



## **Cambridge Halls**

TM54 Operational Energy Assessment  
Stage 4

15299-WAT-XX-XX-RP-V-59026 P03

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EXECUTIVE SUMMARY

The purpose of this report is to evaluate the anticipated operating energy consumption for the development at 41 Cavendish Street, Manchester M15 6TT (“the Site”), hereafter referred to as the ‘Proposed Development’. This report has been prepared to supplement the overarching energy strategy, providing technical insight and analysis in support of the proposed development. Its purpose is to assist the client in making informed design decisions by evaluating energy performance considerations and identifying opportunities for improved sustainability and efficiency. This assessment captures the operational carbon emissions for the Proposed Development for both regulated and unregulated energy use.

The TM54 approach undertaken covers a wide range of uses, including lighting, HVAC systems, lifts, escalators, small power loads, catering facilities, server rooms, and uncontrolled energy loads.

The report's main objective is to calculate the energy usage intensity (EUI) in accordance with the client's instructions for PBSA's portion of the building. The central case scenario generated an EUI of 72.25 kWh/m² for Phase 1 and 70.26 kWh/m² for Phase 2. Including PVs this results in a total consumption of 2,143,300 kWh for Phase 1 and 2,516,788 kWh for Phase 2.

The proposed design comprises of cluster beds, cluster kitchens, and studios heated by direct electric. The amenities and back of house (BOH) areas are heated and cooled using a variable refrigerant flow (VRF) system. Phase 2 consists of an affordable living concept which includes a large ‘Super Kitchen’ on the ground floor to serve a number of clusters. Within these clusters are pantries which have smaller cooking appliances and food storage capacities. The phases have been modelled separately as they are physically separated and have differing layouts and room types.

A review of the results has identified the following top 4 energy hotspots:

- Heating
- Computers
- Small Power
- DHW

The below table shows the energy use intensities with the management ratio included, highlighting the importance of good management.

|                                    | Good Case                                                    |         | Baseline Case                                           |         | Worst Case                                    |         |
|------------------------------------|--------------------------------------------------------------|---------|---------------------------------------------------------|---------|-----------------------------------------------|---------|
|                                    | (Fully functional controls with excellent management skills) |         | (Partially functional controls with average management) |         | (No functional controls with poor management) |         |
| Management Factor                  | 1                                                            |         | 1.05                                                    |         | 1.15                                          |         |
|                                    | Phase 1                                                      | Phase 2 | Phase 1                                                 | Phase 2 | Phase 1                                       | Phase 2 |
| Total Energy Consumption (kWh/ m²) | 72.25                                                        | 70.26   | 75.87                                                   | 73.77   | 83.09                                         | 80.80   |

## 1. PROJECT REQUIREMENTS

This report has been prepared by Waterman Building Services Limited to outline the operational energy consumption for the development at 41 Cavendish Street, Manchester, M15 6TT ("the Site"), hereafter referred to as the 'Proposed Development'.

### 1.1 Planning Requirements

The Greater Manchester Authority does not have any specific requirements, but for the sake of good practice it is recommended that the GMCA "Part 1 Design Guidance for Net-Zero" should be consulted throughout the planning process.

Additionally, in line with Unite Student Construction Framework, this report provides the TM54 analysis for compliance. At all stages of the development, the TM54 will be updated to ensure realistic modelling has been applied.

### 1.2 BREEAM ENE01 Prediction of operational energy consumption

The proposed development is targeting an 'Excellent' rating under BREEAM New Construction V6.1 (BREEAM NC V6.1) and requires a minimum of 4 credits to be achieved under ENE 01. The methodology for the second credit within ENE 01, prediction of operational energy consumption, is based on CIBSE TM54:2022. This modelling has been carried out using Integrated Environmental Solutions Virtual Environment (IESVE), version 2022.2. Through this program, a dynamic model was built to reflect the current design for the proposed development, including building fabric and services, as outlined in the modelling methodology.

The calculations have been undertaken in line with the BREEAM requirements; therefore, 4 credits can be awarded under *ENE01 Prediction of operational energy consumption*.

### 1.3 Next steps

The findings presented in this report should aid the design team as they continue to explore opportunities for energy efficiency. As the design progresses, construction data, manufacturer selections, and façade performance will be refined.

As potential tenants are identified for the commercial areas located on the lower floors, this will also apply to the assumptions made for the equipment and ventilation strategy. If a further analysis is undertaken at a later stage, the project team should feed these refinements and information into the modelling to help focus the key variables for an updated sensitivity analysis.

## 2. INTRODUCTION

Waterman Building Services have been appointed by Unite Students to provide an Operational Energy Assessment for the development at 41 Cavendish Street, Manchester, M15 6TT ("the Site"), hereafter referred to as the 'Proposed Development'. Its purpose is to assist the client in making informed design decisions by evaluating energy performance considerations and identifying opportunities for improved sustainability and efficiency.

### 2.1 Purpose of the report

This report summarises the assessment of predicted operational energy consumption for the proposed building. It provides guidance to the design team on key drivers of energy consumption and meets the requirements of the BREEAM NC V6.1 Ene 01 credits.

The focus on reducing carbon emissions to avoid climate tipping points is crucial in every sector, particularly in construction, where aligning operational energy use with global net zero targets is imperative. As we build new developments expected to last beyond the UK's net zero carbon deadline, it is essential to optimize and transition to a lower carbon future wherever possible. Given the significant impact of climate change, building design must adapt by incorporating sustainable practices and resilience against changing climate conditions.

Quantifying energy consumption at the design stage and identifying key contributors are critical to achieving low-carbon, sustainable development. By reducing energy consumption and thus carbon emissions, developments will be better positioned to address both the current climate crisis and the energy crisis. With record highs in electricity and gas prices, optimizing design to limit consumption will benefit owners and operators by reducing operational costs.

The need to reduce carbon emissions to mitigate climate tipping points permeates across all sectors, but particularly in the built environment. Given that operational energy usage in buildings must strive to align with global net zero targets, the construction of new developments with lifespans extending beyond the UK's net zero carbon timeline underscores the necessity to optimize towards a lower carbon future. It is crucial to quantify energy consumption during the design phase and dissect its key contributors to realise low carbon, sustainable development.

Traditionally, energy calculations for new developments have revolved around compliance, relying on simplified building regulations methodology to estimate regulated consumption. However, this compliance focused approach, framed within relative assessments, lacks the granularity to comprehensively evaluate energy performance. Similarly, Energy Performance Certificates (EPCs), while providing an asset rating of normalised performance across the built environment, present a standardised yet limited perspective on a building's operational efficiency, failing to consider unregulated energy loads or actual occupant usage patterns. For this reason, a disconnect was found between the regulated energy consumption of a building predicted at design, and the actual performance of the building, with research identifying 'performance gaps' of up to five-fold.

As climate change intensifies, building designs must integrate adaptive strategies to ensure sustainability and resilience. Incorporating green infrastructure, enhancing insulation, and using renewable energy sources are vital steps toward future-proofing buildings against the impacts of a changing climate. However, the use of buildings must also change, and robust estimations of energy use at an early stage, to optimise buildings and reduce energy use, are a key part of the design process.

### 2.2 Software Compliance

The building has been modelled using methodology consistent with the National Calculation Method as defined by Environmental Modelling in assessing energy consumptions.

The software used for simulating the DSM results is Integrated Environmental Solutions Virtual Environment (IES:VE), version 2024.0.2.0. Through this software package, a dynamic model was built to reflect the current

building design for the proposed development including thermal construction and building services details which are outlined in the modelling methodology. The simulations account for hourly profiles of occupancy, small power, lighting, and HVAC operation across the whole year.

### 2.3 Methodology

The CIBSE Technical Memorandum 54 (2022), commonly referred to as TM54, offers a robust framework for understanding energy usage dynamics during the design phase, facilitating a more accurate projection of operational energy performance.

The UK has a design-for-compliance culture which has led to the well-known 'performance gap' that exists between original design intent and how a building truly performs in-use. The TM54 process seeks to minimise this gap, by providing a 'not for regulation' evaluation of predicted performance, that can provide valuable insight to the design team on likely energy hotspots whilst not subject to the shadow of regulatory compliance.

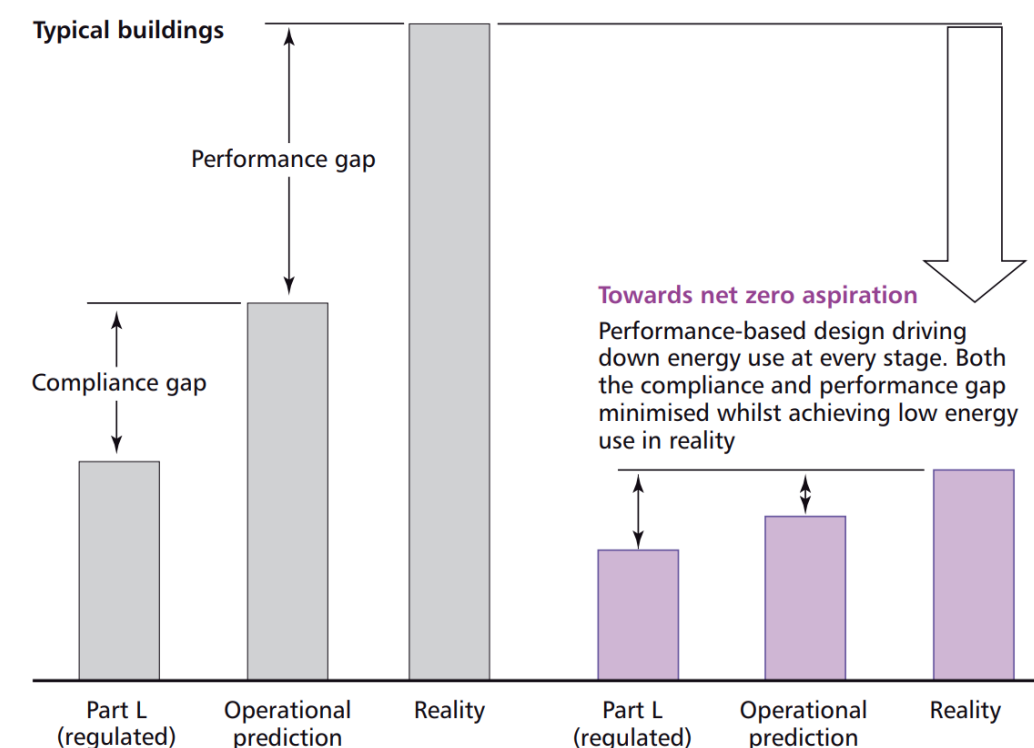


Figure 1: TM54 Energy Explanation

The latest edition of CIBSE TM54 incorporates occupancy modelling and promoting continuous data-driven commissioning. Its methodology encompasses detailed modelling of energy usage across various end uses, dialogues about prospective occupants and operational responsibilities, and sensitivity analyses to identify factors influencing energy consumption.

The methodology used within this report is based on the following principles (adapted from CIBSE TM54 2022):

- Modelling at an appropriate level of detail, commensurate with the stage of design, to more accurately estimate energy use for heating, cooling, ventilation, hot water and pumping systems, incorporating more

realistic profiles and inputs. This modelling approach is supported by additional energy consumption assessments for specific purposes such as lighting, vertical transport, catering and small power.

- Engaging in discussions regarding potential occupants of the building and identification of individuals responsible for its operation, taking into consideration factors such as operational hours and energy management protocols.
- Incorporating all anticipated energy demands within the building, extending beyond just building servicing equipment.
- Disaggregating energy consumption data by end-use, facilitating comparison against established benchmarks and sub-metering.
- Implementing scenario testing and sensitivity analyses to ascertain the most impactful factors influencing overall energy usage, presenting outcomes within a spectrum ranging from high to low energy consumption scenarios.

The step by step methodology can be found in Appendix A.

## 2.4 BREEAM ENE01

The Ene 01 Prediction of operational energy consumption credit is worth four credits and has eight criteria (with criteria 2-6 addressed in this report):

1. Achieve criterion 2 in Ene 04 Low carbon design.
2. Estimate the occupancy, energy use for unregulated energy loads and management practices.
3. Undertake detailed energy modelling to predict the building energy consumption.
4. Undertake sensitivity analysis to determine the factors that can significantly impact building energy consumption.
5. Based on the results of the sensitivity analysis, and in discussion with the project team, the client, and the prospective occupier devise scenarios to explore how high impact factors might influence the building energy consumption.
6. Undertake scenario modelling and use these findings to inform improvements to the design of the building and to operational, maintenance, and handover strategies.
7. Determine an energy target for the building based on the results of the scenario modelling.
8. At the post-construction stage, the scenario modelling should be repeated to reflect the post-construction building specification and, if necessary, adjust the energy target.

The methodology for predicting energy consumption is based on *CIBSE TM54:2022 Evaluating operational energy use at the design stage* and involves undertaking detailed modelling of the building fabric and services and the expected operational hours and occupancy factors and management practices.

## 2.5 Modelling disclaimer

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

The actual performance and/or energy usage for the building once occupied may vary from the calculated values. These differences will occur due to a number of variable parameters between the modelled building and the actual building including the hours, levels of occupancy, how the plant is used and the design criteria with regard to how

the rooms are controlled.

Whilst the simulations have been undertaken in good faith using reasonable skill and care, Waterman can take no responsibility for differences between the computer simulations and the actual performance of the completed building due to the inherent complexity and variability of attempting to predict the future.

## 2.6 Energy Specialist

This report has been produced by James Barker and the team under their direct supervision. James Barker is a qualified Level 3, 4, & 5 Energy Modeller with IESVE software, Low Carbon Consultant, and qualified Low Carbon Energy Assessor. James Barker is also an individual who has acquired substantial expertise or a recognised qualification for undertaking assessments, designs and installations of low and zero carbon solutions in the commercial buildings sector and is not professionally connected to a single low and zero carbon technology or manufacturer.

3. PROJECT DETAIL

3.1 Proposed Development

The planning application seeks planning permission for the following description of development:

*“Demolition of existing halls of residence and erection of two buildings of 30 and 24 storeys above ground, plus basement and rooftop plant levels, comprising purpose-built student accommodation with internal and external rooftop communal amenity space (Sui Generis). Ground floor commercial and community uses (Flexible Use Classes E, F1 or F2). Hard and soft landscaping and associated highway works”*

The 2,284 rooms, all consisting of student accommodation (Use class – Sui Generis), will be split across the two Phases and these have been split within this analysis for energy reporting based on the face that they are physically split and will operate independently of each other. The construction and operation of both phases is much the same with the main difference being the ‘super Kitchen’ on the ground floor of phase 2 which forms part of the affordable cluster layouts.

Table 1 below provides a breakdown of the building’s spaces in terms of area as taken from the energy modelling. This report was completed for the areas considered under purpose-built student accommodation.

Table 1: Building Usage

|       | Phase 1                        | Phase 2 | Phase 1        | Phase 2 |
|-------|--------------------------------|---------|----------------|---------|
|       | Gross Internal Area (GIA) (m²) |         | Percentage (%) |         |
| Total | 30,288                         | 36,084  | 47             | 53      |
|       | 67,022                         |         | 100            |         |



Figure 2: Site Plan/Location with Phase 1 (South) and Phase 2 (North) shown

4. ASSESSMENT INPUTS

4.1 Building Modelling

Building geometry has been modelled in accordance with the drawings that was issued to the project team by Falconer Chester Hall (FCH) Architects for the purpose of energy modelling. The following fabric parameters included in Appendix C were agreed with the architect and have been utilised within the energy model. At present, a dynamic simulation modelling was carried out at Stage 3, meaning that information is currently in flux as the design development progresses. Internal gains and profiles for the PBSA component of the building were previously discussed with the client. This section contains an outline of the building inputs for the base case.

For the simulations, weather data has been utilised from the CIBSE ManchesterTRY.epw

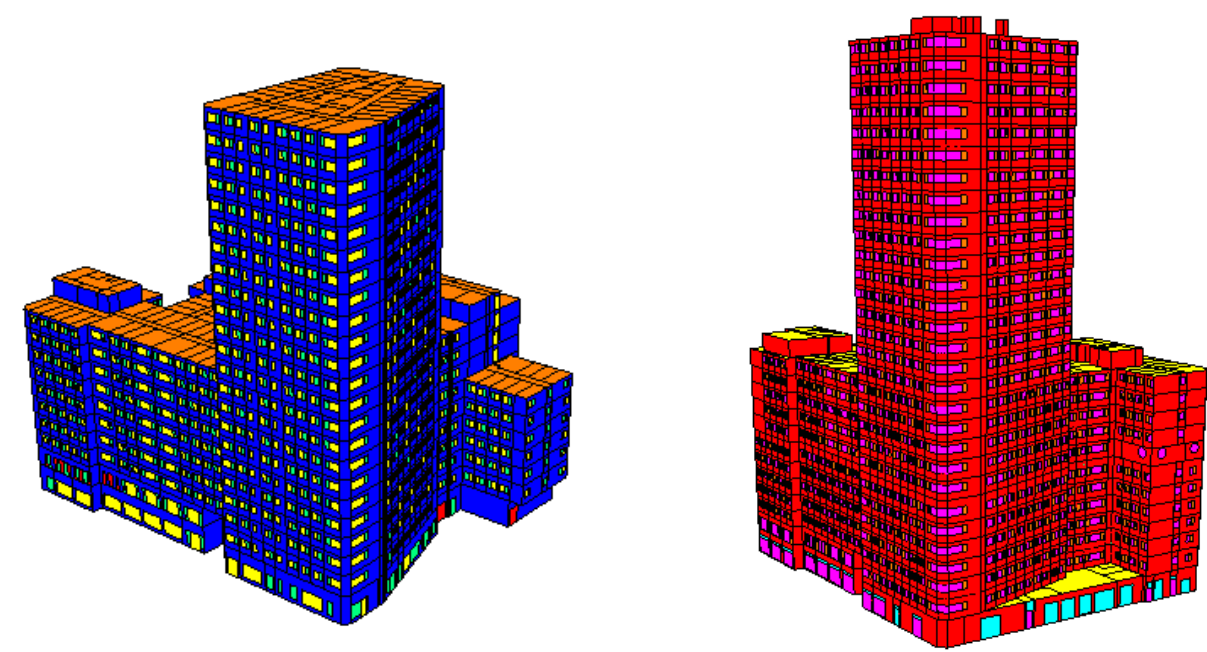


Figure 3: Phase 2 IES Model

4.2 Operating Hours and Occupancy Factors

The building occupancy hours and factors were modelled with guidance from Unite Students as to how they expect it to be run as well as relevant guidance documents. Simplified profiles have been utilised to represent operating hours for occupancy, small power and lighting etc. These will be highlighted in the following steps, and screenshots of daily profiles for the most impactful spaces have been included in Appendix B.

Occupancy figures were reasonably assumed to have a maximum sensible gain of 90 W/person and maximum latent heat gain of 60 W/person. Occupancy Load for commercial workspace is taken as 80 W per person sensible gain; 60 W per person latent.

Table 2: Operation/Occupancy Use - PBSA

| Zone Type        | Persons      | Occupancy Profile                                       | Diversity Factor |
|------------------|--------------|---------------------------------------------------------|------------------|
| Cluster Bedrooms | 1 person     | On continuously                                         | 0.4              |
| Studios          | 1 person     | On continuously                                         | 0.5              |
| Cluster Kitchens | 9 people     | On continuously                                         | 0.6              |
| Amenity Spaces   | 10 m²/person | On continuously                                         | 0.7              |
| Super Kitchen    | 300 people   | On continuously                                         | 0.6              |
| Study            | 10 m²/person | On continuously                                         | 0.15             |
| Offices          | 10 m²/person | On continuously<br>(Occupancy Reduced to 20% overnight) | 1.0              |

4.3 Lighting Energy Use

Energy efficiency LED lamps will be used throughout the development. Student rooms shall be manually controlled, but shared areas and circulation shall benefit from occupancy sensors and daylight dimming where appropriate.

The below table indicates the headline lightning inputs for the primary spaces.

Table 3: Lighting Usage - PBSA

| Zone Type         | Lighting Power | Lighting Usage       | Diversity Factor |
|-------------------|----------------|----------------------|------------------|
| Cluster Bedrooms  | 21 W           | 9 am-11am & 4pm-12pm | 0.5              |
| Studios           | 28 W           | 9 am-11am & 4pm-12pm | 0.6              |
| Cluster Bathrooms | 7 W            | 9 am-11am & 4pm-12pm | 0.3              |
| Shared Kitchens   | 6 W/m²         | On continuously      | 0.4              |
| Super Kitchen     | 6 W/m2         | On continuously      | 0.4              |
| Amenity Spaces    | 6 W/m²         | On continuously      | 0.5              |
| Study             | 6 W/m²         | On continuously      | 0.5              |
| Circulation       | 2 W/m²         | On continuously      | 0.2              |

Table 4: Lighting Usage – Office Areas/BOH

| Zone Type    | Lighting Power | Lighting Usage            | Diversity Factor |
|--------------|----------------|---------------------------|------------------|
| Office Areas | 9 W/m²         | Follows occupancy profile | 0.7              |
| WC's/Showers | 6 W/m²         | Follows occupancy profile | 0.7              |

4.4 Small Power

Estimates for small power has been calculated with guidance from Unite Students which incorporates computer gains, and this has been split into the following profile types as seen in the table below.

The amenity spaces have been split into low and high power to reflect the different space types such as cinemas, gym and meeting rooms etc.

Table 5: Small Power Use

| Zone Type        | Computers | Usage             | Diversity Factor | Miscellaneous        | Usage             | Diversity Factor |
|------------------|-----------|-------------------|------------------|----------------------|-------------------|------------------|
| Cluster Bedrooms | 80 W      | Nighttime Standby | 0.7              | 80 W                 | Nighttime Standby | 0.5              |
| Studios          | 80 W      | Nighttime Standby | 0.7              | 150 W                | Nighttime Standby | 0.5              |
| Amenity Space    | -         | -                 | -                | 75 W/m² (High power) | On continuously   | 0.4              |
|                  |           |                   |                  | 5 W/m² (Low power)   |                   | 0.7              |
| Study            | 8 W/m²    | On continuously   | 0.15             | 5 W/m²               | On continuously   | 0.3              |
| Offices          | 8 W/m²    | 8am – 6pm         | 1.0              | -                    | -                 | -                |
| Cluster Kitchen  | -         | -                 | -                | 150 W                | Nighttime Standby | 0.5              |
| Super Kitchen    |           |                   |                  | 13,500 W             | Nighttime Standby | 0.5              |

4.5 Catering

No significant catering facilities are present; however, a small cooking load has been applied to the kitchens and studios.

Table 6: Catering Use

| Zone Type        | Cooking  | Usage      | Diversity |
|------------------|----------|------------|-----------|
| Cluster Kitchens | 400 W*   | 9am – 10pm | 0.6       |
| Studios**        | 200 W    | 6pm - 8pm  | 1.0       |
| Supper Kitchen   | 18,000 W | 9am – 10pm | 0.6       |

\*Assumed two cookers available per cluster kitchen used by 9 students

\*\* continuous load at 15%

4.6 Lift Energy Use

Multiple passenger lifts are present within the design. Due to the stage of design, an early-stage estimation of lift energy use has been calculated based on the following formula:

$$Elifts (kWh) = (528F + 5.5A)(1 - \alpha)$$

Where A is the net internal area of the building, α is 0.26 for lifts without regeneration and 0.37 for lifts with regeneration and:

$$F = \sum n \text{ all floors}$$

Where n is the number of lifts serving or express bypassing the floor. This is a relatively simple equation which can be used to forward predict energy consumption for lifts in simulation models at an early stage, before design information is available.

4.7 Server Rooms

With guidance from Unite Students the following gains have been applied to the server rooms and comms rooms.

Table 7: Server Use

| Zone Type   | Power   | Usage           | Diversity Factor |
|-------------|---------|-----------------|------------------|
| Server Room | 3,000 W | On continuously | 0.8              |
| Minor Comms | 300 W   | On continuously | 0.1              |

4.8 Other Equipment

The energy modelling has also accounted for the laundry room (PBSA) with 63 W (3 kW per 100 beds) running continuously on a diversity factor of 50%.

4.9 Hot water demand

In lieu of consumption information, DHW demand has been estimated based on CIBSE Guide G benchmarking. with adjustments made in line with the BREEAM WAT01 water efficiency requirements to be implemented into the design

This results in the below DHW demand figures to be applied to the various areas.

Table 8: DHW Demand

| Zone Type | DHW Demand        | System                               |
|-----------|-------------------|--------------------------------------|
| Bedrooms  | 3.0000 l/(h·pers) | SCOP 3.64 (45L Hot Water per person) |
| Studios   | 3.0000 l/(h·pers) |                                      |

Since DHW demand is based on the number of occupants, WC, and circulation areas etc have been apportioned a DHW demand of 0, with the total demand accounted for within the bedroom occupancy.

CIBSE Guide G (CIBSE, 2004) includes average and maximum measured daily hot water use for various types of

commercial buildings.

4.10 Heating, Cooling & Ventilation

The site is located in an area which has high noise levels and air pollution, and therefore mechanical ventilation has been provided to supply fresh air for overheating during nighttime. Cooling has been provided to amenity areas/retail and staff spaces. The student areas have heating only supplied by the district network with radiators in the spaces. More details can be seen the table below.

Table 9: HVAC Set up

| System Type | Student Rooms                            | Cluster Kitchens**                       | Super Kitchen         | Amenity Spaces        | Back of House/Offices |
|-------------|------------------------------------------|------------------------------------------|-----------------------|-----------------------|-----------------------|
| Heating     | Radiators via Direct Electric<br>SCOP: 1 | Radiators via Direct Electric<br>SCOP: 1 | VRF:<br>SCOP: 4.3     | VRF:<br>SCOP: 4.3     | VRF:<br>SCOP: 4.3     |
| Cooling     | N/A                                      | N/A                                      | VRF<br>SEER: 6.8      | VRF<br>SEER: 6.8      | VRF<br>SEER: 6.8      |
| Ventilation | MVHR<br>SFP 0.8 W/l/s                    | Extract Only<br>SFP 0.4 W/l/s            | MVHR<br>SFP 1.5 W/l/s | MVHR<br>SFP 0.8 W/l/s | MVHR<br>SFP 0.8 W/l/s |

\*Back of House includes server rooms/comms and laundry rooms.

\*\* as referred to ventilation drawings

4.10.1 Heating & Cooling Setpoints

The systems are modelled based on the following room set points and occupancy schedules. Where designed, room emitter capacity has been limited to reflect this, and where not yet known this has been modelled with unlimited capacity to maintain room condition set point. The circulation spaces were modelled as unheated.

Table 10: HVAC Setpoints

| Zone Type             | Heating Set Point (°C) | Cooling Set Point (°C) | Operation Profile |
|-----------------------|------------------------|------------------------|-------------------|
| Cluster rooms/Studios | 21                     | -                      | On continuously   |
| Amenity/Study Spaces  | 21                     | 25                     | On continuously   |
| Offices               | 21                     | 23                     | On continuously   |
| Super Kitchen         | 21                     | 26                     | On continuously   |
| Server/Comms          | 15                     | 26                     | On continuously   |
| Laundry               | 15                     | 28                     | On continuously   |

## 5. RESULTS – BASECASE

The results are estimate based on theoretical model and in line with TM54 with data from Unite and preferred suppliers. The main calculations are presented in a way to reflect the range of possible outcomes which depend on management factors and checking against benchmarks.

From the base case simulation, the PBSA portion of the building has the total predicted energy consumption for Phase 1 at 72.25 kWh/m<sup>2</sup>/year, and for Phase 2 70.26 kWh/m<sup>2</sup>/year exceeding the Unite 2025 target of 60 kwh/m<sup>2</sup>.

Table 11: EUI Model Results

| End Use   | Phase 1                    | Phase 2                    |
|-----------|----------------------------|----------------------------|
|           | EUI kWh/m <sup>2</sup> /yr | EUI kWh/m <sup>2</sup> /yr |
| Lighting  | 6.19                       | 6.42                       |
| Computers | 12.24                      | 10.89                      |
| Servers   | 0.09                       | 0.15                       |
| Cooking   | 1.60                       | 2.68                       |
| Equipment | 13.94                      | 16.53                      |
| Heating   | 22.62                      | 19.10                      |
| DHW       | 7.63                       | 6.84                       |
| Cooling   | 0.42                       | 0.72                       |
| Fans      | 1.36                       | 1.17                       |
| Pumps     | 1.48                       | 1.27                       |
| PV        | -1.49                      | -0.51                      |
| Lifts     | 4.70                       | 4.50                       |

A review of the results has identified the primary energy hotspots for Phase 1 and Phase 2.

**Heating:** Heating is the dominant energy end use in both phases. In Phase 1, heating accounts for approximately 31% of total operational energy consumption, confirming a strongly heating-led energy profile. In Phase 2, heating is responsible for 27%, being the largest single end use.

**Computers:** Computers represent a major contributor to energy use in both phases. In Phase 1, computers account for approximately 17% of operational energy, while in Phase 2 they are responsible for 15%, highlighting the influence of occupant-driven energy use.

**Equipment (Small Power):** Small power and equipment loads contribute significantly to overall energy demand. In Phase 1, equipment accounts for approximately 19% of total energy use and in phase 2 it account for 23%, making small power the second-largest end use and reflecting greater reliance on electrically driven equipment and plug loads.

**Domestic Hot Water (DHW):** DHW contributes approximately 10% of operational energy in Phase 1 and in Phase 2.

**Lighting:** Lighting accounts for approximately 8% of total energy use in Phase 1 and in Phase 2 at around 9%. Lighting demand is therefore stable across both phases and within an expected range for buildings of this type.

**Lifts:** Lift energy consumption represents approximately 6% of operational energy in Phase 1 and in Phase 2. This reflects comparable vertical transportation demand.

**Cooking:** Cooking is a relatively minor end use in Phase 1, accounting for approximately 2% of total energy consumption. This increases to around 4% in Phase 2, indicating a greater provision of cooking facilities or higher utilisation.

**Fans:** Fan energy accounts for approximately 2% of total operational energy in both phases, remaining broadly consistent and indicative of efficient ventilation strategies.

**Pumps:** Pump energy contributes approximately 2% of total energy use in both Phase 1 and Phase 2.

**Cooling:** Cooling demand is minimal in both phases, accounting for approximately 1% of total energy use in Phase 1 and around 1% in Phase 2. This indicates limited reliance on active cooling systems.

Figure 4: Central Case Energy Consumption Breakdown – Phase 1

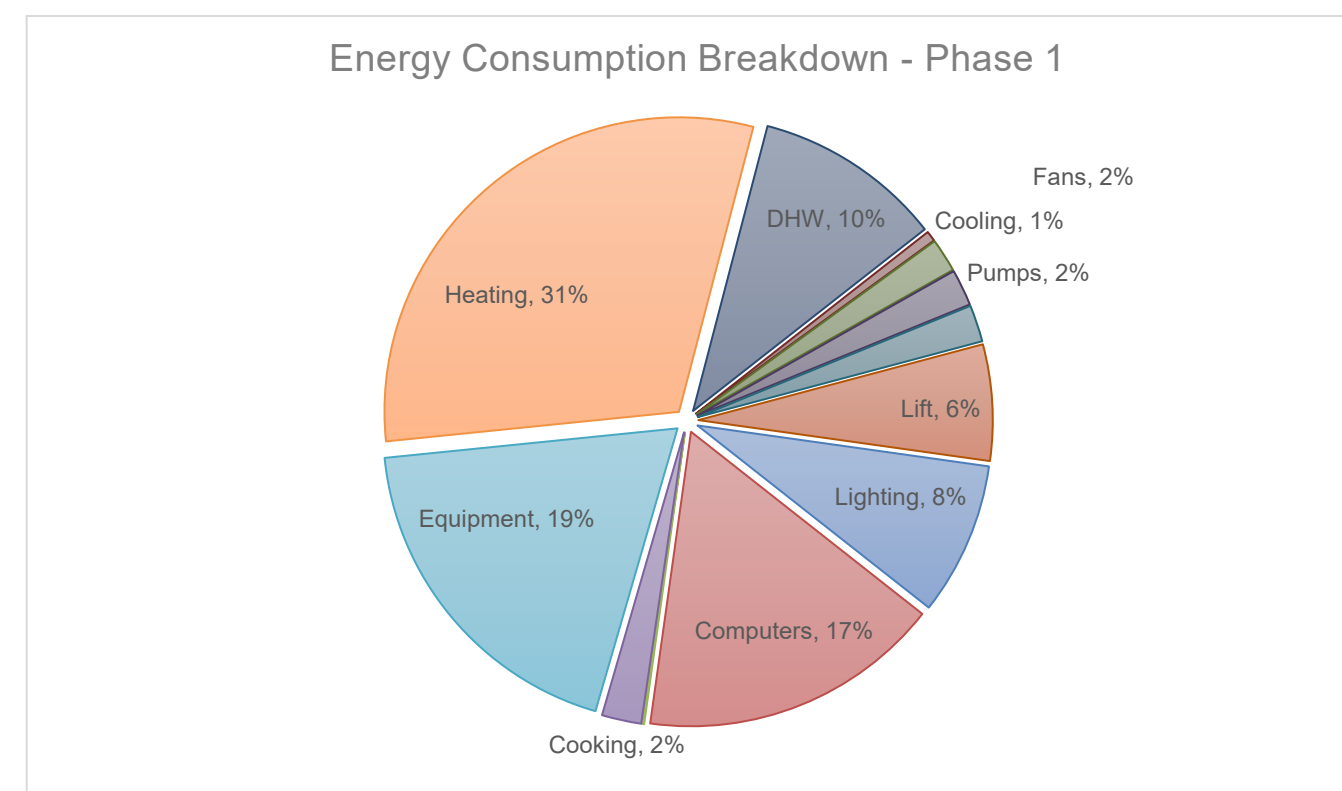
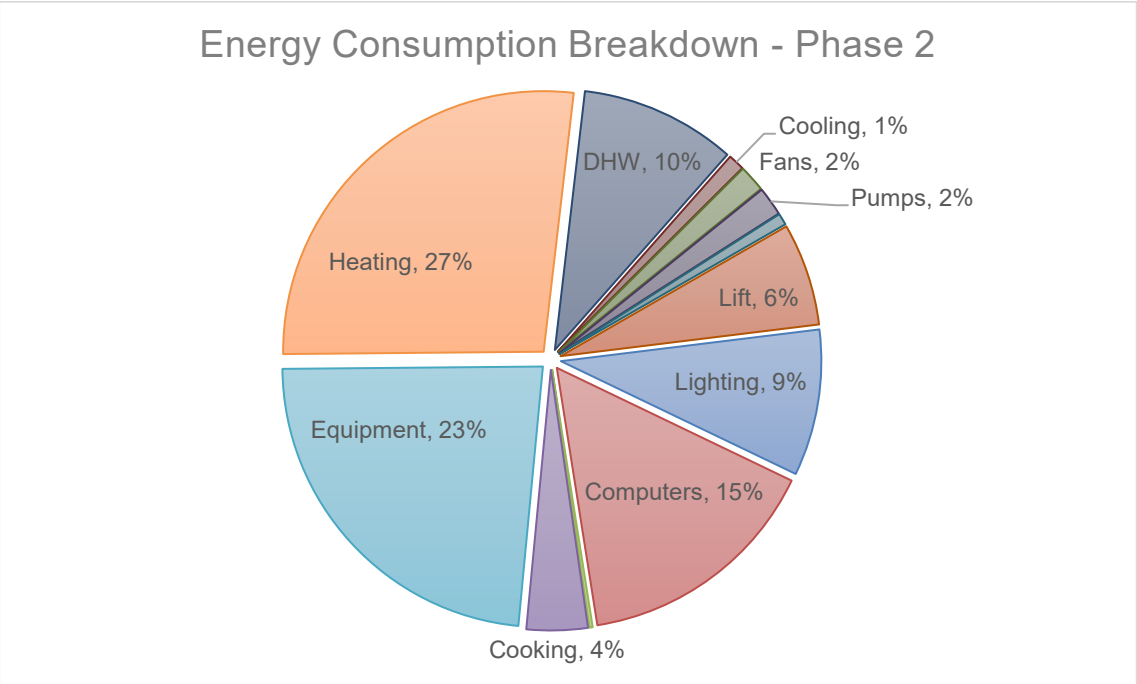


Figure 5: Energy Consumption Breakdown – Phase 2



Regulated components, such as heating, cooling, hot water, fans, pumps, and lights, and unregulated ones, such IT equipment, lab equipment, catering facilities, and so forth, make up total operating energy. This creates a challenge for when calculating the uncontrolled energy use.

5.1 Management Factors

The results of the energy management checklist have been used to judge what a suitable management factor would be for the building. A well-managed building will score one or close to one, and a poorly managed building would be 1.15 or greater. Management is unknown; therefore, we have applied a generic management factor of 1.05.

Taking account of management factors, the student accommodation is in line with the business-as-usual approach (120 kWh/m<sup>2</sup>) shown in figure 7, as well as the worst-case management scenario. It is important to highlight that good building management is necessary to ensure the operation of the building does not negative impact the energy usage.

Table 12: Management factors considered

|                                                 | Good Case                                                    |         | Baseline Case                                           |         | Worst Case                                    |         |
|-------------------------------------------------|--------------------------------------------------------------|---------|---------------------------------------------------------|---------|-----------------------------------------------|---------|
|                                                 | (Fully functional controls with excellent management skills) |         | (Partially functional controls with average management) |         | (No functional controls with poor management) |         |
| Management Factor                               | 1                                                            |         | 1.05                                                    |         | 1.15                                          |         |
|                                                 | Phase 1                                                      | Phase 2 | Phase 1                                                 | Phase 2 | Phase 1                                       | Phase 2 |
| Total Energy Consumption (kWh/ m <sup>2</sup> ) | 72.25                                                        | 70.26   | 75.87                                                   | 73.77   | 83.09                                         | 80.80   |

6. BENCHMARKING

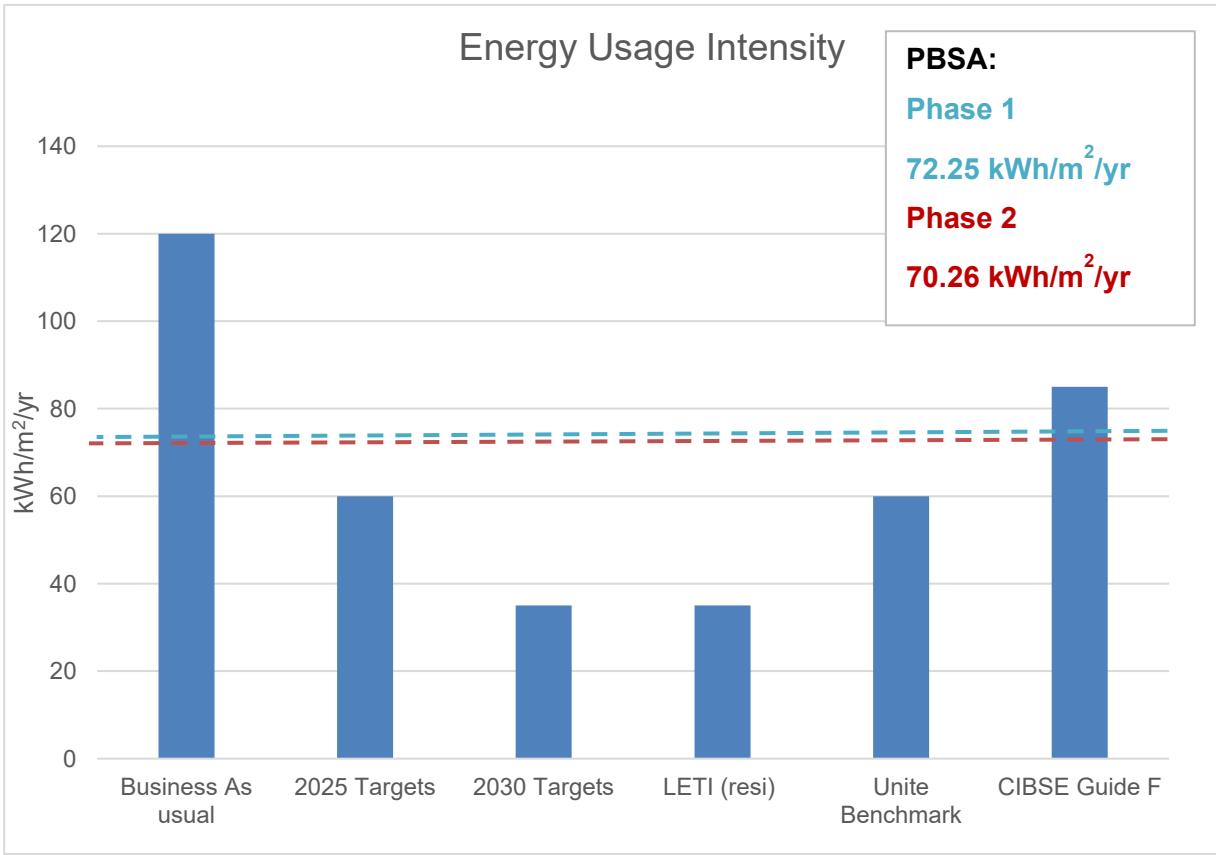
The Unite Sustainable Construction Framework sets out operational energy targets to follow which coincide with the RIBA targets seen in figure below. The development results have been included in the graph for a comparison.

Figure 6 RIBA Benchmarks

| RIBA Sustainable Outcome metrics         | Business as usual<br><small>(new build, compliance approach)</small> | 2025 Targets              | 2030 Targets              |
|------------------------------------------|----------------------------------------------------------------------|---------------------------|---------------------------|
| Operational Energy kWh/m <sup>2</sup> /y | 120 kWh/m <sup>2</sup> /y                                            | <60 kWh/m <sup>2</sup> /y | <35 kWh/m <sup>2</sup> /y |

Amenity areas classified as having ‘high amenity loads’ are assigned a load of 75 W/m<sup>2</sup>, assumed to be operating continuously which is causing the small power to account for 23% for Phase 2 and 19% for Phase 1of the building’s energy consumption.

Figure 7: Benchmarks including Proposed Development



The PBSA is operating in line with ‘business as usual’ target however fails to meet the 2025 and 2030 industry benchmarks set for domestic residential buildings.

The assessment indicates that the highest energy consumption comes from heating and small power. It is recommended to further refine equipment loads in conjunction with system operation data. More detailed small power modelling—once specific equipment is known—will help ensure realistic energy consumption estimates.

## 7. CONCLUSIONS & RECOMMENDATIONS

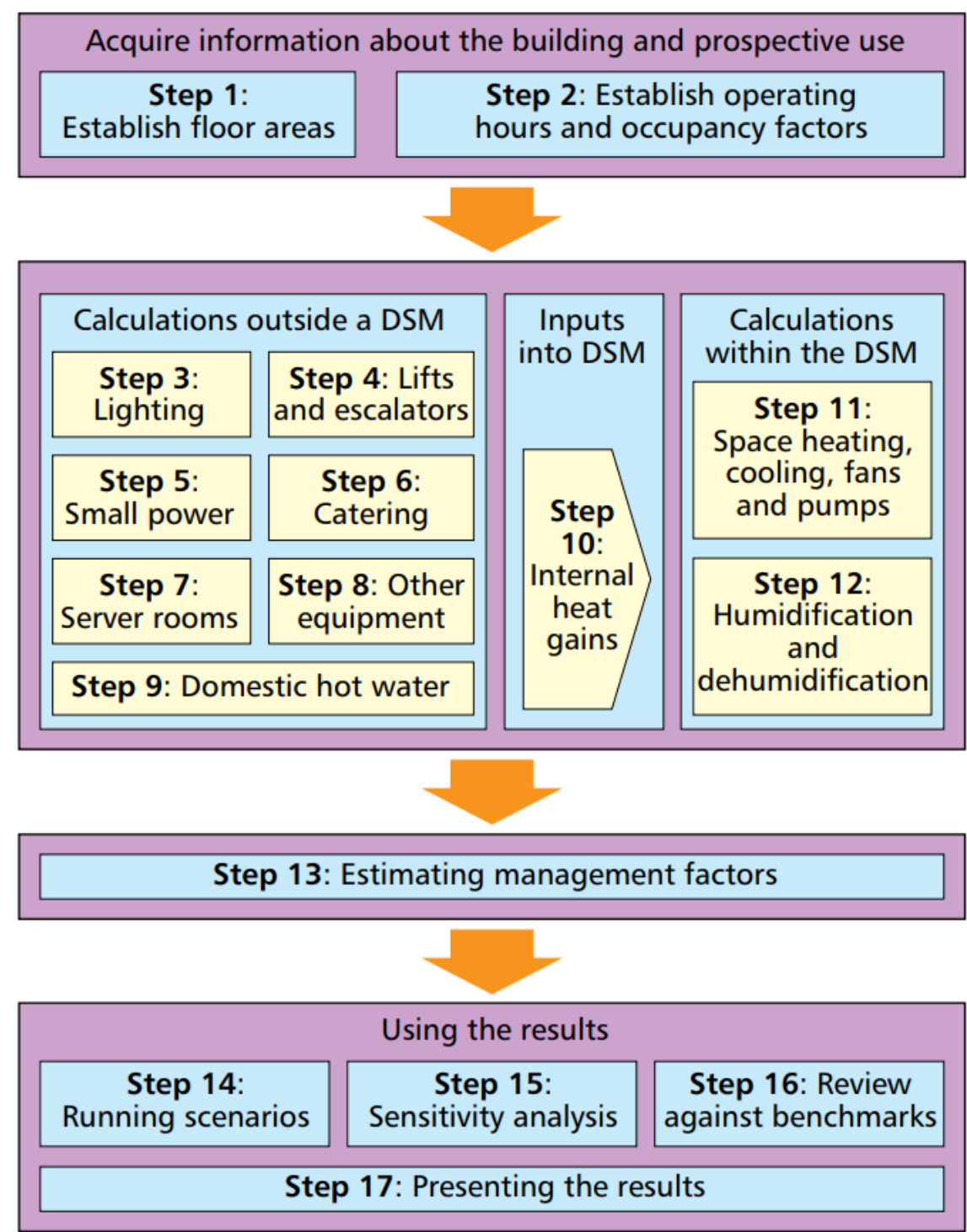
This report has assessed the operational energy consumption of the Proposed Development, the base-case scenario resulted in an EUI of 72.25 kWh/m<sup>2</sup> for Phase 1 and o 72.25 kWh/m<sup>2</sup> for Phase 2. Including PVs this results in a total consumption of 2,143,300 kWh for Phase 1 and 2,516,788 kWh for Phase 2.

The baseline model does not exceed the “business as usual” metrics which accounts for new builds which are in line with building regulation documents, however the proposed development is operating higher than the 2025 target benchmark provided by RIBA.

It is recommended that good management is incorporated into the building operation and efficient, lower energy lighting and small power is considered within the design to reduce the energy consumption.

Appendices

A. Appendices



### B. Implementation Tool

| TM54 steps                                              | Modelling approach (summary)                                                    | Probable range | Confidence level (L/M/H) | QA check |
|---------------------------------------------------------|---------------------------------------------------------------------------------|----------------|--------------------------|----------|
| Step 0: Choosing the right level of modelling           | Relatively simple servicing arrangement. DSM with template HVAC systems applied | +/- 5%         | H                        | Y        |
| Step 1: Constructing and building the model             | Model Build in IES VE using architects' drawings                                | +/-10%         | H                        | Y        |
| Step 2: Estimating Occupancy Hours & Management Factors | Estimated from benchmarks and discussions with tenant                           | +/-30%         | M                        | Y        |
| Step 3: Evaluating lighting energy use                  | Calculated in model using installed power and usage templates                   | +/-10%         | M                        | Y        |
| Step 4: Evaluating energy use for lifts and escalators  | Early-stage analysis undertaken outside of DSM model                            | +/-50%         | L                        | Y        |
| Step 5: Evaluating energy use for small power           | Benchmarks and estimates applied                                                | +/-100%        | L                        | Y        |
| Step 6: Evaluating energy use for catering              | No Catering                                                                     | NA             | NA                       | Y        |
| Step 7: Evaluating energy use for server rooms          | Early-stage benchmarks applied                                                  | +/-20%         | L                        | Y        |

|                                                                 |                                                                                     |         |    |   |
|-----------------------------------------------------------------|-------------------------------------------------------------------------------------|---------|----|---|
| Step 8: Evaluating energy use of additional plant and equipment | Estimates from client discussions and similar projects                              | +/-50%  | M  | Y |
| Step 9: Evaluating energy use of domestic hot water             | Benchmarks applied                                                                  | +/-20%  | M  | Y |
| Step 10: Evaluating internal heat gains                         | Undertaken in Model                                                                 | NA      | M  | Y |
| Step 11: Modelling HVAC systems and their controls              | ApSys Methodology within DSM                                                        | +/-10%  | H  | Y |
| Step 12: Taking management considerations into account          | Management factor of 1.05 applied                                                   | +/-5%   | H  | Y |
| Step 13: Sensitivity analysis                                   | 6 tests conducted focused on hotspots                                               | Unknown | NA | Y |
| Step 14: Scenario testing                                       | Realistic range provided based on sensitivity and other 'good practice' inputs      | Unknown | L  | Y |
| Step 15: Reviewing the results against benchmarks and targets   | Typical and best practice benchmarks applied, in addition to clients other building | NA      | NA | Y |

C. Model Parameters

The building design will target highly efficient U-values and air tightness within occupied spaces.

| Fabric Performance                  |                                              |                   |
|-------------------------------------|----------------------------------------------|-------------------|
| Element                             | Notional Building Regulations<br>Part L 2021 | Proposed Measures |
| Air Tightness                       | 8.00 m³/hr/m²                                | 1.70 m³/hr/m²     |
| External Wall                       | 0.26 W/m²k                                   | 0.15 W/m²k*       |
| Exposed Floor                       | 0.18 W/m²k                                   | 0.09 W/m²k        |
| Roof                                | 0.18 W/m²k                                   | 0.12 W/m²k        |
| External Windows                    | 1.60 W/m²k                                   | 0.80 W/m²k        |
| Glazing G-Value                     | N/A                                          | 0.40              |
| Glazing Light Transmittance<br>(LT) | N/A                                          | -                 |

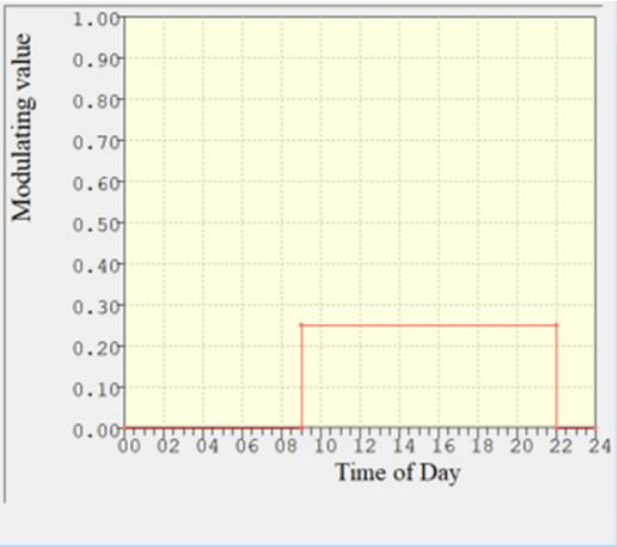
\*Average U value for all wall types

The values provided in the above table demonstrate a series of measures that satisfy the energy efficiency standards; however, the final design solution may vary given the early stage of the design.

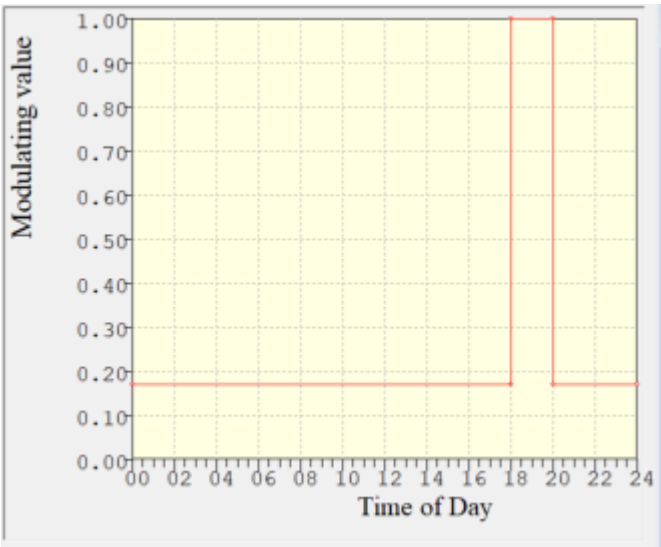
Good air tightness design will reduce heat losses in winter and heat gains in summer and will increase the efficiency of the mechanical ventilation systems. The target design air permeability for the proposed development is 1.7 m³/hr/m² at 50Pa. This represents a significant improvement over the maximum requirements set out in Part L 2021.

Profiles in use

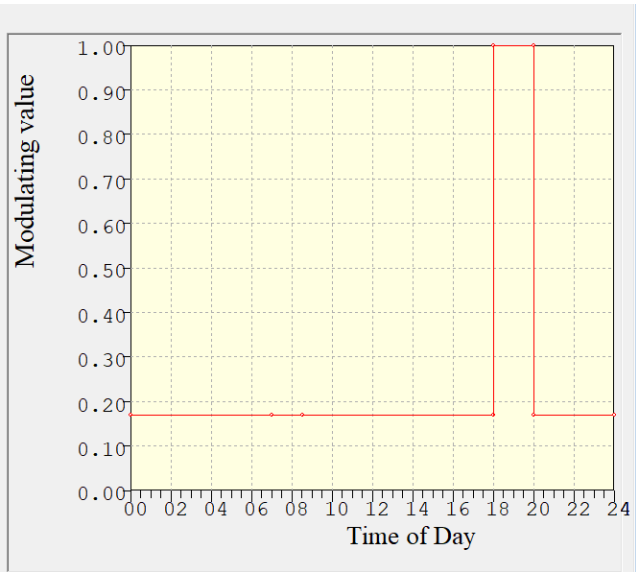
Kitchen Occupancy



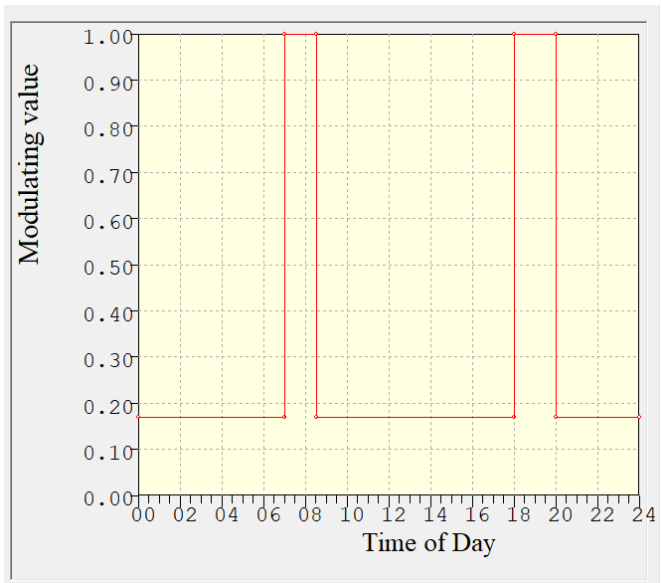
Kitchen Equipment



Studio kitchen

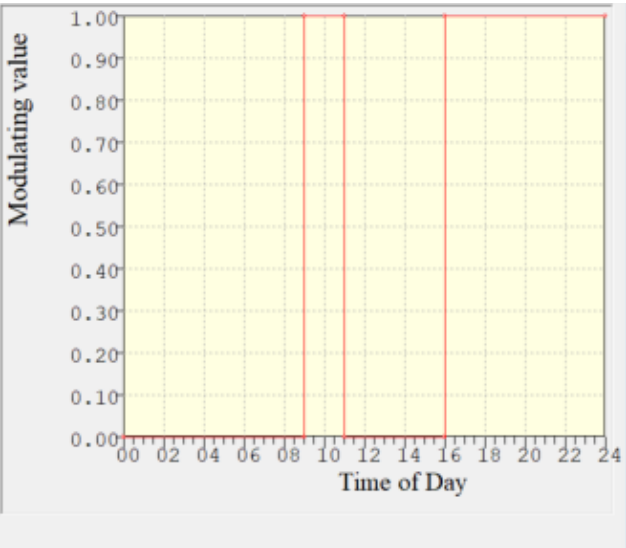


Studio kitchen (high-end scenario)

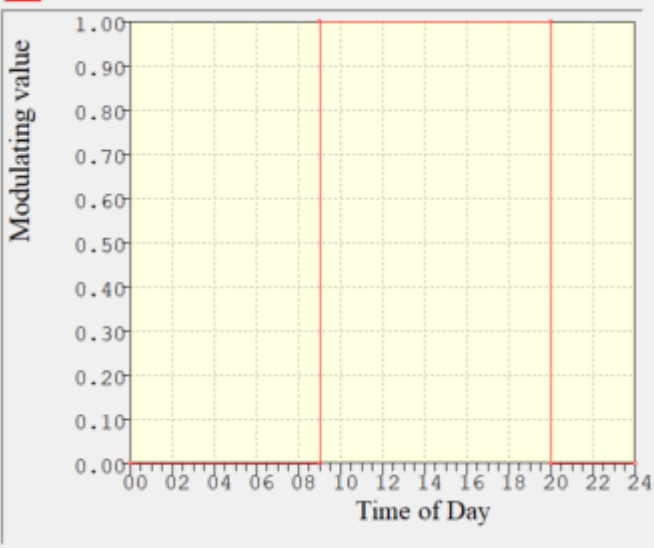


Appendices

Bed Lighting



Common Areas



Summer/Holiday shutdown

Edit Project Annual Profile YEAR0597

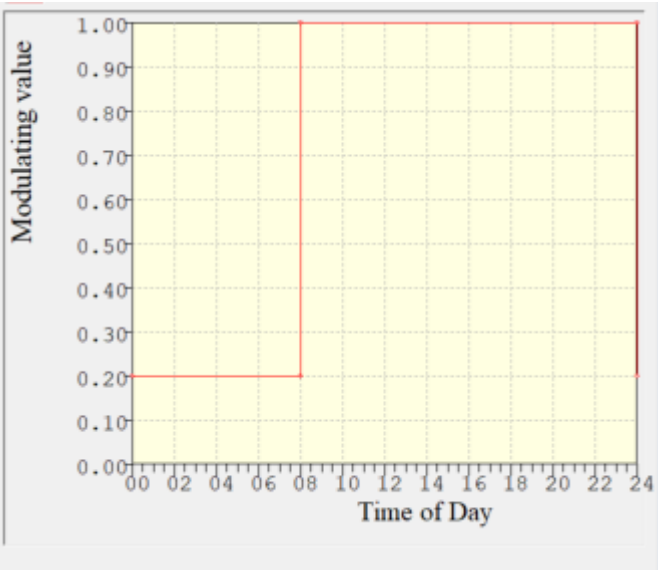
Profile Name: Summer Shutdown

Categories:

ID: YEAR0597 ☒ Modulating ☐ Absolute

| No: | Weekly Profile:            | End month: | End day: |
|-----|----------------------------|------------|----------|
| 1   | Mid Dec-Mid Jan [WEEK0595] | Jan        | 15       |
| 2   | on continuously [ON]       | May        | 1        |
| 3   | May-July [WEEK0596]        | Jul        | 2        |
| 4   | July-Sept [WEEK0597]       | Sep        | 14       |
| 5   | on continuously [ON]       | Dec        | 15       |
| 6   | Mid Dec-Mid Jan [WEEK0595] | Dec        | 31       |

Night Standby



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