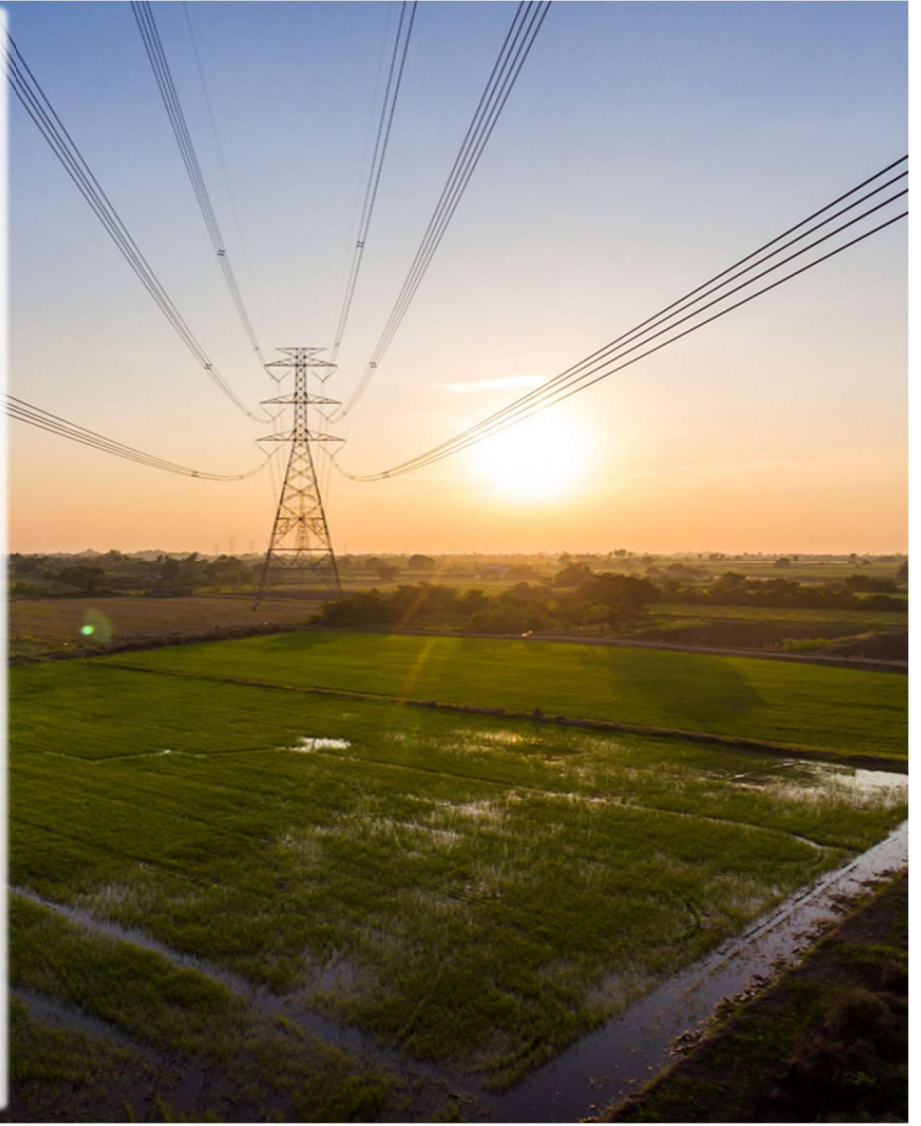


**707-725 Lordship Lane,
Wood Green, London**

TM54 Operational Energy Assessment

**Ensphere Group Ltd on behalf of
Atri7 2 Limited & Fusion Global Management LLP**



Ensphere Group Ltd
55A Catherine Place
London, SW1E 6DY
+44 (0) 20 7846 9040
www.enspheregroup.com



707-725 Lordship Lane, Wood Green, London

TM54 Operational Energy Assessment

Client Name: Atri7 2 Limited & Fusion Global Management LLP
Document Reference: 23-E033-019
Project Number: 23-E033

Quality Assurance Approval Status

This document has been prepared and checked in accordance with Ensphere Group Ltd's Quality Management System.

Issue:	Version:	Prepared by:	Reviewed by:	Date:
Final	V4	Aura Tache	Pete Jeavons	February 2024

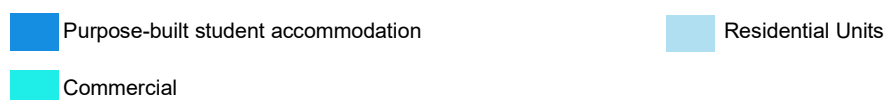
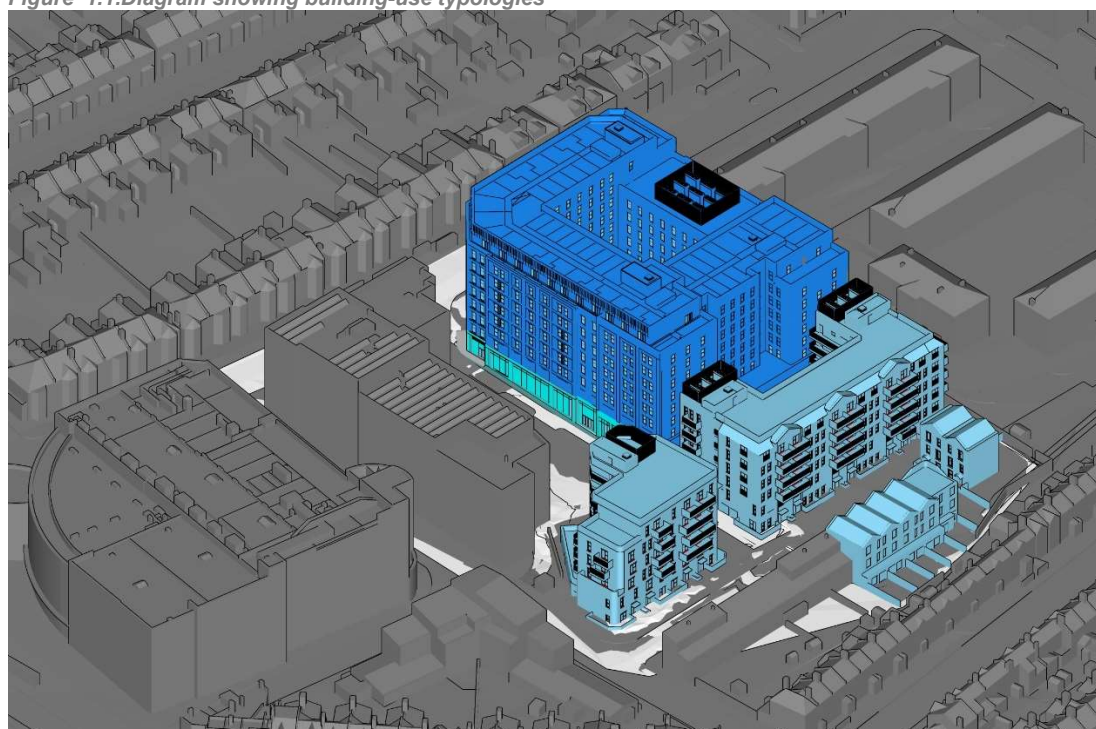
Contents

1.	Executive Summary.....	1
2.	Introduction.....	5
3.	Assessment Methodology	9
4.	Steps 0 – 1 Modelling approach & construction	11
5.	Step 2: Operating Hours & Occupancy.....	20
6.	Steps 3-9: Internal Gains and Associated Energy Uses	23
7.	Adding Internal Heat Gains to the Model.....	33
8.	HVAC Systems & Controls	34
9.	Management Considerations.....	42
10.	Results analysis.....	43
11.	Step 16: Quality assurance	63
12.	Step 17: Reporting & implementation matrix	64
13.	Summary	71
14.	Recommendations.....	74
	Appendices	76
	BREEAM Matrix	77
A.	Data Inputs	83
B.	Data Outputs	122
C.	General Note	128

1. Executive Summary

- 1.1 This assessment presents the anticipated operational energy performance for a proposed development at 707-725 Lordship Lane, Wood Green, London.
- 1.2 The proposed development will comprise a mixed-use scheme consisting of affordable homes, purpose-built student accommodation, and flexible ground floor commercial (Class E) floorspace within buildings ranging between 3 – 9 storeys, public realm and landscaping works, cycle parking, and associated works.

Figure 1.1. Diagram showing building-use typologies



- 1.3 Consideration has primarily been given to the planning policy context and other requirements prior to establishing a strategy based upon the energy hierarchy with a priority given to energy reduction and efficiency. Renewable and low carbon technologies have also been considered in the context of their technical feasibility and financial viability.
- 1.4 A BREEAM assessment will be undertaken for the PBSA, with local policy requiring non-residential to achieve a BREEAM “Very Good” rating and aspire to “Excellent”. It is understood that Atri7 2 Limited is considering voluntarily assessing the scheme against the Home Quality Mark (HQM) for the PRS units as a means of demonstrating its sustainability credentials.

- 1.5 This assessment outlines the design stage evaluation of anticipated operational energy performance of the new proposed scheme at Lordship Lane. It has been prepared based on the Concept and Early Design Stage architectural and M&E information.
- 1.6 The CIBSE Technical Memorandum 54 (TM54) methodology has been followed to provide an estimate of operational energy consumption that will help to identify and quantify the factors associated with operational energy use within the building. Where data was not available, reasonable assumptions have been made.
- 1.7 The energy modelling uses a dynamic simulation approach with advanced capabilities for HVAC system and controls with the ability to:
 - Calculate 8,760 hours of building operation to simulate annual energy use.
 - Model hourly variations in occupancy, lighting power, miscellaneous equipment power, thermostat set points, and HVAC system operation.
 - Model thermal mass effects, part load performance curves for mechanical equipment, capacity and efficiency correction curves for mechanical heating and cooling equipment and air side economisers with integrated control.
 - Be able to take account of lighting controls linked to lighting levels from daylight.
- 1.8 The model considers both regulated and unregulated energy consumption and generates scenarios around central prediction to explore how the building will perform under different operating conditions.
- 1.9 The proposed development comprises all-electric buildings with air-source heat pumps (ASHP) for space and hot water heating. The commercial areas on the ground floor from block A are cooled using a VRF system. Therefore, the following was proposed:
 - High-performance building fabric and energy-efficient lighting, services, and equipment.
 - Passive design measures to reduce energy demand for heating, cooling, ventilation, and lighting.
 - ASHPs for hot water and space heating
- 1.10 As part of the sensitivity analysis, various scenarios have been examined by altering the utilization of space (PBSA Amenity space utilized as a Library, Café, and Gym), considering different weather conditions (DSY1, DSY2, and DSY3 tests), and adjusting equipment loads and operational hours ("LOW," "MEDIUM," "HIGH") to reflect responsible to excessive energy consumption.

- 1.11 Overall, the analysis undertaken for Lordship Lane suggests that the proposed energy demand ranges from 2,861.2 MWh ("LOW") to 5,511 MWh ("HIGH") per year without accounting for the impact of PV panels implementation.
- 1.12 When incorporating PV panel integration into the simulation as per compliance requirements, the range for the development's energy demand is reduced to 1,906.2 to 4,556.1 MWh per year.
- 1.13 The photovoltaic (PV) electricity produced for the Lordship Lane development, in accordance with Part L compliance requirements, can range from approximately 955 to 997.2 MWh per year depending on the weather files applied within the simulation.
- 1.14 Table 1.1. provides a summary of the energy outputs for the scenario considered the most optimal assumption for the proposed design, incorporating sensible and realistic considerations for energy loads, commercial areas functionality, and normal weather conditions files.
- 1.15 When looking at the energy breakdown per end-user, the analysis indicates that the primary contributors to the building's operational energy consumption will be the equipment load, followed by space heating, internal light, external light, elevators, cooling load, and domestic hot water as illustrated in Figure 1.2 for the scenario identified as the most plausible.
- 1.16 Implementing the comfort cooling strategy under the base scenario and moderate weather conditions leads to an increase in annual energy consumption, measured in terms of delivered energy on a gross calorific value basis, from 89.7 KWh/m² per year to 94.1 KWh/m² per year. This uptick is primarily attributed to a roughly 60% increase in the energy allocated to space cooling.

Figure 1.2. Diagram - Energy consumption breakdown for Baseline Test (Lordship Lane development with PBSA Amenity as Gym under DSY1 weather conditions) – MVHR vs Comfort cooling

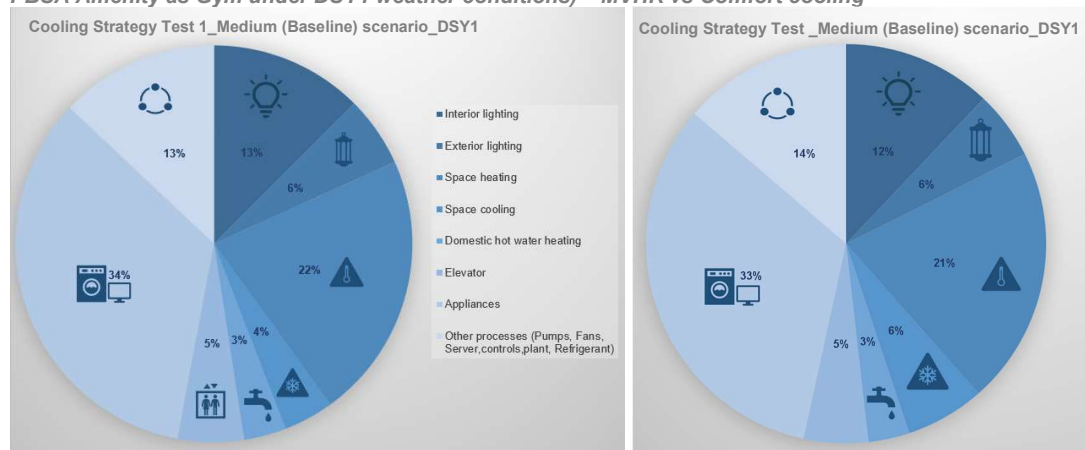


Table 1.1 Energy consumption breakdown for Baseline Test (Cooling Strategy Test 1 and Cooling Strategy Test 2)

		Cooling Strategy Test 1_Medium (Baseline) Scenario_DSY1	Cooling Strategy Test 2_Medium (Baseline) Scenario_DSY1	*Baseline scenario has the PBSA amenity space used as a Gym
	End use	MWh per year	MWh per year	Part L regulation
	Interior lighting	422.2	422.2	Regulated
	Exterior lighting	194.2	194.2	Unregulated
	Space heating	736.1	731.6	Regulated
	Space cooling	138.7	224.0	Regulated
	Domestic hot water heating	116.5	116.5	Regulated
	Cooking	0.0	0.0	Unregulated
	Elevator	182.4	182.4	Unregulated
	Interior central fans (Included in other processes)	n/a	n/a	Unregulated
	Interior local fans (Included in other processes)	76.1	76.1	Unregulated
	Pumps	Included in other processes	Included in other processes	Unregulated
	Appliances	1151.5	1151.5	Unregulated
	Other processes (Pumps, Fans, Server,controls,plant, Refrigerant)	438.5	480.3	Unregulated
	TOTAL electricity	3456.2	2514.3	Regulated+Unregulated
	Total energy	2501.2	3578.8	(Regulated+Unregulated)- PV generated electricity
	PV Generated electricity	955.0	2623.8	PV displaced electricity
	Room heating plant sensible load	2394.6	955.0	Heating Demands
	Room cooling sensible load	581.4	2248.3	Cooling Demands
	Electricity CE (kgCO2)	557721.0	1036.2	Energy Carbon emissions
	Grid displaced electricity PV CE (kgCO2)	12042.0	590130.0	Carbon emissions displaced by PV panels

2. Introduction

- 2.1 Ensphere Group Ltd was commissioned by Atri7 2 Limited & Fusion Global Management LLP to evaluate the anticipated operational energy for a proposed development at 707-725 Lordship Lane, Wood Green, London.

Site and Surroundings

- 2.2 The Site is located within the Wood Green Town Centre, approximately 150m east of Wood Green Station.
- 2.3 The Site is approximately 0.86 hectares (ha) in size and is currently occupied by a single storey building, in use by Mecca Bingo as a bingo hall. The remainder of the Site is occupied by surface level car parking. The site is bound by:
- Lordship Lane (A109) to the north of the site;
 - Sultan Terrace and Vincent Square to the east of the site;
 - Residential properties along Moselle Avenue to the south of the site; and
- Omnibus House and Redvers Road to the west of the site.
- 2.4 Within the surrounding context, Lordship Lane is characterised by a variety of two and three storey properties, to the east of the application site is bound by a housing estate with three storey blocks, the southern boundary is characterised by Wellesley Road with two and three storey town houses and the rear gardens of the properties along Moselle Avenue. The West of the application site is bound by Omnibus House, a seven to nine storey residential building.
- 2.5 The Site is not located within a Conservation Area, nor does it contain any listed buildings. The Noel Park Conservation Area is located immediately to the south of the site.

Figure 2.1. Site Plan (provided by Corstorphine & Wright)



Proposed Development

- 2.6 2.6 Demolition of the existing building and redevelopment to provide affordable homes, purpose-built student accommodation, and flexible ground floor commercial (Class E) floorspace within buildings ranging between 3 – 9 storeys, public realm and landscaping works, cycle parking, and associated works.

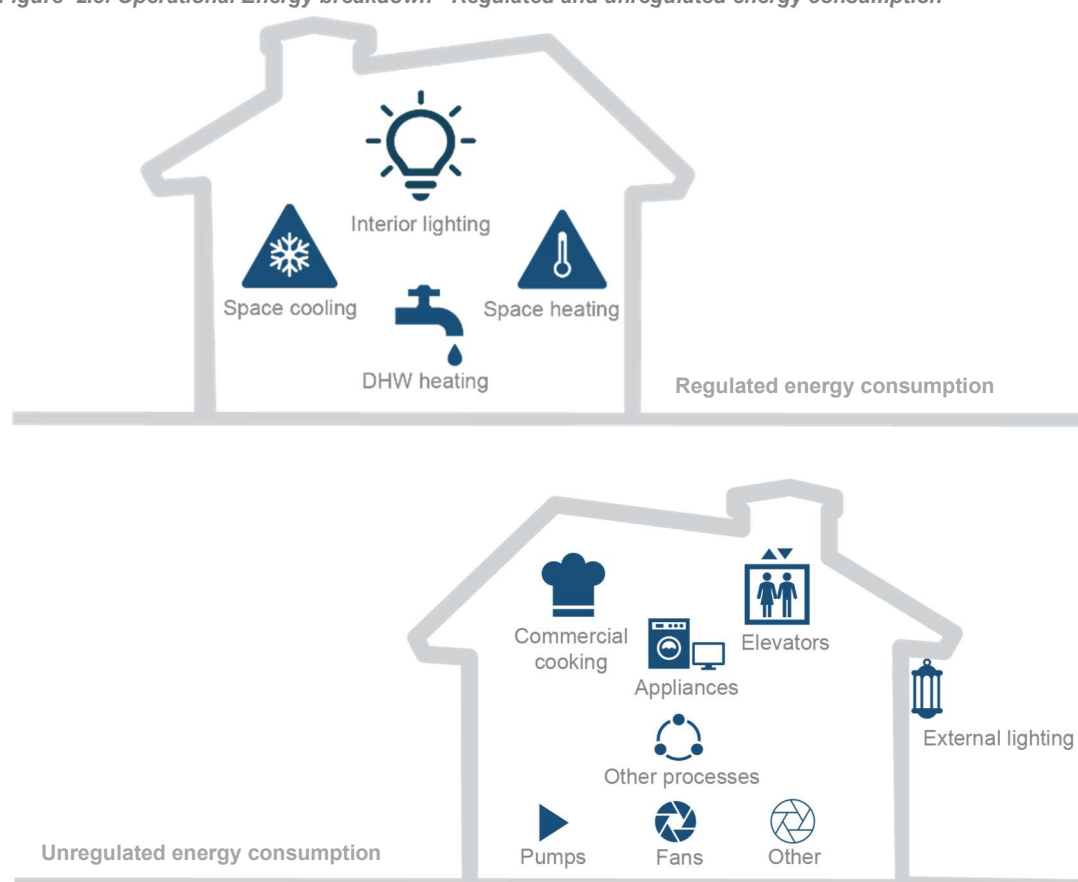
Figure 2.2. Axonometric View of the Development



Report Objective

- 2.7 The objective of this assessment is to demonstrate the operational energy use of the proposed development at Lordship Lane, Haringey.
- 2.8 One notable limitation in the existing Part L calculation methodology is its failure to account for unregulated energy loads. The proportion of unregulated energy, though varying significantly across different building types, can constitute as much as 50% of the overall operational energy. Disregarding unregulated energy at the regulatory level may result in significantly divergent consumption levels compared to those initially estimated during the design phase.
- 2.9 Operational energy consumption is categorised into two primary components. The first is 'Regulated' energy consumption, which arises from controlled and fixed building services like heating, cooling, hot water, ventilation, and lighting. The second is 'Unregulated' energy consumption, which is attributed to processes not subject to building regulations, including ICT equipment, lifts, refrigeration systems, cooking equipment, and other types of 'small power.'

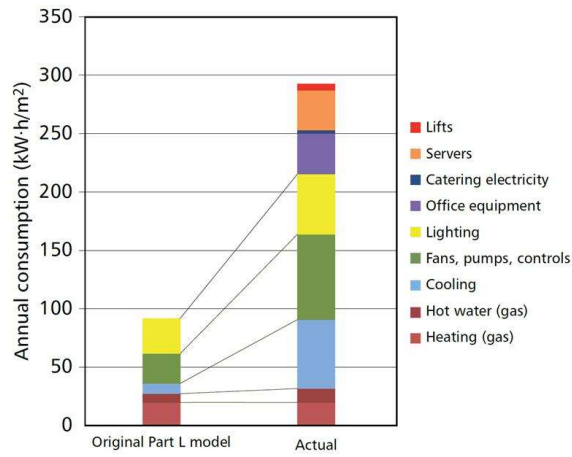
Figure 2.3. Operational Energy breakdown - Regulated and unregulated energy consumption



- 2.10 The TM54 analysis allows a realistic understanding of energy demand at design stage as set out by the CIBSE TM54 Technical Memorandum: Evaluating operational energy use at the

design stage (2022). This methodology will help bridge the performance gap between the regulated energy use from Part L compliance and actual operational energy use.

Figure 2.4. Comparison of Building Regulations Approved Document L2A (HM Government, 2010) calculations and monitored energy use after five years of operation, for an example building



3. Assessment Methodology

- 3.1 The assessment methodology is considerate of the requirements of BREEAM Ene01 and has sought to following the methodology outlined in CIBSE TM54:2022 *Evaluating Operational Energy Use at the Design Stage*.

BREEAM Ene01: Operational Energy Performance estimate

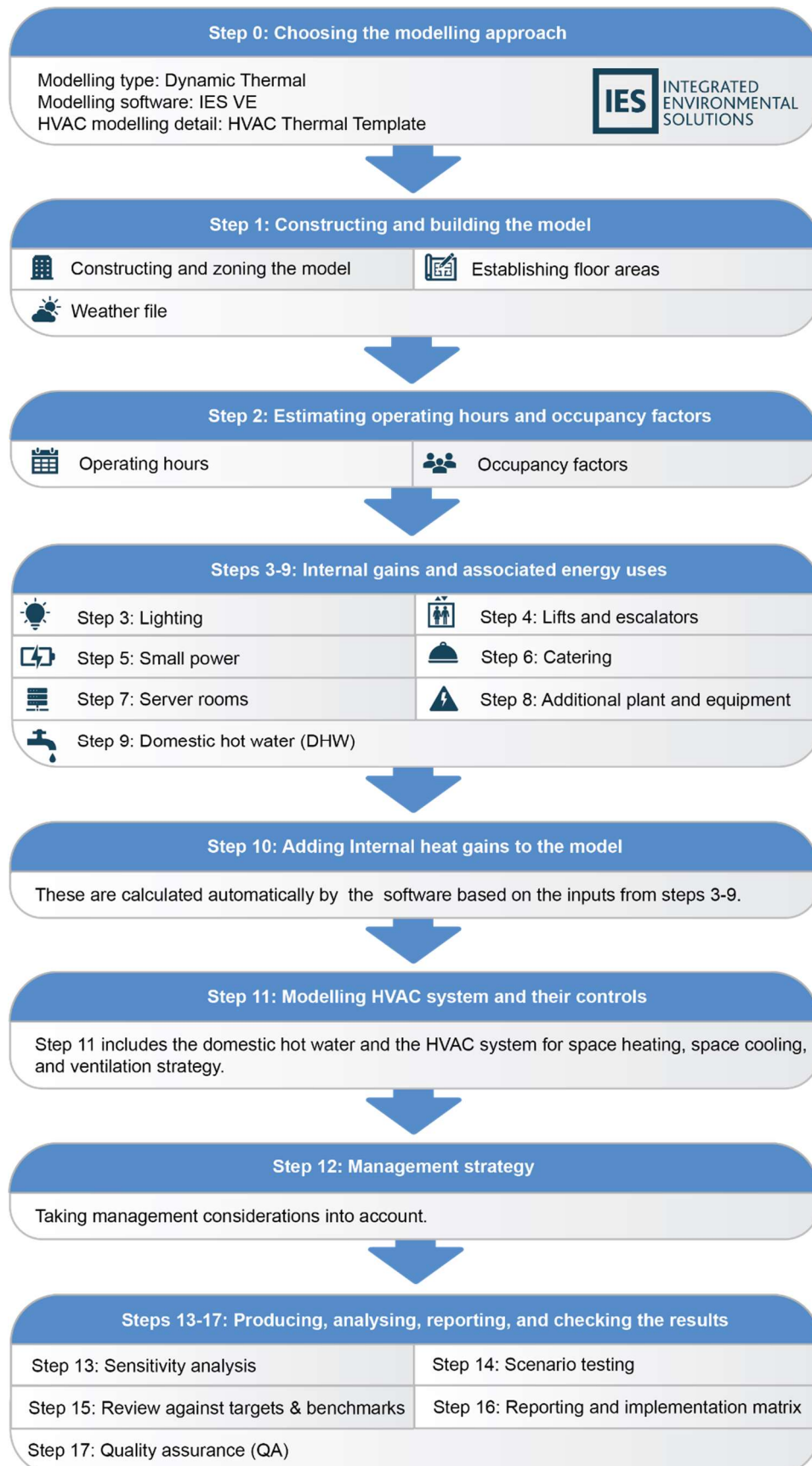
- 3.2 This section considers the requirements of BREEAM's Ene 01: *Reduction of energy use and Carbon Emissions*. Further detail is provided in Guidance note GN32: *BREEAM New Construction Guidance Note - Energy Prediction and Post Occupancy Assessment*.
- 3.3 The BREEAM criteria include reference to the following:
- Energy design workshop focusing on operational energy performance.
 - Undertake additional energy modelling during the design and post-construction stage to generate predicted operational energy consumption figures.
 - Report predicted energy consumption targets by end use, design assumptions and input data (with justifications).
 - Carry out a risk assessment to highlight any significant design, technical, and process risks that should be monitored and managed throughout the construction and commissioning process.

CIBSE TM54 Methodology: Evaluating operational energy use at the design stage (2022)

- 3.4 The CIBSE TM54:2022 modelling procedure consists of a 17-step methodology followed by a preliminary energy performance risk assessment. The energy performance study has been based on the latest architectural, mechanical, and electrical service design available to Ensphere Group Ltd at the time of writing.



Figure 3.1. Methodology for evaluating operational energy use at the design stage based in the CIBSE TM 54 2022 Methodology



4. Steps 0 – 1 Modelling approach & construction

Figure 4.1. 3D view of the energy model IES VE (1)



Step 0: Choosing the Modelling Approach

- 4.1 At the start of a project, it is important to give careful thought to the energy modelling tools chosen for a project as these can serve the lifespan of the project and it can be inconvenient and/or costly to change tools mid-way.
- 4.2 Dynamic Simulation Models (DSMs) provide a better estimate of energy use compared to steady state calculations as they consider more of the complexities of the variation in energy use across time, and interactions between different parts of a building system (i.e. its dynamic nature). DSM tools are designed to simulate the dynamic relationship between the building form, fabric, external weather, occupants, usage patterns and HVAC plant, lighting, and its controls. They require significant input data and experienced and knowledgeable users but provide detailed outputs and insights into building performance.
- 4.3 The software used for the Lordship Lane development TM54 assessment is IESVE 2023. This is a DSM tool with a high level of functionality, enabling control over a significant range of modelling variables.
- 4.4 The HVAC modelling detail level uses the Apache Template approach suitable for the early-stage design of the project (RIBA stages 2 to 3). The modelling strategy has been limited by the availability of detailed information of the HVAC system specifications and manufacturers at the time of this report.

Step 1: Constructing and Building the Model

Constructing and Zoning the Model: Geometry

- 4.5 Generating the model geometry is one of the first steps in undertaking building modelling and forms the basis from which all future calculations are undertaken. Its accuracy and quality determine the future model outputs.
- 4.6 The location is set to Central London within the software. The orientation from true north of the development is set in the IES VE model to 27° based on the DWG site drawings provided by Corstorphine and Wright architects.
- 4.7 The model construction is based on the following architectural design drawings in (PDF, DWG/DXF formats) as well as the SketchUp 3D model:

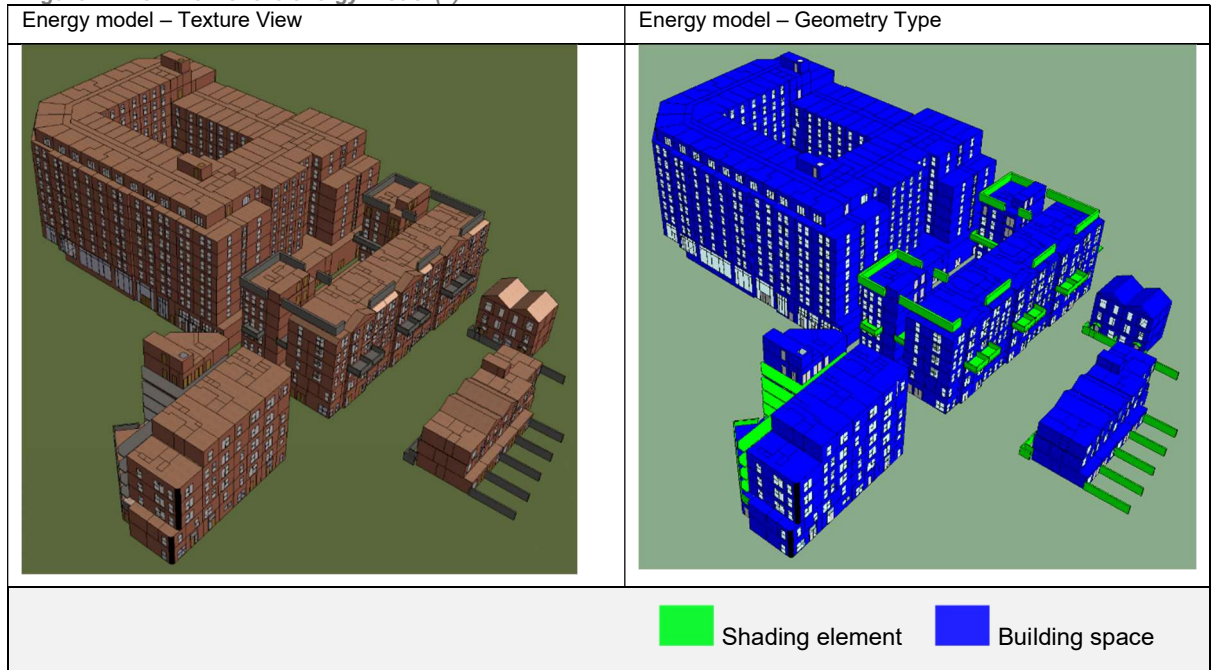
Table 4.1 Table of architectural drawings considered for building geometries

Building Unit	Drawing	Revision	Date
Block A	21820-0150-04 Block A-Proposed Level 00	Rev 04	23/11/2023
	21820-0151-04 Block A-Proposed Mezzanine Level	Rev 04	23/11/2023
	21820-0152-04 Block A-Proposed Level 01	Rev 04	23/11/2023
	21820-0153-04 Block A-Proposed Level 02	Rev 04	23/11/2023
	21820-0154-04 Block A-Proposed Level 03	Rev 04	23/11/2023
	21820-0155-04 Block A-Proposed Level 04	Rev 04	23/11/2023
	21820-0156-04 Block A-Proposed Level 05	Rev 04	23/11/2023
	21820-0157-04 Block A-Proposed Level 06	Rev 04	23/11/2023
	21820-0158-04 Block A-Proposed Level 07	Rev 04	23/11/2023
	21820-0159-04 Block A-Proposed Level 08	Rev 04	23/11/2023
	21820-0160-04 Block A-Proposed Level 09	Rev 04	23/11/2023
	21820-0165-03 Block A Proposed North Elevation	Rev 03	23/11/2023
	21820-0166-03 Block A Proposed South Elevation	Rev 03	23/11/2023
	21820-0167-03 Block A Proposed East Elevation	Rev 03	23/11/2023
	21820-0168-03 Block A Proposed West Elevation	Rev 03	23/11/2023
Block B	21820-0170-03-Block B-Proposed Level 00	Rev 03	23/11/2023
	21820-0171-03-Block B-Proposed Level 01	Rev 03	23/11/2023
	21820-0172-03-Block B-Proposed Level 02	Rev 03	23/11/2023
	21820-0173-03-Block B-Proposed Level 03	Rev 03	23/11/2023
	21820-0174-03-Block B-Proposed Level 04	Rev 03	23/11/2023
	21820-0175-03-Block B-Proposed Level 05	Rev 03	23/11/2023
	21820-0176-03-Block B-Proposed Level 06	Rev 03	23/11/2023
	21820-0212-01-Block B Proposed North Elevation	Rev 01	23/11/2023
	21820-0213-01-Block B Proposed South Elevation	Rev 01	23/11/2023
	21820-0214-01-Block B Proposed East Elevation	Rev 01	23/11/2023
	21820-0215-01-Block B Proposed West Elevation	Rev 01	23/11/2023
Block C	21820-0180-03-Block C-Proposed Level 00	Rev 03	23/11/2023
	21820-0181-03-Block C-Proposed Level 01	Rev 03	23/11/2023
	21820-0182-03-Block C-Proposed Level 02	Rev 03	23/11/2023

	21820-0183-03-Block C-Proposed Level 03	Rev 03	23/11/2023
	21820-0184-03-Block C-Proposed Level 04	Rev 03	23/11/2023
	21820-0185-03-Block C-Proposed Level 05	Rev 03	23/11/2023
	21820-0186-03-Block C-Proposed Level 06	Rev 03	23/11/2023
	21820-0216-01-Block C Proposed North Elevation	Rev 01	23/11/2023
	21820-0217-01-Block C Proposed South Elevation	Rev 01	23/11/2023
	21820-0218-01-Block C Proposed East Elevation	Rev 01	23/11/2023
	21820-0219-01-Block C Proposed West Elevation	Rev 01	23/11/2023
Block D	21820-0190-02 Block D-Proposed Level 00	Rev 02	23/11/2023
	21820-0191-02 Block D-Proposed Level 01	Rev 02	23/11/2023
	21820-0192-02 Block D-Proposed Level 02	Rev 02	23/11/2023
	21820-0193-02 Block D-Proposed Level 03	Rev 02	23/11/2023
	21820-0254-01 Proposed North and South Elevations	Rev 01	23/11/2023
	21820-0255-01 Proposed East and West Elevations 01	Rev 01	23/11/2023
	21820-0256-01 Proposed East and West Elevations 02	Rev 01	23/11/2023

- 4.8 Following the modelling of the building geometry using the drawings outlined above, the architect issued updated proposed building drawings with minor amendments to the building layout which do not bring any significant impacts to the current TM54 assessment.
- 4.9 The volumes have been defined based on the lines from the inside of external walls and in the centre of partitions between conditioned spaces as per the NCM Guide methodology.
- 4.10 The windows and fixed glazed panels have been modelled as per the positioning of the 3D SketchUp model provided by Corstorphine & Wright architects.
- 4.11 The project geometry contains a high level of detail including any building elements that could have an impact on the solar gains and act as shading devices. Thus, the architectural elements such as balconies, brickwork fences, parapets, and terraces were included in the model.

Figure 4.2. 3D view of the energy model (2)



Constructing and Zoning the Model: Fabric

- 4.12 Construction details were specified by the Corstorphine & Wright architects while the fabric thermal performance requirements were provided by Amber Management & Engineering Services Ltd as follows:

Table 4.2. Table showing the Proposed Building Fabric U-Values (Non-Domestic) - Purpose-Built Student Accommodation (PBSA) Block A

Fabric Element	Part L2 (W/m2K)	Proposed (W/m2K)	Thermal mass
Floor	0.18	0.12	Very lightweight
External Wall	0.26	0.14	Mediumweight
Flat Roof	0.18	0.10	Very lightweight
Pitched Roof	0.16	0.10	Very lightweight
Windows	1.6 (including frame)	1.20 (double glazed g-value 0.35)	n/a
Doors	1.6	1.2	n/a
Air permeability	8.0m3/(h·m2) @50Pa	2.0m3/(h·m2) @50Pa (0.1 ACH @50 Pa)	n/a

* Tables A.2. and A.3. from Appendix A provide the full construction details and thermal properties proposed based on the information provided by Corstorphine & Wright architects and Amber Management & Engineering Services Ltd consultants at the time of writing the report. A few assumptions have been made for the building elements and thermal mass based on the "Lordship Lane, Wood Green Stage 2 Cost Plan Revision No. 1" provided by Gardiner & Theobald.

Table 4.3 Table showing the Proposed Building Fabric U-Values (Domestic) – Blocks B, C, and D

Fabric Element	Part L2 (W/m2K)	Proposed (W/m2K)	Thermal mass
Floor	0.18	0.12	Very lightweight
External Wall	0.26	0.15	Mediumweight
Party Wall (Block D)	0.2	0.15	Lightweight
Flat Roof	0.16	0.10	Very lightweight
Pitched Roof	0.16	0.10	Very lightweight
Windows	1.6 (including frame)	1.20 (double glazed with g-value 0.35)	n/a
Doors	1.6	1.2	n/a
Air permeability	8.0m3/(h·m2) @50Pa	2.0m3/(h·m2) @50Pa (0.1 ACH @50 Pa)	n/a

*Tables A.2. and A.4. from Appendix A provide the full construction details and thermal properties proposed based on the information provided by Corstorphine & Wright architects and Amber Management & Engineering Services Ltd consultants at the time of the current report. A few assumptions have been made for the building elements and thermal mass based on the "Lordship Lane, Wood Green Stage 2 Cost Plan Revision No. 1" provided by Gardiner & Theobald.

4.13 The construction of the building elements was defined as per the actual proposed fabric at the time of writing the report in line with the compliance U-values. Table A.2. from Appendix A shows visuals for the details proposed by the architects.

4.14 The air permeability has been input in IES VE as infiltration rate (ACH @50Pa) under the air exchange section.

Zoning and establishing floor areas

4.15 Zoning aligns to a series of considerations and grouping systems: building unit, building-use typology, construction, activity type, HVAC systems. The zoning approach is summarised in table below. The full details and associated surface areas are enclosed in Table A.5. Zoning area strategy under Appendix A.

Table 4.4. Table summarising the Model Zoning strategy.

Building Unit	Building Typology	Floor levels	Construction Type	Activity Type	Thermal strategy
Block A	Non-domestic Area (Commercial – Block A Ground floor)	00	Block A – Ground Floor		
				A-non-Resi	A-non-Resi
				A-PBSA Amenity	A_PBSA Amenity
				A-Circulation Areas	Commercial Circulation Areas
				A-PBSA Plant	A_PBSA Plant
				A-Refuse	Refuse
				A-Commercial Storage	A-Commercial Storage
				A-Riser	A_Riser
				A-Commercial Plant	A_Commercial Plant

	Purpose-built student accommodation	01	Block A – 01-07	A-Corridor/Stairs (Circulation)	Corridor/Stairs (Circulation)
		..		A-Studio	Studio
		...			Studio MVHR only LL façade
				A-Ensuite	Ensuite
		09	Block A – 07-09	A-Kitchen/Living	Kitchen/Living
					Kitchen/Living MVHR only LL façade
				A-Lift	Lift
				A-Storage	Storage
				A-Cycle storage (Unheated Storage)	Cycle storage (Unheated Storage)
				A-PBSA Storage	A-PBSA Storage
				A-PBSA-Plant	A-PBSA-Plant
Block B	Residential Area	00	Blocks B, C, and D – Ground Floor	Resi_1B2P_Kitchen/ Living	Resi_1B2P_Kitchen/ Living
		...		Resi_CBD	Resi_CBD
				Resi_Services	Resi_Services
			Blocks B, C, and D – 01- Below top level	Resi_Internal corridors	Resi_Internal corridors
				Resi_2B4P_Kitchen/ Living	Resi_2B4P_Kitchen/ Living
		06		Resi_2B3P_Kitchen/Living	Resi_2B3P_Kitchen/Living
Block C		00	Blocks B, C, and D – Top level	Resi_Appliances	Resi_Appliances
				Resi_3B5P_Living/ Kitchen	Resi_3B5P_Living/ Kitchen
				Resi_5B8P_Kitchen	Resi_5B8P_Kitchen
				Resi_5B8P_Living	Resi_5B8P_Living
		06		Resi_Lift	Resi_Lift
Block D		00		Resi_Riser	Resi_Riser
		...		Resi_Roof	Resi_Roof
		02		Resi_Circulation common	Resi_Circulation common
				Resi_Storage	Resi_Storage
				Resi_Plant	Resi_Plant
				Resi_Double Bedroom	Resi_Double Bedroom
				Resi_Single Bedroom	Resi_Single Bedroom
				Resi_Bathroom	Resi_Bathroom

- 4.16 The modelled floor areas align with the scaled drawings provided by the architect and considers the Gross Internal Area (GIA) (i.e., total building area measured inside external walls).
- 4.17 There are differences, however, when creating energy models using IESVE whereby internal walls are generally represented as a two-dimensional plane. This has implications for the reported floor area, which therefore excludes the wall thicknesses of the internal walls.

4.18 Hence, the modelled area is presented as circa 27,875.4 sqm.

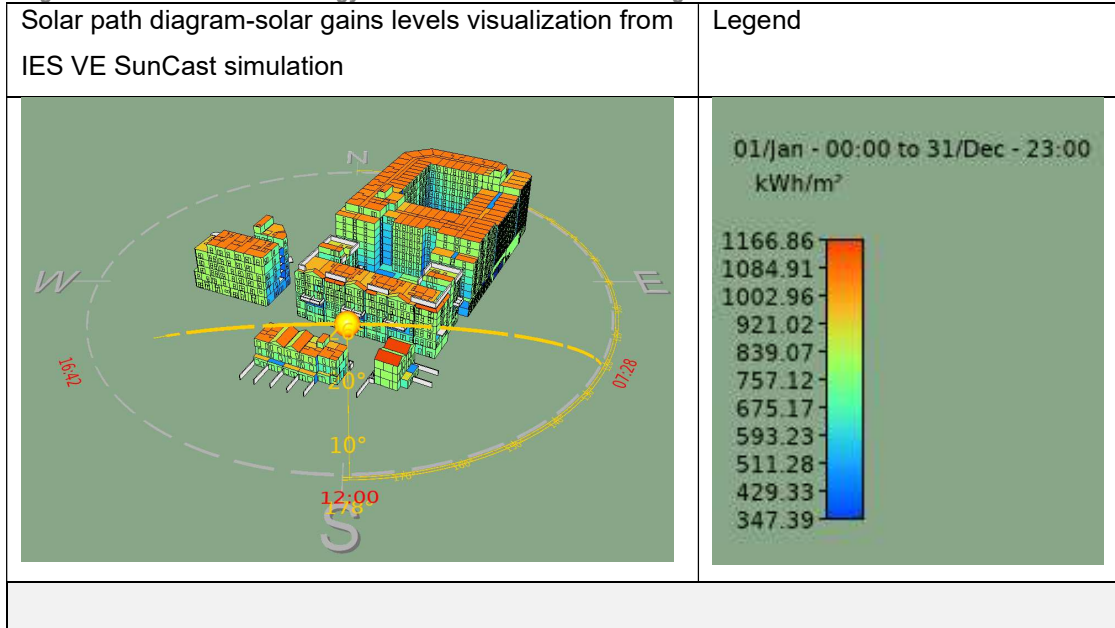
Table 4.5. Table of Floor Areas for Building Uses

Building Typology	Room type	Room Type GIA (gross internal area) (m ²)
Block A-Purpose-built student accommodation	A-Corridor/Stairs (Circulation)	3132.1
	A-Studio	11929.5
	A-Ensuite	923.6
	A-Kitchen/Living	630.8
	A-Lift	279.7
	A-Storage	63.3
	A-Cycle storage (Unheated Storage)	382.7
	A-PBSA Storage	51.2
	A-PBSA-Plant	161.1
Block A-Commercial	A-non-Resi	673.3
	A-PBSA Amenity	1094.7
	A-Circulation Areas	178.6
	A-PBSA Plant	161.1
	A-Refuse	82.6
	A-Commercial Storage	6.0
	A-Riser	275.9
	A-Commercial Plant	204.5
Block B, C, and D	Resi_1B2P_Kitchen/ Living	743.9
	Resi_CBD	216.1
	Resi_Services	29.4
	Resi_Internal corridors	691.9
	Resi_2B4P_Kitchen/ Living	873.9
	Resi_2B3P_Kitchen/Living	283.6
	Resi_Appliances	94.2
	Resi_3B5P_Living/ Kitchen	186.7
	Resi_5B8P_Kitchen	48.1
	Resi_5B8P_Living	175.3
	Resi_Lift	105.0
	Resi_Riser	92.2
	Resi_Roof	218.4
	Resi_Circulation common	595.0
	Resi_Storage	367.5
	Resi_Plant	434.5
	Resi_Double Bedroom	1799.7
	Resi_Single Bedroom	403.5
	Resi_Bathroom	510.0
TOTAL GIA for Lordship Lane Development		27,875.4

Weather Data

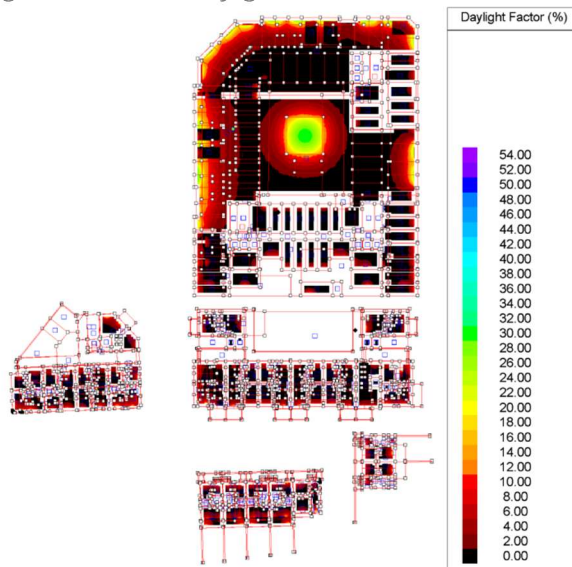
- 4.19 All models use the weather data suitable for the project's location as a reference for the external ambient conditions the building will experience.
- 4.20 Weather files include information on external air temperature, relative humidity, solar radiation, wind speed and direction and cloud cover. In the UK, the CIBSE offers a wide range of weather resources for 14 locations, which include:
- Design Summer Years (DSY1, DSY2, DSY3) that represent different types of hot summer weather and are intended for overheating risk assessments.
 - Future weather based on UKCP09 with projections based on several emission scenarios for 2020 (current) and 2050.
- 4.21 The HVAC design and cooling strategies have been proposed in line with the results of a simulation-based overheating analysis (TM59 Overheating Assessment) carried out by Amber Management & Engineering Services Ltd. As the overheating risk assessment plays a significant role in the design proposal application, further dynamic simulations are subject to using the more intense London summers specific to the urban environment (CIBSE TM49, 2014).
- 4.22 Therefore, the model uses the CIBSE weather files for London Weather Centre assuming more intense summers specific to the central urban London.
- 4.23 The weather files used in the model consider several summer-scenarios:
- London_LWC_DSY1 (Current Scenario)– a year with a moderately warm summer
 - London_LWC_DSY2_2020High50 (Current Intense Scenario)– a year with a very intense single warm spell
 - London_LWC_DSY3_2050High90 (Future Scenario)– a year with a prolonged period of sustained warmth.
- 4.24 The weather files DSY2 and DSY3 are tested for the purposes of assessing more extreme scenarios under Step 13: Sensitivity Analysis section of this report.
- 4.25 Different weather file scenarios have an impact indirectly on the heating and cooling demands of the buildings based on the solar gains levels variations.
- 4.26 The solar gains are calculated within the software through the SunCast tool which considers a full solar shading analysis. The solar shading calculations are a pre-processing simulation ran for every weather file adjustment, geometry, shading device update, and natural ventilation profile defined in the MacroFlo tool.

Figure 4.3. 3D view of IES energy model – SunCast solar shading calculations



- 4.27 The daylight factors are simulated within FlucsDL tool which allows the visualisation of the solar gains through the glazing and the daylight factors.

Figure 4.4. FlucsDL Daylight factor visualisation



5. Step 2: Operating Hours & Occupancy

Estimating Operating Hours and Occupancy Factors

- 5.1 The operating hours for the Baseline simulation have been designed based on a combination of NCM predefined profiles as well as CIBSE TM59, CIBSE Part A and BRE estimates.

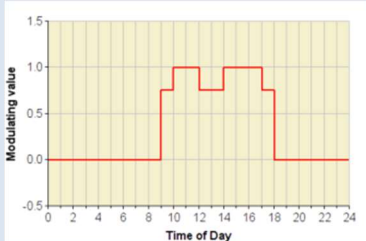
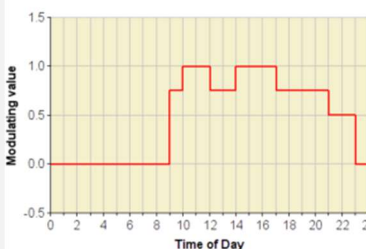
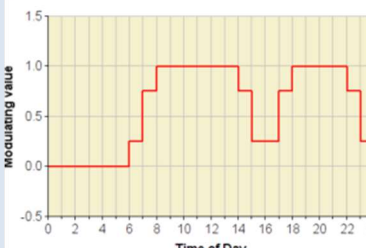
Figure 5.1. CIBSE Reference guides used

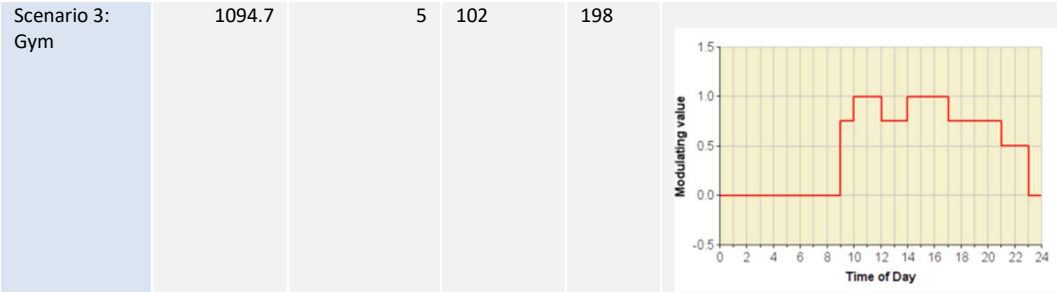


- 5.2 The occupancy profiles and the equipment load for the residential areas and the student bedrooms have been established based on “*Table 2 Occupancy and equipment gain description*” of CIBSE: TM59 Design methodology for the assessment of overheating risk of homes (CIBSE, 2017) (see reference in Appendix A: Table A.7.).
- 5.3 The occupancy for the communal areas/ shared living and kitchen areas for the Purpose-built student accommodation block as well as the commercial zones are defined based on Table D1 Floor space factors of *Approved Document B: Fire safety* (GOV.UK, 2019) to ensure a safe occupancy factor figure. The reference table is enclosed in Appendix B: Table A.6.
- 5.4 The residential have a standard occupancy and equipment use profiles based on the CIBSE TM59 assumptions, while the commercial/non-domestic areas allow room for more variations.
- 5.5 Bedrooms are set with a 24-hour occupancy profile, which means that one person is always considered in each bedroom during the daytime, and two people in each double bedroom at night:
- For the 2-bedroom flat, one person is considered during the daytime in both the bedrooms in order to assess robustly. This means that one excess person (a visitor) to the assumed total number of occupants will be considered in the flat during the daily hours.
 - For the Kitchens/living, rooms are unoccupied during the sleeping hours and occupied during the rest of the day.
 - Bathrooms and corridors are set as unoccupied most of the day.

- 5.6 Where occupancy is intermittent, diversity factors are applied to approximate the average. Occupants' location within a building vary throughout the day and this distribution is valuable information when evaluating energy demand. Diversity factor is a number between zero and one that is used to multiply the peak value which is the actual peak occupancy at a given time.
- 5.7 The full details of the occupancy profiles and operating hours for the domestic and non-domestic spaces input in the IES VE simulation are enclosed in Appendix A- Table A.8 and Table A.9. The tables summarise a series of parameters for the maximum sensible gain (W/P) and Maximum latent gain (W/P), the number of people using the space (applied for the residential spaces) and the occupancy density (for the non-domestic zones) as well as the occupancy schedules.
- 5.8 At this design stage the commercial areas from Block A have not been assigned a specific use. This provides an opportunity to explore a series of activity scenarios for the non-residential spaces and their impact on the Lordship Lane development operational energy. Three possible scenarios for the PBSA Amenity space functionality have been simulated as follows and reviewed as part of the Sensitivity analysis step 13 of the TM54 Methodology.

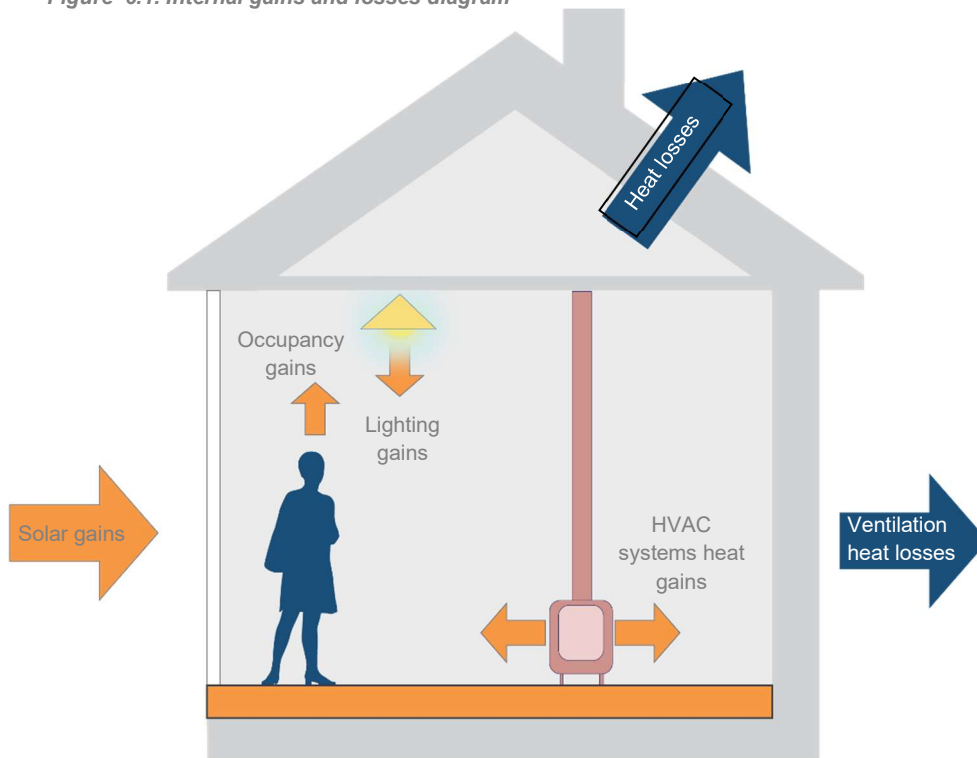
Table 5.1 Operating Hours and Occupancy Patterns for Block A commercial and PBSA Amenity spaces

Room Type Scenarios	GIA (gross internal area) (m2)	Floor space factor (m2/person)	Max. Sensible gain (W/P)	Max. Latent Gain (W/P)	Occupancy Profile
Scenario 1,2,3: Shop (food store)	673.3	8	70	60	
Scenario 1: Study Area (Occupied between 8am and 22:00)	1094.7	5	73.2	46.8	All week: 
Scenario 2: Café	1094.7	9	63	117	



6. Steps 3-9: Internal Gains and Associated Energy Uses

Figure 6.1. Internal gains and losses diagram



- 6.1 The internal gains from the equipment and processes in the building are included in the Dynamic Simulation Model (DSM) when calculating the energy use associated with heating, cooling, and distribution systems.
- 6.2 The profiles have been set up to suit building operating hours as defined previously in Chapter 5.
- 6.3 Generally, the following strategies are used throughout the development:
 - Lighting profile – turned on during occupied hours with various profiles:
 - On between 18:00-24:00
 - Linked to occupancy profile
 - Continuous use with dimming sensors (storage areas/corridors)
 - Occupancy profile – for the residential areas typical NCM occupancy profiles/ TM59 profiles; for the commercial area of block A turned on during building occupied hours with smaller occupancy during holiday and weekend time hours.
 - Small power profile - turned on during space occupied hours.

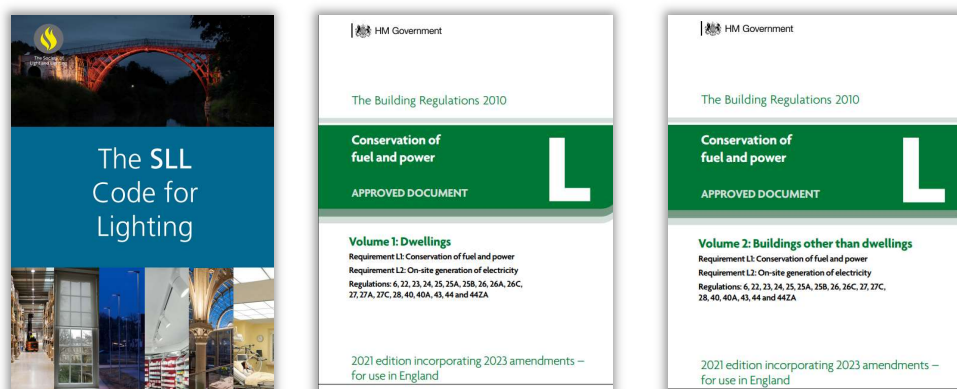
- 6.4 The small power energy usage was estimated based on the equipment used in each of the occupied areas based on the activity type. The approach has been taken for every significant source of internal gain in the building.

Step 3: Evaluating Lighting Energy Use

Interior lighting

- 6.5 The lighting information in this model is taken from the Society of Light and Lighting (SLL) Handbook. Standard LED lighting has been selected with an efficacy of 120lumens/ Watts.
- 6.6 The lighting operation hours are defined based on the occupancy profiles for each room type. The illuminance requirement for each space type is input as per section's 2 tables of The SLL Code for Lighting (CIBSE, 2012).

Figure 6.2. Reference document used in this section



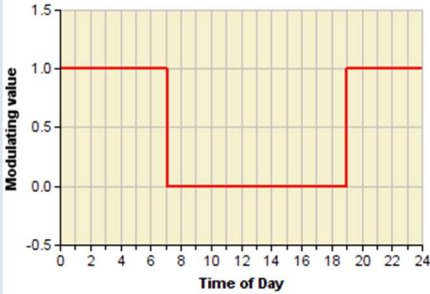
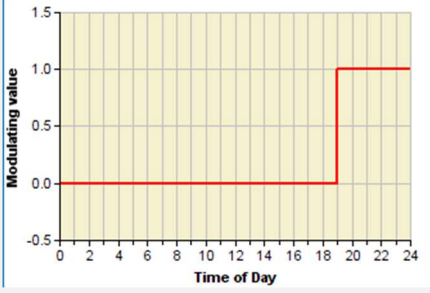
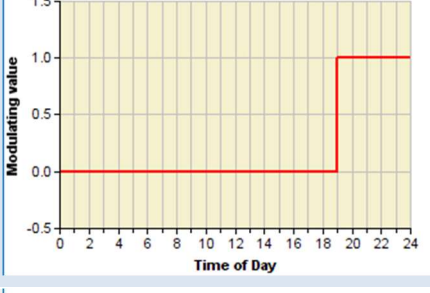
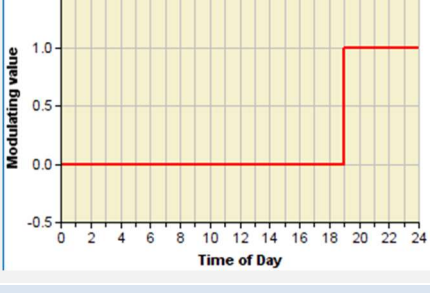
- 6.7 Lighting follows the Approved Document L: Conservation of Fuel and power Volume 1, Volume 2, as well as the operating hours based on the NCM profiles.
- 6.8 The interior lighting is set to achieve lighting levels appropriate to the activity in the space with luminous efficacy of 120 light source lumens per circuit-watt.
- 6.9 *Table A.10. Lighting profile per room activity in relationship with the Occupancy schedules* from Appendix A lists all the parameters input in the model per each space typology. The data shows values for the lighting profiles, power, and illumination requirements per each room based on the activity.
- 6.10 The lighting energy consumption and associated heat gains are automatically calculated by the software.

Other Lighting

- 6.11 The exterior lighting incorporated into this model is presumed to operate continuously from 19:00 to 07:00 for Block A and from 19:00 to 24:00 for the residential flats.

- 6.12 The external light is set in line with the recommended illuminance for each entrance providing 50lux as per the guideline set in the “*Lighting Guide 9:Lighting for communal residential buildings*” (SLL, 2013, p. 20) and in “*Table 3.5 General circulation areas*” from the SLL Code for Lighting (CIBSE, 2012).
- 6.13 The model assumes LED lamps per each main entrance with an illuminance of 50 lux and terrace entrances maximum power consumption of 0.38 KW. This totals of 210 LED lamps for the entire development.

Table 6.1 Table External Lighting operation profile

Block Unit	LED lamp no.	External Light operational profile
Block A	21 Ground floor entrances +3x9 terrace doors +2roof exits Total of 50LED lamps	
Block B	7 Ground floor entrances, 10 for communal courtyard, 5x9 for terrace corridors, 1 for roof exit. Total of 63LED lamps	
Block C	20 for ground floor entrances 13 for communal courtyard, 4x12 for terrace entrances, 2 for roof exits Total of 83LED lamps	
Block D	14 for ground floor entrances	
Total estimation (LED units)	210	

Step 4: Evaluating Energy Use for Lifts and Escalators

Lifts

- 6.14 Estimates of energy consumption of lifts and escalators are based on the following key reference documents:
- BS EN ISO 25745-1:2012: *Energy performance of lifts, escalators and moving walks. Energy measurement and verification*
 - BS EN ISO 25745-2:2015: *Energy performance of lifts, escalators and moving walks. Energy calculation and classification for lifts (elevators)*
 - BS EN ISO 25745-3:2015: *Energy performance of lifts, escalators and moving walks. Energy calculation and classification of escalators and moving walks.*
- 6.15 These standards (as ISO 25745 Parts 1, 2 and 3) are applied worldwide and are used to determine BREEAM credits as well.

Table 6.2 Categorized number of trips per day, n_d

	Usage Category				
	1	2	3	4	5
Usage intensity	Very low	Low	Medium	High	Very High
Number of trips per day (n_d)	50	125	300	750	1500
Typical range	<75	75<200	200<500	500<1000	1000<2000

- 6.16 The running energy consumption (E_{rc}) is the energy consumed to perform the ISO reference cycle. The running energy is measured (using the procedure given in ISO 25745-1) for an empty car travelling the distance between the terminal landings.
- 6.17 The running energy measurement is made between terminal landings. The distance actually travelled for an average trip (s_{av}) is less than the distance between the terminal landings. To correct for this the average distance (s_{av}) can be expressed as a ratio (k_{av}) of the terminal travel distance (s_{rc}). Values are given in Table 6.3.

Table 6.3 Average travel distance ratio (k_{av})

Number of stops	Percentage average travel distance for stated usage category		
	1 – 3	4	5
2	-	1.00	-
3	-	0.67	-

>3	0.49	0.44	0.39
----	------	------	------

Table 6.4. Average car load factor (kL)

	Carload factor for stated usage category					
	1 – 3		4		5	
	Electric	Hydraulic	Electric	Hydraulic	Electric	Hydraulic
≤ 800	0.88	1.05	0.85	1.06	0.79	1.09
801 to ≤ 1275	0.93	1.03	0.90	1.04	0.87	1.06
1276 to ≤ 2000	0.95	1.02	0.94	1.02	0.92	1.04
>2000	0.97	1.01	0.96	1.02	0.95	1.02

- 6.18 ISO 25745-2 provides the energy performance classification for a single lift without the influence of traffic control. The estimated daily energy consumption (E_d) of a lift is the sum of the running consumption (E_{rd}) and the standing (idle/standby) consumption (E_{sd}):

$$E_d = E_{rd} + E_{sd}$$

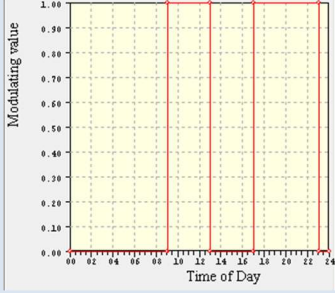
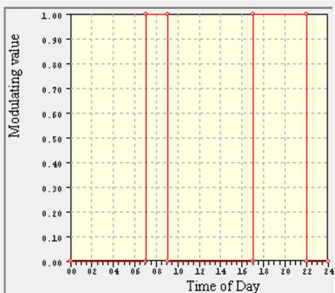
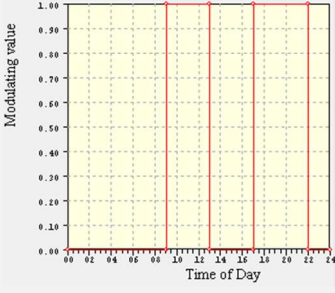
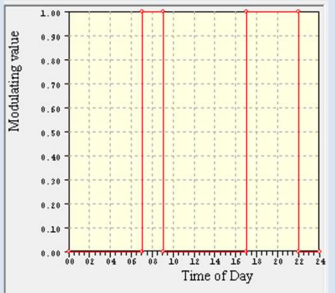
- 6.19 The daily running consumption (E_{rd}) is dependent on the energy used for an average trip that the lift makes multiplied by the number of trips in a day (n_d). The daily running consumption (E_{rd}) in watt-hours (W·h) is given by:

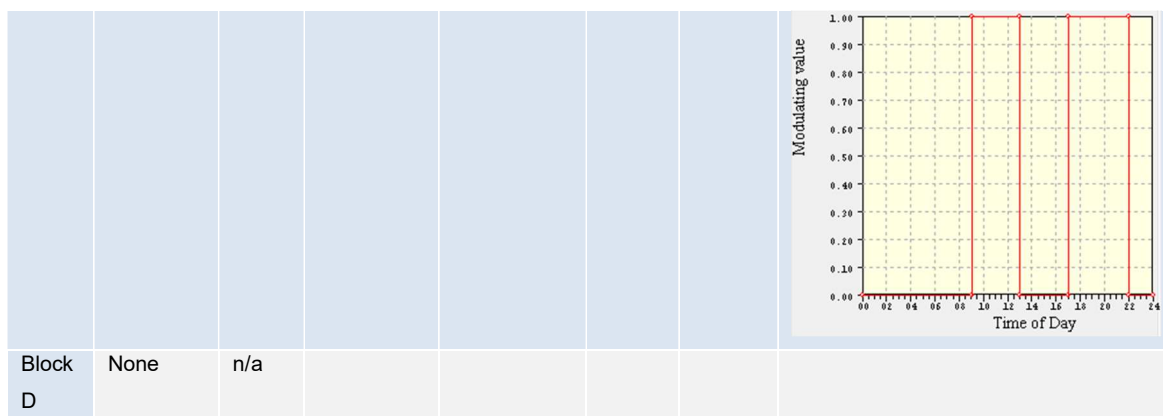
$$E_{rd} = \frac{n_d \times E_{rc} \times k_{av} \times k_L}{2}$$

where n_d is the number of trips in a day, E_{rc} is the measured or estimated running energy consumption of the ISO reference cycle (two trips) (W·h), k_{av} is the average travel distance ratio (see Table 6.4 above) and k_L is a load factor (see Table 6.5 above).

- 6.20 The number of trips per day (n_d) for a specific installation can, according to usage, be taken from Table 6.2. Usage categories are given in Table 6.3.
- 6.21 For the Lordship Lane development, there is assumed that the peak hours for the lift use are from 7AM to 9AM and 5PM to 7PM during workdays with extended usage during the weekend and holidays (see profiles defined in Table 6.5).
- 6.22 Based on the practice of previous developments there has been assumed the installation of OTIS manufactured lifts that have a range of maximum power consumption between 5kW and 9kW.
- 6.23 The table below provides a summary of lift types, their corresponding power consumption, the quantity of units per blocks, and operational profiles.

Table 6.5. Table Lift types and operational profile

Block	No. Elevators	No. of stops	Available Hostway WxL (m)	Number of passengers	Speed (m/s)	Power max. (kW)	Lift profile use
Block A	6	10	2000x2000	8	1	9	
Block B	1	7	2600x1800	8	1	5	Working day  Weekend: 
Block C	2	7				5	Working day  Weekend:



Escalators and Moving Walks

- 6.24 There are no escalators or moving walks within the development.

Step 5: Evaluating Energy Use for Small Power

- 6.25 TM54 methodology seeks to bridge the performance gap between estimated energy usage and actual energy usage. The unregulated energy is accountable for a large portion of the overall energy consumption of the building energy consumption.
- 6.26 Small power (plug loads) can be difficult to estimate. The impact of small power loads is firstly in the power they directly consume, and secondly that most of this power is converted to heat gains within the space with implications for the heating and cooling loads.
- 6.27 This step in the methodology seeks to establish the additional small power gains associated with unregulated equipment and determines the operational profiles most likely to be used. The data input for typical equipment/ appliances load has mainly been based on predefined NCM profiles specific to each space activity type.
- 6.28 For the residential areas, the equipment load has been determined from the “Table 2 Occupancy and equipment gain descriptions” of the CIBSE TM59: Design methodology for the assessment of overheating risk in homes 2017 (Table 6.6.).
- 6.29 Additionally for living/ kitchen areas associated with flats with more than 3 bedrooms the energy use and pattern have been extrapolated from the same table.

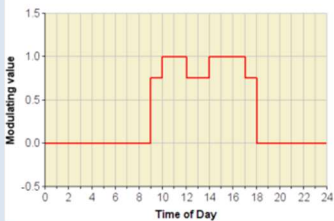
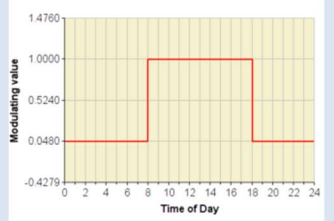
Table 6.6. Residential area room type equipment load (based on CIBSE TM59: Design methodology for the assessment of overheating risk in homes, 2017)

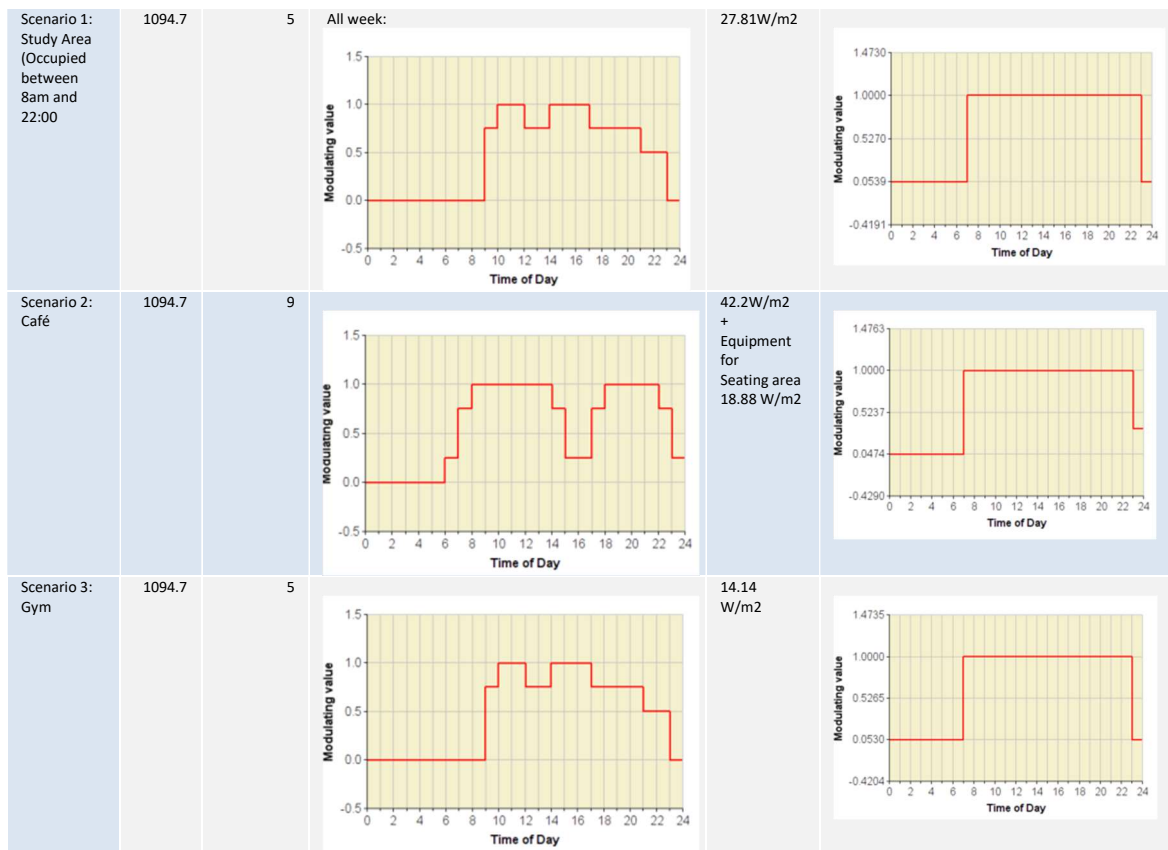
Unit/Room type	Equipment load
Studio	Peak load of 450 W from 6 pm to 8 pm*. 200 W from 8 pm to 10 pm 110 W from 9 am to 6 pm and 10 pm to 12 pm Base load of 85 W for the rest of the day
1-bedroom apartment: living room/kitchen	Peak load of 450 W from 6 pm to 8 pm 200 W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 85 W for the rest of the day

2-bedroom apartment: living room/kitchen	Peak load of 450 W from 6 pm to 8 pm 200 W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 85 W for the rest of the day
2-bedroom apartment: kitchen	Peak load of 150 W from 6 pm to 10 pm 60 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 35 W for the rest of the day
3-bedroom apartment: living room/kitchen	Peak load of 300 W from 6 pm to 8 pm Base load of 50 W for the rest of the day
3-bedroom apartment: living room	Peak load of 450 W from 6 pm to 8 pm 200W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 85 W for the rest of the day
3-bedroom apartment: kitchen	Peak load of 150 W from 6 pm to 10 pm 60 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 35 W for the rest of the day
Double bedroom	Peak load of 80 W from 8 am to 11 pm Base load of 10 W during the sleeping hours
Single bedroom	Peak load of 80 W from 8 am to 11 pm Base load of 10 W during sleeping hours
Communal corridors	Pipework heat loss only

- 6.30 Average power consumption as well as ‘sleep mode’ consumption for common items for non-domestic equipment have been input in the model based on CIBSE Guide F (2012) energy consumption estimations. However, these may be out of date for a number of appliances such as IT equipment types due to increases in energy efficiency, and do not reflect changes over the past decade towards different equipment such as laptops and tablets.
- 6.31 The equipment profile for the domestic areas is listed in Table A.7. of the Appendix A. The appliances for the non-domestic areas have been defined in relationship with the proposed typology use and the typical occupancy pattern as outlined below:

Table 6.7. Table Equipment Profile & Occupancy for PBSA Amenity Scenarios

Room Type Scenario	GIA (gross internal area) (m ²)	Floor space factor (m ² /person)	Occupancy Profile	Equipment Maximum Sensible Gain (W/m ²)	Equipment profile
Scenario 1,2,3: Shop - Normal (food store)	673.3	8		5.2 W/m ²	



Step 6: Evaluating Energy Use for Catering

- 6.32 The energy use for the catering has been calculated only for the scenario where the PBSA Amenity space is used as a Café.
- 6.33 The calculation of the annual energy consumption is based on the methodology presented in CIBSE: TM50 Energy efficiency in commercial kitchens (2021).

Step 7: Evaluating Energy Use for Server Rooms

- 6.34 The unregulated energy includes large power loads resulting from server rooms.
- 6.35 CIBSE Guide F provides benchmark energy consumption for servers and communication rooms.

Table 6.8. Annual energy consumption for server Room by CIBSE (kW-h/m² per year)

Power load	Primary Gain (kW-h/m ² /yr)	Diversity
Server room	3	0.8

- 6.36 However, Guide F does not have the benchmark value associated with Retail/Library/Café/Gym activities. Hence, the server room values (office) from CIBSE guide have been used in the model.

Step 8: Evaluating Energy Use for Additional Plant and Equipment

- 6.37 In addition to the server room, there are plant rooms that constitute power loads that should be accounted for. Data on plant room energy consumption is not available at this stage. Therefore, there has been used the NCM pre-defined equipment use assumption specific to a commercial and student accommodation plant room.
- 6.38 The energy use and operational profiles are presented in Table under Appendix A.

Step 9: Evaluating Energy use of Domestic Hot Water

- 6.39 Evaluating the energy used to provide domestic water (DHW) has several steps:
- Estimating how much water will be used and considering the daily profile for how the DHW will be used.
 - Factoring in heat losses due to distribution through pipework and standing losses from storage cylinders.
 - Modelling how the DHW will be generated and how the generation equipment will be controlled to meet the demand profile.
- 6.40 For this development, the domestic hot water (DHW) consumption per each room has been defined based on the activity type as per the CIBSE Guide G: Public health and plumbing engineering (2014). *Table A. 13. DHW consumption in relationship with the occupancy profile Summary Table* provides an outline of all the data input into the model for the domestic hot water consumption estimates.

7. Adding Internal Heat Gains to the Model

Step 10: Adding Internal Heat Gains to the Model

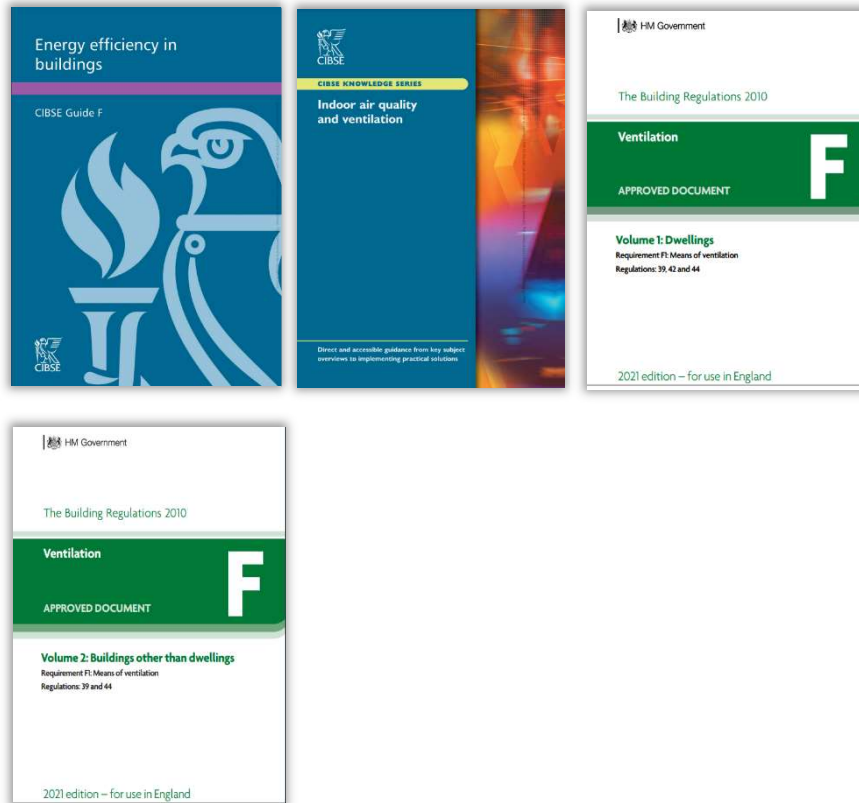
- 7.1 The internal heat gains from all equipment and processes in the building are included in the model when calculating energy use associated with heating, cooling, distribution systems, light, occupants, and appliances. Many of these gains are automatically calculated in the model based on the inputs from steps 3-9 and step 11.
- 7.2 The internal heat gain associated with energy uses calculated outside the model are added to the model.
- 7.3 The internal heat gains have the potential to significantly impact the energy load on a heating or cooling system.
- 7.4 The internal gain from occupants from the domestic and non-domestic areas have been included in the analysis to recreate a realistic scenario based on values provided by CIBSE guide A: Environmental Design and KS17 document. These values (maximum sensible gain and maximum latent gain) vary based on the expected activity within the space. The occupancy gains input in the model are shown in the Occupancy tables A.8. and A.9. enclosed in Appendix A.

8. HVAC Systems & Controls

Step 11: Modelling HVAC Systems and their Controls

- 8.1 The energy use for HVAC systems and associated controls is estimated and separately reported. It takes into account the HVAC system design, individual equipment efficiencies and control strategy.

Figure 8.1. Reference documents used in this section



Defining Space heating, Cooling strategies

- 8.2 It is proposed to incorporate low carbon and renewable technologies as the basis of the heating strategy (see sections below). Heating systems will be all electric in consideration of the decarbonisation of the national grid.
- 8.3 Therefore, for the space heating there is an air source heat pump (predicted model Mitsubishi Electric MEHP with SCOP 3.3). Similarly, for the domestic hot water there is used an air source heat pump (predicted model Mitsubishi Electric MEHP with SCOP 3.3).
- 8.4 The heating system and cooling strategies temperature setpoints have been set as per the recommended values from Table 1.5 CIBSE Guide A (CIBSE, 2017).

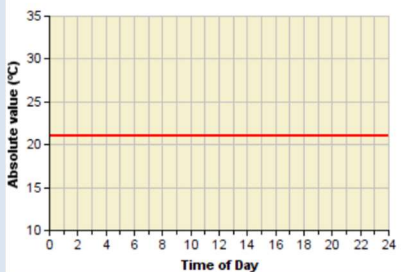
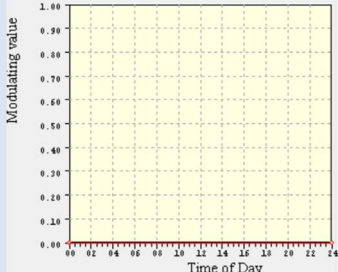
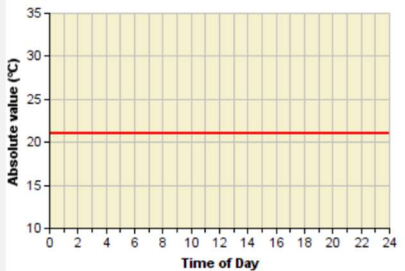
- 8.5 For example, the heating system for the residential areas is set to maintain an optimum temperature of 21°C while the rooms are occupied as per CIBSE Guide A (CIBSE, 2017).
- 8.6 The cooling and ventilation strategy implemented in the modelled development follows the initial recommendations provided by Amber Management & Engineering Services Ltd consultants. The following table provides a summary of the cooling strategies:

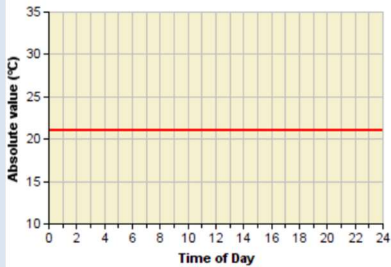
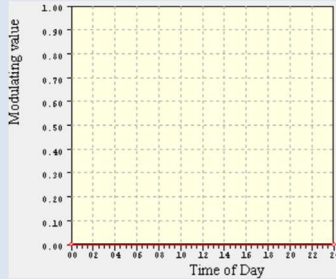
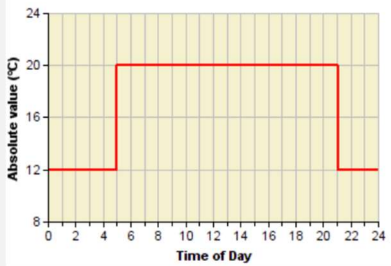
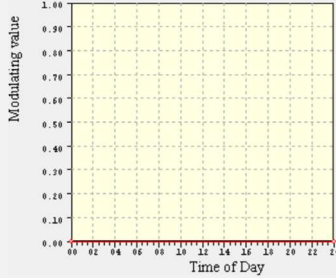
Table 8.1. Cooling/ ventilation strategies as per Amber Management & Engineering Services Ltd consultants recommendations

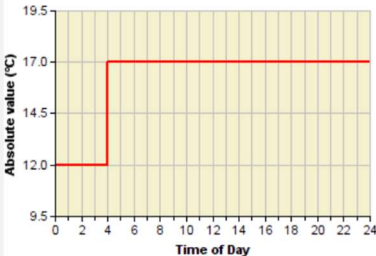
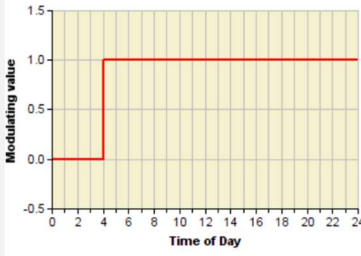
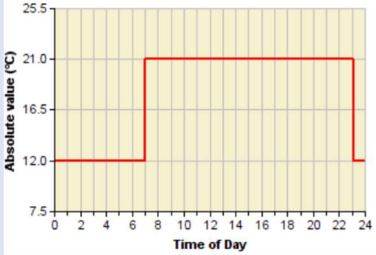
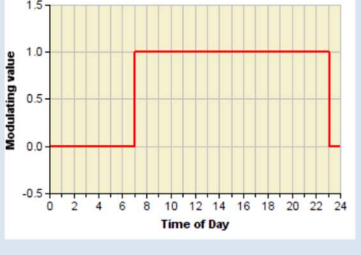
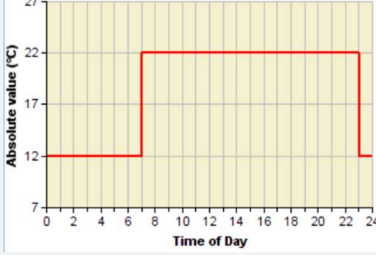
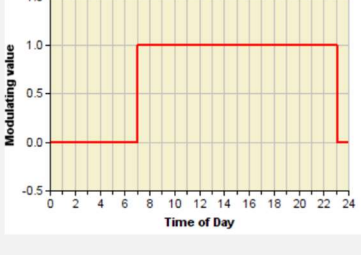
Block Unit		
Block A	PBSA areas	Mechanical extract ventilation (MEV) assisted Natural Ventilation via openable windows
	PBSA areas to the Lordship Lane façade	Mechanical ventilation with heat recovery (MVHR)
	Commercial areas (Block A ground floor)	Mechanical ventilation with heat recovery (MVHR) & Comfort cooling VRF system
Blocks B, C, D	Residential areas	Natural Ventilation

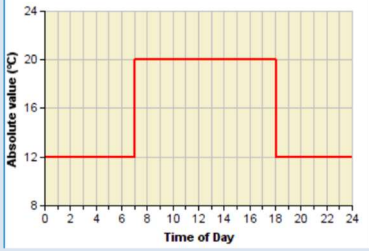
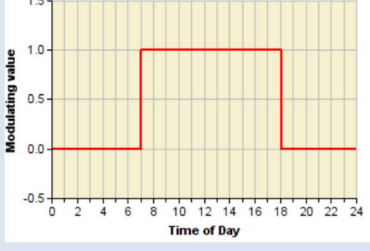
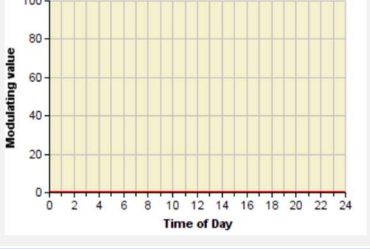
- 8.7 The mechanical extract ventilation (MEV) assisted by natural ventilation and the mechanical ventilation with heat recovery (MVHR) profiles are defined as auxiliary ventilation within the “Air exchange” section of IES VE, with the set point temperature of 22°C based on the CIBSE TM52 (CIBSE, 2013) and TM59 (CIBSE, 2017) guidance.
- 8.8 For the MEV and MVHR within the domestic areas, the required ventilation flow rate inputs are selected from KS17: Indoor Air Quality & Ventilation Table 3.1. Dwelling extract ventilation rates, and Volume 1 of the Approved Document Part F (HM Gov, 2021)
- 8.9 For the other non-domestic areas, the ventilation rates have been estimated based on information sourced from CIBSE Guide F (CIBSE, 2017) and Volume 2 of Approved Document F (HM Gov, 2021).
- 8.10 For the VRF system for the non-domestic areas, the cooling set point for the Gym is 25 C as per Table 1.5 CIBSE Guide A (CIBSE, 2017)
- 8.11 The following table (Table 8.2.) summarises the HVAC system strategies defined in the model for all space types within the Block A, B, C, and D.
- 8.12 The complete detailed model inputs for the cooling/ heating temperature set points, operational profiles and ventilation rates are enclosed in Appendix A Tables A.15 and A.16 for the domestic spaces and in Appendix A Tables A.17 and A.18 for non-domestic zone scenario testing.

Table 8.2. Table summarising the HVAC system strategy for the Baseline Scenario

Area Type	Heating System	Heating Profile (*Temperature set points shown in graphs below)	Operative Temp. Heating Profile	Cooling strategy	Cooling strategy set point T (°C)	Ventilation rate (L/s)						
Residential Areas - Blocks B, C, D (Bedrooms, En-suite, Studio, Bathroom, Kitchen/ Living, Lobby, Corridors)	ASHP (Air source heat pump) SCOP of 3.33 – Mitsubishi Electric MEHP		21°C	Natural Ventilation  <table data-bbox="1283 809 1655 920"><tr><th>Time</th><th>Value</th></tr><tr><td>00:00</td><td>(ta>22)</td></tr><tr><td>24:00</td><td>(ta>22)</td></tr></table>	Time	Value	00:00	(ta>22)	24:00	(ta>22)	22°C	n/a
Time	Value											
00:00	(ta>22)											
24:00	(ta>22)											
PBSA Block A Lordship Lane façade bedrooms	ASHP (Air source heat pump) SCOP of 3.33 – Mitsubishi Electric MEHP		21	Mechanical ventilation with heat recovery (MVHR)	22	13L/s for the Kitchen/ Living & 8L/s for the Bathroom -heat recovery ventilation rate to bedrooms- *Table 1.2 Minimum extract ventilation rates for continuous extract systems (Approved Document Part F						

PBSA Block A (Kitchen/Living, Bathroom, Bedroom)	ASHP (Air source heat pump) SCOP of 3.33 – Mitsubishi Electric MEHP		21°C	Mechanical extract ventilation (MEV) assisted Natural Ventilation  <table data-bbox="1288 569 1653 686"><tr><th>Time</th><th>Value</th></tr><tr><td>00:00</td><td>(ta>22)</td></tr><tr><td>24:00</td><td>(ta>22)</td></tr></table>	Time	Value	00:00	(ta>22)	24:00	(ta>22)	22°C	13L/s Kitchen/ Living & 8L/s Bathroom *Table 1.2 Minimum extract ventilation rates for continuous extract systems (Approved Document Part F
Time	Value											
00:00	(ta>22)											
24:00	(ta>22)											
Residential Area Bathroom	ASHP (Air source heat pump) SCOP of 3.33 – Mitsubishi Electric MEHP		20°C	Natural Ventilation  <table data-bbox="1288 1016 1653 1131"><tr><th>Time</th><th>Value</th></tr><tr><td>00:00</td><td>(ta>22)</td></tr><tr><td>24:00</td><td>(ta>22)</td></tr></table>	Time	Value	00:00	(ta>22)	24:00	(ta>22)	22°C	
Time	Value											
00:00	(ta>22)											
24:00	(ta>22)											
Riser, Lift, CBD, Stairs, Services, Store, Storage,		Unheated spaces	n/a	N/A	n/a							

A-PBSA-Amenity: Café (asper NCM Heating profile)	ASHP (Air source heat pump) SCOP of 3.33 – Mitsubishi Electric MEHP		17°C		25°C	Comfort cooling VRF system To fill (NCM supply rate)
A-PBSA-Amenity: Fitness suite/Gym (heating/ cooling profiles as per NCM)	ASHP (Air source heat pump) SCOP of 3.33 – Mitsubishi Electric MEHP		21°C		25°C	Comfort cooling VRF system (NCM supply rate)
A-PBSA-Amenity: Study Space IT (heating/ cooling profiles as per NCM)	ASHP (Air source heat pump) SCOP of 3.33 – Mitsubishi Electric MEHP		22°C		24°C	Comfort cooling VRF system (NCM supply rate)

A-Commercial Area: Sales Area (heating/ cooling profiles as per NCM)	n/a			23°C	Comfort cooling VRF system (NCM supply rate)
Plant Rooms		Unheated spaces		80	Comfort cooling VRF system

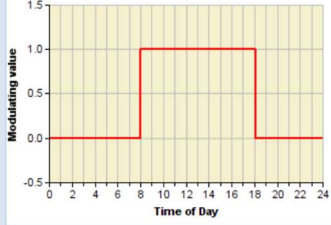
Controls

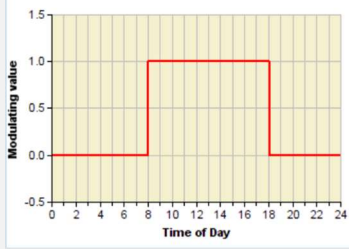
- 8.13 The controls strategy is defined based on room temperature set points and are linked to the occupancy and operational patterns.
- 8.14 Important factors have been considered such as the thermostat profiles (heating/ cooling setpoints and setbacks), implementation of variable temperature, hours of operation, and zoning.
- 8.15 For example, the heating system is set to turn on when the room temperature drops below 21°C in the case of residential spaces while being occupied.
- 8.16 For the natural ventilation there has been created a profile to mimic the opening of windows during the summer when the temperature exceeds 22°C.
- 8.17 The mechanical ventilation and the comfort cooling follow similar patterns linked to a desired optimum room temperature controlled by a thermostat.
- 8.18 Outside the operational hours of the non-domestic areas the heating system is set to turn back on if the temperature drops as low as 12°C.

Fans, Humidification and dehumidification, refrigerant loads

- 8.19 Energy loads for other processes have been summarised in Table 8.3. The parameters input in the model have been selected from CIBSE Guide F: Energy efficiency in buildings (CIBSE, 2017) estimates.
- 8.20 The operational patterns for other processes included in the model are generally linked to the occupancy, or cooling strategy patterns.

Table 8.3. Fans, refrigeration, additional small power, comfort cooling components

Block	Space type	Space-use scenario	Internal Gain Type	Maximum Sensible Gain (W/m ²)	Maximum Power Consumption (W/m ²)	
A- Commercial Areas (*NCM profiles input)	A-PBSA- Amenity: (1094.7m ²)	Study Space (Library)/ Café/ Gym)	Humidification for VRF cooling system (*Benchmark: Table 7.4 from CIBSE Guide F: Energy efficiency in buildings (CIBSE, 2017)	15	20W/m2	
		Store	Refrigeration (*Benchmark: Table 8.2 from CIBSE Guide F: Energy efficiency in buildings (CIBSE, 2017)		90-125W/m2	As per Cooling profile
		Library	Small Power (*Benchmark: Table 13.2 from CIBSE		25W/m2	

			Guide F: Energy efficiency in buildings (CIBSE, 2017)			
			PC & Computer		200W	
		Library				
		Development	Specific Fan Power (for the zonal supply/ extract ventilation units) (*Benchmark: Table 16.3 from CIBSE Guide F: Energy efficiency in buildings (CIBSE, 2017))		2.2 W/m2	On continuously
		Development	Specific Fan Power (for the local supply/ units) (*Benchmark: Table 16.3 from CIBSE Guide F: Energy efficiency in buildings (CIBSE, 2017))		0.6 W/m2	On continuously

On-site renewables

- 8.21 Based on the Part L compliance assessment recommendation from Amber Management & Engineering Services Limited, there have been implemented Circa 200 PV panels of South facing panels, 10° inclination, 400W per panel peak output. This is expected to provide a total output of approximately 800KWp per the entire development.

Table 8.4. On-site renewables – PV panels implementation as per Part L compliance requirement

PV Panel	Monocrystalline	Area (m ²)	Azimuth (°clockwise from north)	Inclination (°from horizontal)	Shading Factor	Rated Power (KWdc)
PV Panel	Monocrystalline	4800	180	10	1	964.8

- 8.22 The on-site electrical generation is included in the model to emphasise the benefits of the PV panels implementation and its contribution to reducing energy demands and carbon emissions.
- 8.23 When presenting the outputs from IES VE, the “Total Electricity” output refers to the energy demand without accounting for the electricity displaced by the PV panels. In contrast, “Total Energy” consumption refers to the total energy consumption accounting for the PV-generated electricity contribution.

9. Management Considerations

Step 12: Taking Management Considerations into Account

- 9.1 It is assumed that the building will be managed and well maintained at all times. This will include control calibration, implementation of energy saving features in lighting and equipment and energy will be monitored using smart meters and submeters.
- 9.2 TM54 methodology targets different possible scenarios where the reality of the situation would not be well managed or well controlled. The results section of this analysis presents possible results with management factors of 1, 1.05 and 1.1 simulated within varying weather scenario intensities. This exercise will explore likely ranges of operational energy usage and guide future decisions on how to lower energy consumption.

10. Results analysis

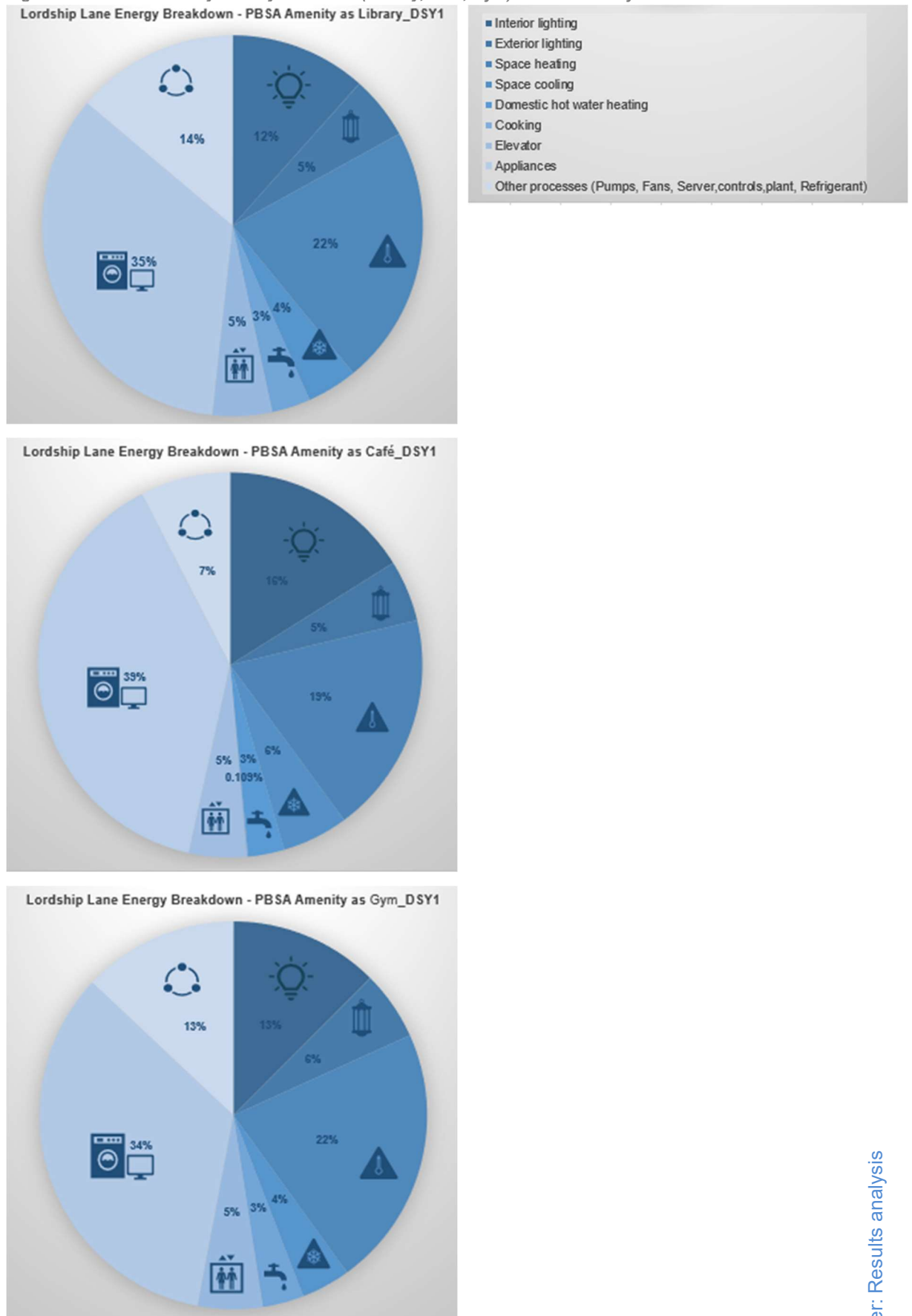
Step 13: Sensitivity Analysis

PBSA Amenity Activity Scenarios

- 10.1 Conducting basic sensitivity tests involves making adjustments to the baseline model one input at a time. This approach offers modelers insights into the relative impact of each change on the overall outcome, helping identify influential parameters and informing scenario testing.
- 10.2 Lordship Lane development contains a mixed-use range of units: Block A (PBSA accommodation and non-domestic uses) and Blocks B, C, D (private accommodation).
- 10.3 The focus of the scenario testing was to explore the parameters that are least certain or more influential.
- 10.4 Initially, a set of scenarios was tested by varying the activities and use for the PBSA amenity space within Block A. At this design stage it is known that the non-residential area will be used as a retail space. However, for the PBSA Amenity space there is still a level of flexibility for the final design purpose. There were assigned a series of potential uses for the non-domestic spaces:
 - Scenario 1: Lordship Lane Development with PBSA Amenity Space as Library/ Study Area
 - Scenario 2: Lordship Lane Development with PBSA Amenity Space as Café/ Canteen
 - Scenario 3: Lordship Lane Development with PBSA Amenity Space as Gym
- 10.5 The operational risks involve variations in the occupancy density, equipment use, and cooling and heating demands specific to the potential activity within the Amenity area.
- 10.6 The variations in equipment loads are influenced by the presence of appliances specific to different activities. In the Study Area, this includes PCs, computer stations, and a server room. The Café incorporates energy consumption related to catering services and refrigeration. The gym was modelled with appropriate exercise machines and water coolers.
- 10.7 The operational hours and occupancy vary as per NCM standard profiles and recommended occupancy factors from the Approved Document B: Fire Safety.
- 10.8 Similarly, the cooling and heating demands as well as the ventilation rates with associated control setpoints are different for each scenario. The NCM defaults and CIBSE Guides were used where data was not available.
- 10.9 The initial series of tests was simulated under the London_LWC_DSY1 weather conditions.

- 10.10 The total annual energy consumption rates for each plausible operating scenario were 3696.4MWh per year (Scenario 1), 3853.8 MWh per year (Scenario 2), and 3456.2MWh per year (Scenario 3).
- 10.11 When considering the PV generated electricity contribution, the annual energy consumption was reduced by circa 25% bringing the annual energy demands down to 2,741.44MWh per year (Scenario 1), 2,898.8 MWh per year (Scenario 2), and 2,501.2 MWh per year (Scenario 3).
- 10.12 Hence, the energy consumption for the three assumptions has an annual energy consumption that ranges from 81.2 KWh/m² per year (Scenario 2) to 98.3 KWh/m² per year (Scenario 1). Scenario 3 achieves an operational energy use on a gross calorific value basis of 89.7 KWh/m² per year.
- 10.13 Scenario 1 has a more significant energy demand due to the increased power consumption associated with the IT equipment as well as the Server Room loads and cooling requirements.
- 10.14 The energy breakdown for each scenario is presented in the diagram below. The full detailed results of this section's IES VE simulations are summarised in Tables B.1, B.2, and B.3 under Appendix B.
- 10.15 The results exhibit a consistent pattern, as highlighted in the diagrams. Unregulated energy consumption ranks highest, followed by space heating, internal lighting, and cooling.

Figure 10.1. PBSA Amenity Activity Scenarios (Library, Café, Gym) – Results Analysis



PBSA Amenity Activity Scenarios – under different Weather Conditions

10.16 The potential impact of different weather conditions has been tested applying different weather files suitable for the project's location:

- London_LWC_DSY1 (Current Scenario), where DSY1 – a year with a moderately warm summer.
- London_LWC_DSY2_2020High50 (Current Intense Scenario), where DSY2 – a year with a very intense single warm spell
- London_LWC_DSY3_2050High90 (Future Scenario), where DSY3 is a year with prolonged sustained warmth.

10.17 The main impact of the different weather conditions is noticed in the PV-generated electricity (Figure 10.2.) and in the cooling demands fluctuations which influence the overall energy consumption (Figure 10.3.).

Figure 10.2. PBSA Amenity used as Gym - various Weather conditions Scenarios – PV-generated electricity levels

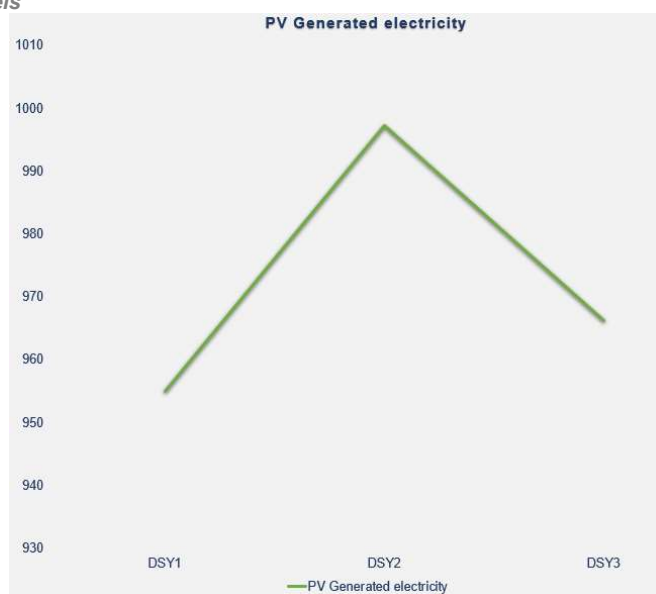
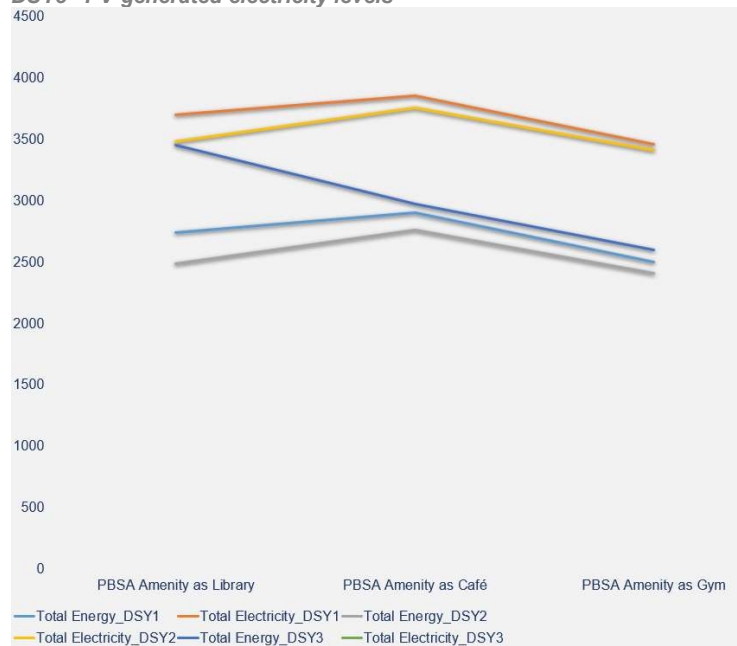


Figure 10.3. PBSA Amenity Scenarios 1, 2, 3 under various Weather conditions Scenarios DSY1, DSY2, DSY3– PV-generated electricity levels



10.18 Diagrams 10.4., 10.5., and 10.6 depict a more comprehensive analysis of energy consumption trends within different services. The trends illustrate that heating loads, along with other processes related to ventilation systems and cooling strategies associated with cooling profiles, are directly influenced by external temperature fluctuations. The observed variations can be substantial, ranging between 40-63%.

Figure 10.4. Scenario 1: PBSA Amenity used as Library under Weather conditions (DSY1, DSY2, DSY3) – Energy consumption breakdown

