Paddington Green Police Station
2 – 4 Harrow Road, London, W2 1XJ

Energy Statement – Part 3

WSP

01/04/2021

Berkeley
Designed for life

Berkeley Homes (Central London) Ltd.

Paddington Green Police Station

Energy Statement

PGPS-WSP-XX-XX-ST-ES-0001_P03

April 2021

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Berkeley Homes (Central London) Ltd.

Paddington Green Police Station, Westminster

Energy Statement

Project No: 70069424

April 2021

WSP
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70 Chancery Lane
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QUALITY CONTROL

Issue/revision	First issue	Revision P01	Revision P02	Revision 3
Remarks	Draft	Draft Planning Submission	Final Planning Submission	Final Planning Submission with GLA evidence
Date	March 2021	19 March 2021	31st March 2021	1st April
Prepared by	Michela Martini	Michela Martini	Michela Martini	Michela Martini
Signature				Martini, Michela (UKMXM082) Digitally signed by Martini, Michela (UKMXM082) DN: E=Michela.Martini@wsp.com, CN="Martini, Michela (UKMXM082)", OU=London (Chancery Lane), OU=Accounts, OU=UK, OU=EMEA, DC=corp, DC=pbwan, DC=net Location: London Date: 2021.04.01 12:34:38+01'00'
Checked by	JC	Stephen Gallacher	Jacob Cox	Jacob Cox/Stephen Gallacher
Signature				
Authorised by		Stephen Gallacher	Stephen Gallacher	Nick Remington
Signature				Remington, Nick (UKNXR001)
Project number	70069424	70069424	70069424	70069424
Report number		PGPS-WSP-XX-XX-ST-ES-0001	PGPS-WSP-XX-XX-ST-ES-0001	PGPS-WSP-XX-XX-ST-ES-0001
File reference				

PRODUCTION TEAM

WSP GLOBAL INC. (WSP)

Principal Energy Engineer	Michela Martini
Associate Director	Stephen Gallacher
Project Director	Nick Remington

16 APPENDIX D

16.1 BE SEEN SPREADSHEET

N	NEV	N	N	N	NEVER	NEVER	NEVER	N	NEVER	NEV	N	N	NEVER
Gap	Cate	Detail											
-	0	2	1			2 Units	Note		Building / RU Data	Reqd?			

OVERALL PROGRESS 90%

CURRENT REPORTING STAGE ---------------------------------- >>	Planning	*

CONTEXTUAL DATA *Progress: 89%*

+ ORGANISATION & CONTACT DETAILS

ORGANISATION DETAILS

Organisation Name	Berkeley Homes (Central London) Ltd	*
Organisation Address	380 Queenstown Road, London, SW11 8PE	*

CONTACT DETAILS

Contact Name	Clara-Rose Wright	*
Email	clara.wright@berkeleygroup.co.uk	*
Additional Email(s)		
Telephone No.	07976 428296	*
Mobile No.		

+ DEVELOPMENT INFORMATION

OVERALL DEVELOPMENT DETAILS

Planning Reference Number	PP-09421899	*
Name of Whole Development	Paddington Green Police Station	*

DEVELOPMENT LOCATION

Development Address			
Address Line 1		2-4 Harrow Road	*
Address Line 2		Westminster	
Address Line 3		London	
Address Line 4			
Post Town		W2 1XJ	*
Postcode		W2 1XJ	*
Ordnance Survey Reference			
Development UPRN (if available)	*Please add if available ->*		
Geo-Location Coordinates			
Latitude (to 6 decimal places)	*Please add if available ->*		
Longitude (to 6 decimal places, +ve or -ve)	*Please add if available ->*		

DEVELOPMENT TOTAL AREA BREAKDOWN

Residential			
Total Residential Floor Area	GIA m2	51,434	*
Dwelling Counts			
Flats	number	556	*
House	number	0	*
Non-Residential			
Non-Residential Floor Area Breakdown		*Please include complete non-resi details below*	
Landlord Circulation (in Residential Blocks)	GIA m2	1,903	*
General office (A2, B1, B8, D1 planning classes)	GIA m2	10,422	*
High street agency (A2 planning classes)	GIA m2	2,214	*
General retail (A1, SG planning classes)	GIA m2		*
Large non-food shop (A1 planning classes)	GIA m2		*
Small food store	GIA m2		*
Large food store	GIA m2		*
Restaurant (A3, A5 planning classes)	GIA m2		*
Bar, pub or licensed club (A4 planning classes)	GIA m2		*
Hotel (C1 planning classes)	GIA m2		*
Cultural Activities	GIA m2		*
Entertainment halls (D2 planning classes)	GIA m2		*
Swimming pool centre	GIA m2		*
Fitness and health centre	GIA m2		*
Dry sports and leisure facility (D2 planning classes)	GIA m2		*
Covered car park	GIA m2		*
Public buildings with light usage (D1, SG planning classe	GIA m2		*
Schools and seasonal public buildings (D1, D2 planning	GIA m2		*
University campus	GIA m2		*
Clinic (D1 planning classes)	GIA m2		*
Hospital (clinical and research)	GIA m2		*
Long term residential (C1, C2, C2A planning classes)	GIA m2		*
General accommodation (C1, C2, C3 planning classes)	GIA m2		*
Emergency services (SG planning classes)	GIA m2		*
Laboratory or operating theatre	GIA m2		*
Public waiting or circulation (SG planning classes)	GIA m2		*
Terminal (B8 planning classes)	GIA m2		*
Workshop (B1, B2 planning classes)	GIA m2		*
Storage Facility (B8 planning classes)	GIA m2		*
Cold Storage (B8 planning classes)	GIA m2		*

Overall Development Summary

Total Development Floor Area			
Residential	GIA m2	51,434	
Non-Residential	GIA m2	14,539	
Total	GIA m2	65,973	
Total Non-Residential Uses		Landlord Circulation; General office; High street agency	

+ SUPPLEMENTARY FILES AND UPCOMING REPORTING STAGES

SUPPLEMENTARY FILES

Site Plan			
Does the development have a site plan?		No	*
Best Practice Documents			
Does the development have a predicted DEC?		No	*
Is there a base building energy rating (in line with DFP)?		No	*

ANTICIPATED DATES FOR UPCOMING REPORTING STAGES

As-Built Stage	*Must complete ->*		*
Operational Year 1 End	*Must complete ->*		*

DEVELOPMENT PERFORMANCE AND EMISSIONS

Progress: 92%

+ DEVELOPMENT PERFORMANCE

DEVELOPMENT OVERALL PREDICTED PERFORMANCE

Predicted Performance Calculation Details				
Fuel Carbon Intensity Source (aligned with planning energy statemen			SAP 2012	*
Residential Elements of the development				
Predicted Annual Energy Use			*Fill in all applicable fuels below*	
Annual Electricity Use	kWh/yr		2,336,881	*
Annual Gas Use	kWh/yr		0	*
Annual Oil Use (if applicable)	kWh/yr		0	*
Annual Biomass Use (if applicable)	kWh/yr		0	*
Annual District Htg Use (if applicable)	kWh/yr		3,484,552	*
Annual District Clg Use (if applicable)	kWh/yr		0	*
Elec Generation, Gross (if applicable)	kWh/yr		0	*
Solar Thermal Generation (if applicable)	kWh/yr		0	*
Predicted Annual Carbon Emissions	tCO2/yr		1,095	*
Non-Residential Elements of the development (Part L Calculation)				
Predicted Annual Energy Use			*Fill in all applicable fuels below*	
Annual Electricity Use	kWh/yr		783,890	*
Annual Gas Use	kWh/yr		0	*
Annual Oil Use (if applicable)	kWh/yr		0	*
Annual Biomass Use (if applicable)	kWh/yr		0	*
Annual District Htg Use (if applicable)	kWh/yr		23,181	*
Annual District Clg Use (if applicable)	kWh/yr		0	*
Elec Generation, Gross (if applicable)	kWh/yr		15,661	*
Solar Thermal Generation (if applicable)	kWh/yr		0	*
Predicted Annual Carbon Emissions	tCO2/yr		399	*
Non-Residential Elements of the development (TM54 Calculation)				
Predicted Annual Energy Use			*Fill in all applicable fuels below*	
Annual Electricity Use	kWh/yr		1,060,000	*
Annual Gas Use	kWh/yr	*Must complete ->*		*
Annual Oil Use (if applicable)	kWh/yr			*
Annual Biomass Use (if applicable)	kWh/yr			*
Annual District Htg Use (if applicable)	kWh/yr		29,000	*
Annual District Clg Use (if applicable)	kWh/yr			*
Elec Generation, Gross (if applicable)	kWh/yr		15,661	*
Solar Thermal Generation (if applicable)	kWh/yr			*
Predicted Annual Carbon Emissions	tCO2/yr		550	*

CARBON OFFSETTING

Predicted Carbon Shortfall (aligned with planning energy st	tCO2	13,913	*
Total Committed Carbon Offset	£	1,321,758	*

END

16.2 CIBSE TM54 ANALYSIS

Berkeley Homes (Central London) Ltd.

PADDINGTON GREEN POLICE STATION

CIBSE TM54 Report: Evaluating Operational Energy Performance of Building at the Design Stage

70069424
APRIL 2021

PUBLIC

Berkeley Homes (Central London) Ltd.

PADDINGTON GREEN POLICE STATION

CIBSE TM54 Report: Evaluating Operational Energy Performance of Building at the Design Stage

TYPE OF DOCUMENT (VERSION) PUBLIC

PROJECT NO. 70069424

OUR REF. NO. 70069424

DATE: APRIL 2021

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QUALITY CONTROL

Issue/revision	First issue	Revision 1	Revision 2	Revision 3
Remarks	Final issue			
Date	April 2021			
Prepared by	Pafsanias Vissariou			
Signature				
Checked by	Michela Martini Jacob Cox			
Signature				
Authorised by	Nick Remington			
Signature				
Project number	70069424			
Report number	PGPS-WSP-XX-XX-RP-ES-0001			
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APPENDIX A

ASSUMPTIONS

EXECUTIVE SUMMARY

The CIBSE TM54:2013 'Evaluating Operational Energy Performance of Buildings at the Design Stage' methodology has been used to evaluate the predicted operational energy use of the building.

For each step of the methodology the design parameters, together with assumptions regarding levels of occupancy and operation have been used to predict the energy consumption for: lighting, lifts, small power, domestic hot water, space heating, cooling, fans and pumps.

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 and operation
Low End:	the low end consumption if the occupancy is lower
High End:	the high end consumption if the occupancy is higher and equipment and systems are used more than anticipated
Worst Case:	the worst case consumption if the occupancy is much higher and equipment and systems are used much more than anticipated

Two of the key assumptions within the analysis are the occupancy and running hours of the building.

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 low occupancy and good operation (Likely or Low End Scenarios) the building will consume significantly less than Good Practice benchmarks, however if the building has high occupancy and unmanaged operation (Worst Case Scenario) the building will perform only slightly better than Good Practice benchmarks.

The predicted Display Energy Certificate (DEC) Rating is also dependent on the level of occupancy and operation of the building. The building could score between a DEC B Rating (Low End Scenario) and a DEC C Rating (Worst Case Scenario) but based on assumed occupancy and operation the building will likely achieve a DEC B Rating (Likely Scenario).

The annual energy and carbon intensity for each scenario are as follows:

Table 1 Comparison of Annual Energy Intensity (including LZC)

	LIKELY	LOW END	HIGH END	WORST CASE
Total Electricity Intensity (inc. LZC) (kWh/m^2)	55.0	48.3	65.0	76.8
Total Thermal (Communal Heating) Intensity (inc. LZC) (kWh/m^2)	0.5	0.5	0.5	0.7
Total Energy Intensity (inc. LZC) (kWh/m^2)	55.5	48.8	65.6	77.4

Table 2 Comparison of Annual Carbon Intensity (including LZC) – SAP10 Factors

	LIKELY	LOW END	HIGH END	WORST CASE
Total Electricity (inc. LZC) Carbon Intensity (kg.CO_2.m^2)	24.7	21.7	29.2	34.5
Total Thermal (Communal Heating) (inc. LZC) Carbon Intensity (kg.CO_2/m^2)	0.8	0.9	1.0	1.2
Total Carbon Intensity (inc. LZC) (kg.CO_2/m^2)	25.5	22.6	30.2	35.7

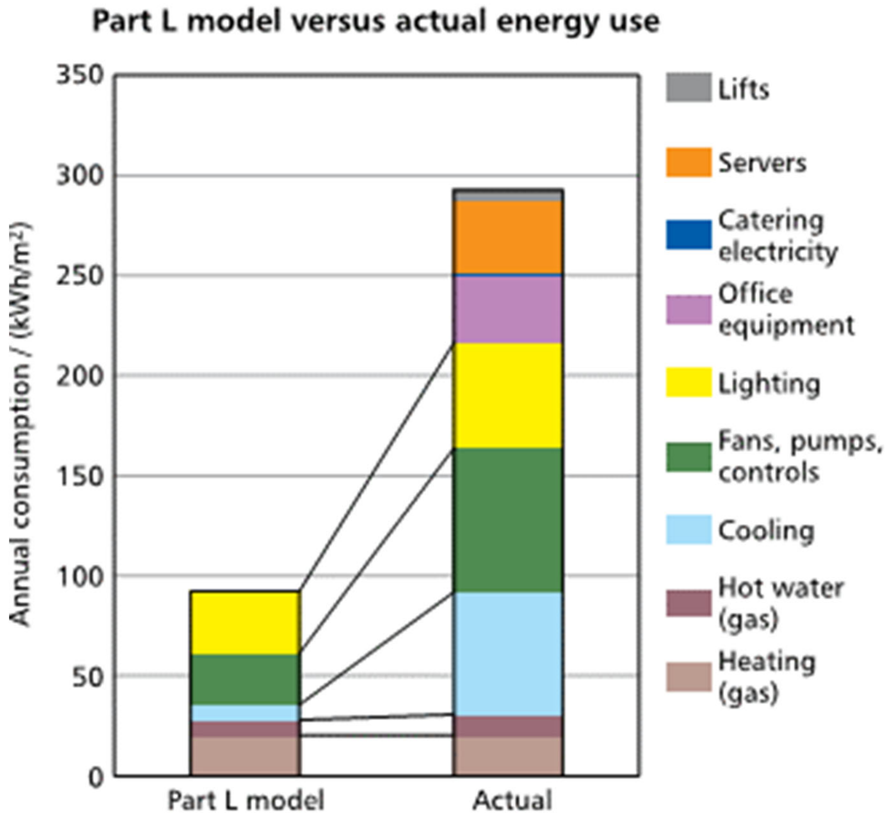
1 INTRODUCTION

WSP has been commissioned by Berkeley Homes (Central London) Ltd. to develop and prepare an Energy Statement for Paddington Green Police Station (the Proposed Development) in the Westminster City Council (WCC) London. As part of the overall energy assessment, this report has been prepared to satisfy the GLA requirements set out in the *'Be Seen' energy monitoring guidance* (pre-consultation draft, April 2020).

The client's ambition for the site is to deliver a high quality residential led mixed-use development that will complete the West End Gate masterplan. The scheme will complement and enhance the local environment including the Paddington Green and the wider Church Street area, improve the quality of life for local people and provide a sustainable development for new residents. The proposals will regenerate this part of the Edgware Road providing active frontages on Edgware Road and Harrow Road, in hand with an improved public realm and townscape.

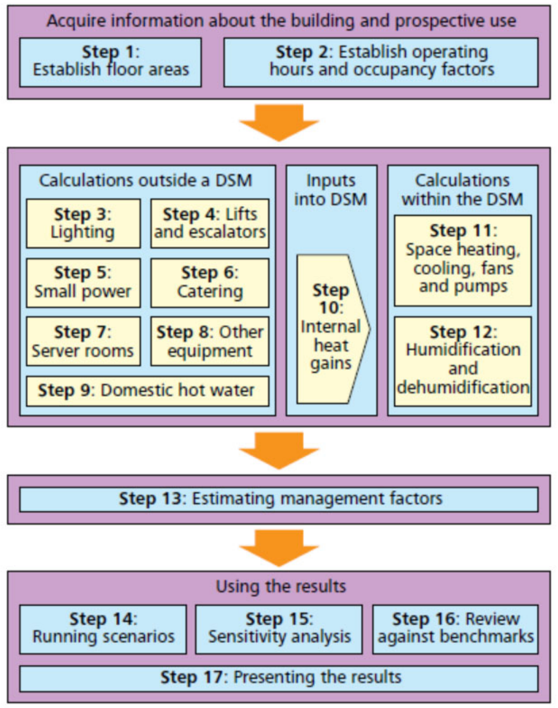
In the UK there are several regulatory and voluntary measures that aim to improve the energy performance of buildings (Part L etc). However, the current schemes do not measure actual performance outcomes which has led to a 'Design for Compliance' culture and the 'Performance Gap' where actual new building performance is drastically different from the designed performance. Figure 1 highlights the potential differences in actual energy consumption vs the energy consumption predicted by a Part L model.

Figure 1 - Comparison of Part L2A calculations and operational performance for a case study (Source: CIBSE TM54:2013)



To evaluate the operational energy use during the design stage we are following the CIBSE TM54 methodology (Figure 2). 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.

Figure 2 - Methodology for evaluating operational energy at the design stage. Source: CIBSE TM54:2013



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 METHODOLOGY

2.1 GENERAL

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

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 and operation
Low End:	the low-end consumption if the occupancy is lower
High End:	the high-end consumption if the occupancy is higher and equipment and systems are used more than anticipated
Worst Case:	the worst-case consumption if the occupancy is much higher and equipment and systems are used much more than anticipated.

2.2 SOFTWARE

A simulation model has been built for the purposes 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 systems.

The geometry of the model has been built in IES VE 2021 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 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 exercise the London weather file has been selected.

2.4 GEOMETRY

2.4.1 ARCHITECTURAL DRAWINGS

Paddington Green is a high-rise mixed-use development in Paddington with a 2-storey basement below. There are retail and reception areas on the ground floor. The model is based on the Design Freeze 02 architectural drawings by Squire & Partners. A 3D render from IES VE can be seen in Figure 3**.**

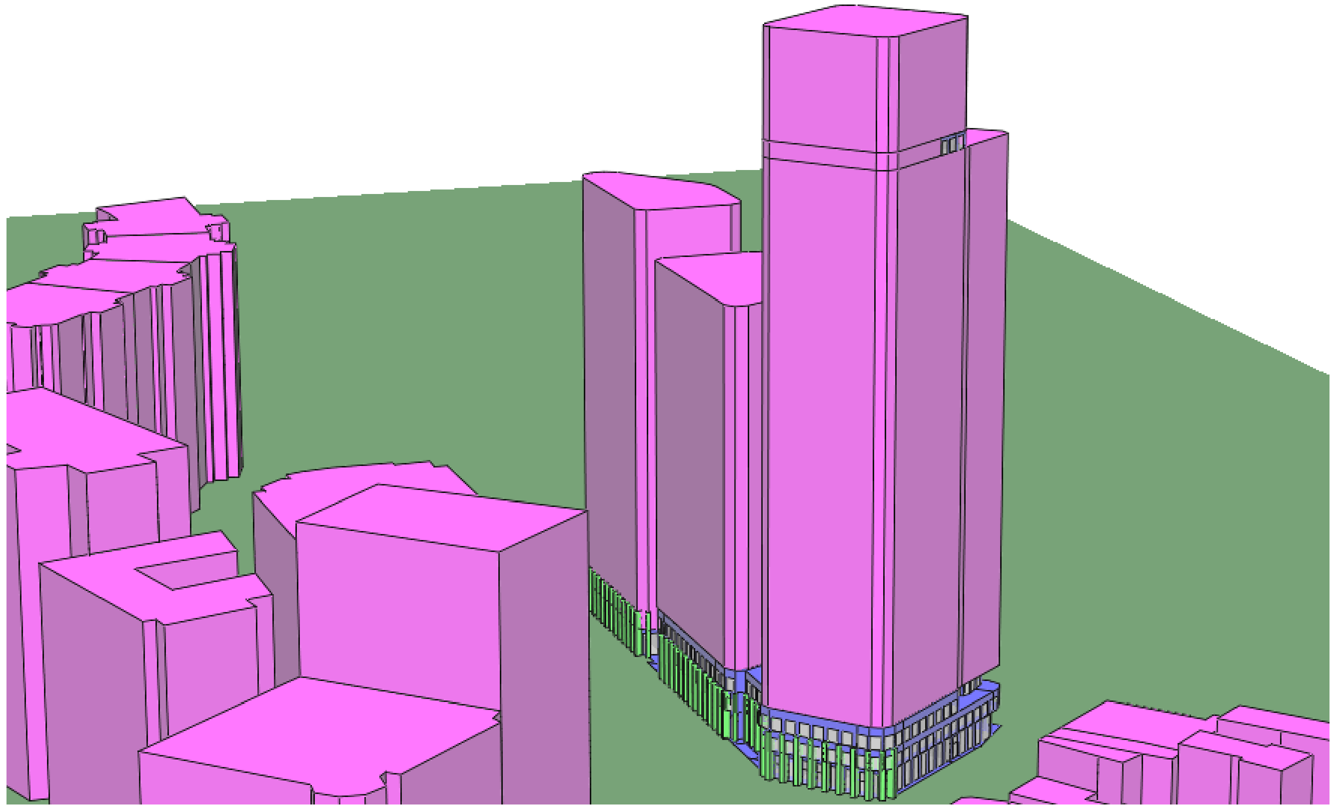


Figure 3 - 3D render of the IES model

2.4.2 EXTERNAL SHADING

Shading from building elements such as fins and columns has been included. This is based on the same architectural drawings by Squire & Partners. Shading from surrounding external buildings has also been included.

2.5 LIMITATIONS

Computer building simulation provides an estimate of building performance. This estimate is based on a necessarily simplified and idealised version of the building that does not and cannot fully represent all of the intricacies of the building once built. As a result, simulation results only represent an interpretation of the potential performance of the building. No guarantee or warrantee of building performance in practice can be based on simulation results alone.

2.6 BUILDING ENVELOPE

The building envelope is the first opportunity for a building to reduce the demand for energy consumption and consequential greenhouse gas emissions. The proposed design for the building is outlined below and has been included in the energy model.

2.6.1 AIR TIGHTNESS

Good air permeability of a building is required to achieve an air tightness of 10m^3/hr/m^2 @ 50Pa to comply with Building Regulations Part L2A Criterion 2. To improve the building's energy performance, it is intended that the proposed development will be designed and built to achieve an air tightness of 3 m^3/hr/m^2 @ 50Pa.

The above has been translated into air infiltration of 0.10 ach^{-1} for the whole building. The above conversion has been based on table 4.19 from CIBSE Guide A 2015.

2.6.2 FABRIC PERFORMANCE

Table 3 lists the façade performance which has been proposed.

Table 3 Building Fabric Performance

Element	Value
External wall U-Value (W/m^2-K)	0.13
Glazing U-Value (W/m^2-K)	1.20
Roof U-Value (W/m^2-K)	0.13
Ground Floor U-Value (W/m^2-K)	0.13
South glazing g-value	0.30
Other glazing g-value	0.40

3 RESULTS

For each step, the operational parameters are explained and the results are presented for each scenario. All of the detailed assumptions are included in Appendix A.

3.1 STEP 1: ESTABLISH FLOOR AREAS

The floor areas have been determined based on the Stage 2 architectural layouts. Each room has been categorised into different space types:

- Car parking
- Circulation
- Cycle store
- Welfare
- Office - Internal
- Office - Perimeter
- Plant
- Reception
- Retail
- Store
- WC

Each space type has then been allocated one of the following occupancy types:

- Office
- Retail
- Ancillary
- Reception

3.2 STEP 2: ESTABLISH OPERATING HOURS AND OCCUPANCY FACTORS

The Likely Scenario assumes an occupancy density of 8m^2/person in the office spaces. The Low End Scenario assumes a reduced occupancy density of 10m^2/person, whereas the High End and Worst Case Scenarios assume an increased occupancy density at 7m^2/person and 6m^2/person. Occupancies have been adjusted in a similar way for retail spaces, with 5m^2/person for the Likely Scenario.

Assumed occupancy densities for all space types are presented in Appendix A Step 2.

The Likely scenario assumes the following occupancy profiles, in line with the NABERS methodology:

Table 4 Occupancy profiles for the Likely scenario

Time Period	Office		Retail		Reception		Ancillary
	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekly
00:00-01:00	0%	0%	0%	0%	0%	0%	0%
01:00-02:00	0%	0%	0%	0%	0%	0%	0%
02:00-03:00	0%	0%	0%	0%	0%	0%	0%
03:00-04:00	0%	0%	0%	0%	0%	0%	0%
04:00-05:00	0%	0%	0%	0%	0%	0%	0%
05:00-06:00	0%	0%	0%	0%	0%	0%	0%
06:00-07:00	0%	0%	1%	1%	0%	0%	0%
07:00-08:00	10%	0%	3%	3%	30%	0%	0%
08:00-09:00	20%	5%	10%	9%	100%	0%	0%
09:00-10:00	70%	5%	18%	20%	50%	0%	0%
10:00-11:00	70%	5%	21%	27%	10%	0%	0%
11:00-12:00	70%	5%	25%	30%	10%	0%	0%
12:00-13:00	70%	5%	22%	26%	100%	0%	0%
13:00-14:00	70%	5%	20%	22%	50%	0%	0%
14:00-15:00	70%	5%	18%	18%	10%	0%	0%
15:00-16:00	70%	5%	17%	14%	10%	0%	0%
16:00-17:00	70%	5%	14%	10%	50%	0%	0%
17:00-18:00	70%	0%	8%	5%	100%	0%	0%
18:00-19:00	35%	0%	4%	3%	50%	0%	0%
19:00-20:00	10%	0%	2%	1%	0%	0%	0%
20:00-21:00	5%	0%	1%	0%	0%	0%	0%
21:00-22:00	0%	0%	0%	0%	0%	0%	0%
22:00-23:00	0%	0%	0%	0%	0%	0%	0%
23:00-24:00	0%	0%	0%	0%	0%	0%	0%

The Low End Scenario assumes the same occupancy hours as the Likely Scenario.

The High End Scenario increases the weekend use for office spaces.

The Worst Case Scenario further increases the weekend use for office spaces.

All occupancy profiles are presented in colour coded tables for each scenario and occupancy type in Appendix A Step 2.

3.3 STEP 3: LIGHTING

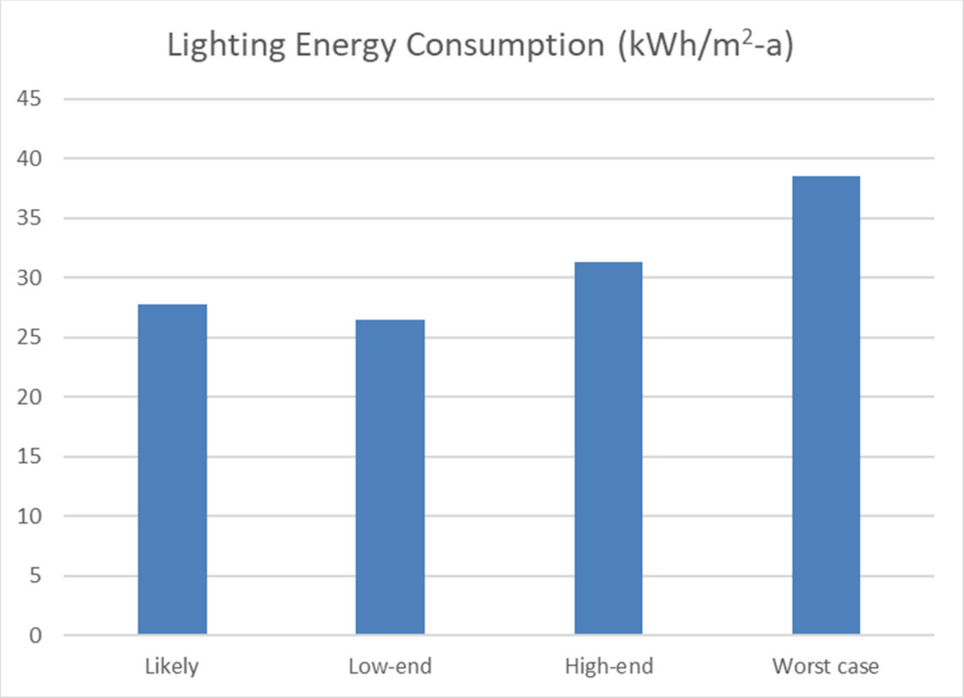
Lighting operating profiles are adjusted to follow occupancy as per NABERS guidance for the Likely scenario.

Lighting profiles are presented for each occupancy type in Appendix A Step 3.

The overnight and weekend general lighting consumption varies across different scenarios, from 5% to 20% for office spaces and from 15% to 50% for retail spaces.

The lighting annual energy consumption is presented in Figure 4.

Figure 4 - Lighting Annual Energy Consumption



3.4 STEP 4: LIFTS AND ESCALATORS

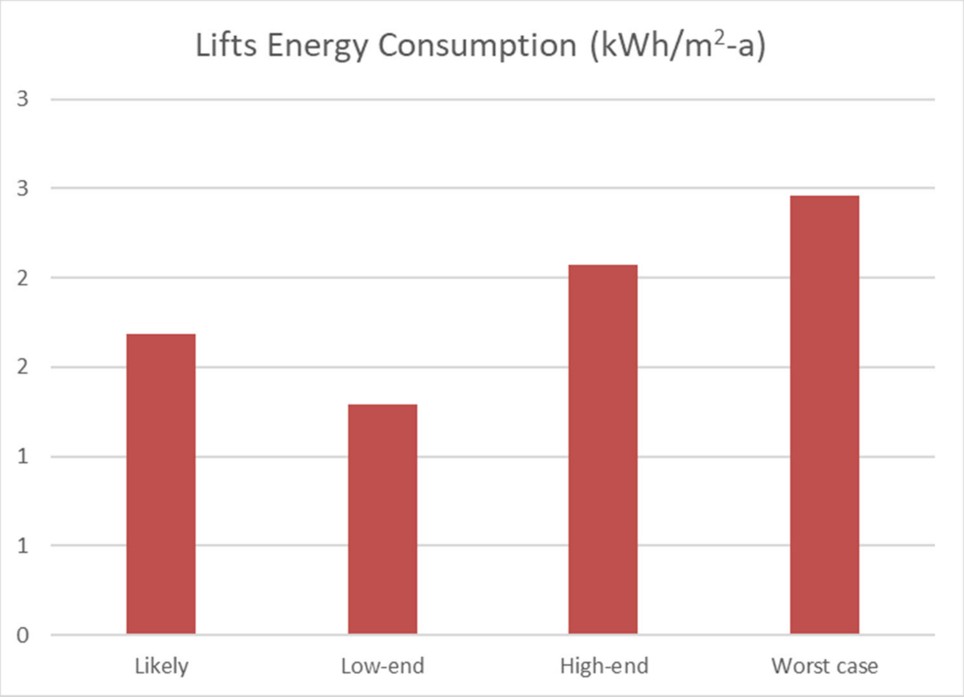
Lift energy consumption has been calculated based on the methodology presented within CIBSE Guide D: Transportation Systems in Buildings.

The number of lift starts per day for the Likely scenario is based on guidance within CIBSE Guide D for an office (750 lift starts per day).

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 in Figure 5.

Figure 5 - Lifts Annual Energy Consumption



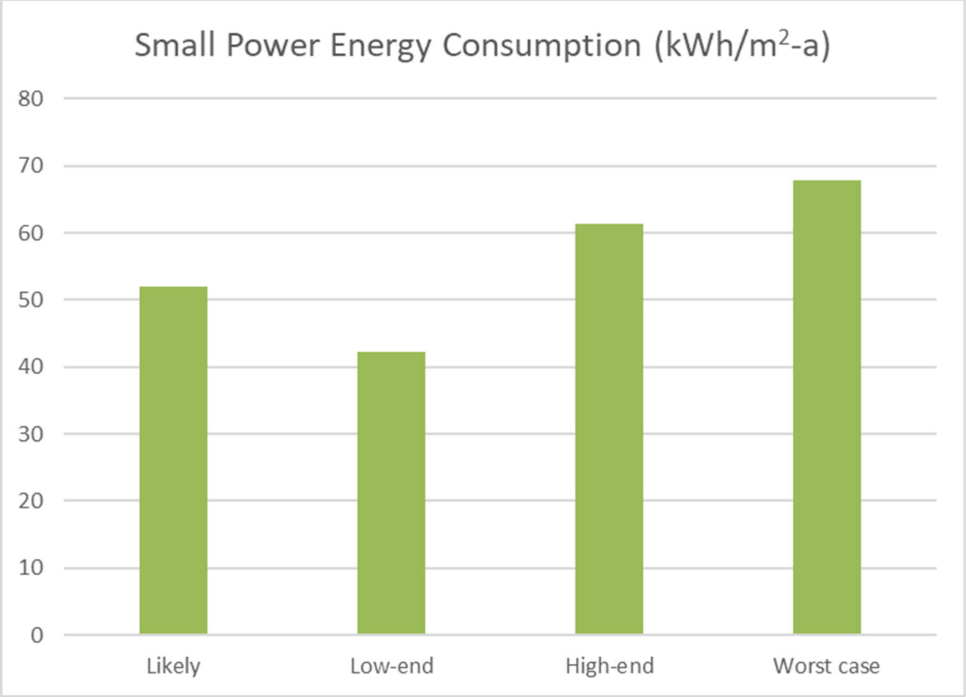
3.5 STEP 5: SMALL POWER

Small power loads for the office and retail areas have been assumed to be 25 W/m^2 and 5 W/m^2 respectively. (based on the MEP design).

The Likely scenario assumes 25% of small power equipment is left on during evenings and weekends. The Low End scenario assumes 10%, High End Scenario assumes 40% and the Worst Case scenario assumes 50%.

The small power annual energy consumption is presented in Figure 6.

Figure 6 - Small Power Annual Energy Consumption



3.6 STEP 6: CATERING

There is no catering in the building.

3.7 STEP 7: SERVER ROOMS

There are no server rooms in the building.

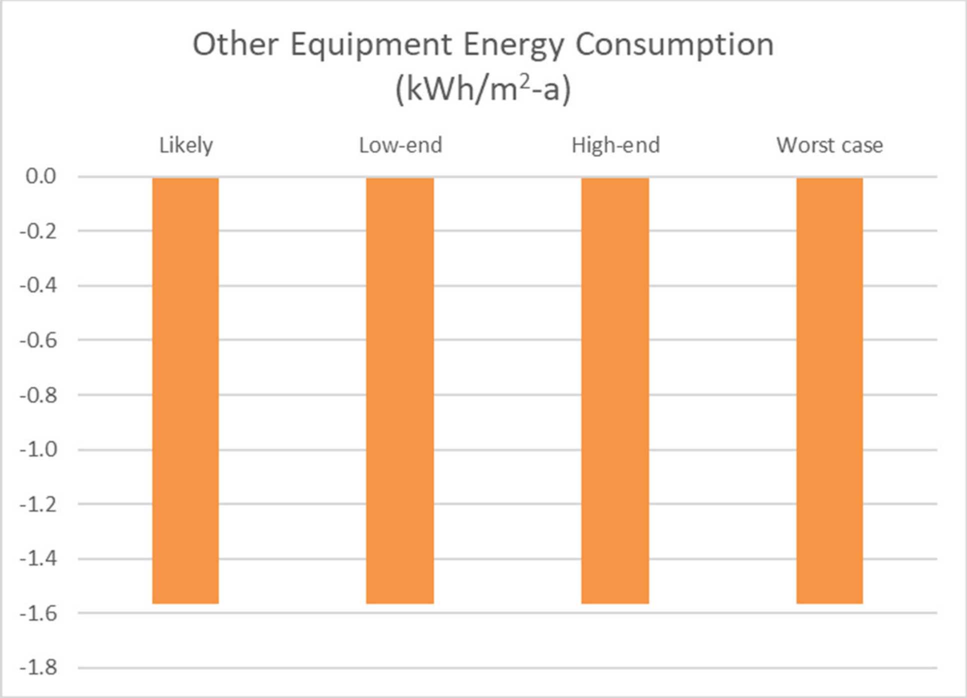
3.8 STEP 8: OTHER EQUIPMENT

No other equipment energy use has been accounted for.

There are photovoltaic panels included in the design. The energy yield for a typical year is expected to be 15,670 kWh. This is assumed to be used on site and has been applied as a reduction to the overall energy consumption values.

The other equipment reduction is presented in Figure 7.

Figure 7 – Other Equipment Annual Energy Consumption



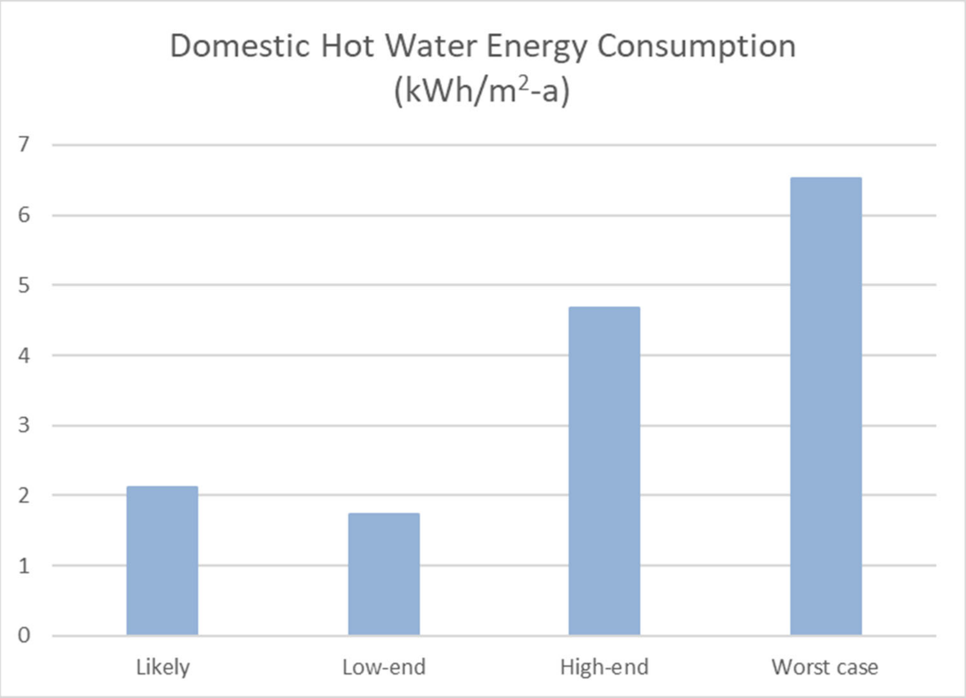
3.9 STEP 9: DOMESTIC HOT WATER

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 4 litres/person/day as per NABERS guidance for the office spaces. For retail a similar figure is established.

The domestic hot water annual energy consumption is presented in Figure 8.

Figure 8 - Domestic Hot Water Annual Energy Consumption



3.10 STEP 10: INTERNAL HEAT GAINS

Internal gains 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 loads have been undertaken using the above bespoke internal gains and profiles in a DSM (Dynamic Simulation Model).

Plant operation profiles have been assumed as per NABERS guidance for the office spaces. For retail, HVAC plant follows the occupancy profile.

Pump energy has been determined using the methodology used within NCM and allocated based on the below assumptions:

- LTHW pumping: $0.3W/m^2$
- LTHW & CHW pumping: $0.9W/m^2$

The heating annual energy consumption is presented in Figure 9.

The cooling annual energy consumption is presented in Figure 10.

The auxiliary annual energy consumption (fans and pumps) is presented in Figure 11.

Figure 9 - Heating Annual Energy Consumption

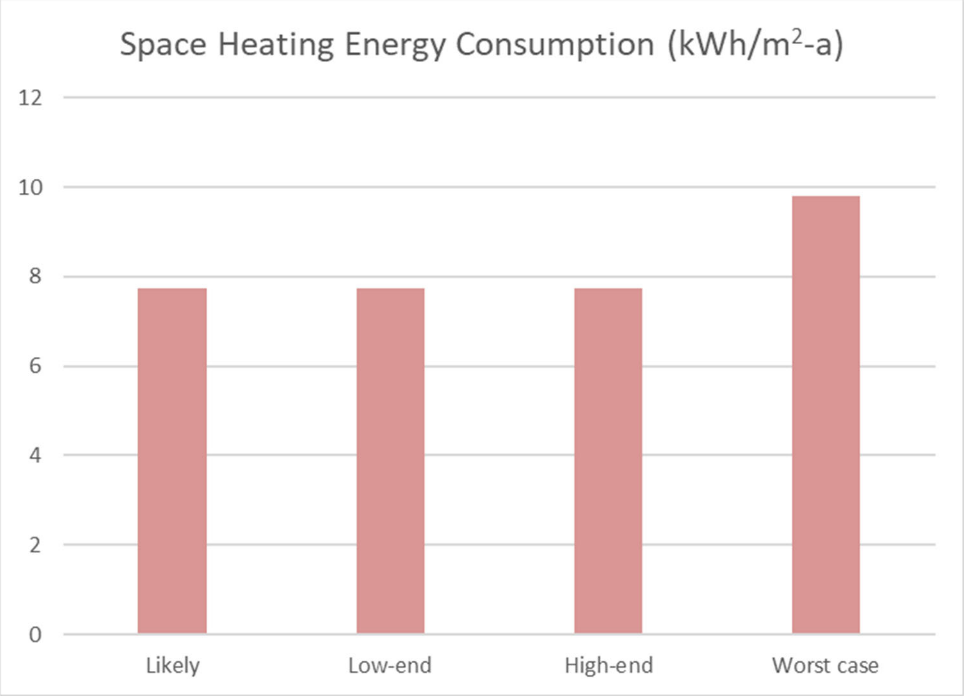


Figure 10 - Cooling Annual Energy Consumption

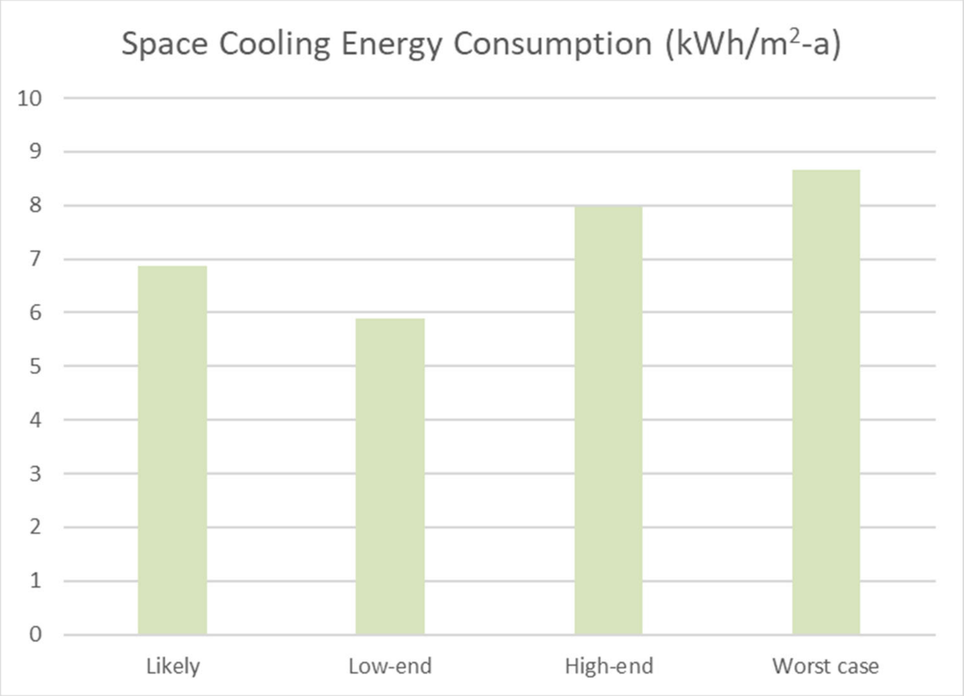
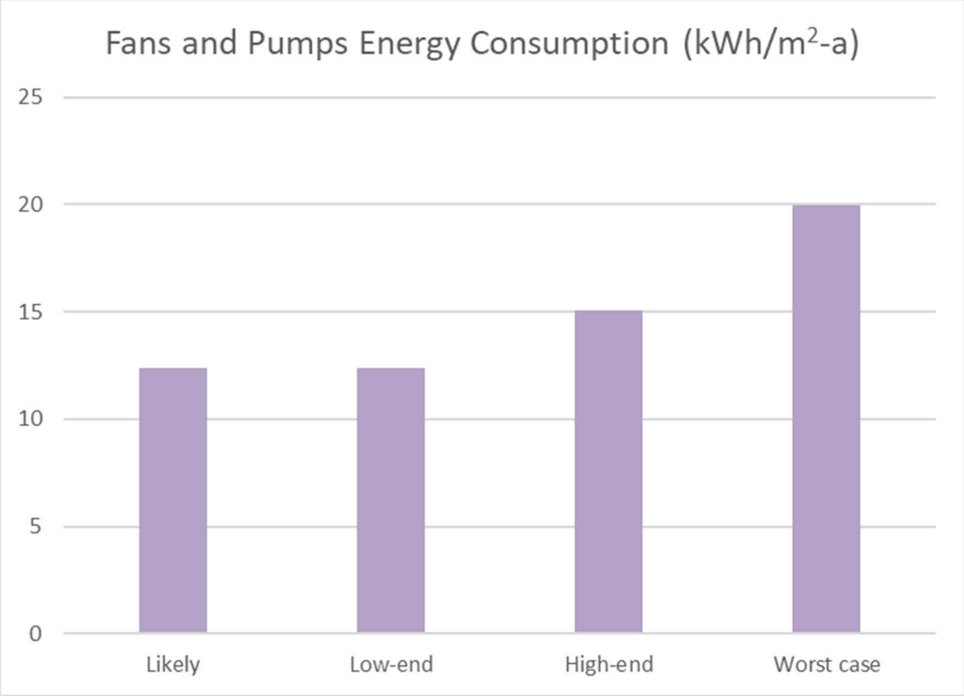


Figure 11 – Fans and Pumps Annual Energy Consumption



3.12 STEP 12: HUMIDIFICATION & DEHUMIDIFICATION

No humidification or dehumidification energy has been accounted for.

4 COMPARISON WITH BENCHMARKS

Comparing this to CIBSE Energy Benchmarks* (CIBSE Guide F: 2012) shows that if the building is operated as anticipated (Likely scenario):

- Total Energy: 73% below Typical and 52% below Good Practice

*Energy Benchmarks based on Offices – air conditioned, standard

Electricity: Typical Practice 226kWh/m^2/annum, Good Practice 128kWh/m^2/annum. Fossil Fuels: Typical Practice 178kWh/m^2/annum, Good Practice 97kWh/m^2/annum

However, if the hours of use of the building are higher than anticipated and the use of the domestic hot water and lifts is higher (High End Scenario):

- Total Energy: 68% below Typical and 43% below Good Practice

If the hours of use of the building are much higher than anticipated and the use of the domestic hot water and lifts is much higher (Worst Case Scenario):

- Total Energy: 62% below Typical and 32% below Good Practice

Figure 12 Comparison of annual energy consumption

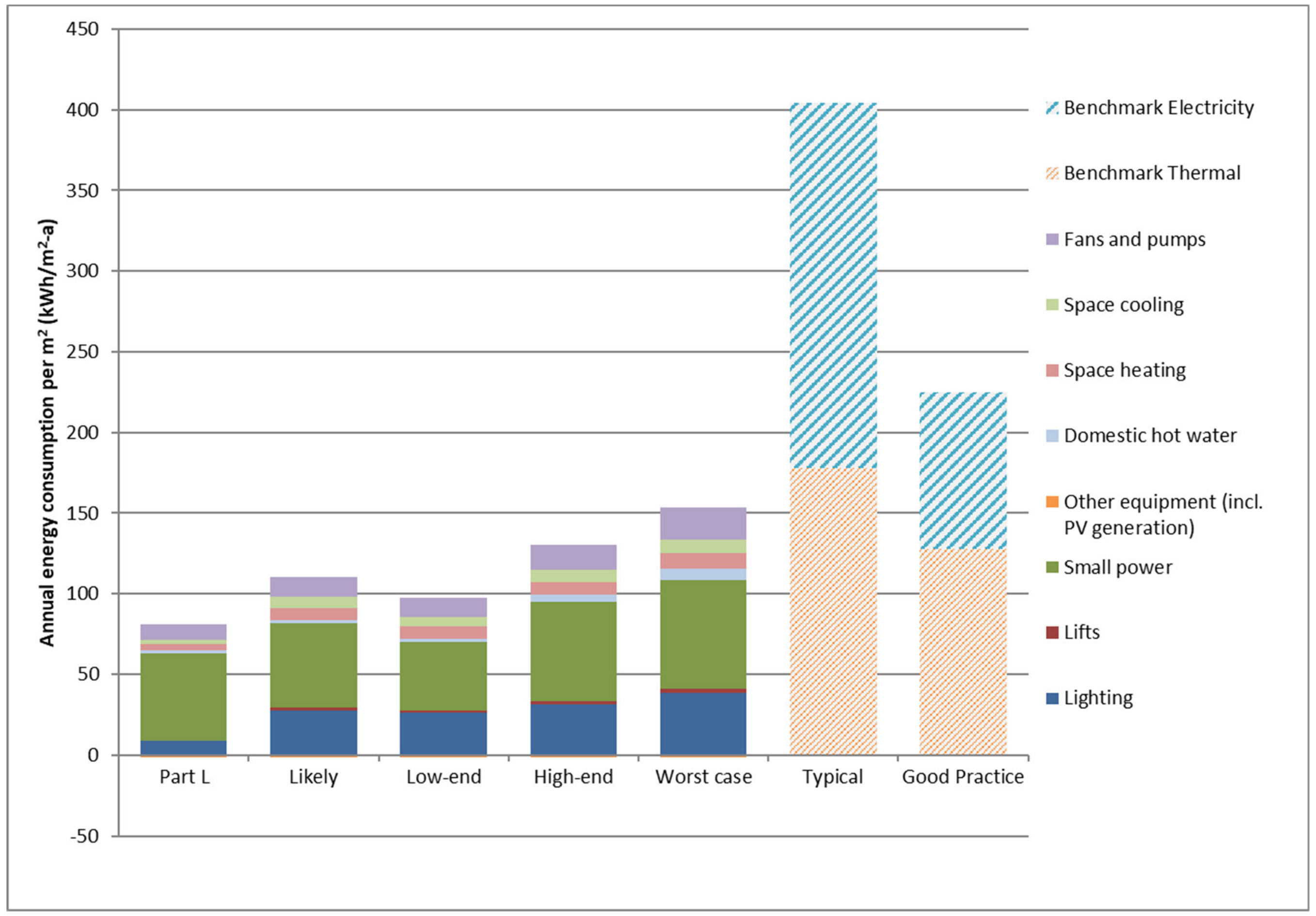


Table 5 Comparison of total annual energy consumption

	LIKELY	LOW END	HIGH END	WORST CASE
Total Energy Consumption (kWh/m^2)	108.9	96.1	128.7	152.2
% Improvement against Typical	73%	76%	68%	62%
% Improvement against Good Practice	52%	57%	43%	32%

Table 6 Annual energy consumption by end use

End Use (kWh/m^2)	Part L	LIKELY	LOW END	HIGH END	WORST CASE
Lighting	9.0	27.8	26.5	31.3	38.5
Lifts	0.0	1.7	1.3	2.1	2.5
Small power	53.7	51.9	42.2	61.4	67.8
Other equipment (incl. PV generation)	-1.6	-1.6	-1.6	-1.6	-1.6
Domestic hot water	2.1	2.1	1.7	4.7	6.5
Space heating	4.1	7.7	7.7	7.8	9.8
Space cooling	2.4	6.9	5.9	8.0	8.7
Fans and pumps	9.5	12.4	12.4	15.1	20.0
Total Energy Consumption	**79.1**	**108.9**	**96.1**	**128.7**	**152.2**

5 DISPLAY ENERGY CERTIFICATE (DEC)

Although a Display Energy Certificate (DEC) may not be required for this building, it is still a good indication of the operational performance of a building.

The results from the CIBSE TM54 analysis have also been used to predict the Display Energy Certificate (DEC) Rating that would be achieved (see Figure 13).

It is likely that the building will achieve a DEC B Rating. It also has to be noted that higher occupancy and operation of the building could result in the building achieving a DEC C Rating.

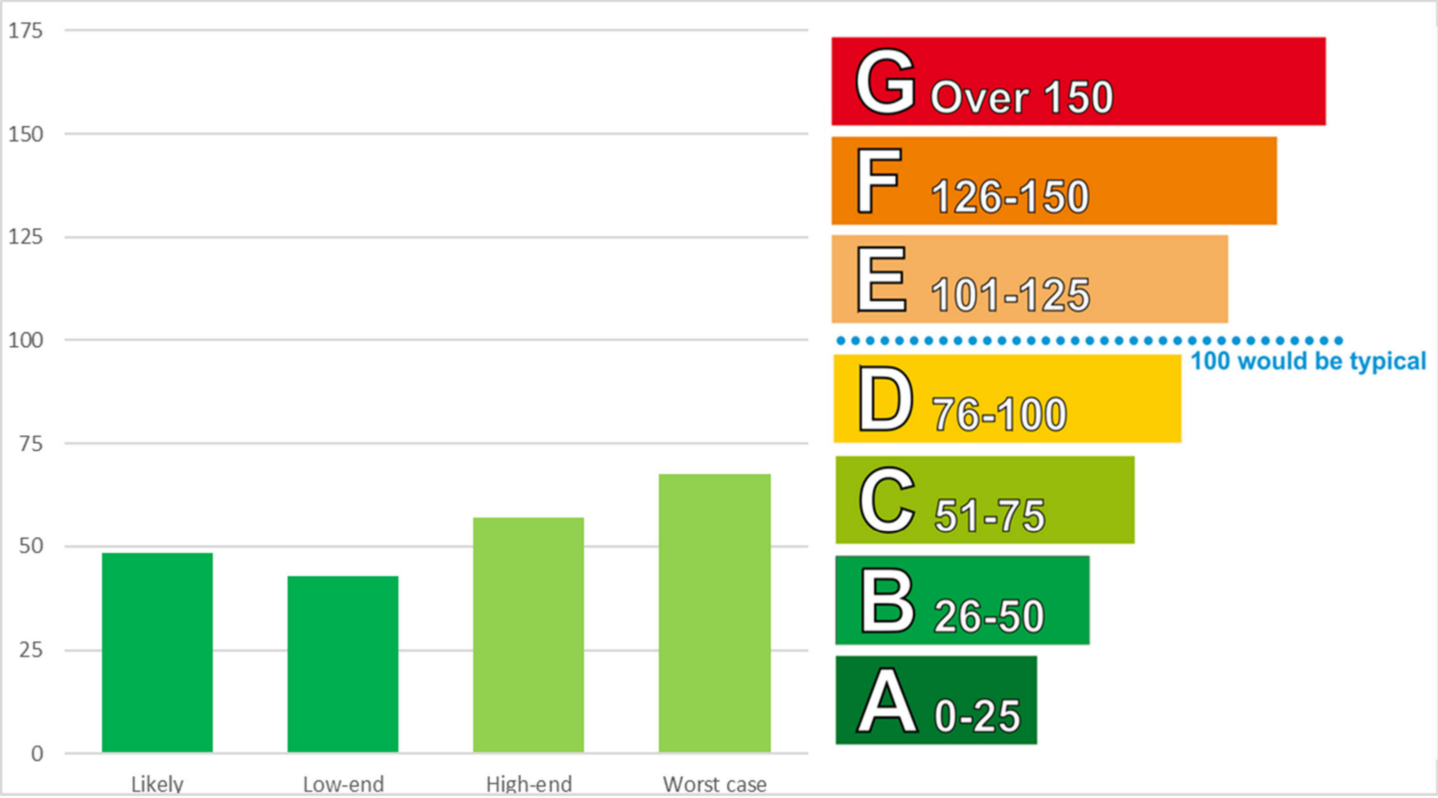


Figure 13 Predicted DEC Ratings

6 CARBON DIOXIDE EMISSIONS

In the following section carbon dioxide emissions are calculated for each scenario as a result of the energy consumption (including energy generation).

The total annual energy consumption by fuel type and end use is presented in Table 7 and the annual energy intensity is presented in Table 8.

Carbon factors for the Communal Heating network were generated with a bespoke calculation accounting for the building loads, storage/distribution losses and CHP power generation.

Using the SAP 2012 carbon factors (0.519kg.CO_2kWh for electricity and 0.216kg.CO_2.kWh for gas), the annual total carbon emissions by fuel type and end use is presented in Table 9 and the annual carbon intensity is presented in Table 10. The Communal Heating carbon factor was calculated at 0.155 kg.CO_2kWh.

Using the SAP 10.0 carbon factors (0.233kg.CO_2.kWh for electricity and 0.210kg.CO_2.kWh for gas), the annual total carbon emissions by fuel type and end use is presented in Table 11 and the total carbon intensity is presented in Table 12. The Communal Heating carbon factor was calculated at 0.284 kg.CO_2kWh.

Table 7 Comparison of Annual Energy Consumption

Consumption in MWh	LIKELY	LOW END	HIGH END	WORST CASE
Lighting	278	265	314	385
Lifts	17	13	21	25
Small power	519	422	615	679
Other equipment (incl. PV generation)	-16	-16	-16	-16
Domestic hot water	21	17	47	65
Space heating	77	78	78	98
Space cooling	69	59	80	87
Fans and pumps	124	124	151	200
	-	-	-	-
Total Electricity Consumption	**1060**	**931**	**1254**	**1480**
Total Thermal (Communal Heating) Consumption	**29**	**31**	**34**	**43**
Total Energy Consumption	**1090**	**962**	**1288**	**1523**

Table 8 Comparison of Annual Energy Intensity (including LZC)

Consumption in kWh/m^2	LIKELY	LOW END	HIGH END	WORST CASE
Total Electricity Intensity (kWh/m^2)	**106.0**	**93.0**	**125.3**	**147.9**
Total Thermal (Communal Heating) Intensity (kWh/m^2)	**2.9**	**3.1**	**3.4**	**4.3**
Total Energy Intensity (kWh/m^2)	**108.9**	**96.1**	**128.7**	**152.2**

Table 9 Comparison of Annual Carbon Dioxide Emissions – SAP 2012 factors

Carbon Dioxide Emissions in tonnes CO_2	LIKELY	LOW END	HIGH END	WORST CASE
Lighting	144	137	163	200
Lifts	9	7	11	13
Small power	270	219	319	352
Other equipment (incl. PV generation)	-8	-8	-8	-8
Domestic hot water	11	9	24	34
Space heating	29	29	28	35
Space cooling	36	31	41	45
Fans and pumps	64	64	78	104
	-	-	-	-
Total Electricity Carbon Emissions	**550**	**483**	**651**	**768**
Total Thermal (Communal Heating) Carbon Emissions	**5**	**5**	**5**	**7**
Total Carbon Emissions	**555**	**488**	**656**	**775**

Table 11 Comparison of Annual Carbon Dioxide Emissions – SAP 10.0 factors

Carbon Dioxide Emissions in tonnes CO_2	LIKELY	LOW END	HIGH END	WORST CASE
Lighting	65	62	73	90
Lifts	4	3	5	6
Small power	121	98	143	158
Other equipment (incl. PV generation)	-4	-4	-4	-4
Domestic hot water	5	4	11	15
Space heating	20	20	20	25
Space cooling	16	14	19	20
Fans and pumps	29	29	35	47
	-	-	-	-
Total Electricity Carbon Emissions	**247**	**217**	**292**	**345**
Total Thermal (Communal Heating) Carbon Emissions	**8**	**9**	**10**	**12**
Total Carbon Emissions	**255**	**226**	**302**	**357**

Table 10 Comparison of Annual Carbon Intensity – SAP 2012 factors

Carbon Intensity in $kgCO_2/m^2$	LIKELY	LOW END	HIGH END	WORST CASE
Total Electricity Carbon Intensity	**55.0**	**48.3**	**65.0**	**76.8**
Total Thermal (Communal Heating) Carbon Intensity	**0.5**	**0.5**	**0.5**	**0.7**
Total Carbon Intensity	**55.5**	**48.8**	**65.6**	**77.4**

Table 12 Comparison of Annual Carbon Intensity – SAP 10.0 factors

Carbon Intensity in $kgCO_2/m^2$	LIKELY	LOW END	HIGH END	WORST CASE
Total Electricity Carbon Intensity	**24.7**	**21.7**	**29.2**	**34.5**
Total Thermal (Communal Heating) Carbon Intensity	**0.8**	**0.9**	**1.0**	**1.2**
Total Carbon Intensity	**25.5**	**22.6**	**30.2**	**35.7**

7 ‘BE SEEN’ REPORTING SPREADSHEET INPUTS

Aligning with the above analysis and the Energy Strategy, the following values were input in the ‘Be Seen’ reporting spreadsheet:

Non-Residential Elements of the development (Part L Calculation)

- Annual Electricity Use: 783,890 kWh/yr
- Annual District Htg Use: 23,181 kWh/yr
- Elec Generation, Gross: 15,661 kWh/yr
- Predicted Annual Carbon Emissions: 399 tCO_2/yr

Non-Residential Elements of the development (TM54 Calculation)

- Annual Electricity Use: 1,060,000 kWh/yr
- Annual District Htg Use: 29,000 kWh/yr
- Elec Generation, Gross: 15,661 kWh/yr
- Predicted Annual Carbon Emissions: 550 tCO_2/yr

8 CONCLUSIONS

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 low occupancy and good operation (Likely or Low End Scenarios) the building will consume significantly less than Good Practice benchmarks, however if the building has high occupancy and unmanaged operation (Worst Case Scenario) the building will still perform better than Good Practice benchmarks, but with an energy increase of approx. 40%.

Appendix A

ASSUMPTIONS

STEP 2: ESTABLISHING OPERATING HOURS AND OCCUPANCY FACTORS

DESIGN

Table 13 Occupancy Design Data – Likely & Low End

Space Type (MEP Profile)	Occupancy Type	Heated area (m^2)	Likely		Low End	
			Occupancy Density (m^2/person)	Peak Occupancy	Occupancy Density (m^2/person)	Peak Occupancy
Car parking	Ancillary	1125.9	-	-	-	-
Circulation	Office	921.9	-	-	-	-
Cycle store	Ancillary	746.4	-	-	-	-
Welfare	Office	109.2	8.0	14	10.0	11
Office - Internal	Office	1201.4	8.0	150	10.0	120
Office - Perimeter	Office	3265.7	8.0	408	10.0	327
Plant	Ancillary	1061.2	-	-	-	-
Reception	Reception	406.6	8.0	51	10.0	51
Retail	Retail	916	5.0	183	6.0	183
Store	Ancillary	7	-	-	-	-
WC	Ancillary	244.7	-	-	-	-
Total		**10006.0**		**806**		**692**

Table 14 Occupancy Design Data – Likely & Low End

Space Type (MEP Profile)	Occupancy Type	Heated area (m^2)	High End		Worst Case	
			Occupancy Density (m^2/person)	Peak Occupancy	Occupancy Density (m^2/person)	Peak Occupancy
Car parking	Ancillary	1125.9	-	-	-	-
Circulation	Office	921.9	-	-	-	-
Cycle store	Ancillary	746.4	-	-	-	-
Welfare	Office	109.2	7.0	16	6.0	18
Office - Internal	Office	1201.4	7.0	172	6.0	200
Office - Perimeter	Office	3265.7	7.0	467	6.0	544
Plant	Ancillary	1061.2	-	-	-	-
Reception	Reception	406.6	7.0	58	6.0	68
Retail	Retail	916	4.0	229	4.0	229
Store	Ancillary	7	-	-	-	-
WC	Ancillary	244.7	-	-	-	-
Total		**10006.0**		**941**		**1059**

OPERATIONAL

Table 15 Occupancy Holiday Data

Occupancy Type	Holiday 1		Holiday 2		Holiday 3		Weeks/ Year
	Start	End	Start	End	Start	End	
Office	51	52					1
Retail	51	52					1
Ancillary	51	52					1
Reception	51	52					1

Table 16 Occupancy – Office and Retail

	Office				Retail			
	Mon-Fri	Sat	Sun	Hol	Mon-Fri	Sat	Sun	Hol
00:00	0%	0%	0%	0%	0%	0%	0%	0%
01:00	0%	0%	0%	0%	0%	0%	0%	0%
02:00	0%	0%	0%	0%	0%	0%	0%	0%
03:00	0%	0%	0%	0%	0%	0%	0%	0%
04:00	0%	0%	0%	0%	0%	0%	0%	0%
05:00	0%	0%	0%	0%	0%	0%	0%	0%
06:00	0%	0%	0%	0%	1%	1%	1%	1%
07:00	10%	0%	0%	0%	3%	3%	2%	3%
08:00	20%	5%	5%	5%	10%	9%	5%	9%
09:00	70%	5%	5%	5%	18%	20%	13%	20%
10:00	70%	5%	5%	5%	21%	27%	20%	27%
11:00	70%	5%	5%	5%	25%	30%	21%	30%
12:00	70%	5%	5%	5%	22%	26%	18%	26%
13:00	70%	5%	5%	5%	20%	22%	16%	22%
14:00	70%	5%	5%	5%	18%	18%	13%	18%
15:00	70%	5%	5%	5%	17%	14%	10%	14%
16:00	70%	5%	5%	5%	14%	10%	6%	10%
17:00	70%	0%	0%	0%	8%	5%	4%	5%
18:00	35%	0%	0%	0%	4%	3%	2%	3%
19:00	10%	0%	0%	0%	2%	1%	1%	1%
20:00	5%	0%	0%	0%	1%	0%	0%	0%
21:00	0%	0%	0%	0%	0%	0%	0%	0%
22:00	0%	0%	0%	0%	0%	0%	0%	0%
23:00	0%	0%	0%	0%	0%	0%	0%	0%

Table 17 Occupancy – Ancillary and Reception

	Ancillary				Reception			
	Mon-Fri	Sat	Sun	Hol	Mon-Fri	Sat	Sun	Hol
00:00	0%	0%	0%	0%	0%	0%	0%	0%
01:00	0%	0%	0%	0%	0%	0%	0%	0%
02:00	0%	0%	0%	0%	0%	0%	0%	0%
03:00	0%	0%	0%	0%	0%	0%	0%	0%
04:00	0%	0%	0%	0%	0%	0%	0%	0%
05:00	0%	0%	0%	0%	0%	0%	0%	0%
06:00	0%	0%	0%	0%	0%	0%	0%	0%
07:00	0%	0%	0%	0%	30%	0%	0%	0%
08:00	0%	0%	0%	0%	100%	0%	0%	0%
09:00	0%	0%	0%	0%	50%	0%	0%	0%
10:00	0%	0%	0%	0%	10%	0%	0%	0%
11:00	0%	0%	0%	0%	10%	0%	0%	0%
12:00	0%	0%	0%	0%	100%	0%	0%	0%
13:00	0%	0%	0%	0%	50%	0%	0%	0%
14:00	0%	0%	0%	0%	10%	0%	0%	0%
15:00	0%	0%	0%	0%	10%	0%	0%	0%
16:00	0%	0%	0%	0%	50%	0%	0%	0%
17:00	0%	0%	0%	0%	100%	0%	0%	0%
18:00	0%	0%	0%	0%	50%	0%	0%	0%
19:00	0%	0%	0%	0%	0%	0%	0%	0%
20:00	0%	0%	0%	0%	0%	0%	0%	0%
21:00	0%	0%	0%	0%	0%	0%	0%	0%
22:00	0%	0%	0%	0%	0%	0%	0%	0%
23:00	0%	0%	0%	0%	0%	0%	0%	0%

STEP 3: LIGHTING

DESIGN

Table 18 Lighting Design Data

Space Type (MEP Profile)	Lighting Power Density (W/m^2)	Constant Illuminance Control	Occupancy Sensing	Area Daylit (%)
Car parking	2	No	Auto On / Auto Off	0%
Circulation	2	No	Auto On / Auto Off	0%
Cycle store	2	No	Auto On / Auto Off	0%
Welfare	6	No	Auto On / Auto Off	0%
Office - Internal	8	No	Auto On / Auto Off	0%
Office - Perimeter	8	No	Auto On / Auto Off	100%
Plant	4	No	Manual	0%
Reception	4	No	Auto On / Auto Off	0%
Retail	25	No	Auto On / Auto Off	100%
Store	2	No	Auto On / Auto Off	0%
WC	4	No	Auto On / Auto Off	0%

Table 19 Lighting Parasitic Power Design Data

Space Type (MEP Profile)	Parasitic Power Density (W/m^2)	
	Lighting control	Emergency
Car parking	0.1	0.1
Circulation	0.1	0.1
Cycle store	0.1	0.1
Welfare	0.1	0.1
Office - Internal	0.1	0.1
Office - Perimeter	0.1	0.1
Plant	0.1	0.1
Reception	0.1	0.1
Retail	0.1	0.1
Store	0.1	0.1
WC	0.1	0.1

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Table 20 Lighting – Operational factors

Space Type (MEP Profile)	Management Factor	Overnight Retail Lighting Consumption	Overnight General Lighting Consumption
Likely	1.05	15%	5%
Low End	1.00	15%	5%
High End	1.10	30%	10%
Worst Case	1.20	50%	20%

Table 21 Likely Lighting – Office and Retail

	Office				Retail			
	Mon-Fri	Sat	Sun	Hol	Mon-Fri	Sat	Sun	Hol
00:00	5%	5%	5%	5%	15%	15%	15%	15%
01:00	5%	5%	5%	5%	15%	15%	15%	15%
02:00	5%	5%	5%	5%	15%	15%	15%	15%
03:00	5%	5%	5%	5%	15%	15%	15%	15%
04:00	5%	5%	5%	5%	15%	15%	15%	15%
05:00	5%	5%	5%	5%	15%	15%	15%	15%
06:00	5%	5%	5%	5%	75%	75%	75%	75%
07:00	30%	5%	5%	5%	100%	100%	100%	100%
08:00	75%	15%	15%	15%	100%	100%	100%	100%
09:00	100%	15%	15%	15%	100%	100%	100%	100%
10:00	100%	15%	15%	15%	100%	100%	100%	100%
11:00	100%	15%	15%	15%	100%	100%	100%	100%
12:00	100%	15%	15%	15%	100%	100%	100%	100%
13:00	100%	15%	15%	15%	100%	100%	100%	100%
14:00	100%	15%	15%	15%	100%	100%	100%	100%
15:00	100%	15%	15%	15%	100%	100%	100%	100%
16:00	100%	15%	15%	15%	100%	100%	100%	100%
17:00	75%	5%	5%	5%	100%	100%	100%	100%
18:00	25%	5%	5%	5%	100%	100%	100%	100%
19:00	15%	5%	5%	5%	75%	75%	75%	75%
20:00	15%	5%	5%	5%	15%	15%	15%	15%
21:00	5%	5%	5%	5%	15%	15%	15%	15%
22:00	5%	5%	5%	5%	15%	15%	15%	15%
23:00	5%	5%	5%	5%	15%	15%	15%	15%

Table 22 Likely Lighting – Ancillary and Reception

	Ancillary				Reception			
	Mon-Fri	Sat	Sun	Hol	Mon-Fri	Sat	Sun	Hol
00:00	5%	5%	5%	5%	5%	5%	5%	5%
01:00	5%	5%	5%	5%	5%	5%	5%	5%
02:00	5%	5%	5%	5%	5%	5%	5%	5%
03:00	5%	5%	5%	5%	5%	5%	5%	5%
04:00	5%	5%	5%	5%	5%	5%	5%	5%
05:00	5%	5%	5%	5%	5%	5%	5%	5%
06:00	5%	5%	5%	5%	5%	5%	5%	5%
07:00	30%	5%	5%	5%	30%	5%	5%	5%
08:00	75%	15%	15%	15%	75%	15%	15%	15%
09:00	100%	15%	15%	15%	100%	15%	15%	15%
10:00	100%	15%	15%	15%	100%	15%	15%	15%
11:00	100%	15%	15%	15%	100%	15%	15%	15%
12:00	100%	15%	15%	15%	100%	15%	15%	15%
13:00	100%	15%	15%	15%	100%	15%	15%	15%
14:00	100%	15%	15%	15%	100%	15%	15%	15%
15:00	100%	15%	15%	15%	100%	15%	15%	15%
16:00	100%	15%	15%	15%	100%	15%	15%	15%
17:00	75%	5%	5%	5%	75%	5%	5%	5%
18:00	25%	5%	5%	5%	25%	5%	5%	5%
19:00	15%	5%	5%	5%	15%	5%	5%	5%
20:00	15%	5%	5%	5%	15%	5%	5%	5%
21:00	5%	5%	5%	5%	5%	5%	5%	5%
22:00	5%	5%	5%	5%	5%	5%	5%	5%
23:00	5%	5%	5%	5%	5%	5%	5%	5%

STEP 4: LIFTS AND ESCALATORS

DESIGN

Table 23 Lift Design Data

Description	Rating of the Motor (kW)	Travel Height (m)	Speed (m/s)	Standby Energy Consumption (kWh/annum)
B1 I	10	5.5	1	100
B1 I	10	5.5	1	100
B1 I Cycle	10	5.5	1	100
B1 I NW	10	5.5	1	100
B1 J	10	15.2	1	100
B1 J	10	15.2	1	100
B1 J Cycle	10	11	1	100
B1 K	10	15.2	1	100
B1 K	10	15.2	1	100
B1 K	10	15.2	1	100
B1 K Cycle	10	5.5	1	100
B1 K Cycle	10	5.5	1	100

OPERATIONAL

Table 24 Lift Operational Assumptions – Likely and Low End

Description	Number of Starts per Day							
	Likely				Low End			
	Mon-Fri	Sat	Sun	Holiday	Mon-Fri	Sat	Sun	Holiday
All lifts	750	0	0	0	562.5	0	0	0

Table 25 Lift Operational Assumptions – High End and Worst Case

Description	Number of Starts per Day							
	High End				Worst Case			
	Mon-Fri	Sat	Sun	Holiday	Mon-Fri	Sat	Sun	Holiday
All lifts	937.5	0	0	0	1125	0	0	0

STEP 5: EVALUATING ENERGY USE FOR SMALL POWER

DESIGN

Table 26 Small Power Design Data

Space Type (MEP Profile)	Small Power Density (W/m^2)	Source
Car parking	-	-
Circulation	-	-
Cycle store	-	-
Welfare	5	MEP design info
Office - Internal	25	MEP design info
Office - Perimeter	25	MEP design info
Plant	-	-
Reception	5	MEP design info
Retail	5	MEP design info
Store	-	-
WC	-	-

OPERATIONAL

Table 27 Small Power – Operational factors

Space Type (MEP Profile)	Overnight power consumption as fraction of rated power (%)			
	Likely	Low End	High End	Worst Case
Car parking	-	-	-	-
Circulation	-	-	-	-
Cycle store	-	-	-	-
Welfare	25%	10%	40%	50%
Office - Internal	25%	10%	40%	50%
Office - Perimeter	25%	10%	40%	50%
Plant	-	-	-	-
Reception	25%	10%	40%	50%
Retail	50%	30%	60%	70%
Store	-	-	-	-
WC	-	-	-	-

Table 28 Likely Small Power – Office and Retail

	Office				Retail			
	Mon-Fri	Sat	Sun	Hol	Mon-Fri	Sat	Sun	Hol
00:00	25%	25%	25%	25%	25%	25%	25%	25%
01:00	25%	25%	25%	25%	25%	25%	25%	25%
02:00	25%	25%	25%	25%	25%	25%	25%	25%
03:00	25%	25%	25%	25%	25%	25%	25%	25%
04:00	25%	25%	25%	25%	25%	25%	25%	25%
05:00	25%	25%	25%	25%	25%	25%	25%	25%
06:00	25%	25%	25%	25%	25%	25%	25%	25%
07:00	65%	25%	25%	25%	65%	25%	25%	25%
08:00	80%	25%	25%	25%	80%	25%	25%	25%
09:00	100%	25%	25%	25%	100%	25%	25%	25%
10:00	100%	25%	25%	25%	100%	25%	25%	25%
11:00	100%	25%	25%	25%	100%	25%	25%	25%
12:00	100%	25%	25%	25%	100%	25%	25%	25%
13:00	100%	25%	25%	25%	100%	25%	25%	25%
14:00	100%	25%	25%	25%	100%	25%	25%	25%
15:00	100%	25%	25%	25%	100%	25%	25%	25%
16:00	100%	25%	25%	25%	100%	25%	25%	25%
17:00	80%	25%	25%	25%	80%	25%	25%	25%
18:00	65%	25%	25%	25%	65%	25%	25%	25%
19:00	55%	25%	25%	25%	55%	25%	25%	25%
20:00	25%	25%	25%	25%	25%	25%	25%	25%
21:00	25%	25%	25%	25%	25%	25%	25%	25%
22:00	25%	25%	25%	25%	25%	25%	25%	25%
23:00	25%	25%	25%	25%	25%	25%	25%	25%

Table 29 Likely Small Power – Ancillary and Reception

	Ancillary				Reception			
	Mon-Fri	Sat	Sun	Hol	Mon-Fri	Sat	Sun	Hol
00:00	0%	0%	0%	0%	25%	25%	25%	25%
01:00	0%	0%	0%	0%	25%	25%	25%	25%
02:00	0%	0%	0%	0%	25%	25%	25%	25%
03:00	0%	0%	0%	0%	25%	25%	25%	25%
04:00	0%	0%	0%	0%	25%	25%	25%	25%
05:00	0%	0%	0%	0%	25%	25%	25%	25%
06:00	0%	0%	0%	0%	25%	25%	25%	25%
07:00	0%	0%	0%	0%	65%	25%	25%	25%
08:00	0%	0%	0%	0%	80%	25%	25%	25%
09:00	0%	0%	0%	0%	100%	25%	25%	25%
10:00	0%	0%	0%	0%	100%	25%	25%	25%
11:00	0%	0%	0%	0%	100%	25%	25%	25%
12:00	0%	0%	0%	0%	100%	25%	25%	25%
13:00	0%	0%	0%	0%	100%	25%	25%	25%
14:00	0%	0%	0%	0%	100%	25%	25%	25%
15:00	0%	0%	0%	0%	100%	25%	25%	25%
16:00	0%	0%	0%	0%	100%	25%	25%	25%
17:00	0%	0%	0%	0%	80%	25%	25%	25%
18:00	0%	0%	0%	0%	65%	25%	25%	25%
19:00	0%	0%	0%	0%	55%	25%	25%	25%
20:00	0%	0%	0%	0%	25%	25%	25%	25%
21:00	0%	0%	0%	0%	25%	25%	25%	25%
22:00	0%	0%	0%	0%	25%	25%	25%	25%
23:00	0%	0%	0%	0%	25%	25%	25%	25%

STEP 6: CATERING

No catering has been included within the analysis.

STEP 7: SERVER ROOMS

No server rooms have been included within the analysis.

STEP 8: OTHER EQUIPMENT

There are photovoltaic panels included in the design. The expected energy yield for a typical year is expected to be 15,700 kWh or 1.57 kWh/m2 of heated area. This is assumed to be used on site and has been applied as a reduction to the overall energy consumption values.

STEP 9: DOMESTIC HOT WATER

DESIGN

Table 30 Domestic Hot Water Design Assumptions

Incoming Water Temperature (ºC)	10
Delivered Water Temperature (ºC)	42
Generator Efficiency (SCOP kW/kW)	2.22
Storage Losses (kWh)	0.0027
Storage Volume (L)	3000
Distribution Losses (%)	5

OPERATIONAL

Table 31 Domestic Hot Water Operational Assumptions

Space Type (MEP Profile)	Daily Hot Water Consumption per Person (l/person.day)			
	Likely	Low End	High End	Worst Case
Car parking	-	-	-	-
Circulation	-	-	-	-
Cycle store	-	-	-	-
Welfare	-	-	-	-
Office - Internal	4	4	8	10
Office - Perimeter	4	4	8	10
Plant	-	-	-	-
Reception	-	-	-	-
Retail	4.4	4.4	8	10
Store	-	-	-	-
WC	-	-	-	-

STEP 10: INTERNAL HEAT GAINS

Internal gains from the above steps are imported into the DSM for space heating and cooling loads calculations.

STEP 11A: SPACE HEATING & COOLING

DESIGN

Table 32 Space Heating Design Data

	Heat pump Efficiency (SCoP kW/kW)	Delivery Efficiency (%)
Space Heating	3.74	93

Table 33 Space Cooling Design Data

	Generator Efficiency (SEER kW/kW)	Delivery Efficiency (%)
Space Cooling	7.42	80%

STEP 11B: FRESH AIR HANDLING UNITS

DESIGN

Table 34 Fresh Air Handling Units Design Data

Type	AHU Volume Flow Rate (l/s-p)	AHU Volume Flow Rate (ACH)	Specific Fan Power (W/l/s)	Heat Recovery (%)	Variable Speed Fresh Air Factor (%)
Car parking	-	1	1.6	80%	100% (No VAV)
Circulation	-	1	1.6	80%	100% (No VAV)
Cycle store	-	1	1.6	80%	100% (No VAV)
Welfare	12	-	1.6	80%	100% (No VAV)
Office - Internal	12	-	1.9	80%	100% (No VAV)
Office - Perimeter	12	-	1.9	80%	100% (No VAV)
Plant	-	1	1.6	80%	100% (No VAV)
Reception	12	-	1.6	80%	100% (No VAV)
Retail	12	-	1.6	80%	100% (No VAV)
Store	-	1	1.6	80%	100% (No VAV)
WC	-	-	-	-	-

Table 35 Fresh Air Handling Units Design Data – Space Heating

	Heat pump Efficiency (SCoP kW/kW)	Delivery Efficiency (%)
Fresh Air Heating	3.74	93

Table 36 Fresh Air Handling Units Design Data – Space Cooling

	Generator Efficiency (SEER kW/kW)	Delivery Efficiency (%)
Fresh Air Cooling	7.42	80%

Table 37 AHU Likely and Low End Operation

	Retail				Reception, Office, Ancillary			
	Mon-Fri	Sat	Sun	Hol	Mon-Fri	Sat	Sun	Hol
00:00	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
01:00	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
02:00	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
03:00	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
04:00	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
05:00	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
06:00	ON	ON	ON	ON	OFF	OFF	OFF	OFF
07:00	ON	ON	ON	ON	ON	OFF	OFF	OFF
08:00	ON	ON	ON	ON	ON	OFF	OFF	OFF
09:00	ON	ON	ON	ON	ON	OFF	OFF	OFF
10:00	ON	ON	ON	ON	ON	OFF	OFF	OFF
11:00	ON	ON	ON	ON	ON	OFF	OFF	OFF
12:00	ON	ON	ON	ON	ON	OFF	OFF	OFF
13:00	ON	ON	ON	ON	ON	OFF	OFF	OFF
14:00	ON	ON	ON	ON	ON	OFF	OFF	OFF
15:00	ON	ON	ON	ON	ON	OFF	OFF	OFF
16:00	ON	ON	ON	ON	ON	OFF	OFF	OFF
17:00	ON	ON	ON	ON	ON	ON	ON	ON
18:00	ON	ON	ON	ON	OFF	OFF	OFF	OFF
19:00	ON	ON	ON	ON	OFF	OFF	OFF	OFF
20:00	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
21:00	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
22:00	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
23:00	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

Table 38 AHU High End and Worst Case Operation

	Retail				Reception, Office, Ancillary			
	Mon-Fri	Sat	Sun	Hol	Mon-Fri	Sat	Sun	Hol
00:00	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
01:00	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
02:00	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
03:00	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
04:00	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
05:00	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
06:00	ON	ON	ON	ON	OFF	OFF	OFF	OFF
07:00	ON	ON	ON	ON	ON	OFF	OFF	OFF
08:00	ON	ON	ON	ON	ON	OFF	OFF	OFF
09:00	ON	ON	ON	ON	ON	OFF	OFF	OFF
10:00	ON	ON	ON	ON	ON	OFF	OFF	OFF
11:00	ON	ON	ON	ON	ON	OFF	OFF	OFF
12:00	ON	ON	ON	ON	ON	OFF	OFF	OFF
13:00	ON	ON	ON	ON	ON	OFF	OFF	OFF
14:00	ON	ON	ON	ON	ON	OFF	OFF	OFF
15:00	ON	ON	ON	ON	ON	OFF	OFF	OFF
16:00	ON	ON	ON	ON	ON	OFF	OFF	OFF
17:00	ON	ON	ON	ON	ON	ON	ON	ON
18:00	ON	ON	ON	ON	ON	OFF	OFF	OFF
19:00	ON	ON	ON	ON	ON	OFF	OFF	OFF
20:00	OFF	OFF	OFF	OFF	ON	OFF	OFF	OFF
21:00	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
22:00	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
23:00	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

Table 39 AHU Worst Case Operation

	Retail				Reception, Office, Ancillary			
	Mon-Fri	Sat	Sun	Hol	Mon-Fri	Sat	Sun	Hol
00:00	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
01:00	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
02:00	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
03:00	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
04:00	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
05:00	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
06:00	ON	ON	ON	ON	OFF	OFF	OFF	OFF
07:00	ON	ON	ON	ON	ON	ON	ON	ON
08:00	ON	ON	ON	ON	ON	ON	ON	ON
09:00	ON	ON	ON	ON	ON	ON	ON	ON
10:00	ON	ON	ON	ON	ON	ON	ON	ON
11:00	ON	ON	ON	ON	ON	ON	ON	ON
12:00	ON	ON	ON	ON	ON	ON	ON	ON
13:00	ON	ON	ON	ON	ON	ON	ON	ON
14:00	ON	ON	ON	ON	ON	ON	ON	ON
15:00	ON	ON	ON	ON	ON	ON	ON	ON
16:00	ON	ON	ON	ON	ON	ON	ON	ON
17:00	ON	ON	ON	ON	ON	ON	ON	ON
18:00	ON	ON	ON	ON	ON	ON	ON	ON
19:00	ON	ON	ON	ON	ON	ON	ON	ON
20:00	OFF	OFF	OFF	OFF	ON	ON	ON	ON
21:00	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
22:00	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
23:00	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

STEP 11C: TERMINAL FANS

DESIGN

Table 40 Terminal Fans Design Data

Space Type (MEP Profile)	Average Space Height (m)	Air Change Rate (ac/hr)	Terminal Fan Power (W/l/s)
Office/Welfare/Reception/Retail FCU	4	6	0.17
WC Extract	4	10	0.6

OPERATIONAL

Profiles are identical to the fresh air handling units' profiles.

STEP 11D: PUMPS

DESIGN

Table 41 Pumps Design Data

Space Type (MEP Profile)	Pumps
Car parking	LTHW
Circulation	LTHW
Cycle store	LTHW
Welfare	LTHW & CHW
Office - Internal	LTHW & CHW
Office - Perimeter	LTHW & CHW
Plant	LTHW
Reception	LTHW & CHW
Retail	LTHW & CHW
Store	LTHW
WC	LTHW

OPERATIONAL

Profiles are identical to the fresh air handling units' profiles.

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17 APPENDIX D

17.1 OVERHEATING CHECKLIST

EARLY STAGE OVERHEATING RISK TOOL

Version 1.0, July 2019

Good Homes Alliance

This tool provides guidance on how to assess overheating risk in residential schemes at the early stages of design. It is specifically a pre-detail design assessment intended to help identify factors that could contribute to or mitigate the likelihood of overheating.

The questions can be answered for an overall scheme or for individual units. Score zero wherever the question does not apply. Additional information is provided in the accompanying guidance, with examples of scoring and advice on next steps.

Find out more information and download accompanying guidance at goodhomes.org.uk/overheating-in-new-homes.

KEY FACTORS INCREASING THE LIKELIHOOD OF OVERHEATING | **KEY FACTORS REDUCING THE LIKELIHOOD OF OVERHEATING**

Geographical and local context

#1 Where is the scheme in the UK? See guidance for map	South east	**4**	4
	Northern England, Scotland & NI	**0**	
	Rest of England and Wales	**2**	

#2 Is the site likely to see an Urban Heat Island effect? See guidance for details	Central London (see guidance)	**3**	3
	Grtr London, Manchester, B'ham	**2**	
	Other cities, towns & dense sub-urban areas	**1**	

#8 Do the site surroundings feature significant blue/green infrastructure? Proximity to green spaces and large water bodies has beneficial effects on local temperatures; as guidance, this would require at least 50% of surroundings within a 100m radius to be blue/green, or a rural context	**1**	0

Site characteristics

#3 Does the site have barriers to windows opening? - Noise/Acoustic risks - Poor air quality/smells e.g. near factory or car park or very busy road - Security risks/crime - Adjacent to heat rejection plant	**Day** - reasons to keep all windows closed	**8**	4
	Day - barriers some of the time, or for some windows e.g. on quiet side	**4**	
	Night - reasons to keep all windows closed	**8**	4
	Night - bedroom windows OK to open, but other windows are likely to stay closed	**4**	

#9 Are immediate surrounding surfaces in majority pale in colour, or blue/green? Lighter surfaces reflect more heat and absorb less so their temperatures remain lower; consider horizontal and vertical surfaces within 10m of the scheme	**1**	1
#10 Does the site have existing tall trees or buildings that will shade solar-exposed glazed areas? Shading onto east, south and west facing areas can reduce solar gains, but may also reduce daylight levels	**1**	0

Scheme characteristics and dwelling design

#4 Are the dwellings flats? Flats often combine a number of factors contributing to overheating risk e.g. dwelling size, heat gains from surrounding areas; other dense and enclosed dwellings may be similarly affected - see guidance for examples	**3**	3
#5 Does the scheme have community heating? i.e. with hot pipework operating during summer, especially in internal areas, leading to heat gains and higher temperatures	**3**	3

#11 Do dwellings have high exposed thermal mass AND a means for secure and quiet night ventilation? Thermal mass can help slow down temperature rises, but it can also cause properties to be slower to cool, so needs to be used with care - see guidance	**1**	0

#12 Do floor-to-ceiling heights allow ceiling fans, now or in the future? Higher ceilings increase stratification and air movement, and offer the potential for ceiling fans	>2.8m and fan installed	**2**	0
	> 2.8m	**1**	

Solar heat gains and ventilation

#6 What is the estimated average glazing ratio for the dwellings? (as a proportion of the facade on solar-exposed areas i.e. orientations facing east, south, west, and anything in between). Higher proportions of glazing allow higher heat gains into the space	>65%	**12**	7
	>50%	**7**	
	>35%	**4**	

#7 Are the dwellings single aspect? Single aspect dwellings have all openings on the same facade. This reduces the potential for ventilation	Single-aspect	**3**	3
	Dual aspect	**0**	

#13 Is there useful external shading? Shading should apply to solar exposed (E/S/W) glazing. It may include shading devices, balconies above, facade articulation etc. See guidance on "full" and "part". Scoring depends on glazing proportions as per **#6**		Full	Part	2
	>65%	**6**	**3**	
	>50%	**4**	**2**	
	>35%	**2**	**1**	

#14 Do windows & openings support effective ventilation? Larger, effective and secure openings will help dissipate heat - see guidance		Openings compared to Part F purge rates			4
		= Part F	+50%	+100%	
	Single-aspect	minimum required	3	4	
	Dual aspect		2	3	

TOTAL SCORE 24 = Sum of contributing factors: 31 *minus* Sum of mitigating factors: 7

High 12 **Medium** 8 **Low**

score >12:
Incorporate design changes to reduce risk factors and increase mitigation factors AND Carry out a detailed assessment (e.g. dynamic modelling against CIBSE TM59)

score between 8 and 12:
Seek design changes to reduce risk factors and/or increase mitigation factors AND Carry out a detailed assessment (e.g. dynamic modelling against CIBSE TM59)

score <8:
Ensure the mitigating measures are retained, and that risk factors do not increase (e.g. in planning conditions)

18 APPENDIX E

18.1 NETWORK DECARBONISATION PLAN

Berkeley Homes (Central London) Ltd

PADDINGTON GREEN POLICE STATION, WESTMINSTER

Network Decarbonisation Strategy

PGPS-WSP-XX-XX-PL-ES-0001
APRIL 2021

PUBLIC

Berkeley Homes (Central London) Ltd

PADDINGTON GREEN POLICE STATION, WESTMINSTER

Network Decarbonisation Strategy

TYPE OF DOCUMENT (VERSION) PUBLIC

PROJECT NO. 70069424

OUR REF. NO. PGPS-WSP-XX-XX-PL-ES-0001-P01

DATE: APRIL 2021

Berkeley Homes (Central London) Ltd

PADDINGTON GREEN POLICE STATION, WESTMINSTER

Network Decarbonisation Strategy

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QUALITY CONTROL

Issue/revision	First issue	Revision P01	Revision 2	Revision 3
Remarks	Draft	Final Issue		
Date	March 2021	April 2021		
Prepared by	Richard Bolton	Richard Bolton/Michela Martini		
Signature				
Checked by	James Eland	Nick Remington		
Signature				
Authorised by	Nick Remington	Nick Remington		
Signature				
Project number	70069424	70069424		
Report number	PGPS-WSP-XX-XX-PL-ES-0001	PGPS-WSP-XX-XX-PL-ES-0001-P01		
File reference	\\uk.wspgroup.com\central data\Projects\700694xx\70069424 - Paddington Green Police Station\03 WIP\E&S Energy & Sustainability\07-Decarbonisation Plan\08-Decarbonisation Strategy			

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1 INTRODUCTION

WSP has been commissioned by Berkeley Homes (Central London) Ltd to develop and prepare a decarbonisation strategy for the Paddington Green Police Station development in Westminster City Council (WCC) London. This document should be read alongside the site Energy Strategy prepared by WSP[1].

The Paddington Green Police Station (PGPS) is a 3 tower block development located next to the West End Gate (WEG) and 14-17 Paddington Green sites.

The client's ambition for the site is to deliver a high quality residential led mixed-use development that will complete the West End Gate masterplan. In line with the GLA heating hierarchy, main heating to the development will be provided through connection to the existing area-wide West End Gate network fed by highly efficient CHP and gas fired boilers.

The WEG and 14-17 Paddington Green energy strategy has been consented based on SAP2012 carbon factors.

SAP 2012 emission factors can continue to be used according to the latest edition of the GLA Energy Assessment Guidance if the development is in a Heat Network Priority Area and there is a potential to connect to an existing network using gas-engine CHP or a new network using low-emission CHP. Where this is the case the network operator is required to have a strategy to decarbonise the network. This document presents that strategy and outlines the options available for decarbonisation, the timelines and actions taken to ensure the process is monitored and implemented when viable.

---

[1] PGPS-WSP-PDF-ES-0001-P03-Energy Statement

2 SITE

The Applicant is submitting a full detailed planning application for “demolition and redevelopment of the site to provide three buildings, providing private and affordable residential units (Class C3), commercial uses (Class E), flexible community/affordable workspace (Class E/F.1), provision of private and public amenity space, landscaping, tree and other planting, public realm improvements throughout the site including new pedestrian and cycle links, provision of public art and play space, basement level excavation to provide associated plant, servicing and disabled car and cycle parking, connecting through to the basement of the neighbouring West End Gate development.”

The development presented in Figure 2-1 and Figure 2-2 are labelled in the development plan as Block I, J and K.

Figure 2-1 - Top view showing the West End Gate Masterplan

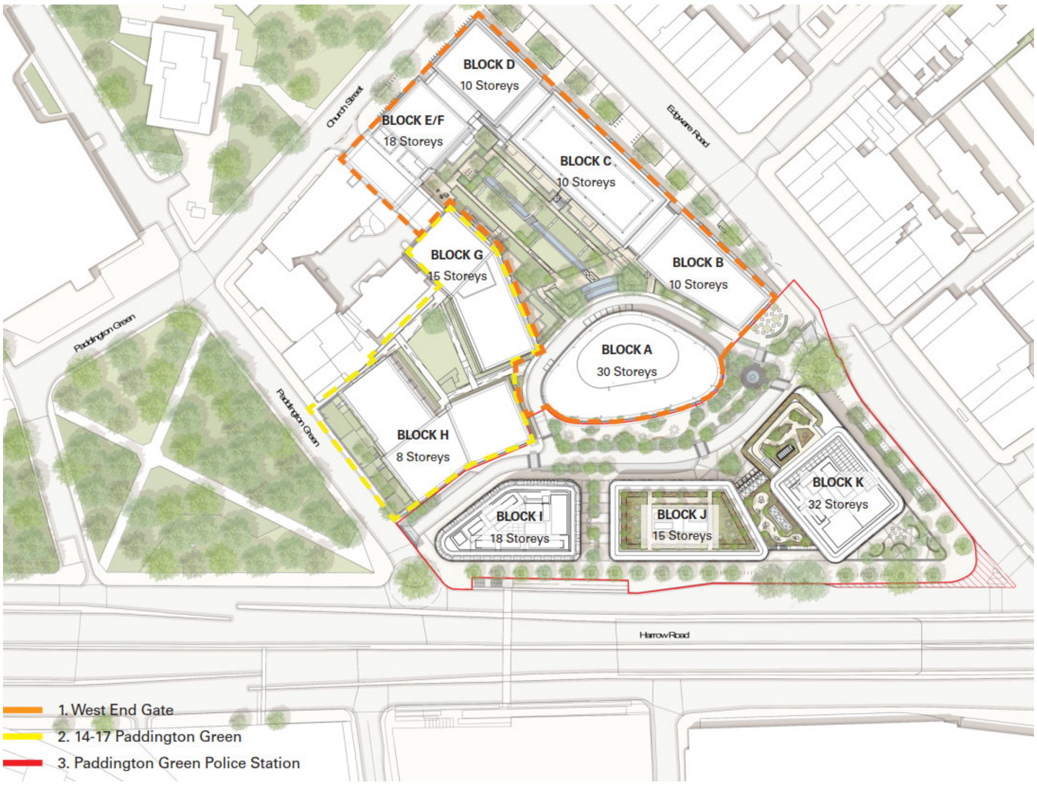
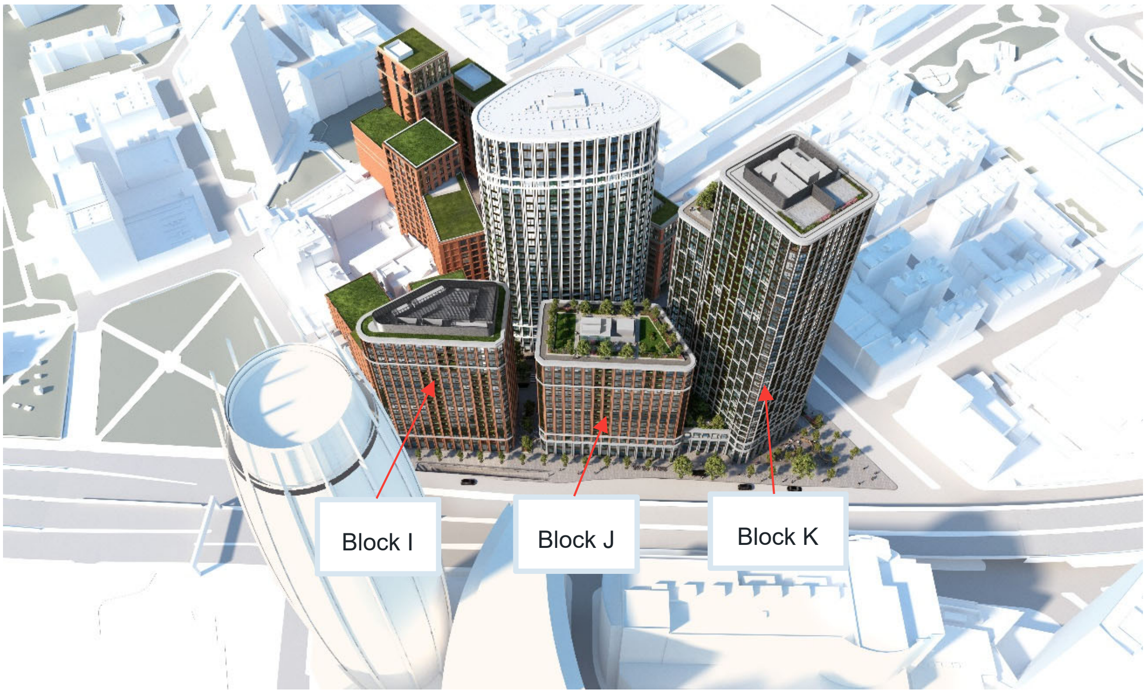


Figure 2-2 Perspective view of the Proposed Development



3 SITE HEAT STRATEGY

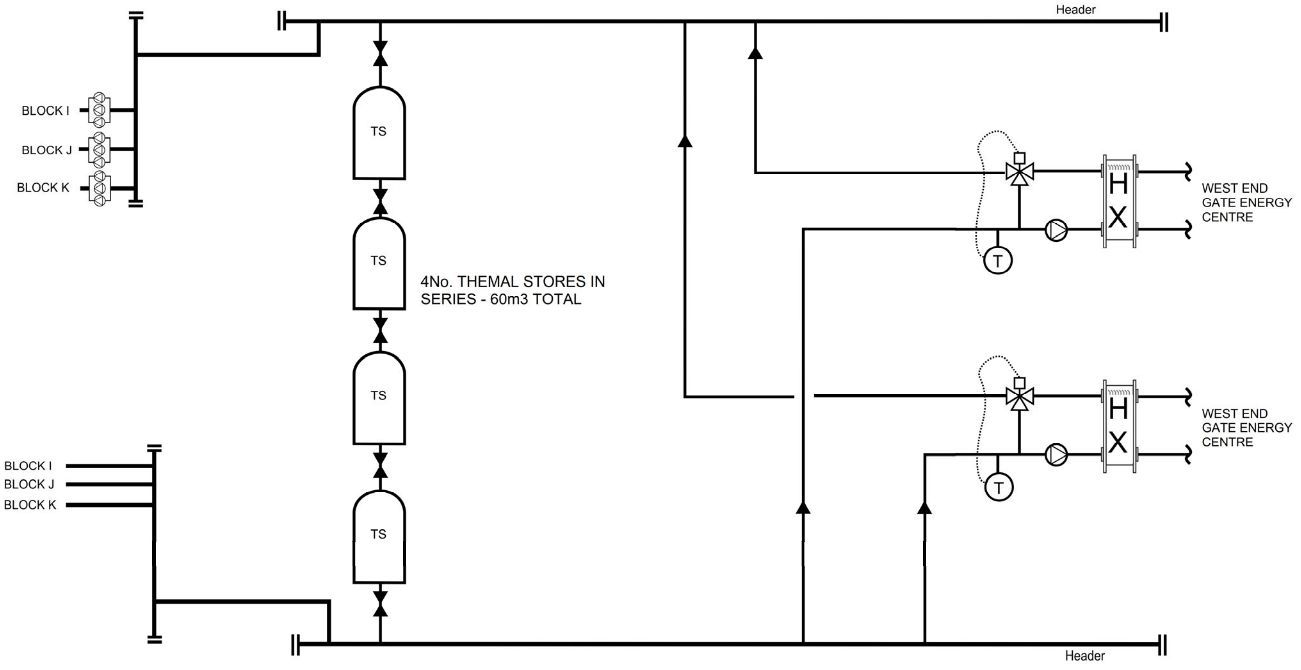
The following is a summary of the PGPS heating strategy. Full details of the site energy strategy are presented in the Energy Statement.[2]

The PGPS heating strategy is split into two systems. The first supplies the requirements of the commercial and retail units via an all-electric solution using Air Source Heat Pumps (ASHPs) for space heating (located on the roof of Building I) and for domestic hot water an ASHP supplies heat to a Water Source Heat Pump (WSHP) at each office floor level.

Residential units and landlord's areas will be connected to the site-wide Low Temperature Hot Water (LTHW) network for the provision of space heating and domestic hot water. This will be via a heat interface unit (HIU) within each apartment to transfer heat from the network to the apartment and will include heat metering. The LTHW network will also supply fan coil units (FCUs) in non-residential areas.

The LTHW network is to be supplied from a site wide plantroom located at basement level in Block K (Figure 2-2). Heat is received via 2 no. Plate Heat Exchangers from the WEG Energy Centre. The concept schematic for the PGPS plantroom is presented in Figure 3-1.

Figure 3-1 – PGPS Mechanical Concept Schematic



The PGPS plantroom will include 60m^3 of thermal storage from 4 No. 15m^3 thermal stores. The large store has been selected to allow the PGPS manage the variable demand from the residential load

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[2] PGPS-WSP-PDF-ES-0001-P03-Energy Statement

and to smooth out the demand presented to WEG EC. This approach will minimise intervention from the WEG EC top-up boilers and assist in maximising CHP operating hours.

The WEG Energy Centre has the capacity to serve both the WEG and PGPS sites from the primary heat source, a 464kWe gas engine CHP and 4 no. 1.4MW highly efficient gas boilers (N+1 basis). Further thermal storage capacity of 40m^3 is provided within the WEG energy centre to help maximise CHP operation and minimise use of boilers.

4 DECARBONISATION STRATEGY

This section presents the decarbonisation strategy for the Paddington Green Police Station site.

4.1 OPTION A - WIDE AREA HEAT NETWORK CONNECTION

In line with the GLA energy hierarchy the primary decarbonisation route is connection to a wide area heat network.

The West End Green energy centre to which the Paddington Green Police Station site will connect for its residential heat has allowed for a wide area heat network connection in its designs.

As part of the S106 agreements, the West End Gate (WEG) energy centre has been designed to facilitate connection to the Church Street district heating network and space has been provided for an interface substation. Furthermore, distribution pipework connecting the development to the DHN has been installed to allow for future connection to the network as soon as this becomes operational.

The Church Street heat network forms a key part of the Church Street and Paddington Green Regeneration Strategy (CPS370-DR-2-02) published prior to the development of the West End Green Energy Strategy in 2015.

It is envisaged that the West End Gate will connect into the planned Church Street heat network. An extract of the proposed network from the London Heat Map is presented in Figure 4-1 and it can be seen that this includes for a connection to the West End Gate site. As of Q4 2020, the Church Street heat network is listed in the pipeline of active heat network delivery unit (HNDU) projects.[3]

The availability of the combined heat load of the West End Gate and Paddington Green Police Station sites and their plan to decarbonise through a connection to the Church Street network should assist the viability of the Church Street network by providing a significant heat customer base.

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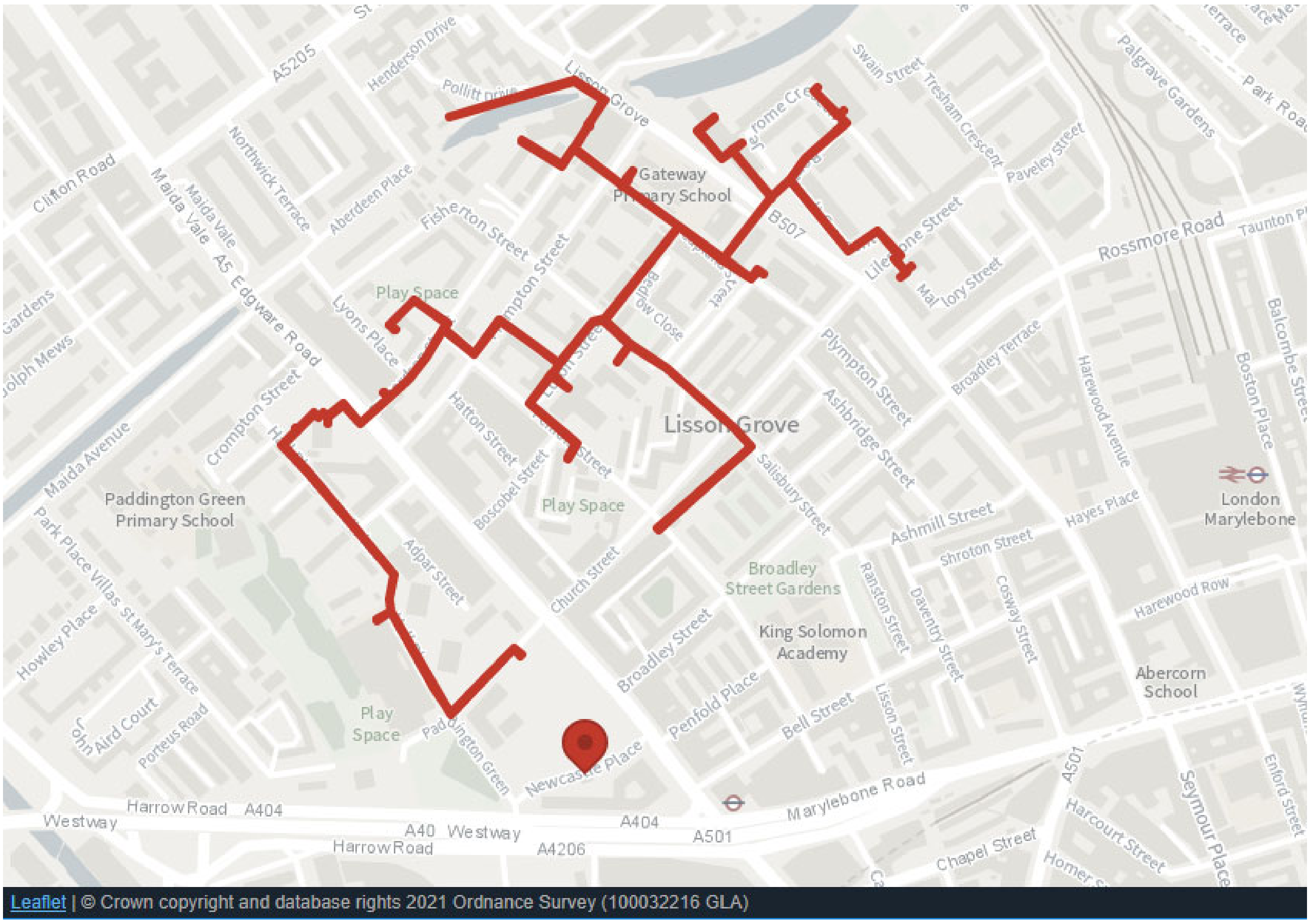
[3] https://www.gov.uk/government/publications/hndu-pipeline

Figure 4-1 – Church Street Heat Network - Proposed[4]



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In the longer term it could be envisaged that separate but nearby networks would link up to trade heat, benefit from lower cost and low or zero carbon heat production. Table 4-1 lists several networks as noted on the London Heat Map.

Table 4-1 – Wide Area Heat Network

Network	Borough	Distance (km)
Church Street	City of Westminster	0
Euston Road	Camden	1.8
South Kilburn	Brent	1.8

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[4] https://maps.london.gov.uk/heatmap

Bloomsbury	Camden	3.0
White City / Hammersmith & Fulham	Hammersmith and Fulham	3.2
Pimlico / Whitehall	City of Westminster	3.8

4.2 OPTION B - ONSITE OPTIONS

In the long term, should a district heating connection not prove feasible, the provision of residential heat for PGPS could decarbonise via onsite measures. Technology options are limited, with ASHP the most viable.

On the PGPS site suitable locations for ASHP are limited. Space is not available at ground level and the roof level space of each block is proposed to be used as follows:

- Block I – heating plant to serve commercial loads;
- Block J – amenity space and smoke control equipment;
- Block K – amenity space, PV panels, LV switchgear and smoke control equipment.

If necessary, space could be made available at roof level of Blocks J or K of one or more ASHP units with the loss of some amenity or utility space.

At present the preference would be to use the PV area on Block K for the following reasons:

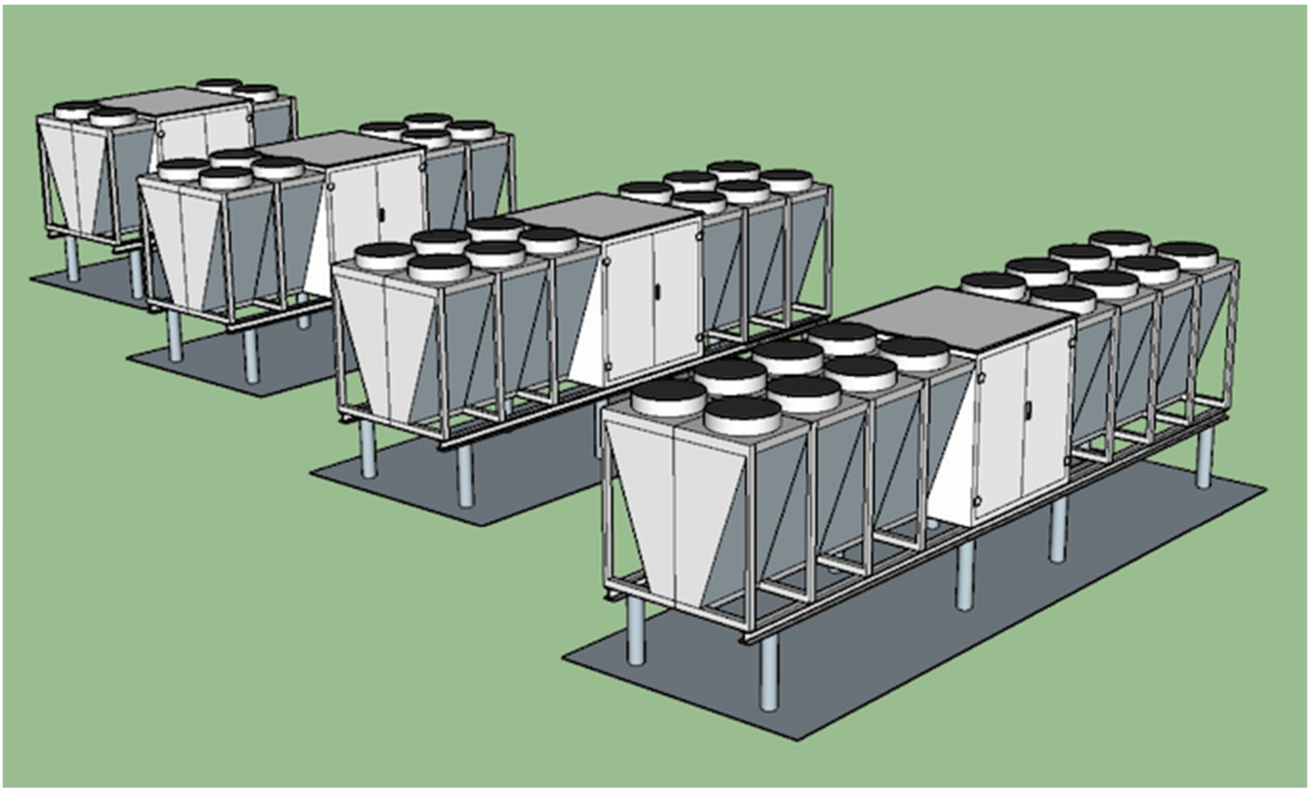
- The Paddington Green Police Station residential heat plant room is located at the basement level of this block.
- An area of approximately 15m by 5m could be made available allowing for one or more heat pump units as shown in Figure 4-2 to be used.

The loss of PV would reduce the proportion of renewable electricity on the site, but this would be replaced with renewable heating. This option would only be progressed where in the long term a wide area heat network connection was not feasible. In this circumstance it is envisaged the PV panels would be in the mid to lay cycle of their life, and further that the electricity grid would have further decarbonised by this point in time, reducing the environmental benefit that PV panels produce.

Connecting the ASHP into residential heating system would be achieved at the LTHW plantroom between the WEG heat exchange interface and the 60m^3 thermal storage. The thermal storage would ensure the proportion of heat generated from the ASHP is maximised whilst retaining the WEG connection for backup.

This solution can be co-ordinated with the WEG operator to develop the most effective solution for the combined WEG and PGPS.

Figure 4-2 - Air Source Heat Pump, Capacities 60kW to 1MW shown (2.3m wide, 4.7 to 11.6m long) – Credit Solid Energy



4.3 SUMMARY – TIME LINE AND MONITORING

The primary decarbonisation route will be through the connection of the WEG EC to an external low carbon supply in the form of a connection to the proposed Church Street DHN. This combined network in turn in the long term has the potential to expand and / or interconnect with other networks to reduce carbon emissions and cost of heat. The PGPS operator will monitor and support the WEG operator's plans in this regard.

In the event the WEG EC is not able to decarbonise through an external connection the PGPS operator would seek to work with the WEG operator to develop an effective combined site solution; one element of this would be to consider PGPS roof space as a potential location for ASHPs which can be used to supply the residential heat demands, and for which space would become available when the PV panels approach their end of life. This new source of heat could be tied into the PGPS residential supply or as part of a combined site wide strategy.

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