



BREEAM IN USE ENERGY MODELLING & PREDICTION

Endoscopy & Cardiorespiratory
Withington Community Hospital
Manchester
May 2023

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IN USE ENERGY MODELLING & PREDICTION OF WITHINGTON HOSPITAL

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Revision Record			
Rev	Date	By	Summary of Changes
01	17.05.23	BDF	

1 EXECUTIVE SUMMARY

JJMTEC has been appointed to undertake a BREEAM Operational Energy Prediction for the proposed development of Withington Endoscopy & Cardiorespiratory Community Hospital, on the existing site.

The purpose of this report is to provide an indicative picture of the building energy consumption and the impact of changes to how the buildings are managed in operation and the effects of poor weather.

In line with the BREEAM criteria, five different modelling scenarios have been investigated. This report outlines the modelling inputs for each case and provide a visual comparison of the results.

The total annual In Use Energy Consumption for each scenario ranges from 68.7kWh/m² for the Central Case Scenario, 61.8kWh/m² in the Good Management Scenario and 75.6kWh/m² for the Poor Management Scenario.

Whilst no formal Operational Energy Usage targets have been set for this building at earlier RIBA stages, an Operational Energy Usage of 68.7kWh/m² the current design falls within the RIBA 2030 Climate Change target metrics for non-domestic buildings 2025 Targets of <110 kWh/m²/y but falls short of the 2030 Targets.

However, when taking into account the proposed 222m² PV system, the potential yield brings the Central Case Scenario annual estimate (49.9 kWh/m²/y) to within the 2030 Targets figure of < 0 to 55 kWh/m²/y.

RIBA 2030 Climate Challenge target metrics for non-domestic buildings

RIBA Sustainable Outcome Metrics	Current Benchmarks	2020 Targets	2025 Targets	2030 Targets	Notes
Operational Energy kWh/m ² /y 	225 kWh/m ² /y DEC D rated (CIBSE TM46 benchmark)	< 170 kWh/m ² /y DEC C rating	< 110 kWh/m ² /y DEC B rating	< 0 to 55 kWh/m ² /y DEC A rating	UKGBC Net Zero Framework 1. Fabric First 2. Efficient services, and low-carbon heat 3. Maximise onsite renewables 4. Minimum offsetting using UK schemes (CCC)
Embodied Carbon kgCO ₂ e/m ² 	1100 kgCO ₂ e/m ² (M4i benchmark)	< 800 kgCO ₂ e/m ²	< 650 kgCO ₂ e/m ²	< 500 kgCO ₂ e/m ²	RICS Whole Life Carbon (A-C) 1. Whole Life Carbon Analysis 2. Using circular economy Strategies 3. Minimum offsetting using UK schemes (CCC)
Potable Water Use Litres/person/day 	>16 l/p/day (CIRA W11 benchmark)	< 16 l/p/day	< 13 l/p/day	< 10 l/p/day	CIBSE Guide G

Figure 1. Extract from RIBA 2030 Climate Challenge target metrics for non-domestic buildings

A comparison of the In Use Energy consumption from the five modelling scenarios shows the major factor in energy efficiency for this building is management. The building has been designed well to adapt to changing climate this is evident in how similar the energy consumption is for the Central Case Scenario and the Extreme Weather Scenario.

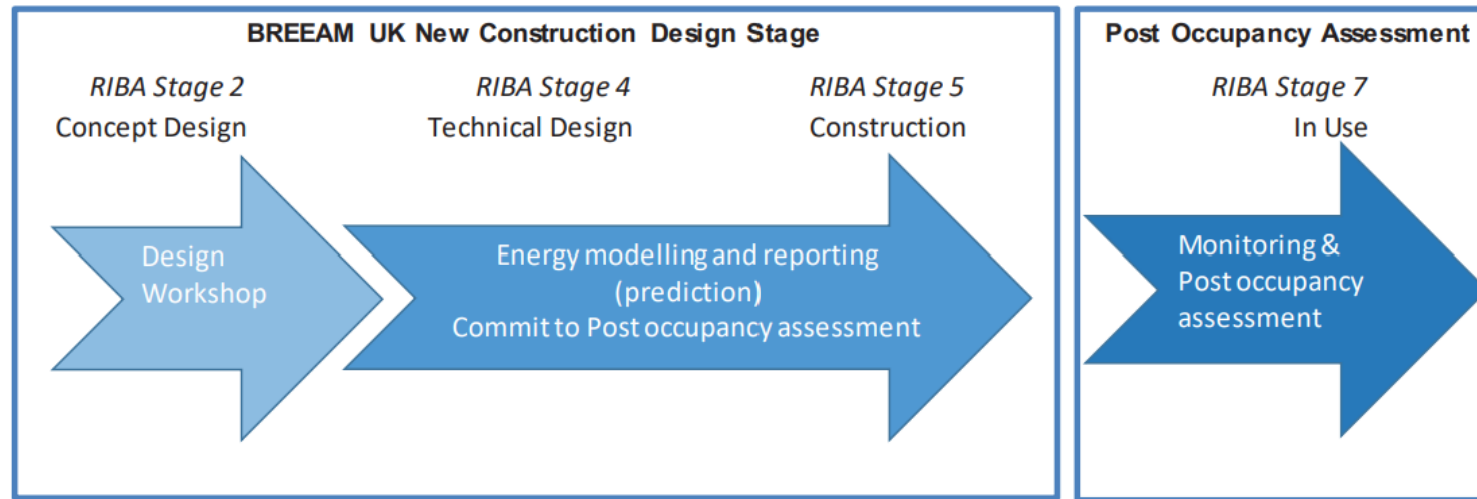


Figure 2. Image from BREEAM GN32 illustrating how energy prediction is implemented at various RIBA stages

Delivering net zero buildings relies on setting absolute operational energy targets that can be readily verified in-use.

Although the proposed building does not fit directly into any of the listed LETI archetypes, when taking into account the proposed 222m² PV system, the Central Case Scenario EUI is estimated to be 49.9 kWh/m²/y, which meets the office target of < 55 kWh/m²/y.

Striving to meet the consistent across all building types space heating demand target of <15 kWh/m²/y is encouraged. In the Central Case Scenario, the space heating demand was found to be 8 kWh/m²/y which meets this target.

A requirement for net zero buildings is they must use all electric systems – which the proposed building is designed to be.

LETI net zero targets

LETI's net zero targets for each archetype are as follows:

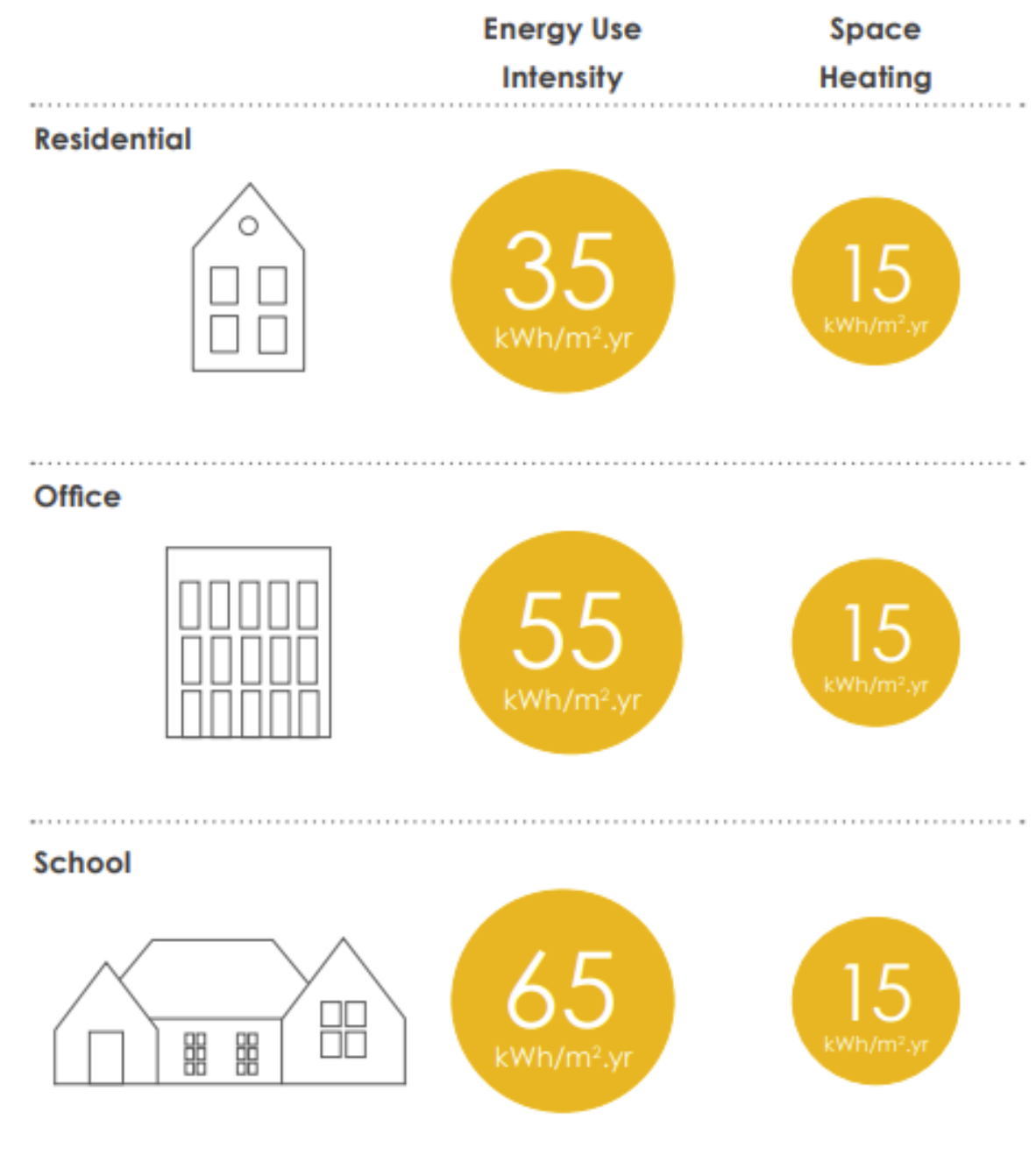


Figure 3. LETI EUI Targets

2 INTRODUCTION TO PROPOSED BUILDING

The layouts are similar throughout the building floorplate. Two circulation corridors run the length on the building effectively splitting the floorplan into three wings whereby access is provided to the various office, consulting, care and treatment areas. Two stairwells and a single lift provide access to the upper floor, which a plantroom takes up a third of the upper-floor space.

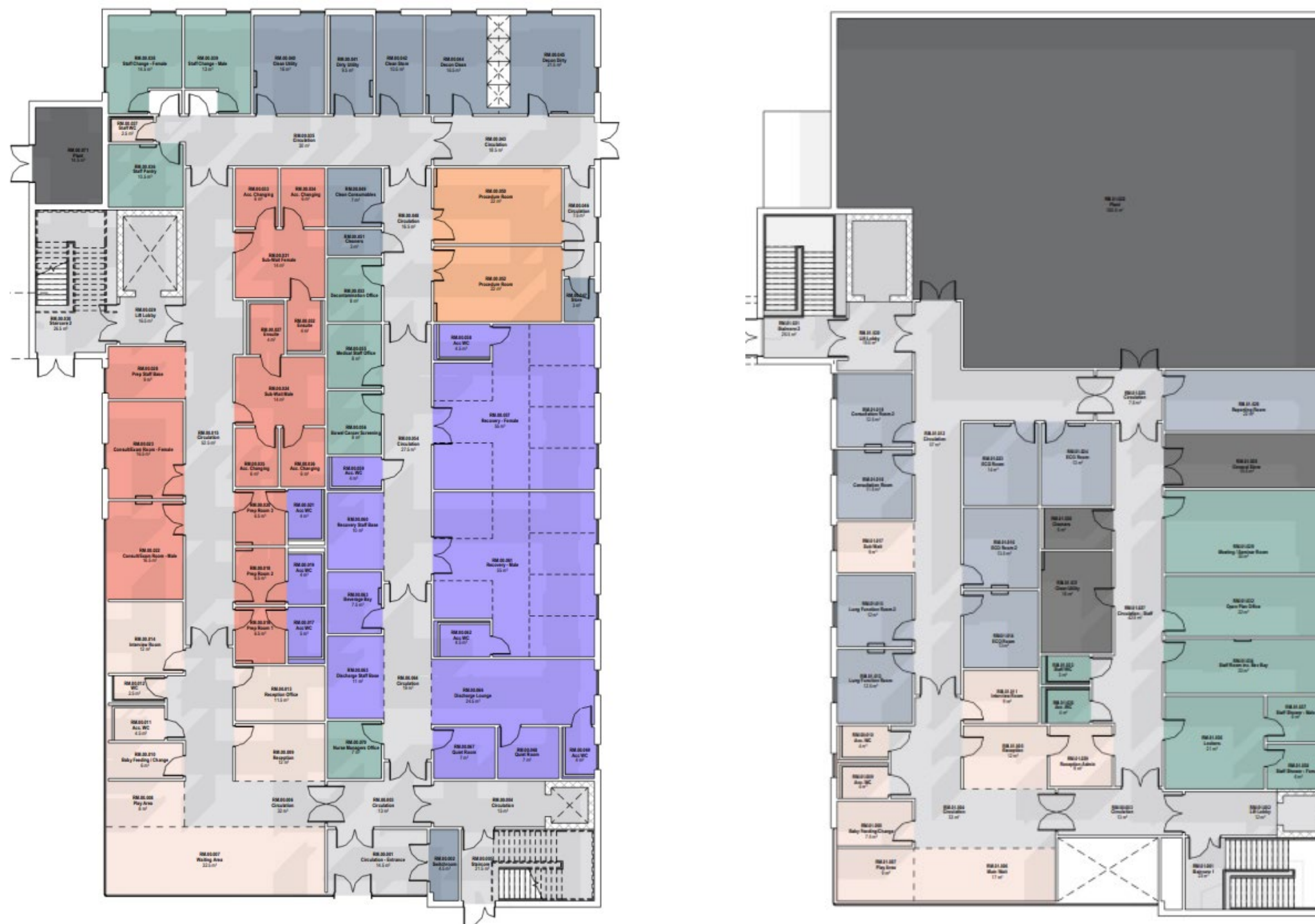


Figure 4. Floor Layouts

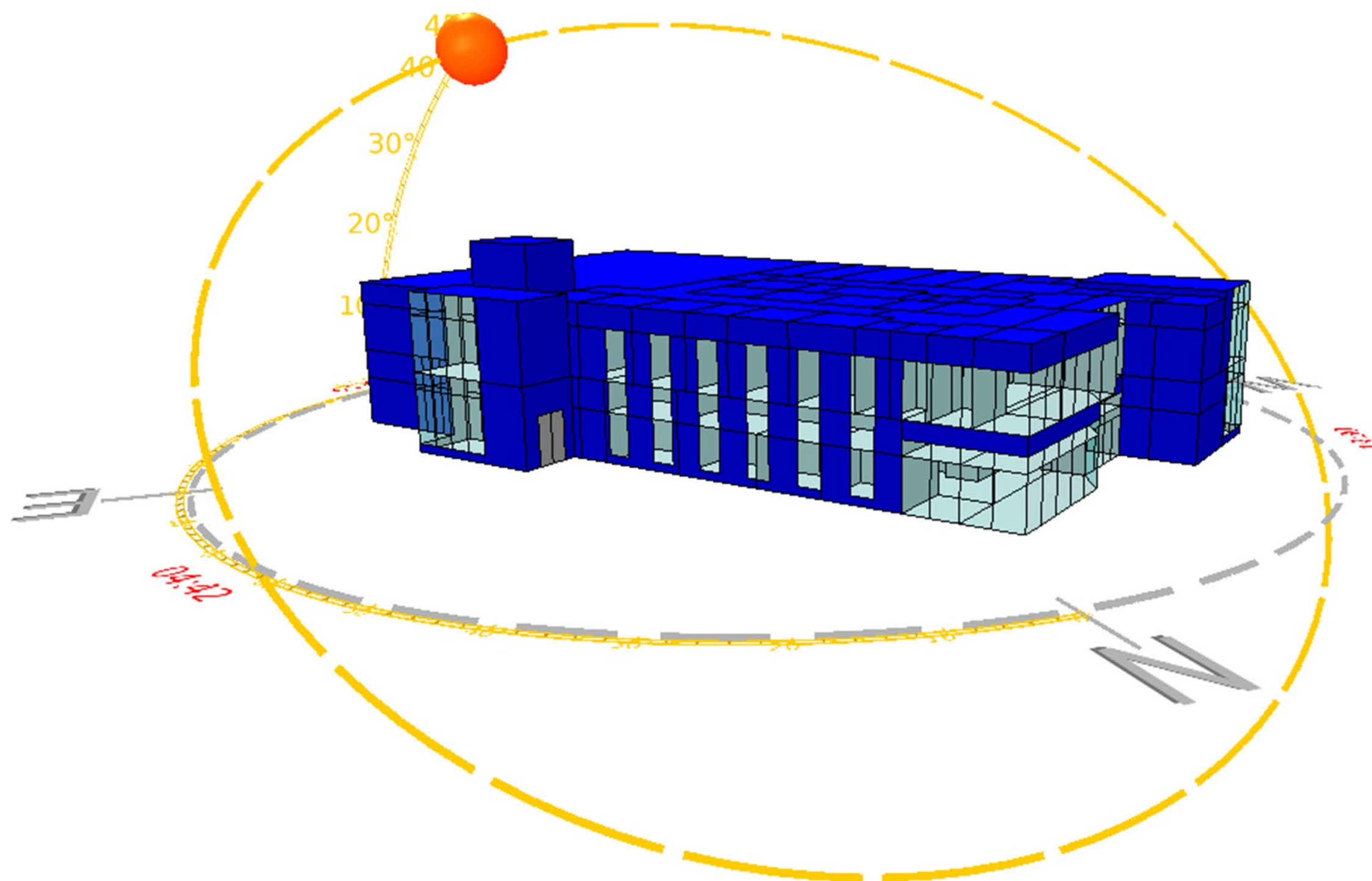


Figure 5. IES Energy Model with sunpath

3 DECLARATION OF COMPLIANCE WITH CIBSE AM11

CIBSE Applications Manual AM11: 1998, Building Energy and Environmental Modelling has been written to help in the selection and application of BEEM software in practice.

The manual covers:

- a) *Applicability*: BEEM software is normally a complex package of various calculation procedures; it should only be used when it is appropriate to do so.
- b) *Selection*: a large number of BEEM software tools exist; choosing the right tool for the job is the first important task in modelling.
- c) *Quality*: there is always the possibility of errors within software, mistakes in implementation and/ or the misapplication of software. Consideration should be given to validation of software and procedures for their use.
- d) *User skills*: the effect of user errors and assumptions on the results obtained can far outweigh the accuracy of BEEM software. Appropriate training, together with the establishment and use of quality assurance procedures, is an important part of developing a modelling capability.
- e) *Input data*: access to guidance and sources of information for deriving appropriate input data is pertinent to good modelling.

The guidance given in AM11: 1998 has been followed in the production of this report.

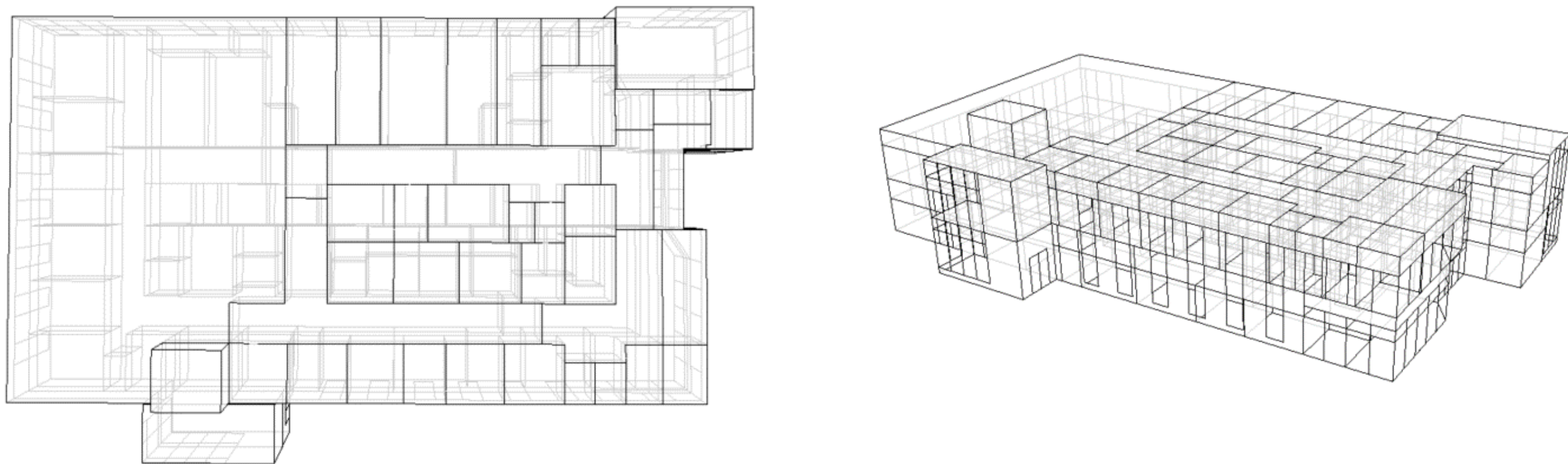


Figure 6. Top and axonometric view of the proposed building from IES Energy Model

4 SOFTWARE USED FOR BUILDING ENERGY MODELLING

The simulation tool used for this investigation is IES Virtual Environment, Version 2022.4.0.0

The calculation methodology adopted was full Dynamic Thermal Simulation over a period of 365 days with a 20-day pre-conditioning period.

The ApacheSim calculation engine was used, and a full SunCast solar shading analysis was performed to ensure the local shading devices and overhangs were accurately reflected in the simulation.

ApacheSim is comprised of the following tools:

- Apache
- ApacheEngine
- Vista & VistaPro
- ApacheView
- ApachePro
- ApacheLocate
- Constructions Database

Calculations are based on first-principles models of heat transfer process and are driven by real weather data.

Data Entry Options

- Extensive database of global weather
- Data detailing layer-by-layer thermo-physical properties of building elements
- Comprehensive data on glazing systems including angle-dependent transmissivity and absorptivity.
- Sensible and latent gains from lights, equipment, and occupants
- Natural ventilation, mechanical ventilation, and infiltration
- Plant operation profiles
- Plant efficiency and fuel characteristics
- Facilities for assigning and editing time-varying room data such as plant, casual gains and air exchanges.
- Database of constructions
- Time-series profiles
- Tabular Edit feature for Building Template Manager & NCM (for UK Part L)
- Tabular Edit interface for entering properties of thermal templates, room thermal properties, HVAC systems and constructions. Gives ability to quickly enter data, review inputs and includes option to export and import *.csv files (e.g., Excel)
- Faster project setup using Master Template and Design Options features. The Master Templates feature delivers bulk data copying & rapid automatic seeding of data into a project while the Design Option feature provides a means to make specific and targeted changes to specified data in a project



Analysis options

- User-controlled time steps down to 1 minute
- Idealised or detailed HVAC plant modeling
- Options for natural and mechanical ventilation; specify flows in advance or calculate using MacroFlo and ApacheHVAC
- Choice of models for internal and external convection

SunCast – Solar Shading Analysis

SunCast is used to perform shading and solar insolation studies. It can be used to investigate:

- External obstruction and self-shading of a building.
- Solar mapping through windows and openings.
- The effects of changing orientation of building.

SunCast generates shadows and internal solar insolation from any sun position defined by date, time, orientation, site latitude and longitude. This shadow information can be stored for subsequent analysis by:

- Viewing shadows from any eye position.
- Animating the solar analyses by generating a sequence of images and creating an *.avi movie.
- Making opaque surfaces "transparent" to permit the user to better view the solar insolation on internal surfaces e.g., "removing" roofs or surfaces to identify internal solar insolation paths.
- Displaying solar surface shading/insolation statistics.
- Output data for thermal simulation.

SunCast can be used in a variety of studies including passive solar design and is essential at the planning stage to visualize the effect of the building on surrounding buildings.

MacroFlo – Multi Zone Air Movement

MacroFlo uses a multi-zone thermo-fluid solver to simulate bulk air flow driven by wind pressure and buoyancy forces. It allows analysis of problems involving infiltration, natural ventilation, and mechanical ventilation. Typical applications include:

- Evaluation of natural ventilation solutions (including Advanced Natural Ventilation and Mixed-mode systems).
- Evaluation of ventilation control strategies.
- An understanding of the performance of double-skin façades.
- Analysis of room temperature statistics in naturally ventilated buildings (simulation of overheating risk).
- Predictions of air velocities through openings.
- Analysis of HVAC systems where the building is used as a return air pathway.

5 BREEAM SCENARIO MODELLING

According to the BREEAM Technical Guide multiple scenarios modelled to account for the impact of changing environmental conditions and how the building is used. As a minimum the scenarios considered must include the following:

1. Central Case – This is the central case energy model for the expected occupancy and equipment loads, “typical” weather and central case management factors for servicing systems and equipment and uses reference year weather data.
2. Good Management – As for Central Case prediction but with “typical” weather and a management factor of 1.0 applied for all servicing systems and equipment.
3. Poor Management – As for Central Case prediction but with a management factor of 1.15 applied for all servicing systems and equipment.
4. Extreme Weather – As for Central Case prediction but using an extreme weather file, Manchester_DSY1_2020High50_.epw
5. Worst Case – As for Central Case prediction but with a management factor of 1.15 applied for all servicing systems and equipment prediction and using DSY weather file.

At the Concept Design Stage (RIBA Stage 2) a preliminary design workshop focusing on design for operational energy performance was completed by relevant members of the design team. The occupancy profiles, HVAC, lighting, and equipment loads agreed upon in that workshop have been used in the Central Case Model.

6 DESIGN CRITERIA

The following general criteria have been used throughout the simulation:-

6.1 AIR PERMEABILITY

An air infiltration rate of 0.20ACH has been applied to all external (perimeter) spaces based on Table 4.24 of CIBSE Guide A.

6.2 EXTERNAL ENVELOPE

The following U-values have been used:-

Element	Proposed U-value (W/m ² K)	Part L2A U-value (W/m ² K)
External walls	0.18	0.18
Exposed floor	0.15	0.15
Roof (flat)	0.15	0.15
Glazing (and Rooflights)	1.20	1.40

Building envelope U-values

6.3 GLAZING SPECIFICATION

The glazing is based on a G-value of 0.35 to East/South/West elevations and 0.40 to the North elevation.

6.4 INTERNAL WINDOW BLINDS

Internal blinds have not been modelled. Although, if the sun shines directly into a habitable space, room occupants should consider closing the curtains or blinds to limit solar gains and try and keep rooms as cool as possible.

6.5 WEATHER

The building is to be located in Manchester. Weather file used in the calculation is - **Manchester_TRY.epw**. This represents a “Typical” weather file Test Reference Year (TRY) used for Central Case Scenario. Whereas **Manchester_DSY1_2020High50_.epw** has been used to represent an extreme weather scenario.

6.6 SITE & ORIENTATION

The building has been modelled in the orientation represented in Figure 7.

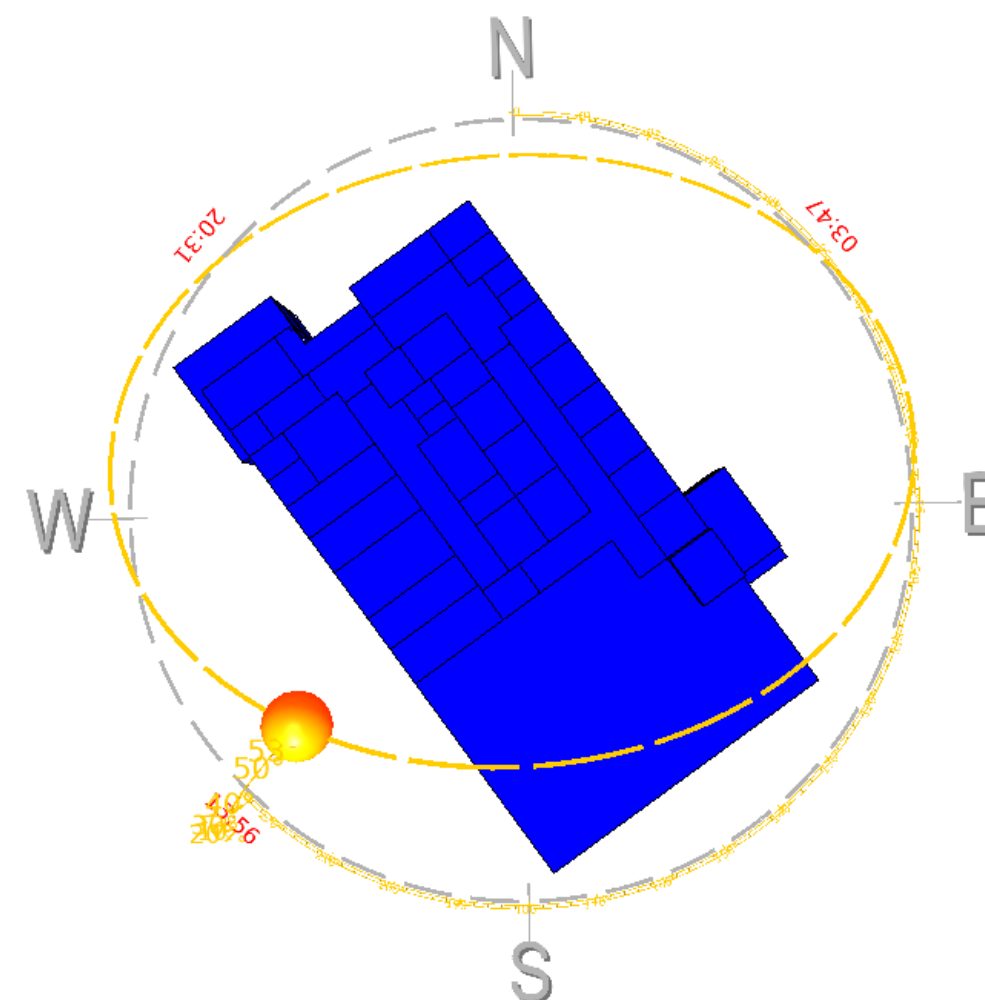


Figure 7. Orientation of the proposed site

7 INTERNAL GAINS

The internal gains used throughout the simulations are detailed below. Anticipated building operation is between the hours of 08:00 and 18:00 weekdays, with no building operation at weekends.

Room Reference	Occupancy			Lighting	Equipment	Gains Schedule
	W/person Sensible	W/person Latent	People	W/m²	W/m²	
Ground Floor						
RM.00.Lift 2	-	-	-	-	-	-
RM.00.Lift 1	-	-	-	-	-	-
RM.00.070 Nurse Managers Office	75	55	2	10	15	08:00 – 18:00
RM.00.069 Acc WC			-	10	-	08:00 – 18:00
RM.00.068 Quiet Room	75	55	3	10	3	08:00 – 18:00
RM.00.067 Quiet Room	75	55	3	10	3	08:00 – 18:00
RM.00.064 Circulation	-	-	-	10	-	08:00 – 18:00
RM.00.063 Beverage Bay	-	-	-	10	-	08:00 – 18:00
RM.00.062 Acc WC	-	-	-	10	-	08:00 – 18:00
RM.00.061 Recovery -Male	75	55	6	10	3	08:00 – 18:00
RM.00.060 Recovery Staff Base	75	55	2	10	15	08:00 – 18:00
RM.00.059 Acc WC	-	-	-	10	-	08:00 – 18:00
RM.00.058 Acc WC	-	-	-	10	-	08:00 – 18:00
RM.00.057 Recovery - Female	75	55	6	10	3	08:00 – 18:00
RM.00.056 Bowel Cancer Screen	75	55	2	10	3	08:00 – 18:00
RM.00.055 Medical Staff Office	75	55	2	10	15	08:00 – 18:00
RM.00.054 Circulation	-	-	-	10	-	08:00 – 18:00
RM.00.053 Decontamination Office	75	55	2	10	15	08:00 – 18:00
RM.00.052 Procedure Room	75	55	2	10	3	08:00 – 18:00
RM.00.051 Cleaners	-	-	-	10	-	08:00 – 18:00
RM.00.050 Procedure Room	75	55	2	10	3	08:00 – 18:00
RM.00.049 Clean Consumables	-	-	-	10	-	08:00 – 18:00
RM.00.048 Circulation	-	-	-	10	-	08:00 – 18:00
RM.00.047 Store	-	-	-	10	-	08:00 – 18:00
RM.00.046 Circulation	-	-	-	10	-	08:00 – 18:00
RM.00.045 Decon Dirty	-	-	-	10	-	08:00 – 18:00
RM.00.044 Decon Clean	-	-	-	10	-	08:00 – 18:00

Room Reference	Occupancy			Lighting	Equipment	Gains Schedule
	W/person Sensible	W/person Latent	People	W/m ²	W/m ²	
RM.00.043 Circultion	-	-	-	10	-	08:00 – 18:00
RM.00.042 Clean Utility	-	-	-	10	-	08:00 – 18:00
RM.00.041 Dirty Utility	-	-	-	10	-	08:00 – 18:00
RM.00.040 Clean Utility	-	-	-	10	-	08:00 – 18:00
RM.00.039 Staff Change -Male	-	-	-	10	-	08:00 – 18:00
RM.00.038 Staff Change - Female	-	-	-	10	-	08:00 – 18:00
RM.00.037 Staff WC	-	-	-	10	-	08:00 – 18:00
RM.00.036 Staff Pantry	-	-	-	10	-	08:00 – 18:00
RM.00.034 Acc Changing	-	-	-	10	-	08:00 – 18:00
RM.00.033 Acc Changing	-	-	-	10	-	08:00 – 18:00
RM.00.032 Ensuite	-	-	-	10	-	08:00 – 18:00
RM.00.031 Sub-Wait Female	75	55	6	10	0	08:00 – 18:00
RM.00.030 Staircore 2	-	-	-	-	-	08:00 – 18:00
RM.00.029 Lift Lobby	-	-	-	10	-	08:00 – 18:00
RM.00.028 Staff Base	75	55	2	10	15	08:00 – 18:00
RM.00.027 Ensuite	-	-	-	10	-	08:00 – 18:00
RM.00.026 Acc Changing	-	-	-	10	-	08:00 – 18:00
RM.00.025 Acc Changing	-	-	-	10	-	08:00 – 18:00
RM.00.024 Sub-Wait Male	75	55	6	10	0	08:00 – 18:00
RM.00.023 Consult/Exam Room - Female	75	55	2	10	3	08:00 – 18:00
RM.00.022 Consult/Exam Room - Male	75	55	2	10	3	08:00 – 18:00
RM.00.021 Acc WC	-	-	-	10	-	08:00 – 18:00
RM.00.020 Prep Room 3	75	55	2	10	3	08:00 – 18:00
RM.00.019 Acc WC	-	-	-	10	-	08:00 – 18:00
RM.00.018 Prep Room 2	75	55	2	10	3	08:00 – 18:00
RM.00.017 Acc WC	-	-	-	10	-	08:00 – 18:00
RM.00.016 Prep Room 1	75	55	2	10	3	08:00 – 18:00
RM.00.015 Circulation	-	-	-	10	-	08:00 – 18:00
RM.00.014 Interview Room	75	55	2	10	3	08:00 – 18:00
RM.00.013 Reception Office	75	55	2	10	15	08:00 – 18:00

Room Reference	Occupancy			Lighting	Equipment	Gains Schedule
	W/person Sensible	W/person Latent	People	W/m²	W/m²	
First Floor						
RM.01.001 Staircore 1	-	-	-	-	-	-
RM.01.003 Circulation	-	-	-	10	-	08:00 – 18:00
RM.01.004 Circulation	-	-	-	10	-	08:00 – 18:00
RM.01.005 Reception	75	55	2	10	15	08:00 – 18:00
RM.01.006 Main Wait	75	55	9	10	-	08:00 – 18:00
RM.01.007 Play Area	75	55	2	10	-	08:00 – 18:00
RM.01.008 Baby Feeding/Changing	-	-	-	10	-	08:00 – 18:00
RM.01.009 Acc WC	-	-	-	10	-	08:00 – 18:00
RM.01.010 Acc WC	-	-	-	10	-	08:00 – 18:00
RM.01.011 Interview Room	75	55	2	10	3	08:00 – 18:00
RM.01.012 Circulation	-	-	-	10	-	08:00 – 18:00
RM.01.013 Lung Function Room	75	55	2	10	200	08:00 – 18:00
RM.01.014 ECO Room	75	55	2	10	200	08:00 – 18:00
RM.01.015 Lung Function Room 2	75	55	2	10	200	08:00 – 18:00
RM.01.016 ECO Room 2	75	55	2	10	200	08:00 – 18:00
RM.01.017 Sub Wait	75	55	5	10	-	08:00 – 18:00
RM.01.018 Consultation Room	75	55	2	10	3	08:00 – 18:00
RM.01.019 Consultation Room 2	75	55	2	10	3	08:00 – 18:00
RM.01.020 Lift Lobby	-	-	-	10	-	08:00 – 18:00
RM.01.021 Staircore 2	-	-	-	-	-	-
RM.01.022 Plant	-	-	-	-	-	-
RM.01.023 ECG Room	75	55	2	10	200	08:00 – 18:00
RM.01.024 ECG Room	75	55	2	10	200	08:00 – 18:00
RM.01.025 Circulation	-	-	-	10	-	08:00 – 18:00
RM.01.026 Reporting Room	75	55	4	10	15	08:00 – 18:00
RM.01.027 Circulation - Staff	-	-	-	10	-	08:00 – 18:00
RM.01.028 General Store	-	-	-	10	-	08:00 – 18:00
RM.01.029 Meeting/Seminar Room	75	55	6	10	3	08:00 – 18:00
RM.01.030 Cleaners	-	-	-	10	-	08:00 – 18:00
RM.01.031 Clean Utility	-	-	-	10	-	08:00 – 18:00
RM.01.032 Open Plan Office	75	55	4	10	15	08:00 – 18:00

Room Reference	Occupancy			Lighting	Equipment	Gains Schedule
	W/person Sensible	W/person Latent	People	W/m ²	W/m ²	
RM.01.033 Staff WC	-	-	-	10	-	08:00 – 18:00
RM.01.034 Staff Room inc Bev Bay	75	55	11	10	15	08:00 – 18:00
RM.01.035 Acc WC	-	-	-	10	-	08:00 – 18:00
RM.01.036 Lockers	-	-	-	10	-	08:00 – 18:00
RM.01.037 Staff Shower - Male	-	-	-	10	-	08:00 – 18:00
RM.01.038 Staff Shower - Female	-	-	-	10	-	08:00 – 18:00
RM.01.039 Reception Admin	75	55	1	10	15	08:00 – 18:00
RM.01.Lift 1	-	-	-	-	-	-
RM.01.Lift 2	-	-	-	-	-	-
RM.01.Lift Lobby	-	-	-	10	-	08:00 – 18:00
RM.01.Void	-	-	-	-	-	-

8 SERVICING STRATEGY

8.1 VENTILATION SUMMARY

Supply and Extract Ventilation with Heat Recovery (70% efficiency) is provided locally at a rate of 10l/s/person to most occupied spaces. Ventilation assumed to run out of occupied hours until room setback temperatures are met.

WC, Shower and changing areas have extract only ventilation at a rate of 6ACH with makeup air being supplied from adjacent zones.

Room Name / Reference	Ventilation Strategy
Consultation	MVHR 10L/s/person
Treatment	MVHR 10L/s/person
Office	MVHR 10L/s/person
Reception / Waiting	MVHR 10L/s/person
WC/Changing	6ACH Extract

8.2 HEATING AND COOLING SYSTEMS

The Air Source Heat Pumps provide the heating to the building, with occupied spaces generally having a heating setpoint of 21°C. Circulation, WC and transient spaces are heating to 18°C. A weekend and nighttime setback temperature of 18°C has been modelled whereas a preheat period of 1 hour has been assumed prior to occupied periods.

Cooling via air conditioning to 23°C is present in the conference room, imaging rooms, endoscopy procedure spaces, recovery ward and IT room only.

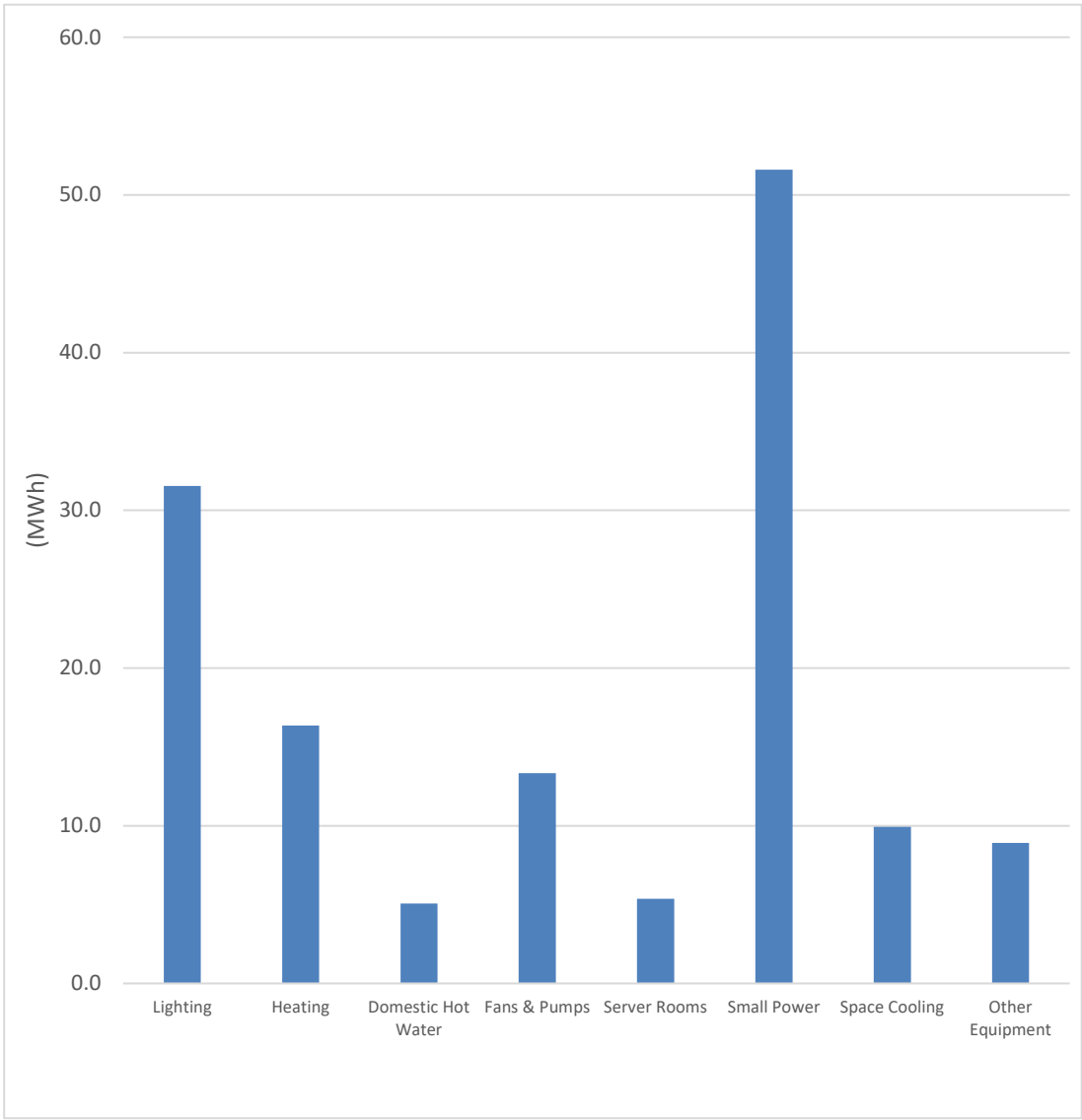
All system efficiencies have been based on the stage 3 Part L compliance model.

9 RESULTS

9.1 RUN 1 - FROM DYNAMIC SIMULATION – CENTRAL CASE SCENARIO

The following table provides the CENTRAL CASE SCENARIO data, showing the annual In Use Energy consumption by each end use considered.

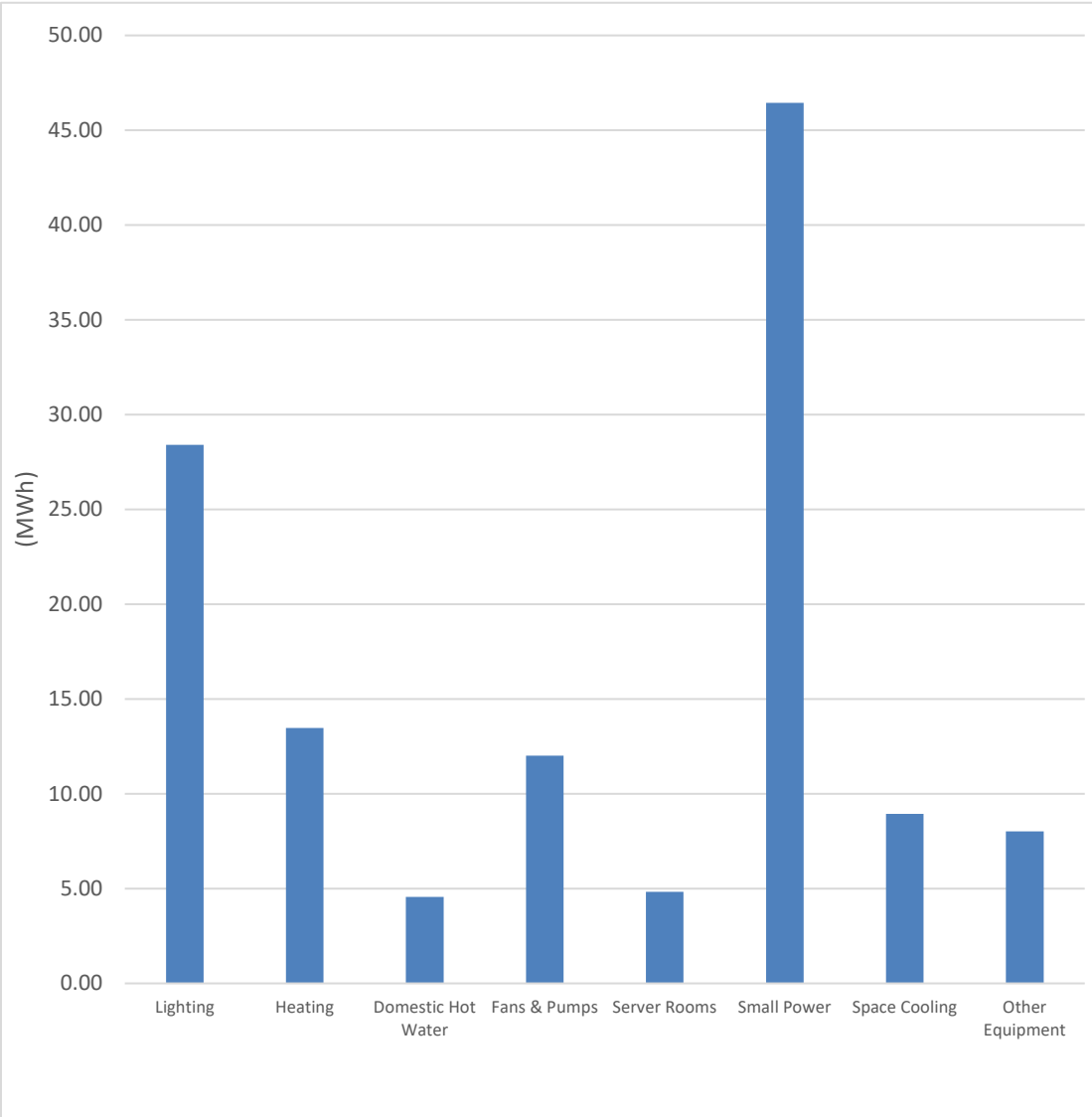
Month	Lighting	Heating	DHW	Fans & Pumps	Server Room	Small Power	Server Room Cooling	Other Equipme nt	TOTAL
Jan	2.54	2.83	0.42	1.13	0.45	4.15	0.64	0.74	12.91
Feb	2.42	2.33	0.42	1.02	0.45	3.95	0.62	0.74	11.96
Mar	2.78	2.57	0.42	1.13	0.45	4.55	0.70	0.74	13.34
Apr	2.66	1.05	0.42	1.10	0.45	4.35	0.76	0.74	11.53
May	2.54	0.36	0.42	1.13	0.45	4.15	0.83	0.74	10.62
Jun	2.66	0.01	0.42	1.10	0.45	4.35	1.01	0.74	10.74
Jul	2.66	0.01	0.42	1.13	0.45	4.35	1.11	0.74	10.87
Aug	2.66	0.00	0.42	1.13	0.45	4.35	1.09	0.74	10.84
Sep	2.66	0.04	0.42	1.10	0.45	4.35	0.97	0.74	10.73
Oct	2.54	0.64	0.42	1.13	0.45	4.15	0.80	0.74	10.87
Nov	2.66	2.11	0.42	1.10	0.45	4.35	0.72	0.74	12.55
Dec	2.78	3.01	0.42	1.13	0.45	4.55	0.69	0.74	13.77
TOTAL	31.55	14.97	5.08	13.34	5.37	51.60	9.94	8.90	140.74



9.2 RUN 2 - FROM DYNAMIC SIMULATION – GOOD MANAGEMENT SCENARIO

The following table provides the GOOD MANAGEMENT SCENARIO data, showing the annual In Use Energy consumption by each end use considered.

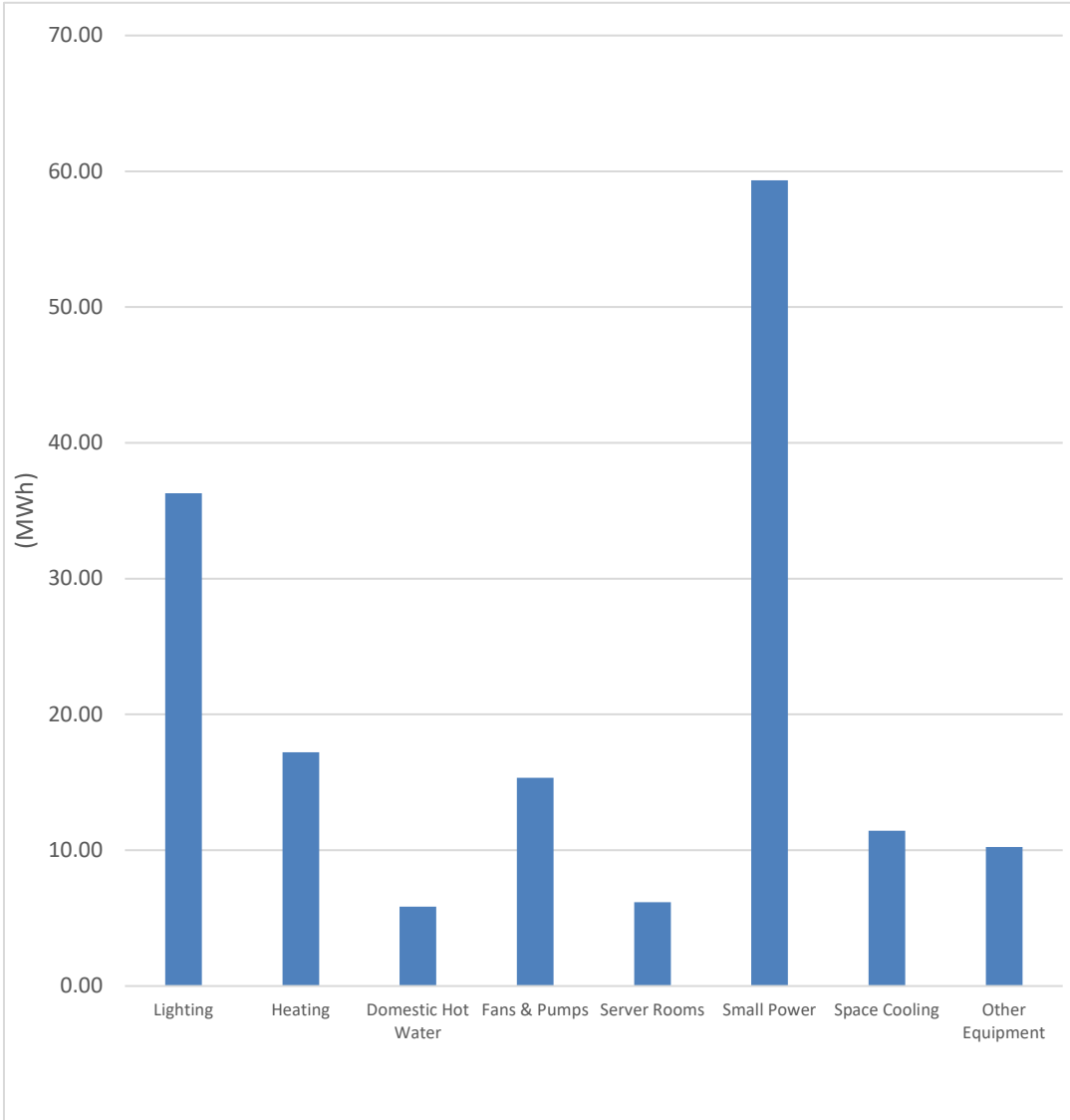
Month	Lighting	Heating	DHW	Fans & Pumps	Server Room	Small Power	Server Room Cooling	Other Equipme nt	TOTAL
Jan	2.28	2.55	0.38	1.02	0.40	3.74	0.58	0.67	11.62
Feb	2.18	2.10	0.38	0.92	0.40	3.56	0.56	0.67	10.76
Mar	2.50	2.31	0.38	1.02	0.40	4.09	0.63	0.67	12.01
Apr	2.39	0.95	0.38	0.99	0.40	3.91	0.69	0.67	10.38
May	2.28	0.33	0.38	1.02	0.40	3.74	0.74	0.67	9.56
Jun	2.39	0.01	0.38	0.99	0.40	3.91	0.91	0.67	9.66
Jul	2.39	0.00	0.38	1.02	0.40	3.91	1.00	0.67	9.78
Aug	2.39	0.00	0.38	1.02	0.40	3.91	0.98	0.67	9.76
Sep	2.39	0.04	0.38	0.99	0.40	3.91	0.87	0.67	9.66
Oct	2.28	0.57	0.38	1.02	0.40	3.74	0.72	0.67	9.78
Nov	2.39	1.90	0.38	0.99	0.40	3.91	0.65	0.67	11.29
Dec	2.50	2.71	0.38	1.02	0.40	4.09	0.62	0.67	12.40
TOTAL	28.40	13.47	4.57	12.00	4.83	46.44	8.94	8.01	126.66



9.3 RUN 3 - FROM DYNAMIC SIMULATION – POOR MANAGEMENT SCENARIO

The following table provides the POOR MANAGEMENT SCENARIO data, showing the annual In Use Energy consumption by each end use considered.

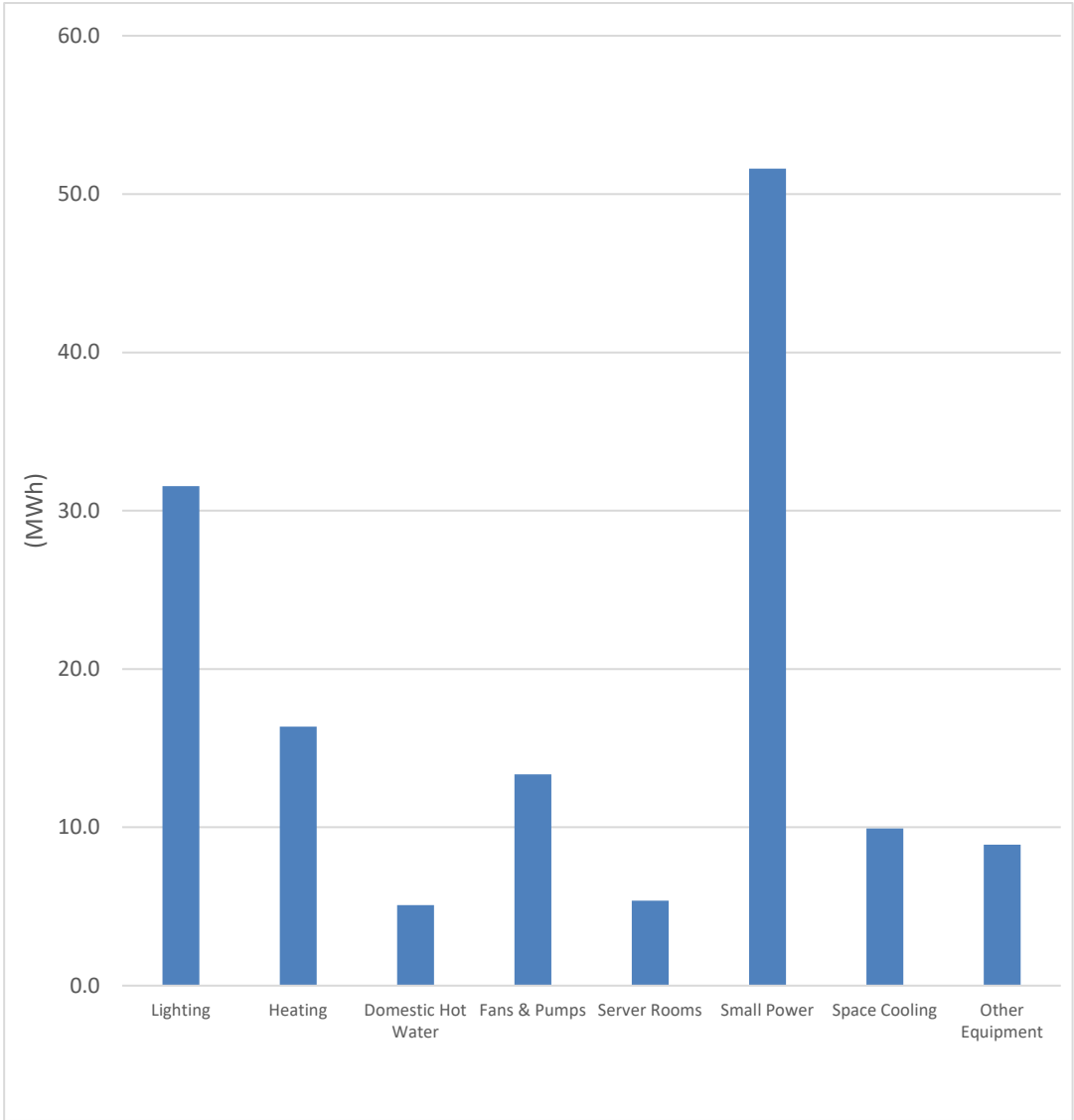
Month	Lighting	Heating	DHW	Fans & Pumps	Server Room	Small Power	Server Room Cooling	Other Equipme nt	TOTAL
2.92	3.26	0.49	1.30	0.51	4.77	0.73	0.85	14.84	2.92
2.78	2.68	0.49	1.18	0.51	4.55	0.71	0.85	13.75	2.78
3.20	2.95	0.49	1.30	0.51	5.23	0.81	0.85	15.34	3.20
3.06	1.21	0.49	1.26	0.51	5.00	0.88	0.85	13.26	3.06
2.92	0.42	0.49	1.30	0.51	4.77	0.95	0.85	12.22	2.92
3.06	0.02	0.49	1.26	0.51	5.00	1.16	0.85	12.35	3.06
3.06	0.01	0.49	1.30	0.51	5.00	1.28	0.85	12.50	3.06
3.06	0.00	0.49	1.30	0.51	5.00	1.25	0.85	12.47	3.06
3.06	0.05	0.49	1.26	0.51	5.00	1.12	0.85	12.34	3.06
2.92	0.73	0.49	1.30	0.51	4.77	0.92	0.85	12.50	2.92
3.06	2.43	0.49	1.26	0.51	5.00	0.83	0.85	14.43	3.06
3.20	3.46	0.49	1.30	0.51	5.23	0.79	0.85	15.84	3.20
TOTAL	36.29	17.21	5.84	15.34	6.17	59.34	11.43	10.23	161.85



9.4 RUN 4 - FROM DYNAMIC SIMULATION – EXTREME WEATHER SCENARIO

The following table provides the EXTREME WEATHER SCENARIO data, showing the annual In Use Energy consumption by each end use considered.

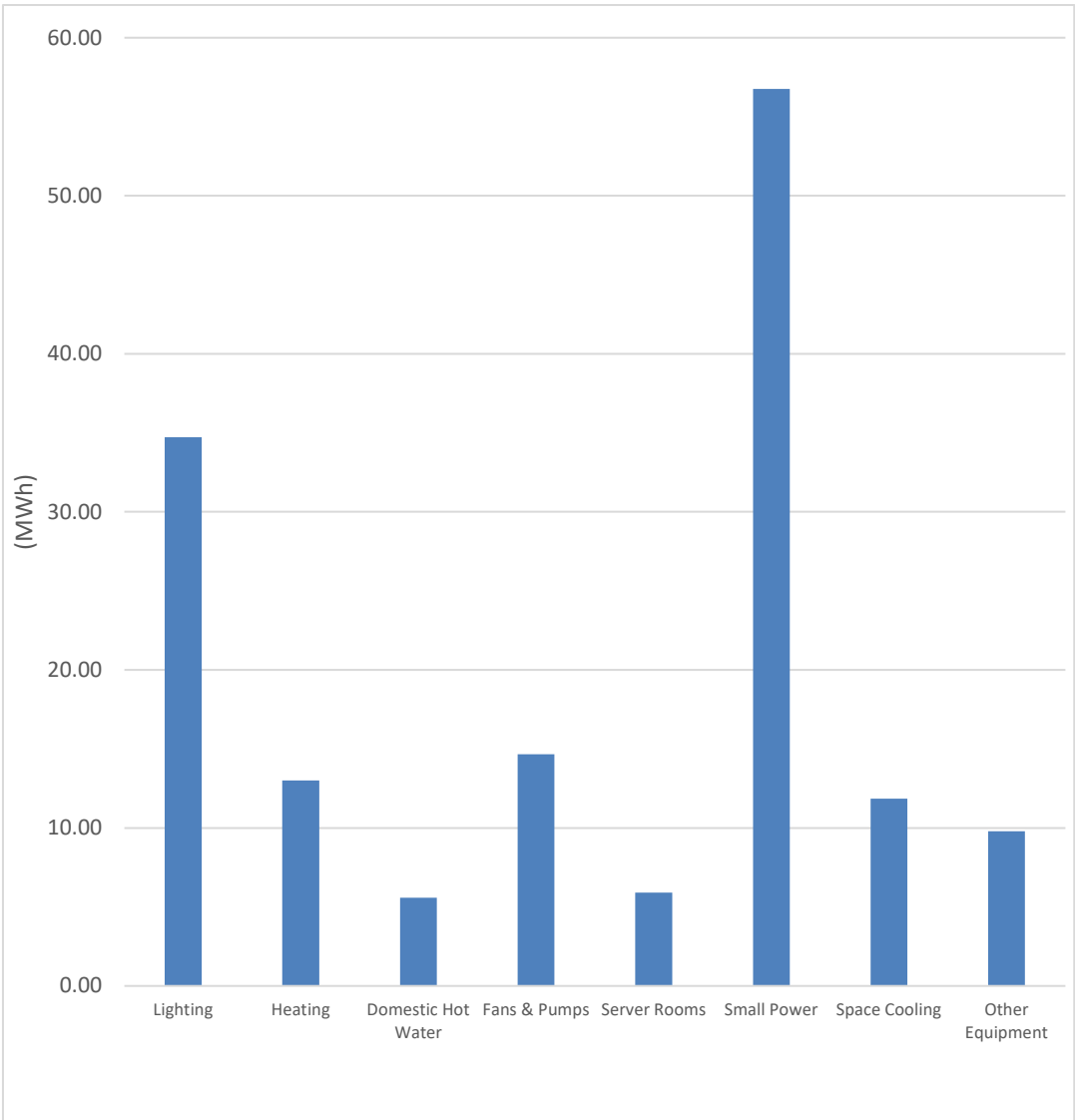
Month	Lighting	Heating	DHW	Fans & Pumps	Server Room	Small Power	Server Room Cooling	Other Equipme nt	TOTAL
Jan	2.54	3.38	0.42	1.13	0.45	4.15	0.60	0.74	13.41
Feb	2.42	1.93	0.42	1.02	0.45	3.95	0.64	0.74	11.58
Mar	2.78	1.18	0.42	1.13	0.45	4.55	0.82	0.74	12.07
Apr	2.66	0.75	0.42	1.10	0.45	4.35	0.81	0.74	11.28
May	2.54	0.14	0.42	1.13	0.45	4.15	0.89	0.74	10.47
Jun	2.66	0.01	0.42	1.10	0.45	4.35	1.06	0.74	10.78
Jul	2.66	0.00	0.42	1.13	0.45	4.35	1.23	0.74	10.99
Aug	2.66	0.00	0.42	1.13	0.45	4.35	1.38	0.74	11.13
Sep	2.66	0.02	0.42	1.10	0.45	4.35	1.03	0.74	10.77
Oct	2.54	0.66	0.42	1.13	0.45	4.15	0.81	0.74	10.91
Nov	2.66	1.31	0.42	1.10	0.45	4.35	0.78	0.74	11.81
Dec	2.78	2.44	0.42	1.13	0.45	4.55	0.73	0.74	13.24
TOTAL	31.55	11.82	5.08	13.34	5.37	51.60	10.78	8.90	138.44



9.5 RUN 5 - FROM DYNAMIC SIMULATION – WORST CASE SCENARIO

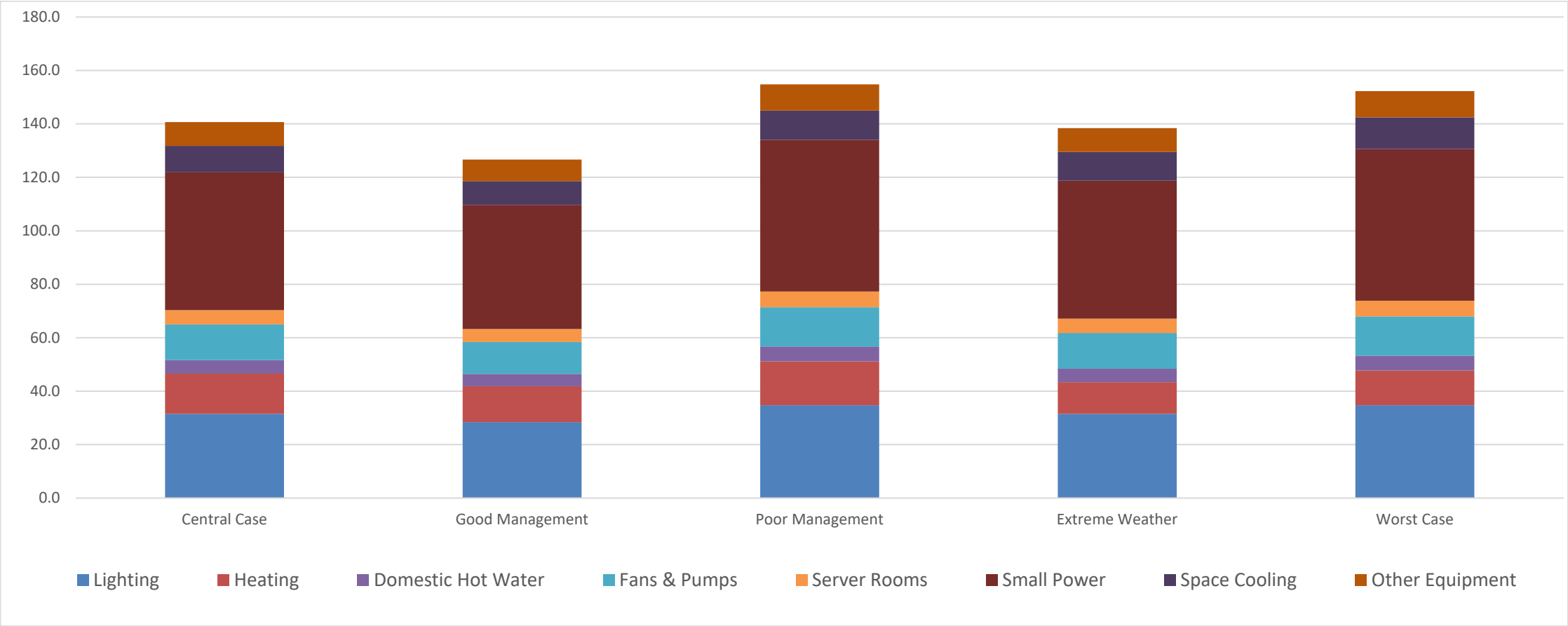
The following table provides the WORST CASE SCENARIO data, showing the annual In Use Energy consumption by each end use considered.

Month	Lighting	Heating	DHW	Fans & Pumps	Server Room	Small Power	Server Room Cooling	Other Equipme nt	TOTAL
Jan	2.79	3.72	0.47	1.25	0.49	4.57	0.66	0.82	14.75
Feb	2.66	2.12	0.47	1.13	0.49	4.35	0.71	0.82	12.73
Mar	3.06	1.30	0.47	1.25	0.49	5.00	0.90	0.82	13.28
Apr	2.93	0.82	0.47	1.21	0.49	4.78	0.89	0.82	12.40
May	2.79	0.16	0.47	1.25	0.49	4.57	0.98	0.82	11.52
Jun	2.93	0.01	0.47	1.21	0.49	4.78	1.16	0.82	11.86
Jul	2.93	0.00	0.47	1.25	0.49	4.78	1.35	0.82	12.08
Aug	2.93	0.00	0.47	1.25	0.49	4.78	1.51	0.82	12.24
Sep	2.93	0.02	0.47	1.21	0.49	4.78	1.13	0.82	11.84
Oct	2.79	0.73	0.47	1.25	0.49	4.57	0.89	0.82	12.00
Nov	2.93	1.44	0.47	1.21	0.49	4.78	0.86	0.82	12.99
Dec	3.06	2.69	0.47	1.25	0.49	5.00	0.80	0.82	14.57
TOTAL	34.71	13.00	5.58	14.67	5.90	56.76	11.86	9.79	152.28



10 REVIEW OF ALL FIVE BREEAM MODELLING SCENARIO'S

	Central Case	Good Management	Poor Management	Extreme Weather	Worst Case
	MWh				
Lighting	31.6	28.4	34.7	31.6	34.7
Heating	15.0	13.5	16.5	11.8	13.0
Domestic Hot Water	5.1	4.6	5.6	5.1	5.6
Fans & Pumps	13.3	12.0	14.7	13.3	14.7
Server Rooms	5.4	4.8	5.9	5.4	5.9
Small Power	51.6	46.4	56.8	51.6	56.8
Server Room Cooling	9.9	8.9	10.9	10.8	11.9
Other Equipment	8.9	8.0	9.8	8.9	9.8
Total Electric energy	111.8	100.6	123.0	112.6	123.9
Total Thermal energy	0	0	0	0	0
Total Energy (kWh/m²)	68.7	61.8	75.6	67.6	74.3



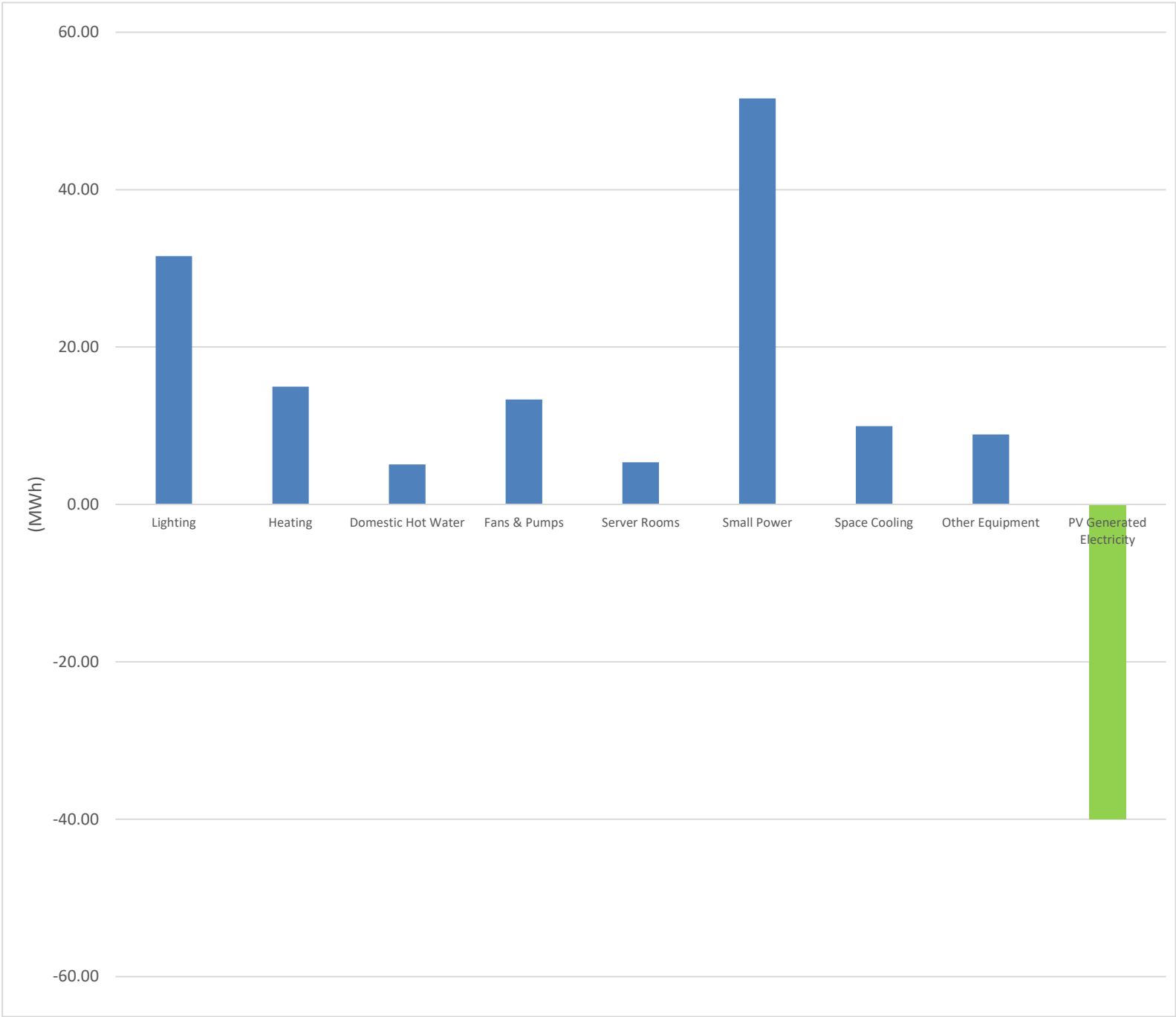
11 ON-SITE RENEWABLES

We have reviewed the renewable options available to this site and have included Circa 222m of PV across the development which has been included in the compliance calculations, this is an estimate on the available roof space available. It is estimated that the proposed PV system would generate circa 40MWh of electrical energy annually.

When taking into account the electrical energy generated by the proposed PV, the central case modelling scenario EUI could be as low as 49.9kWh/m²/y.

The below graph maps the central case scenario annual energy consumption against the PV generated electricity.

Month	Total Building energy consumption	PV Generated Electricity
Jan	12.91	-1.23
Feb	11.96	-2.13
Mar	13.34	-3.16
Apr	11.53	-4.02
May	10.62	-5.31
Jun	10.74	-4.98
Jul	10.87	-5.53
Aug	10.84	-4.83
Sep	10.73	-3.84
Oct	10.87	-2.63
Nov	12.55	-1.25
Dec	13.77	-1.04
TOTAL	140.74	-39.95



12 CONCLUSION

The total annual In Use Energy Consumption for each scenario ranges from 68.7kWh/m² for the Central Case Scenario, 61.8kWh/m² in the Good Management Scenario and 75.6kWh/m² for the Poor Management Scenario.

Whilst no formal Operational Energy Usage targets have been set for this building at earlier RIBA stages, an Operational Energy Usage of 68.7kWh/m² the current design falls within the RIBA 2030 Climate Change target metrics for non-domestic buildings 2025 *Targets* of <110 kWh/m²/y but falls short of the *2030 Targets*. This also exceeds the LETI EUI target for offices of 55 kWh/m²/y, however this proposed building does not entirely fit into the LETI building archetype and therefore is not an accurate comparison.

In the Central Case Scenario, the LETI space heating demand target of < 15kWh/m²/y is achieved.

When taking into account the proposed 222m² PV system, the potential yield brings the Central Case Scenario annual estimate (49.9 kWh/m²/y) to within the RIBA 2030 *Targets & LETI EUI (for offices)* figure of < 0 to 55 kWh/m²/y.

RIBA 2030 Climate Challenge target metrics for non-domestic buildings

RIBA Sustainable Outcome Metrics	Current Benchmarks	2020 Targets	2025 Targets	2030 Targets	Notes
Operational Energy kWh/m ² /y 	225 kWh/m ² /y DEC D rated (CIBSE TM46 benchmark)	< 170 kWh/m ² /y DEC C rating	< 110 kWh/m ² /y DEC B rating	< 0 to 55 kWh/m ² /y DEC A rating	UKGBC Net Zero Framework 1. Fabric First 2. Efficient services, and low-carbon heat 3. Maximise onsite renewables 4. Minimum offsetting using UK schemes (CCC)
Embodied Carbon kgCO ₂ e/m ² 	1100 kgCO ₂ e/m ² (M4i benchmark)	< 800 kgCO ₂ e/m ²	< 650 kgCO ₂ e/m ²	< 500 kgCO ₂ e/m ²	RICS Whole Life Carbon (A-C) 1. Whole Life Carbon Analysis 2. Using circular economy Strategies 3. Minimum offsetting using UK schemes (CCC)
Potable Water Use Litres/person/day 	>16 l/p/day (CIRA W11 benchmark)	< 16 l/p/day	< 13 l/p/day	< 10 l/p/day	CIBSE Guide G

LETI net zero targets

LETI's net zero targets for each archetype are as follows:

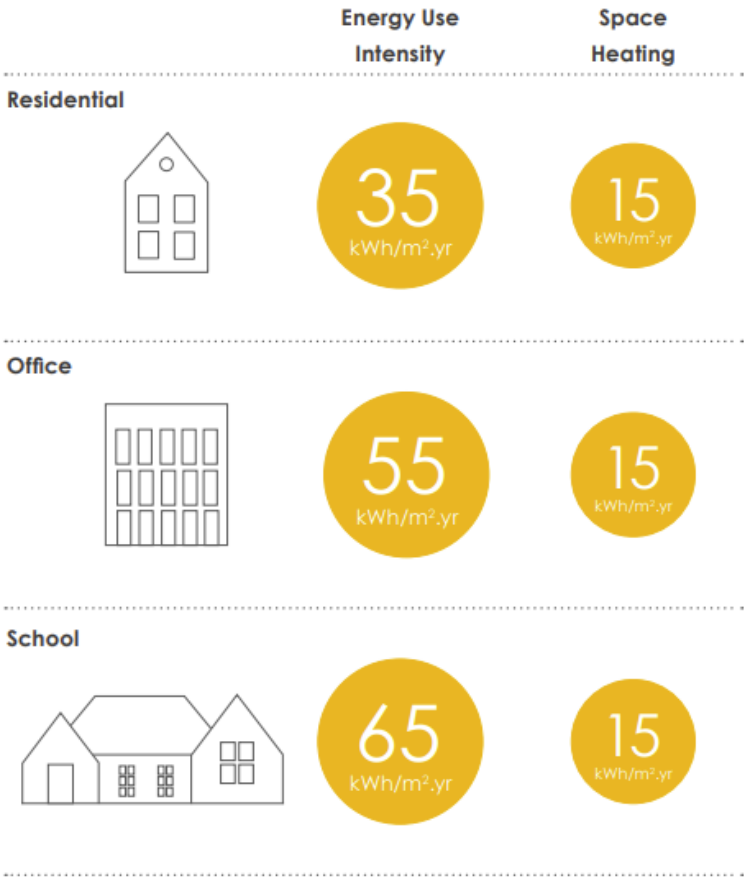


Figure 8. Extract from RIBA 2030 Climate Challenge target metrics for non-domestic buildings & LETI EUI Targets