TM54 Operational Energy Calculation for

Hillingdon Water Sports & Activity Centre

Uxbridge

Report prepared by

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1.0 Introduction

HIBEC have undertaken Operational Energy Calculations, as outlined in CIBSE TM54, of the proposed development at Hillingdon Water Sports Facility and Activity Centre, Uxbridge.

The Thermal Model has been run to evaluate the operational energy use using the CIBSE TM54 methodology. To allow us to understand the sensitivity of a number of the input parameters we have developed a tool to predict a range within which the operational energy should sit, whilst identifying the key parameters that need to be controlled during operation to ensure excessive energy isn't consumed.

This report presents the methodology, explains the operational parameters for each end use, presents the results for each end use, then concludes by comparing the results against CIBSE Energy Typical and Good Practice Benchmarks (CIBSE Guide F:2012).

2.0 Methodology

2.1 General

The annual energy consumption is determined by both the design and operation of the buildings.

The design elements are fixed and are as per the design of the building.

The operational elements are dependent on how the building is used and particularly the hours the building is occupied, and the building services systems are on.

To understand the impact of how the building is operated on the annual energy consumption four scenarios have been analysed.

- Likely – The likely consumption based on anticipated occupancy, operation and building management.
- Low End – The low-end consumption if the occupancy hours are lower with excellent building management.
- High End – The high-end consumption if the occupancy hours are higher and equipment and systems are used more than anticipated and building management is poor.
- Worst Case – the worst-case consumption if the occupancy is much higher and equipment and systems are used much more than anticipated and with no building management - *Extreme Weather conditions are also considered for this scenario.*

2.2 Software

A simulation model has been built for the purpose of making a suitably accurate prediction of the building's future energy consumption. This includes consideration of the building location, massing, envelope, thermal loads, system efficiencies and other energy consuming services.

The geometry of the model has been built in IESVE 2024 and analysed with the Apache simulation module for this analysis. This program is fully accredited under CIBSE TM33.

2.3 Climate Data

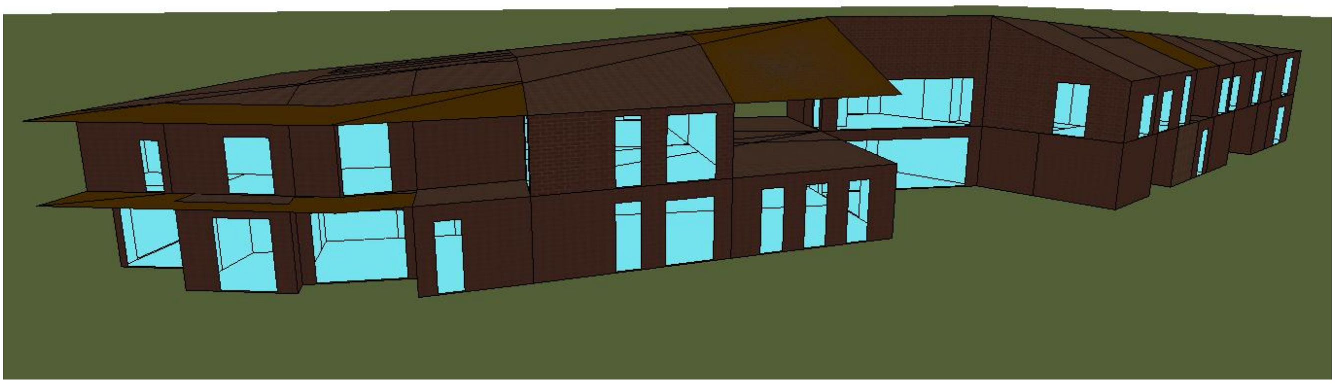
This simulation uses hourly recorded weather data for London of the twelve most typical months chosen to create an "average" year. This is the designated Test Reference Year (TRY). A TRY (London Heathrow 2020 TRY) has been selected to be ideal for energy modelling and represents a typical year without unusually hot or cold conditions. There are only a select few areas with associated TRY weather files. Therefore, for this analysis the London Heathrow weather file has been deemed most appropriate.

For extreme weather conditions the CIBSE London Heather 2080 High emissions 50 percentile TRY weather data has been used. This represents a summer with a long intense warm spell.

2.4 Geometry

The proposed developed consists of 3 buildings, A Main Operations Building, "Camp Zone" Building and a "Safety Zone" Building. The Main Operations Buildings contains staff living accommodation, offices, changing facilities, storerooms, an Observation space and indoor Activity areas. The "Camp Zone" building contains Changing facilities and toilets as well as storerooms. The "Safety Zone" Building is unheated and contains only Storage areas for outdoor equipment.

The model is based on the design drawings provided. A 3D image of the Main Operations Building can be seen below;



3D model of the Main Building

2.5 Limitations

Computer building simulation provides an estimate of the building performance. This estimate is based on a necessarily simplified and idealised version of the buildings that does not and cannot fully represent an interpretation of the potential performance of the buildings. No guarantee or warranty of buildings performance in practice can be based on simulation alone.

2.6 Building Envelope

The building envelopes are the first opportunity to reduce the demand for energy consumption and consequential greenhouse gas emissions. The proposed designs for the buildings are outlined below and has been included in the model.

2.6.1 Design Data – *Energy Model*

The following data has been used to produce the model,

Building Air Permeability has been set at 5m³/hr.m²@50 Pa this has been translated into air infiltration of 0.2ach for each building.

Construction U values

External Wall	0.20 W/m²K
Roof	0.15 W/m²K
Ground Floor	0.15 W/m²K
Glazing	1.40 W/m²K
Opaque Doors	1.40 W/m²K

Reception Glazing

Light Transmittance 70%
Solar Energy Transmittance (G Value) 30%

All Other Glazing

Light Transmittance 70%
Solar Energy Transmittance (G Value) 40%

3.0 Results

For each step, the operational parameters are explained and the results are presented for each scenario.

3.1 Step 1: Establish Floor Areas

The floor areas have been determined based on the drawings provided. Each room has been categorized into different space types;

- Accessible Camp Areas (Support and Activity)
- Cabins*
- Crew/Wellbeing Room
- *Dining (Staff Accommodation)
- Galleys (Kitchen Areas)
- *Lounge (Staff Accommodation)
- Main Office
- Observations Area
- Operations Office
- Reception
- Training Room
- Circulation Areas
- Store Rooms
- Changing Rooms, WCs & Showers

The Occupancy times for the building have been set as 9.00am to 5.00pm, Monday to Friday and 10.00am to 6.00pm Saturday & Sunday.

*The Cabins have assumed an occupancy similar to TM59 for a single bedroom. Additionally the Dining Room has an occupancy period of 8.00am - 09.00am & 6.00pm – 7.00pm and the Lounge has an occupancy period of 08.00am – 09.00am & 7.00pm – 11.00pm. Both the Dining Room and Lounge have assumed a diversity factor of 0.75.

These Occupancy times are between 1st April and 31st October. The building is unoccupied outside these times.

3.2 Step 2: Establish operating hours and occupancy factors.

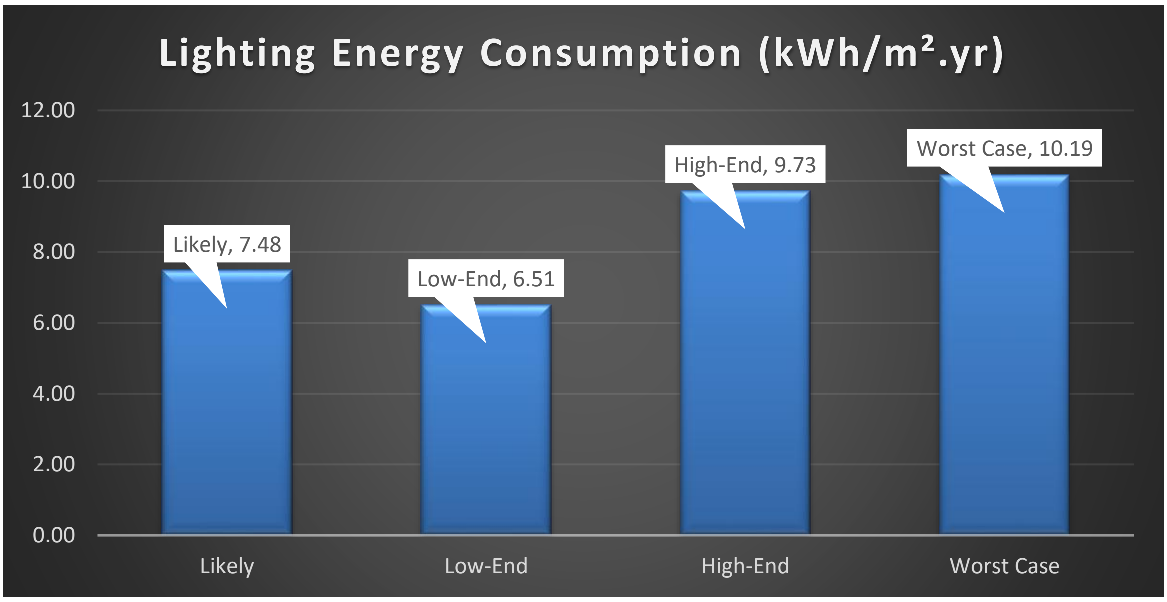
The occupancy for each room type are as follows;

Zone Type	Occupancy
Accessible Camp Areas	10m^2/person
Crew/Wellbeing Room	5m^2/person
Dining Room	5m^2/person*
Lounge	5m^2/person*
Main Office	6 persons
Observation Area	10m^2/person
Operations Office	4 persons
Reception	10m^2/person
Training Room	5m^2/person
Cabins	TM59 Occupancy (Single Bedroom)

- The Likely scenario assumes the operational hours throughout the building for 8hrs per day with the occupancy as shown above. Good Building Management has been assumed
- The Low-End Scenario assumes reduced operational hours of 7hrs per day with 75% occupancy. Excellent Building Management has been assumed.
- High End Scenarios assumes operational hours of 10hrs with a 25% increase occupancy shown above. Poor Building Management has been assumed
- The Worst Case Scenario assumed increased operational hours of 12hrs and occupancy of 25% and poor plant efficiencies and no automatic lighting controls. No Building Management has been assumed.

3.3 Step 3: Lighting

Lighting operating profiles are adjusted to follow the occupancy of the buildings for the likely scenario.



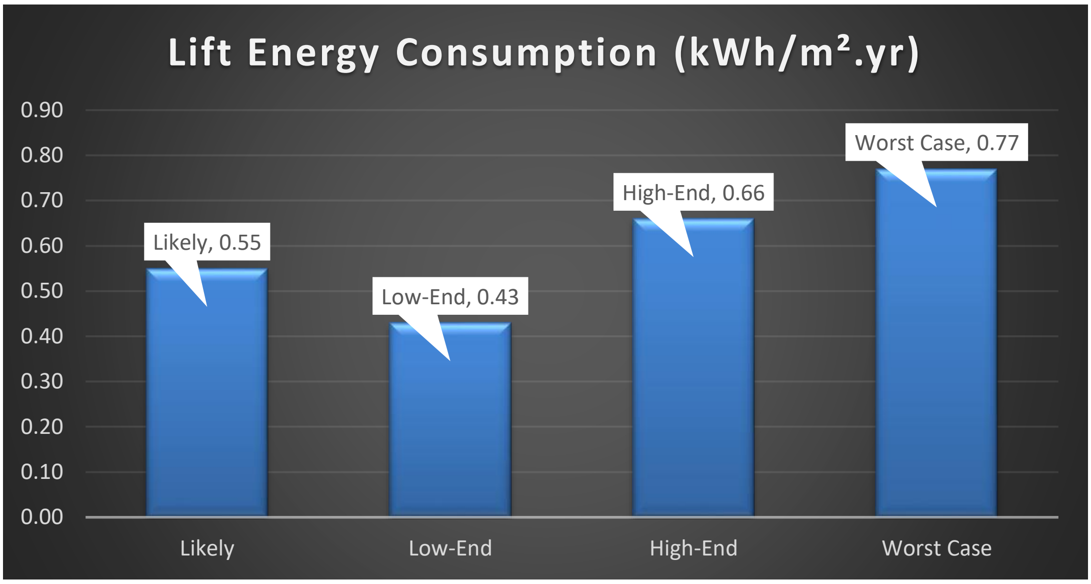
3.4 Step 4: Lifts and Escalators

Lift energy consumption has been calculated based on the methodology presented within CIBSE Guide D (2020): Transportation Systems in Buildings.

The number lift starts per day for the Likely scenario is based on a sports centre with guidance from CIBSE Guide D. The assumption of 60 lift starts per day used.

The Low End Scenario assumes 25% less lift starts per day, the High End Scenario assumes 25% more lift starts per day and the Worst Case scenario assumes 50% more lift starts per day.

The lifts annual energy consumption is presented below

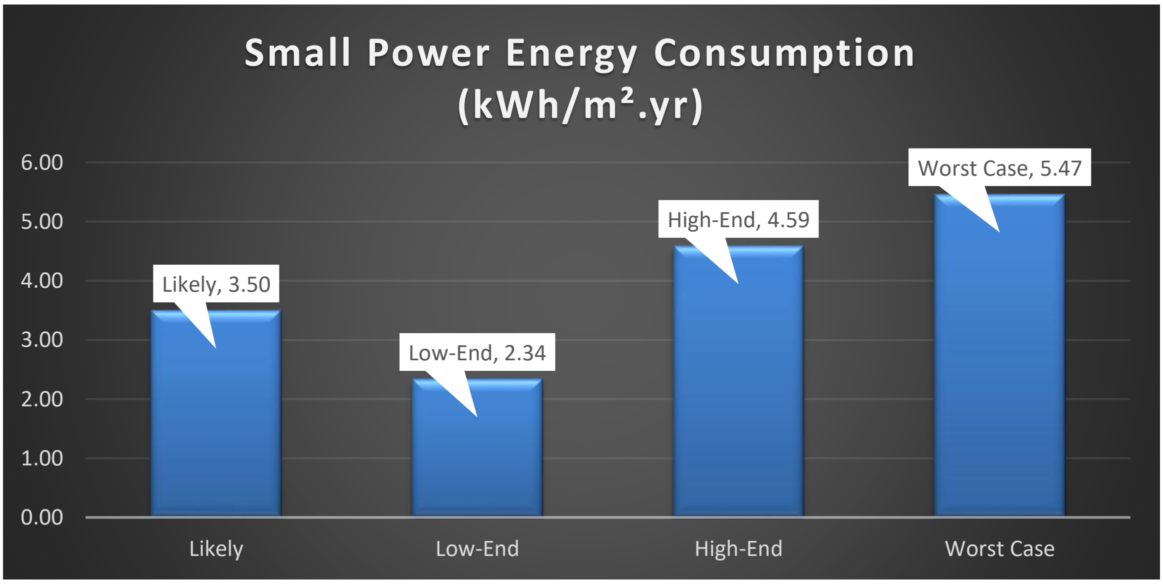


3.5 Step 5: Small Power

Small power loads for the building have been set as follows;

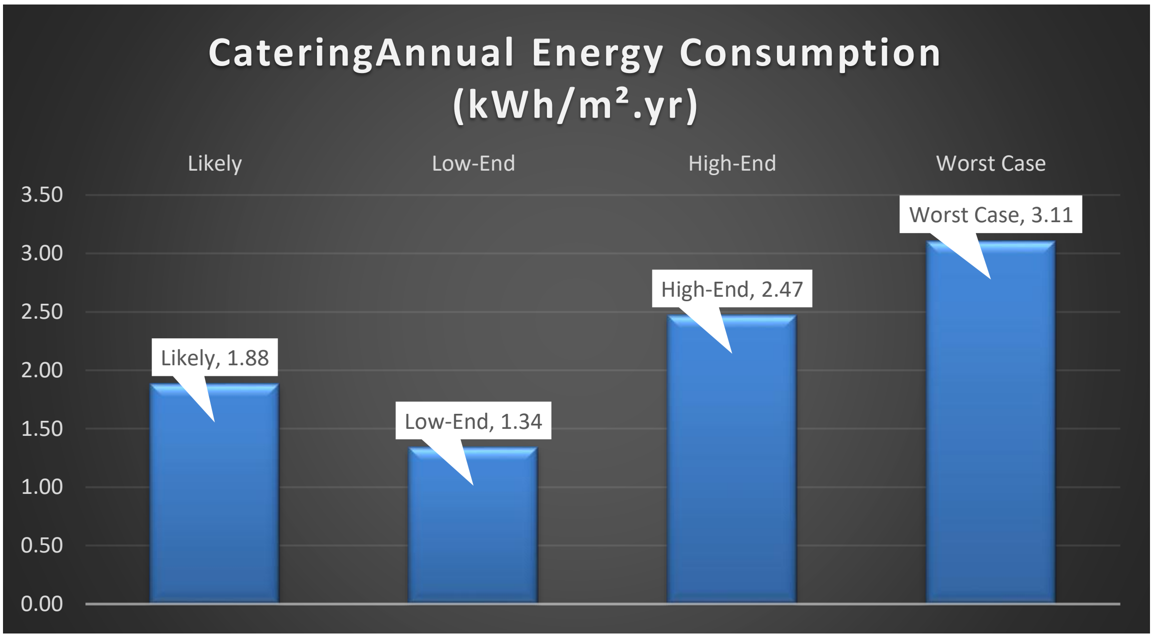
Zone Type	Equipment Gains
Cabins	80Watts
Crew/Wellbeing Room	5 W/m^2
Lounge	5 W/m^2
Main Office	10 W/m^2
Observation Area	5 W/m^2
Operations Office	10 W/m^2
Reception	10 W/m^2
Training Room	5 W/m^2

The Low-End scenario assumes a 25% reduction is equipment usage, whereas the High-End and Worst-Case scenarios assume 10% and 25% increase respectively.



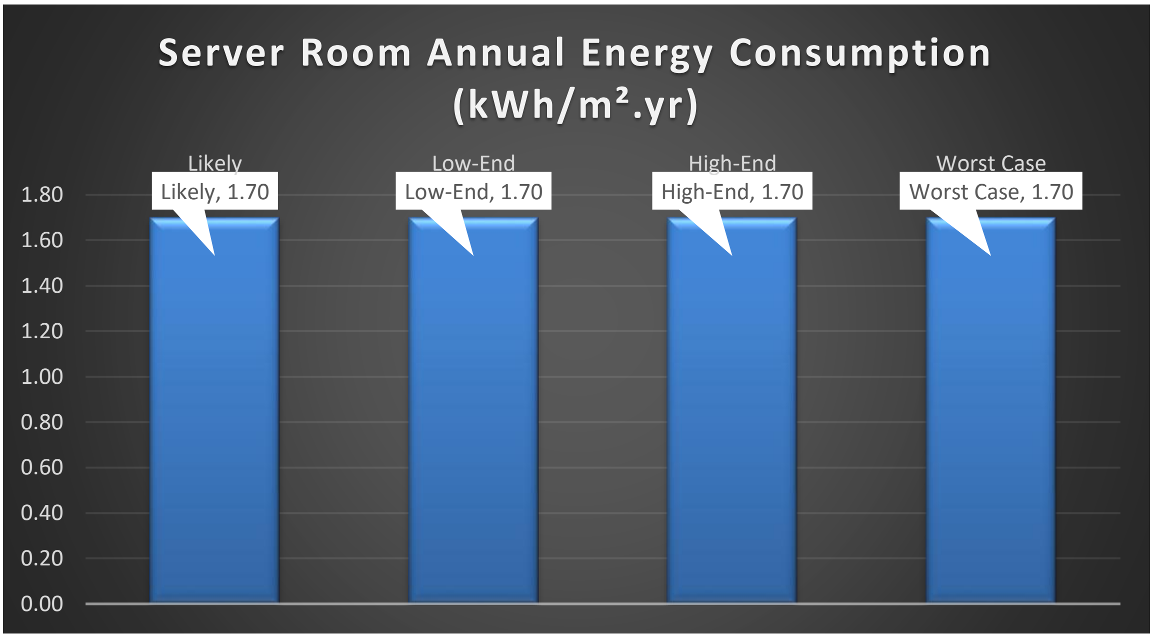
3.6 Step 6: Catering

The catering has been calculated at a baseline of 0.2kWh per meal based on 100 persons.



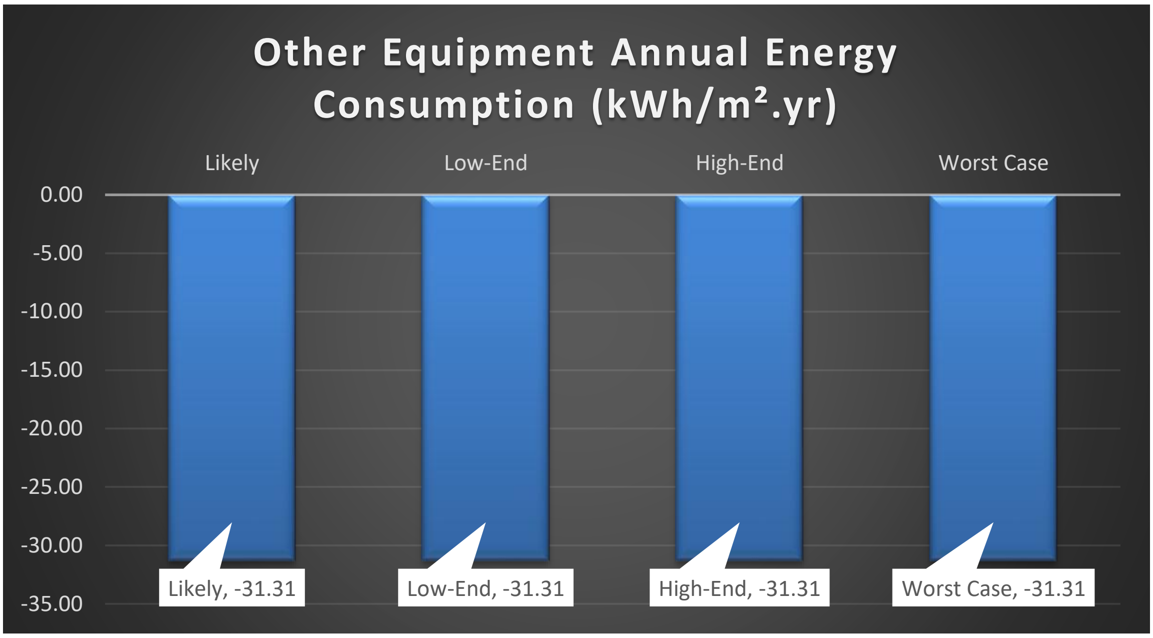
3.7 Step 7: Server Room

The server rooms has assumed 250W/m^2 and is operational all year round.



3.8 Step 8: Other Equipment

There are photovoltaic panels included in the design. The energy yield for a typical year is expected to be 71194.32 kWh. This is assumed to be used on site and has been applied as a reduction to the overall energy consumption values.

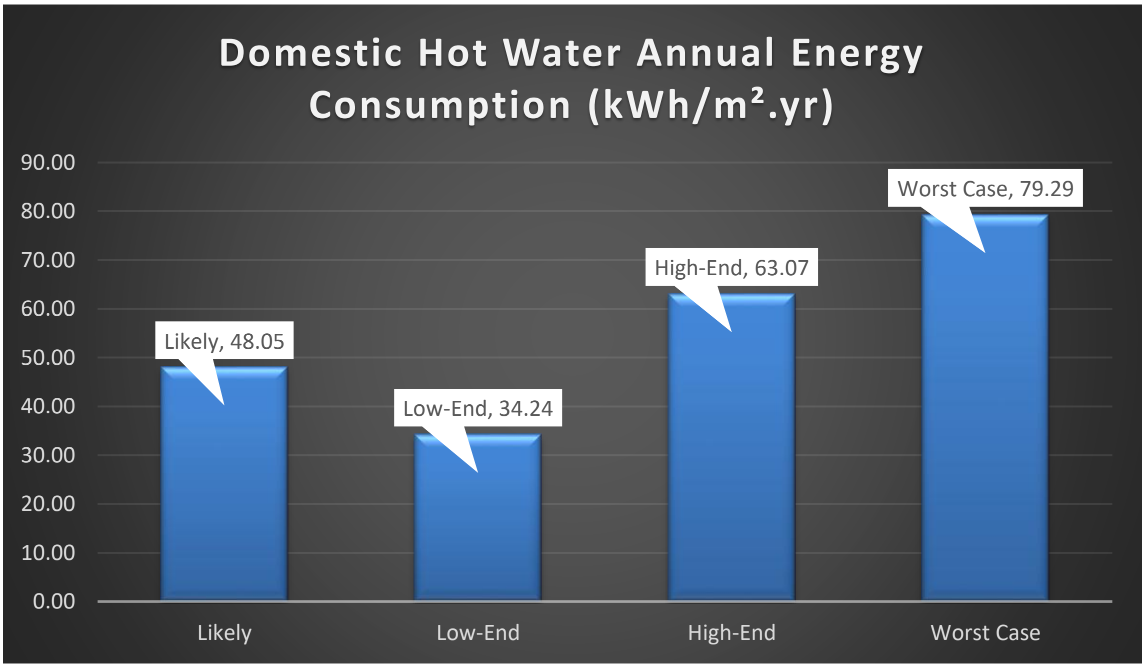


3.9 Step 9: Domestic Hot Water

The number of occupants for each scenario is determined using the occupancy densities from Step 2.

All scenarios assume a daily hot water consumption of 27.5 litres/person/day as per CIBSE Guide G for sports centre.

Domestic Hot Water Annual Energy Consumption



3.10 Step 10: Internal Heat Gains

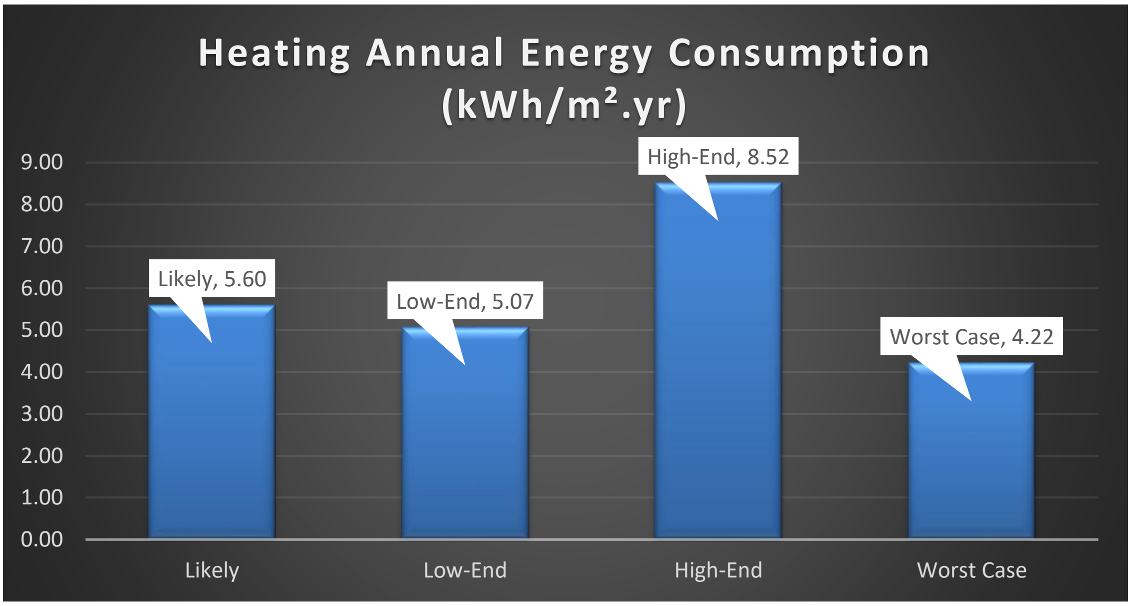
Internal gain within the energy model (only used to determine space heating and cooling) are as per the above steps.

3.11 Step 11: Space Heating, Cooling, Fans & Pumps

The space heating and space cooling have been undertaken using the above bespoke internal gains and profiles in a DSM (Dynamic Simulation Model).

Plant operation profiles have been assumed with guidance from CIBSE Guide H (2009). The HVAC plant follows the occupancy profile.

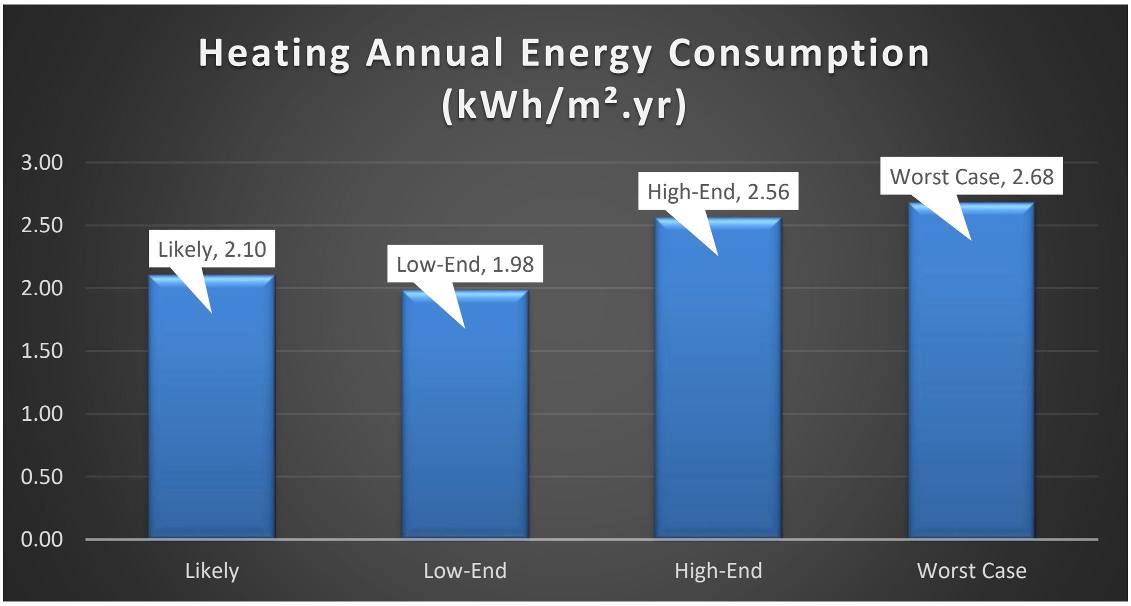
Heating Annual Energy Consumption



Cooling Annual Energy Consumption

The is no cooling in the proposed buildings.

Fans and Pumps Annual Energy Consumption

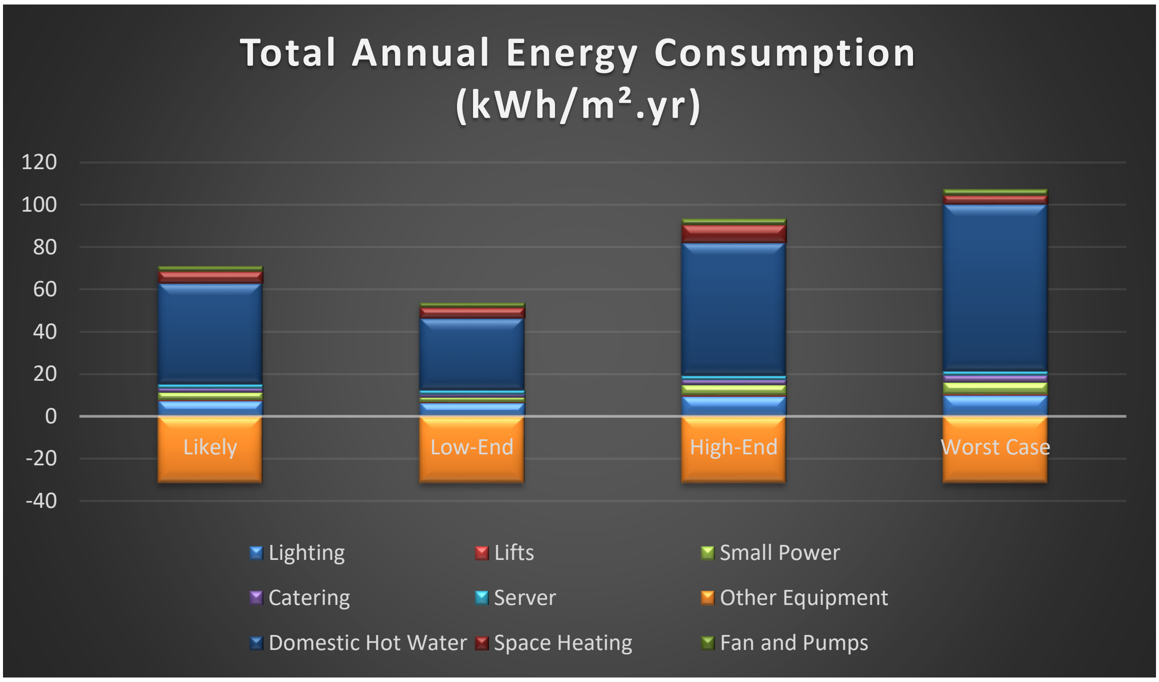


3.12 Step 12: Humidification & Dehumidification

No humidification or dehumidification energy has been accounted for.

<u>4.0 Comparison with Benchmarks</u>

Total Annual Energy consumption



Comparing the results to CIBSE Energy Benchmarks* (CIBSE Guide F:2012) shows that if the buildings are operating as anticipated (Likely Scenario):

- Total Energy: 73.99% below Typical and 58.80% below Good Practice

*Energy Benchmarks based on a Combined Sports and Recreation Centre

Electricity: Typical Practice 152kWh/m^2.yr, Good Practice 96kWh/m^2.yr.
Fossil Fuels: Typical Practice 598kWh/m^2, Good Practice 264kWh/m^2.yr

However, if the hours of operation in the buildings are higher than anticipated and the use of the equipment and DHW is higher. (High-End Scenario):

- Total Energy: 59.22% below Typical and 35.43% below Good Practice

If the occupancy of the buildings are much higher than anticipated and the use of the equipment, DHW and lighting is much higher (Worst Case Scenario).

- Total Energy: 49.92% below Typical and 20.71% below Good Practice.

	Likely Scenario	Low-End Scenario	High-End Scenario	Worst Case Scenario
Total Energy Consumption ($kWh/m^2.yr$)	39.55	22.30	61.99	76.12
% Improvement against Typical Practice	73.99%	85.33%	59.22%	49.92%
% Improvement against Good Practice	58.80%	76.77%	35.43%	20.71%

5.0 Conclusion

The results have clearly demonstrated that the operational energy performance of the building is dependent on the level of occupancy and operation of the building.

With very good operation (Low-End Scenario) the building will consume considerably less energy than Good Practice benchmarks. If the building has higher hours of operation and unmanaged operation (Worst Case Scenario) the building will still perform better than Typical Practice benchmarks but not much better than good practice benchmarks.