

Figure 10.5. Scenario 2: PBSA Amenity used as Café under Weather conditions (DSY1, DSY2, DSY3) – Energy consumption breakdown

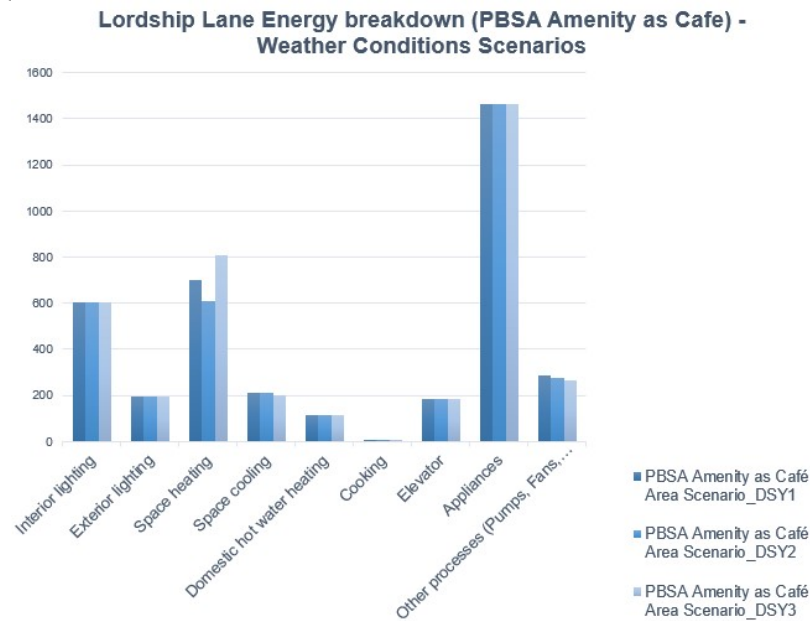
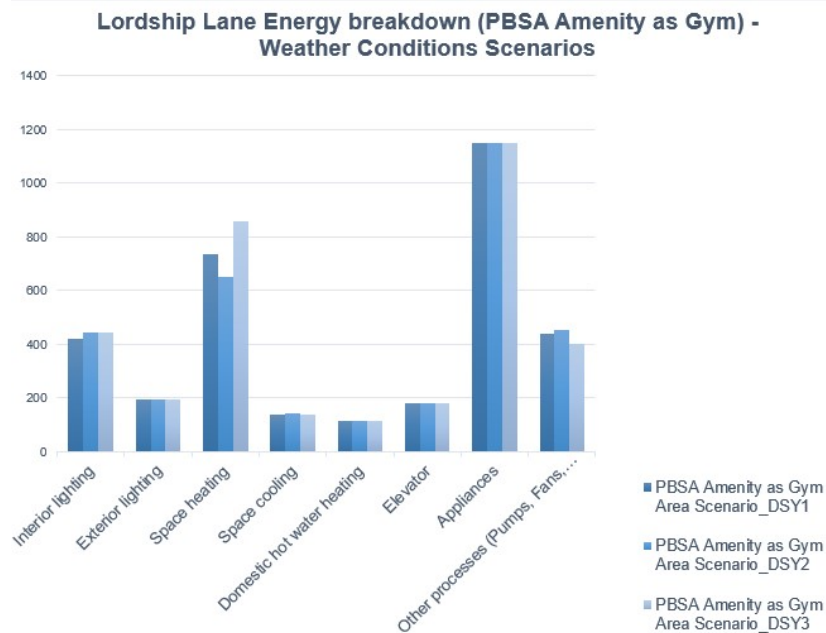


Figure 10.6. Scenario 3: PBSA Amenity used as Gym under Weather conditions (DSY1, DSY2, DSY3) – Energy consumption breakdown



Step 14: Scenario Testing

10.19 To conduct additional testing, the most realistic scenario identified in Step 13, Scenario 3_DSY1, was chosen as the baseline scenario for further simulation processes.

Defining and comparing “LOW”, “MEDIUM”, “HIGH” scenarios

10.20 The equipment loads have been identified in previous testing as the main energy consumption driver. Further tests were carried out in this next stage by varying the equipment operational hours, defining three separate scenarios:

- “LOW” Scenario – associated with a good occupant behaviour and operational energy management;
- “MEDIUM” Scenario – associated with a plausible real-world occupant behaviour and operational energy management
- “HIGH” Scenario – associated with an irresponsible occupant behaviour and an unstructured operational energy management

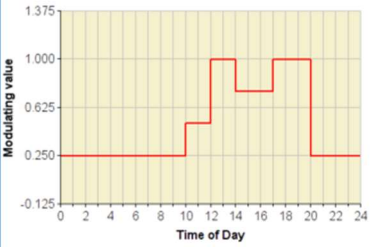
10.21 The above-mentioned scenarios were tested under moderate weather conditions (London_LWC_DSY1 file).

10.22 The activity for the non-residential space is assigned as retail space based on client preferences, while the PBSA Amenity space remains designated for physical exercise activities.

10.23 The Baseline scenario uses the standard NCM profiles for the commercial areas and the TM59 occupancy and equipment profiles for the residential areas.

10.24 For the "worst-case" scenario, the Shop and Gym shifted to a 24/7 schedule (Tables 10.1 and 10.2). Additionally, the operational hours for equipment within the residential areas have been extended into the evening (Table 10.4). The external lighting for all units has been set to operate between 19:00-7:00 instead of just during the evening periods (19:00-24:00). This scenario will be referred as the “HIGH” use simulation.

Table 10.1. Non-domestic Area (PBSA Amenity)_HIGH Scenario

Parameter	Non-domestic Area Profile_HIGH Scenario
Equipment/ Occupancy/ Light	

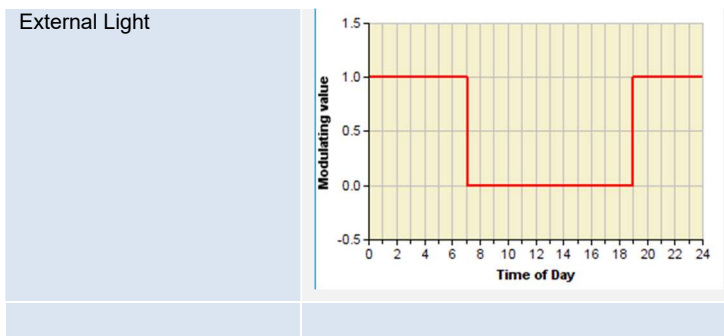
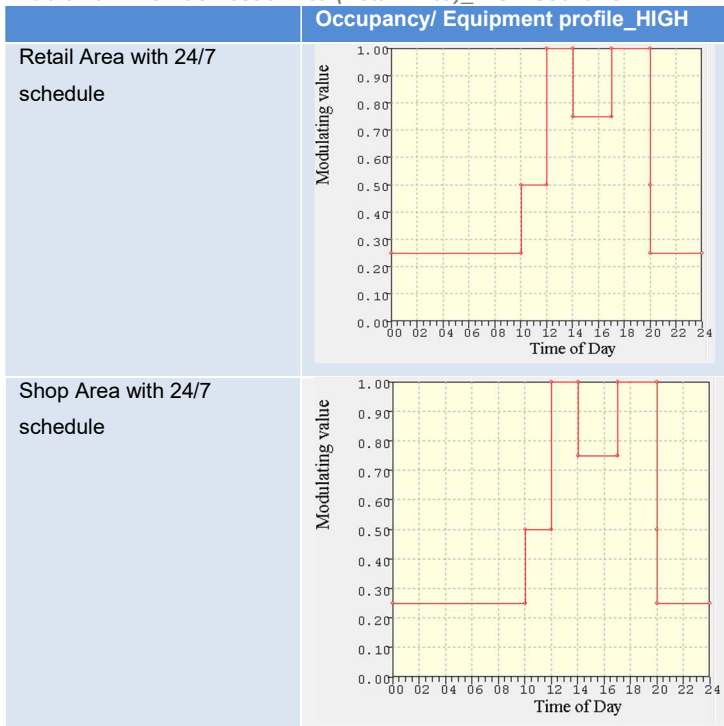
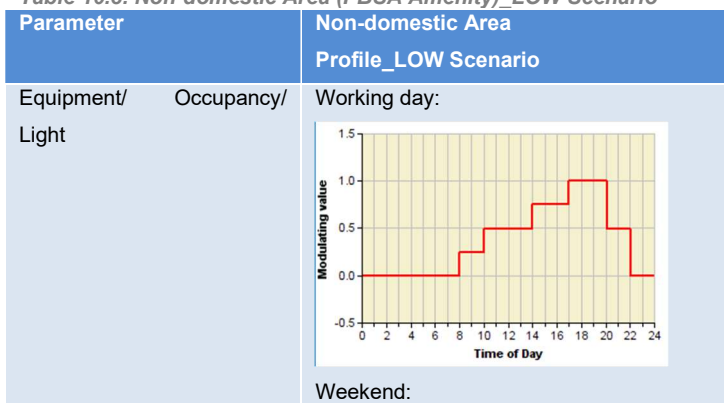


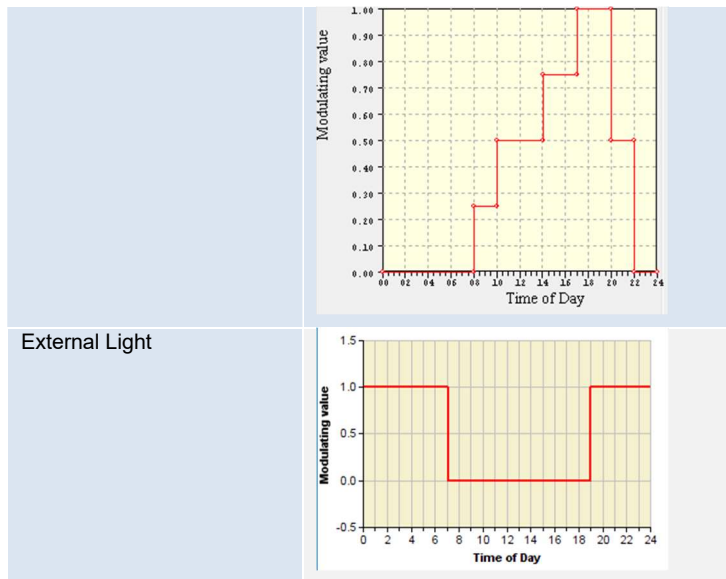
Table 10.2. Non-domestic Area (Retail Area) *HIGH* Scenario



10.25 In the "LOW" scenario, the Shop and Gym have shortened their weekend opening hours impacting on the internal gains and equipment use (Table 10.3). External lighting has been adjusted to function only in the evenings (19:00-24:00). Moreover, the operational profile for equipment within residential areas has been minimized (Table 10.4).

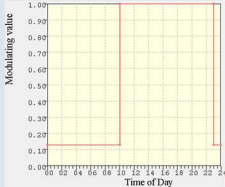
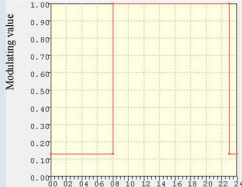
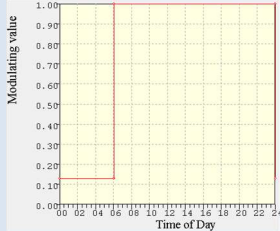
Table 10.3. Non-domestic Area (PBSA Amenity) *LOW* Scenario





- 10.26 Therefore, there have been simulated three series of scenarios using key variables for the occupancy and equipment levels with three levels of energy consumption: Low-end, Medium, High-end under the normal weather conditions London_LWC_DSY1.

Table 10.4. Residential Area Equipment Profiles LOW MEDIUM HIGH Scenarios

Residential Equipment Scenarios	Low	Medium	High
		As per the NCM profile	
	07:00-09:00 and 17:00-23:00	08:00-23:00	05:00-24:00
Eg: Double Bedroom			

- 10.27 The results have been analysed and broken down by end use consumption to better understand its distribution among the development (Figure 10.7).
- 10.28 Extending operational hours and occupied periods automatically leads to an increase in equipment energy loads, cooling and heating demands, and other associated processes. Light usage rates also exhibit minimal increases, as depicted in the diagrams below ((Figure 10.8).

Figure 10.7. Lordship Lane development Energy consumption breakdown for Low, Baseline (Medium), High Activity Scenarios – Results Analysis

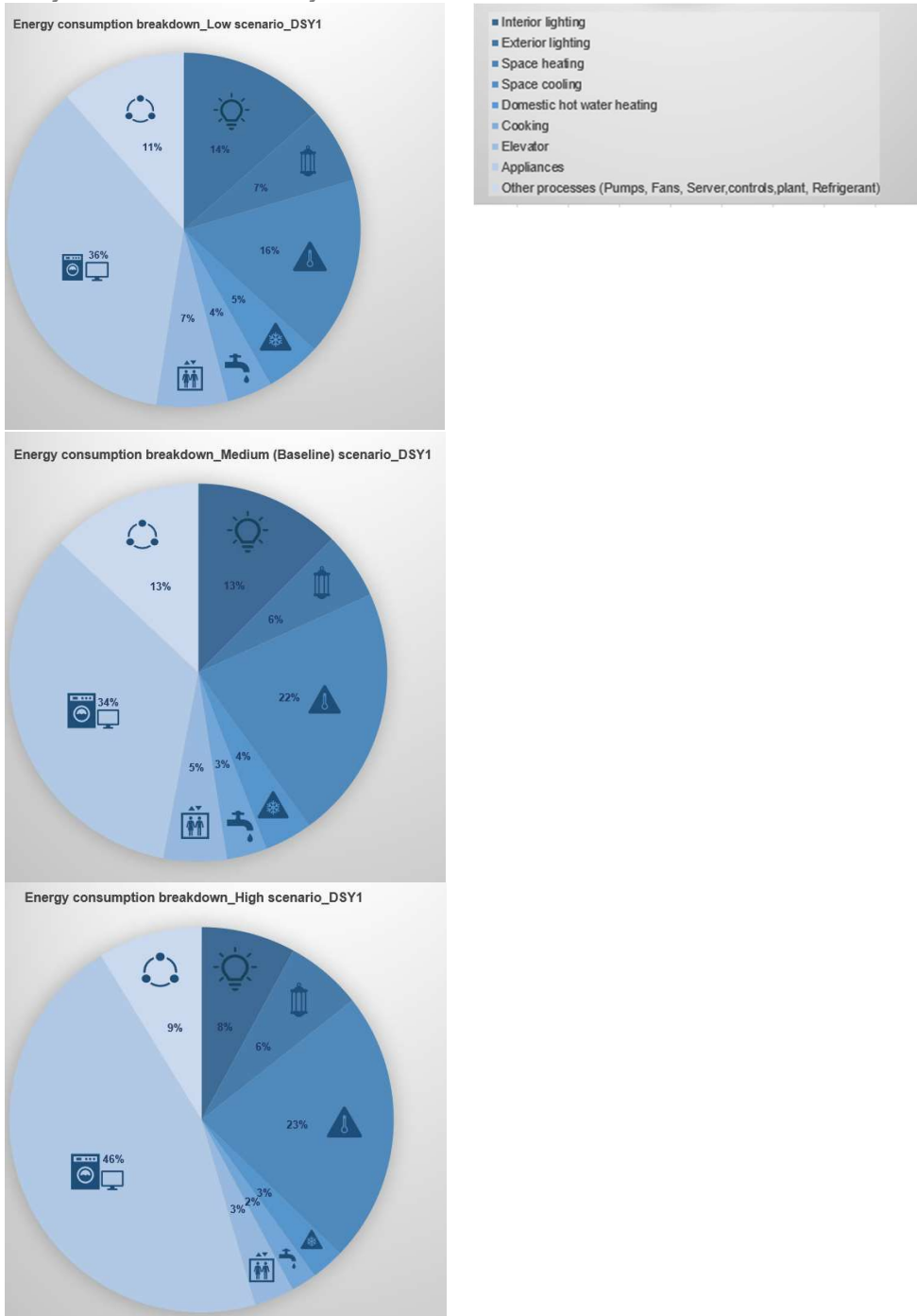
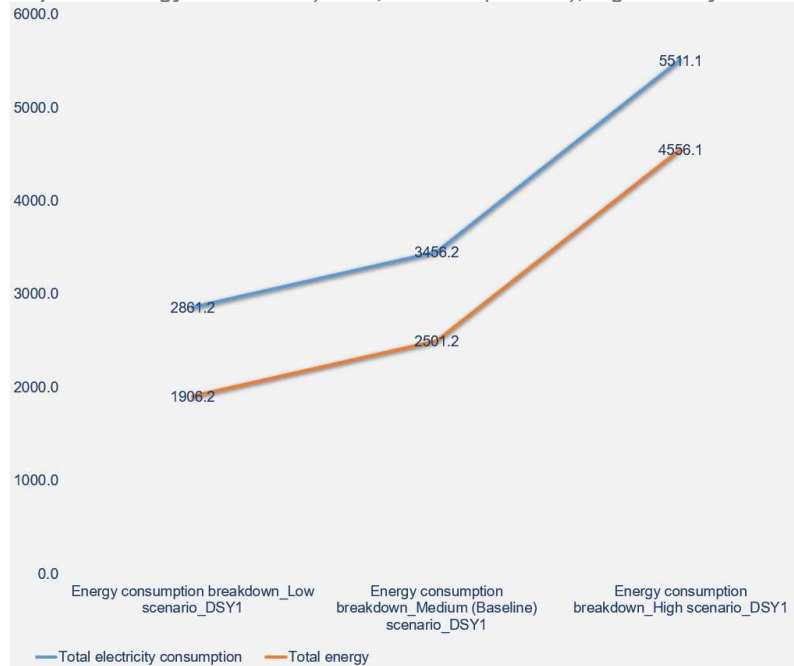


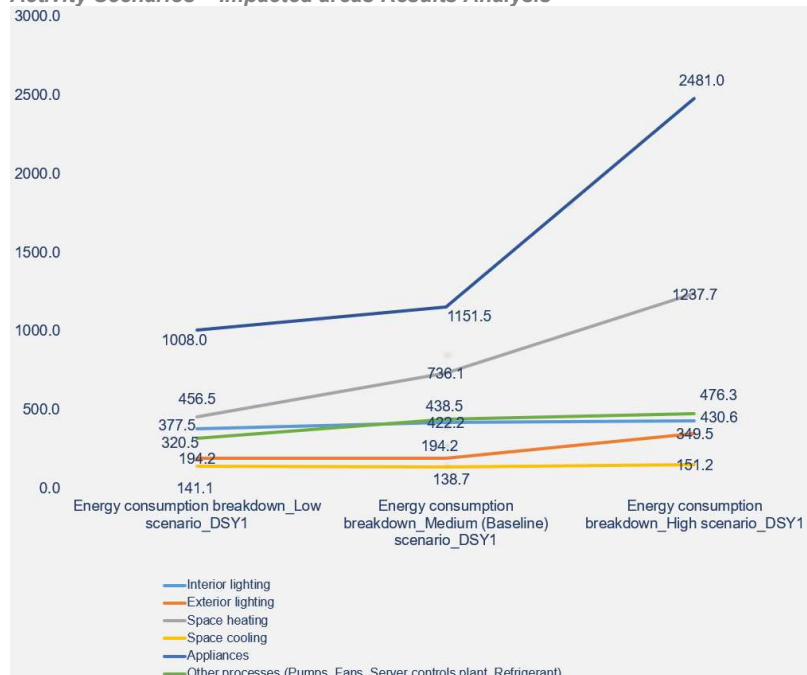
Figure 10.8. Lordship Lane development Electricity consumption and Energy consumption (including PV displaced energy contribution)- Low, Baseline (Medium), High Activity Scenarios



10.29 There is a strong surge in the energy use associated with the excessive overuse of equipment all throughout the spaces (Figure 10.8.).

10.30 Diagram 10.9. shows the trends of the affected loads due to the changes within the equipment and operational schedules. The most affected parameters are as expected in the following order from highest energy drive to the lowest: appliances, space heating, other processes, interior light, exterior light, and space cooling.

Figure 10.9. Lordship Lane development Energy consumption breakdown for Low, Baseline (Medium), High Activity Scenarios – Impacted areas Results Analysis



- 10.31 The annual energy consumption in terms of delivered energy on a gross calorific value basis for the “LOW”, “MEDIUM”, and “HIGH” scenarios ranges from 68.4KWh/m² per year to 89.7 KWh/m² per year and 163.4 KWh/m² per year respectively.
- 10.32 The annual energy consumption varies from the “LOW” to “HIGH” scenario with rate that ranges between 45-58% (please see output values in Table 10.5). The complete detailed energy end-user breakdown is summarised in Table B4 under Appendix B.

Table 10.5. Lordship Lane development Annual Energy consumption breakdown for Low, Baseline (Medium), High Activity Scenarios

	Test	Energy consumption Low scenario DSY1	Energy consumption Medium(Baseline) scenario DSY1	Energy consumption High scenario DSY1	
	End use	Electricity (MWh/yr)	Electricity (MWh/yr)	Electricity (MWh/yr)	Part L regulation
	TOTAL electricity	2861.2	3456.2	5511.1	Regulated+Unregulated
	Total energy	1906.2	2501.2	4556.1	(Regulated+Unregulated)-PV generated electricity
	PV Generated electricity	955.0	955.0	955.0	PV displaced electricity

PBSA Lordship Lane façade areas under different Cooling strategies – Cooling Strategy Test 1 vs Cooling Strategy Test 2

- 10.33 As a result of the overheating assessment undertaken by Amber Management and Engineering Services Limited (B2921 - Lordship Lane - Thermal Comfort Assessment), it was concluded that the MVHR system is not sufficient to mitigate the overheating risk assessment. comfort cooling has been implemented in the PBSA block for areas situated on the Lordship Lane façade side, where cooling via openable windows is restricted due to noise concerns.
- 10.34 Two series of additional tests were undertaken to assess the impact of different cooling strategies
- Cooling Strategy Test 1– PBSA areas to the Lordship Lane façade have a mechanical ventilation with heat recovery system as cooling strategy, Baseline test ("MEDIUM" scenario) profiles applied, moderate weather conditions in DSY1.
 - Cooling Strategy Test 2– PBSA areas to the Lordship Lane façade have comfort cooling system as cooling strategy, Baseline test ("MEDIUM" scenario) profiles applied, moderate weather conditions in DSY1.
- 10.35 The test “Cooling Strategy Test 2” has been run under the new proposed cooling strategy in the conditions defined previously for the Medium (Baseline) scenario, where the PBSA amenity is used as a Gym, and the internal loads are as per the standard NCM profiles.

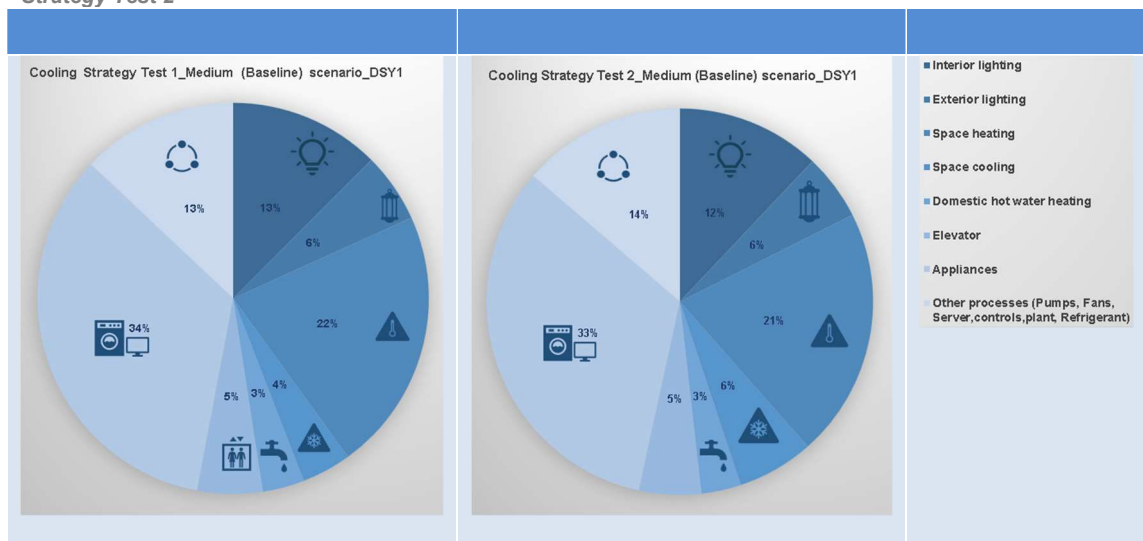
- 10.36 The two cooling strategy tests were conducted under moderate weather conditions using London_LWC_DSY1 CIBSE weather file.
- 10.37 Table 10.6 summarises the cooling approaches applied for the two tests (Cooling Strategy Test 1 and 2) for a clear understanding.

Table 10.6. Cooling/ ventilation strategies as per Amber Management & Engineering Services Ltd consultants recommendations – MVHR vs Comfort Cooling

Block Unit	Zone	Cooling Strategy Test 1: Medium (Baseline) scenario_MVHR LL Lane facade_DSY1	Cooling Strategy Test 2: Medium (Baseline) scenario_Comfort Cooling LL Lane facade_DSY1
Block A	PBSA areas	Mechanical extract ventilation (MEV) assisted Natural Ventilation via openable windows	Mechanical extract ventilation (MEV) assisted Natural Ventilation via openable windows
	PBSA areas to the Lordship Lane façade	Mechanical ventilation with heat recovery (MVHR)	Comfort cooling
	Commercial areas (Block A ground floor)	Mechanical ventilation with heat recovery (MVHR) & Comfort cooling VRF system	Mechanical ventilation with heat recovery (MVHR) & Comfort cooling VRF system
Blocks B, C, D	Residential areas	Natural Ventilation	Natural Ventilation

- 10.38 Figure 10.10 shows the energy breakdown percentage for each end user within the Lordship Lane development comparing the two scenarios for the PBSA cooling strategy. The energy consumption associated with space witnessed a notable rise, accounting for 6% of the total energy consumption, compared to the 4% observed with the MVHR system in place.

Figure 10.10. Lordship Lane development Energy consumption breakdown Cooling Strategy Test 1 vs Cooling Strategy Test 2



- 10.39 The energy consumption breakdown per end-use is enclosed in Appendix B Data Outputs, Table B.5. When implementing comfort cooling for the PBSA block spaces to the Lordship Lane façade, the energy consumption associated with the space cooling increases by almost 62% impacting on the total energy consumption that reaches a figure of 26238 MVh/year when compared to 2501.2 MWh/ year figure of the MVHR system scenario.
- 10.40 When translating the results to annual energy consumption based on gross calorific value, the initial value of 89.7 KWh/m² per year (for Test 1) increases to 94.1 KWh/m² per year.

Step 15: Review against targets & benchmarks

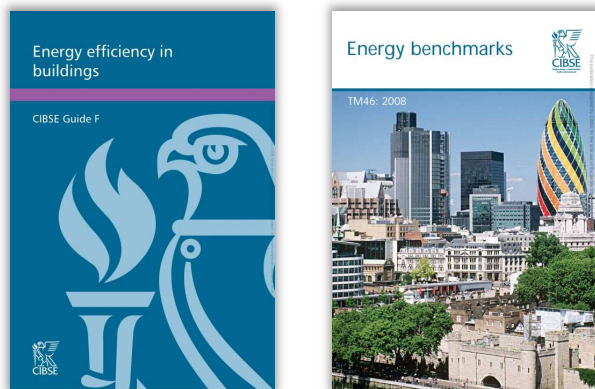
- 10.41 The proposed design for Lordship Lane development does not have a specific set target to achieve apart from the standard Part L compliance assessment and related planning policy Part L targets.
- 10.42 However, the simulation results have been sense-checked with benchmarks published by official institutions in official guides "CIBSE TM46 Energy Benchmarks"(2008) and "CIBSE Guide F: Energy Efficiency in Buildings" (2021) as well as other more ambitious targets established by RIBA and LETI.
- 10.43 The IES VE outputs required adjustments to suit the to suit the level of services considered in the available published benchmarks. Consequently, while certain official estimates encompass both regulated and unregulated energy consumption, others may omit specific elements present in TM54 simulations. Examples include external lighting, elevators, or PV electricity contribution, which have been taken into account in the TM54 simulations.

Table 10.7. Table of calculation for the delivered energy on a gross calorific value basis – results used for comparison against benchmarks and targets

	Retail & Gym Area_DSY1_Low (Cooling Strategy Test 1)	Retail & Gym Area Baseline Scenario_DSY1 (Cooling Strategy Test 1)	Retail & Gym Area_DSY1_High (Cooling Strategy Test 1)	Retail & Gym Area Baseline Scenario_DSY1 (Cooling Strategy Test 2)
TOTAL Electricity MWh per year	2861.2	3456.2	5511.1	3578.8
TOTAL Energy MWh per year	1906.2	2501.2	4556.1	2623.8
A=Electricity to use for benchmark comparison = Total electricity- (Elevator+external light) MWh per year	2164.2	2641.1	4502.9	2721.9
B=Energy to use for benchmark comparison (A-PV panel generated electricity) MWh per year	1209.2	1686.1	3547.9	1766.9
TOTAL Energy KWh/m2 per year	68.4	89.7	163.4	94.1
A (without PV panels) KWh/m2 per year	77.6	94.7	161.5	97.6
B (with PV panels) KWh/m2 per year	43.4	60.5	127.3	63.4
Total development Area (m2)	27875.4			

Review against benchmarks: CIBSE Guide F and CIBSE TM46

Figure 10.11. Reference CIBSE Documents for Energy consumption benchmarks



- 10.44 The results are compared with industry benchmarks published by CIBSE for simulation quality purposes. The results are checked against various data from older energy consumption estimates from “CIBSE TM46: Energy benchmarks” (CIBSE, 2008) to newer data from “CIBSE Guide F: Energy efficiency in buildings” (CIBSE, 2021).

- 10.45 The available operational energy benchmarks and targets vary based on the elements included in their calculation such as the number of hours per year considered and the services included. For example, the CIBSE benchmarks include heating, lighting, cooling, typical appliances specific to the space activity, and hot water services where appropriate.
- 10.46 Table below shows the conditions and the services considered in determining the CIBSE estimates.

Table 10.8. Services included in the Energy benchmarks as per CIBSE Guide F and CIBSE TM46

Category	GIA	%Develop. Area	Space usage	Operational schedule	Features	Services included
Residential	7869.0	28.2	Full accommodation , including sleeping space, day time space, all domestic facilities, some office facilities	Continuous	24-hour fully conditioned and serviced accommodation	Heating, lighting, cooling, appliances, food and hot water services, entertainment , laundry
PBSA accommodation	17554.0	63.0	Full accommodation , including sleeping space, day time space, all domestic facilities, some office facilities	Continuous	24-hour fully conditioned and serviced accommodation	Heating, lighting, cooling, appliances, food and hot water services, entertainment , laundry
Retail	673.3	2.4	Mainly by customers for purchasing goods — some facilities required for employees	Typically week and weekend days	Greater needs for refrigeration of goods than other shops	Heating, lighting, display cabinets, food storage, employee appliances
Gym Area + Commercial auxiliary	2002.7	7.2	Fitness/Physical exercise	Typically daily and evenings	Provision of sports and entertainment equipment with generally high energy usage, and internal gains	Heating, lighting, cooling of all spaces. Office appliances, showers, snack provision and bar

- 10.47 Lordship Lane proposed design consists of both domestic and non-domestic units. For the purposes of reflecting a mixed-use development, the benchmarks have been calculated and extrapolated considering the GIA ratios between residential and non-residential areas (90.4% and 9.6%).
- 10.48 There is a good range of benchmarks from old estimates to new and from typical practice to good, and very good practice.
- 10.49 Table 10.9. contains the CIBSE Energy estimates on which the mixed-use benchmarks were extrapolated for the purposes of comparison with the IES VE outputs.

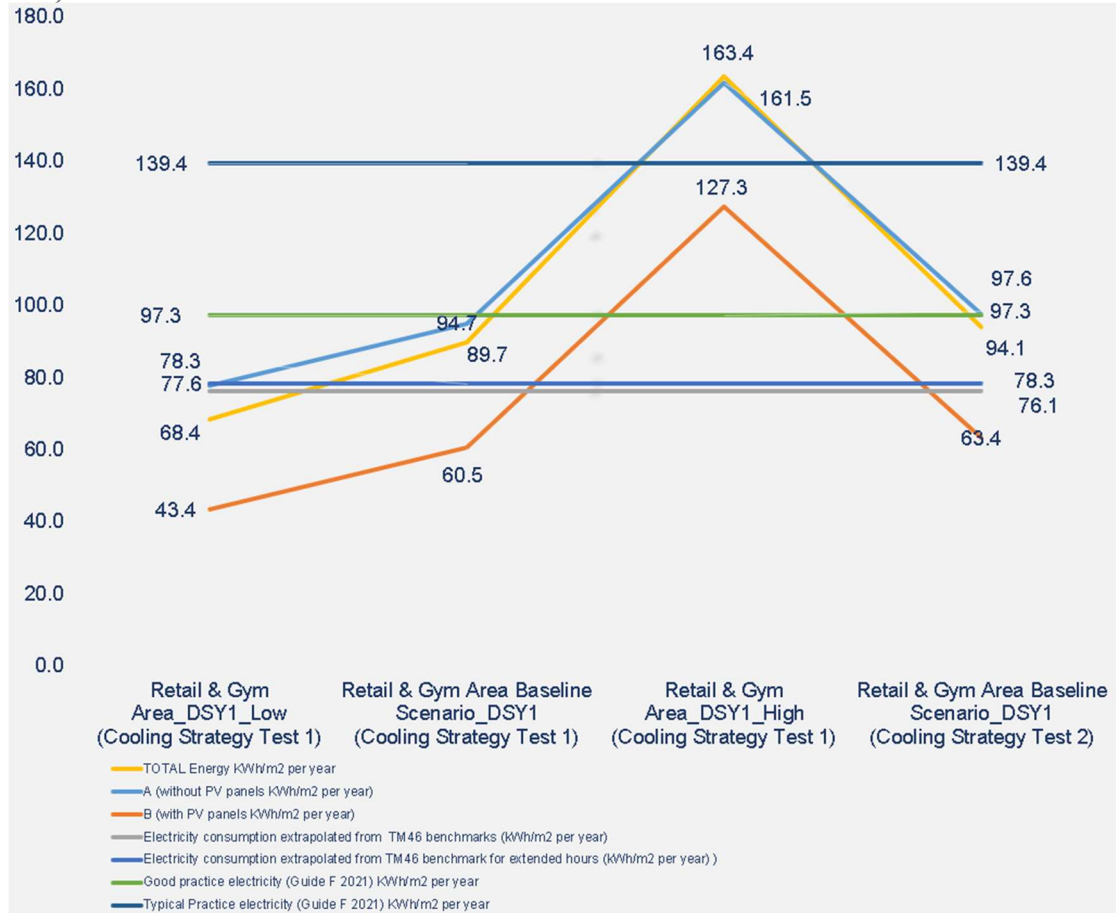
Table 10.9. Calculation and results of extrapolated benchmarks based on data published by CIBSE Guide F and CIBSE TM46

Category	Electricity typical benchmark (kWh/m ²) per year	Reference hours per year	Max. allowed hours per day	Percentage increase in electricity benchmark at maximum allowed hours per year	Typical Electricity extrapolated from TM46 benchmark for Reference Hours (kWh/m ²)	Typical Electricity extrapolated from TM46 Benchmarks for extended hours (kWh/m ²)	Good practice electricity (Guide F 2021) KWH/m ²	Typical Practice electricity (Guide F 2021) KWH/m ²
Residential	65	continuous	-	-	65	65	85	123
PBSA accommodation	65	continuous	-	-	65	65	85	123
Retail	310	2448	3672	22%	310	310	440	550
Gym Area + Commercial auxiliary	160	2754	5355	39%	130	160	127	194
Total Mixed-use extrapolated benchmark (KWh/year)	Calculated Extrapolated Benchmarks				76.1	78.3	97.3	139.4
Lordship Lane development Total GIA=27875.4m ²								

- 10.50 To provide a relevant comparison the electricity consumed by the elevators, external lighting, and by the other processes are subtracted from the IES VE outputs.
- 10.51 Diagram 10.12. shows that the whole range of scenarios from “LOW” to “HIGH” energy output stay below the CIBSE TM46 and CIBSE Guide F 2021 benchmarks especially when considering the PV renewable energy contribution.
- 10.52 When replacing the MVHR system for PBSA Lordship Lane façade with the comfort cooling strategy (Cooling Strategy Test 2) the calculated annual energy consumption in terms of delivered energy on a gross calorific value basis remains below the benchmarks especially when considering the use of renewables.
- 10.53 The most plausible scenario marked by the orange trend (89.7 kWh/m² per year for Cooling Strategy Test 1 and 94.1 kWh/m² per year for Cooling Strategy Test 2) emphasises that the

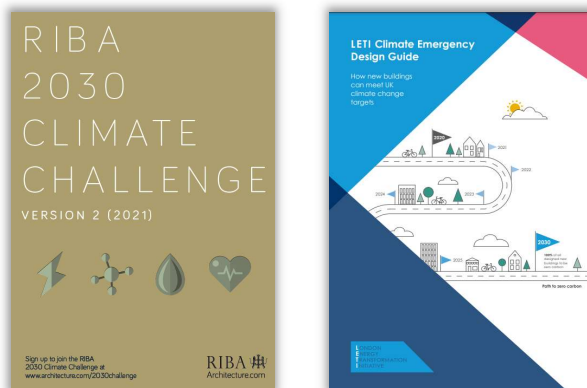
proposed design is successful from an operational energy efficiency as it lies below the Good practice electricity estimates established by Guide F (2021) (the green constant).

Figure 10.12. Lordship Lane Energy Consumption – Comparing “Low”, “Medium”, “High” scenarios & Cooling Strategy Test 1 and Cooling Strategy Test 2 against CIBSE Benchmarks (CIBSE TM46 and CIBSE Guide F 2021)



Review against targets: RIBA 2030 Climate Challenge and LETI Climate Emergency Design Guide

Figure 10.13. Target Documentation: RIBA 2030 Climate Challenge; LETI Climate Emergency Design Guide



- 10.54 In this section, the total energy consumption results for the proposed development are checked against ambitious targets established by RIBA's published document "RIBA 2030 Climate Challenge version 2 (2021)" and LETI's "Climate Emergency Design Guide".
- 10.55 The energy consumption figures provided by "RIBA 2030 Climate challenge" are based on the GIA and include regulated & unregulated energy consumption irrespective of source (grid/renewables).
- 10.56 The energy consumption targets provided in "LETI Climate Emergency Design Guide" (LETI) consider the energy used intensity (EUI) in GIA excluding the renewable energy contribution.
- 10.57 The same principles used in the previous sections have been applied to extrapolate benchmarks that reflect a mix between domestic and non-domestic areas (Table 10.10.).

Table 10.10. Calculation and results of extrapolated targets based on data published by RIBA and LETI

			% Domestic/ Non-domestic areas of Lordship Lane development (%m2)	Extrapolated Operational Energy Benchmark kWh/m2/y
		Domestic Area RIBA targets (kWh/m2/y)	90.4	
	Non-domestic Area RIBA targets (kWh/m2/y)		9.6	
RIBA (new build, compliance approach) targets	130	120		120.96
RIBA 2025 Targets	75	60		61.44
RIBA 2030 Targets	60	35		37.4
LETI	65	35		37.88

- 10.58 The "LOW" and "MEDIUM" operational scenarios of the development demonstrate highly efficient performance. These designs not only adhere to the minimum Part L common practice compliance but also align with future-proofing goals, including the RIBA 2025 targets, particularly when taking into account the contribution of PV panels. However, it's worth noting that the "HIGH" scenario, although highly unlikely to represent real-life building performance, exceeds the compliance standards set by RIBA for normal practice (refer to Figure 10.14).
- 10.59 When implementing the comfort cooling system to the bedrooms to Lordship Lane façade of Unit A PBSA block, there is a minimal exceedance of the RIBA 2025 targets.

Figure 10.14. Lordship Lane Energy Consumption – Comparing “Low”, “Medium”, “High” DSY1 scenarios against Targets (RIBA 2030 Climate Challenge targets and LETI targets)



11. Step 16: Quality assurance

- 11.1 A review of the model, report, and associated design is essential for whichever level of modelling detail is adopted. The QA involves the model itself and its consistency with the project information (design proposals, control strategy, project brief, etc) and modelling report. The QA considers both the quality of the model and that of the information provided to those who will utilise the report and modellers who may be responsible for the model in the future.
- 11.2 The Ensphere energy modeller carried out regular checks to ensure that the model had an appropriate level of oversight and QA to minimise mistakes, misinterpretation of data, etc. Partial QAs were carried out at dedicated steps, e.g. at the end of Step 1, to check the building geometry and envelope are set up properly and in the Sensitivity Analysis and Scenario Testing stages (steps 13 and 14).
- 11.3 QA was carried out before any issue of the modelling results was reported to external parties. Brief notes were included and checked against the implementation matrix (shown in the next section).

12. Step 17: Reporting & implementation matrix

- 12.1 The implementation matrix summarises the TM54 process, the key inputs for each step of the methodology, and how each result has been calculated.
- 12.2 The 'probable range' column is filled-in to reflect the likely variability in the input. The 'confidence level' column is filled-in to reflect the modeller's assessment of the level of certainty they have for the input.
- 12.3 'Low confidence' can indicate where values are taken from CIBSE guidance, benchmarks or standard databases, as well as data assumptions prior to a finalised detailed design of certain building components or spaces within the project.
- 12.4 'Medium' refers to values that are based on outline design information bespoke to the project, but that more detailed values are expected.
- 12.5 'High' indicates that detailed design information has been provided, with input from well-informed future users, and is unlikely to change significantly through construction.

Table 12.1. TM54 Implementation Matrix

TM54 Steps	Recommendation	Modelling approach (Summary)	Probable range	Confidence level (L/M/H)	QA check
Simplifications and assumptions (see section 5.2 of Evaluating operational energy use at the design stage CIBSE TM54:2022)	They should be used appropriately and judiciously, and detailed in the report	See report entitled. '23-E033 Lordship Lane Haringey TM54 Report' Sections 0-1.	n/a	n/a	Yes
Use of benchmarks and targets (see section 6.2.2 of Evaluating operational energy use at the design stage CIBSE TM54:2022)	Benchmarks should not replace a dedicated calculation of energy use. Targets that can be verified in use are recommended to be set for the project from the early stages and should be reported alongside the modelling results. The aim of the modelling will be to test whether the targets are achievable, and inform the design proposals to meet the targets.	The proposed design has not set any project-specific targets apart from the standard Part L compliance assessment targets. However, the simulation results have been sense-checked with benchmarks published by official institutions in official guides "CIBSE TM46 Energy Benchmarks"(2008) and "CIBSE Guide F: Energy Efficiency in Buildings" (2021). The simulation results are compared against more ambitious targets established by RIBA in "RIBA 2030 Climate Challenge Version 2 (2021)" and LETI (The London Energy Transformation Initiative) in "LETI Climate Emergency Design Guide" (2020). This comparative analysis aims to gauge the gap between current practice for new built projects and future expectations,	n/a	n/a	Yes

		serving as an assessment of the potential for future-proofing new projects and increase energy use efficiency.			
Step 0: Choosing the right level of modelling	The project team should establish early in the project, in discussion with the client, the right level of modelling for the project. This should consider multiple factors including the complexity of the building and its systems, the resources available for the modelling, and the level of accuracy and certainty needed from the results. The discussions should also determine whether some steps in this methodology should be carried out within or outside the model, e.g. Step 3 (Lighting), Step 9 (Domestic hot water).	The project consists of a mixed-use development comprising the construction of four blocks: Block A, designated for Purpose-Built Student Accommodation (PBSA) along with commercial/non-residential spaces. Blocks B, C, and D, allocated for residential/ private accommodations. The residential areas predominantly rely on natural ventilation, whereas the commercial spaces and PBSA bedrooms along the façade facing Lordship Lane are equipped with a comfort cooling strategy system. A dynamic thermal modelling approach has been chosen as this enables the model to provide a very detailed energy consumption simulation. The HVAC was modelled starting from templates and tuned to more accurately reflect the design proposals. The energy use associated with hot water and lighting is calculated within the DSM. DHW volumes were based on anticipated usage data provided by CIBSE guides and NCM pre-defined profiles where available.	n/a	n/a	Yes
Step 1: Constructing and building the model	Constructing and zoning: Consider the level of detail needed for the model to be accurate and robust. Always check the North arrow. Check the modelled envelope properties against information provided by design team members (engineer, façade consultant, architect etc). Carry out simple checks at the end of this stage, with default settings, to ensure the model operates as expected.	The model used information provided by the design team, including the architect and building services engineer. Notable simplifications include the zoning of the ground floor area of Block A into retail and PBSA amenity space, which will be detailed at the next stage. The North arrow was taken from the architectural site drawings. The development was set to a 27° angle from the true North. Neighbouring buildings are distant and not expected to affect the building through considerable height differences; therefore, they were omitted.	Circa ± 10% (based on the surface area ratio between residential and non-residential areas)	M	Yes
	Establishing floor areas: Identify or estimate NIA, GIA, or TFA for the building, as required for the calculations and in line with the floor area used in targets and benchmarks for the project, and include this in the report	The (Total gross internal area) GIA within the model is 27 875.4 m². As the volumes have been defined as per the NCM Guide (National Calculation Methodology Guide) using the lines from the inside of external walls and in the centre of partitions between rooms, there are some minor differences between the surface area shown in the architectural drawings and the areas defined in the IES VE model.	Less than ±1%	H	Yes

	The weather data used for the model should be clearly stated in the report, and appropriate for the purpose of the modelling. Where the site location is not close to any of the CIBSE weather file locations, the best match should be used based on the local climate.	The model uses the CIBSE weather files for London Weather Centre assuming more intense summers specific to the central urban London suitable for the project's location. The weather file choice is also in line with the TM59 Overheating assessment. The weather files used in the model consider several summer scenarios: •London_LWC_DSY1 (Current Scenario), where DSY1 – a year with a moderately warm summer. •London_LWC_DSY2_2020High 50 (Current Intense Scenario), where DSY2 – a year with a very intense single warm spell •London_LWC_DSY3_2050High 90 (Future Scenario), where DSY3 is a year with prolonged sustained warmth.	n/a	n/a	Yes. the site is likely to be in a significant urban heat island, which is not accounted for in the regional weather file.
Step 2: Estimating operating hours and occupancy factors	Request anticipated operational profiles from the client, for example through structured interview.	NCM profiles, as well as TM59 occupancy and equipment patterns, were used. Actual values are unknowable until post-occupancy. Sensible assumptions based on typical operational schedules were made where official data and benchmarks were not available. Where defaults were used, further analysis was carried out in sensitivity tests and in scenario testing.	±50%	L	Further discussions with clients are recommended to establish more specific operational patterns, occupancy and equipment use expectations.
Step 3: Evaluating lighting energy use	Assess the energy use for each element, as per guidance provided in each step. Where steps are omitted, state and justify (e.g. Step 4 omitted if the building has no lifts). Make a note of instances where benchmarks or assumptions have been used, rather than project-specific and confirmed information. Identify likely variability and uncertainty, to take account of it in the scenario testing and sensitivity analysis.	Model uses lighting efficacies recommended by Amber Management & Engineering Services Ltd consultants in line with their Part L compliance assessment. The target illuminance levels are defined as per CIBSE Guide A and The SLL Code for Lighting (Edition 2022). The detailed lighting parameters included in the model are enclosed in the report and in the Appendix A.	±20%	H	Yes. The lighting strategy consistency was ensured through workshops and emails with consultant from Amber Management & Engineering Services Ltd.
Step 4: Evaluating energy use for lifts and escalators		Blocks A, B, C have disabled access – lift services. The model uses the power consumption specific to OTIS lift products as per Amber Management & Engineering Services Ltd. consultants' recommendations.	±10%	H	Yes. Requesting specification data sheets for lift products used in previous similar projects from Amber Management & Engineering Services Ltd.
Step 5: Evaluating energy use for small power		Small power inputs were defined based on BRE estimated and pre-defined NCM profiles as well as calculation and estimates from CIBSE Guide F: Energy efficiency in buildings (2012) 2021 edition.	±50%	L	Further discussions with clients are recommended to establish more specific operational patterns, occupancy and equipment

					use expectations.
Step 6: Evaluating energy use for catering		Domestic induction hob and electric fan ovens (A+ rated) are to be provided to each apartment.	±30%	M	
Step 7: Evaluating energy use for server rooms		No server rooms are indicated on plans, no further info currently available. There has been assumed one server room in Block A (for the scenario where the PBSA Amenity room is assigned as Library/ Study Area). Loads for this room were based on NCM defaults for now — will be updated at next stage 3. There are two plant rooms in block A and one per each of the other three blocks (B, C, D). Loads for the Plant rooms were based on NCM defaults for now — will be updated at next stage.	±100%	L	
Step 8: Evaluating energy use of additional plant and equipment		After dark external lighting is proposed to cover all external areas at every main entrances. An allowance has been made for each of these (see modelling report), but this needs to be more accurately assessed at the next stage.	±100%	L	Yes These needs more accurate assessment at Stage 3.
Step 9: Evaluating energy use of domestic hot water		Domestic hot water heating system was set as an Air Source Heat Pump with SCOP of 3.33. The system implemented is expected to be a Mitsubishi Electric MEHP model as recommended by Amber Management & Engineering Services Ltd. consultants. The domestic hot water demands are as per NCM profile defaults and in line with Guide G: Public health and plumbing engineering (2014) were NCM data was not available.	±30%	M	Yes These needs To be agreed at next stage.
Step 10: Evaluating internal heat gains		Internal heat gains have been calculated automatically in the IES VE software based on the defined profiles and parameters for air exchange, infiltration rates, solar gains from various weather files, occupancy, equipment, and HVAC systems.	±20%	M	Yes These needs To be agreed at next stage.
Step 11: Modelling HVAC systems and their controls	Assess the energy use with the appropriate modelling method, as determined in Step 0. Report separately for heating, hot water, cooling, and fans and pumps. Model controls carefully, and use this to inform the control strategy and design.	Air source heat pump (ASHP) is implemented for the space heating with SCOP of 3.33. Mitsubishi Electric MEHP model is most likely to be the system implemented as recommended by Amber Management & Engineering Services Ltd. consultants. The domestic areas (Blocks B, C, D, some residential areas of Block A) have mechanical extract ventilation systems	±30%	M	Yes These needs To be agreed at next stage.

		assisted by natural ventilation via openable windows. The commercial areas and the student accommodation areas facing Lordship Lane have comfort cooling strategy via VRF systems. The controls are modelled as per design principles, including general temperature set points and variable volume ventilation as per CIBSE Guide A and CIBSE Guide F. However, they will need more detail at the next stage.			
	Evaluating energy use for humidification and dehumidification: Active (de)humidification systems should be modelled using detailed HVAC simulation.	Assumptions have been made for the areas with comfort cooling based on CIBSE Guide F estimates.	±100%	H	Yes These needs To be agreed at next stage.
Step 12: Taking management considerations into account	Review management considerations, ideally through structured interview/information request with future occupants. This should determine variability in the inputs due to management considerations. Blanket management factors should not be used.	Sensible assumptions have been made as noted in the current report.	n/a	n/a	Yes A more detailed strategy to be established in the next stage at client requests.
Step 13: Sensitivity analysis	At the minimum, run basic sensitivity tests on the impact of individual inputs, to identify the most influential and inform scenario testing. The range of factors to include in the sensitivity tests will vary for different building types, but typically would include: • weather and climate • heat gain scenarios, including occupancy density and hours (and associated loads) • management and occupant behaviour. Discuss with the client whether a proper sensitivity analysis (beyond these basic tests) is required and record the justification and decision.	A series of sensitivity cases were run. The proposed tests include potential uses for the PBSA Amenity from block A, varying the occupant density, heating, cooling, and equipment loads specific to each proposed activity (Library, Café, and gym). Another series of tests looks at the impact of future weather files.	n/a	n/a	Yes. Consistent simulations and checks were run by the modeller based on every change applied.
Step 14: Scenario testing	Produce mid-range, low-end and high-end scenarios. As an additional option, a 'worst case' scenario can be run, with caveats as noted in section. This should take account of variability in inputs established in each of the previous steps. Scenarios will vary per project, but typically would include variations in the following inputs:	Additional scenarios have been run with minimum and maximum equipment loads influenced by occupant behaviours, and extended hours for occupied spaces and services.			Yes. Consistent simulations and checks were run by the modeller based on every change applied.

	• controls • hours of operation of plant and equipment • heat gain scenarios, including occupancy density and hours (and associated loads) • design efficiencies of key plant and equipment items • weather scenarios, including future climate change • management considerations, as examined in Step 13 • occupant behaviour.				
Step 15: Reviewing the results against benchmarks and targets	Compare results with the project targets and, if relevant, benchmarks. If using benchmarks, provide context on their relevance to the project. Use the comparison to check whether the design proposals are on track to achieve the target, and inform any change required. If the comparison and iterative review of design options and modelling concludes that the initial target is not achievable, this should be carefully recorded and justified, along with a recommendation for alternative target and design proposals to achieve it. If the range for the low-mid-high scenarios for the project is higher than acceptable levels for a project, then the project team should seek to refine the variability of the input factors, including further discussions with the client on likely operation of the building; design measures may also need to be implemented, if variability is expected to remain, and safeguards should be put in place to keep them in check through construction and into operation.	The proposed design lacks specific project targets beyond standard Part L compliance assessments. Nevertheless, simulation results underwent scrutiny against benchmarks from official guides like "CIBSE TM46 Energy Benchmarks" (2008) and "CIBSE Guide F: Energy Efficiency in Buildings" (2021). The simulation results were further compared to ambitious targets set by RIBA in the "RIBA 2030 Climate Challenge Version 2 (2021)" and LETI in the "LETI Climate Emergency Design Guide" (2020). This comparative analysis aims to assess the disparity between current practices in new projects and future expectations, providing insights into the potential for future-proofing and enhancing energy efficiency.			Yes. The low to-high range is quite wide, with the 'high' scenario exceeding the low scenario by 58% and the medium scenario by 45%. This should be reviewed at the next stage.
Step 18: QA	QA should be carried out by an experienced modeller, at least at each stage before the results and report are issued to external parties. It should be recorded, with clear recommendations to be acted upon before issue, or for the next stage. It should encompass the model, the report, and their consistency with each other and with the project information. Intermediate QAs may also be carried out, e.g. at the end of Step 1,	Carried out by Ensphere energy modeller before issue to project team. The quality check included the model, the modelling report, and relevant design information. Brief comments are made against each step in this matrix, and more details are recorded in the body of the report. Overall, the QA review concludes that the model and report are satisfactory for this stage but will need to address the listed recommendations at the next stage. An intermediate review of the model at the end of Step 1 was also carried out to ensure no			

	rather than waiting for the whole model and report to be available.	errors would be encountered within the software at further stages of the simulations.			
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13. Summary

- 13.1 This TM54 report presents a comprehensive assessment of the operational energy use for the proposed development at Lordship Lane, Wood Green, Haringey, London.
- 13.2 The proposal is for a series of units: Block A (containing a mix of purpose-built student accommodation and commercial zones), Blocks B, C, and D (residential areas).
- 13.3 Consideration has primarily been given to the planning policy context and other requirements, as well as the parameters and energy strategy.
- 13.4 Several simulations have been carried out using a dynamic simulation modelling approach where several assumptions have been made.
- 13.5 A sensitivity analysis has been performed to obtain a low-high range scenarios using low and high occupancy schedules. The results were compared with the mid-range occupancy using the current weather data, to understand the energy consumption in different occupancy.
- 13.6 Within the sensitivity analysis, there were explored different scenarios by modifying the use of space (utilizing PBSA Amenity space as a Library, Café, and Gym), considering diverse weather conditions (DSY1, DSY2, and DSY3 tests), and adjusting equipment loads and operational hours ("LOW," "MEDIUM," "HIGH") to represent a range of responsible to excessive energy consumption.
- 13.7 In summary, the annual energy consumption in terms of delivered energy on a gross calorific value basis for the proposed development ranges from 81.2-93.4 KWh/m² per year for the sensitivity tests. The further low-medium-high range test have a performance of 68.4KWh/m² per year, 89.7 KWh/m² per year, and respectively 163.4 KWh/m². When implementing the comfort cooling strategy under the base scenario and moderate weather conditions, the annual energy consumption in terms of delivered energy on a gross calorific value basis increases from 89.7 KWh/m² per year to 94.1 KWh/m² per year. This is due to the increase by approximately 60% of the energy accounted for the space cooling.

Table 13.1. TM54 Scenarios Total Energy Consumption - Summary Table of the calculated annual energy consumption in terms of delivered energy on a gross calorific value basis

	TEST	PBSA Amenity as Study Area Scenario_DSY1	PBSA Amenity as Study Area Scenario_DSY2	PBSA Amenity as Study Area Scenario_DSY3	
	End use	Electricity (MWh/yr)			Part L regulation
	TOTAL electricity	3696.4	3480.3	3772.5	Regulated+Unregulated
	Total energy	2741.4	2483.0	3450.3	(Regulated+Unregulated)-PV generated electricity
	PV Generated electricity	955.0	997.2	966.2	PV displaced electricity

	A=Electricity to use for benchmark comparison = Total electricity- (Elevator+external light)	3320.3	3103.7	3395.9	
	Energy to use for benchmark comparison (A-PV panel generated electricity)	2365.3	2106.5	2429.8	
	Total energy (KWh/m2 per year)	98.3	89.1	123.8	
	KWh/m2 without PV	119.1	111.3	121.8	
	KWh/m2 with PV	84.9	75.6	87.2	
	TEST	PBSA Amenity as Café Area Scenario_DSY1	PBSA Amenity as Café Area Scenario_DSY2	PBSA Amenity as Café Area Scenario_DSY3	
	End use	Electricity (MWh/yr)			Part L regulation
	TOTAL electricity	3853.8	3755.1	3934.2	Regulated+Unregulated
	Total energy	2898.8	2757.8	2968.0	(Regulated+Unregulated)- PV generated electricity
	PV Generated electricity	955.0	997.2	966.2	PV displaced electricity
	Room heating plant sensible load	2264.8	1964.9	2610.2	Heating Demands
	Room cooling sensible load	875.8	875.0	836.3	Cooling Demands
					Energy Carbon emissions
	Total electricity	3853.8	3755.1	3934.2	
	Total energy	2898.8	2757.8	2968.0	
	A=Electricity to use for benchmark comparison = Total electricity- (Elevator+external light)	3473.6	3374.9	3553.5	
	B=Energy to use for benchmark comparison (A-PV panel generated electricity)	2518.7	2377.7	2587.3	
	Total electricity (MWh/yr)	3853.8	3755.1	3934.2	
	Total energy (MWh/yr)	2898.8	2757.8	2968.0	
	Total energy (KWh/m2 per year)	81.2	70.5	93.6	
	A (KWh/m2 per year without PV)	124.6	121.1	127.5	
	B (KWh/m2 per year with PV)	90.4	85.3	92.8	
	TEST	PBSA Amenity as Gym Area Scenario_DSY1	PBSA Amenity as Gym Area Scenario_DSY2	PBSA Amenity as Gym Area Scenario_DSY3	
	End use				Part L regulation
	TOTAL electricity	3456.2	3406.3	3559.8	Regulated+Unregulated

E 	Total energy	2501.2	2409.0	2593.7	(Regulated+Unregulated)- PV generated electricity
	PV Generated electricity	955.0	997.2	966.2	PV displaced electricity
	Room heating plant sensible load	2394.6	2102.4	2775.9	Heating Demands
	Room cooling sensible load	581.4	598.0	575.7	Cooling Demands
	A=Electricity to use for benchmark comparison = Total electricity- (Elevator+external light) (MWh/yr)	2641.1	2578.7	2781.5	
	B=Energy to use for benchmark comparison (A-PV panel generated electricity) (MWh/yr)	1686.1	1581.5	1815.3	
	Total energy (KWh/m2 per year)	89.7	86.4	93.0	
	KWh/m2 without PV	94.7	92.5	99.8	
	KWh/m2 with PV	60.5	56.7	65.1	
	Test	Retail & Gym Area_DSY1_Low	Retail & Gym Area Scenario DSY1	Retail & Gym Area_DSY1_High	
	TOTAL electricity	2861.2	3456.2	5511.1	
	A=Electricity to use for benchmark comparison = Total electricity- (Elevator+external light)	2164.2	2641.1	4502.9	
	B=Energy to use for benchmark comparison (A-PV panel generated electricity)	1209.2	1686.1	3547.9	
	KWh/m2 without PV	102.6	124.0	197.7	
	KWh/m2 without PV	77.6	94.7	161.5	
	KWh/m2 with PV	43.4	60.5	127.3	
	Total development Area	27875.4			
	Test	Cooling Strategy Test 1		Cooling Strategy Test 2	
	TOTAL electricity	3456.2	3578.8		
	TOTAL energy	2501.2	2623.8		
	A=Electricity to use for benchmark comparison = Total electricity- (Elevator+external light)	2641.1	2721.9		
	B=Energy to use for benchmark comparison (A-PV panel generated electricity)	1686.1	1766.9		
	KWh/m2 without PV	124.0	94.1		
	KWh/m2 without PV	94.7	97.6		
	KWh/m2 with PV	60.5	63.4		
	Total development Area	27875.4			

14. Recommendations

- 14.1 Ensure effective building services management to minimize overall energy consumption and discourage irresponsible small power usage.
- 14.2 The implementation of renewables such as PV panels installation play a critical role in balancing the total energy consumption of the development through the electricity generation contribution.
- 14.3 The renewables should be maximised to generate the annual energy requirement for at least two floors of the development on-site, in the case of Lordship Lane to supply energy for Block A ground floor.
- 14.4 Covering 30-70% of the roof with renewables can reduce overall building energy consumption by 25%-50%.
- 14.5 A series of other measures could be implemented to reduce the energy consumption involving both equipment and occupancy control. One solution could be the installation of smart metering per categories: submeter renewables for energy generation, submeter for air source heat pump consumption, ventilation, and cooling systems.
- 14.6 Ensuring continuously monitor with a smart meter and internal temperatures linked to occupancy density can identify sources of excess energy use and keep under control the energy distribution.
- 14.7 A data logger could be included alongside the smart metering system to make data sharing possible that could be disclosed for better operational energy management.
- 14.8 Additional considerations may include minimizing peak energy demand for heating and hot water, and implementing controls for heating and cooling set points along with thermal storage.
- 14.9 Promote responsible occupancy, regular meter readings, and consistent maintenance of renewable energy generators for optimal functionality and efficiency. Maximize on-site renewable energy generation with storage solutions and battery considerations.
- 14.10 Occupant behaviour significantly impacts energy consumption fluctuations. Employ separate landlord and tenant energy use meters, clearly labelled with serial numbers and designated uses. Provide detailed meter schematics and information on meter maintenance and use.
- 14.11 In the upcoming years, Post-Occupancy Evaluation (POE) is anticipated to become more widespread. Notably, The London Plan 2021 (GLA, 2020) mandates major developments to annually monitor and disclose energy usage over a five-year period, comparing it with design stage modelling. Industry initiatives, such as the BSRIA Soft Landings framework and CIBSE awards, emphasize the importance of assessing and reporting in-use performance data.

Additionally, the UKGBC Net Zero Carbon framework now includes the disclosure of operational energy use as a vital component.

- 14.12 In the future TM63 (2020c) will complement TM54, serving as a relevant guide for post-occupancy energy evaluation. It offers a model calibration framework and step-by-step instructions for measuring and verifying energy performance in-use, aiming to identify the operational energy performance gap and its root causes. Building on the design stage modelling in TM54, TM63 becomes its natural successor for post-occupancy modelling and diagnosis. The design documentation, metering strategy, and modelling guided by TM54 establish the baseline for subsequent modelling as per TM63 guidance.

Appendices

A. BREEAM Matrix

Criteria		Number of Credits
Energy modelling and reporting criteria: Energy design workshop focusing on operational energy performance	- The design team members (Ensphere Group Ltd. Amber Management & Engineering Services Ltd consultants) held an energy design workshop focusing on operational energy performance. - The purpose of the workshop was to ensure that the starting point of the TM54 Assessment is in line with the Part L compliance recommendations. - Ensphere Group Ltd. undertook advanced energy modelling, including scenario modelling during the detailed design stage for the purposes of predicting the operational energy consumption. Ensphere Group Ltd. will update the model and associated report during the postconstruction stage to account for any changes to the building specification, and the consumption target revised accordingly.	4
Building energy models	- The energy modelling was carried out using a dynamic simulation model with advanced capabilities for HVAC system and controls – IES VE 2023. - The IES VE energy model meets the suggested minimum requirements: - Calculate 8,760 hours of building operation to simulate annual energy use – by running annual simulations. - Model hourly variations in occupancy, lighting power, miscellaneous equipment power, thermostat set points, and HVAC system operation – by using APACHE Tool integrated in IES VE. - 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 – automatically calculated based on detailed construction templates as per the actual proposed fabric, and on thoroughly defined thermal templates. - Be able to take account of lighting controls linked to lighting levels from daylight – by defining lighting controls linked to occupancy and daylight levels. - There has been created a robust energy model for the proposed Lordship Lane development as it is predicted to perform providing a range of outputs. - The annual energy consumption in terms of delivered energy on a gross calorific value basis should be broken down into: - Fuel/energy source	

	○ Building servicing systems and end use group ○ Functional area and/or separately tenanted and common areas ○ Month ○ Occupancy profiles e.g., standard working days or non-working days. • The TM54 Lordship Lane assessment provides the following annual energy consumption breakdown: ○ Interior lighting ○ Exterior lighting ○ Space heating ○ Space cooling ○ Domestic hot water heating ○ Cooking ○ Elevator ○ Interior central fans ○ Interior local fans ○ Pumps ○ Appliances ○ Other processes (Pumps, Fans, Server, controls, plant, Refrigerant) ○ Total equipment energy consumption (Appliances+Elevator+Other Process) ○ TOTAL electricity ○ Total energy ○ PV Generated electricity	
Calculating unregulated energy demand for building systems or processes	• The unregulated energy use was calculated from the installed equipment loads and hours use. • The intended usage patterns for different functional areas, the expected equipment densities and usage factors were determined together with the identification of any special or process equipment. Where data was not available estimates were input from CIBSE Guides A, B, and F as well as NCM pre-defined profiles. • The following aspects were considered when defining internal gains profiles and power consumption rates ○ Operating hours - As well as determining core working hours, the likelihood of extended working hours, weekend and holiday operation, cleaning hours, and any out of hours operational equipment usage will need to be determined, e.g. lighting for security, IT left running overnight, night set back or night purge for HVAC services. ○ Occupancy factors – These should take account of the intended occupancy densities across the building and how this is expected to vary over time, and the activity level of the occupants.	

	Equipment loads were based on actual consumption estimates rather than nameplate ratings where they exist.	
Management factors	- CIBSE TM 54 report provides the generation of a predicted range based on the idealised operation of the building and anticipated operational performance of the building, which includes a margin to account for differences between ideal and actual performance. - This action is outside of the control of the client and efforts should be made to engage with prospective occupiers/building managers to ensure a satisfactory management level will be implemented. - The management factors for specific end uses, and/or functional areas can have a significant impact to the actual energy consumption vs the predicted range. For example 1.1 management factor represents a 10% increase in energy use due to poor management compared to modelled results.	
Weather files	- The weather files used in the model consider several suitable for the project's location - Typical weather file TRY (Test Reference Year) - 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.	
Scenario modelling: Several alternative scenarios are to be modelled at the design stage and should explicitly consider the possibility of changes to how the building is used, how it is managed, and the effect of the weather, along with any other changes the modeller deems necessary to capture building energy performance. This can also provide a valuable record for each project to inform future modelling, e.g. the expected occupancy versus actual occupancy. Suggested tests to consider(likely variations in occupancy, management factors and more extreme weather should be modelled) : 1. Good Management - As for Central Case prediction but with "typical"	- As part of the scenario testing a series of scenarios has been explored based on: - activity variations (PBSA Amenity as Library, café, and Gym) - extreme weather conditions: - 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. - Occupancy/ Equipment use variations: - Low - Medium - High	

weather and a management factor of 1.0 applied for all servicing systems and equipment. 2. Poor Management - As for Central Case prediction but with a management factor of 1.1 applied for all servicing systems and equipment. 3. Extreme Weather - As for Central Case prediction but using an extreme weather file. 4. Worst Case - As for Central Case prediction but with a management factor of 1.1 applied for all servicing systems and equipment prediction and using a more extreme weather file.		
Prediction stage reporting	• The TM54 Assessment report for Lordship Lane development captures both the modelling assumptions and results in accordance with TM54 Methodology by providing the following: ○ Source of the information for the assumptions and inputs ○ Key assumptions that have been made and the risks of these being wrong ○ Level of accuracy that can be ascribed to the key assumptions and inputs ○ Ranges of possible outcomes ○ Division between the variables that are under the control of the designers and those that are controlled by the occupants ○ Changes to the results as the project progresses from design through construction and to completion. ○ Sensitivity of the variables.	
Occupation stage assessment	• The energy metering strategy must be sufficiently detailed to allow comparison between predicted and actual consumption at a disaggregated level. This requires a metering strategy that is in accordance with CIBSE TM39 Building Energy Metering. • Data collection for this stage must be carried out over a one-year period which commences once the building is substantially occupied and within two years after the first occupants enter the building. • The energy modelling (comprising the model, input assumptions and outputs) carried out for the prediction stage must be submitted to BRE and also provided to the building owner to allow this credit to be awarded. This is to ensure that the energy predictions and overall energy • Both the metered energy consumption data and that generated by the weather adjusted modelling must be	2

	reported via the BREEAM energy data reporting template. Target can be adjusted subsequently to take account of actual weather conditions during the monitoring period.	

A.Data Input

Table A. 1. Methodology for evaluating operational energy use at the design stage as per CIBSE TM 54 2022

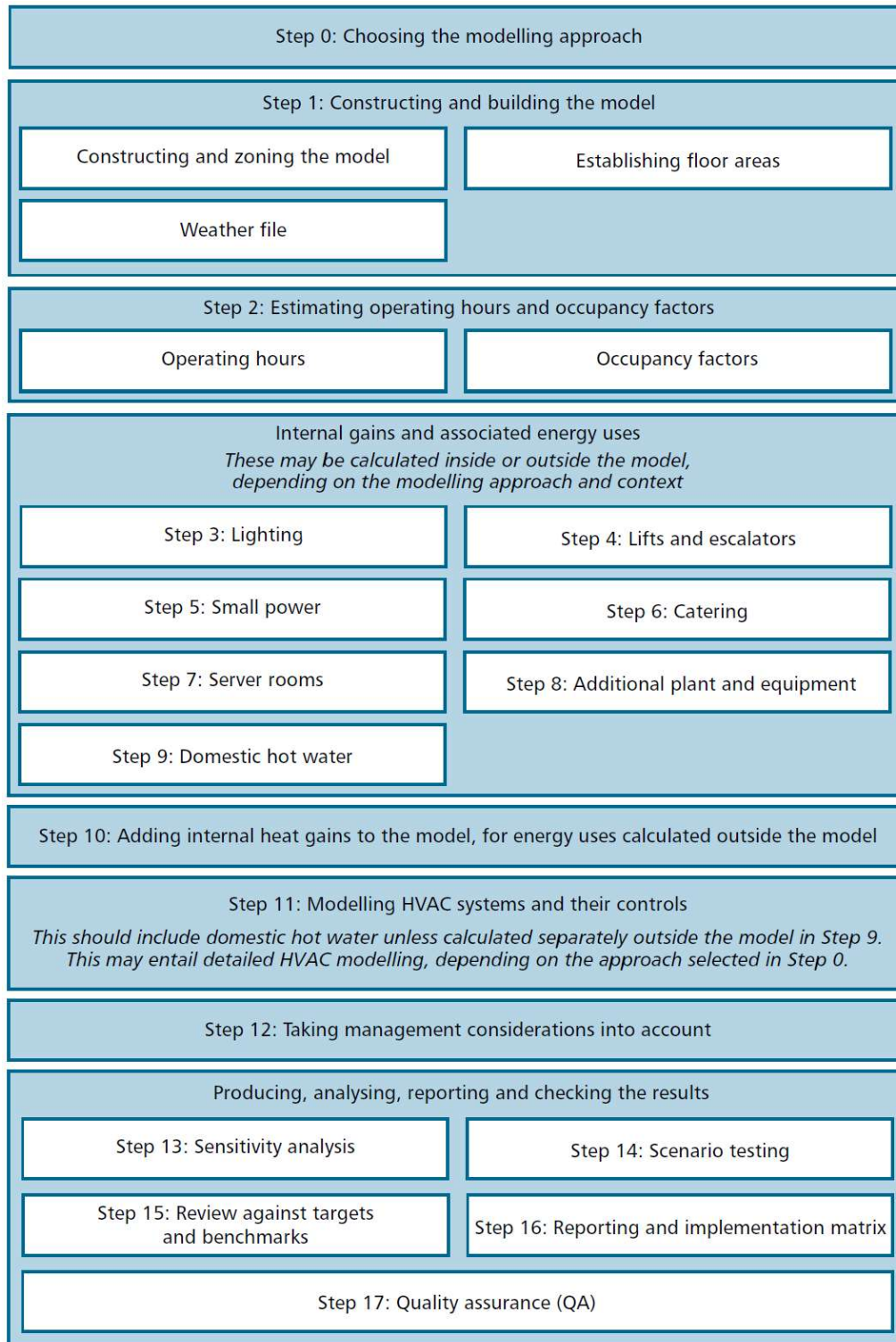
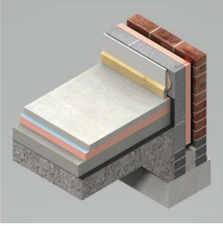
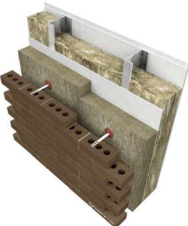
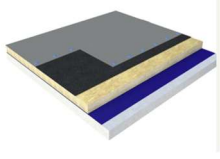


Table A. 2 Summary of proposed Construction Building elements

Fabric Element	Brief description	Illustrative construction detail input in the model	Proposed (W/m ² K)
Ground Floor			0.12
Internal Floor			
External Wall PBSA			0.14
External Wall Residential			0.15
Party Wall (Block D)			0.15
Internal Partition	Double Steel Stud		0.23
Flat Roof			0.10
Pitched Roof	Steel frame		0.10

Windows			1.20 (double glazed)
Doors	Timber/ Aluminium		1.2
* The fabric construction imagery has been simulated and selected from the Knauf insulation U-value calculator (KnaufInsulation, 2023). *The u-value for the transfer decks for the first floor across the units has been defined as 0.12 W/m2K) to suit the ground floor u-value compliance requirements.			

Table A. 3 Proposed-built student accommodation (PBSA) - Indicative construction details breakdown.

Building element	Building Component	Thickness (mm)	Total thickness	G-Value	U-Value (W/m²K)	Thermal Mass Cm (kJ/(m²K))
Ground Floor			950"+ " or "-"	n/a	0.12	85 (Very lightweight)
	Finish (TBC)					
	HardBoard/ Sheet	20				
	Concrete deck	150				
	Insulating material (thickness TBC)	180				
	Concrete Slab	600				
External Wall Type 1 (00-01)			499.5	n/a	0.15	204.9206 (Mediumweight)
(Reinforced Concrete frame)	Brickwork	102.5				
	Cavity unventilated	50				
	Insulation	210				
	Breather membrane	0				
	Continuous sheathing board	12				
Composite layer	Insulation between RC frame	100				
	Reinforced Conceret Frame	100				
	VCL	0				
	Plasterboard	25				
External Wall Type 2 (01-07)			439.5	n/a	0.15	204.9206 (Mediumweight)
(Lightsteel frame)	Brickwork	102.5				
	Cavity unventilated	50				
	Insulation	210				
	Breather membrane	0				
	Continuous sheathing board	12				
Composite layer	Insulation between steel frame	100				
	Steel frame	100				
	VCL	0				
	Plasterboard	25				
External Wall Type 3 (07-09)			454.5		0.15	204.9206 (Mediumweight)
(Lightsteel frame)	Metal cladding	15				
	Brickwork	102.5				
	Cavity unventilated	50				

	Insulation	210				
	Breather membrane	0				
	Continuous sheathing board	12				
Composite layer	Insulation between steel frame	100				
	Steel frame	100				
	VCL	0				
		25				
Internal Partitions			150		1.32	145.38 (Mediumweight)
Ligh gauge steel frame with plasterboard	Plasterboard	25				
	Steel frame with insulation between the studs	100				
		25				
Internal Floor Type 1			745		0.12	120.9796 (Lightweight)
(Transfer deck for level 01 - Steel deck with in-situ concrete)	Hardboard/ Sheets	20				
	Screed	50				
	Insulation (thickness tbc)	160				
Composite layer	Steel deck with in-situ concrete (composite layer)	600				
	Cavity	50				
	Plaster	15				
Internal Floor Type 2 (upper levels)			335		0.3	223.7476 (Heavyweight)
	Chipboard flooring	20				
	Screed	50				
	Insulation	50				
Composite layer	Concrete deck	200				
	Metal Deck	200				
	Plasterboard	15				
Roof (where applicable)					0.1	10.5 (very lightweight)
(warm or cold)	Asphalts & Other Roofing	2	632			
Composite layer	Concretes	100	"+" or "-"			
	Metal deck	100				
	Insulation	365				
	Cavity	50				
	Plaster	15				
Window Type 1	External Pane	10		0.35	1.2	
(double glazing)	Cavity	16				
	Internal Pane	10				

Table A. 4 Residential Units (Blocks B,C,D) - Indicative construction details breakdown

Building element	Building Component	Thickness (mm)	Total thickness	G-Value	U-Value (W/m²K)	Thermal Mass Cm (kJ/(m²K))
Ground Floor			950"±" or "-"	n/a	0.12	85 (Very lightweight)
	Finish (TBC)					
	HardBoard/ Sheet	20				
	Concrete deck	150				
	Insulating material (thickness TBC)	180				
	Concrete Slab	600				
External Wall Type 1 (00-01)			439.5	n/a	0.15	204.9206 (Mediumweight)
(Reinforced Concrete frame)	Brickwork	102.5				
	Cavity unventilated	50				
	Insulation	150				
	Breather membrane	0				
	Continuous sheathing board	12				
Composite layer	Insulation between RC frame	100				
	Reinforced Conceret Frame	100				
	VCL	0				
	Plasterboard	25				
External Wall Type 2 (01-07)			439.5	n/a	0.15	204.9206 (Mediumweight)
(Lightsteel frame)	Brickwork	102.5				
	Cavity unventilated	50				
	Insulation	150				
	Breather membrane	0				
	Continuous sheathing board	12				
Composite layer	Insulation between steel frame	100				
	Steel frame	100				
	VCL	0				
	Plasterboard	25				
External Wall Type 3 (07-09)			454.5		0.15	204.9206 (Mediumweight)
(Lightsteel frame)	Metal cladding	15				
	Brickwork	102.5				
	Cavity unventilated	50				
	Insulation	150				
	Breather membrane	0				
	Continuous sheathing board	12				
Composite layer	Insulation between steel frame	100				
	Steel frame	100				
	VCL	0				
		25				
Party wall (Block D)			679		0.15	127.07 (Lightweight)
	Plasterboard	25				
	Brickwork	102.5				
	Cavity unventilated	50				
	Insulation	100				

	Continuous sheathing board	12				
	Steel frame with insulation between the frame	100				
	Continuous sheathing board	12				
	Insulation	100				
	Cavity unventilated	50				
	Brickwork	102.5				
	Plasterboard	25				
Internal Partitions			150		1.32	145.38 (Mediumweight)
Ligh gauge steel frame with plasterboard	Plasterboard	25				
	Steelframe with insulation between the studs	100				
		25				
Internal Floor Type 1			745		0.12	120.9796 (Lightweight)
(Transfer deck for level 01 - Steel deck with in-situ concrete)	Hardboard/ Sheets	20				
	Screed	50				
	Insulation (thickness tbc)	160				
Composite layer	Steel deck with in-situ concrete (composite layer)	450				
	Cavity	50				
	Plaster	15				
Internal Floor Type 2 (upper levels)			335		0.3	223.7476 (Heavyweight)
	Chipboard flooring	20				
	Screed	50				
	Insulation	50				
Composite layer	Concrete deck	200				
	Metal Deck	200				
	Plasterboard	15				
Roof (where applicable)					0.1	10.5 (very lightweight)
(warm or cold)	Asphalts & Other Roofing	2	632			
	Concretes	100	"+" or "-"			
	Metal deck	100				
	Insulation	365				
	Cavity	50				
	Plaster	15				
Window Type 1	External Pane	10		0.35	1.2	
(double glazing)	Cavity	16				
	Internal Pane	10				

Table A. 5 Zoning area strategy

Building Unit	Building GIA (Gross internal area)	Building Typology	Building Typology GIA	Floor levels	Construction Type	Activity Type	Room Type GIA (gross internal area)	Thermal strategy	Thermal strategy room GIA
Block A	20 006.3	Non-domestic Area (Commercial – Block A Ground floor)	15198.2	00	Block A – Ground Floor				
			(including groundfloor lift and stairs GIA)			A-non-Resi	673.3	A-non-Resi	673.3
						A-PBSA Amenity	1094.7	A_PBSA Amenity	1094.7
						A-Circulation Areas	178.6	Commercial Circulation Areas	178.6
						A-PBSA Plant	161.1	A_PBSA Plant	161.1
						A-Refuse	82.6	Refuse	82.6
						A-Commercial Storage	6.0	A-Commercial Storage	6.0
						A-Riser	275.9	A_Riser	275.9
						A-Commercial Plant	204.5	A_Commercial Plant	204.5
		Purpose-built student accommodation	17341.7	01	Block A – 01-07	A-Corridor/Stairs (Circulation)	3132.1	Corridor/Stairs (Circulation)	3132.1
				..		A-Studio	11929.5	Studio	7813.6
				...				Studio MVHR only LL façade	4115.9
						A-Ensuite	923.6	Ensuite	923.6
				09	Block A – 07-09	A-Kitchen/Living	630.8	Kitchen/Living	303.4
								Kitchen/Living MVHR only LL façade	327.5
						A-Lift	279.7	Lift	279.7
						A-Storage	63.3	Storage	63.3
						A-Cycle storage (Unheated Storage)	382.7	Cycle storage (Unheated Storage)	382.7
						A-PBSA Storage	51.2	A-PBSA Storage	51.2
						A-PBSA-Plant	161.1	A-PBSA-Plant	161.1
Block B	2268.4	Residential Area		00	Blocks B, C, and D – Ground Floor	Resi_1B2P_Kitchen/Living	743.9	Resi_1B2P_Kitchen/Living	743.9
				...		Resi_CBD	216.1	Resi_CBD	216.1
						Resi_Services	29.4	Resi_Services	29.4
					Blocks B, C, and D – 01-Below top level	Resi_Internal corridors	691.9	Resi_Internal corridors	691.9
						Resi_2B4P_Kitchen/Living	873.9	Resi_2B4P_Kitchen/Living	873.9
				06		Resi_2B3P_Kitchen/Living	283.6	Resi_2B3P_Kitchen/Living	283.6
Block C	4433.0			00	Blocks B, C, and D – Top level	Resi_Appliances	94.2	Resi_Appliances	94.2
						Resi_3B5P_Living/Kitchen	186.7	Resi_3B5P_Living/Kitchen	186.7
						Resi_5B8P Kitchen	48.1	Resi_5B8P Kitchen	48.1
						Resi_5B8P_Living	175.3	Resi_5B8P_Living	175.3

				06					
						Resi_Lift	105.0	Resi_Lift	105.0
Block D	1167.6			00		Resi_Riser	92.2	Resi_Riser	92.2
				...		Resi_Roof	218.4	Resi_Roof	218.4
				02		Resi_Circulation common	595.0	Resi_Circulation common	595.0
						Resi_Storage	367.5	Resi_Storage	367.5
						Resi_Plant	434.5	Resi_Plant	434.5
						Resi_Double Bedroom	1799.7	Resi_Double Bedroom	1799.7
						Resi_Single Bedroom	403.5	Resi_Single Bedroom	403.5
						Resi_Bathroom	510.0	Resi_Bathroom	510.0

Table A. 6. Table D1 Floor space factors from the Approved Document B (fire safety) volume 2: Buildings other than dwellings, 2019 edition incorporating 2020 and 2022 amendments (GOV.UK, 2019)

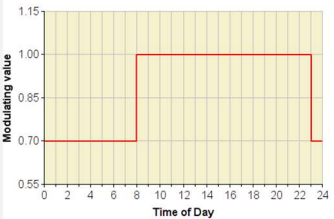
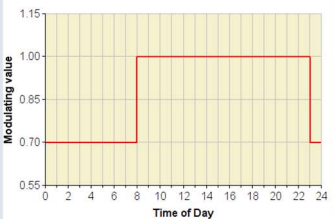
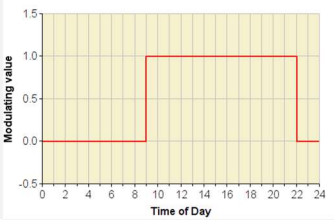
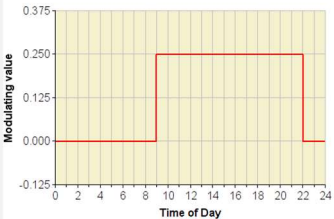
Table D1 Floor space factors⁽¹⁾	
Type of accommodation ⁽²⁾⁽³⁾	Floor space factor (m ² /person)
1. Standing spectator areas, bar areas (within 2m of serving point), similar refreshment areas	0.3
2. Amusement arcade, assembly hall (including a general purpose place of assembly), bingo hall, club, crush hall, dance floor or hall, venue for pop concerts and similar events and bar areas without fixed seating	0.5
3. Concourse or queuing area ⁽⁴⁾	0.7
4. Committee room, common room, conference room, dining room, licensed betting office (public area), lounge or bar (other than in (1) above), meeting room, reading room, restaurant, staff room or waiting room ⁽⁵⁾	1.0
5. Exhibition hall or studio (film, radio, television, recording)	1.5
6. Skating rink	2.0
7. Shop sales area ⁽⁶⁾	2.0
8. Art gallery, dormitory, factory production area, museum or workshop	5.0
9. Office	6.0
10. Shop sales area ⁽⁷⁾	7.0
11. Kitchen or library	7.0
12. Bedroom or study-bedroom	8.0
13. Bed-sitting room, billiards or snooker room or hall	10.0
14. Storage and warehousing	30.0
15. Car park	Two persons per parking space
NOTES:	
1. As an alternative to using the values in the table, the floor space factor may be determined by reference to actual data taken from similar premises. Where appropriate, the data should reflect the average occupant density at a peak trading time of year.	
2. Where accommodation is not directly covered by the descriptions given, a reasonable value based on a similar use may be selected.	
3. Where any part of the building is to be used for more than one type of accommodation, the most onerous factor(s) should be applied. Where the building contains different types of accommodation, the occupancy of each different area should be calculated using the relevant space factor.	
4. For detailed guidance on appropriate floor space factors for concourses in sports grounds refer to <i>Concourses</i> published by the Football Licensing Authority.	
5. Alternatively the occupant number may be taken as the number of fixed seats provided, if the occupants will normally be seated.	
6. Shops excluding those under item 10, but including: supermarkets and department stores (main sales areas), shops for personal services, such as hairdressing, and shops for the delivery or collection of goods for cleaning, repair or other treatment or for members of the public themselves carrying out such cleaning, repair or other treatment.	
7. Shops (excluding those in covered shopping complexes but including department stores) trading predominantly in furniture, floor coverings, cycles, prams, large domestic appliances or other bulky goods, or trading on a wholesale self-selection basis (cash and carry).	

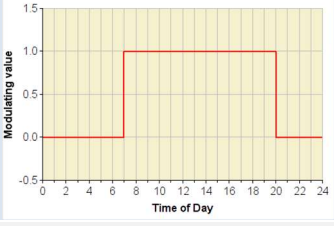
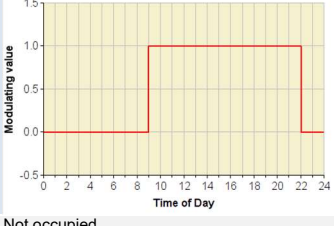
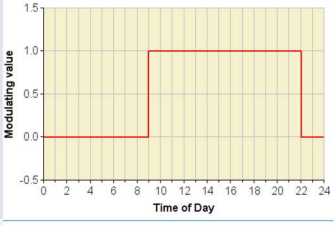
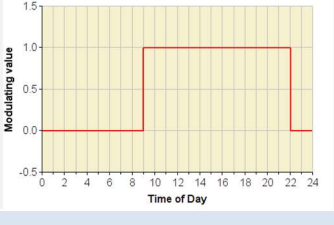
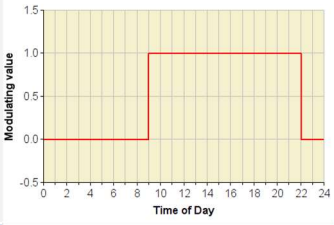
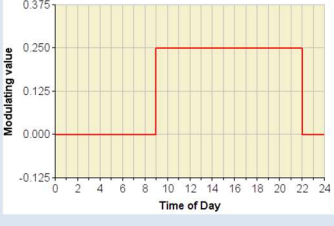
Table A. 7. Table 2 Occupancy and equipment gain description for residential areas from CIBSE TM59: Design methodology for the assessment of overheating risk in homes (2017) (CIBSE, 2017)

Table 2 Occupancy and equipment gain descriptions

Unit/ room type	Occupancy	Equipment load
Studio	2 people at 70% gains from 11 pm to 8 am 2 people at 100% gains from 8 am to 11 pm	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	1 person from 9 am to 10 pm; room is unoccupied for the rest of the day	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
1-bedroom apartment: living room	1 person at 75% gains from 9 am to 10 pm; room is unoccupied for the rest of the day	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
1-bedroom apartment: kitchen	1 person at 25% gains from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 300 W from 6 pm to 8 pm Base load of 50 W for the rest of the day
2-bedroom apartment: living room/kitchen	2 people from 9 am to 10 pm; room is unoccupied for the rest of the day	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	2 people at 75% gains from 9 am to 10 pm; room is unoccupied for the rest of the day	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
2-bedroom apartment: kitchen	2 people at 25% gains from 9 am to 10 pm; room is unoccupied for the rest of the day	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/kitchen	3 people from 9 am to 10 pm; room is unoccupied for the rest of the day	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: living room	3 people at 75% gains from 9 am to 10 pm; room is unoccupied for the rest of the day	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: kitchen	3 people at 25% gains from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 300 W from 6 pm to 8 pm base load of 50 W for the rest of the day
Double bedroom	2 people at 70% gains from 11 pm to 8 am 2 people at full gains from 8 am to 9 am and from 10 pm to 11 pm 1 person at full gains in the bedroom from 9 am to 10 pm	Peak load of 80 W from 8 am to 11 pm Base load of 10 W during the sleeping hours
Single bedroom (too small to accommodate double bed)	1 person at 70% gains from 11 pm to 8 am 1 person at full gains from 8 am to 11 pm	Peak load of 80 W from 8 am to 11 pm Base load of 10 W during sleeping hours
Communal corridors	Assumed to be zero	Pipework heat loss only; see section 3.1 above

Table A. 8. Operating Hours and Occupancy Patterns for Baseline Scenario

Building Typology	Room type	Room Type GIA (gross internal area) (m ²)	No. p	Occupancy density (m ² /person)	Maximum Sensible Gain (W/P)	Maximum latent gain (W/P)	Occupancy	Occupancy Profile
Block A- Purpose-built student accommodation.	A- Corridor/Stairs (Circulation)	3132.1					Assumed to be zero	N/A
	A-Studio	11929.5	1		75	55	2 people at 70% gains from 11 pm to 8 am 2 people at 100% gains from 8 am to 11 pm	
	A-Ensuite	923.6			75	55	2 people at 70% gains from 11 pm to 8 am 2 people at 100% gains from 8 am to 11 pm	
	A- Kitchen/Living (Communal Area)	630.8		7 (*as per Table D1 Approved Document Part B (GOV.UK, 2019))	75	55	Full occupancy between 9 am to 10 pm; room is unoccupied for the rest of the day	
	A-Lift	279.7			N/A	N/A		N/A
	A-Storage	63.3						Space not occupied
	A-Cycle storage (Unheated Storage)	382.7		9.858 (*NCM profile)	70	70	Full occupancy between 7 am to 8 pm; room is unoccupied for the rest of the day	
	A-PBSA Storage	51.2						Space not occupied
	A-PBSA-Plant	161.1						Space not occupied
Block A- Commercial	A-non-Resi	673.3						Please see scenarios in Table
	A-PBSA Amenity	1094.7						Please see scenarios in Table
	A-Circulation Areas	178.6						N/A
	A-Refuse	82.6						
								

	A-Commercial Storage	6.0		9.858 (*NCM profile)	70	70		
	A-Riser	275.9					Assumed to be zero	
	A-Commercial Plant	204.5						
Block B, C, and D			2				2 people from 9 am to 10 pm; room is unoccupied for the rest of the day	
	Resi_1B2P_Kitchen/ Living	743.9						
	Resi_CBD	216.1						Not occupied
	Resi_Services	29.4						
	Resi_Internal corridors	691.9						
			4				4 people from 9 am to 10 pm; room is unoccupied for the rest of the day	
	Resi_2B4P_Kitchen/ Living	873.9						
			3				3 people from 9 am to 10 pm; room is unoccupied for the rest of the day	
	Resi_2B3P_Kitchen/Living	283.6						
	Resi_Appliances (CBD with HIU services)	94.2						
			5				5 people from 9 am to 10 pm; room is unoccupied for the rest of the day	
	Resi_3B5P_Living/ Kitchen	186.7						
			8				8 people at 25% gains from 9 am to 10 pm; room is unoccupied for the rest of the day	
	Resi_5B8P_Kitchen	48.1						

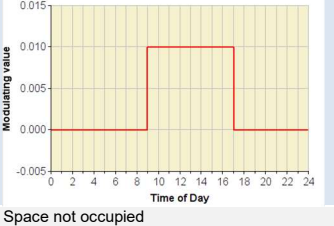
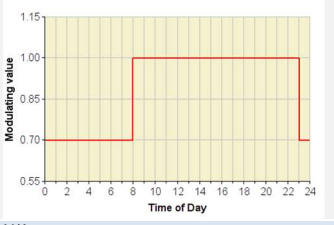
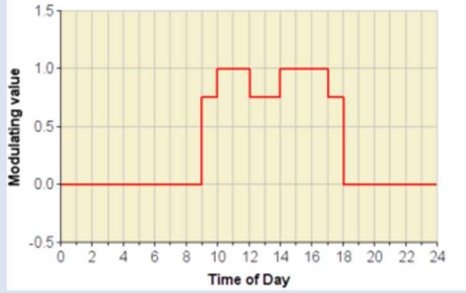
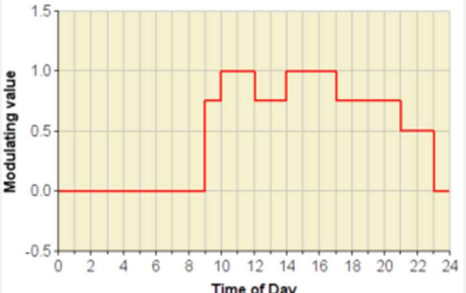
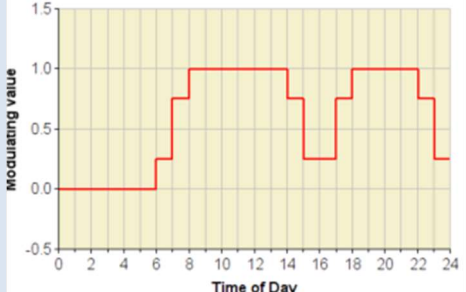
			8				8 people at 75% gains from 9 am to 10 pm; room is unoccupied for the rest of the day	
	Resi_5B8P_Living	175.3						
	Resi_Lift	105.0					Assumed to be zero	Not occupied
	Resi_Riser	92.2					Assumed to be zero	Not occupied
	Resi_Roof	218.4					Assumed to be zero	Not occupied
	Resi_Circulation common	595.0					Assumed to be zero	N/A
	Resi_Storage (Cycle storage)	367.5						
	Resi_Plant	434.5					Assumed to be zero	Space not occupied
			2		75	55	2 people at 70% gains from 11 pm to 8 am 2 people at full gains from 8 am to 9 am and from 10 pm to 11 pm 1 person at full gains in the bedroom from 9 am to 10 pm	
	Resi_Double Bedroom	1799.7			75	55	1 person at 70% gains from 11 pm to 8 am 1 person at full gains from 8 am to 11 pm	
	Resi_Single Bedroom	403.5	1					
	Resi_Bathroom	510.0						N/A

Table A. 9. Operating Hours and Occupancy Patterns for Block A non-residential and PBSA Amenity spaces

Room Type Scenarios	GLA (gross internal area) (m2)	Floor space factor (m2/person)	Maximum Sensible gain (W/P)	Maximum Latent Gain (W/P)	Occupancy Profile
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	
Scenario 3: Gym	1094.7	5	102	198	