Prediction of Performance and Operational Energy Use

TM54 Methodology
RIBA Stage 2

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Executive Summary

This Energy Modelling exercise, based on Chartered Institution of Building Services Engineers (CIBSE) Technical Memorandum (TM) 54 methodology, has been carried out by SRE Ltd. on behalf of Royal UK Property Holdings Ltd (the Client) for 1 & 2 Longwalk Road, Stockley Park, London (the Proposed Development), in order to predict the likely performance and operational energy use of the Proposed Development at the Design Stage to support the Building Research Establishment Environmental Assessment Method (BREEAM) UK New Construction 2025 (V7) issue Ene 02 and to provide operational energy use inputs for the Whole Life-Cycle Carbon Assessment (WLCA). In the context of the project stage, this report highlights key inputs, assumptions, and results of the Royal Institute of British Architects (RIBA) Stage 2 TM54 modelling study.

All assumptions have been based on a combination of client requirements, CIBSE Guide A, National Australian Built Environment Ratings System (NABERS), and technical expertise within SRE.

Table 1 demonstrates the predicted operational energy use of the Proposed Development. The energy performance of the whole building has been benchmarked against the CIBSE Guide F and the targets set out in the Energy Assessment Guidance 2022.

Energy Hierarchy Category	EUI (kWh/m2/annum)	Space Heating Demand (kWh/m^2/annum)	Energy Source
CIBSE Guide F	34.00	-	Electricity only
EAG 2022	55.00	15	Electricity only
Proposed Development (excl. renewables)	24.29	1.84	Electricity only
Proposed Development (incl. renewables)	13.56	-	Electricity only

Table 1 - Predicted Operational Performance with Benchmarks

This TM54 report undertakes sensitivity analysis and scenario testing for three scenarios:

- Mid Scenario – this is the best estimate of the overall operational energy use
- High and Low Scenarios – these consider uncertainties of model inputs.

The results are shown in Figure 1 below and are discussed in Section 3.3 of this report and can be used to inform design decisions post-planning.

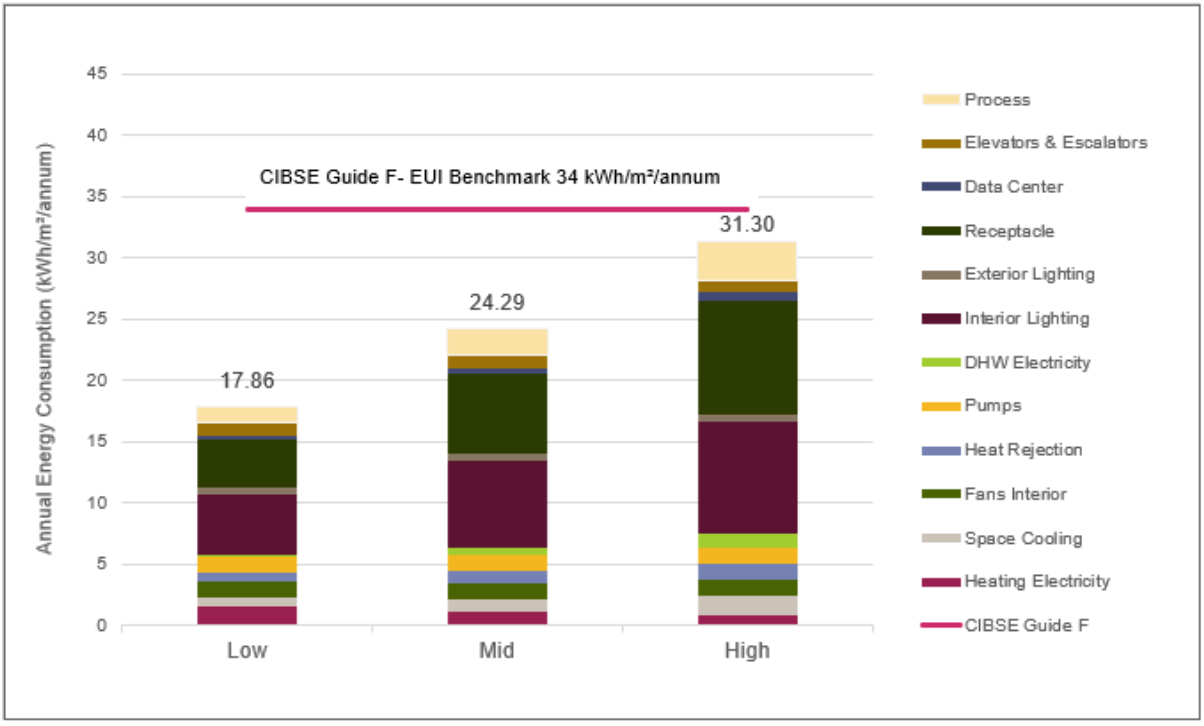


Figure 1 – Low, Mid and High Scenario Predicted Energy Consumption excluding renewables

The Proposed Development achieves an energy use intensity (EUI) of 24.29 kWh/m²/annum (Figure 2) excluding renewables, which is below the lowest energy benchmark target of 34 kWh/m²/annum of CIBSE Guide F, without incorporating photovoltaics (PV). However, by incorporating renewable energy sources (photovoltaics), the Proposed Development achieves an EUI of 13.56 kWh/m²/annum (Figure 3).

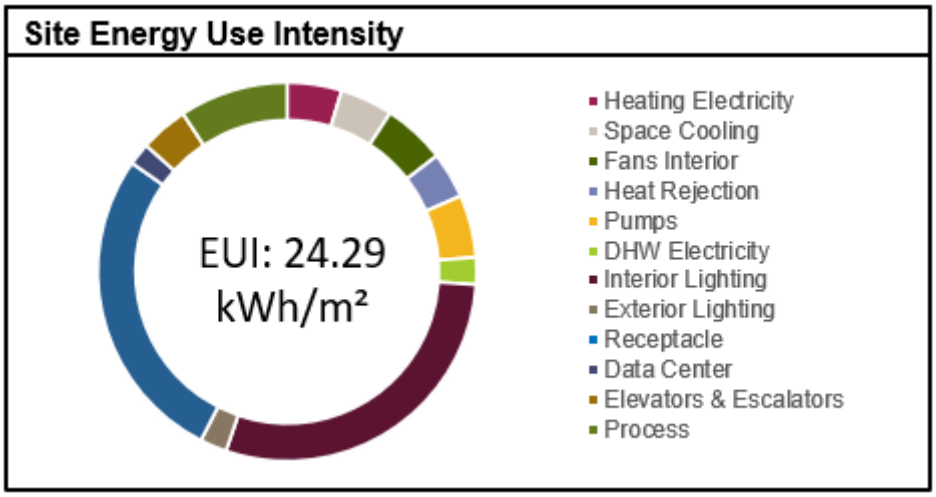


Figure 2 – Site Energy Use Intensity excluding PV

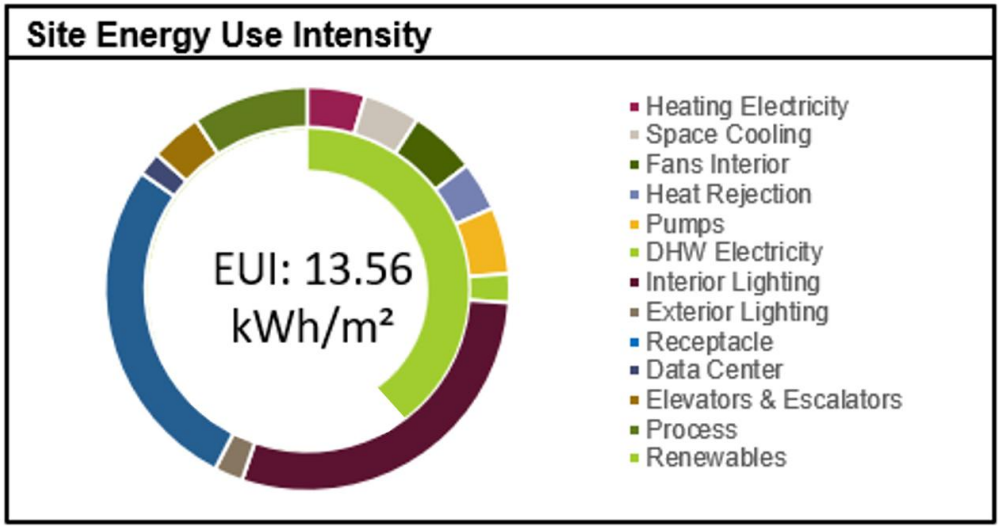


Figure 3 – Site Energy Use Intensity incorporating PV

During the final design phase (RIBA Stage 3-5), the model should be reviewed and updated in accordance with the latest design decisions and client proposals. Future building operators should be involved to confirm if it is feasible to operate the building as modelled.

A site inspection at structural completion can confirm if any engineering or item changes will impact whether the model achieves the operational energy targets. Based on the As-Built Final information, energy use estimates will be determined, aligning with the sub-metering strategy.

Post-occupancy data (at best after 12 months of occupancy) can create a robust in-use energy performance model i.e., a ‘digital twin’ of the Proposed Development. The post-occupancy data must be collected through rigorous monitoring, recording and filing of metering logs, energy bills, maintenance records, etc.

The calibrated energy performance model - or ‘digital twin’ - would enable the building maintenance team or building user to understand end energy usage. This can highlight key discrepancies in results, in which any outlying causes can be determined, and potential solutions can be recommended.

Introduction

1.0 Introduction

This Energy Modelling exercise, based on CIBSE TM 54 methodology, has been carried out by SRE Ltd (the Modeller) on behalf of Zinc (the Client) for 1 & 2 Longwalk Road, London (the Proposed Development), to predict the likely performance and operational energy use of the Proposed Development at the RIBA Stage 2.

In the context of the project stage, this report highlights key inputs, assumptions, and results of the As-Designed TM54 modelling study. Sensitivity analysis and scenario testing have been conducted, as presented in Section 3.3 which investigates the impacts of changing parameters within the Baseline Model to determine the most influential parameters in relation to the overall predicted energy use. This helps inform design decisions throughout the design stages and outlines the feasibility of meeting the energy requirements.

A CIBSE TM54 implementation matrix has been filled out at the end of each section, summarising the modelling approach, the probability range, and the confidence level of the approach and assumptions.

1.1 Proposed Development

The Proposed Development consists of two commercial units with a total Gross Internal Area (GIA) of 11,006 m². The warehouse areas shall not be fitted out initially, while the office space shall be fitted out as part of the development.

The site plan of the Proposed Development in Figure 4. Please refer to Appendix A for further architectural details of the Proposed Development.



Figure 4 – Site plan of the Proposed Development (UMC ARCHITECTS)

1.2 TM54 Methodology

One of the main reasons for the performance gap[1] is the choice of energy use calculation methodology applied to predict the energy consumption of a building at the design stage. The predicted operational energy use has a large margin for error due to the infrequency of recorded results (e.g., monthly), the exclusion of unregulated energy uses, and the standard templates used for occupant density and operational hours. Therefore, the compliance methodologies and associated user interfaces are not a good indicator of the end energy use of a building, as they were developed originally for compliance purposes only. Compliance methods can, however, be used as a comparative tool for testing energy efficiency between various design options, especially during RIBA Stages 0-2[2].

The TM54 methodology uses dynamic simulations (e.g., using at least hourly resolution) to predict operational energy use. The Modeller can input unregulated energy use and has the flexibility to use non-standard values for occupant density and operation hours to reflect the building use more accurately. The difference in results between these standardised methodologies, TM54 methodology and actual building energy use has been captured and demonstrated in Figure 5 below.

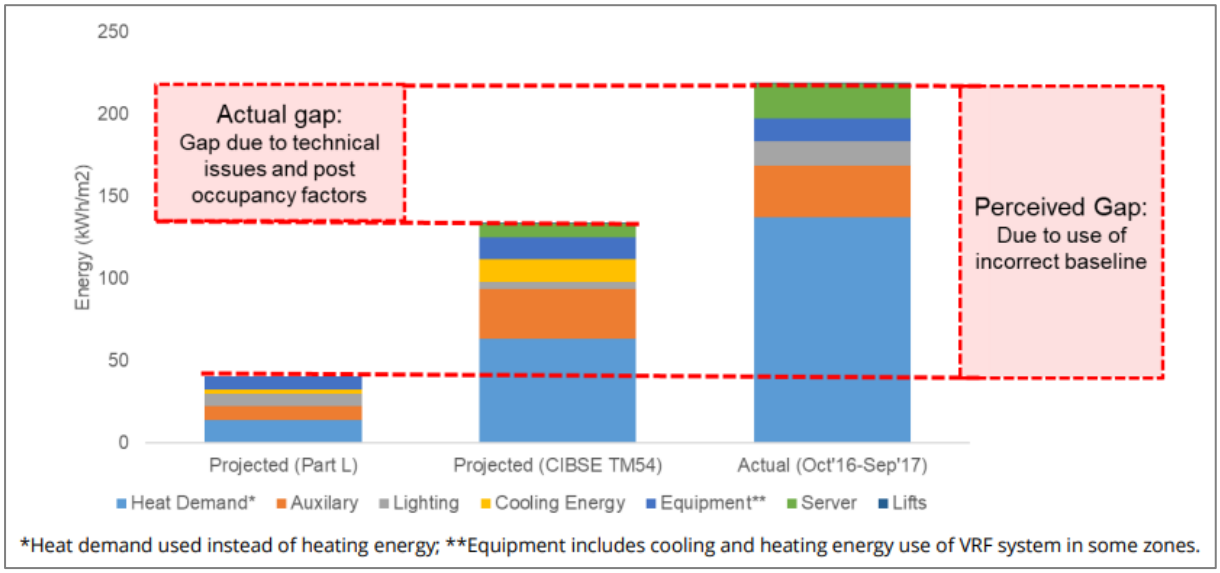


Figure 5 – Actual energy use vs simulation for a case study school building[3]

The Energy Modelling exercise carried out for the Proposed Development is based on the TM54 methodology, which is summarised through a step-by-step process in Figure 6. Quality assurance (Step 17) has been carried out in line with CIBSE Application Manual (AM) 11 guidance through an in-house quality assurance procedure where the model has been critiqued by experienced modellers.

[1] The difference between design stage intent and the actual energy use during operation.
[2] Also known as Pre-Planning.
[3] DesignBuilder Case Study for a School in London.
https://designbuilder.co.uk/casestudies/DesignBuilderCaseStudySchoolMV.pdf

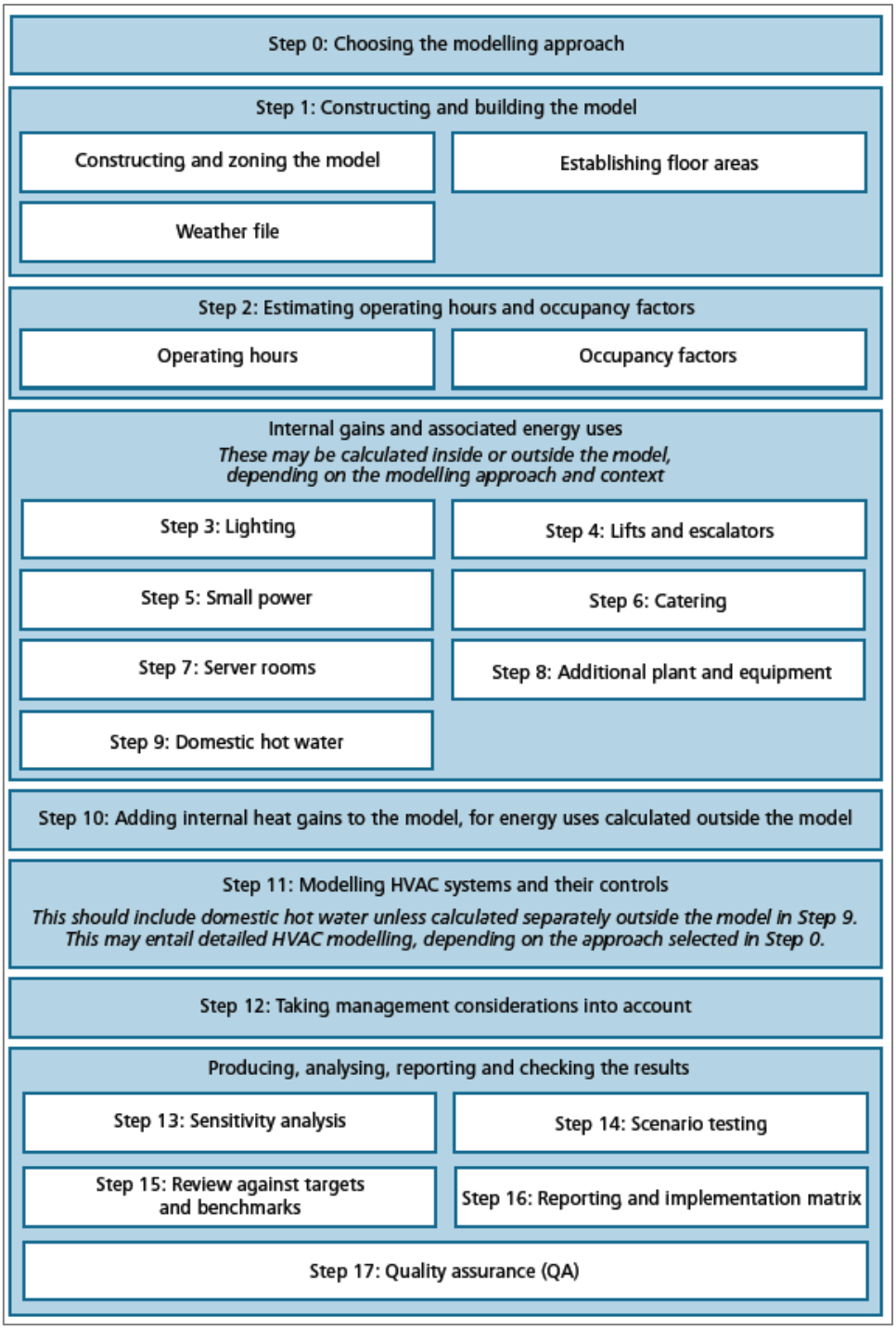


Figure 6 – TM54 modelling guidance[4]

[4]Page 15, TM54 2022

1.2.1 Modelling Context

TM54 modelling is an iterative process which is typically undertaken at all phases of a construction project. Decisions are made in collaboration with architects, mechanical and electrical designers, occupiers, and facility managers. Figure 7 outlines the modelling context of TM54 at different stages of construction.

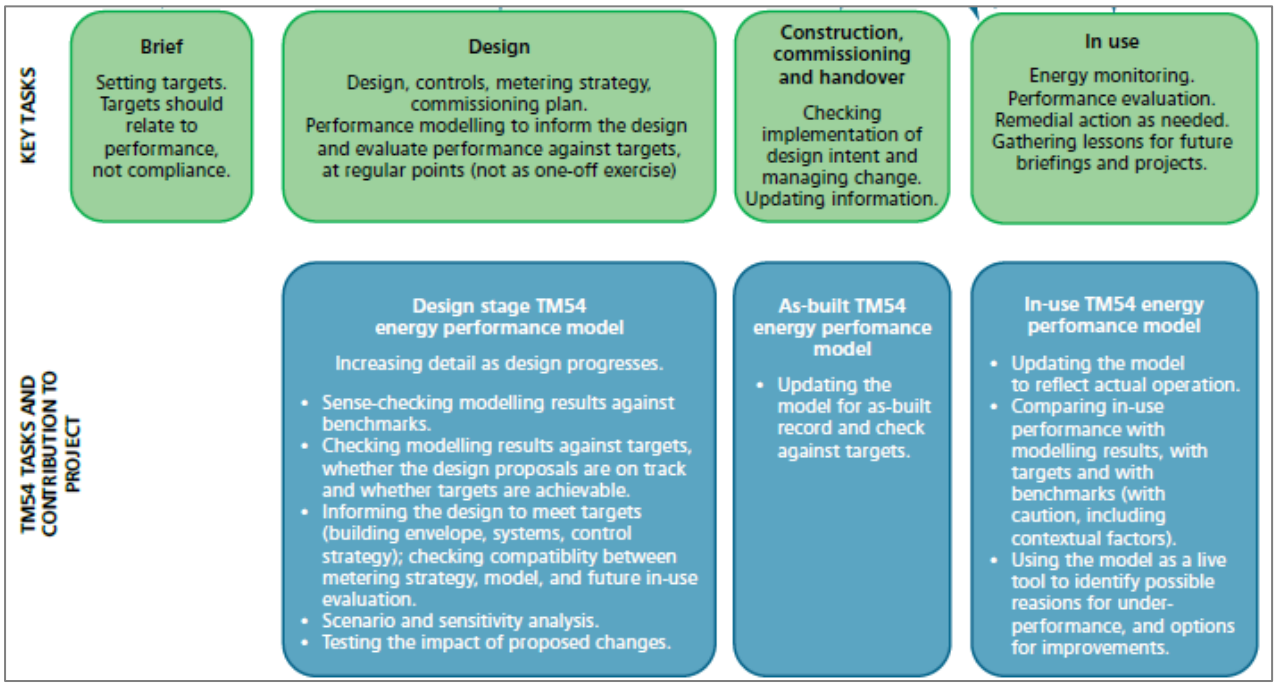


Figure 7 – TM54 in context - tasks and contribution for each project stage[5]

1.2.2 Limitations and Assumptions

It is important to note that with any modelling exercise, there are assumptions and approximations that have to be made. As far as possible, details of all assumptions made and approximations used are supplied as part of this report.

The TM54 methodology is carried out using dynamic simulation modelling tools (DSMs), which contain simplifications and assumptions compared to the way that a real building operates. This includes the use of standard weather files, fixed air leakage rates, simplification of occupancy and operation pattern profiling, and static U-values[6].

1.2.3 Sensitivity Analysis and Scenario Testing

At early design stages, sensitivity analysis and scenario testing can provide clarity on which modelling input parameters have the most significant impact on the building energy use. The TM54 methodology creates three scenarios:

- Mid Scenario – this is the best estimate of the overall operational energy use
- High and Low Scenarios – these consider uncertainties of model inputs.

[5]Page 12, TM54 2022
[6] Page 11, TM54 2022

The results help inform design decisions through RIBA Stages 2-5, provide guidance on potential improvements and flag areas which should be effectively managed during construction and handover to avoid potential problems in the future.

1.2.4 Targets and Benchmarking

There are several different sources which provide guidance on targets and benchmarks for a variety of building types, including:

- CIBSE Guide F (Energy efficiency in buildings)
- Energy Assessment Guidance 2022
- National Australian Built Environment Rating System (NABERS)
- CIBSE Benchmarking Online
- ASHRAE Fundamentals Handbook.

The targets could also be set by clients in line with corporate strategies or could be requested by a Local Authority for planning.

The two metrics commonly used to determine the energy consumption of a development are Energy Use Intensity (EUI) and the space heating demand, both measured in kWh/m^2/annum.

1.2.5 Design and Modelling for In-Use Evaluation

Metering is key within the TM54 methodology for post-construction monitoring and calibration purposes. Developments should be designed to align with CIBSE TM63: Operational performance: Building performance modelling (2020).

Modelling Inputs

2.0 Modelling Inputs

2.1 Modelling Approach and Constructing the Model

The modelling approach is shown in Table 2 below.

	Description
Location	Longwalk Road, London
Weather File	London TRY (CIBSE 2016)
Building Type	Warehouse
Benchmark (CIBSE Guide F) Stores/Warehouses (Occupied)	Electric: 34 (kWh/m²/annum)
Energy Assessment Guidance Target	Electric: EUI - 55 (kWh/m²/annum), Space Heating - 15(kWh/m²/annum)
Gross Internal Floor Area	11000 m² (Model Area)
Project Team	UMC (Architect), Zinc (the PM)
Modeller Name with energy modelling experience	Nikolaos Protogeros (+20 years) /Jean Dib (5 Years)
Modelling Context	RIBA Stage 2 – Design Stage
Level of Modelling	Dynamic Simulation with template HVAC modelling
Software used	IES VE 2025

Table 2 - Modelling Approach

The dynamic modelling software Integrated Environmental Solutions Virtual Environment (IES VE) 2025 has been used to model the Proposed Development based on the drawings received from UMC Architects. The IES VE 2025 3D model of the Proposed Development is shown in Figure 8.

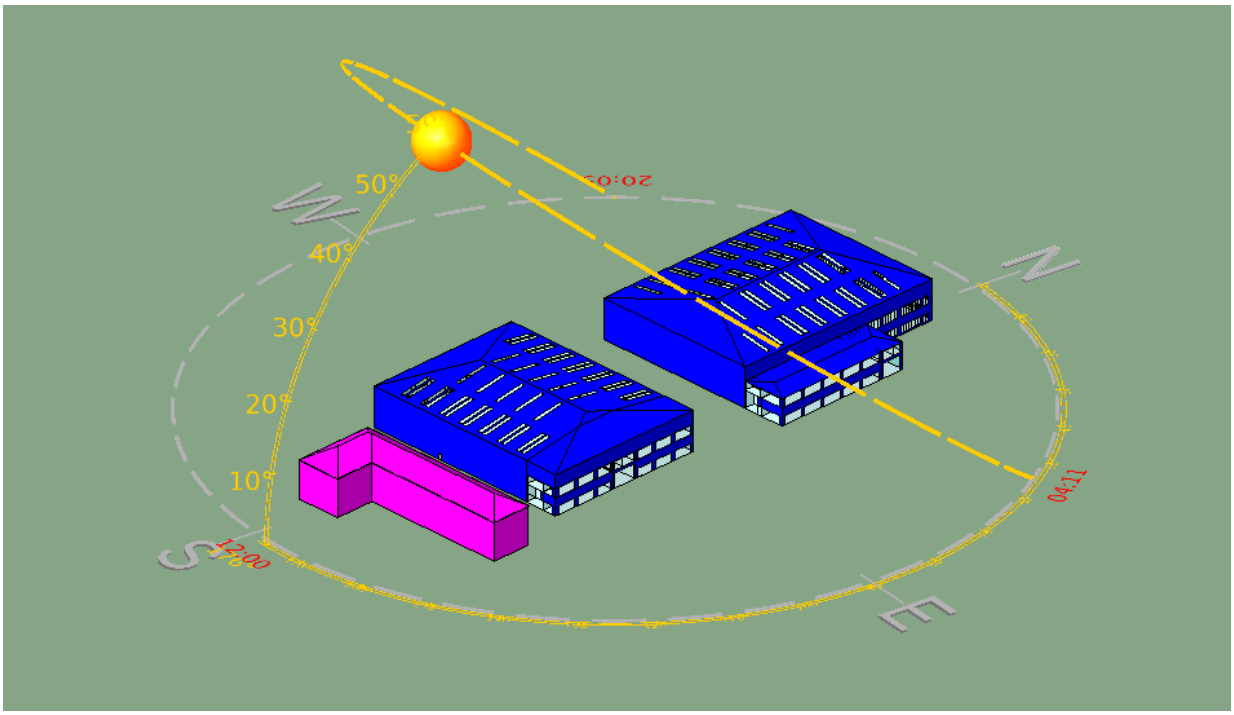


Figure 8 – 3D model in IES VE 2025 from Southeast

2.2 Model Zoning

Different zones have been created in relation to activity types, ventilation strategy and storeys.

2.3 Envelope

The envelope details within the TM54 modelling are based on the architectural design. All U-values, shown in Table 3, comply with Building Regulations 2021 Part L V2 standards.

Element	Proposed U-value (W/m^2K)
External Wall	0.16
Pitched / Flat Roof	0.14
Ground Floor - Basement Storage Area	0.14
Windows, & Glazed Door	1.4 / G Value 0.4
Access Doors - Large	1.3
Access Doors - Personnel	1.4
Additional Elements	**Detail measures**

Element	Proposed U-value (W/m^2K)
Air Tightness @50 Pa	3

Table 3 – Assigned construction and thermal properties

The exact build-ups used for the Proposed Development have been replicated within the IES VE 2025 software to accurately take into account the thermal mass.

2.3.1 Thermal Bridge

Heat loss through non-repeating thermal bridges has not been accounted for. Default values have been set in IES VE 2025.

TM54 Step	Probability Range	Confidence Level	QA check (filled by Examiner)
Step 0-1	n/a	High	Yes

Table 4 - Steps 0-1: Implementation Matrix

2.4 Thermal Templates

The thermal templates are created based on a combination of client requirements, CIBSE Guide A and G, NABERS, and technical expertise within SRE Ltd. Figure 9 shows the 3D model of the Proposed Development with thermal properties.

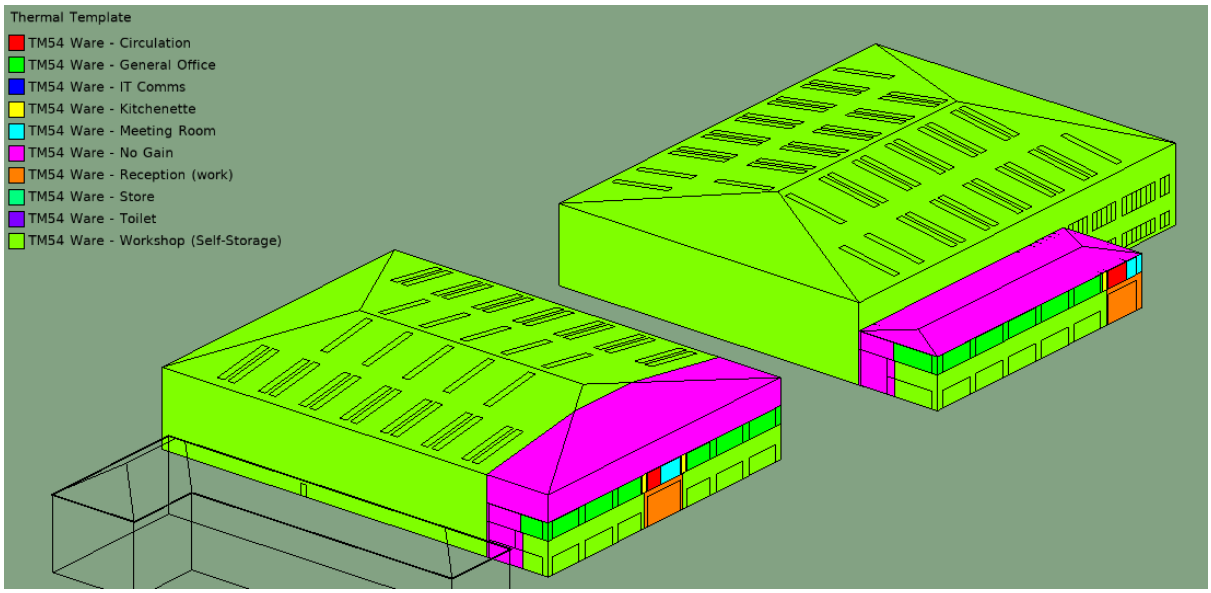


Figure 9 – 3D model in IES VE 2025 with thermal properties (view from Southeast)

2.5 Estimating Operating Hours and Occupancy Factors

Occupancy patterns and behaviours are one of the biggest drivers impacting the energy use of buildings. Sensitivity analysis and scenario testing in the Section 3.3 will indicate the likely impact on the predicted operational energy use.

TM54 Step	Probability Range	Confidence Level	QA check (filled by Examiner)
Step 2	±30%	High	Yes

Table 5 - Step 2: Implementation Matrix

2.6 Internal Gains and Associated Energy Uses

Through liaison with the Project Team, basic assumptions for internal gains and associated energy uses have been determined at the current design stage. CIBSE Guide A and NABERS have all been used to inform profile creation within IES VE 2025. At the Detailed Design Stage, the modelling assumptions and results can be used to dictate decisions relating to the fit-out of equipment.

Appendix C provides details on occupancy, small power equipment and internal lighting. Daylight dimming sensors have been considered for the warehouse area. The sensors have been considered within the operational hours of internal lighting. External lights have been assumed in the parking area, entrances, and footpaths. PIR and daylight sensors will also control these.

At this stage, the consumption of Domestic Hot Water (DHW) has been guided by NABERS of 4litres/person/day.

TM54 Step	Probability Range (%)	Confidence Level	QA check (filled by Examiner)
Step 3: Lighting	±5	High	Yes
Step 4: Lifts and Escalators	±15	Medium	Yes
Step 5: Small Power	±35	Medium	Yes
Step 6: Catering	±35	Medium	Yes
Step 7: Server Rooms	±15	Medium	Yes
Step 8: Additional Plant	±8	Medium	Yes
Step 9: Domestic Hot Water	±20	Medium	Yes
Step 10: Gains calculated outside model	±10	High	Yes

Table 6 – Steps 3-10: Implementation Matrix

2.7 Modelling HVAC Systems and their Controls

A Variable Refrigerant Flow (VRF) system is proposed to provide space heating and cooling to the reception, office, and meeting rooms. Electric panel heaters will supply the circulation areas and WCs. An electric instantaneous system will supply domestic hot water (DHW) in the WCs and kitchenette. Details of these systems are specified in Appendix B.

Mechanical Ventilation with Heat Recovery (MVHR) will provide both supply and extract ventilation to the reception, office, and meeting spaces. A separate zoned extract ventilation system will serve all WCs.

The heating set point and setback temperatures (°C) and the mechanical ventilation rates (l/s) have been informed by British Council for Offices (BCO) guidelines, CIBSE Guide A, Tender Design Manual for the Development and Building Regulations Part F. Appendix C and Appendix D presents the operation profiles for heating and mechanical ventilation, which are in relation to the occupancy profiles.

TM54 Step	Probability Range	Confidence Level	QA check (filled by Examiner)
Step 11	± 5%	High	Yes

Table 7 – Step 11: Implementation Matrix

2.8 Management Considerations

If a building is poorly managed, this can significantly increase the building's energy use. A management strategy should be documented and provided at handover to inform building occupants and managers how to efficiently operate the building.

At this stage of the construction process, it is unknown who will be occupying the building. Investigating the impact on the management strategy is considered beneficial and has therefore been included in this report; however, due to the early stage of this project, this has been carried out as a high-level analysis. Management impact is, however, considered to be relatively small in the case of this building due to the nature of the occupancy class.

TM54 Step	Probability Range	Confidence Level	QA check (filled by Examiner)
Step 12	± 5%	High	Yes

Table 8 – Step 12 Implementation Matrix

Predicted Operational Energy Results

3.0 Predicted Operational Energy Results

3.1 Baseline Model – Mid Scenario

Based on the modelling inputs detailed in Section 2.0, the results of the Baseline Model (Mid Scenario) are presented in this section.

The Proposed Development is predicted to have an annual energy consumption significantly lower than the EUI benchmarks specified in CIBSE Guide F of 34kWh/m²/annum, with an overall EUI of 24.29 kWh/m²/annum (excl. renewables) and 13.56 kWh/m²/annum (incl. renewables).

Figure 10 and Figure 11 shows the Mid Scenario predicted energy consumption with and without renewables.

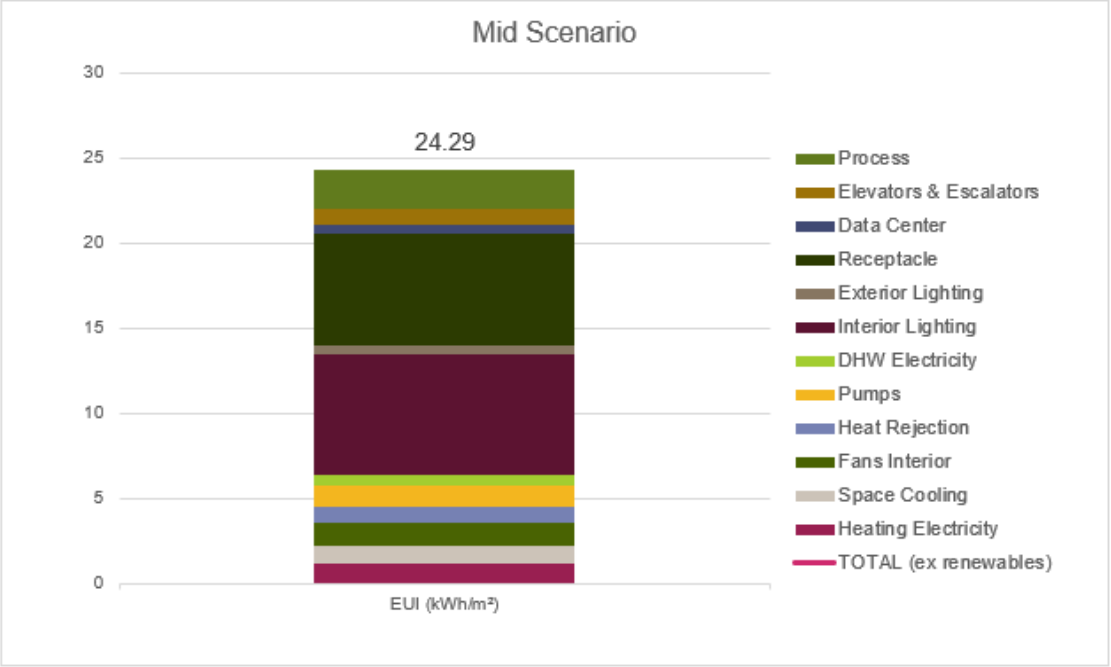


Figure 10 – Mid Scenario Predicted Energy Consumption (Excl. Renewables)

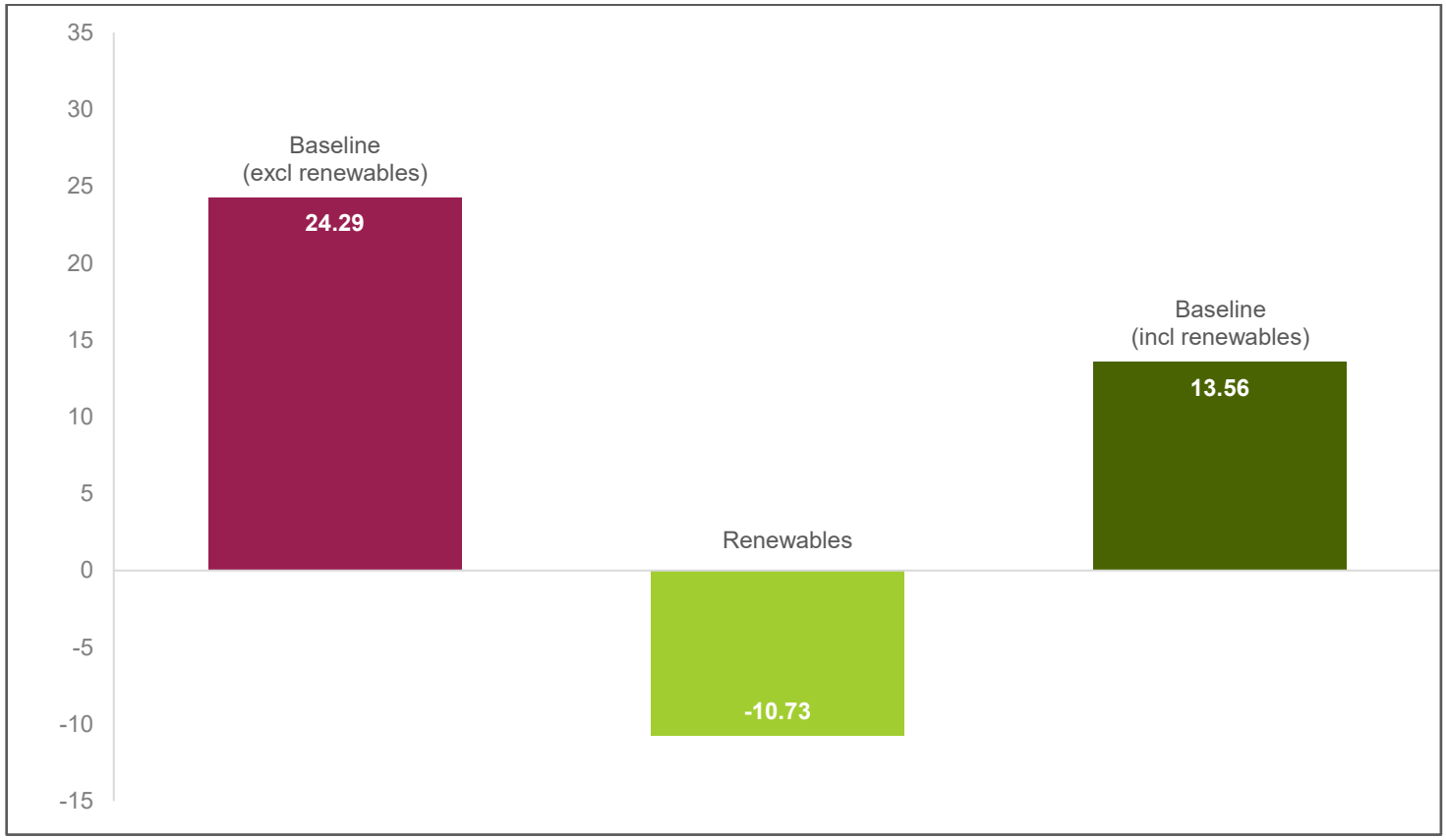


Figure 11 – Mid Scenario Predicted Energy Consumption (Incl. Renewables)

3.2 Energy Generation

The Proposed Development will incorporate 118 PV panels for Unit 100 and 113 PV panels for Unit 200, providing a total installed capacity of 44.52kWp and 42.6kWp respectively. The PV modules have a module efficiency of 20% and are designed with an inclination of 30°.

3.3 Sensitivity Analysis and Scenario Testing

Based on the implementation matrix, 5 no. variables with uncertainty were chosen to be reviewed in more detail through sensitivity analysis and scenario testing[7].

Table 9 presents descriptions of parameters changed within the TM54 Energy Model. Variation of parameters has been carried out using a diversity factor. This is a multiplier to the calculated load applied to each space and represents a change to the affected parameter.

Scenario	Building Parameter	Low Scenario	Mid Scenario	High Scenario
1	Small Power	0.6 Diversity Factor - 40% reduction in energy consumption from small power equipment	1.0 Diversity Factor - In line with CIBSE Guide A	1.4 Diversity Factor - 40% increase in energy consumption from small power equipment
2	Internal Lighting	0.7 Diversity Factor - 30% reduction in energy consumption from Internal Lighting	1.0 Diversity Factor All areas - 135 lm/W PIR Sensors - Throughout	1.3 Diversity Factor - 30% increase in energy consumption from Internal Lighting

[7] All results are rounded to 2 decimal places.

Scenario	Building Parameter	Low Scenario	Mid Scenario	High Scenario
3	Occupancy	0.6 Diversity Factor - 40% reduction in occupancy density	1.0 Diversity Factor Cafe –3m^2/person Reception – 1 person Co-working, Flexible Units - 10m^2/Person Tea Point - 1 person Circulation – 1 person	1.4 Diversity Factor - 40% increase in occupancy density
4	DHW	0.25 l/hr/Person - 50% reduction in hot water consumption	0.50 l/hr/Person	0.75 l/hr/Person - 50% increase in hot water consumption
5	Maintenance	5% decrease in EUI added as a maintenance factor	0	5% increase in EUI added as a maintenance factor

Table 9 – TM54 Scenario Testing Description

Refer to Figure 12 and Table 10 for the impact of each scenario on the total energy use intensity of the Proposed Development. As the development is a storage facility with offices, the small power (equipment load) and internal lighting drive the energy use of the building, and therefore, careful consideration should be taken when choosing light fittings, equipment and controls.

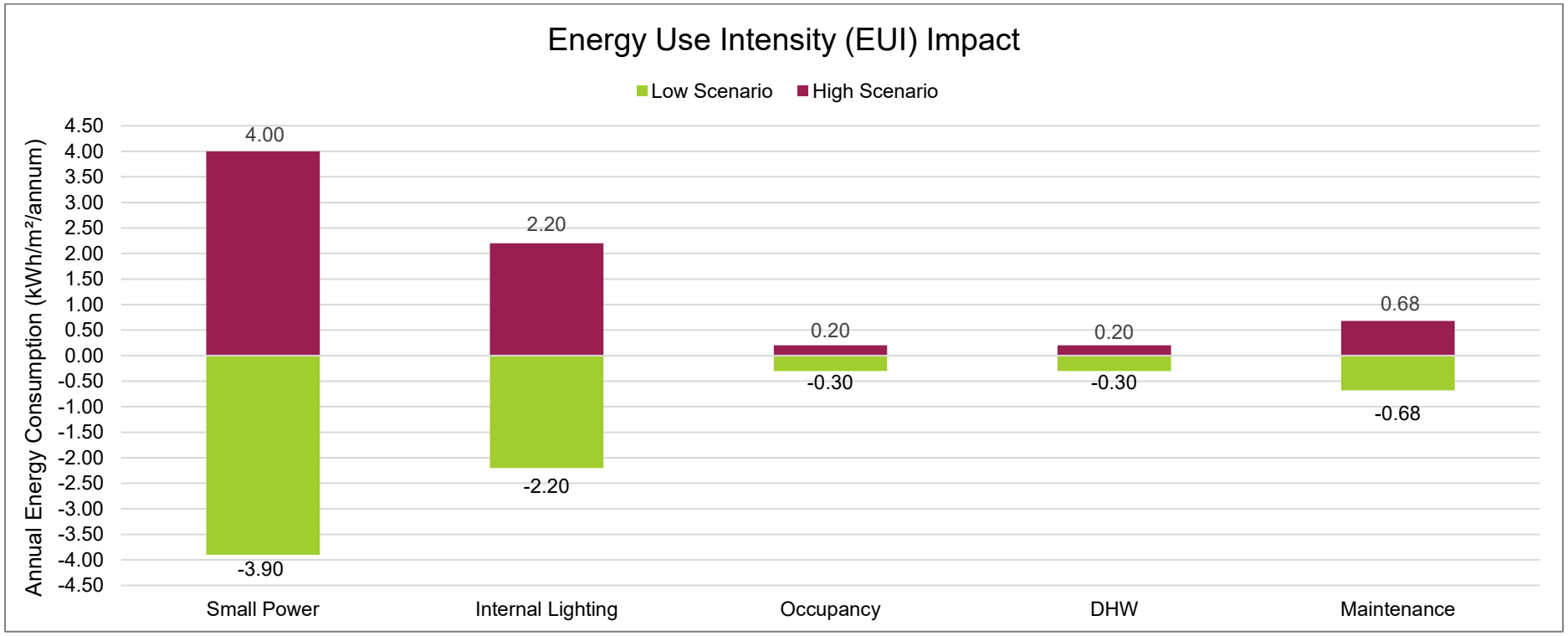


Figure 12 - Low, Mid, and High Scenario Impact Assessment (excl. renewables)

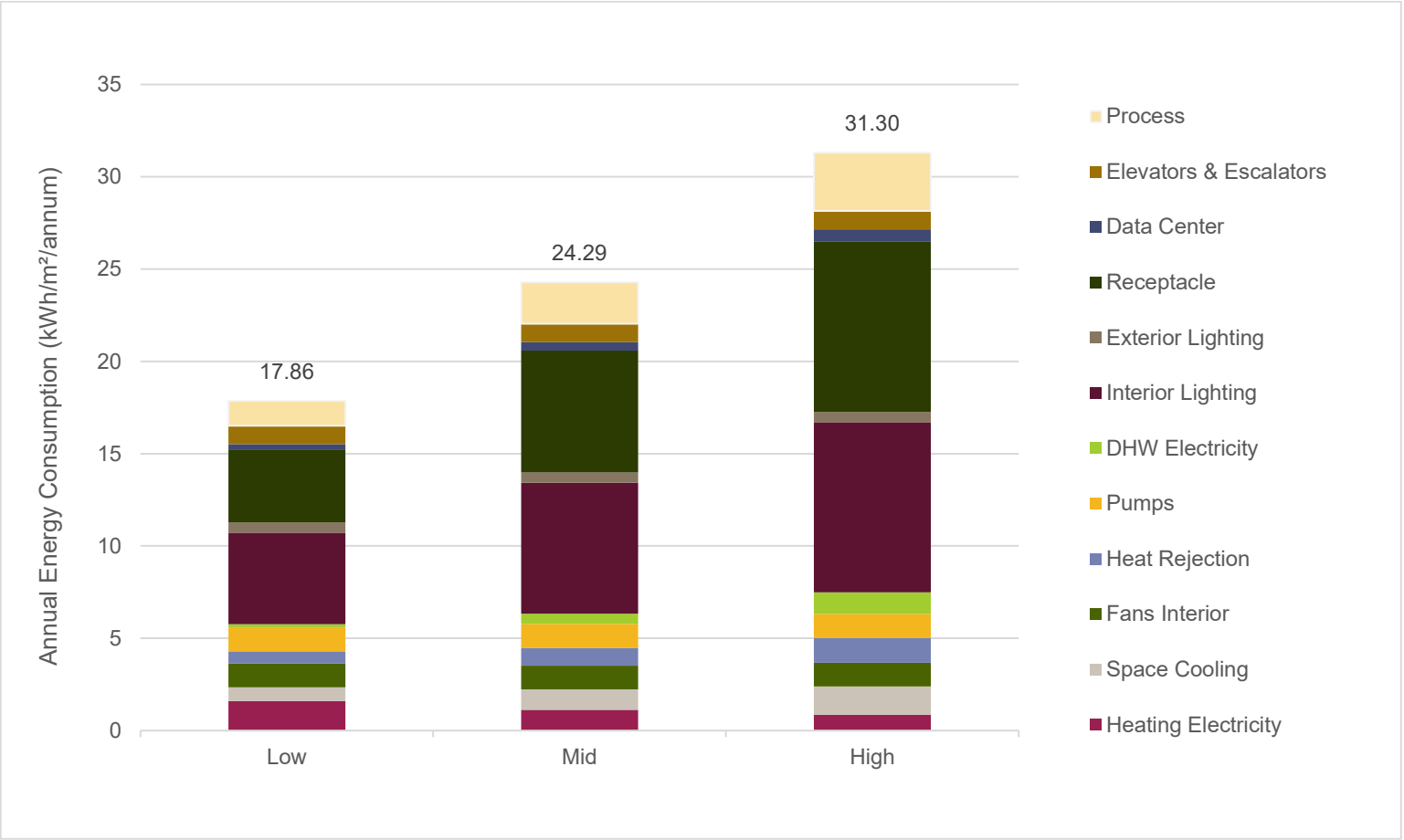


Figure 13 - Low, Mid and High Scenario Predicted Energy Consumption (excl. renewables)

The results highlighted in Figure 13 show that the predicted energy consumption excluding renewables for the Mid Scenario is 24.29 kWh/m^2/annum, compared to the High Scenario of 31.30 kWh/m^2/annum and the Low Scenario of 17.86 kWh/m^2/annum.

The low scenario is the best outcome, although it is unlikely the building will outperform the Mid Scenario. As the design progresses, the Low Scenario can inform improvements to be made to the design, and the likely impact this will have on the EUI target.

Scenario	Building Parameter	Low Scenario	Mid Scenario	High Scenario	Range	Impact
1	Small Power	9.70	13.60	17.60	7.90	HIGH
2	Internal Lighting	11.40	13.60	15.80	4.40	HIGH
3	Occupancy	13.30	13.60	13.80	0.50	Low
4	DHW	13.30	13.60	13.80	0.50	Low
5	Maintenance	12.92	13.60	14.28	1.36	Medium

Table 10 – TM54 Scenario Testing Impact Summary

Figure 14 and Figure 15 provides a detailed impact assessment of each scenario (Low, Mid and High) on the heating, cooling, DHW, internal lighting, process load and the other miscellaneous loads.

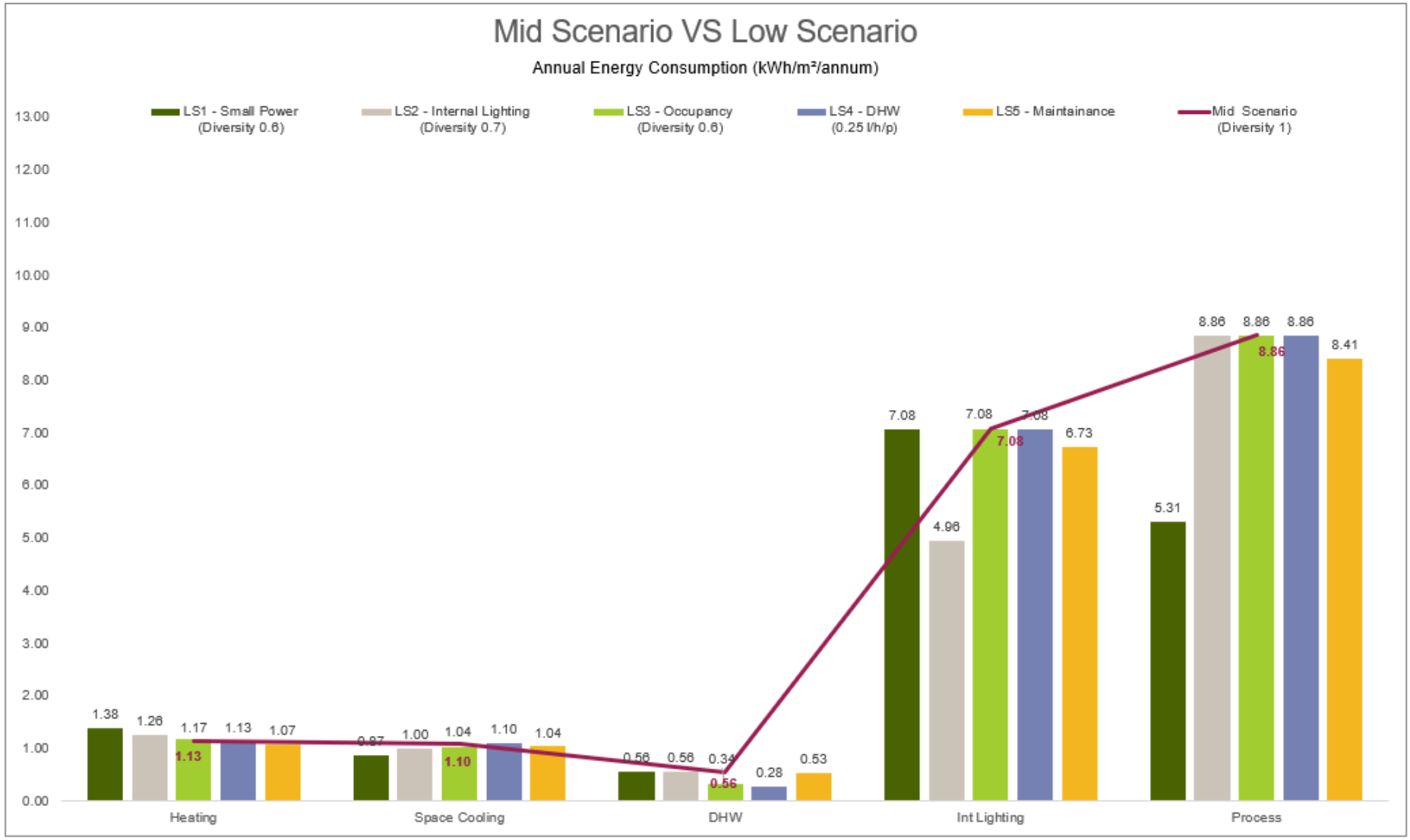


Figure 14 - Mid vs Low Scenario Predicted Energy Consumption (excl. renewables)

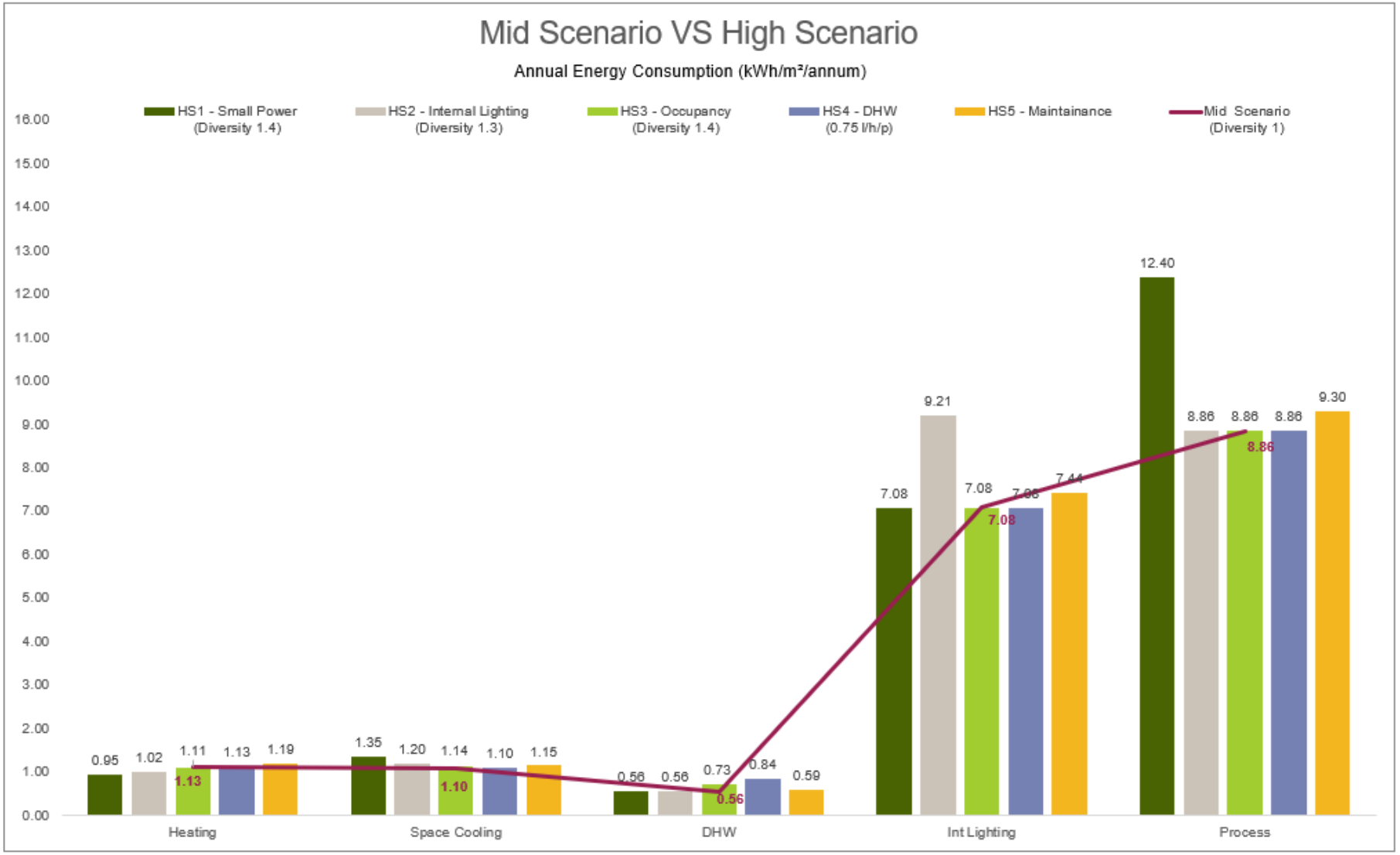


Figure 15 - Mid vs High Scenario Predicted Energy Consumption (excl. renewables)

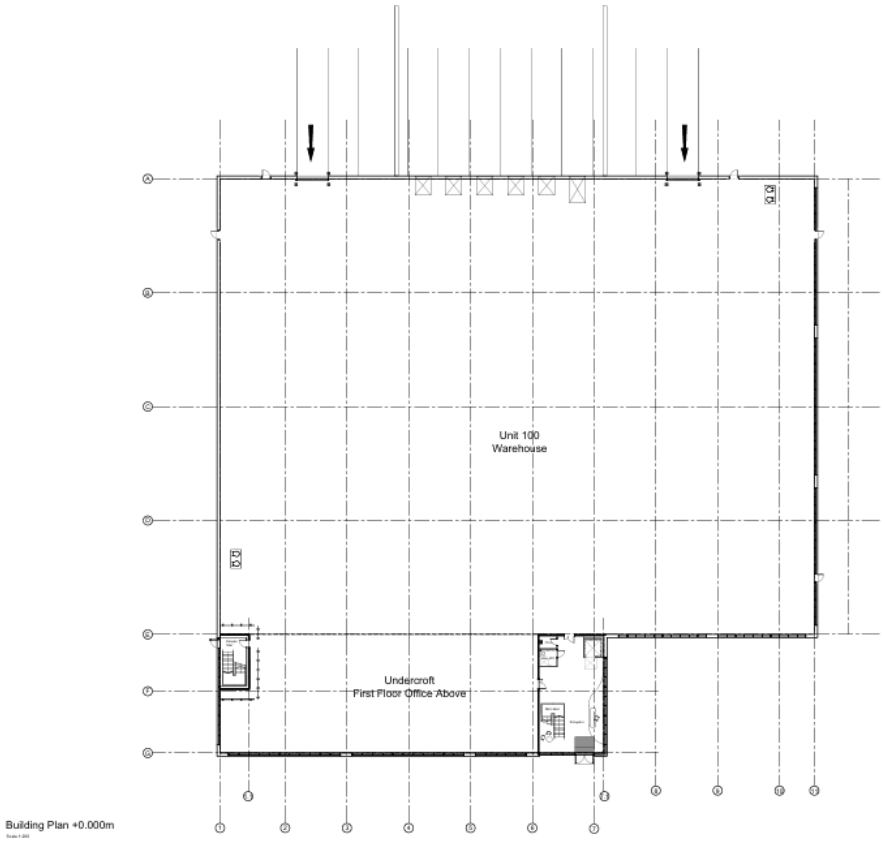
TM54 Step	Probability Range	Confidence Level	QA check (filled by Examiner)
Steps 13-15	± 10%	High	Yes

Table 11 – Results Implementation Matrix

Appendices

Appendix A – Architecture Plans

Unit 100 – Ground Floor



UMC ARCHITECTS.

1 & 2 Longwalk Road

Unit 100 - Building Plan

23517 - UMC - 0100 - ZZ - DR - A - 1002

P03

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Unit 100 – First Floor – Office Plans



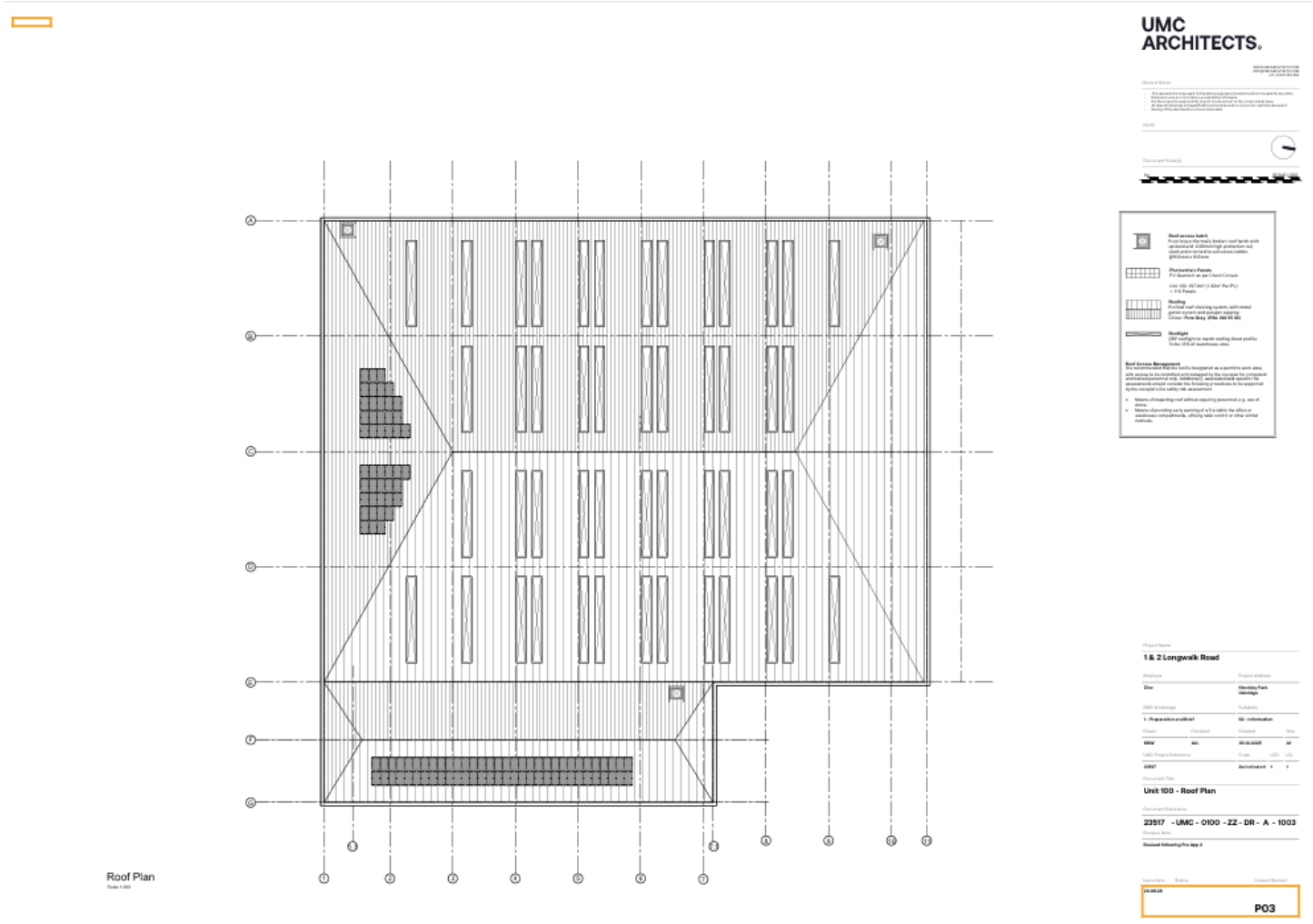
UMC ARCHITECTS.

1 & 3 Longwalk Road

Unit 100 - Office Plans

P02

Unit 100 – Roof Plan



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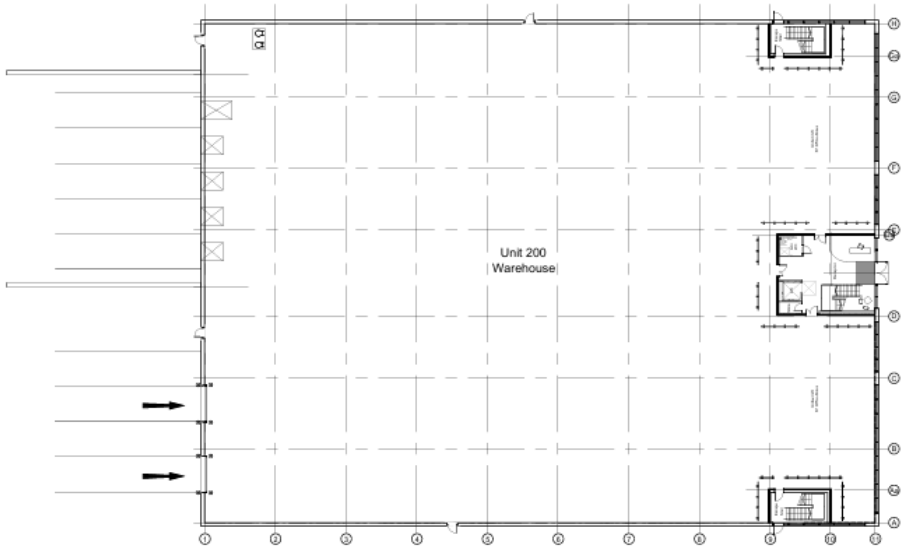
Unit 200 – Ground Floor



Building Plan +0.000m

UMC ARCHITECTS.

1 & 2 Longwalk Road

Unit 200 - Building Plan

23517 - UMC - 0200 - ZZ - DR - A - 1001

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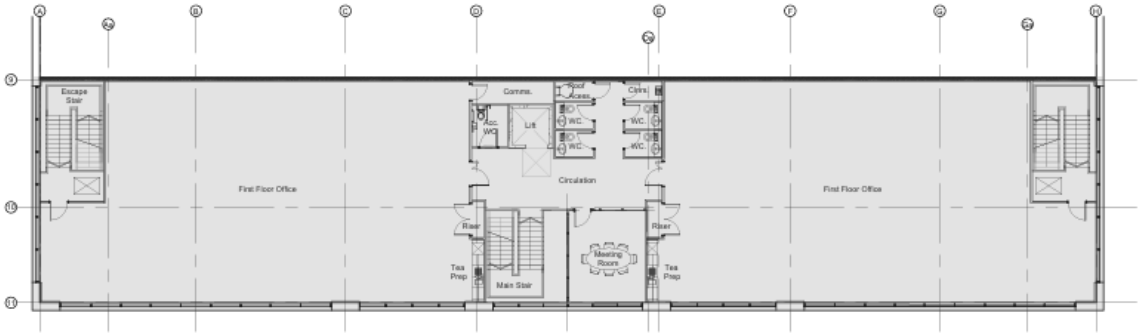
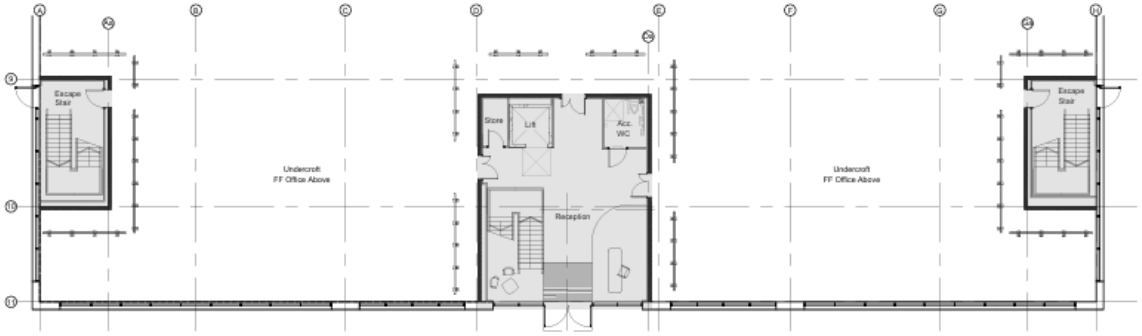
sre

Unit 200 – First Floor – Office Plans



First Floor Office Plan +6.000m



Ground Floor Office Plan +0.000m

UMC ARCHITECTS.

1 & 2 Longwalk Road

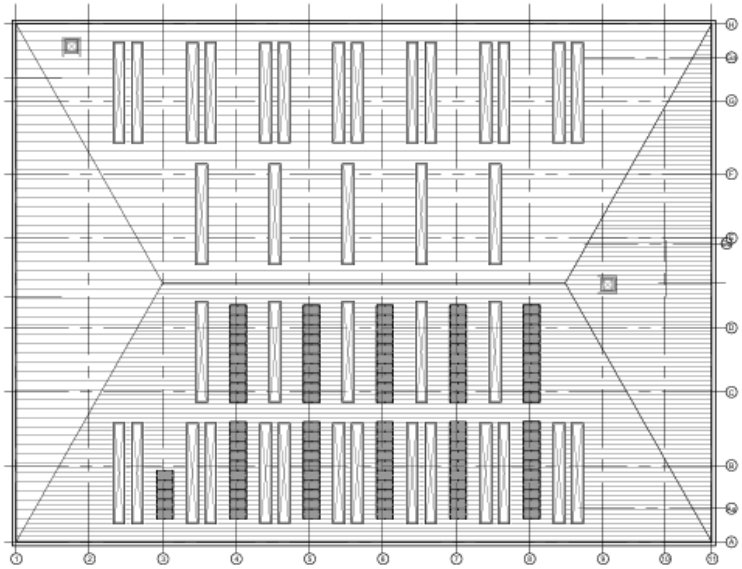
Unit 200 - Office Plans

23517 - UMC - 0200 - ZZ - DR - A - 1002

P02

sre

Unit 200 – Roof Plan



Roof Plan

UMC ARCHITECTS.

1 & 2 Longwalk Road

Unit 200 - Roof Plan

23517 - UMC - 0200 - ZZ - DR - A - 1003

P03

sre

Appendix B – Summary Building Performance Specification

Longwalk - London

sre

Construction Element	U-Value	Description
External Wall - (Storage)	0.16	As per the BRUKL document
Pitched / Flat Roof	0.14	As per the BRUKL document
Ground Floor	0.14	As per the BRUKL document

Construction Element	U-Value	G Value	Frame Factor	Description (manufacturer, make and model)
External Windows	1.40	0.4	15%	Double Glazed with Whole Window U-value
Rooflight	1.30	0.4	15%	Double Glazed with Whole Window U-value
Access Doors - Large	1.30	n/a	n/a	Whole Door U-value
Access Doors - Personnel	1.40	n/a	n/a	Whole Door U-value

Construction Notes	Description (manufacturer, make and model)
Air-permeability	3 $m^3/(h.m^2)$ at 50 Pa (Targeted)

Heating and Cooling	System Details	Emitter	Location	Controls
Heating/Cooling System 1	Mitsubishi Split System (Seasonal efficiency SCOP 4.39, SEER 7.74, EER 3.5)	Ceiling Cassettes	Office, Meeting room, and Reception	Wall mounted room controller linked to a central control unit
Heating System 2	Dimplex PLXE panel heaters (Seasonal efficiency COP 1)	Wall Mounted radiator	Circulation areas / WCs	Local temperature control

Hot Water	System Details	Secondary Circulation	Circulation Losses (W/m)	Pump Power (kW)	Loop Length (m)	Storage Tank (l)	Storage Losses (kWh/l.day)	Delivery Efficiency
Hot Water System 1	Point of Use	N	N/A	N/A	N/A	-	-	1.00

Ventilation	System Details	Specific Fan Power (W/l/s)	Location	Heat Recovery	Heat Recovery efficiency (%)	Heat exchanger type	Variable Heat Recovery
Ventilation 1	Mechanical Ventilation (Zonal Extract - Fan remote from Zone)	0.30	WCs	N	n/a	n/a	n/a
Ventilation 2	Mechanical Ventilation with Heat Recovery	1.50	Office, Meeting room, and Reception	Y	80.00%	Plate Type	-

Electrical Flow Control		Description
Power Correction Factor	Y	
Separate Metering	Y	

Renewables	Description
Photovoltaics	Unit 100 : 44.52 kWp of PV array. 118 panels on main roof, Module Efficacy of 20%/ Unit 200 : 42.6 kWp of PV array. 113 panels on main roof, Module Efficacy of 20%
Solar Water Heating	N
Wind Turbine	N

Lighting	Description
Lighting	All Areas to have LED Lighting with a minimum efficacy of 95 Lm/Watts,
Lighting Controls	PIR sensors throughout. Daylight Dimming sensors within the storage area
Parasitic Power	0.10 W/m^2 for Stand-Alone Sensors and 0.05 W/m2 for the Combination of Daylight and PIR Sensors

Sign Off Details	Name	Jean Dib	Date	16.09.2026	By signing this document, I declare that the aformentioned details are all correct as per the final "as build" specifications:	Name		Date	
						Signature			

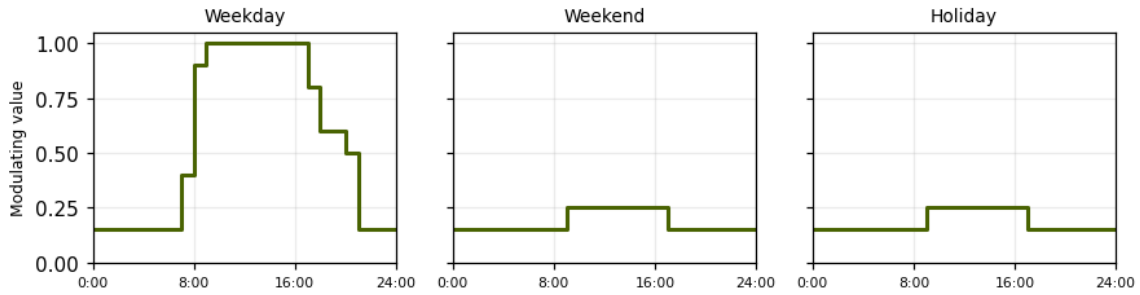
SRE Main Office, Greenforde Farm, Stoner Hill Road, Froxfield, Petersfield, GU32 1DY
tel: +44 (0)1730 710044
info@sre.co.uk

Appendix C – Baseline Model – Thermal Template

Warehouse

TM54 Warehouse (Active Area) Lighting	
Lighting Power Consumption (W/m²)	1.50
Lighting Heat Gain (W/m²)	1.50
Radiant Fraction	0.45
Diversity Factor	1
Profile	WEEK0396
Dimming Profile	WEEK0399
Dimming profile (formula '00 TM54 - Daylight Sensors')	ramp(e1, 0, 1, 300, 0.2)

Lighting profile: 00_TM54 Warehouse (Active Area) - Lighting



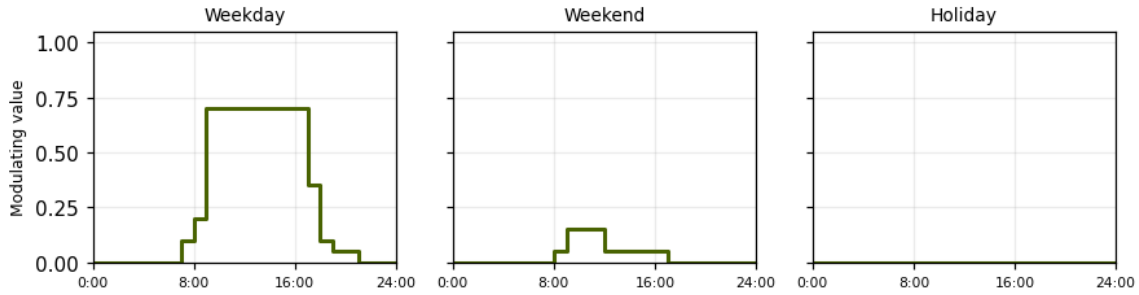
Infiltration	
Name	Infiltration
Flow rate (ach)	0.02

Auxiliary Energy (Plant)	
Plant profile type	Set independently
Plant profile	OFF

General Office

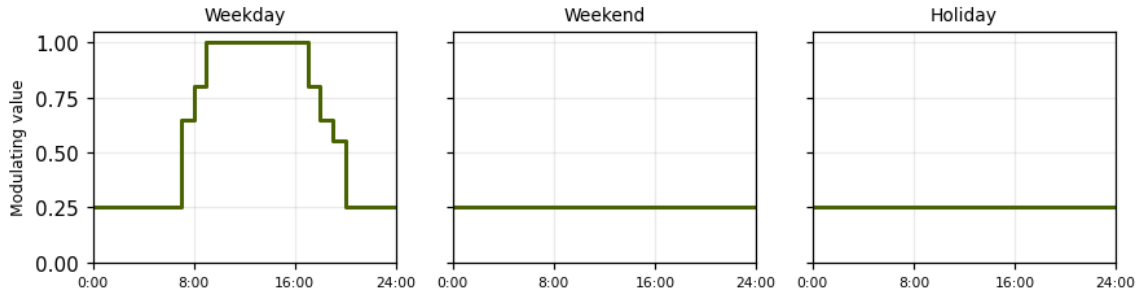
TM54 Office - Occupancy	
Occupancy Density (m²/person)	10
Sensible Gain (W/person)	90
Latent Gain (W/person)	50
Diversity Factor	1
Profile	WEEK0211

Occupancy profile: 00_TM54 Office/Reception - Occupancy



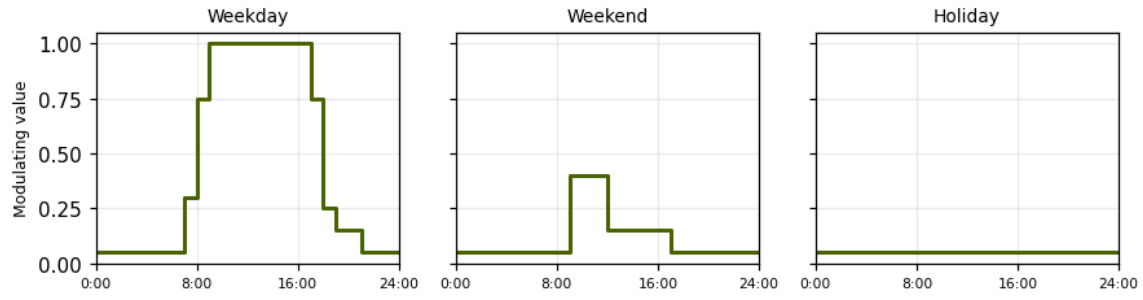
TM54 Reception/Office - Equipment	
Power Consumption (W/m²)	15
Sensible Gain (W/m²)	15
Radiant Fraction	0.22

Equipment profile: 00_TM54 Office/Reception - Equipment



TM54 Reception/Office - Lighting	
Lighting Power Consumption (W/m²)	12
Lighting Heat Gain (W/m²)	12
Radiant Fraction	0.45
Diversity Factor	1
Profile	WEEK0212
Dimming Profile	ON

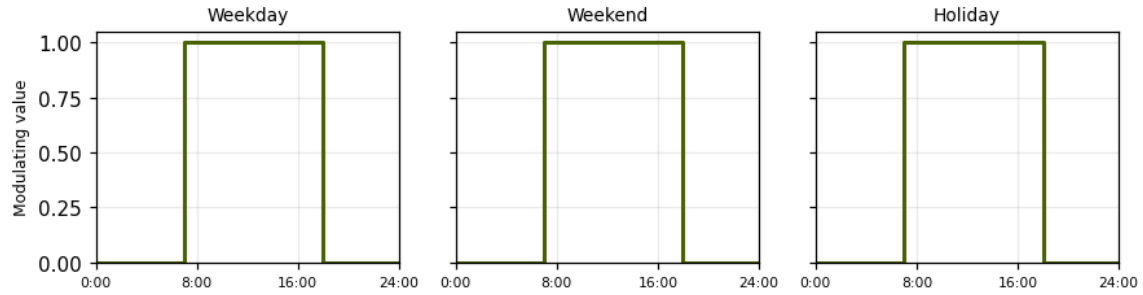
Lighting profile: 00_TM54 Office/Reception - Internal Lighting



Infiltration	
Name	Infiltration
Flow rate (ach)	0.02
Adjacent condition	External air
Variation profile	ON

Auxiliary Ventilation	
Name	Auxiliary Ventilation Office
Flow rate (l/s/person)	8
Adjacent condition	Temperature from profile
Variation profile	WEEK0378
Temperature profile	WEEK0398
Auxiliary Ventilation temperature profile (formula '00 TM54 - MVHR NEW')	if((ta>=22)&(to>15)&(to<24),to,((0.8*ta)+(0.2*to)))

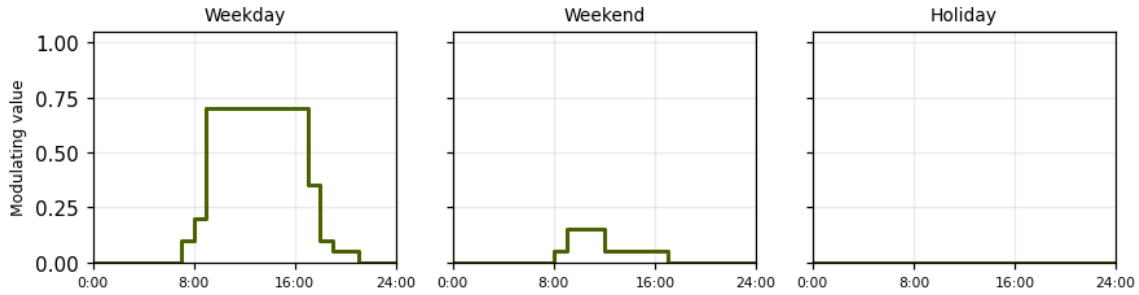
Auxiliary Ventilation variation profile: 00_TM54 - MVHR Operation



Reception

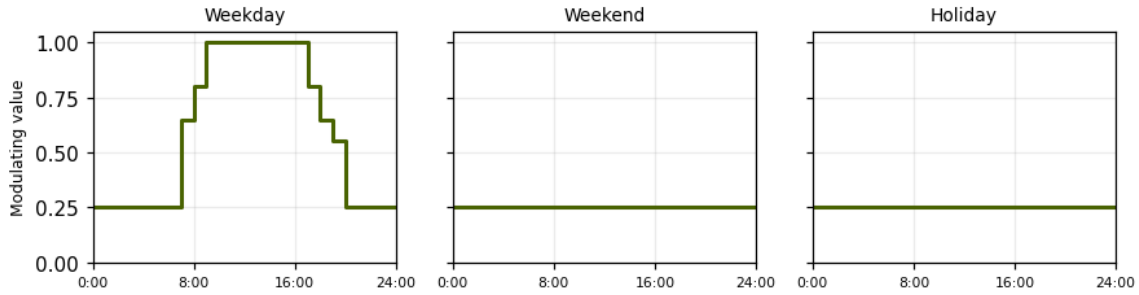
TM54 Reception Occupancy	
Occupancy Density (people)	1
Sensible Gain (W/person)	90
Latent Gain (W/person)	50
Diversity Factor	1
Profile	WEEK0211

Occupancy profile: 00_TM54 Office/Reception - Occupancy



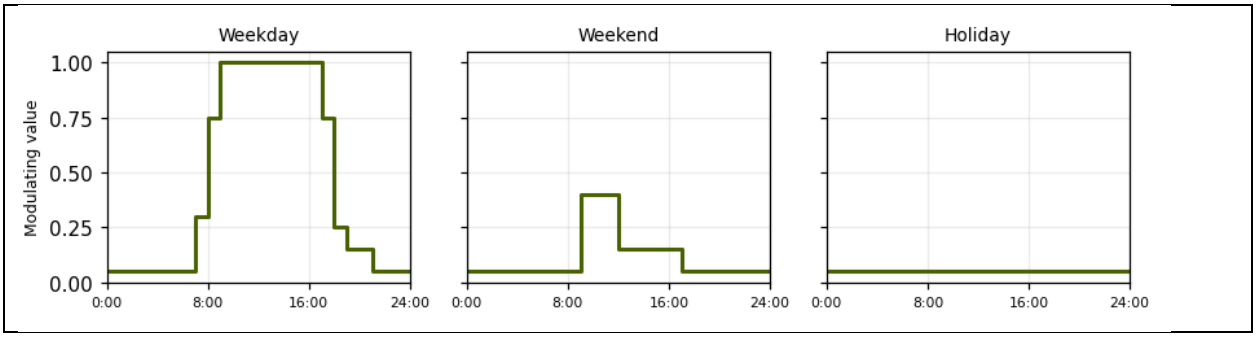
TM54 Reception Equipment	
Power Consumption (W/m²)	5
Sensible Gain (W/m²)	5
Latent Gain (W/m²)	0
Radiant Fraction	0.22
Diversity Factor	1
Energy Source	<dict>
Profile	WEEK0214

Equipment profile: 00_TM54 Office/Reception - Equipment



TM54 Reception - Lighting	
Lighting Power Consumption (W/m²)	15
Lighting Heat Gain (W/m²)	15
Radiant Fraction	0.45
Diversity Factor	1
Profile	WEEK0212
Dimming Profile	ON

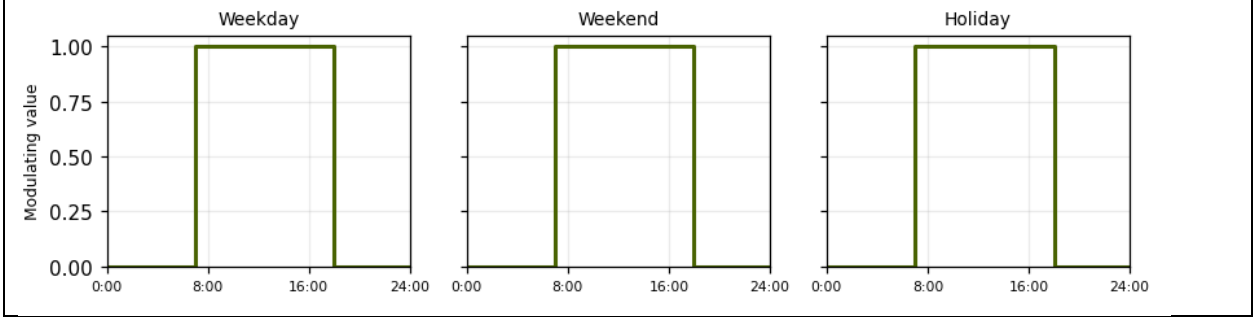
Lighting profile: 00_TM54 Office/Reception - Internal Lighting



Infiltration	
Name	Infiltration
Flow rate (ach)	0.02
Adjacent condition	External air
Variation profile	ON

Auxiliary Ventilation	
Name	Auxiliary ventilation Reception
Flow rate (l/s/person)	8
Adjacent condition	Temperature from profile
Variation profile	WEEK0378
Temperature profile	WEEK0398
Auxiliary Ventilation temperature profile (formula '00 TM54 - MVHR NEW')	if((ta>=22)&(to>15)&(to<24),to,((0.8*ta)+(0.2*to)))

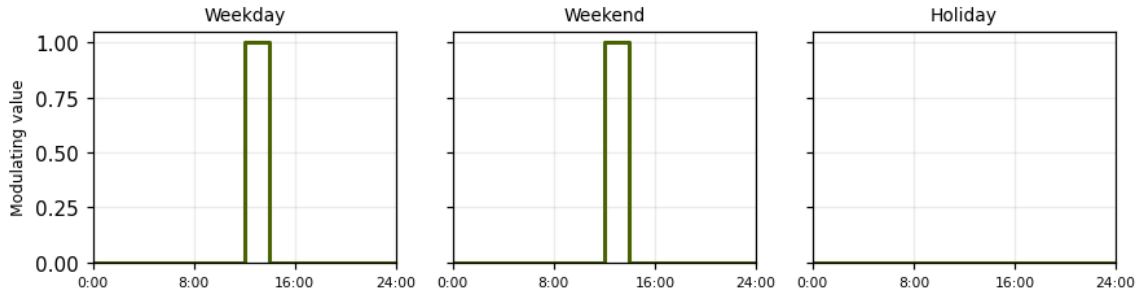
Auxiliary Ventilation variation profile: 00_TM54 - MVHR Operation



Circulation

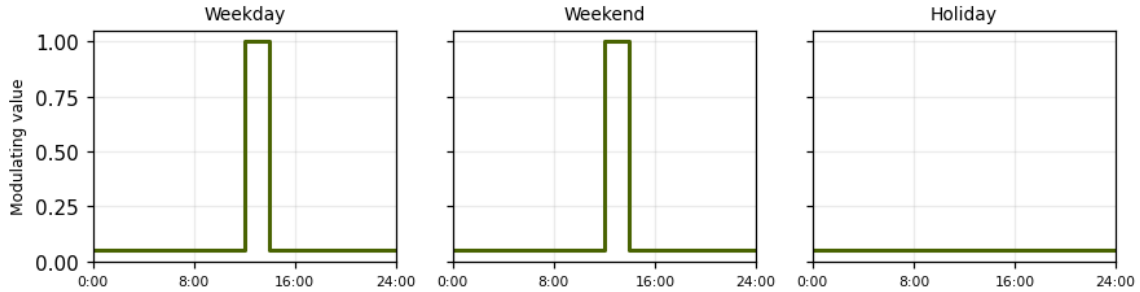
TM54 Circulation - General 2 hours (1 person)	
Occupancy Density (people)	1
Sensible Gain (W/person)	90
Latent Gain (W/person)	50

Occupancy profile: 00_TM54 General - 2 hours



TM54 General 2 Hours	
Lighting Power Consumption (W/m²)	10.76
Lighting Heat Gain (W/m²)	10.76
Radiant Fraction	0.45
Diversity Factor	1
Profile	WEEK0213
Dimming Profile	ON

Lighting profile: 00_TM54 General - Internal Lighting - 2 hours

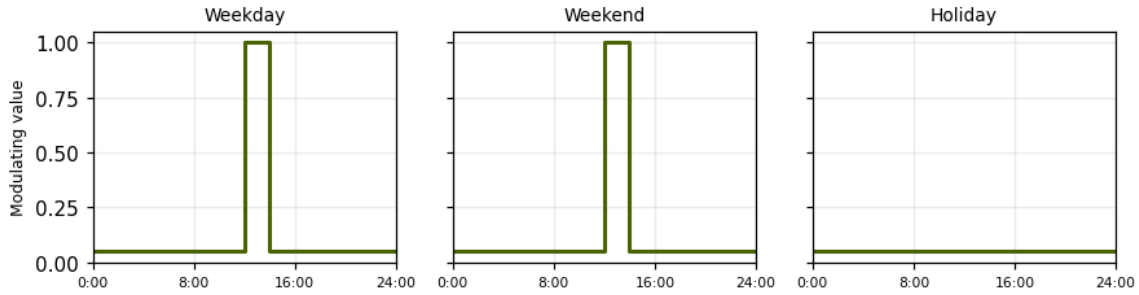


TM54 Circulation - Infiltration	
Name	Infiltration
Flow rate (ach)	0.02
Adjacent condition	External air
Variation profile	ON

Toilet

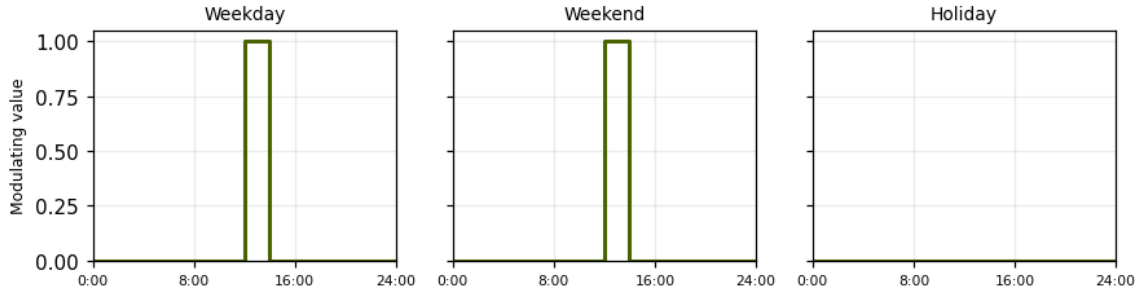
TM54 General 2 Hours	
Lighting Power Consumption (W/m²)	10.76
Lighting Heat Gain (W/m²)	10.76
Radiant Fraction	0.45
Diversity Factor	1
Profile	WEEK0213
Dimming Profile	ON

Lighting profile: 00_TM54 General - Internal Lighting - 2 hours



People - WC	
Occupancy Density (m²/person)	10
Sensible Gain (W/person)	90
Latent Gain (W/person)	50
Diversity Factor	1
Profile	WEEK0209

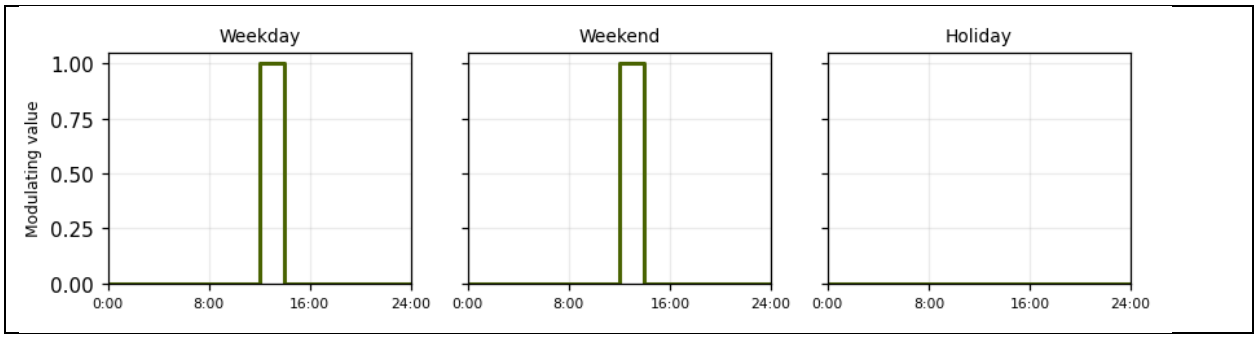
Occupancy profile: 00_TM54 General - 2 hours



Infiltration	
Name	Infiltration
Flow rate (ach)	0.02
Adjacent condition	External air
Variation profile	ON

Auxiliary Ventilation	
Name	WC Extract
Flow rate (ach)	0.60
Adjacent condition	External air
Variation profile	WEEK0209

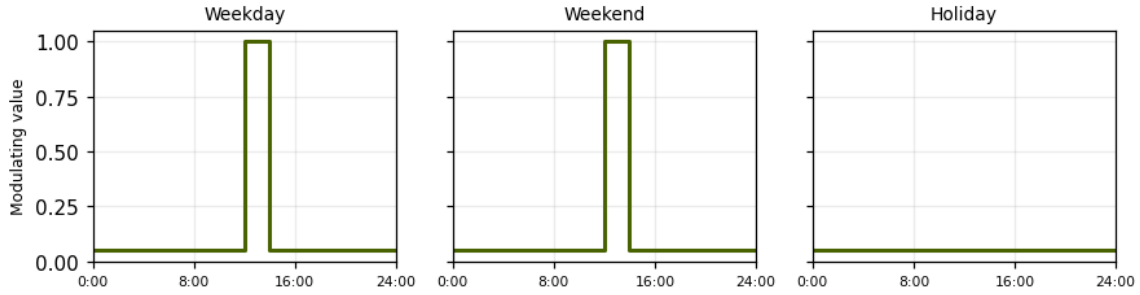
Auxiliary Ventilation variation profile: 00_TM54 General - 2 hours


Weekday
Weekend
Holiday
Modulating value
1.00
0.75
0.50
0.25
0.00
0:00
8:00
16:00
24:00

IT Comms

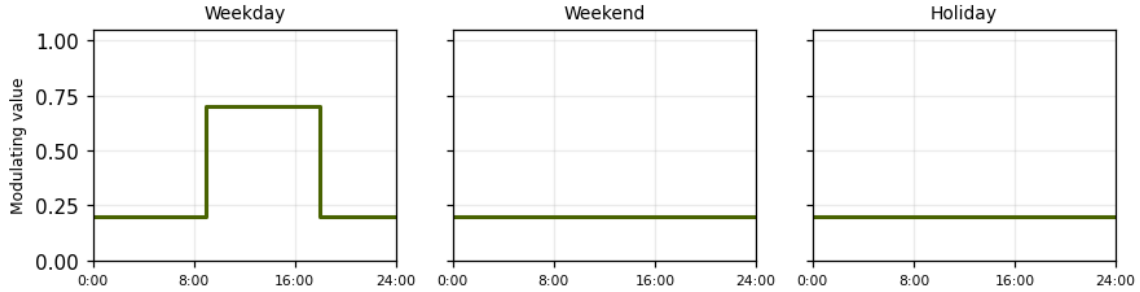
TM54 IT Comms - Lighting	
Lighting Power Consumption (W/m²)	10.76
Radiant Fraction	0.45

Lighting profile: 00_TM54 General - Internal Lighting - 2 hours



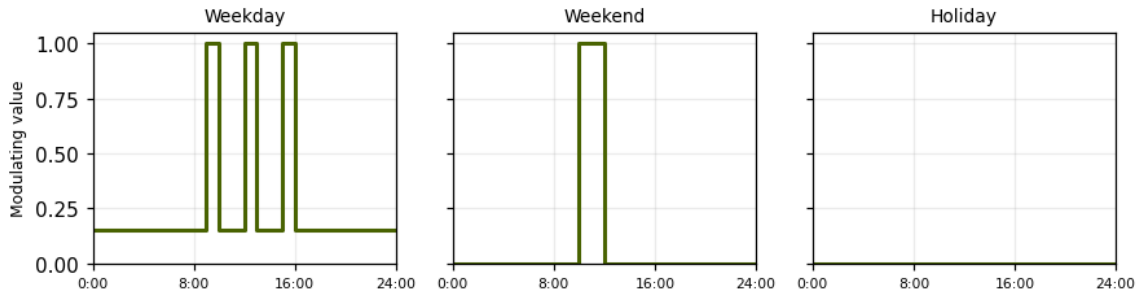
TM54 IT Comms - Equipment	
Power Consumption (W/m²)	200
Sensible Gain (W/m²)	200
Latent Gain (W/m²)	0
Radiant Fraction	0.22
Energy Source	<dict>
Profile	WEEK0386

Equipment profile: 00_TM54 Server - Equipment

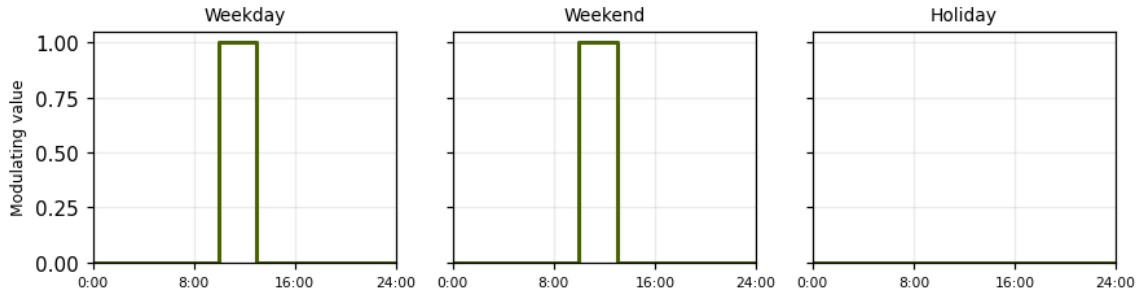


Tea Point

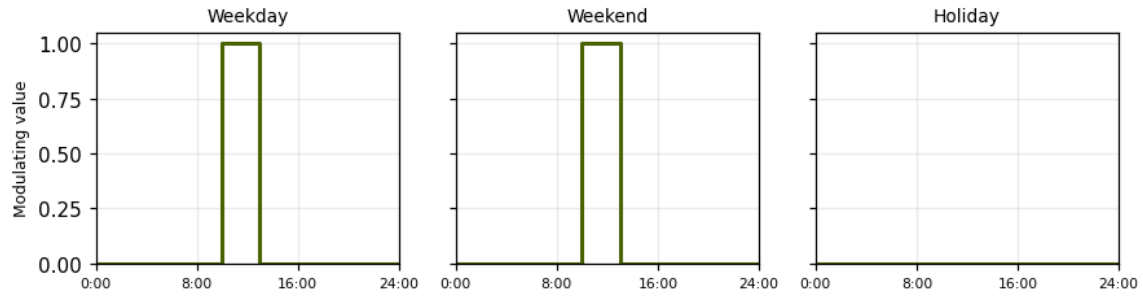
TM54 Kitchenitte	
Power Consumption (W)	4000
Sensible Gain (W)	4000
Latent Gain (W)	0
Radiant Fraction	0.22
Diversity Factor	1
Energy Source	<dict>
Profile	WEEK0432
Equipment profile: 11. TM54 3 hour/day (Microwave; Ketle)	



TM54 Kitchenitte	
Occupancy Density (people)	1
Sensible Gain (W/person)	90
Latent Gain (W/person)	50
Diversity Factor	1
Profile	04TM0000
Occupancy profile: 04. TM54 3 hour/day	



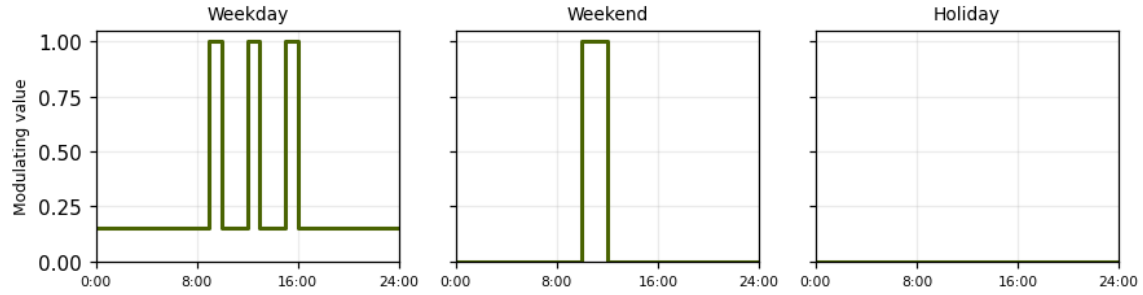
TM54 General 3 Hours	
Lighting Power Consumption (W/m²)	10.76
Lighting Heat Gain (W/m²)	10.76
Radiant Fraction	0.45
Diversity Factor	1
Profile	04TM0000
Dimming Profile	ON
Lighting profile: 04. TM54 3 hour/day	



Infiltration	
Name	Infiltration
Flow rate (ach)	0.02
Adjacent condition	External air
Variation profile	ON

Auxiliary Ventilation	
Name	Kitchen Extract
Flow rate (l/s)	15
Adjacent condition	External air
Variation profile	WEEK0432

Auxiliary Ventilation variation profile: 11. TM54 3 hour/day (Microwave; Ketle)

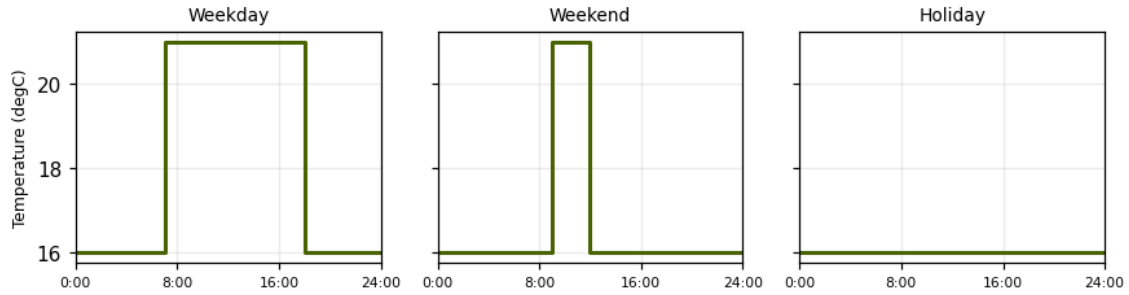


Appendix D – Baseline Model – Heating & Cooling Profiles

Heating – Cooling (Warehouse – Self storage / Store / IT Comms)	
Timing profile	OFF

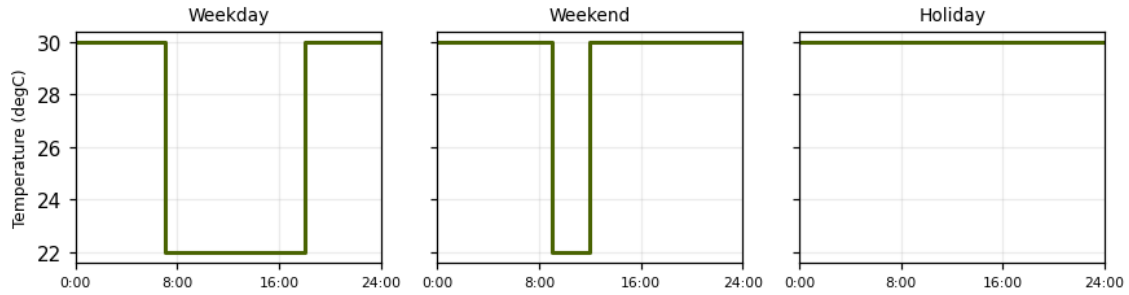
Heating – Office – Reception – Meeting Room	
Setpoint type	variable

Heating setpoint profile: 00_TM54 Office - Heating [temperature]



Cooling – Office – Reception – Meeting Room	
Setpoint type	variable

Cooling setpoint profile: 00_TM54 Office - Cooling [temperature]



Heating – Circulation - WCs	
Setpoint type	constant
Heating Setpoint (degC)	16
Timing profile	ON

Appendix E – Baseline Model – DHW Consumption

Domestic Hot Water	
DHW (l/(h·pers))	0.5
Linked to occupancy	True

Appendix F – Analysis Results (kWh/annum)

Mid Scenario

Energy Model Output Report

Project name:	3590_LONG_TM54_V1_Mid
Project Address:	
Climate File:	London_TRY.epw
Simulation:	3590_LONG_TM54_V1_Mid.aps

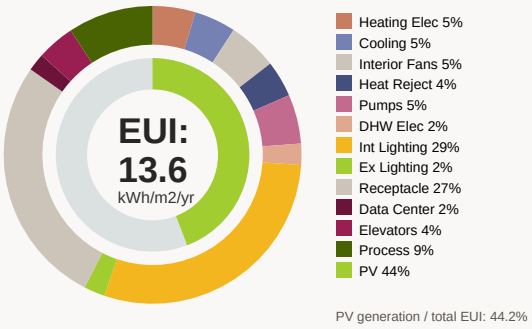
Design Team:	
Energy Analyst:	
Area (m2):	11,000.000
Generated:	2026-09-15 11:50:54

APS period: 01 Jan 1986 - 31 Dec 1986 (365 days); days 1-365 | Reporting basis: Annual

Annual Energy Consumption (kWh/m2/yr; kgCO2/m2/yr)

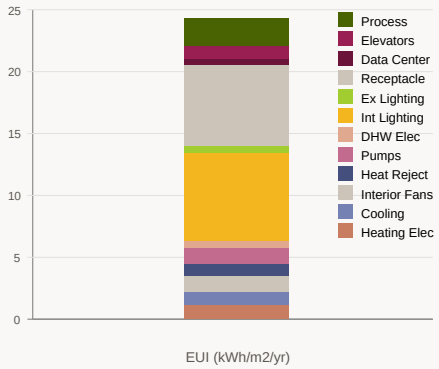
Energy End Use	Site	Source	CO2
Heating Fossil Fuel	0.00	0.00	0.00
Heating Electricity	1.13	1.70	0.18
Space Cooling	1.10	1.64	0.14
Fans Interior	1.30	1.95	0.18
Heat Rejection	0.96	1.44	0.12
Pumps	1.30	1.95	0.18
DHW Fossil Fuel	0.00	0.00	0.00
DHW Electricity	0.56	0.84	0.08
Interior Lighting	7.08	10.62	0.99
Exterior Lighting	0.56	0.84	0.08
Receptacle	6.61	9.91	0.92
Data Center	0.46	0.69	0.06
Cooking Fossil Fuel	0.00	0.00	0.00
Cooking Electricity	0.00	0.00	0.00
Elevators & Escalators	1.00	1.49	0.14
Refrigeration	0.00	0.00	0.00
Process	2.25	3.38	0.31
TOTAL (ex renewables)	**24.29**	**36.44**	**3.37**
PV / On-site Generation	10.73	10.73	1.38
Net total incl. PV	**13.56**	**25.71**	**1.99**

Site Energy Use Intensity



PV generation / total EUI: 44.2%

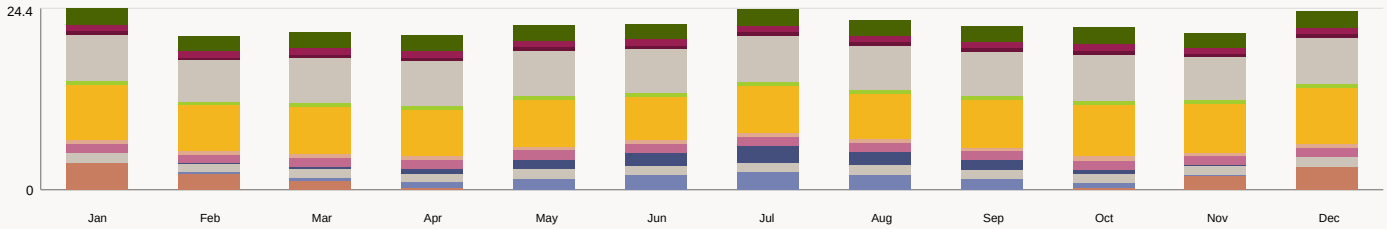
Predicted Energy Consumption (excl. Renewables)



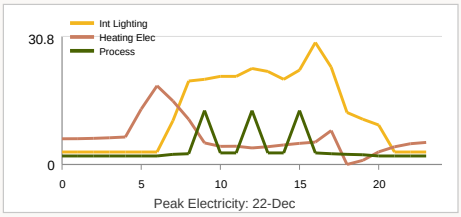
Monthly Site Energy Dashboard (MWh)

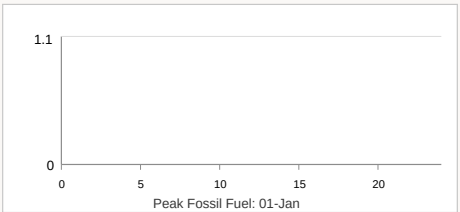
Total site MWh by month - stacked by end use

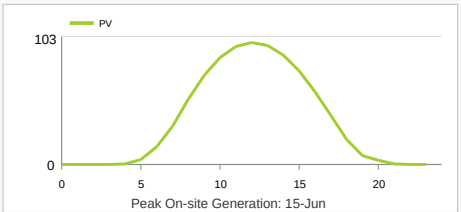
Annual 267.2 MWh



Peak Energy Sources for Electricity (kW), Fossil Fuel (kW) and Onsite Power Generation (kW): Top 3 Contributors







Annual Fuel Costs and Heating Metrics

Fuel	MWh	Est. Cost	Rate
Electricity	267	66,805	0.25
Fossil Fuel	0.0	0	0.07
PV Generation	118	0	0.00

Total est. cost 66,805

Heating metrics (kWh/m2/year)

Room heating	3.29	**Purchased useful heat**	**3.29**
System air heating	0.00	Heating input raw	1.13
Aux vent heating raw	0.00	**TM54 adjusted input**	**n/a**
MVHR recovered heat	**0.00**	**TM54 adjusted COP**	**n/a**

Annual reporting basis - no annualisation/scaling applied; MVHR audit: 7 candidate(s), 0 confirmed; audit only; raw IES EUI retained.

Low Scenario

Energy Model Output Report

Project name:	3590_LONG_TM54_V1_Low
Project Address:	
Climate File:	London_TRY.epw
Simulation:	3590_LONG_TM54_V1_Low.aps

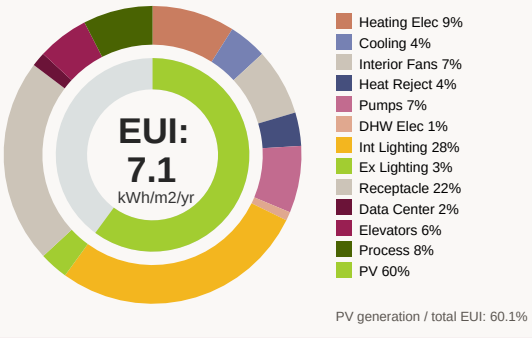
Design Team:	
Energy Analyst:	
Area (m2):	11,000.000
Generated:	2026-09-15 12:43:03

APS period: 01 Jan 1986 - 31 Dec 1986 (365 days); days 1-365 | Reporting basis: Annual

Annual Energy Consumption (kWh/m2/yr; kgCO2/m2/yr)

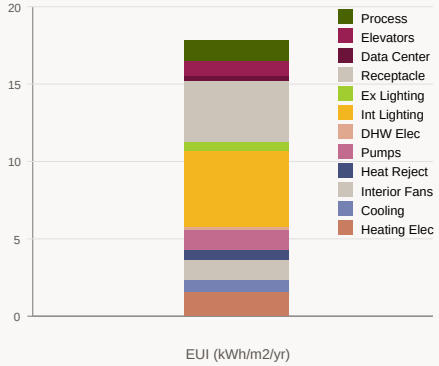
Energy End Use	Site	Source	CO2
Heating Fossil Fuel	0.00	0.00	0.00
Heating Electricity	1.61	2.41	0.25
Space Cooling	0.74	1.11	0.09
Fans Interior	1.30	1.95	0.18
Heat Rejection	0.65	0.97	0.08
Pumps	1.30	1.95	0.18
DHW Fossil Fuel	0.00	0.00	0.00
DHW Electricity	0.17	0.25	0.02
Interior Lighting	4.96	7.44	0.69
Exterior Lighting	0.56	0.84	0.08
Receptacle	3.96	5.95	0.55
Data Center	0.28	0.42	0.04
Cooking Fossil Fuel	0.00	0.00	0.00
Cooking Electricity	0.00	0.00	0.00
Elevators & Escalators	1.00	1.49	0.14
Refrigeration	0.00	0.00	0.00
Process	1.35	2.03	0.19
TOTAL (ex renewables)	**17.86**	**26.79**	**2.49**
PV / On-site Generation	10.73	10.73	1.38
Net total incl. PV	**7.13**	**16.06**	**1.11**

Site Energy Use Intensity



PV generation / total EUI: 60.1%

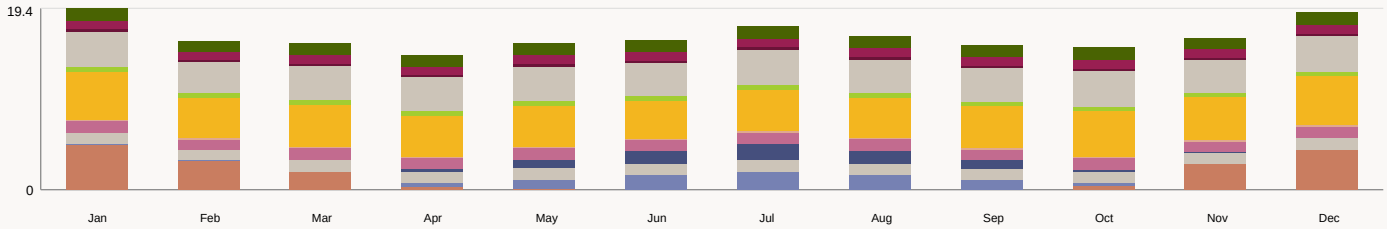
Predicted Energy Consumption (excl. Renewables)



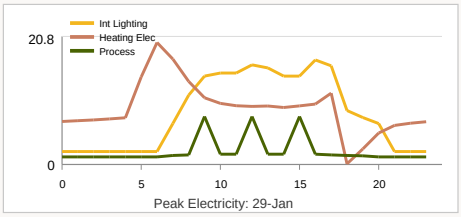
Monthly Site Energy Dashboard (MWh)

Total site MWh by month - stacked by end use

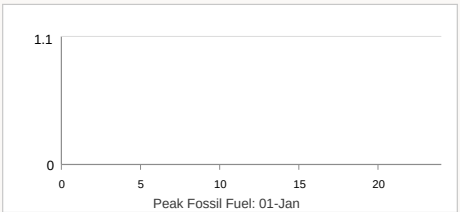
Annual 196.5 MWh



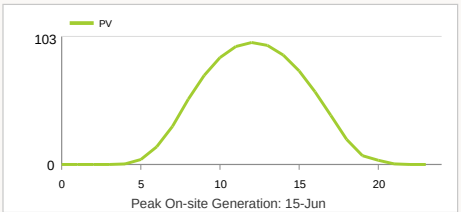
Peak Energy Sources for Electricity (kW), Fossil Fuel (kW) and Onsite Power Generation (kW): Top 3 Contributors



Peak Electricity: 29-Jan



Peak Fossil Fuel: 01-Jan



Peak On-site Generation: 15-Jun

Annual Fuel Costs and Heating Metrics

Fuel	MWh	Est. Cost	Rate
Electricity	196	49,117	0.25
Fossil Fuel	0.0	0	0.07
PV Generation	118	0	0.00

Total est. cost 49,117

Heating metrics (kWh/m2/year)

Room heating	4.95	**Purchased useful heat**	**4.95**
System air heating	0.00	Heating input raw	1.61
Aux vent heating raw	0.00	**TM54 adjusted input**	**n/a**
MVHR recovered heat	**0.00**	**TM54 adjusted COP**	**n/a**

Annual reporting basis - no annualisation/scaling applied; MVHR audit: 7 candidate(s), 0 confirmed; audit only; raw IES EUI retained.

High Scenario

Energy Model Output Report

Project name:	3590_LONG_TM54_V1_High
Project Address:	
Climate File:	London_TRY.epw
Simulation:	3590_LONG_TM54_V1_High.aps

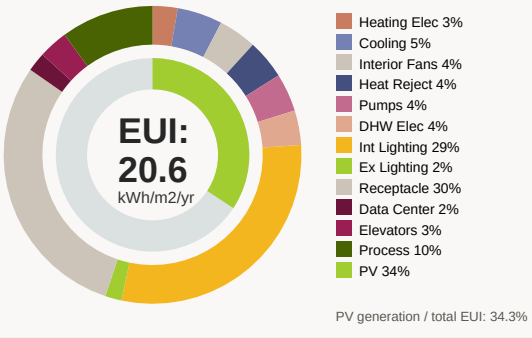
Design Team:	
Energy Analyst:	
Area (m2):	11,000.000
Generated:	2026-09-15 12:42:35

APS period: 01 Jan 1986 - 31 Dec 1986 (365 days); days 1-365 | Reporting basis: Annual

Annual Energy Consumption (kWh/m2/yr; kgCO2/m2/yr)

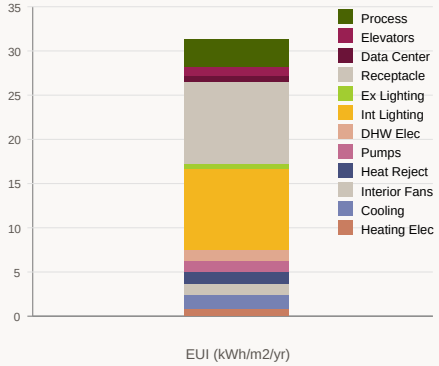
Energy End Use	Site	Source	CO2
Heating Fossil Fuel	0.00	0.00	0.00
Heating Electricity	0.85	1.27	0.13
Space Cooling	1.53	2.30	0.19
Fans Interior	1.30	1.95	0.18
Heat Rejection	1.34	2.01	0.17
Pumps	1.30	1.95	0.18
DHW Fossil Fuel	0.00	0.00	0.00
DHW Electricity	1.18	1.77	0.16
Interior Lighting	9.21	13.81	1.29
Exterior Lighting	0.56	0.84	0.08
Receptacle	9.25	13.87	1.28
Data Center	0.65	0.97	0.09
Cooking Fossil Fuel	0.00	0.00	0.00
Cooking Electricity	0.00	0.00	0.00
Elevators & Escalators	1.00	1.49	0.14
Refrigeration	0.00	0.00	0.00
Process	3.15	4.73	0.44
TOTAL (ex renewables)	**31.30**	**46.95**	**4.34**
PV / On-site Generation	10.73	10.73	1.38
Net total incl. PV	**20.57**	**36.22**	**2.95**

Site Energy Use Intensity



PV generation / total EUI: 34.3%

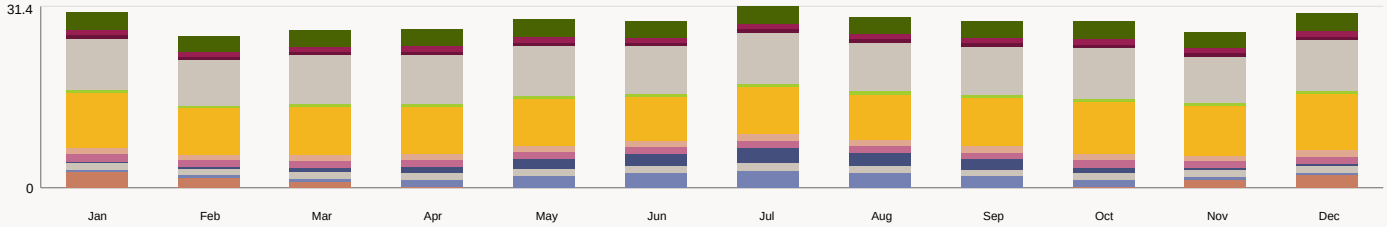
Predicted Energy Consumption (excl. Renewables)



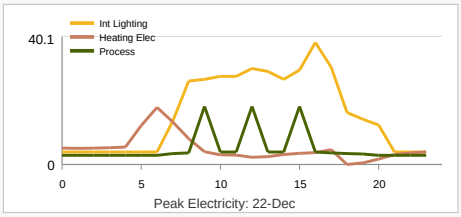
Monthly Site Energy Dashboard (MWh)

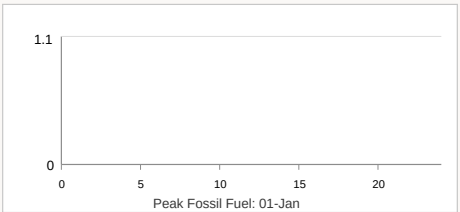
Total site MWh by month - stacked by end use

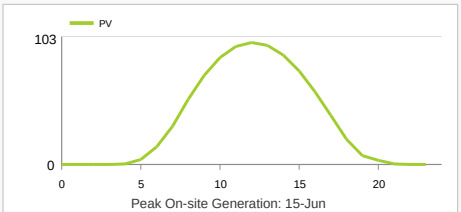
Annual 344.3 MWh



Peak Energy Sources for Electricity (kW), Fossil Fuel (kW) and Onsite Power Generation (kW): Top 3 Contributors







Annual Fuel Costs and Heating Metrics

Fuel	MWh	Est. Cost	Rate
Electricity	344	86,083	0.25
Fossil Fuel	0.0	0	0.07
PV Generation	118	0	0.00

Total est. cost 86,083

Heating metrics (kWh/m2/year)

Room heating	2.38	**Purchased useful heat**	**2.38**
System air heating	0.00	Heating input raw	0.85
Aux vent heating raw	0.00	**TM54 adjusted input**	**n/a**
MVHR recovered heat	**0.00**	**TM54 adjusted COP**	**n/a**

Annual reporting basis - no annualisation/scaling applied; MVHR audit: 7 candidate(s), 0 confirmed; audit only; raw IES EUI retained.

Appendix G – TM54 Quality Assurance Independent Review Record

G.1 Purpose of Review

A quality assurance review has been undertaken to provide an independent check of the CIBSE TM54 operational energy assessment for Longwalk Road, London (the Proposed Development). The purpose of the review was to reduce the risk of modelling errors, misinterpretation of design information, inconsistent assumptions, or unclear reporting, and to confirm whether the model and report are suitable for the current RIBA Stage 2 design stage.

The review has been undertaken in accordance with the intent of CIBSE TM54 Step 17, which requires quality assurance of the model, report and associated design information, and with reference to the quality assurance principles set out in CIBSE AM11.

G.2 QA Review Scope, Findings and Close-Out Status

The TM54 model and associated report have been reviewed as part of the quality assurance process. The review considered the consistency of the modelling methodology, model inputs, design information, HVAC system assumptions, operational profiles, sensitivity analysis, benchmark comparison, planning-condition assessment and reported results.

The review covered the model, report and supporting design information available at the current RIBA Stage 2 design stage. The purpose of the review was to reduce the risk of modelling errors, misinterpretation of design information, inconsistent assumptions or unclear reporting, and to confirm whether the TM54 assessment is suitable for its intended use at this design stage.

The review covered the following items:

Review area	Scope of check	QA review outcome
TM54 methodology and report structure	Review of methodology, project stage, reporting structure and implementation matrices	Reviewed and accepted
Project description and building use	Review of project description, building-use classification and activity assumptions	Reviewed and corrected
Benchmark selection and narrative	Review of CIBSE TM46 / Guide F benchmark selection and explanatory caveats	Reviewed and corrected
Model basis	Review of software version, weather file, simulation basis, geometry, zoning and area basis	Reviewed and accepted
Building fabric	Review of U-values, glazing assumptions, airtightness and infiltration treatment	Reviewed and accepted
Thermal bridges	Review of thermal-bridge treatment, limitations and explanatory wording	Reviewed and clarified
Internal gains	Review of occupancy, small power, internal lighting and associated operational profiles	Reviewed and accepted
Domestic hot water	Review of DHW demand, temperature basis and system efficiency assumptions	Reviewed and clarified

Review area	Scope of check	QA review outcome
HVAC systems	Review of apartment ASHP/WSHP system, MVHR, communal VRF, electric heating and auxiliary assumptions	Reviewed and accepted
Renewable energy	Review of PV area, orientation, inclination, module efficiency and reported generation	Reviewed and accepted
Other energy uses	Review of lifts, external lighting, comms/server load and miscellaneous energy uses	Reviewed and accepted
Sensitivity analysis	Review of Low, Mid and High scenarios and key uncertainty parameters	Reviewed and corrected
Results and planning conditions	Review of EUI, space-heating demand, end-use breakdown, PV treatment and planning-condition comparison	Reviewed and corrected
Report clarity and presentation	Review of terminology, figures, tables, numbering, captions, appendices and assumptions records	Reviewed and corrected

The review comments raised during the QA process have been addressed in the current revision of the report and model. This included review and correction of the benchmark narrative, building-use description, model area basis, software/version references, section numbering, figure and table captions, planning-condition wording, sensitivity-analysis narrative, DHW assumptions, PV assumptions and the description of the building services systems.

The QA process also reviewed the key technical modelling assumptions, including building fabric, infiltration, thermal bridging treatment, internal gains, domestic hot water demand, heat-pump efficiencies, auxiliary energy, MVHR, communal cooling systems, lifts, external lighting and PV generation. These assumptions are considered appropriate for the current RIBA Stage 2 design stage, subject to the limitations and future update requirements identified elsewhere in the report.

No outstanding material QA issues have been identified that would prevent the report from being issued for the current RIBA Stage 2 assessment purpose. Future updates should be undertaken if the design changes materially, or once final supplier selections, commissioning data, controls strategies, pump schedules, lift supplier data, external lighting schedules and PV design information become available.

G.4 Review Conclusion

The quality assurance review confirms that the TM54 model and report are considered suitable for the current RIBA Stage 2 design stage. The model has been prepared using a recognised predictive modelling methodology and includes the principal regulated and relevant unregulated energy uses expected for the Proposed Development.

The reported results, sensitivity analysis and planning-condition checks are considered consistent with the modelling assumptions documented in the report. The Mid Scenario represents the current best estimate of predicted operational energy use, while the Low and High Scenarios provide a reasonable indication of the potential effect of key modelling uncertainties.

The review confirms that the QA comments raised during the review process have been addressed and closed out in the current revision. On this basis, the report is considered suitable for issue, subject to the normal limitations of design-stage operational energy modelling and the requirement to update the model as further design, procurement, commissioning and operational information becomes available.

Reviewer: Alisha Pinheiro
Organisation: SRE Ltd
Role / experience: Principal Building Physics Engineer - +6 years of Experience
Independence status: Independent Internal / Internal QA
Date of review: 28-06-2026
Review outcome: Accepted for the current RIBA Stage 2 issue



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