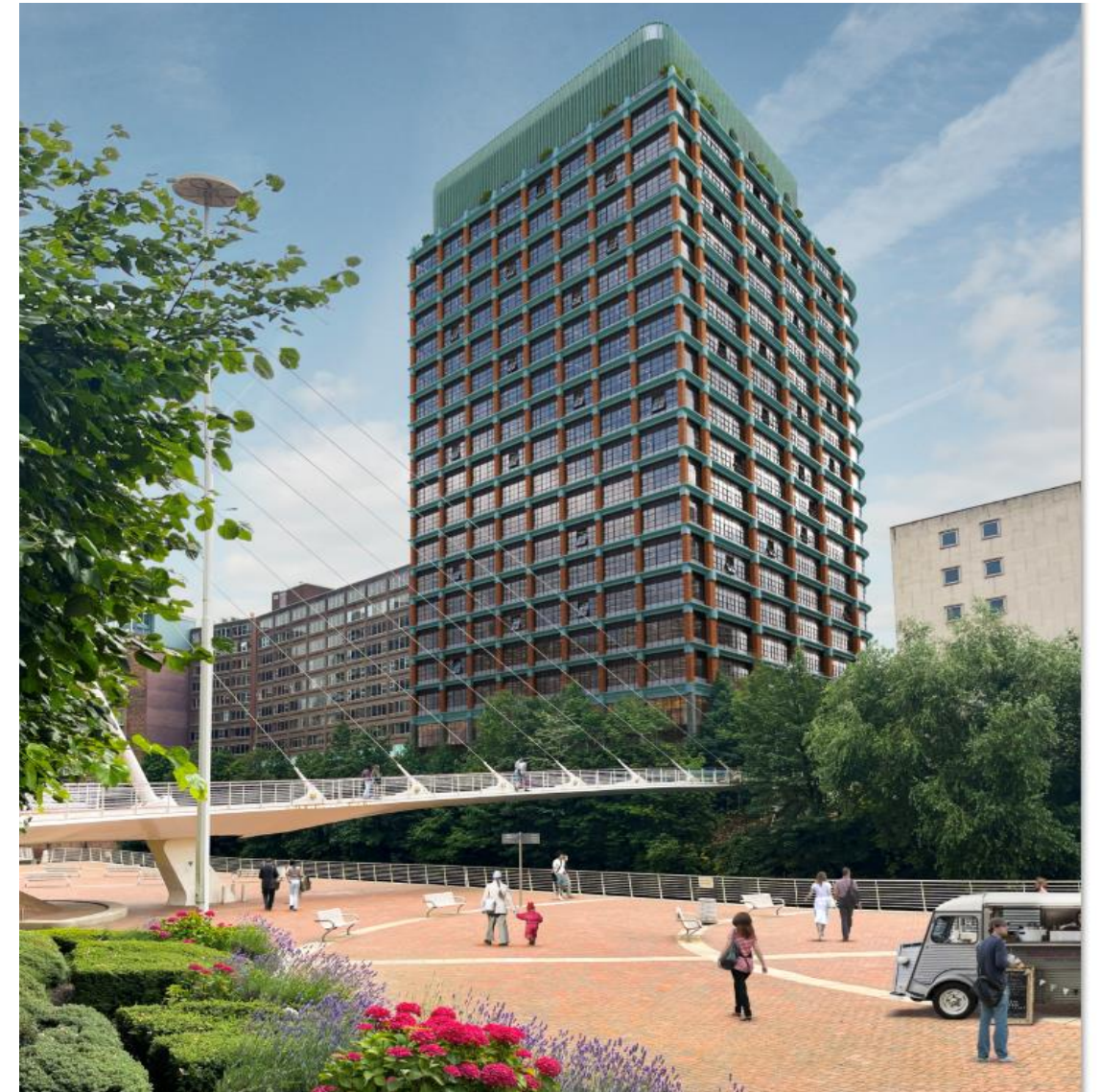


Operational Energy Assessment Alberton House

DATE OF ISSUE: 27 MAY 2022
ISSUE: P03
HM REFERENCE: 30098-RP-SU-005
CLIENT REF: ALBH-HMM-ZZ-ZZ-RP-Y-0007

PROJECT:
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PROJECT NAME: ALBERTON HOUSE

REPORT NAME: Operational Energy Assessment
Alberton House

ISSUE STATUS: ISSUED FOR RIBA STAGE 3

HM REFERENCE: 30098-RP-SU-005

CLIENT REF: ALBH-HMM-ZZ-ZZ-RP-Y-0007

DATE OF ISSUE: 27 MAY 2022

ISSUE: P03

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DOCUMENT HISTORY:

ISSUE	DATE	DETAILS
P01	18/10/2021	ISSUED FOR RIBA STAGE 2
P02	23/11/2021	ISSUED FOR RIBA STAGE 2 - OFFSET CORE UPDATE
P03	27/5/2022	ISSUED FOR RIBA STAGE 3

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Contents

1. Background..... 1

2. CIBSE TM 54 Methodology 1

3. Analysis Setup..... 2

3.1. Inputs2

3.2. Evaluated Scenarios4

4. Results and Discussion 5

5. Conclusions..... 7

6. Recommendations 7

1. Background

Hilson Moran has been appointed by Bruntwood to provide an Operational Energy Assessment for the Proposed redevelopment of Alberton House in Manchester.

The Proposed Development consists of a 21-storey building, including basement, ground, mezzanine 16 office floors and 2 leisure floors.



Figure 1 - Site Location

The project is aspiring for several sustainability targets, including:

- BREEAM 2018 New Construction – Excellent
- Net Zero Carbon
- NABERS – 5.5 Star Rating

2. CIBSE TM 54 Methodology

To conduct a CIBSE TM 54 assessment, the Part L model is usually used as a starting point and modified based on information on tenant occupancy patterns, operating hours, internal heat gains, controls and management regimes. Then a combination of DTM and manual calculation is adopted to predict the operational energy of the Alberton House development.

Figure 2 illustrates the methodology, proposed by CIBSE TM 54:2013 to predict operational energy at the design stage.

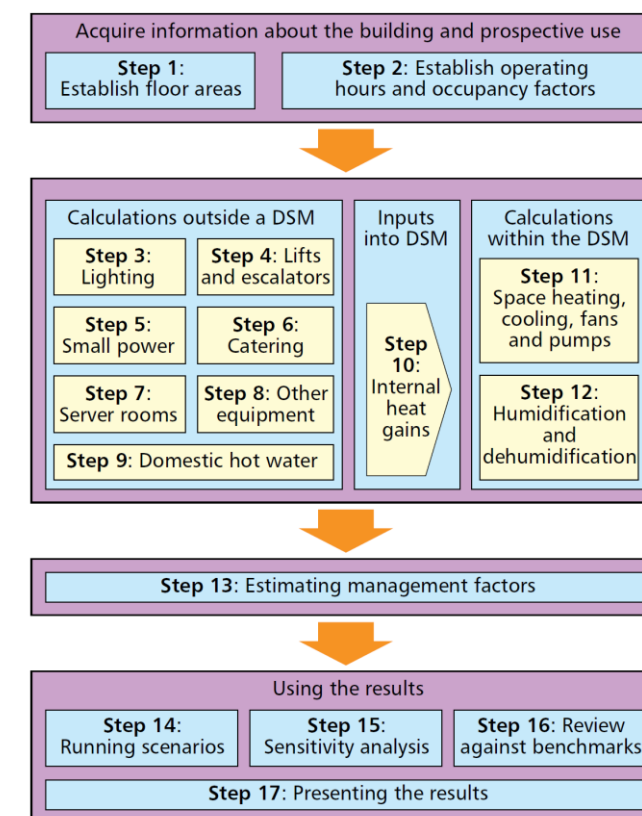


Figure 2 - CIBSE TM 54 methodology for evaluating operational energy use

The following five stages should be considered when conducting a CIBSE TM 54: 2013 analysis.

1) Establishing floor areas and operating hours

Since the results of CIBSE TM 54 analysis are usually compared with the results of benchmarks, establishing treated floor areas plays an important role for this comparison. The CIBSE TM54 model is developed based on the results of Part L model. All conditioned areas within thermal envelope are included as per the Part L assessment.

The results are displayed against Gross Internal Area, In the case of the development this equates to an area of **31,032 m²**. The occupancy behaviour within the building will introduce a high level of variability

to the building's energy consumption and therefore establishing this parameter can influence the overall results. CIBSE TM 54: 2013 suggests conducting a survey to collect data from potential or actual occupants of the building. Considering the stage of development establishing this parameter is very challenging. For this reason, a range of potential operating scenarios, and associated energy consumption are considered based on the outcomes of the operational energy.

2) Estimating end user's energy consumption

Energy consumption for lighting, lifts, small power, catering and hot water should be estimated manually using relevant CIBSE guidance. To estimate energy use for heating, cooling, fans, pumps and humidification, dynamic thermal models should be adopted. Table 1 summarises the proposed methodologies by CIBSE TM 54: 2013 to estimate energy consumption for each individual end use categories.

3) Estimating management factors

In many buildings, systems may not perform at the quoted efficiency due to poor commissioning, lack of efficient management etc. According to CIBSE TM 54: 2013, in order to account for this, an overall management factor can be applied to the calculation results, representing how well the building systems are likely to be managed during its operation.

4) Establishing scenarios

The operational use of the building is likely to introduce a high level of variability to the building's energy consumption and establishing this parameter can influence the overall results. As determining day to day operation of a building is almost impossible, CIBSE TM 54: 2013 suggests presenting the results as a range with high and low energy use scenarios to show the level of uncertainty around estimating operational energy use in buildings. Bruntwood has provided standardised inputs for scenarios for operational energy for office areas which have been followed at The Alberton.

5) Analysing the results

As suggested by CIBSE TM 54: 2013, sensitivity analysis should be conducted to determine parameters which have high influence on overall energy consumption in the building.

3. Analysis Setup

3.1. Inputs

The physical geometry and orientation of the building is as per the reported drawings from EPR Architects dated 31/03/2022. Operational energy has been predicted and modelled based on the GIA, this is calculated at 31,032.

For all tested scenarios identical building fabric has been modelled. It is assumed that this represents the fabric to be installed as consulted with throughout the process of Stage 3.

Air infiltration rate is set as 0.25ach to all perimeter zones.

Bruntwood has provided standardised inputs for scenarios for operational energy for office areas which have been followed at The Alberton and can be seen in section 5.2 Evaluated scenarios.

1) Weather data

The Manchester Test Reference Year (TRY) weather data is used for all scenarios analysed.

TRY weather data is used for the studies, being representative of typical site weather. Data files use a 30-year baseline, aiming to ensure that the observed effects of climate change will be included.

2) Occupancy level and profiles

The building is not currently occupied and as such the specific floor layouts and operating hours are yet to be defined.

As far as can be projected with information available at this stage, the expected occupancy density for office areas is specified at (1p /8 m²). Often these fall below the maximum levels for which the building is designed to once tenancy requirements are incorporated into the fit-out designs and diversity is accounted for. As such, the occupancy densities accounted for are as follows:

Low occupancy scenario (1) – 1 person per 12 m²

Central occupancy scenario (2) – 1 person per 10m²

High Scenario (3) – 1 person per 8 m²

For the purposes of this analysis, it is assumed the building will not be occupied in office areas at weekends and bank holidays. However, the leisure areas will be which is accounted for in all scenarios.

3) Domestic hot water consumption

Domestic hot water consumption for the building is particularly difficult to estimate. Domestic hot water consumption will be dependent on the incoming tenant's requirements in the office spaces and for tenants in the leisure areas.

CIBSE Guide G predicts a daily consumption of **8 litres per person** for an average 'office'.

4) HVAC Systems

Much information from the Part L analysis has been used to determine the system specification (as recommended under section 7.11 of the CIBSE TM 54 methodology). As for occupancy gain; small power consumption is calculated for all areas and installed lighting power has been determined based on built definition and Part L model. Efficiencies for mechanical and electrical systems can be seen in ALBH-HMM-ZZ-ZZ-RP-N-0006_P03 Energy strategy.

Lift consumption has been estimated utilising the DfP Guide v.01 utilising information provided by the lift consultant – LECS UK. The cycle lift has been excluded as part of this analysis – It is thought the usage will be minimal and not have impact on the overall figures.

5) External lighting

The roof terrace and mezzanine external lighting loads have been provided by Artin Lighting. It is unsure as of yet who is responsible for the ground floor external lighting loads and will be further developed with the specialist lighting manufacture during the design process.

6) Catering

Within the Ground Floor a restaurant and bar area has been developed to provide a food and beverage retail area for the building users. To calculate the energy impact of this **CIBSE TM50 – Energy efficiency in commercial kitchens** has been referenced. A maximum occupancy capacity of 260 has been referenced with 180 maximum meal settings and 80-person bar capacity.

Table 7.2 shows the yearly sales per place setting, a themed scenario was used for a factor of **1278**. A diversity of 75% and 50% was used for central and low input scenarios resulting in a factor of **959** and **639** respectively.

Table 7.7 from CIBSE TM50, shows the breakdown of energy per meal for environmental and operational energy. A themed scenario has been used with a turnover rate of **3**.

Within the office areas additional allowance has been made within the internal gains, equipment loads and domestic hot water allowances for smaller staff tea points and kitchens being located uniformly throughout the building. These areas will require further assessment as the design develops.

Table 7.2 Catering energy benchmarks: coffee shops, fast food outlets and restaurants

Facility type	Area to support setting (m ²)	Yearly sales per place setting	Annual benchmark	Energy benchmark per meal produced (kW-h/m ²)					
				Good practice			Typical practice		
				Fossil fuel	Elec.	Total	Fossil fuel	Elec.	Total
Coffee shop	1.8	2190	See Table 7.1	0.90	0.53	1.43	1.03	0.60	1.63
Fast food outlet	1.0	910	See Table 7.1	0.53	0.90	1.43	0.98	0.74	1.72
Restaurant:									
— fine dining	4.4	912	See Table 7.1	5.31	3.14	8.45	—	—	—
— staff	2.1	936	See Table 7.1	2.47	1.46	3.93	—	—	—
— themed	2.4	1278	See Table 7.1	2.07	1.22	3.29	—	—	—
— traditional (full service)	2.6	1095	See Table 7.1	2.61	1.54	4.15	—	—	—

Table 7.7 Environmental and operational energy usage benchmarks per meal served

Facility	Standard	Environment (kW-h/meal)			Operational (kW-h/meal)			Combined (kW-h/meal)		
		Fossil fuel	Elec.	Total	Fossil fuel	Elec.	Total	Fossil fuel	Elec.	Total
Coffee shop	Good practice	0.36	0.21	0.57	0.54	0.32	0.86	0.90	0.53	1.43
	Typical	0.41	0.24	0.65	0.62	0.36	0.98	1.03	0.60	1.63
Fast food outlet	Good practice	0.21	0.36	0.57	0.32	0.54	0.86	0.53	0.90	1.43
	Typical	0.30	0.39	0.69	0.44	0.59	1.03	0.74	0.98	1.72
Restaurant:										
— fine dining	Good practice	2.12	1.26	3.38	3.19	1.88	5.07	5.31	3.14	8.45
	Typical	2.41	1.41	3.82	3.62	2.11	5.73	6.03	3.52	9.55
— staff	Good practice	0.99	0.58	1.57	1.48	0.88	2.36	2.47	1.46	3.93
	Typical	1.12	0.66	1.78	1.69	0.98	2.67	2.81	1.64	4.45
— themed	Good practice	0.83	0.49	1.32	1.24	0.73	1.97	2.07	1.22	3.29
	Typical	0.94	0.55	1.49	1.41	0.82	2.23	2.35	1.37	3.72
— traditional (full service)	Good practice	1.04	0.62	1.66	1.57	0.92	2.49	2.16	1.54	4.15
	Typical	1.19	0.69	1.88	1.78	1.04	2.82	2.97	1.73	4.70

7) Un-accounted for consumption

In addition to the external lighting, there may be other areas of smaller consumption which are not accounted for at this stage but are unlikely to have significant impact upon the overall figures e.g. sump pumps, consumption linked to security/CCTV, and testing of life safety generators.

3.2. Evaluated Scenarios

Due to considerable uncertainty linked to how incoming tenants will operate spaces post occupancy, it is not meaningful to provide a single figure for an operational energy prediction. It is more useful to estimate the range in which energy consumption is likely to be. Considering the variability in occupancy behaviour or expected small power consumption (how varying small power impacts the demand on the building's systems) leads to significant fluctuations in energy consumption. Bruntwood has provided standardised inputs for scenarios for operational energy for office areas which have been followed at The Alberton.

Table 1 summarises the values provided by Bruntwood that have been used in each scenario:

Inputs for Scenarios	Low	Central	High
Occupancy Density	12	10	8
Operating Hours/Days	09:00 -17:00 5 days a week	08:00 -18:00 5 days a week	08:00 -20:00 5 days a week
Heating & Cooling Set Points	21°C Heating 24°C Cooling 16°C set back	21°C Heating 24°C Cooling 16°C set back	21°C Heating 24°C Cooling 16°C set back
Heating & Cooling Hours / Days	09:00 -17:00 5 days a week	08:00 -18:00 5 days a week	08:00 -20:00 5 days a week
Out of Hours Heating/ Cooling Provision	Heating night set back	Heating night set back	Heating night set back
Ventilation Rates (litres/second/person)	14	14	14
Ventilation Hours / Days	09:00 -17:00 5 days a week	08:00 -18:00 5 days a week	08:00 -20:00 5 days a week
Out of Hours Ventilation Provision	None	None	None

Domestic Hot Water Provision (litres/person/day)	8	8	8
Office Small Power Loads (W/m ²)	8	15	25
Office Small Power Hours / Days	09:00 -17:00 5 days a week	08:00 -18:00 5 days a week	08:00 -20:00 5 days a week
Office Out of Hours Small Power Provision (W/m ²)	20%	20%	20%
Common Areas Small Power Loads (W/m ²)	5	5	5
Common Areas Small Power Hours/Days	09:00 -17:00 5 days a week	08:00 -18:00 5 days a week	08:00 -20:00 5 days a week
Common Areas Out of Hours Small Power Provision (W/m ²)	1	1	1
Lighting Hours / Days	09:00 -17:00 5 days a week	08:00 -18:00 5 days a week	08:00 -20:00 5 days a week
Lighting Power / Provision	10% of load	10% of load	10% of load
Management Factor	1	1.1	1.15
Weather File	Manchester TRY	Manchester TRY	Manchester TRY

Table 1 - Office Inputs for Scenarios

A breakdown of zones other than offices can be seen in Table 2.

Zone	Basement Gym	L17-Events/Amenity Space	L18- Juice Bar
Occupancy Density	Low – 1/5 Central – 1/5 High – 1/5	Low – 1/12 Central – 1/10 High – 1/8	Low – 1/12 Central – 1/10 High – 1/8
Operating Hours/Days	Low – 8-6 (WEEK) Central – 8-8 (WEEK) High – 6-8 (WEEK)	Low – 8-6 (WEEK) Central – 8-10 (WEEK) High – 6-10 (WEEK)	Low – 8-6 (WEEK) Central – 8-10 (WEEK) High – 6-10 (WEEK)
Heating & Cooling Set Points	20°C Heating 21°C Cooling 16°C set back	21°C Heating 24°C Cooling 16°C set back	21°C Heating 24°C Cooling 16°C set back

Table 2 - Additional Zones Inputs for Scenarios

4. Results and Discussion

Based on the current information it is estimated that the total annual energy consumption for the Gross Internal Area could be in the range of 86 kWh/year/m² to 207.64 kWh/year/m² (Table 3).

Since the results of the 'Optimistic Case' were predicted based on actual operational periods and reasonable assumptions for occupancy density, internal loads, controls and management regimes, with ideal system performance this scenario is likely to provide a target which could be aimed towards, for typical tenants. However, based on the day-to-day operation of building and occupants' behaviour in future considerable variation from the baseline is possible

GIA Usage (kWh/m ²)	Low	Central	High
Heating	4.13	6.34	12.71
Cooling	3.93	8.91	18.43
Auxiliary	17.32	21.79	25.93
Landlord Lighting	4.66	5.94	7.12
Tenant Lighting	7.43	10.21	12.81
How Water	2.63	3.27	4.22

Landlord Equipment	2.57	4.59	7.86
Tenant Equipment	16.50	38.11	73.52
Landlord Servers	0.81	1.07	1.50
Tenant Servers	1.85	2.42	3.38
Lifts	4.40	4.84	5.06
External Lighting	0.21	0.35	0.48
Catering (Environmental)	4.89	8.07	11.26
Catering (Operational)	7.30	12.06	16.79
Sauna	2.82	3.10	3.24
Steam Room	4.09	4.50	4.70
Indicative Pool (with heating)	2.29	2.52	2.63
Total	86.09	135.21	207.64

Table 3 – Operational Energy Results

Figure 3 shows the breakdown of the three scenarios with regulated, unregulated, and additional energy factors. Furthermore, Table 4 shows the breakdown of energy for total energy kWh/m² (GIA and NLA), base building energy kWh/m² (GIA and NLA) and tenant energy kWh/m² (NLA).

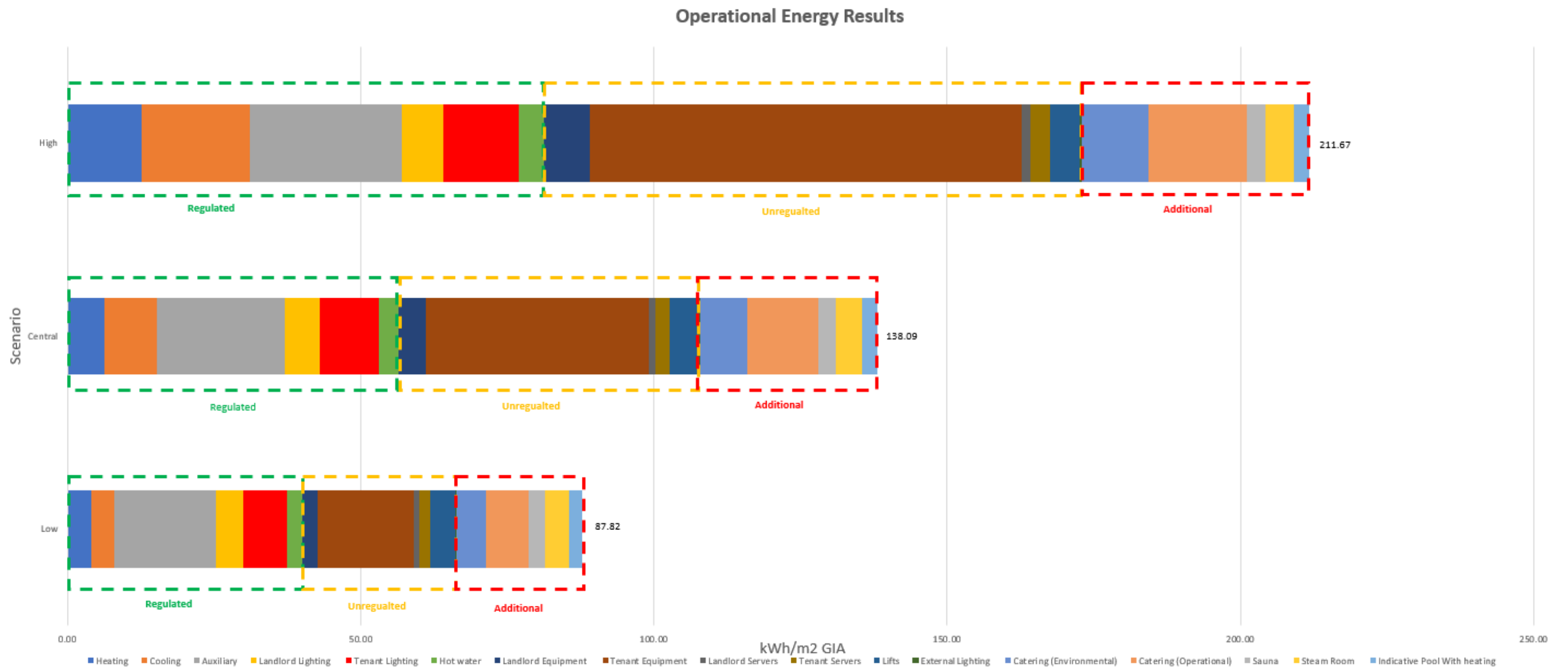


Figure 3 – Operational Energy Results

Scope & Metric	Low	Central	High	Description
Total building energy intensity (GIA) (kWh/m²/year)	87.82	138.09	211.67	This is total energy divided by the total gross floor area
Total building energy intensity (NLA) (kWh/m²/year)	121.38	190.87	292.57	This is total energy divided by the total gross floor area
Base building energy intensity (GIA) (kWh/m²/year)	32.61	47.51	72.06	This is all landlord small power and lighting as well as all heating, cooling and ventilation energy divided by the total gross floor area
Base building energy intensity (NLA) (kWh/m²/year)	45.07	65.67	99.6	This is all landlord small power and lighting as well as all heating, cooling and ventilation energy divided by the total net lettable area
Tenant energy (NLA) (kWh/m²/year)	33.07	66.79	119.34	This is all tenant small power and lighting divided by the total net lettable area

Table 4 – Total, Base build and Tenant Energy breakdown

The results of this assessment also show that, among all tested variables, equipment is predicted to consume the highest amount of energy. Considering that depending on the day to day operation of the building usage of equipment can vary considerably, equipment energy consumption is a significant unknown variable which has a considerable effect on the overall building energy consumption.

Based on the TM54 Compliant methodology, heating and cooling consumption is predicted by DTM which has some limitations. For instance, it is assumed that systems follow a regular schedule with fixed set-points which is an optimistic assumption. Simultaneous operation of heating and cooling in a room can occur in practice; however, this is not simulated currently. Moreover, out of hours operation of the building such as cleaning and maintenance has been ignored in DTM models. Considering these limitations, the CIBSE TM 54: 2013 methodology may underestimate the total heating and cooling demand in the building.

It is worth additionally noting that there may be further areas of consumption which are not encompassed by these early stage studies. Pool consumption is still under investigation.

Server consumption makes up a small percentage of total electricity usage, however true consumption is highly uncertain due to tenancy usage and requirements currently being unknown. Exact landlord requirements (and corresponding likely power draw) from Main equipment rooms, switch rooms etc will additionally be confirmed in upcoming stages.

5. Conclusions

Based on the current information and assumptions the indicative results suggest that electrical consumption for the Alberton house development will likely fall in the range of 87.82 to 211.67 kWh/year/m² (GIA).

Since the results of the baseline model were predicted based on what, at this initial stage, are believed to be the most likely/reasonable operational periods and assumptions for occupancy density, internal loads, controls and management regimes, it provides the most representative results, based on the TM54 methodology. However, depending on the actual day to day operation of the building and occupants' behaviour as shown in this assessment; considerable variation from the baseline is possible.

6. Recommendations

Hilson Moran are committed to ensuring that the most efficient building is realised. As a more detailed design is generated the model will be further modified to predict further energy consumption. The recommendations of the TM54 report follow the same as NABERS and therefore further recommendations can be found within ALBH-HMM-ZZ-ZZ-RP-Y-0011_P01.

