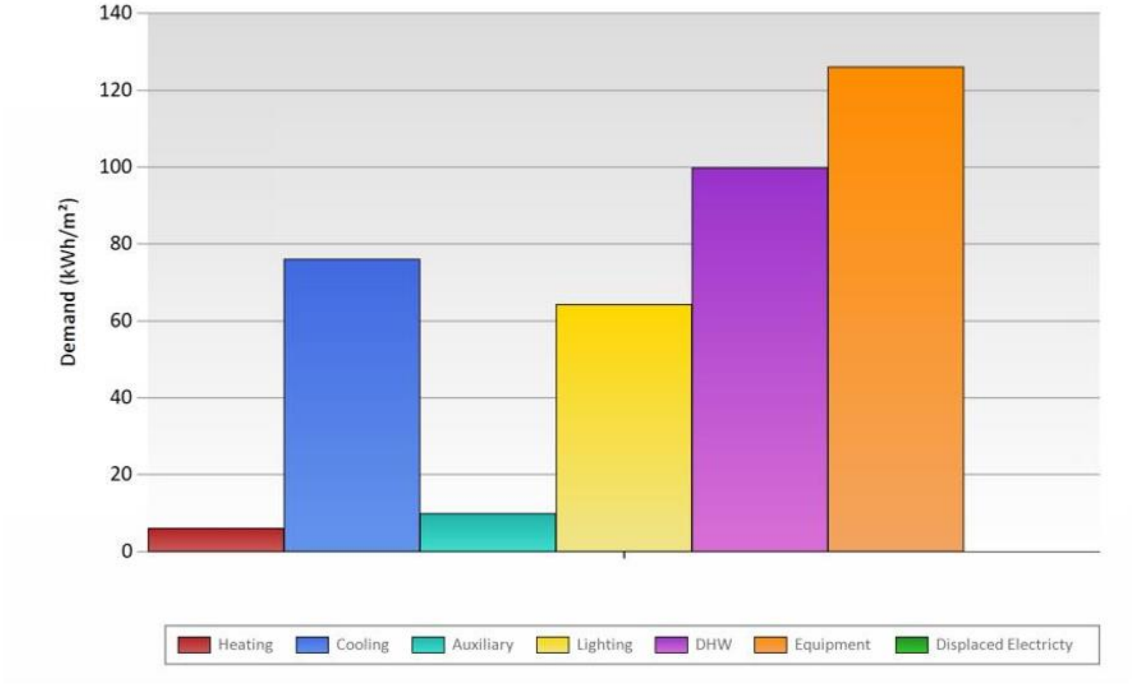
11.4 Area-weighted Average Actual and Notional Cooling Demands for Non-domestic Buildings

Actual Annual Demand: Bar-Restaurant



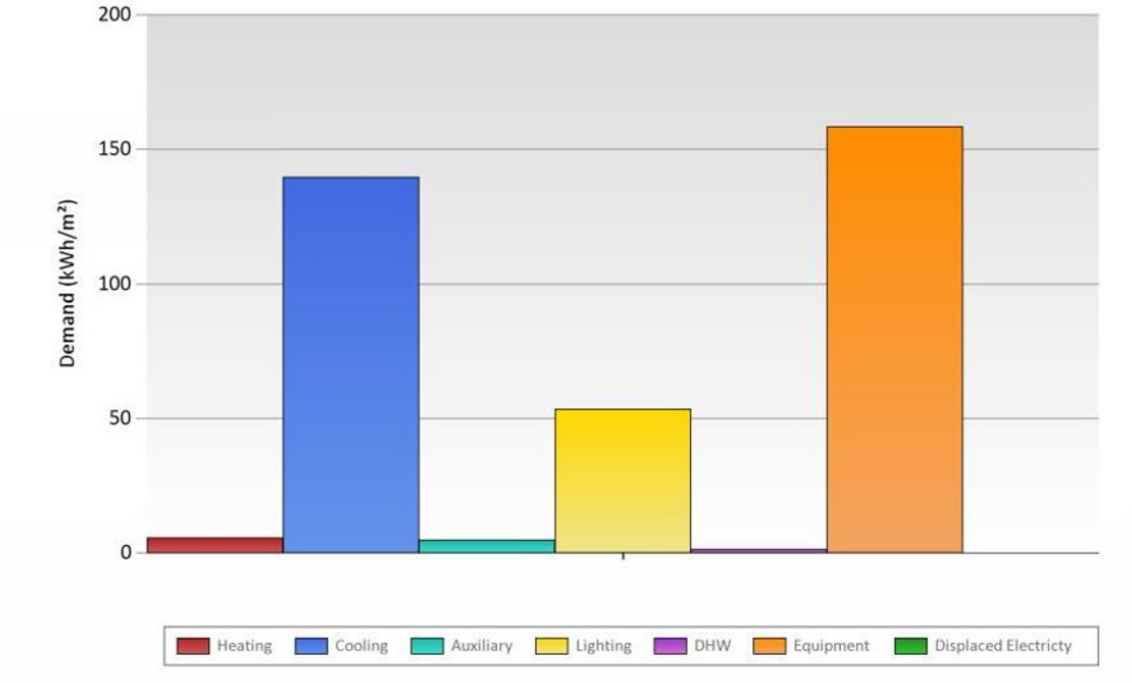
	Heating	Cooling	Auxiliary	Lighting	DHW	Equipment	Displaced Electricity
Demand (kWh/m²)	1.82	42.69	12.64	73.59	99.88	126.06	0.00

Notional Annual Demand: Bar-Restaurant



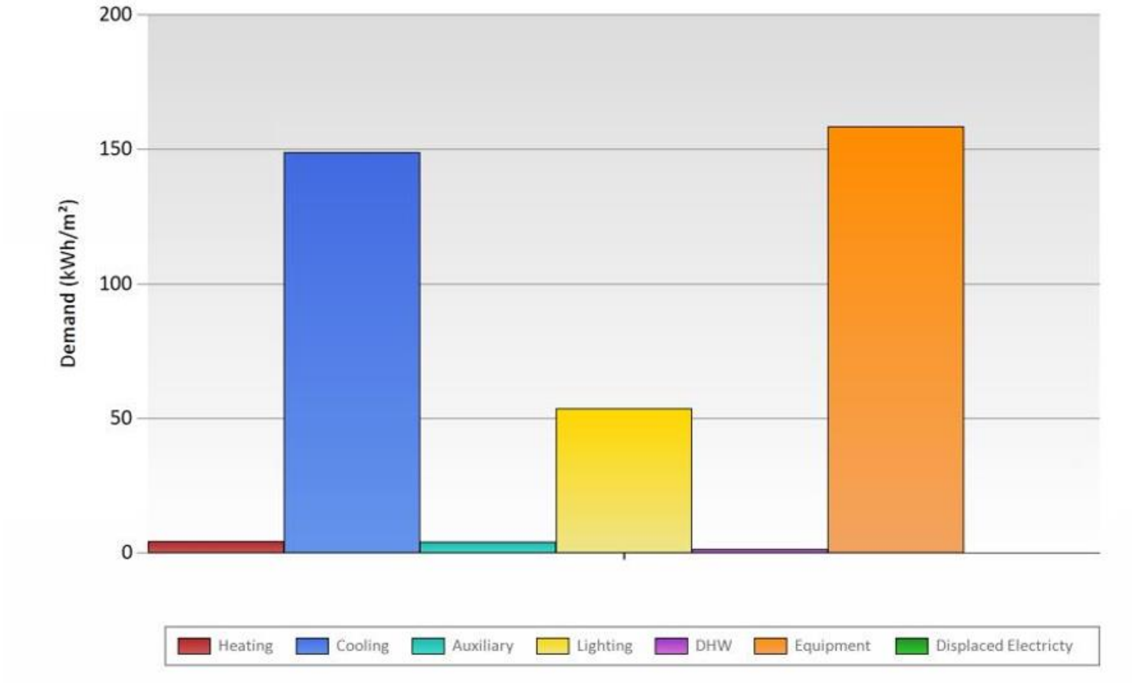
	Heating	Cooling	Auxiliary	Lighting	DHW	Equipment	Displaced Electricity
Demand (kWh/m²)	6.04	76.02	10.00	64.38	99.88	126.06	0.00

Actual Annual Demand: Supermarket



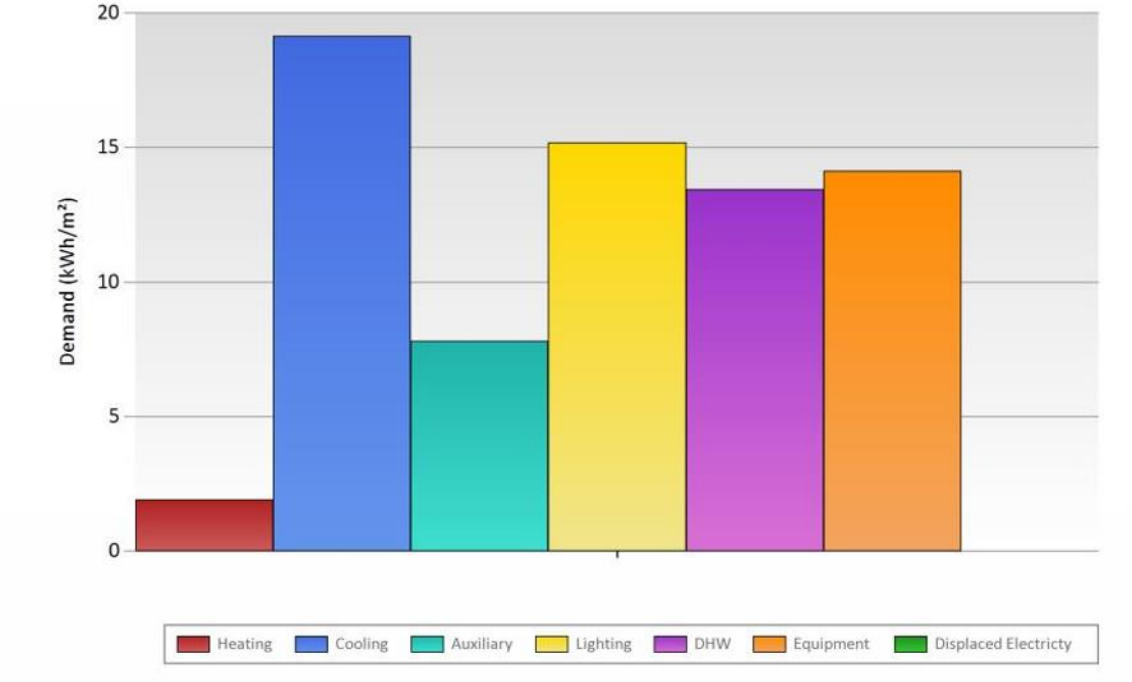
	Heating	Cooling	Auxiliary	Lighting	DHW	Equipment	Displaced Electricity
Demand (kWh/m²)	5.66	139.77	4.86	53.35	1.23	158.51	0.00

Notional Annual Demand: Supermarket



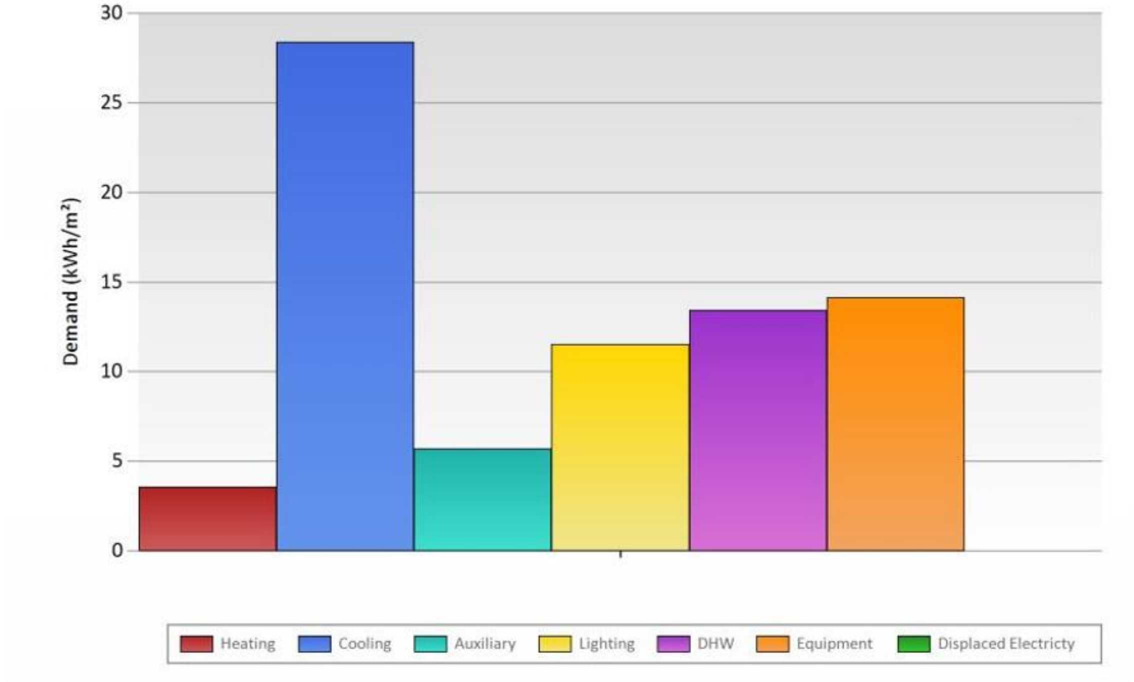
	Heating	Cooling	Auxiliary	Lighting	DHW	Equipment	Displaced Electricity
Demand (kWh/m²)	4.30	148.89	4.11	53.55	1.23	158.51	0.00

Actual Annual Demand: Nursery



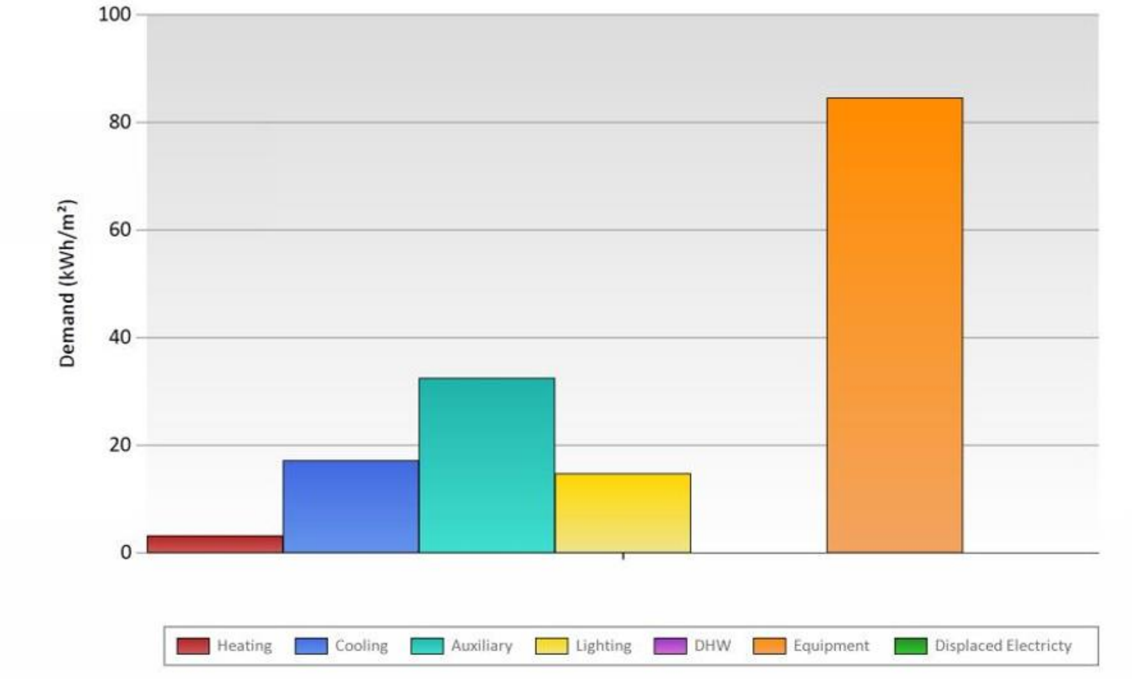
	Heating	Cooling	Auxiliary	Lighting	DHW	Equipment	Displaced Electricity
Demand (kWh/m²)	1.90	19.15	7.80	15.18	13.44	14.12	0.00

Notional Annual Demand: Nursery



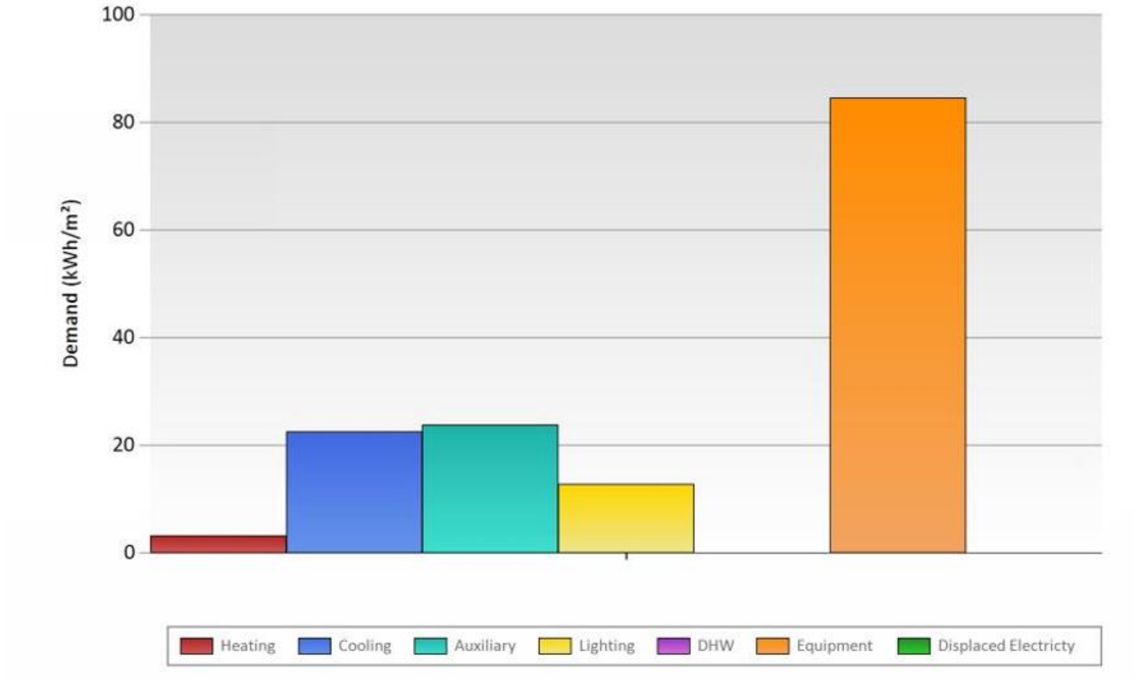
	Heating	Cooling	Auxiliary	Lighting	DHW	Equipment	Displaced Electricity
Demand (kWh/m²)	3.56	28.39	5.72	11.52	13.44	14.12	0.00

Actual Annual Demand: Fitness Centre



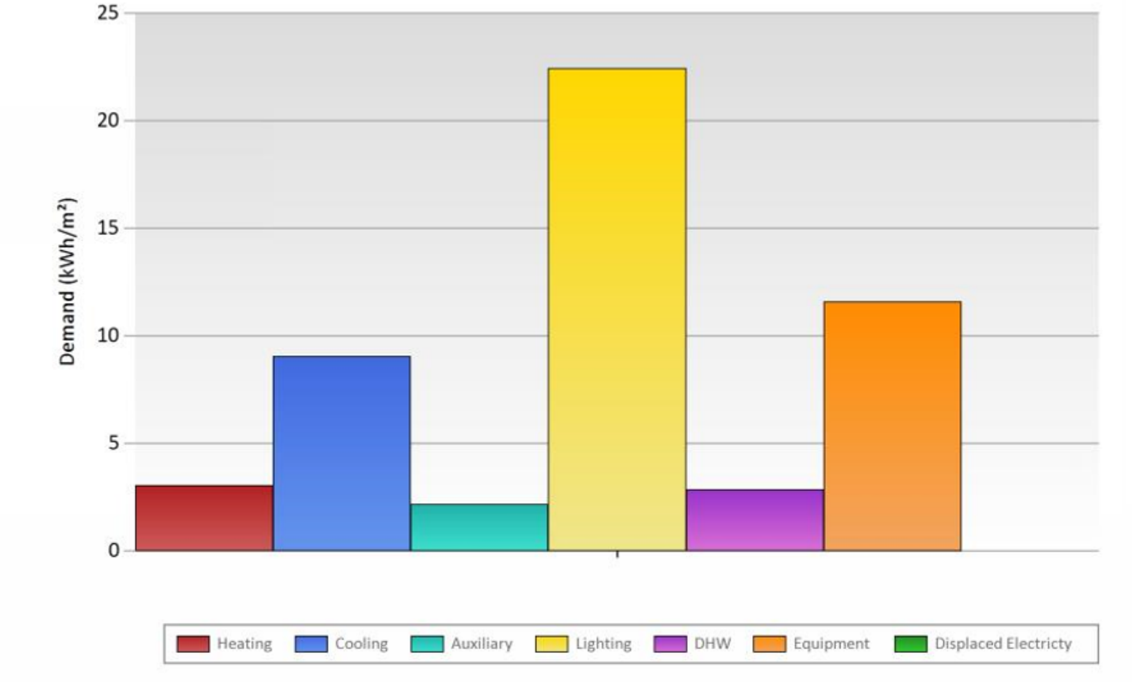
	Heating	Cooling	Auxiliary	Lighting	DHW	Equipment	Displaced Electricity
Demand (kWh/m²)	3.15	17.11	32.47	14.67	0.00	84.59	0.00

Notional Annual Demand: Fitness Centre



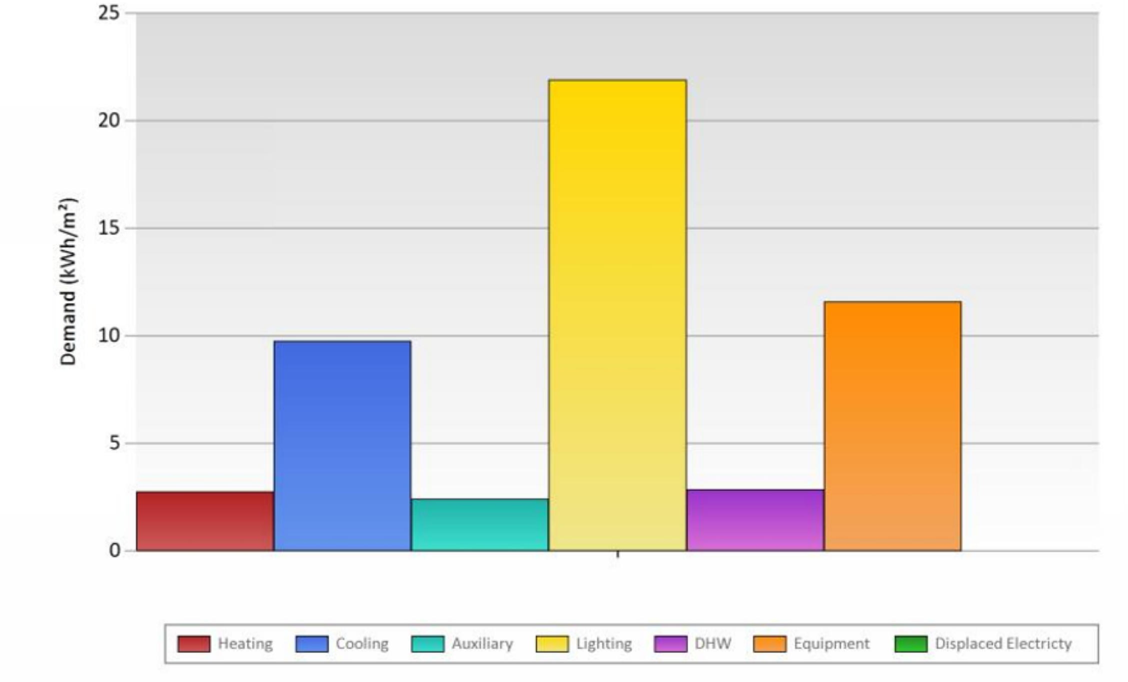
	Heating	Cooling	Auxiliary	Lighting	DHW	Equipment	Displaced Electricity
Demand (kWh/m²)	3.16	22.51	23.79	12.74	0.00	84.59	0.00

Actual Annual Demand: Coffee shop



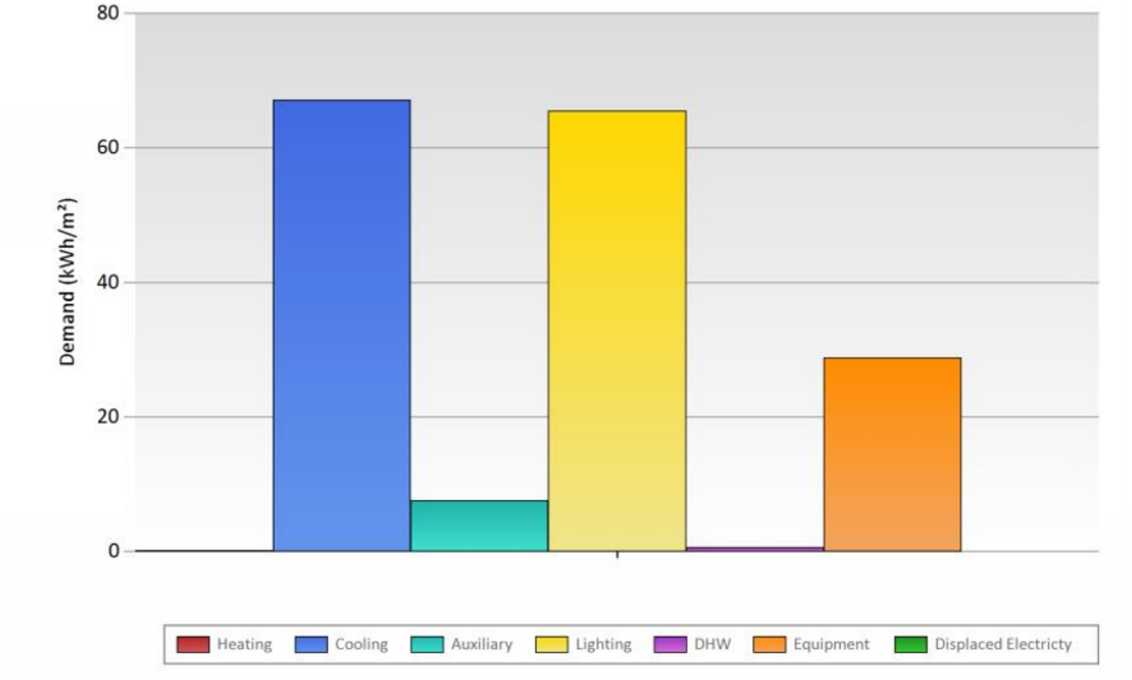
	Heating	Cooling	Auxiliary	Lighting	DHW	Equipment	Displaced Electricity
Demand (kWh/m²)	3.05	9.06	2.16	22.44	2.85	11.58	0.00

Notional Annual Demand: Coffee shop



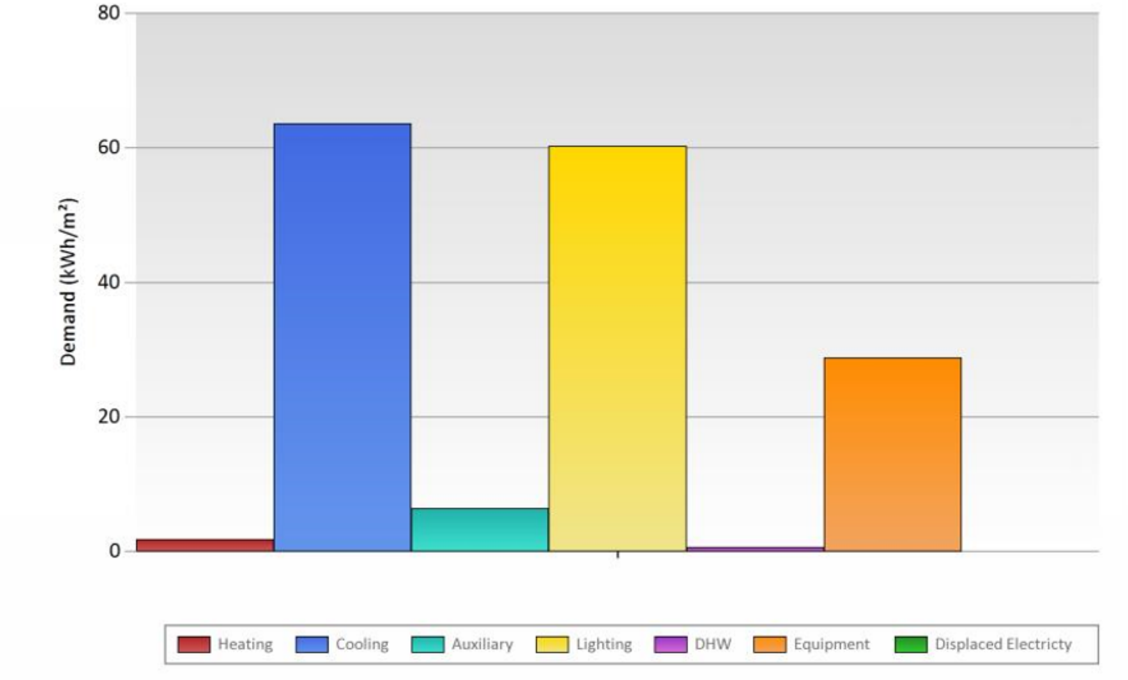
	Heating	Cooling	Auxiliary	Lighting	DHW	Equipment	Displaced Electricity
Demand (kWh/m²)	2.75	9.75	2.41	21.90	2.85	11.58	0.00

Actual Annual Demand: Residents lounge



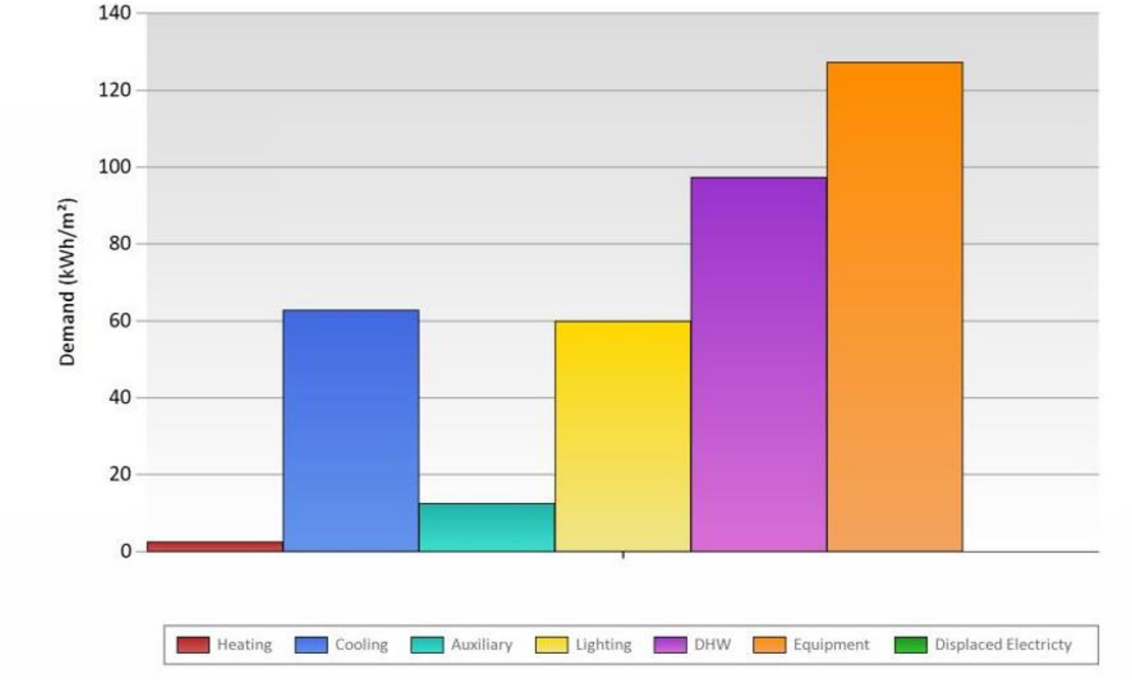
	Heating	Cooling	Auxiliary	Lighting	DHW	Equipment	Displaced Electricity
Demand (kWh/m²)	0.16	67.17	7.58	65.50	0.63	28.79	0.00

Notional Annual Demand: Residents lounge



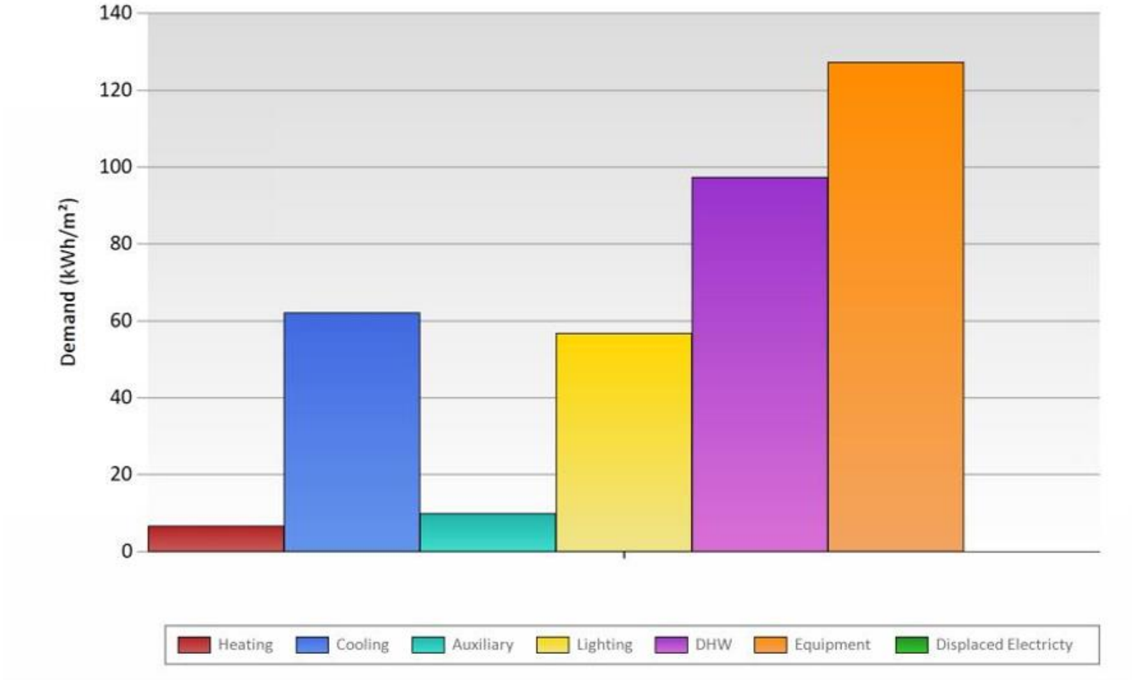
	Heating	Cooling	Auxiliary	Lighting	DHW	Equipment	Displaced Electricity
Demand (kWh/m²)	1.73	63.62	6.41	60.23	0.63	28.79	0.00

Actual Annual Demand: Coffee shop



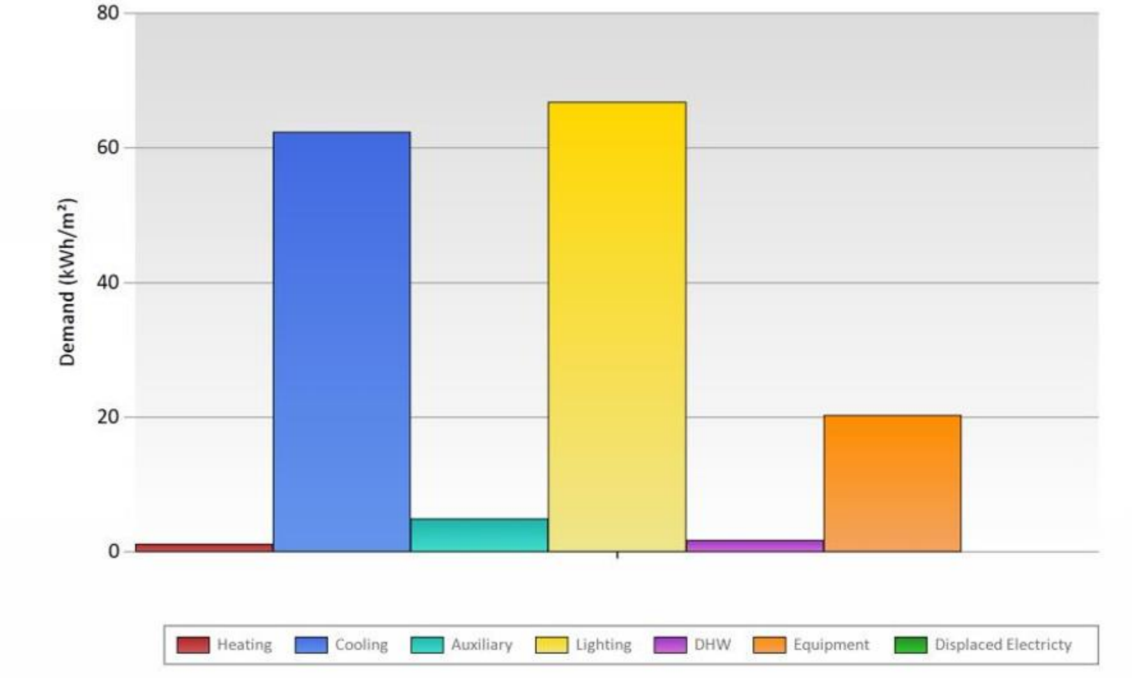
	Heating	Cooling	Auxiliary	Lighting	DHW	Equipment	Displaced Electricity
Demand (kWh/m²)	2.56	62.85	12.52	59.98	97.44	127.34	0.00

Notional Annual Demand: Coffee shop



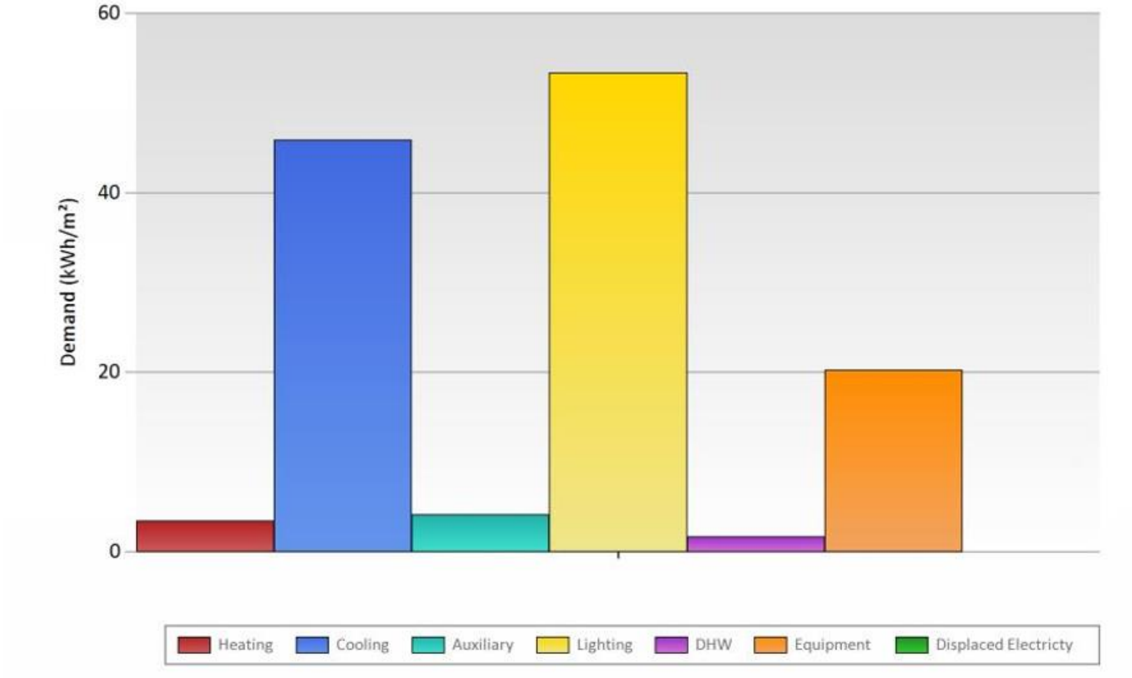
	Heating	Cooling	Auxiliary	Lighting	DHW	Equipment	Displaced Electricity
Demand (kWh/m²)	6.62	62.11	9.99	56.83	97.44	127.34	0.00

Actual Annual Demand: Hair dresser



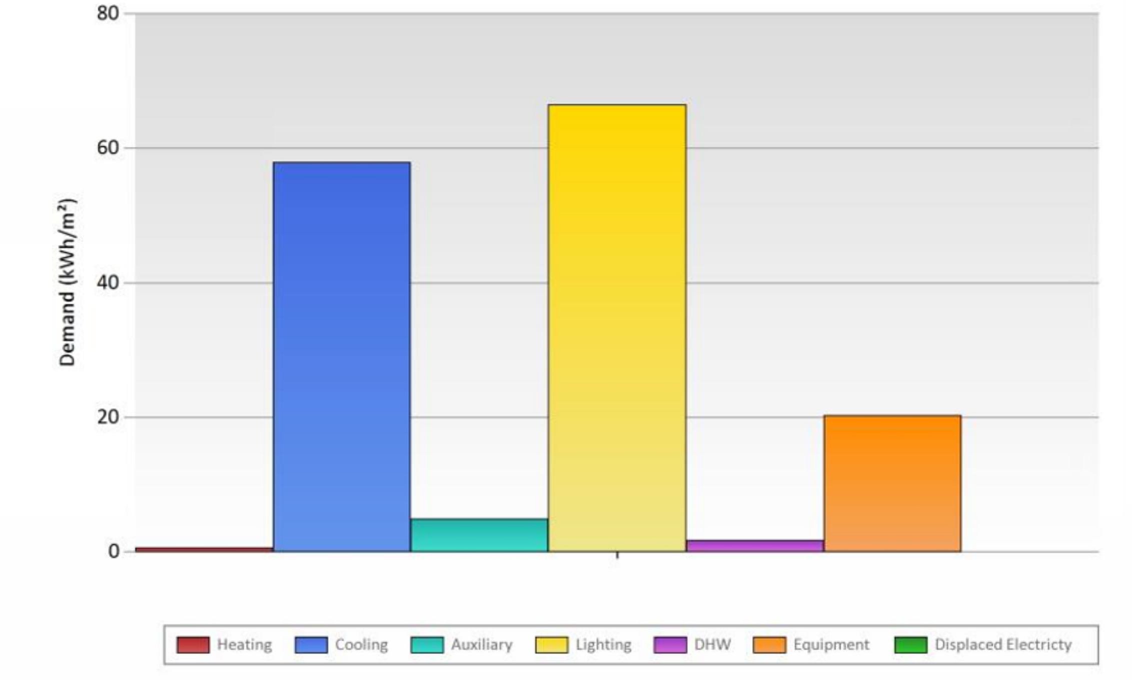
	Heating	Cooling	Auxiliary	Lighting	DHW	Equipment	Displaced Electricity
Demand (kWh/m²)	1.16	62.41	4.90	66.80	1.70	20.26	0.00

Notional Annual Demand: Hair dresser



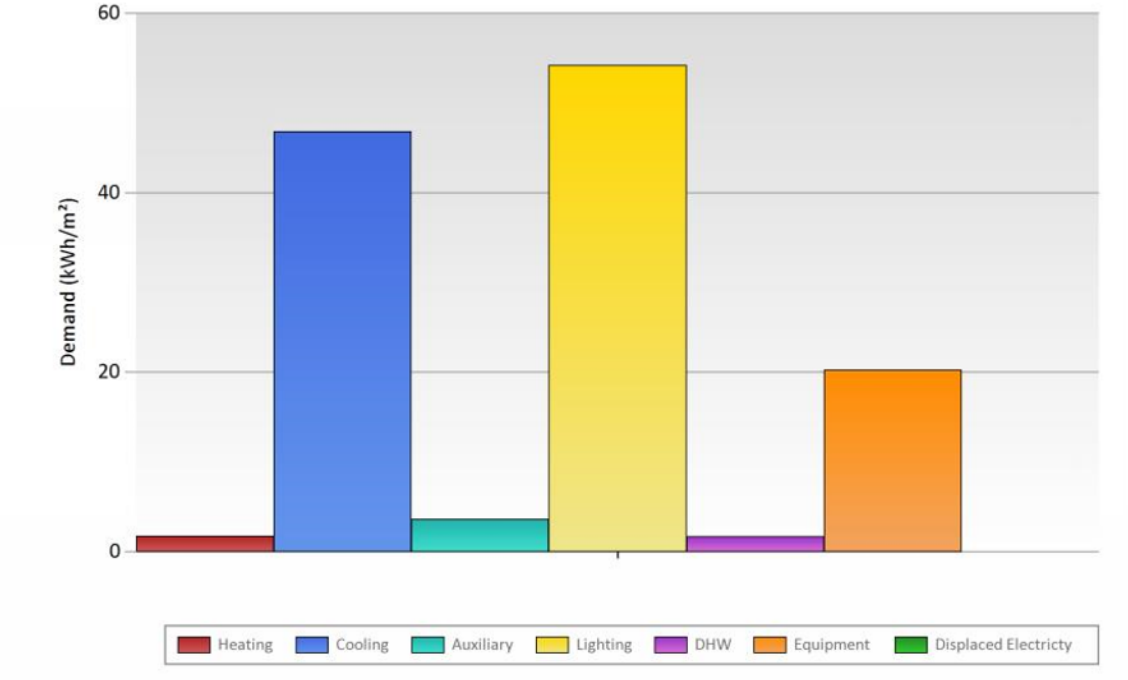
	Heating	Cooling	Auxiliary	Lighting	DHW	Equipment	Displaced Electricity
Demand (kWh/m²)	3.45	45.93	4.15	53.39	1.70	20.26	0.00

Actual Annual Demand: Dry cleaner



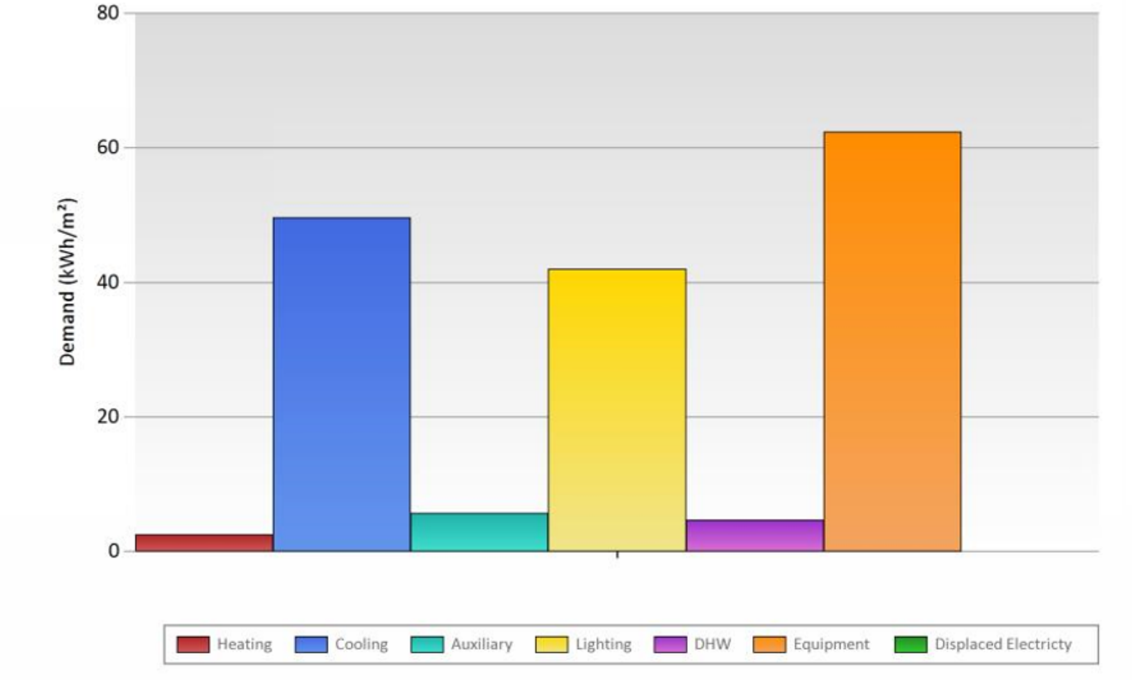
	Heating	Cooling	Auxiliary	Lighting	DHW	Equipment	Displaced Electricity
Demand (kWh/m²)	0.57	57.96	4.90	66.53	1.70	20.26	0.00

Notional Annual Demand: Dry cleaner



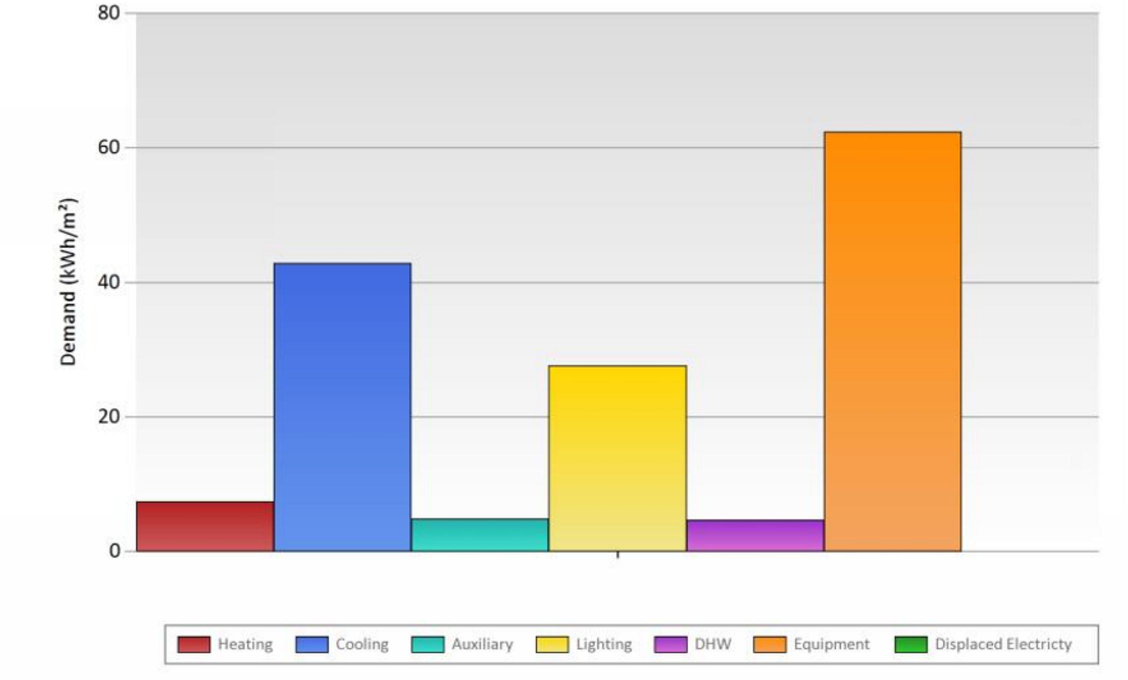
	Heating	Cooling	Auxiliary	Lighting	DHW	Equipment	Displaced Electricity
Demand (kWh/m²)	1.72	46.83	3.59	54.21	1.70	20.26	0.00

Actual Annual Demand: Workshare hub



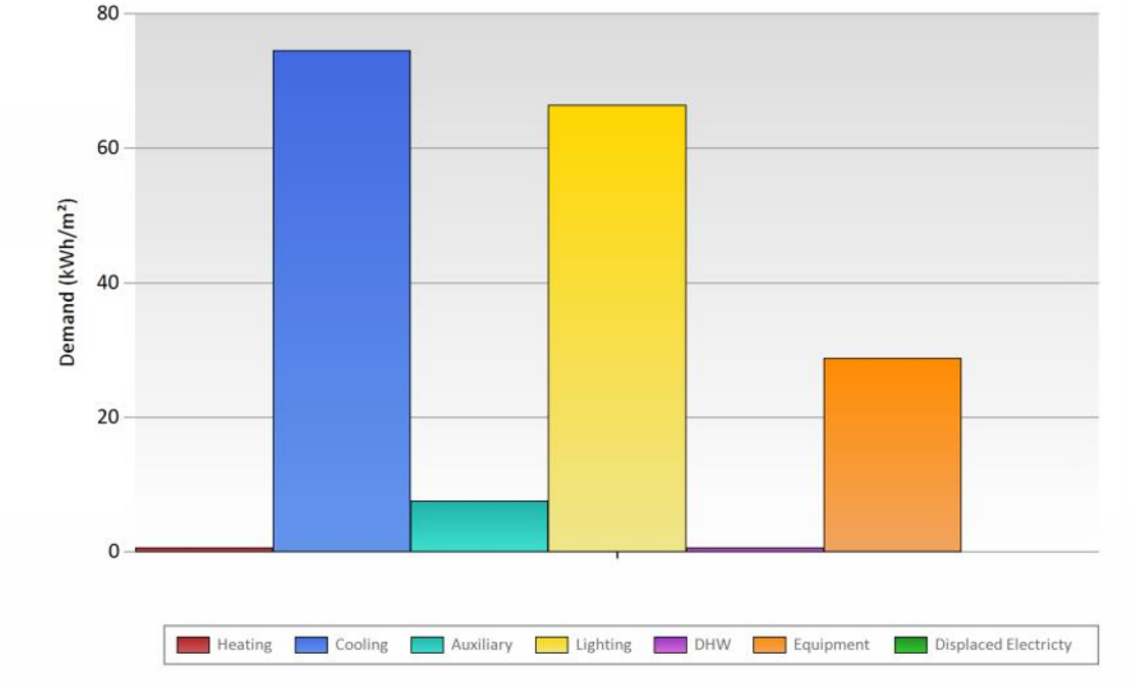
	Heating	Cooling	Auxiliary	Lighting	DHW	Equipment	Displaced Electricity
Demand (kWh/m²)	2.44	49.63	5.66	41.97	4.69	62.34	0.00

Notional Annual Demand: Workshare hub



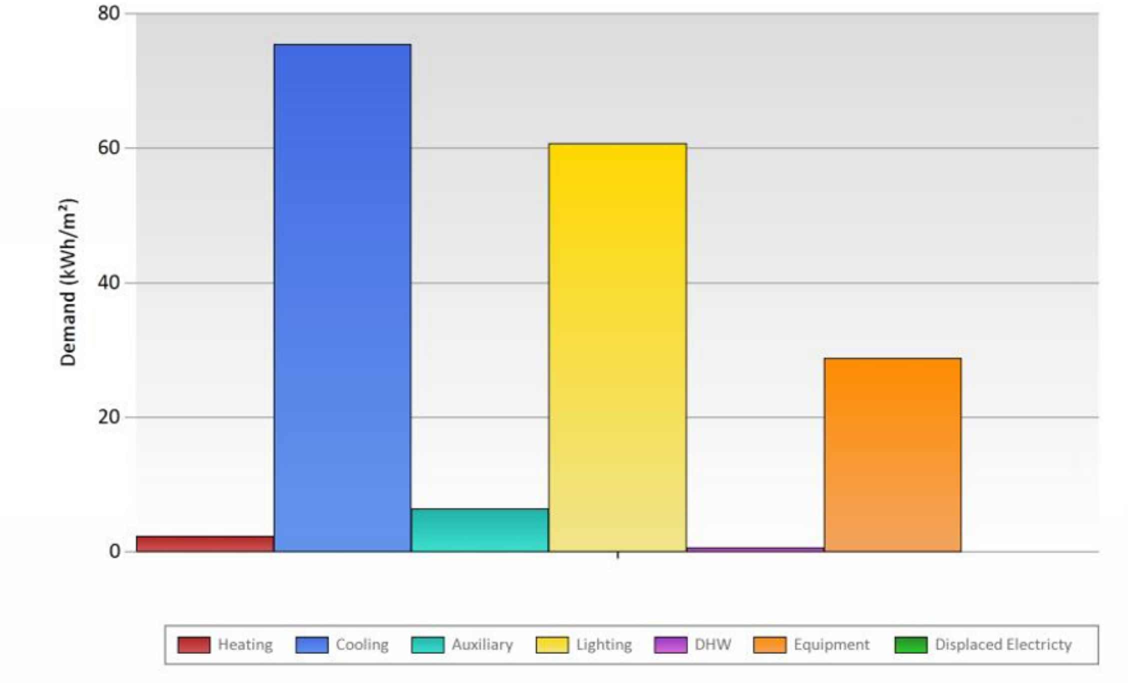
	Heating	Cooling	Auxiliary	Lighting	DHW	Equipment	Displaced Electricity
Demand (kWh/m²)	7.37	42.84	4.79	27.59	4.69	62.34	0.00

Actual Annual Demand: Concierge post office



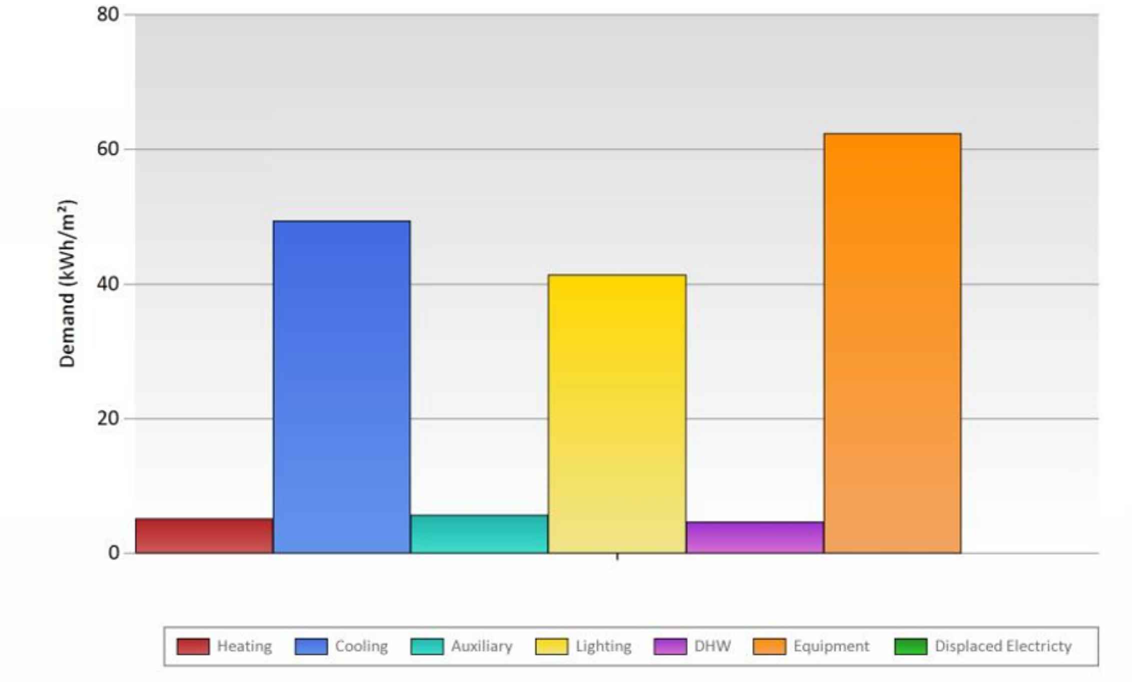
	Heating	Cooling	Auxiliary	Lighting	DHW	Equipment	Displaced Electricity
Demand (kWh/m²)	0.63	74.54	7.58	66.42	0.63	28.78	0.00

Notional Annual Demand: Concierge post office



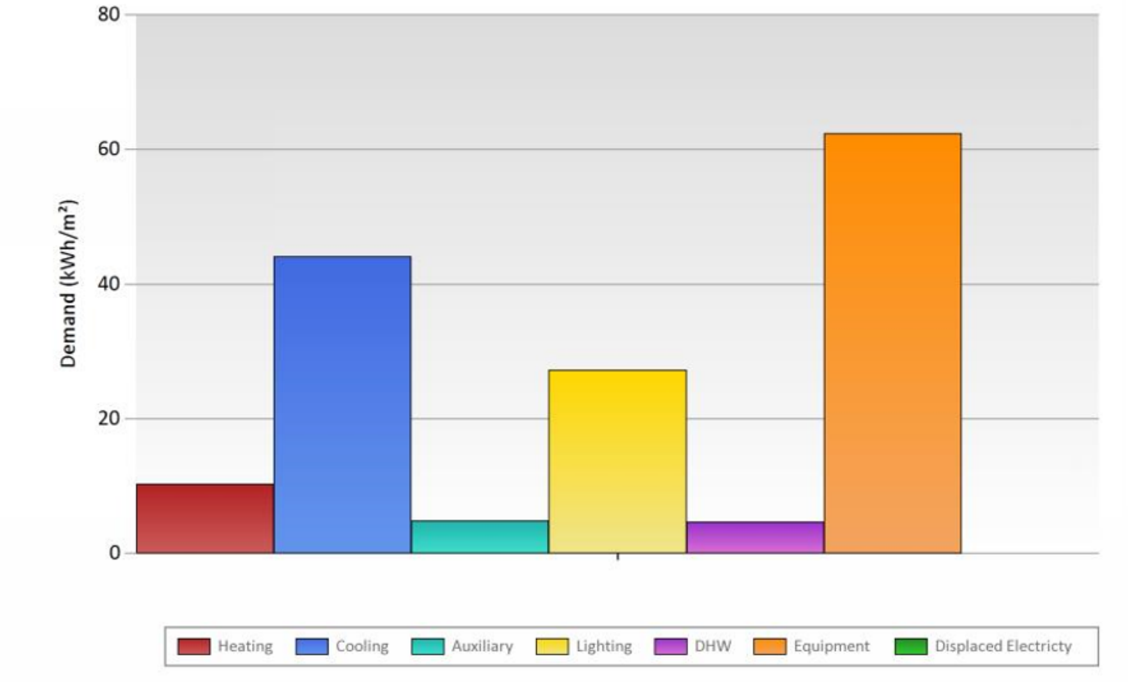
	Heating	Cooling	Auxiliary	Lighting	DHW	Equipment	Displaced Electricity
Demand (kWh/m²)	2.31	75.49	6.41	60.74	0.63	28.78	0.00

Actual Annual Demand: Maintenance office



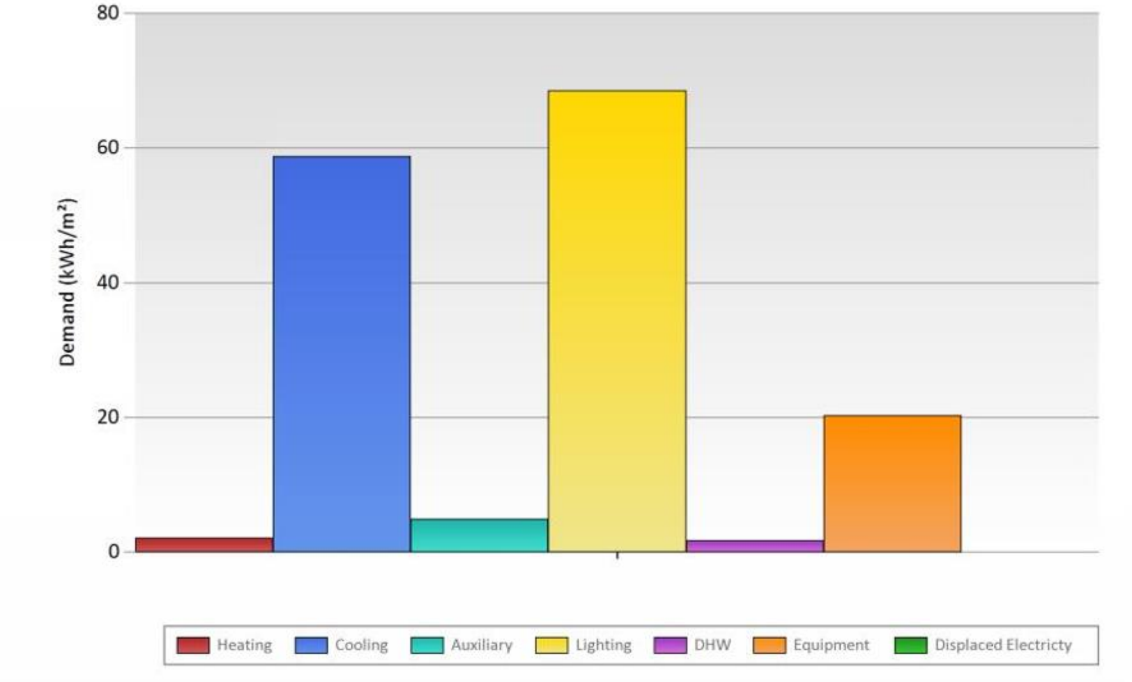
	Heating	Cooling	Auxiliary	Lighting	DHW	Equipment	Displaced Electricity
Demand (kWh/m²)	5.14	49.38	5.66	41.40	4.69	62.34	0.00

Notional Annual Demand: Maintenance office



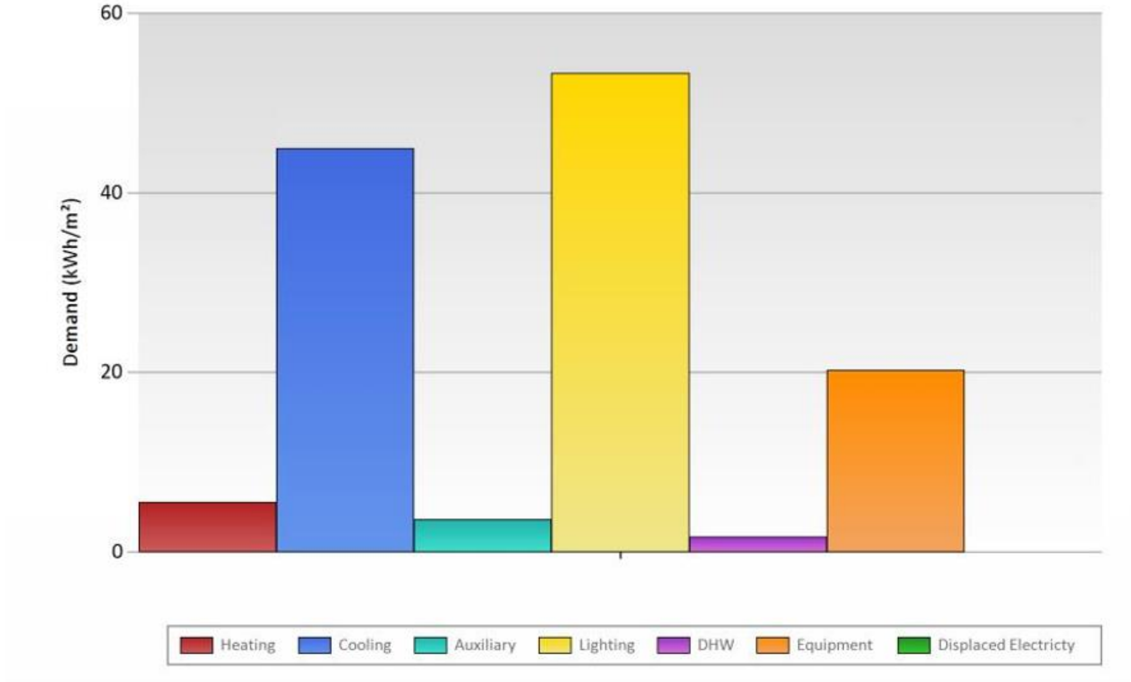
	Heating	Cooling	Auxiliary	Lighting	DHW	Equipment	Displaced Electricity
Demand (kWh/m²)	10.27	44.08	4.79	27.23	4.69	62.34	0.00

Actual Annual Demand: Retail unit



	Heating	Cooling	Auxiliary	Lighting	DHW	Equipment	Displaced Electricity
Demand (kWh/m²)	2.07	58.79	4.90	68.53	1.70	20.26	0.00

Notional Annual Demand: Retail unit



	Heating	Cooling	Auxiliary	Lighting	DHW	Equipment	Displaced Electricity
Demand (kWh/m²)	5.52	44.99	3.59	53.36	1.70	20.26	0.00

11.5 Communication with Local Borough and/or Local Heat Network Operators

chapmanbdsp has contacted Barnet's Energy Resource Manager (Nigel Bell) to enquire about the potential of connecting to this network. As the email correspondence shows, he confirmed the complexity brought by the distance and having the M1 as an obstacle. He also mentioned not being aware of any other network on Mill Hill's side of the M1, recommending us to look in the London Heat Map. As the London Heat Map image shows, there are no other networks in the vicinity.

Nonetheless, Pentavia Mill Hill's Energy Centre is being equipped with connection points that will allow the development to connect to a district network, shall one become available in the future. The location, size and layout of the plantroom as well as the set-up of the building heating system (i.e. communal heating system with single plantroom, single capped off pipework connection point, space for heat exchanger) allows for the easy connection to such a network.

From: Bell, Nigel
To: Bandler, John (Capita)
Cc: Gary Wedlake; Paul Hussey; Joanna Conceicao; john.mitri@cpcprojectservices.com
Subject: FW: Mill Hill - Availability of Heat Networks
Date: 14 December 2016 18:37:38
Attachments: 72df6397-7261-4e2e-83ad-beb9c08102fb.png
imageccade0.PNG
SKMBT_C364e16121217470.pdf

Hi John,

Trust you are keeping well.

Are you aware of any potential heating networks in the vicinity of this proposed housing development which appears to occupy the site of the former Pentavia Retail Park at Mill Hill adjacent the Watford Way?

Gary - As you mention I am aware of the Grahame Park District Heating Scheme on the opposite side of the M1 which is currently part of a major regeneration scheme and as noted is some distance away.

On the development side of the M! I am not aware of any significant schemes currently operating in the vicinity although if you have not already done so it may be worthwhile referring to the GLA London Heat Map.

https://www.london.gov.uk/what-we-do/environment/energy/london-heat-map/view-london-heat-map

John - your thoughts in respect to current initiates in the area would be helpful.

Kind Regards

Nigel

Nigel Bell
Energy Resource Manager
Customer and Support Group
London Borough of Barnet
Barnet House
1255 High Road
Whetstone
London N20 0EJ

Tel: 020 8359 4571
Mobile: 07958 796 501
Barnet Online: www.barnet.gov.uk

please consider the environment - do you really need to print this email?

From: Gary Wedlake [mailto:Gary.Wedlake@chapmanbdsp.com]
Sent: 12 December 2016 17:08
To: Bell, Nigel
Cc: Paul Hussey; Joanna Conceicao; 'john.mitri@cpcprojectservices.com'
Subject: Mill Hill - Availability of Heat Networks

Hi Nigel

We are looking at a proposed housing development in Mill Hill of 695 properties.

Could you advise if there are any existing district heating networks within the vicinity that would be suitable for the connection of this size of development. Our initial investigations indicated that the only possible heat network was on the other side of the M1 and hence provide difficulties to connect.

If no suitable existing heat networks are available we would be propose an on site energy centre with CHP and Boiler provision for a localised on site district heating network for heating and hot water services. The system would be left with the facility to connect on to any future district heating network that becomes available in the area.

Please would you advise if there are any existing suitable district heating opportunities in this area. I attach a location plan for the project. If you have any queries please do not hesitate to contact me.

Thanks

Gary

Gary Wedlake
Associate Director

Chapman BDSP

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Kent, ME19 4DG

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11.6 Energy Centre

Preliminary Energy Centre sizing analysis produces a requirement for circa 250 m² as shown in the illustrations on the right.

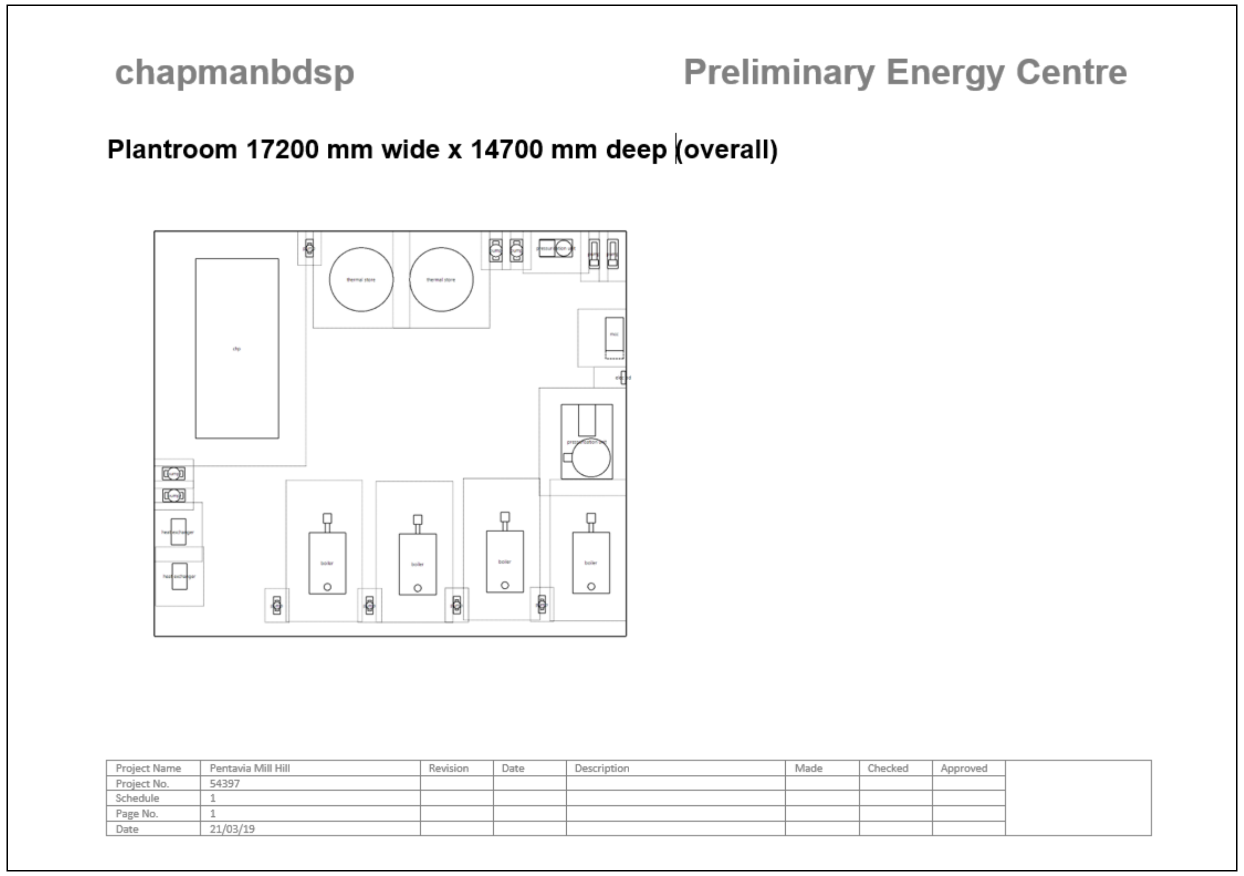


Figure 11.1 - Preliminary plant room layout

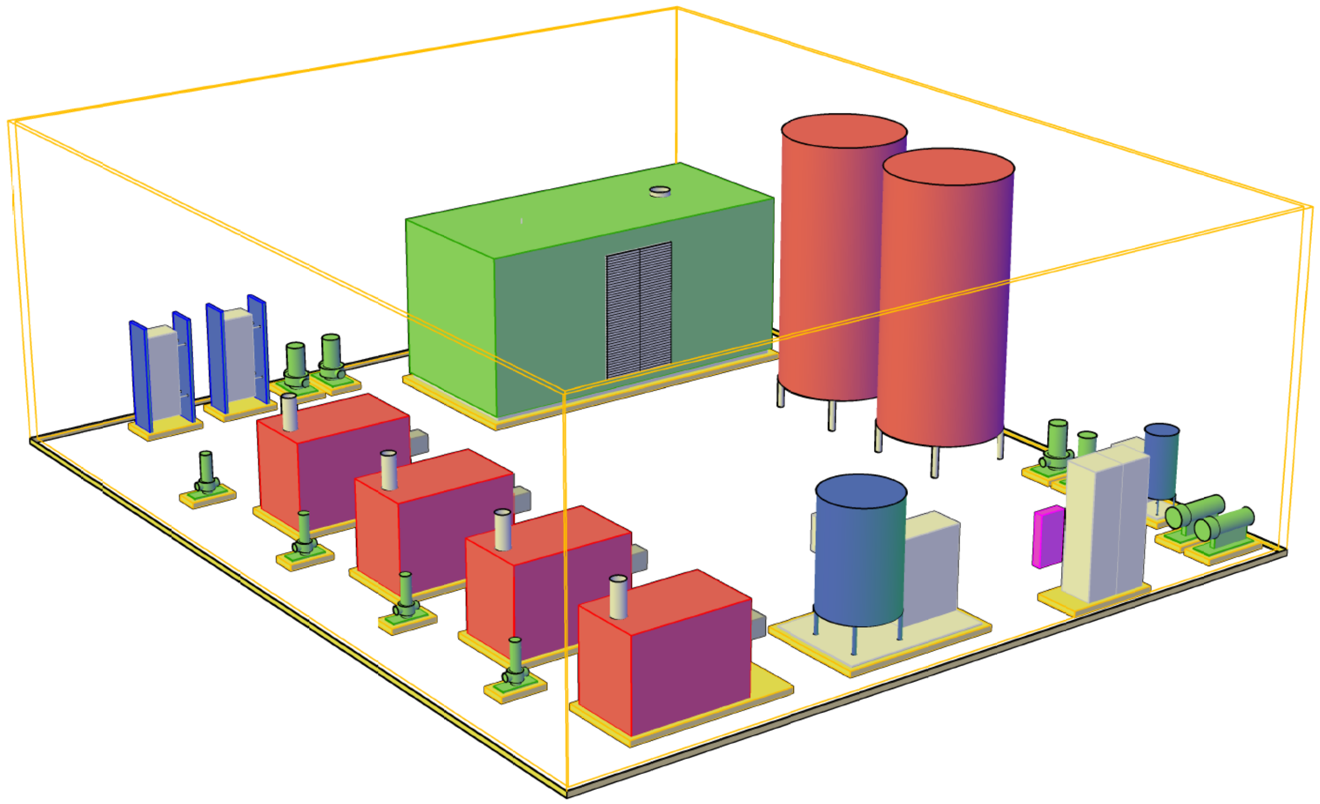


Figure 11.2 - 3D view of the preliminary plant room layout

11.7 Preliminary Demand Profiles & CHP Assessment

Estimating annual energy demand/consumption

For the purposes of the preliminary CHP analysis, the following empirical benchmarks have been used:

Usage	Heat (including DHW)	Electricity	Notes/Sources
	kWh/m2/an	kWh/m2/an	
Residential	50 (55% of which DHW)	43	Based on approx. primary energy targets for residential from literature
Commercial [A1, A3-A4, D1, C3]	120 (80% of which DHW)	95	Allowance – exact mix of uses TBC
Car Park	0	20	TM46
Plant/Refuse/Bike Store	0	20	Allowance – as Car Park

Table 11.7 – Benchmarks for different categories of usage used to generate synthetic load profiles

The specific benchmark figures are intended to be realistic rather than overly optimistic in terms of performance (especially given the so-called 'performance gap' between operation and design), but equally to allow for improved energy standards as a result of better specification and higher build quality in-line with improvements to the Building Regulations.

As noted above, annual hourly load profiles for heat and electricity demand have been generated for (i) the residential areas, and (ii) all other uses.

While additional load profiles could, in principle, have been created for each type of commercial areas to reflect the different planning classes, specific usages for these commercial areas have yet to be fully defined and they constitute a small fraction of the total area of the scheme.

Residential benchmarks

In relation to new-build dwellings, there is very little solid published information available on the range of actual energy consumption in use (let alone that for medium-rise apartment blocks which characterise the Pentavia scheme). For instance, the information in CIBSE Guide F and TM46 is somewhat out of date and does not specifically address residential use anyway (other than quasi-residential uses such as hostels, nursing homes etc.).

In terms of primary energy, example benchmarks include:

Benchmark	Figure (Primary Energy)
Dwellings built to Passivhaus Standards	≤ 120kWh/m2/yr (≤ 15kWh/m2/yr for space heating, etc.)
AECB Silver Standard	≤ 135 kWh/m2/yr (≤ 40kWh/m2/yr for heating + cooling, etc.)
Low-Energy Buildings (LEB) Database (average of completed projects)	145 kWh/m2/yr
Average UK Home	>400 kWh/m2/yr

Table 11.8 – *Example empirical benchmarks from the literature*

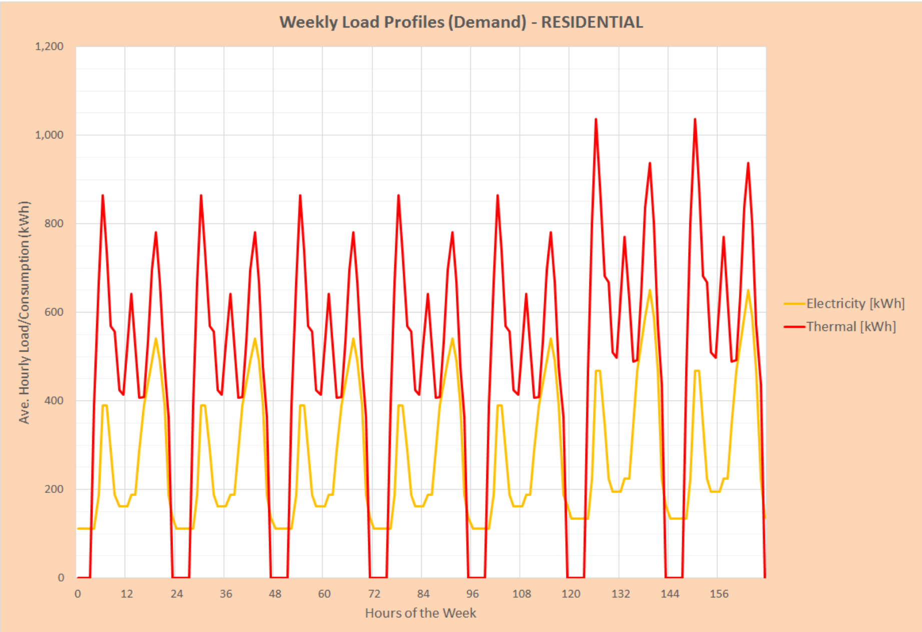
chapmanbdsp have used a benchmark which equates to c.175 kWh/m2/yr in terms of primary energy consumption (to get to a primary energy figure, metered electricity assumption is multiplied by a primary energy factor to account for generation and transmission losses in the electricity supply grid. For UK, the figure is approximately 2.92).

In comparison to the consumption figures for the 'Be Lean' case from the SAP Calculations, the assumed specific heat and electricity consumptions are about 16% higher, which seems reasonable.

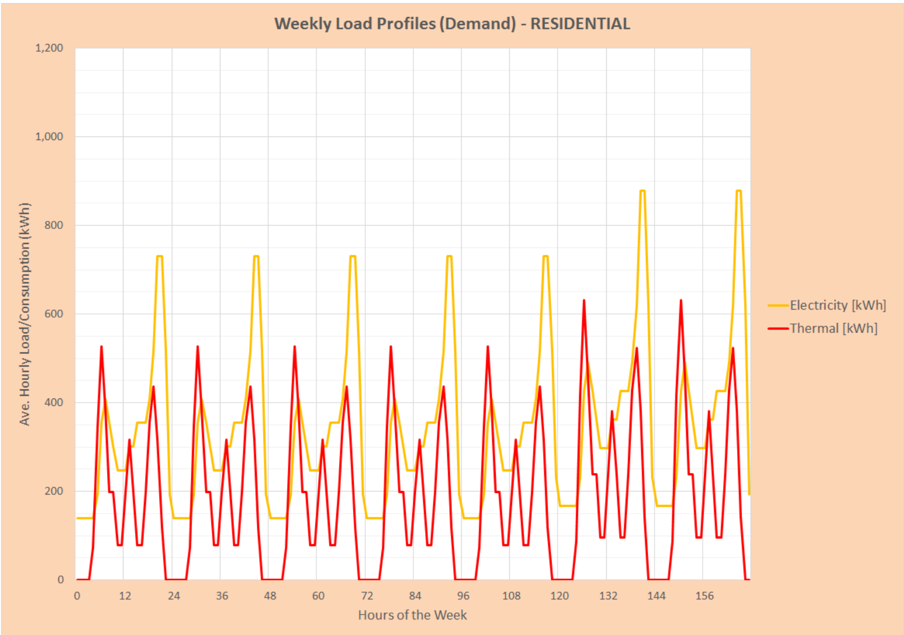
From the SAP calculations, domestic hot water (DHW) heating accounts for c.57% of overall heat demand (whereas for the SBEM calculations for commercial (non-domestic) areas, DHW accounted for c.95%).

Annual demand profiles

The graphs in Figure 11.3 show example profiles for the residential element of the scheme for a peak winter and summer week:



(a) Example Residential Demand Profiles for a Winter Week (December)



(b) Example Residential Demand Profiles for a Summer Week (July)

Figure 11.3 - Example weekly load profiles for the Residential Buildings

Key points to note are that:

- The demand profiles are estimations only, although their shapes are derived from monitoring of real buildings in use (also, for example, the electricity profile is similar to those reported from research projects and as used in UK in electricity settlements);

- The demand profiles are normalised by the annual energy demand figures for heat (thermal) and electricity (as explained earlier);
- It is assumed that demand for heating would occur primarily between 05:00 and 24:00, so there would be minimal demand in the early hours of the morning. Whereas for electricity, there will be a ‘base load’ at all times due to plant, appliances (even if in stand-by mode), lighting and so on (> 100kW);
- The profiles also assume that energy demand will peak in the early morning and later afternoon/evening as the majority of people get ready to leave for work and return home respectively;
- The heating demand is dominated by the spikes in the DHW demand. During the summer week, there is no demand for space heating and this ‘variable’ demand disappears;
- The profiles allow for an increase in energy demand during weekends (in comparison to weekdays) when more residents are expected to be at home.

The estimated annual site demand profiles used in the CHP Analysis are shown in the figure below:

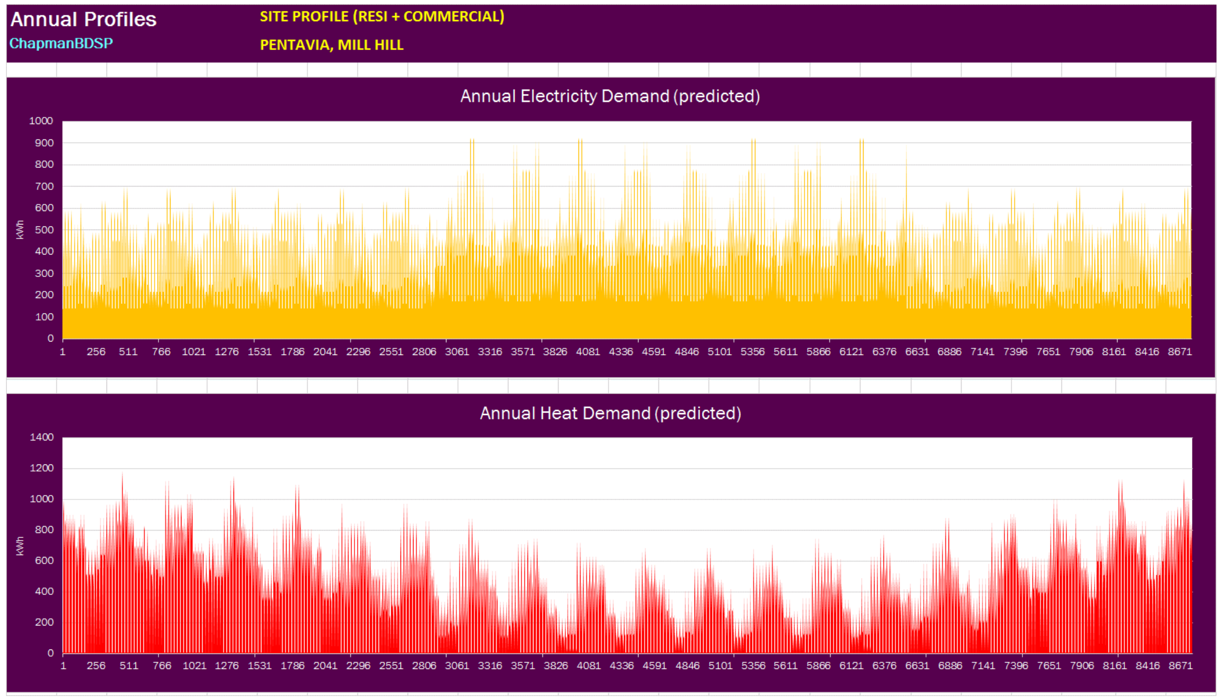


Figure 11.4 - Estimated Annual hourly Combined (Site) Demand Profiles for Electricity and Heat

The estimated thermal demand is also plotted as a load duration curve in Figure 11.5:

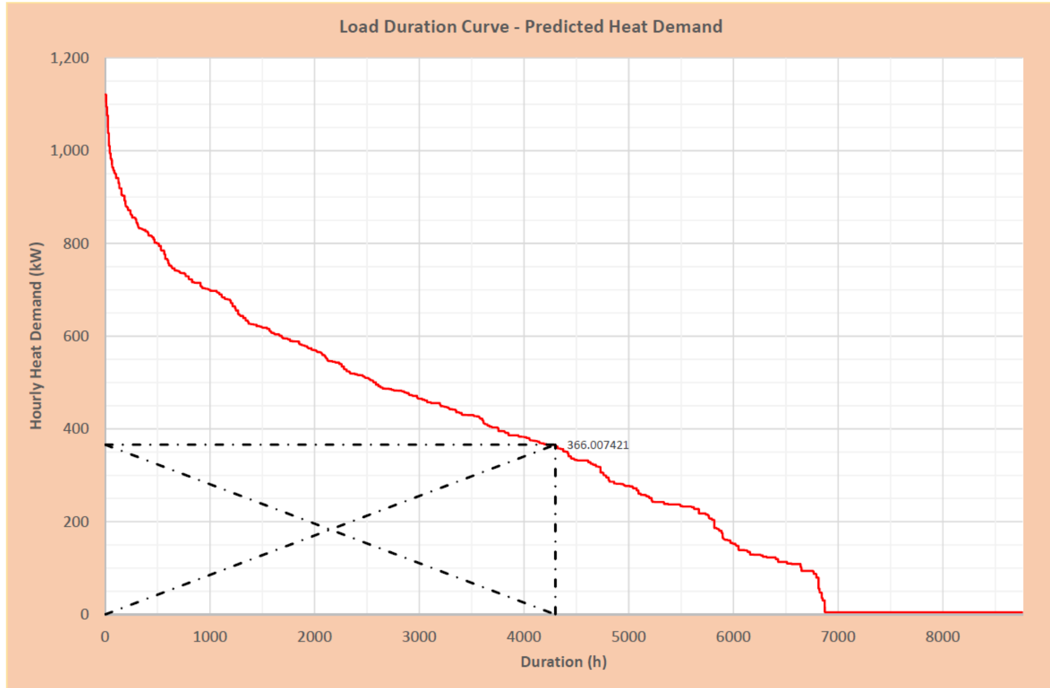


Figure 11.5 - Approximate Load Duration Curve showing site thermal/heat demand (*this also shows the largest rectangle that can fit under the curve, which is a common technique for giving an initial feel for the thermal capacity of a CHP unit, but does not allow for factors such as turn-down, thermal storage and so on*)

As the scheme progresses, it is expected that further work will be undertaken to evaluate demand profiles with inputs from dynamic thermal modelling of buildings and so on.

CHP analysis

CHP analysis is carried out on the basis of the estimated site hourly annual demand profiles using an in-house Excel-based CHP Analysis Tool.

This works on the following basis:

- Information on efficiencies at part-load for both the CHP units and back-up boilers is entered on the basis of gross efficiencies (i.e. for the CHP, net electrical and thermal outputs (after accounting for parasitic loads) divided by the fuel input (based on the gross calorific value of, in this case, natural gas);
- A single CHP Unit strategy is assumed with associated thermal store and back-up boilers;
- The heat load of the building is met by the CHP, thermal store and (back-up) boilers in that order of priority;
- All heat generators/sources are available 24 hours per day. However, it is assumed that the CHP would be unavailable for 3 days per annum for maintenance (as an initial assumption, so as not to over-exaggerate run hours or carbon savings), during which the demands would be met by the gas boilers (once the thermal store had been exhausted) and grid electricity import;
- The CHP charges the thermal store whenever it is able (the thermal store is only charged by the CHP and not by the boilers, which are for meeting peak loads);
- It is assumed that the CHP Unit (as per manufacturer’s information) can modulate or turn-down to 50% of peak output (but no lower) – this is in fact automatically inferred based on the part-load data entered - and would also run for a minimum one hour cycle when on (to avoid excessive cycling and also so as not to exaggerate run hours);
- The CHP unit is also regulated to avoid the need to dump excess heat or power
- The size of the CHP unit and the size of the thermal store can be varied automatically to assist in optimising sizing of the CHP and thermal store;

- Detailed quantitative and graphical outputs/results are generated together with reflected inputs for each scenario;
- Results can be analysed on an annual, weekly, and daily basis – with shorter timescales giving more information about how the CHP plant is being operated and controlled and allowing different strategies to be tested

Illustrative Weekly Outputs from the chapmanbdsp CHP Analysis Tool are shown in Figure 11.6 and Figure 11.7.

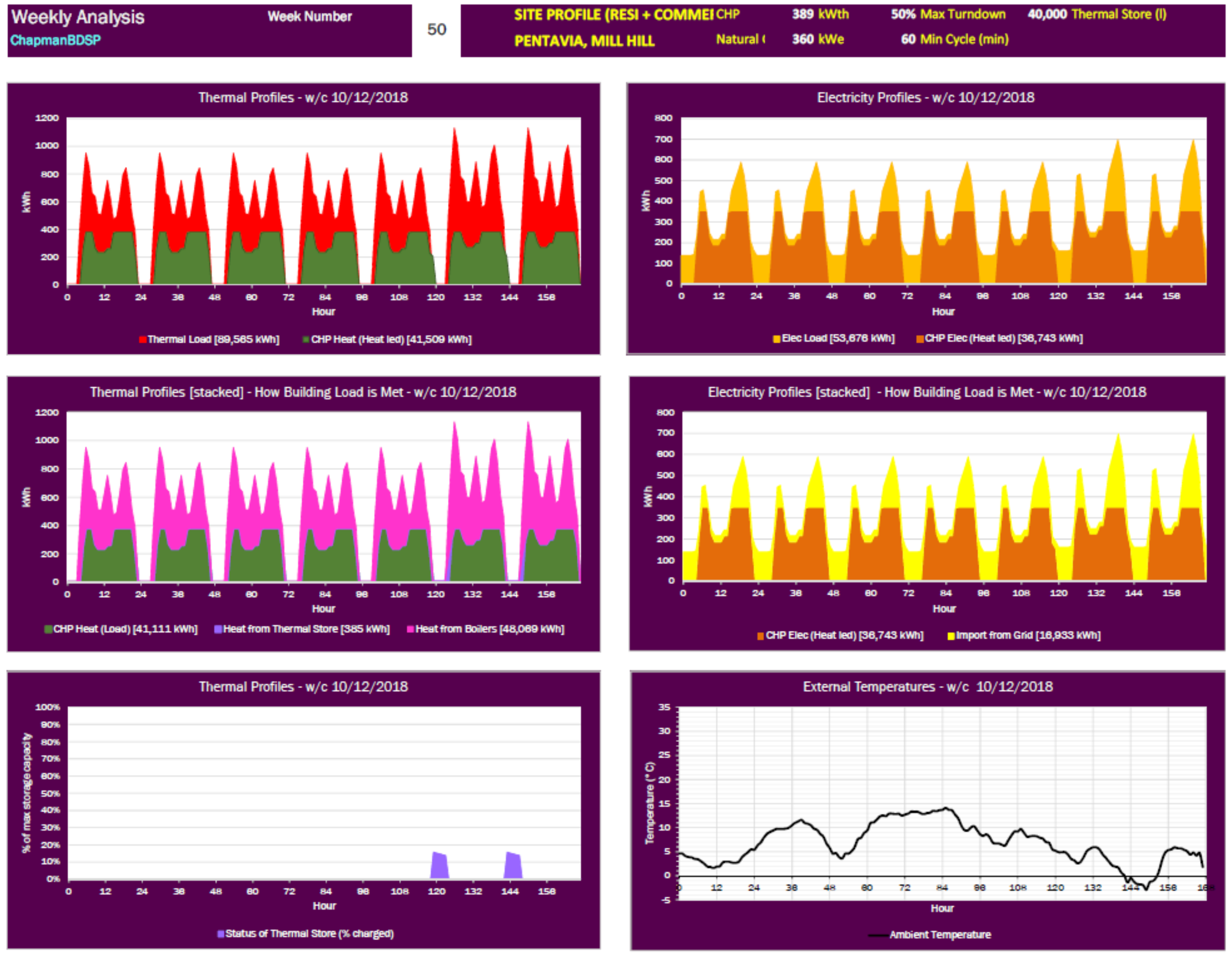


Figure 11.6 - Thermal output of the single CHP Unit is regulated to avoid the need to 'dump' excess electricity

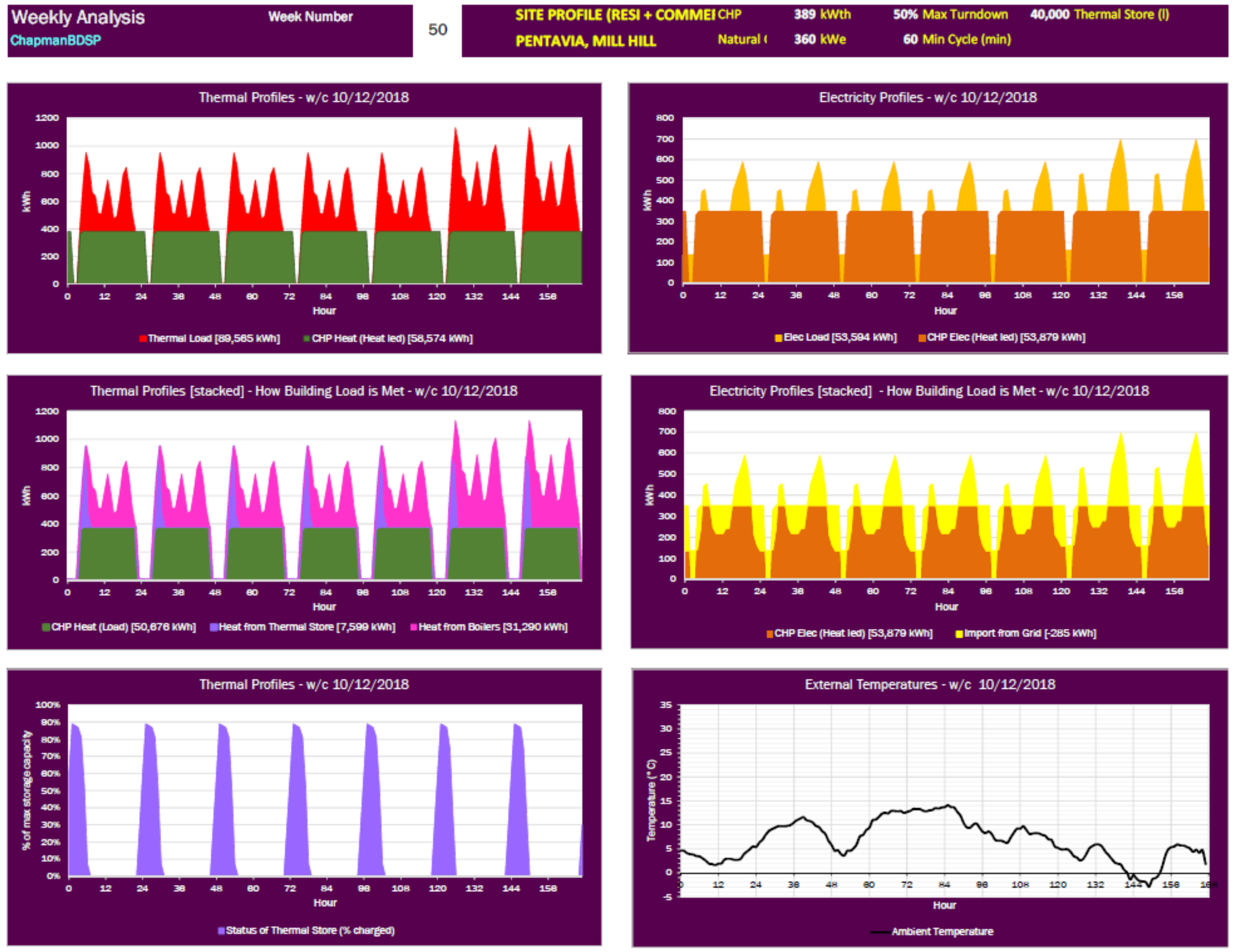


Figure 11.7 - Excess electricity (beyond that required to meet the electrical load of the buildings) can be dumped or (preferably) exported to the grid

Each graphic shows 6 individual weekly graphs (running from Monday to Sunday) illustrating the following:

- Thermal/Heat Demand Profile for Site (with CHP Heat Generation overlaid);
- How the Thermal Demand is met (through heat from CHP, Thermal Store and then Boilers);
- Electrical Demand Profiles (with CHP Electricity Generation overlaid);
- How the Electrical Demand is met (through CHP generation and import from the grid);
- State of the thermal store (% charged);
- Ambient temperature profile.

Optimal CHP size

In terms of identifying an optimal CHP size, analysis was run on the basis of engines with Heat to Power Ratios (HPR) of 1.6 (as per the Ener-G units and other 'Low NOx' units) and 1.1 (i.e. more bias to power generation) with gross efficiencies of c.80% at full-load and similar part-load performance.

Two graphics are presented - Figure 11.8 and Figure 11.9, with the thermal capacity of the CHP Unit (kWth) is varied in steps, with the thermal store auto-sized so that it can be charged on the basis of 4 hours of the CHP engine running at full output.

Each graphic contains 6 individual graphs:

- Annual carbon emissions (in tCO2e per annum);
- Annual operational time (in hours per annum – full load equivalent (FLE));
- Annual heat fraction (%);
- Annual power fraction (%);
- Annual breakdown of carbon emissions from CHP, Boilers, and Grid Electricity Import (%);
- Size of the Thermal Store (litres) assumed for the given CHP size.

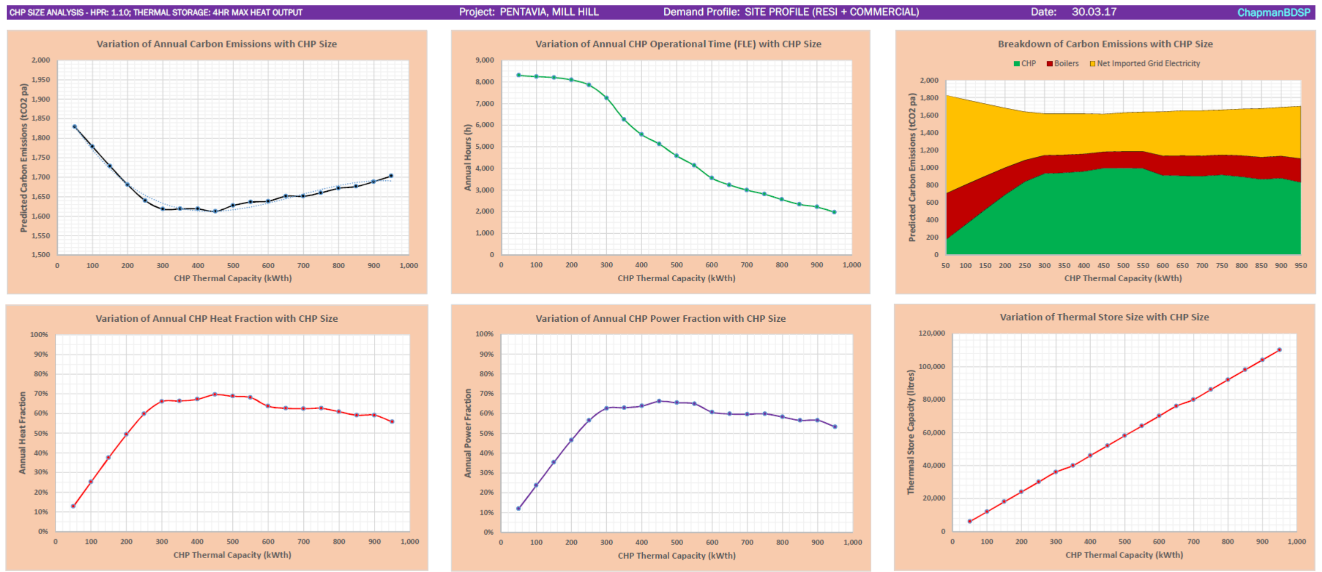


Figure 11.8 - Impact of varying CHP Thermal Capacity for single CHP engine with HPR of 1.1 (gross efficiency 80% at full-load and 76% at 50% load)
Thermal store is auto-sized to provide 4 hours heat storage at maximum engine output for each CHP size

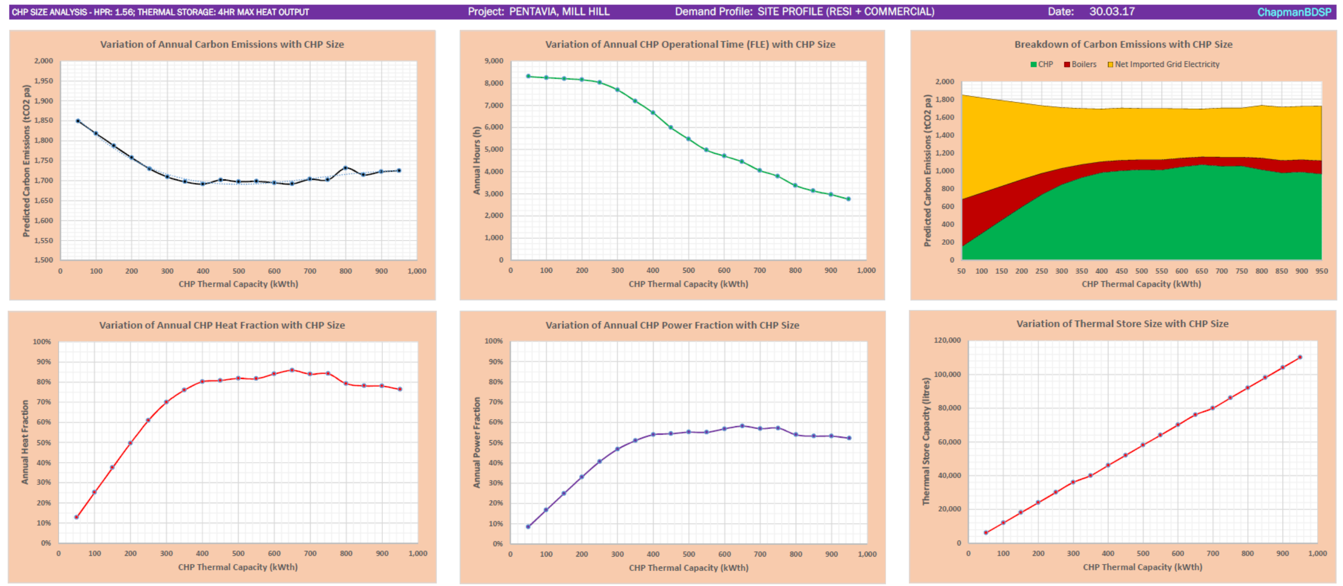


Figure 11.9 Impact of varying CHP Thermal Capacity for single CHP engine with HPR of 1.56 (gross efficiency 80% at full-load and 76% at 50% load)
Thermal store is auto-sized to provide 4 hours heat storage at maximum engine output for each CHP size

The analysis suggests that for a CHP unit with a HPR of 1.1, the optimum size would be c.300-400 kWth (270 – 360 kWe) as above this there is little benefit in respect to reduced site-wide carbon emissions (as run hours would tend to reduce for larger units due to their more limited flexibility to turn-down during periods when loads are low). For instance, a c.400 kWth engine could run for around 6,500 hours per annum (full load equivalent) and meet c.65-70% of the annual heat demand and c.62-65% of the annual electricity demands.

For a CHP unit with a higher HPR of 1.5-1.6, the optimum size would be c.400kWth (250 kWe). This could run for around 6,700 hours per annum (full load equivalent) and provided up to 80% of the site annual heat demand and around 55% of the annual electricity demands.

As the graphs demonstrate, where a single CHP unit becomes 'too big', its run hours and potential for carbon savings eventually become limited by its inability to run when loads are too low.

Note that the thermal storage in this case is auto-sized to represent 4 hours of maximum heat output from the engine running at full-load (rather than, say, 1 hour of maximum heat output), based on findings from initial analysis and also taking into account that on a daily basis there should be 4-6 hour 'windows' in late evening and early morning where heat demand should be very low and there is an opportunity to recharge the thermal store to help meet peak daily heat loads.

With regarding to sizing of the CHP units and NOx emissions, research undertaken by chapmanbdsp has indicated that there are relatively few packaged CHP units (based on spark ignition engines) with integrated NOx abatement that can meet the GLA Emissions Standards for Band B developments such as Pentavia.

For example, as well as the Ener-G Units, Bosch also produce packaged low NOx CHP Units. However, the packaged low NOx units all seem to be limited to electrical outputs of c.230-240kWe or lower and have similarly (high) HPRs.

Gas turbines can also produce very low NOx emissions but tend to be much bigger in terms of capacity. There are a few smaller units such as the Capstone C200 (200kWe) MicroTurbine (which can also be linked together to form modular installations with a shared flue), but these have HPRs of 1.5-1.6 as well (i.e. similar to the Bosch and Ener-G low NOx engines). Fuel Cell CHP units can have HPRs lower than 1 but are still very rare in the UK and very expensive.

It therefore seems to make sense to look at CHP engines with lower HPR (increased bias towards electricity generation, which are more suited to the predicted demand profile of the Pentavia site given current information) combined with separate 'external' pollution abatement (i.e. this is not part of the packaged CHP Unit) using SCR (Selective Catalytic Reduction) technology.

Hoval power block EG 460 unit

Based on the findings above, further analysis has been carried out based on a Hoval PowerBlock 460 Unit – 460 kWe/584kWth. Efficiencies stated in the manufacturer's datasheets are net and have been converted to gross. The boilers provisionally selected for the scheme are also manufactured by Hoval.

The unit has a gross efficiency of 80.2% at full load (HPR 1.27), 80.4% at 75% load (HPR 1.29) and 80.5% at 50% load (HPR 1.37). The performance of this unit (including part-load efficiencies) has been analysed using the CHP Tool. The results from this have been in turn been fed into the updated SAP Calculations in order to calculate the site wide emissions savings. The analysis indicates that an annual heat fraction of c.66% should be achievable.

The analysis (which also produces detailed numerical outputs) also indicated that the average annual efficiencies of the unit were very close to the efficiencies at 75% load and so these have also been used in the SAP Calculations (i.e. electrical efficiency of 35% and thermal efficiency of 45.3%).

It is noted that similar performance should be achievable from units from other manufacturers (which might differ slightly in terms of rated capacities), so the analysis is not critically dependent on one CHP unit from one supplier.

11.8 Unviable Low and Zero Carbon technologies

Solar thermal

Solar water heating is currently one of the most cost effective and affordable renewable technologies. Renewable solar energy is converted to heat via panels that absorb the high frequency heat radiation emitted from the sun. Evacuated tube technology maximises useful heat extraction even on a cold, cloudy day.

However solar thermal installation would compete against the proposed communal CHP installation for the base heating load hence reducing the impact of "CLEAN" measures and further increasing the system control and maintenance complexity.

Therefore, solar water heating is not appropriate for the Pentavia, Mill Hill development.

Wind turbines

Wind turbines come in vertical and horizontal axis forms and generate electrical energy using the wind. They have in the past received a poor reputation due to their carbon intensive construction and issues associated with noise and visual impact of wind farms. However, systems are becoming more and more common as well as more accepted even in some low-density urban areas or for exceptionally tall buildings. Small scale turbines suitable for domestic type environments are also now more available and affordable.

With consideration to the low average wind speeds in the densely built area of the site, wind turbines are not proposed.

Heat pumps

Air source heat pump systems can efficiently elevate low-grade environmental heat from air or ground to the level required for space heating and even domestic hot water system (albeit at low efficiency). Heat pumps work much more efficiently at a lower temperature (28-35 C) than a standard boiler system and are hence more suitable to "low-exergy" underfloor heating systems or larger low-temperature radiator and fan-coil systems that are also considered low-response systems as they give out heat at lower temperatures over longer periods of time.

This proposed scheme includes a fast response CHP system that is higher on the Energy Hierarchy. Also, CHP would compete with heat pumps for the building heating base load and increase communal system control complexity.

Ground Source and Air Source Heat Pumps are therefore not proposed for this development.

Alternative fuels (i.e. Biofuels and Biomass)

Alternative fuels such as solid biomass or liquid bio-fuels are used to achieve very high NET carbon emissions savings under building regulations, albeit often with local increase in pollutant emissions and raising some concerns about sustainable management of natural resources related to overexploitation of biomass fuel. The rationale for using biomass fuels is that carbon dioxide released when energy is generated using bio fuels is balanced by that absorbed during the fuels production though sustainable management practices (i.e. deforestation).

In order to ensure efficient operation, biomass boilers are typically sized to meet a constant rather than highly variable base load. Moreover, in an urban location such as that of Mill Hill, transport and delivery of biomass would be extremely problematic and would increase the carbon intensity of the fuel. Certain biomass sources are also claimed to threaten food production and as such considered unsustainable. From an air quality perspective Bio fuels commonly produce higher NOx emissions when burnt than conventional natural gas combustion and often do not meet requirements of the Clean Air Act and Local Air Quality Management Plans.

Some liquid bio fuels relate to organic matter similar to biomass and hence don't offer significant advantages over solid biomass. However certain liquid bio-fuels such as that derived from medical waste and certified by ISCC protocol have extremely low pollutant emission factors (i.e. CO_2, NOx and particulates emission much lower than biomass) that qualifies them as a viable solution even in the areas with sensitive air quality. This is termed a carbon neutral process but only when the source of the fuel is renewable. Examples include sustainable rotation coppiced woodland used to produce solid biomass fuels and rape seed oil/ waste used to produce biodiesel.

Both biomass and bio fuels would require a significant fuel storage area or regular fuel deliveries with significant noise impact in this predominantly quiet residential and leisure area and the resulting increase in pollution (emissions and dust from deliveries).

Given the impact of local emissions from combustion of biomass fuel on air quality, biomass have not been proposed for this development whilst ISCC certified biofuel is eliminated due to noise and traffic issues related to frequent fuel deliveries in a residential area.

11.9 GLA Carbon Emissions Reporting Spreadsheet (v1.1)

chapmanbdsp

Mill Hill

The applicant should complete all the light blue cells including information on the modelled units, the area per unit, the number of units, the baseline energy consumption figures, the TER and the TFEE.

DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

				VALIDATION CHECK		REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - TER WORKSHEET							SAP 2012 CO2 PERFORMANCE: REGULATED CO2 EMISSIONS PER UNIT (kgCO2 p.a.)						SAP10 CO2 PERFORMANCE: REGULATED CO2 EMISSIONS PER UNIT							DEMAND
Unit identifier (e.g. plot number, dwelling type etc.)	Model total floor area (m²)	Number of units	Total area represented by model (m²)	Calculated TER 2012 (kgCO2 / m2)	TER Worksheet TER 2012 (kgCO2 / m2)	Space Heating	Fuel type Space Heating	Domestic Hot Water	Fuel type Domestic Hot Water	Lighting	Auxiliary	Cooling	Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	2012 CO2 emissions (kgCO2 p.a.)	Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	SAP10 CO2 emissions (kgCO2 p.a.)	Calculated TER SAP10 (kgCO2 / m2)	Fabric Energy Efficiency (FEE) Target Fabric Energy Efficiency (TFEE) (kWh/m²)
	TER Worksheet (Row 4)				TER Worksheet (Row 273)	TER Worksheet (Row 211)		TER Worksheet (Row 219)		TER Worksheet (Row 232)	TER Worksheet (Row 231)	N / A														
All	59126.11	1	59126.11	17.2	17.2	1979160.57	Natural Gas	1931036.77	Natural Gas	263327.6	63825		427,499	417,104	136,667	33,125		1,014,395	415,624	405,518	61,355	14,871		897,368	15.2	44.64281371
Sum	59,126	1	59,126	17.2	-	1,979,161	N/A	1,931,037	N/A	263,328	63,825	0	427,499	417,104	136,667	33,125	0	1,014,395	415,624	405,518	61,355	14,871	0	897,368	15.2	44.64

NON-DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

				VALIDATION CHECK		REGULATED ENERGY CONSUMPTION BY END USE (kWh/m² p.a.) TER - SOURCE: BRUKL OUTPUT							REGULATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) TER - SOURCE: BRUKL.INP or *SIM.CSV FILE						REGULATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) - TER BRUKL					REGULATED CO2 EMISSIONS	
Building Use	Area per unit (m²)	Number of units	Total area represented by model (m²)	Calculated TER 2012 (kgCO2 / m2)	BRUKL TER 2012 (kgCO2 / m2)	Space Heating	Fuel type Space Heating	Domestic Hot Water	Fuel type Domestic Hot Water	Lighting	Auxiliary	Cooling	Natural Gas	Grid Electricity				2012 CO2 emissions (kgCO2 p.a.)	Natural Gas	Grid Electricity				SAP10 CO2 emissions (kgCO2 p.a.)	BRUKL TER SAP10 (kgCO2 / m2)
													##############	##############					##############	##############					
Mill Hill	20321	1	20321	14.8	14.8	6.47	Natural Gas	3.13	Natural Gas	20.81	1.27	3.1	10	25				301,062	10	25				157,209	7.7
Sum	20,321	1	20,321	14.8	-	131,477	131,477	0	0	0	0	0	10	25	N/A	N/A	N/A	301,062	10	25	N/A	N/A	N/A	157,209	7.7

SITE-WIDE ENERGY CONSUMPTION AND CO_2 ANALYSIS

				REGULATED ENERGY CONSUMPTION							REGULATED CO2 EMISSIONS	REGULATED CO2 EMISSIONS PER UNIT	
Use	Total Area (m²)	Calculated TER 2012 (kgCO2 / m2)	-	Space Heating (kWh p.a.)	N/A	Domestic Hot Water (kWh p.a.)	N/A	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)	2012 CO2 emissions (kgCO2 p.a.)	SAP10 CO2 emissions (kgCO2 p.a.)	Calculated TER SAP10 (kgCO2 / m2)
Sum	79,447	16.6	-	2,110,637		1,931,037		263,328	63,825	0	1,315,457	1,054,577	13.3

gla_carbon_emission_reporting_spreadsheet_v1.1_PP.xlsx

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The applicant should complete all the light blue cells including information on the 'be lean' energy consumption figures, the 'be lean' DER, the DFEE and the regulated energy demand of the 'be lean' scenario.

DOMESTIC ENERGY CONSUMPTION AND CO₂ ANALYSIS

Unit identifier (e.g. plot number, dwelling type etc.)	Model total floor area (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK: Calculated DER 2012 (kgCO2 / m2)	VALIDATION CHECK: DER Worksheet DER 2012 (kgCO2 / m2)
					DER Sheet (Row 384)
All	59126.11	1	59126.11	16.5	16.5
Sum	59,126	1	59,126	16.5	-

REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - 'BE LEAN' SAP DER WORKSHEET

Unit identifier	Space Heating	Fuel type Space Heating	Domestic Hot Water	Fuel type Domestic Hot Water	Lighting	Auxiliary	Cooling
	DER Sheet [(Row 307a) + (Row 367a x 0.01)]	Select fuel type	DER Sheet [(Row 310a) + (Row 367a x 0.01)]	Select fuel type	DER Sheet Row 332	DER Sheet (Row 313 + 331)	DER Sheet Row 315
All	1540507.419	Natural Gas	1999040.983	Natural Gas	261322.26	150161.0982	0
Sum	1,540,507	N/A	1,999,041	N/A	261,322	150,161	0

SAP 2012 CO2 PERFORMANCE – REGULATED CO2 EMISSIONS PER UNIT (kgCO2 p.a.)

Unit identifier	Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	2012 CO2 emissions (kgCO2 p.a.)
All	332,750	431,793	135,626	77,934	0	978,102
Sum	332,750	431,793	135,626	77,934	0	978,102

SAP10 CO2 PERFORMANCE – REGULATED CO2 EMISSIONS PER UNIT

Unit identifier	Space Heating CO2 emissions (kgCO2 p.a.)	Domestic Hot Water CO2 emissions (kgCO2 p.a.)	Lighting CO2 emissions (kgCO2 p.a.)	Auxiliary CO2 emissions (kgCO2 p.a.)	Cooling CO2 emissions (kgCO2 p.a.)	SAP10 CO2 emissions (kgCO2 p.a.)	Calculated DER SAP10 (kgCO2 / m2)
All	323,507	419,799	60,888	34,988	0	839,181	14.2
Sum	323,507	419,799	60,888	34,988	0	839,181	14.2

DOMESTIC ENERGY DEMAND DATA

Unit identifier	Fabric Energy Efficiency (FEE): Dwelling Fabric Energy Efficiency (DFEE) (kWh/m²)	Space Heating (kWh p.a.)	Domestic Hot Water (kWh p.a.)	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)
		REGULATED ENERGY DEMAND PER UNIT PER ANNUM (kWh p.a.)				
All	46.15309742	1,313,099	1,703,944	261,322	150,161	0
Sum	46.15	1,313,099	1,703,944	261,322	150,161	0

NON-DOMESTIC ENERGY CONSUMPTION AND CO₂ ANALYSIS

Building Use	Area per unit (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK: Calculated BER 2012 (kgCO2 / m2)	VALIDATION CHECK: BRUKL BER 2012 (kgCO2 / m2)
Mill Hill	20321	1	20321	12.8	12.8
Sum	20,321	1	20,321	12.8	-

REGULATED ENERGY CONSUMPTION BY END USE (kWh/m² p.a.) 'BE LEAN' BER - SOURCE: BRUKL OUTPUT

Building Use	Space Heating (kWh/m² p.a.)	Fuel type Space Heating	Domestic Hot Water (kWh/m² p.a.)	Fuel type Domestic Hot Water	Lighting (kWh/m² p.a.)	Auxiliary (kWh/m² p.a.)	Cooling (kWh/m² p.a.)
Mill Hill	5.21	Natural Gas	3.27	Natural Gas	17.42	1.24	2.51
Sum	105,872	N/A	66,450	N/A	353,992	25,198	51,006

LATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) 'BE LEAN' BER - SOURCE: BRUKL.INP or *SIM.CSV

Building Use	Natural Gas	Grid Electricity				2012 CO2 emissions (kgCO2 p.a.)
	############	############				
Mill Hill	8	21				260,493
Sum	8	21	N/A	N/A	N/A	260,493

REGULATED CO2 EMISSIONS PER UNIT

Building Use	Natural Gas	Grid Electricity	SAP10 CO2 emissions (kgCO2 p.a.)	BRUKL BER SAP10 (kgCO2 / m2)	
	############	############			
Mill Hill	8	21	136,423	6.7	N/A
Sum	8	21	136,423	6.7	

NON-DOMESTIC ENERGY DEMAND – REGULATED ENERGY DEMAND PER UNIT PER ANNUM (kWh p.a.)

Building Use	Space Heating (kWh p.a.)	Domestic Hot Water (kWh p.a.)	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)
Mill Hill	95,895	57,658	352,424	25,086	253,697
Sum	95,895	57,658	352,424	25,086	253,697

SITE-WIDE ENERGY CONSUMPTION AND CO₂ ANALYSIS

Use	Total Area (m²)	Calculated BER 2012 (kgCO2 / m2)	-	Space Heating (kWh p.a.)	N/A	Domestic Hot Water (kWh p.a.)	N/A	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)
				REGULATED ENERGY CONSUMPTION						
Sum	79,447	15.6	-	1,646,380		2,065,491		615,314	175,359	51,006

Use	REGULATED CO2 EMISSIONS: 2012 CO2 emissions (kgCO2 p.a.)	REGULATED CO2 EMISSIONS: SAP10 CO2 emissions (kgCO2 p.a.)	Calculated BER SAP10 (kgCO2 / m2)	N/A
Sum	1,238,595	975,604	12.3	

Use	Space Heating (kWh p.a.)	Domestic Hot Water (kWh p.a.)	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)
	REGULATED ENERGY DEMAND PER UNIT PER ANNUM (kWh p.a.)				
Sum	1,408,994	1,761,603	613,746	175,248	253,697

The applicant should complete all the light blue cells including information on the 'be clean' energy consumption figures and the 'be clean' DER.

DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

Unit identifier (e.g. plot number, dwelling type etc.)	Model total floor area (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK: Calculated DER 2012 (kgCO2 / m2)	VALIDATION CHECK: DER Worksheet DER 2012 (kgCO2 / m2)	REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - 'BE CLEAN' SAP DER WORKSHEET: Space Heating (Heat Source 1)	Fuel type Space Heating	Domestic Hot Water (Heat Source 1)	Fuel type Domestic Hot Water	Space and Domestic Hot Water from CHP if applicable	Fuel type CHP if applicable	Total Electricity generated by CHP ( ) if applicable	Lighting	Auxiliary	Cooling
					DER Sheet (Row 384)	DER Sheet [Row 307b ÷ (Row 367b x 0.01)]	Select fuel type	DER Sheet [Row 310b ÷ (Row 367b x 0.01)]	Select fuel type	DER Sheet [(Row 307a + 310a) ÷ (Row 362 x 0.01)]	Select fuel type	DER Sheet [(Row 307a + 310a) × (Row 361 ÷ 362)]	DER Sheet Row 332	DER Sheet (Row 313 + 331)	DER Sheet Row 315
All	59126.11	1	59126.11	10.4	10.4	489839.5064	Natural Gas	635640.7223	Natural Gas	4615477.354	Natural Gas	-1615417.074	261322.26	150161.0982	0
Sum	59,126	1	59,126	10.4	-	489,840	N/A	635,641	N/A	4,615,477	N/A	-95,513,327,600	261,322	150,161	0

Unit identifier	SAP 2012 CO2 PERFORMANCE – REGULATED CO2 EMISSIONS PER UNIT (kgCO2 p.a.): Space Heating	Domestic Hot Water	Space Heating and DHW from CHP if applicable	Electricity generated by CHP if applicable	Lighting	Auxiliary	Cooling	2012 CO2 emissions (kgCO2 p.a.)	SAP10 CO2 PERFORMANCE – REGULATED CO2 EMISSIONS PER UNIT (kgCO2 p.a.): Space Heating	Domestic Hot Water	Space Heating and DHW from CHP if applicable	Electricity generated by CHP if applicable	Lighting	Auxiliary	Cooling	SAP10 CO2 emissions (kgCO2 p.a.)	Calculated DER SAP10 (kgCO2 / m2)
All	105,805	137,298	996,943	-838,401	135,626	77,934	0	615,205	102,866	133,485	969,250	-376,392	60,888	34,988	0	925,085	15.6
Sum	105,805	137,298	996,943	-838,401	135,626	77,934	0	615,205	102,866	133,485	969,250	-376,392	60,888	34,988	0	925,085	15.6

NON-DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

Building Use	Area per unit (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK: Calculated BER 2012 (kgCO2 / m2)	VALIDATION CHECK: BRUKL BER 2012 (kgCO2 / m2)	REGULATED ENERGY CONSUMPTION BY END USE (kWh/m² p.a.) 'BE CLEAN' BER - SOURCE: BRUKL OUTPUT: Space Heating	Fuel type Space Heating	Domestic Hot Water	Fuel type Domestic Hot Water			Total Electricity generated by CHP ( ) if applicable	Lighting	Auxiliary	Cooling
Mill Hill	20321	1	20321	11.5	11.5	10.54	Natural Gas	6.32	Natural Gas	N/A	N/A	-5.98	17.42	1.24	2.51
Sum	20,321	1	20,321	11.5	-	214,183	N/A	128,429	N/A			-121,520	353,992	25,198	51,006

Building Use	REGULATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) 'BE CLEAN' BER - SOURCE: BRUKL.INP or *SIM.CSV FILE: Natural Gas	Grid Electricity	Bespoke DH Factor	Electricity generated by CHP (-) if applicable	2012 CO2 emissions (kgCO2 p.a.)	REGULATED CO2 EMISSIONS PER UNIT: Natural Gas	Grid Electricity	Bespoke DH Factor	Electricity generated by CHP (-) if applicable	SAP 10 CO2 emissions (kgCO2 p.a.)	BRUKL BER SAP10 (kgCO2 / m2)
	##############	##############	##############	##############		##############	##############	##############	##############		
Mill Hill	17	21		-5.98	234,207	17	21		-6	143,870	7.1
Sum	17	21	0	-6	234,207	17	21	0	-6	143,870	7.1

SITE-WIDE ENERGY CONSUMPTION AND CO_2 ANALYSIS

Use	Total Area (m²)	Calculated BER 2012 (kgCO2 / m2)	-	REGULATED ENERGY CONSUMPTION: Space Heating (kWh p.a.)		Domestic Hot Water (kWh p.a.)		Space and Domestic Hot Water from CHP (kWh p.a.)		Electricity generated by CHP (kWh p.a.) if applicable	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)	REGULATED CO2 EMISSIONS: 2012 CO2 emissions (kgCO2 p.a.)	REGULATED CO2 EMISSIONS PER UNIT: SAP 10 CO2 emissions (kgCO2 p.a.)	Calculated BER SAP10 (kgCO2 / m2)
					N/A		N/A		N/A							
Sum	79,447	10.7	-	704,023		764,069		4,615,477		-95,513,449,119	615,314	175,359	51,006	849,412	1,068,955	13.5

The applicant should complete all the light blue cells including information on the 'be green' energy consumption figures and the 'be green' DER.

DOMESTIC ENERGY CONSUMPTION AND CO2 ANALYSIS

Unit identifier (e.g. plot number, dwelling type etc.)	Model total floor area (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK: Calculated DER 2012 (kgCO2 / m2)	DER Worksheet DER 2012 (kgCO2 / m2)	Space Heating (Heat Source 1)	Fuel type Space Heating	Domestic Hot Water (Heat Source 1)	Fuel type Domestic Hot Water	Space Heating (Heat source 2) if applicable	Fuel type Space Heating	Domestic Hot Water (Heat source 2) if applicable	Fuel type Domestic Hot Water	Space and Domestic Hot Water from CHP if applicable	Fuel type CHP if applicable	Total Electricity generated by CHP ( ) if applicable	Electricity generated by renewable (-) if applicable	Lighting	Auxiliary	Cooling
					DER Sheet (Row 384)	DER Sheet [Row 307b + (Row 367b x 0.01)]	Select fuel type	DER Sheet [Row 310b + (Row 367b x 0.01)]	Select fuel type	DER Sheet [Row 307c + (Row 367c x 0.01)]	Select fuel type	DER Sheet [Row 310c + (Row 367c x 0.01)]	Select fuel type	DER Sheet [(Row 307a + 310a) ÷ (Row 362 x 0.01)]	Select fuel type	DER Sheet [(Row 307a + 310a) × (Row 361 ÷ 362)]	DER Sheet Row 380	DER Sheet Row 332	DER Sheet (Row 313 + 331)	DER Sheet Row 315
All	59126.11	1	59126.11	9.0	9.0	489839.5064	Natural Gas	635640.7223	Natural Gas	0	Natural Gas	0	Natural Gas	4615477.354	Natural Gas	-1615417.074	-161690	261322.26	150161.0982	0
Sum	59,126	1	59,126	9.0	-	489,840	N/A	635,641	N/A	0	N/A	0	N/A	4,615,477	N/A	-95,513,327,608	-161,690	261,322	150,161	0

The column group Space Heating (Heat Source 1) to Cooling is headed REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - 'BE GREEN' SAP DER WORKSHEET.

Unit identifier	SAP 2012 CO2 PERFORMANCE – REGULATED CO2 EMISSIONS PER UNIT (kgCO2 p.a.): Space Heating	Domestic Hot Water	Space Heating and DHW from CHP if applicable	Electricity generated by CHP if applicable	Electricity generated by renewable if applicable	Lighting	Auxiliary	Cooling	2012 CO2 emissions (kgCO2 p.a.)	SAP10 CO2 PERFORMANCE – REGULATED CO2 EMISSIONS PER UNIT: Space Heating	Domestic Hot Water	Space Heating and DHW from CHP if applicable	Electricity generated by CHP if applicable	Electricity generated by renewable if applicable	Lighting	Auxiliary	Cooling	SAP10 CO2 emissions (kgCO2 p.a.)	Calculated DER SAP10 (kgCO2 / m2)
All	105,805	137,298	996,943	-838,401	-83,917	135,626	77,934	0	531,288	102,866	133,485	969,250	-376,392	-37,674	60,888	34,988	0	887,411	15.0
Sum	105,805	137,298	996,943	-838,401	-83,917	135,626	77,934	0	531,288	102,866	133,485	969,250	-376,392	-37,674	60,888	34,988	0	887,411	15.0

NON-DOMESTIC ENERGY CONSUMPTION AND CO2 ANALYSIS

Use	Area per unit (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK: Calculated BER 2012 (kgCO2 / m2)	BRUKL BER 2012 (kgCO2 / m2)	Space Heating	Fuel type Space Heating	Domestic Hot Water	Fuel type Domestic Hot Water	N/A	Electricity generated by CHP ( ) if applicable	Electricity generated by renewable technology ( ) if applicable	Lighting	Auxiliary	Cooling
Mill Hill	20321	1	20321	11.5	11.5	10.14	Natural Gas	6.32	Natural Gas	N/A	-5.98	0	17.42	1.24	2.51
Sum	20,321	1	20,321	11.5	-	214,183	N/A	128,429	N/A		-121,520	0	353,992	25,198	51,006

The column group Space Heating to Cooling is headed REGULATED ENERGY CONSUMPTION BY END USE (kWh/m² p.a.) 'BE GREEN' BER - SOURCE: BRUKL OUTPUT.

Use	REGULATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) 'BE GREEN' BER - SOURCE: BRUKL.INP or *SIM.CSV FILE: Natural Gas	Grid Electricity	Bespoke DH Factor	Electricity generated by CHP ( ) if applicable	Electricity generated by renewable technology ( ) if applicable	Enter Carbon Factor 1	Enter Carbon Factor 2	Enter Carbon Factor 3	2012 CO2 emissions (kgCO2 p.a.)	REGULATED CO2 EMISSIONS PER UNIT: Natural Gas	Grid Electricity	Bespoke DH Factor	Electricity generated by CHP ( ) if applicable	Electricity generated by renewable technology ( ) if applicable	Enter Carbon factor 1	Enter Carbon factor 2	Enter Carbon factor 3	SAP10 CO2 emissions	BRUKL BER SAP10 (kgCO2 / m2)
Mill Hill	17	21		-5.98	0				234,207	17	21		6					143,870	7.1
Sum	17	21	0	-6	0	0	0	0	234,207	17	21	0	-6	0	0	0	0	143,870	7.1

SITE-WIDE ENERGY CONSUMPTION AND CO2 ANALYSIS

Use	Total Area (m²)	Calculated BER 2012 (kgCO2 / m2)	-	Space Heating (kWh p.a.)	N/A	Domestic Hot Water (kWh p.a.)	N/A	Space Heating (kWh p.a.)	N/A	Domestic Hot Water (kWh p.a.)	N/A	Space and Domestic Hot Water from CHP (kWh p.a.)	N/A	Electricity generated by CHP (kWh p.a.) if applicable	Electricity generated by renewable (kWh p.a.) if applicable	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)
Sum	79,447	12.5	-	704,023		764,069		0		0		4,615,477		-95,513,449,119	-161,690	615,314	175,359	51,006

The column group Space Heating (kWh p.a.) to Cooling (kWh p.a.) is headed REGULATED CO2 EMISSIONS.

Use	REGULATED CO2 EMISSIONS: Space Heating CO2 emissions	Domestic Hot Water CO2 emissions	Space Heating and DHW from CHP CO2 emissions if applicable	Electricity generated by CHP CO2 savings if applicable	Electricity generated by renewable CO2 savings if applicable	Lighting CO2 emissions	Auxiliary CO2 emissions	Cooling CO2 emissions	2012 CO2 emissions	REGULATED CO2 EMISSIONS PER UNIT: Space Heating CO2 emissions	Domestic Hot Water CO2 emissions	Space Heating and DHW from CHP CO2 emissions if applicable	Electricity generated by CHP CO2 savings if applicable	Electricity generated by renewable CO2 savings if applicable	Lighting CO2 emissions	Auxiliary CO2 emissions	Cooling CO2 emissions	SAP10 CO2 emissions	Calculated BER SAP10 (kgCO2 / m2)
Sum	105,822	137,320	996,943	-838,407	-83,917	135,626	77,934	0	765,495	102,883	133,506	969,250	-376,398	-37,674	60,888	34,988	0	1,031,281	13.0

SAP 2012 PERFORMANCE

DOMESTIC

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

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	1,014	1,122
After energy demand reduction	978	1,122
After heat network / CHP	615	1,122
After renewable energy	531	1,122

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

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	36	4%
Savings from heat network / CHP	363	36%
Savings from renewable energy	84	8%
Cumulative on site savings	**483**	**48%**
Annual savings from off-set payment	531	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**15,939**	-
Cash in-lieu contribution (£)	**956,319**	

NON-DOMESTIC

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

	Carbon Dioxide Emissions for non-domestic buildings (Tonnes CO2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	301	122
After energy demand reduction	260	122
After heat network / CHP	234	122
After renewable energy	234	122

SAP10 PERFORMANCE

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

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	897	504
After energy demand reduction	839	504
After heat network / CHP	925	504
After renewable energy	887	504

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

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	58	6%
Savings from heat network / CHP	-86	-10%
Savings from renewable energy	38	4%
Cumulative on site savings	**10**	**1%**
Annual savings from off-set payment	887	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**26,622**	-
Cash in-lieu contribution (£)	**1,597,339**	

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

	Carbon Dioxide Emissions for non-domestic buildings (Tonnes CO2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	157	55
After energy demand reduction	136	55
After heat network / CHP	144	55
After renewable energy	144	55

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

	Regulated non-domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	41	13%
Savings from heat network / CHP	26	9%
Savings from renewable energy	0	0%
Total Cumulative Savings	**67**	**22%**

Table 5: Shortfall in regulated carbon dioxide savings

	Annual Shortfall (Tonnes CO_2)	Cumulative Shortfall (Tonnes CO_2)
Total Target Savings	**105**	-
Shortfall	39	1,156
Cash in-lieu contribution (£)	**69,330**	-

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

	Regulated non-domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	21	13%
Savings from heat network / CHP	-7	-5%
Savings from renewable energy	0	0%
Total Cumulative Savings	**13**	**8%**

Table 5: Shortfall in regulated carbon dioxide savings

	Annual Shortfall (Tonnes CO_2)	Cumulative Shortfall (Tonnes CO_2)
Total Target Savings	55	-
Shortfall	42	1,251
Cash in-lieu contribution (£)	**75,032**	-

SITE-WIDE

	Total regulated emissions (Tonnes CO2 / year)	CO2 savings (Tonnes CO2 / year)	Percentage savings (%)
Part L 2013 baseline	1,315		
Be lean	1,239	77	6%
Be clean	849	389	30%
Be green	765	84	6%
	-	**CO2 savings off-set (Tonnes CO2)**	-
Off-set	-	**17,094**	-

	Total regulated emissions (Tonnes CO2 / year)	CO2 savings (Tonnes CO2 / year)	Percentage savings (%)
Part L 2013 baseline	1,055		
Be lean	976	79	7%
Be clean	1,069	-93	-9%
Be green	1,031	38	4%
	-	**CO2 savings off-set (Tonnes CO2)**	-
Off-set	-	**27,873**	-

Building use	Energy demand following energy efficiency measures (MWh/year)						
	Space Heating	Hot Water	Lighting	Auxilary	Cooling	Unregulated electricity	Unregulated gas
Domestic	1313	1704	261	150	0	31.54428359	0
Non-domestic	96	58	352	25	254	234.27498	0

	Target Fabric Energy Efficiency (kWh/m²)	Dwelling Fabric Energy Efficiency (kWh/m²)	Improvement (%)
Development total	44.64	46.15	-3%

	Area weighted average non-domestic cooling demand (MJ/m^2)	Total area weighted non-domestic cooling demand (MJ/year)
Actual	45.144	917371.224
Notional	42.264	858846.744