Energy Review Report

Block B

PMC Construction and Development Services

Former Adur Civic Centre,
Shoreham-by-Sea,
BN43 6EW

SRE

Version	Revision	Date	Author	Reviewer	Project Manager
1	A	2024.02.23	Findlay Matheson	Elsa Withnell	Findlay Matheson
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The figures within this report are based on indicative modelling utilising standard or explicitly outlined methodologies and an assumed specification as outlined within the relevant sections of the report which incorporates a margin of error associated with the adopted approach. It is also noted that should any specified values or the design layout change, the modelling may not represent the as-built emissions or energy use of the Proposed Development. Please contact SRE should you have any questions, or should you wish further modelling to be undertaken post planning.

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SRE Registered Office

3 London Square | Cross Lanes

Guildford | Surrey | GU1 1UJ

01730 710044

info@sre.co.uk

www.sre.co.uk

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Executive Summary

Executive Summary

This Energy Review has sought to provide an overview of the predicted Energy Use Intensity (EUI), associated carbon emissions and predicted operational energy costs of two roof configurations for a number of sample residential units in Block B of the Former Adur Civic Centre, Ham Road, Shoreham-by-Sea (Proposed Development). These two roof configurations are defined as Scenarios and differ as follows:

- Scenario 1 – Pitched roof design option. This offers limited viable roof space for Photovoltaic (PV) panels due to large north-facing area, but increased operational efficiency of PV panels due to the 35° inclination of the roof. A baseline Energy Performance Certificate (EPC) B-rating can be achieved throughout the block.

- Scenario 2 – Flat roof design option. This offers a significant amount of roof space for PV panels, but slightly reduced operational efficiency of PV panels in arrangement of 10° inclination to avoid overshading. A baseline EPC A-rating can be achieved throughout the block.

The analysis has been conducted utilising the nationally recognised Standard Assessment Procedure (SAP) 2012 software in conjunction with up-to-date carbon factors and costs for energy ensuring it holds relevance to the current time period. Further depth to the analysis and accuracy to the results are achieved through adoption of industry recognised guidance in the American Society for Heating, Refrigeration and Air-conditioning Engineers (ASHRAE) Fundamentals Handbook incorporating cooking loads to the EUI and carbon emissions.

The results of this Energy Review find significant improvements to all parameters considered throughout the Proposed Development should Scenario 2 be employed. Significant improvements are achieved across each unit analysed and an overall gain across the whole block is determined through extrapolation.

Considering the EUI, a reduction of 12.65kWh/m²/year is achieved as seen graphically in Figure 1 which equates to a 34.61% improvement over Scenario 1.

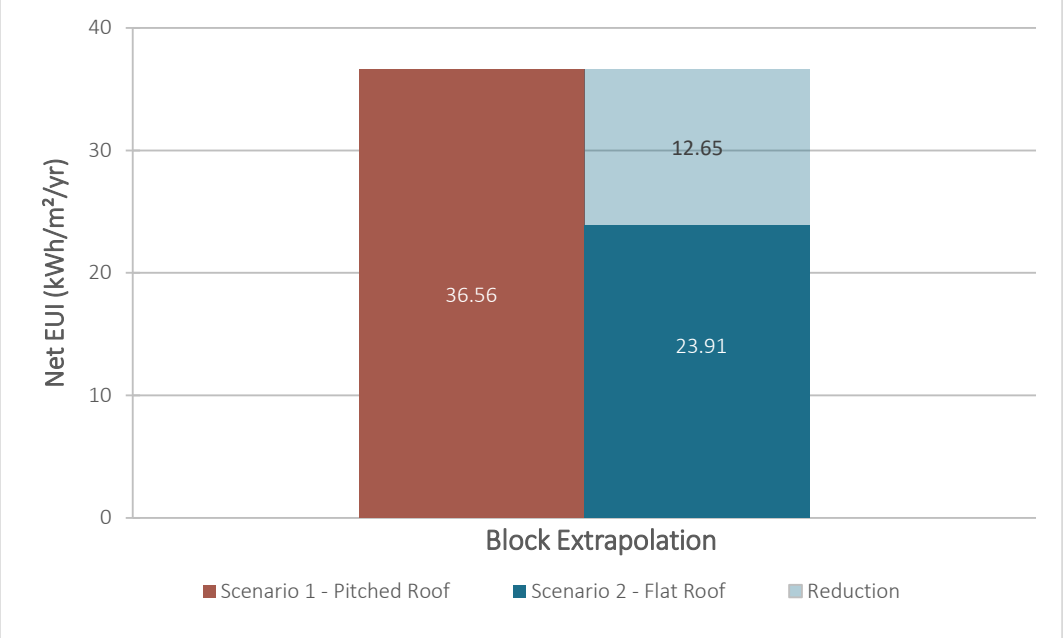

Figure 1 - Scenario comparison of EUI extrapolated across the block

This is a substantial improvement with a notable reduction in energy consumption for the occupants and closely aligns with national energy consumption reduction targets. This is closely paralleled through carbon emissions

reductions seen in Figure 2 which shows the annual carbon emissions using carbon factors taken from SAP 2012, SAP10 and the latest National Greenhouse Gas Reporting Carbon Factors (NGGRCF).

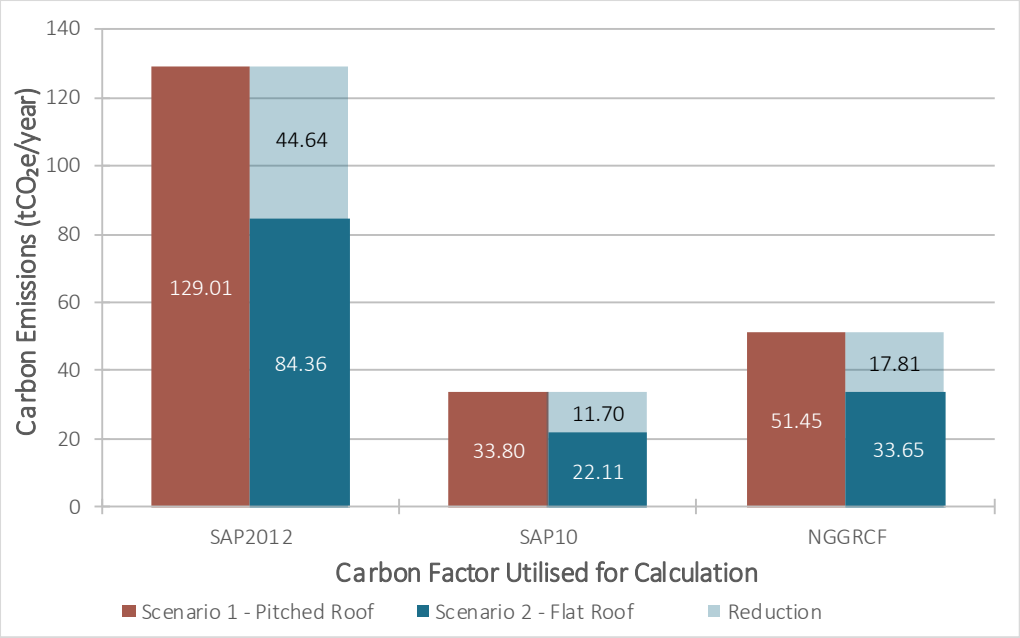

Figure 2 - Scenario comparison of net carbon emissions for the block based upon each assessed carbon factor

Reviewing the predicted emissions based upon each source of carbon factor values, the reductions are notable and significant. Considering the reduction achieved based upon the latest NGGRCF, a reduction of 17.81 tonnes of Carbon Dioxide equivalent (CO_2e) can be achieved should Scenario 2 be adopted over Scenario 1. This closely aligns to National carbon emission reduction objectives.

The benefits observed also extend to notable reductions in operational costs for the future residents of the units as seen in Figure 3 for an approximated typical unit and Figure 4 for the block overall.

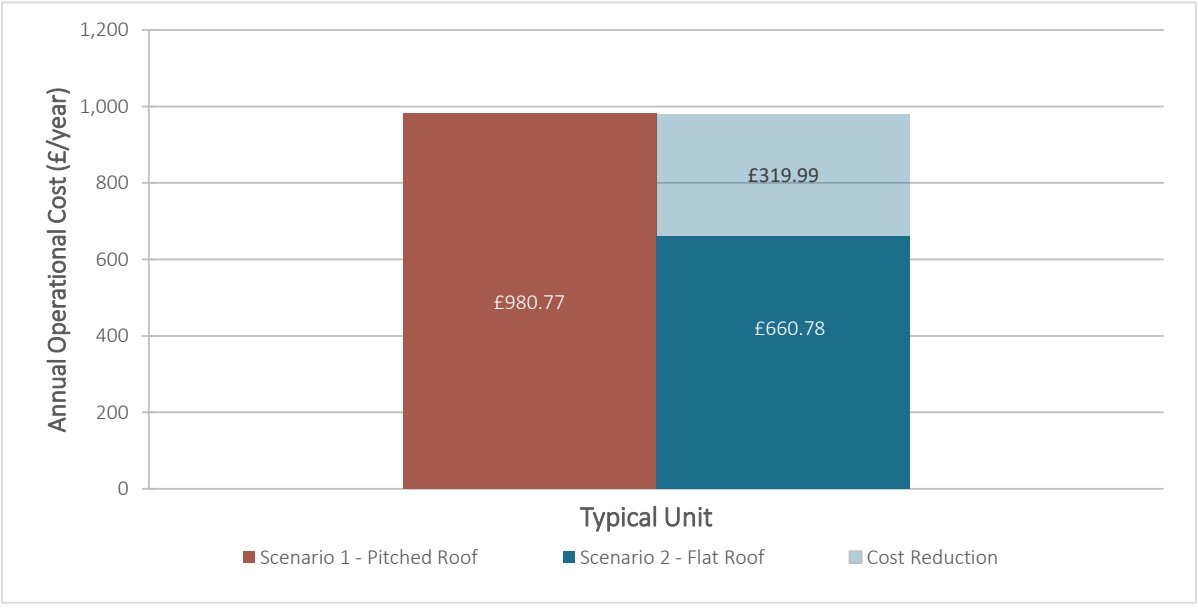

Figure 3 - Scenario comparison of annual operational cost for a typical unit

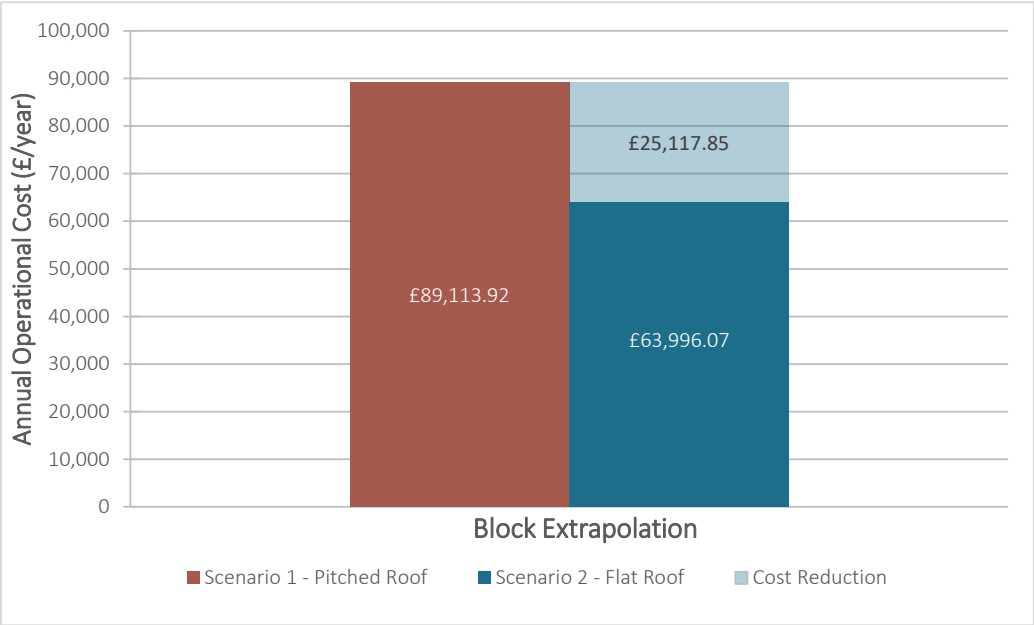

Figure 4 - Scenario comparison of annual operational cost extrapolated across the block

The net impact of Scenario 2 over Scenario 1 is significant estimating a £320 annual reduction for a typical unit and £25,117.85 annual reduction cumulatively for all residents throughout the block. This represents a 29.69% reduction in operational energy costs offering a tremendous improvement to the financial situation of the future tenants.

This Energy Review demonstrates that it is highly recommended that Scenario 2 is prioritised. It offers exceptional benefits across all building performance metrics assessed. These improvements contribute towards national energy consumption reduction targets, lower carbon emissions across the built environment and significant cost savings to every occupant of the Proposed Development.

Energy Review Report

1.0 Introduction

This Energy Review Report has been written by SRE Ltd for PMC Construction and Development Services Ltd (PMC) to evaluate the differences in building performance between two roof design scenarios for the development at the site of the former Adur Civic Centre, Ham Road (the Proposed Development). The objective of this report is to provide analytics-driven insight and informed recommendations as to the energy impact of each design scenario on the future resident.

1.1 The Proposed Development

As shown in Figure 5, the Proposed Development consists of a new multi-unit mixed-use development across 2 no. blocks at the former Adur Civic Centre site, Shoreham. This Proposed Development involves the construction of two towers with commercial units on the ground floor and 159 no. residential 1-bed, 2-bed and 3-bed apartments, which will be split across shared ownership and social rented uses, on all upper levels.

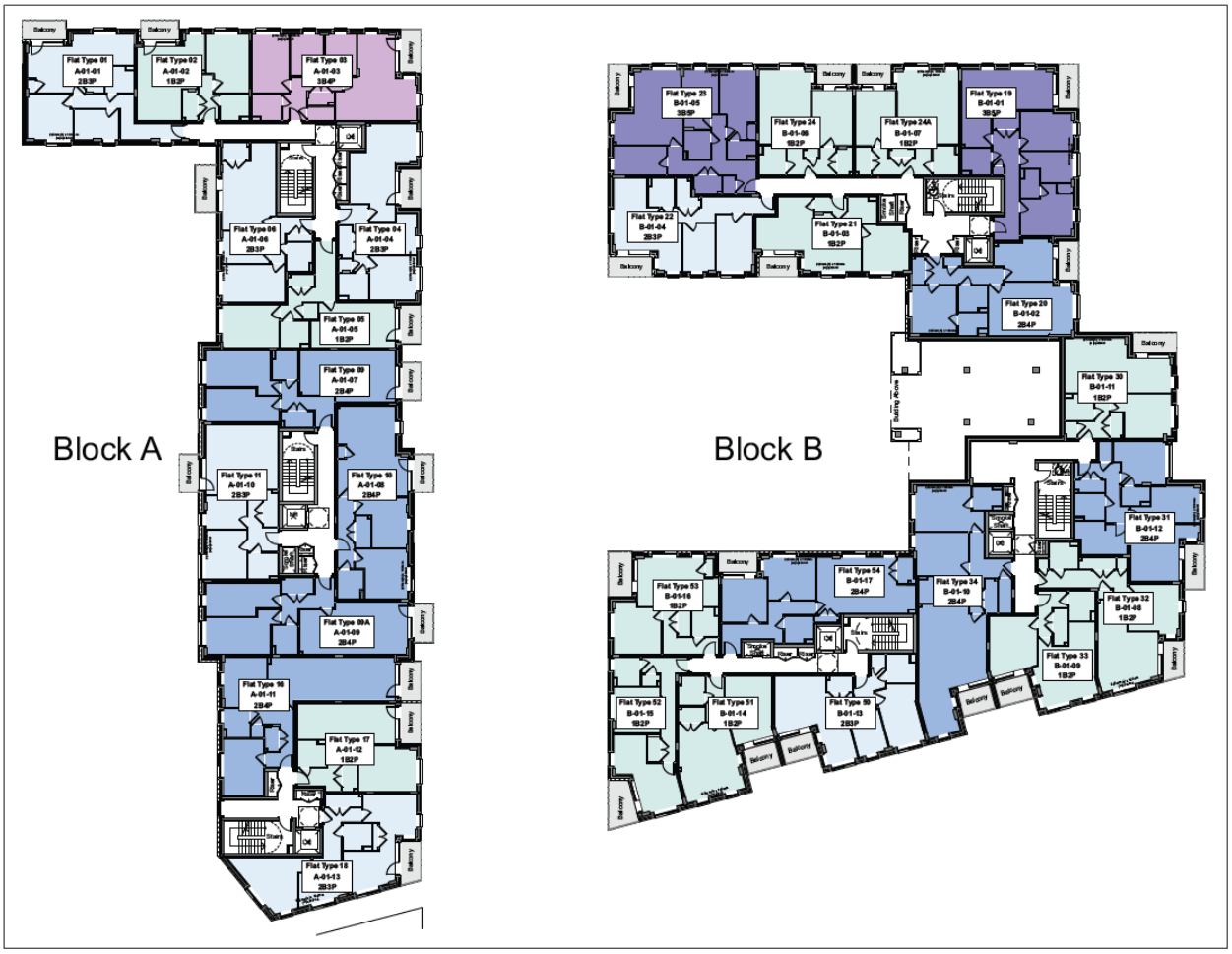

Figure 5 - Typical floor plan of the Proposed Development (HGP Architects)

The focus of this Energy Review is on Block B of the Proposed Development which will stand at 9 no. storeys tall with 106 no. residential units contained therein. It has been designed with energy efficiency in mind from the outset taking on a Lean, fabric-first approach and incorporating Green Low and Zero Carbon (LZC) technologies.

1.2 Overview

PMC is committed to developing energy efficient and low-carbon developments prioritising the long-term impact of their developments, and, in doing so, seek to address the social impact of the decisions being made as part of their wider Environmental, Social and Governance (ESG) work. Through setting the operational performance of the units as a high priority and going above and beyond in carrying out further energy review analytics, it is clear that PMC is seeking the best for the future residents of the Proposed Development.

This Energy Review spans 8 no. sample units representative of the residential component of Block B. This has been carried out utilising data calculated and extracted from the nationally recognised Elmhurst Standard Assessment Procedure (SAP) 2012 software. The Energy Review further takes a good-practice approach in contextualising and further validating these values against current carbon factors and energy costs.

The metrics of the Energy Review include Energy Use Intensity (EUI), carbon dioxide equivalent (CO_2e) emissions and cost which are studied across two different roof design configurations Through carrying out these analytics, insight on a per-unit basis and a projection of the overall impact for each scenario for Block B are considered assessing the implications of the two options and resulting baseline EPC ratings that can be achieved. Guided by these results, an informed recommendation is provided weighing in on the significance of the energy performance differences and the potential benefits that are attainable.

2.0 Energy Review

This Energy Review has been conducted using the analytics results from SAP 2012. This has been expanded upon using internationally recognised guidance and recently published datasheets. All methodologies and processes have been described and documented.

2.1 Definition of Scope

In accordance with conventional analytics and experimental procedure, a well-defined scope has been outlined in advance of carrying out calculations. This ensures professional integrity and ensures the conclusions that are reached are independent and impartial.

2.1.1 Scenarios

Two roof design scenarios have been considered within this Energy Review. In assessing the differences between these scenarios, numerous factors have been considered as tabulated in Table 1 with the cells highlighted in green indicating the improved scenario.

	Scenario 1: Pitched Roof Scenario	Scenario 2: Flat Roof Scenario
Fabric Performance	Insulated with U-value=0.11W/m².K	Insulated with U-value=0.11W/m².K
Top Floor Unit Internal Volume	Plane Ceiling at 2.40m or 2.63m floor dependent.	Plane Ceiling at 2.40m or 2.63m floor dependent.
PV System Factors: Orientation	North-South pitched roof. North-facing areas are deemed non-viable for PV due to limited solar exposure.	Flat roof. Entire roof can be utilised for PV utilising an East-West 10° arrangement.
PV System Factors: Areas	Smaller overall areas limit how panels can be arranged and reduces the overall possible PV:roof area factor.	Larger overall areas increase layout options with less edge offsets necessary. This increases the possible PV:roof area factor.
PV System Factors: Efficiency	South-facing pitched roof offers greater PV panel efficiency.	East-West 10° panel arrangement offers slightly lower PV panels efficiency.
	30° South facing offers approximately: 12.1% improvement over East-West 10° pitch per panel[1] 5.8% considering PV requirements of typical units for inverter and system purposes[2]	

Table 1 - Summary of differences between scenarios resulting from the change in roof structure

[1] Calculated based upon SAP2012 Appendix U 3.2 Solar radiation on vertical and inclined surfaces exclusively considering PV output values.
[2] Calculated based upon SAP2012 Appendix U 3.2 Solar radiation on vertical and inclined surfaces taking into account unit requirements and their efficiency of use of the PV guided by the electrical design.

As can be seen, the primary variable between the two scenarios pertains to the PV in viable area, and efficiency of its operation. The two scenarios have thus been defined accordingly with the PV varied between each scenario in terms of area and inclination. This is based upon reasonable assumption of what would likely be installed ensuring the respective EPC baseline rating is achieved.

2.1.2 Metrics

The metrics by which performance is measured have been selected based upon industry assessment standards and ensuring relevance to objective of the study, specifically examining the impact on the future residents. Each of these parameters are discussed in this section with specific reference to their project relevance.

While it is acknowledged that these factors do all vary based upon the lifestyle of the tenant, this variance is considered to be largely mitigated through industry accepted methodology employed within the SAP software and variation reduction through extrapolation across multiple units. This error can therefore be considered to be relatively minor and of minimal consequence.

Energy Usage Intensity (EUI)

A building's EUI (measured in terms of kW/m²/year) is considered a primary metric of performance as it represents the necessary power needed in the typical operations of the building. This takes into account regulated energy use encompassing space and Domestic Hot Water (DHW), heating, lighting, ventilation pumps and fans and energy offsets for renewables. In addition to this, the energy use through cooking has also been incorporated based upon thermal loads determined through SAP2012 and equivalent typical power usage to generate these loads in accordance with American Society for Heating, Refrigeration and Air-conditioning Engineers (ASHRAE) Fundamentals 2017 guidelines.

Carbon Emissions

The carbon emissions (measured in terms of $kgCO_2e/m^2$/year) through operation of the Proposed Development have a direct impact on the long-term sustainability of any building and thus forms a crucial metric. The energy used for building operation including heating, cooling and powering buildings is a significant contributor to greenhouse gas emissions, contributing approximately 19% of the UK's carbon footprint according to the UK Green Building Council[3]. As the Proposed Development utilised a purely electrical energy strategy, these emissions are directly related to the carbonisation state of the grid. Due to the need for a static benchmark, the SAP 2012 software utilises carbon factors based upon a 3-year projection over 2013 to 2015. To provide greater accuracy and validity, analysis also includes carbon emission calculation based upon based upon a 5-year projection from 2020 to 2025 in accordance with SAP10 software and the latest National Greenhouse Gas Reporting Carbon Factors (NGGRCF) published in June 2023 [4]. The factors utilised are outlined in Table 2.

[3] https://www.ukgbc.org/climate-change-2/
[4] https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2023

Source	Electricity CO_2e Conversion Factor ($kgCO_2e/kWh$)
SAP2012 (projection from 2013-2015)	0.519
SAP10 (projection from 2020-2025)	0.136
NGGRCF (June 2023)	0.207

Table 2 - CO_2e electricity conversion factors by source

Operational Energy Cost

The operational energy cost (predominantly measured in terms of £/year) for the Proposed Development is considered a pivotal factor in assessing the impact on the occupying resident. This factor is subject to change based upon the national energy generation industry and the national supply and demand of power. To ensure up-to-date estimations, the calculated cost has been indicated in accordance with SAP2012 parameters, SAP10 parameters and reported rates from 2023 to 2024[5]. These factors are outlined in Table 3 below.

Source	Electricity Cost (p/kWh)	Standing Charge (£)
SAP2012 (projection from 2013-2015)	13.19	54.00
SAP10 (projection from 2020-2025)	16.49	81.00
Reported Pricing for South East England	29.20[6]	164.25

Table 3 - Cost factors utilised in determination of operational energy cost

2.2 Methodology

The complete methodology followed has been documented and described in accordance with good practice principles and procedures. Where appropriate, equations have been provided demonstrating any direct calculations performed.

2.2.1 Assumptions

The Proposed Development has been designed with a high-performing envelope taking on a fabric first approach as summarised in Table 4 below. This approach has ensured that energy requirements are minimised throughout such that high performance is achieved through synergy between systems. This has been refined, developed and optimised to maximal feasible performance.

[5] https://www.nimblefins.co.uk/average-cost-electricity-kwh-uk
[6] Price has been averaged based upon pricing over the last 4 reported annual quarters.

Construction Type	U-value (W/m^2K)	Details
External Wall	0.16	102.5mm facebrick, 50mm clear cavity, 150mm Rockwool Duo Slab (0.035W/mK - or similar approved), Breather membrane, 12mm RCM Y-wall board, 90mm SFS stud full filled with mineral wool insulation (0.035W/mK – or similar approved), VCL, 30mm plasterboard.
Sheltered Wall – risers/lift/stairs	0.32	2 layers of 15mm Knauf Plasterboard with 3mm skim coat, 50mm I-stud full filled with Rockwool RW3 insulation (0.032W/mK - or similar approved), 25mm cavity filled with 25mm INsover APR acoustic roll (0.039W/mK - or similar approved), 200mm reinforced concrete (RC) wall (including shelter factor of 0.9).
Party Wall / Corridor Walls	0.00	Fully filled cavity and thermally sealed edges treated as adiabatic boundary in accordance with standard analysis methods. Stud wall construction throughout residential units.
Exposed Floor / Heatloss Floor	0.14	75mm screed, 150mm rigid PIR insulation (0.022W/mK - or alternative achieving similar performance), RC Slab (Applicable shelter factors applied where appropriate).
External Fenestration	1.20	Double glazed, low-E soft coating to surface 2 or 3 to attain whole window g-value, equal or superior whole window U-Value of 1.20 and whole window G-Value 0.45.
Air Permeability	-	3.00 $m^3/hr/m^2$ per blower door test at 50Pa.
Flat Roof	0.11	Waterproof membrane; 200mm PIR insulation (0.024W/mK - Sopratherm G or similar approved), vapour control layer, 225mm RC at 1:40 slope; min 210mm void formed with MF system; 15mm plasterboard ceiling.
Pitched Roof	0.11	Pitched roof structure; 250mm mineral wool (0.042W/mK - Rockwool or similar approved) over joists, 150mm joists fully filled with mineral wool (0.042W/mK - Rockwool or similar approved); 15mm plasterboard ceiling.

Table 4 – Fabric Specification.

The systems that contribute towards the EUI of the building are outlined in Table 5. These are reasonable and feasible systems given the nature of occupancy and design of the Proposed Development.

System	Description
Space Heating	Electric panel heating with programmer and appliance thermostat and controls.
DHW	Edel Dimplex System - 200ℓ system with a standing loss of 1.61kW/24hr.
Waste Water Heat Recovery	Recoup Easyfit - Type B, 38.7% efficient to all showers and shower-over-baths.
Ventilation	Mechanical Ventilation with Heat Recovery. Vectair WHHR Midi or similar approved system - insulated duct work and approved installation.
Lighting	100% Low Energy Lighting - LED throughout at 85lm/W efficiency.
Renewables	PV panels varying per unit/scenario in inclination, orientation and area. PV area is set to achieve the feasible baseline EPC rating per scenario.

Table 5 – Summary of the systems contributing towards the EUI of the building

2.2.2 Sample Units

A total of 8 no. sample units have been selected for the Energy Review analysis. A rational and representative range of units have been selected encompassing a diverse spread of units deemed to represent each aspect of Block B. This requires adequate variation in each criterion present throughout the units represented as given in Table 6.

Criteria	Value Range
Floor	1 to 8
Typology	19 to 58
Bedroom / Person (xByP)	1B2P; 2B3P; 2B4P; 3B5P; 3B6P

Table 6 - Sample unit criteria

The units selected and considered reasonable to provide an adequate representation of Block B are outlined in Table 7 with each value for the criteria of variation. As noted, the sample units encompass all values in cases where there are more sample units than values in the criterion set, and have no duplication where the criterion set size exceeds the number of sample units.

Unit Property Reference	Floor	Typology	Bedroom / Person
B-01-17	1	54	2B4P
B-02-12	2	38	1B2P
B-03-01	3	19	3B5P
B-04-19	4	55	1B2P
B-05-16	5	58	3B5P
B-06-01	6	25	2B4P
B-07-04	7	39	2B3P
B-08-01	8	49	3B6P

Table 7 - Sample units selected and corresponding criteria

In order to determine a representation for Block B based upon these selected sample units, a rational extrapolation is necessary to be performed. As one unit per floor has been utilised, extrapolation is performed through normalising each metric with respect to area, and extrapolating each sample unit across its respective floor. This is expected to yield a reasonable approximation of the energy performance of Block B.

2.2.3 Calculation of Metrics

Where analytics software has been used in the calculation of metrics, national standardised assessment conventions and procedures have been followed. Where analytics goes beyond that which is defined within national standards, recognised international industry conventions have been used and are referenced accordingly.

Energy Usage Intensity (EUI)

As discussed in section 2.1.2, the EUI has been determined through incorporation of regulated EUI and the unregulated energy associated with cooking.

The regulated EUI has been determined in accordance with nationally recognised and approved Elmhurst's SAP 2012 software and methodology[7]. This software has been utilised as the Proposed Development is being constructed under Building Regulations Part L1 2013. While the more recently released SAP10 software is available, it follows the same procedure with the primary differences pertaining to the new notional building specification and updated carbon factors. As such, these differences do not have a notable impact on the EUI although the updated carbon factors do impact the estimated carbon emissions and costs to occupants.

The unregulated EUI associated with cooking (EUI_{cook_use}) has been determined utilising the thermal gains load from cooking (L_{cook_gains}) as determined by SAP 2012[8] and calculated using proportional relationships in accordance with ASHRAE documentation[9]. A reasonable approximation has been assumed that 1 hour of cooking occurs per day.

It is assumed that the heat gains from cooking can be approximated as 30% of the estimated energy consumption based upon a typical hooded cooking system [10]. Utilising this relationship and normalising with respect to Area (A) provides the relationship outlined in Equation 1 for the EUI_{cook_use}.

$$EUI_{cook_use} = \frac{\left(\frac{L_{cook_gains} \times 30day \times 1hr}{30\%}\right)}{A} \quad \text{Equation 1}$$

The net EUI (EUI_{net}) is determined as a sum of the two EUI values as per Equation 2.

$$EUI_{net} = EUI_{regulated} + EUI_{cook_use} \quad \text{Equation 2}$$

Carbon Emissions

As discussed in section 2.1.2, the operational carbon emissions are a function of the grid. The normalised carbon emissions (C_e) have been calculated in accordance with Equation 3 based upon the carbon factor (CF) and the net EUI (EUI_{net}).

$$C_e = CF \times EUI_{net} \quad \text{Equation 3}$$

Operational Energy Cost

This has been calculated based upon SAP2012, SAP10 and current pricing multipliers as discussed in Section 2.1.2. The normalised operational energy cost ($£_{operation}$) with respect to floor area (A) is determined using the EUI_{net}, the cost of electricity ($£_{per\ kWh}$) and the standing electricity charge ($£_{standing}$) in accordance with Equation 4.

$$£_{operation} = EUI_{net} \times £_{per\ kWh} + \frac{£_{standing}}{A} \quad \text{Equation 4}$$

[7] The methodology is outlined in full within SAP 2012 version 9.92 rev June 2014 published on behalf of DECC by BRE.
[8] SAP 2012, Appendix L, equation L15/L15a.
[9] 2017 ASHRAE Handbook Fundamentals.
[10] Average value used based upon guidance stating heat gains from hooded cooking to be estimated at 15-45% of the energy consumption (2017 ASHRAE Handbook Fundamentals Ch 18.8).

2.3 Results

2.3.1 Energy Use Intensity (EUI)

The results of the analysis have been calculated as described in section 2.2.3. The EUI has been tabulated in Table 8 and represented graphically for each sample unit in Figure 6.

Reference	Unit Area (m²)	Representative Area (m²)	Net EUI (kWh/m²/yr)		EUI Improvement
			Scenario 1 Pitched Roof	Scenario 2 Flat Roof	
B-01-17	74.12	1091.09	36.71	23.82	35.12%
B-02-12	54.66	1188.85	37.88	26.19	30.86%
B-03-01	87.00	1188.85	29.42	22.08	24.96%
B-04-19	51.11	1188.85	40.73	28.23	30.69%
B-05-16	85.66	1056.87	36.63	21.92	40.15%
B-06-01	72.03	655.82	37.77	19.56	48.22%
B-07-04	64.21	309.39	38.86	23.94	38.40%
B-08-01	118.48	118.48	38.70	18.74	51.58%
Block	**6798.20**	**6798.20**	**36.56**	**23.91**	**34.61%**

Table 8 – Calculated net EUI for each sample unit and extrapolation for the block

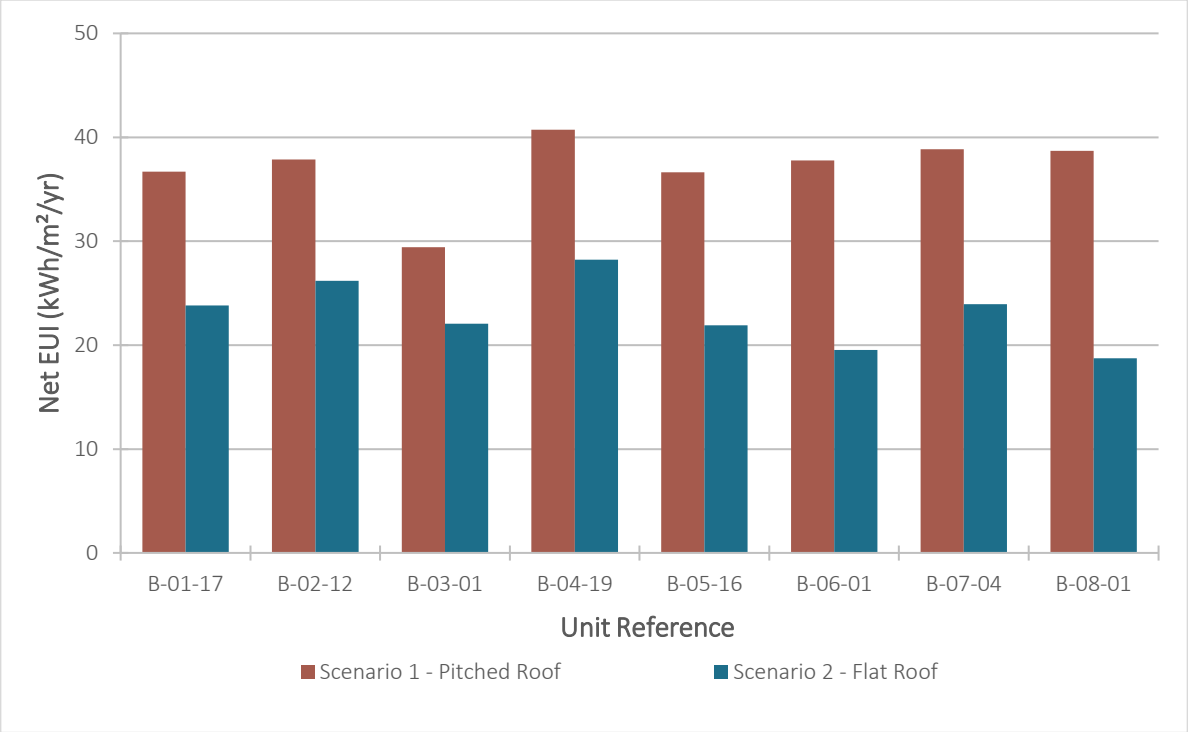

Figure 6 – Scenario comparison of EUI of each sample unit

The results show that the improvement of the flat roof over the pitched roof is significant. Scenario 2 ranges from a 24.96% to a 51.58% improvement in EUI over Scenario 1 across the sample units with each and every

unit demonstrating a substantial and significant impact. These results demonstrate the same trend when extrapolated across the entire block as shown in Figure 7.

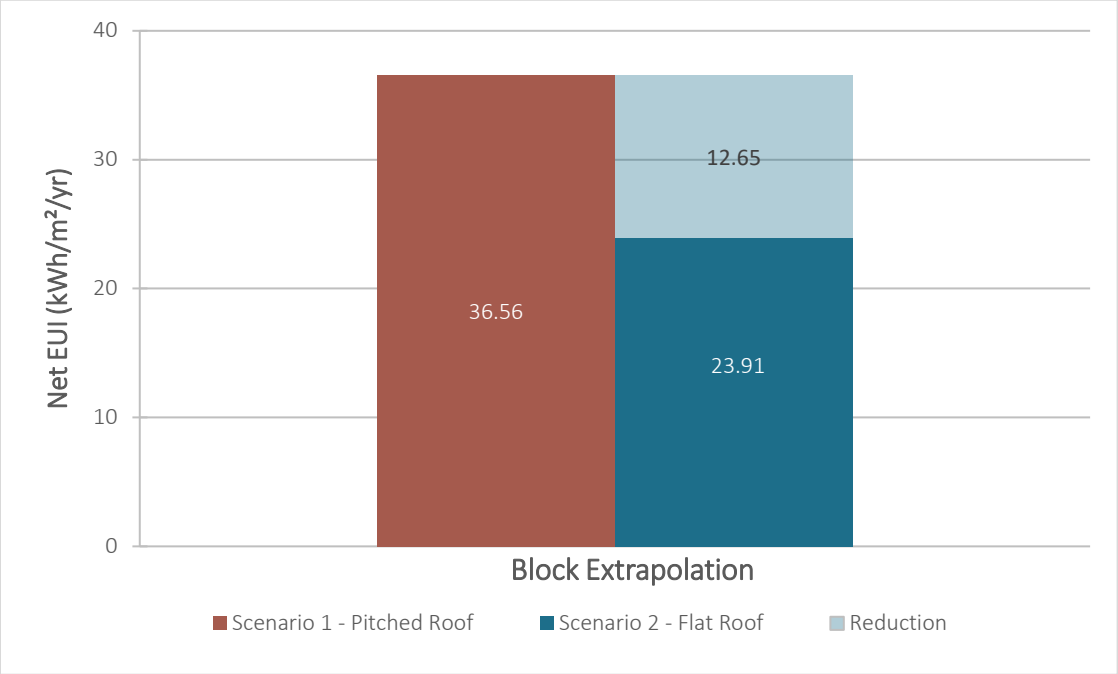

Figure 7 - Scenario comparison of EUI extrapolated across the block

Scenario 2 continues to demonstrate a significant improvement over Scenario 1 when extrapolated across the block reinforcing the benefits of the increased PV area of the Flat Roof design. This impact is expected to be mirrored across each of the further metrics to varying extents given their dependence upon the EUI.

2.3.2 Carbon Emissions

The results of the analysis have been calculated as described in section 2.2.3. The carbon emissions calculated to be generated by each sample unit have been tabulated in Table 9.

Reference	Unit Area (m²)	Representative Area (m²)	Carbon Emissions ($kgCO_2e/m^2/year$)						Carbon Improvement
			SAP2012		SAP10		NGGRCF		
			Scenario 1	Scenario 2	Scenario 1	Scenario 2	Scenario 1	Scenario 2	
B-01-17	74.12	1091.09	19.05	12.36	4.99	3.24	7.60	4.93	35.12%
B-02-12	54.66	1188.85	19.66	13.59	5.15	3.56	7.84	5.42	30.86%
B-03-01	87.00	1188.85	15.27	11.46	4.00	3.00	6.09	4.57	24.96%
B-04-19	51.11	1188.85	21.14	14.65	5.54	3.84	8.43	5.84	30.69%
B-05-16	85.66	1056.87	19.01	11.38	4.98	2.98	7.58	4.54	40.15%
B-06-01	72.03	655.82	19.60	10.15	5.14	2.66	7.82	4.05	48.22%
B-07-04	64.21	309.39	20.17	12.42	5.28	3.26	8.04	4.95	38.40%
B-08-01	118.48	118.48	20.08	9.72	5.26	2.55	8.01	3.88	51.58%
Block	**6798.20**	**6798.20**	**18.98**	**12.41**	**4.97**	**3.25**	**7.57**	**4.95**	**34.61%**

Table 9 – Calculated carbon emissions for each sample unit and extrapolation for the block

Due to the nature of carbon emission calculations from a single fuel source (namely grid electricity), each of the carbon factor sources are directly proportional and demonstrate the same percentage improvement. For this reason, only the most recent NGGRCF have been represented for each sample unit seen in Figure 8.

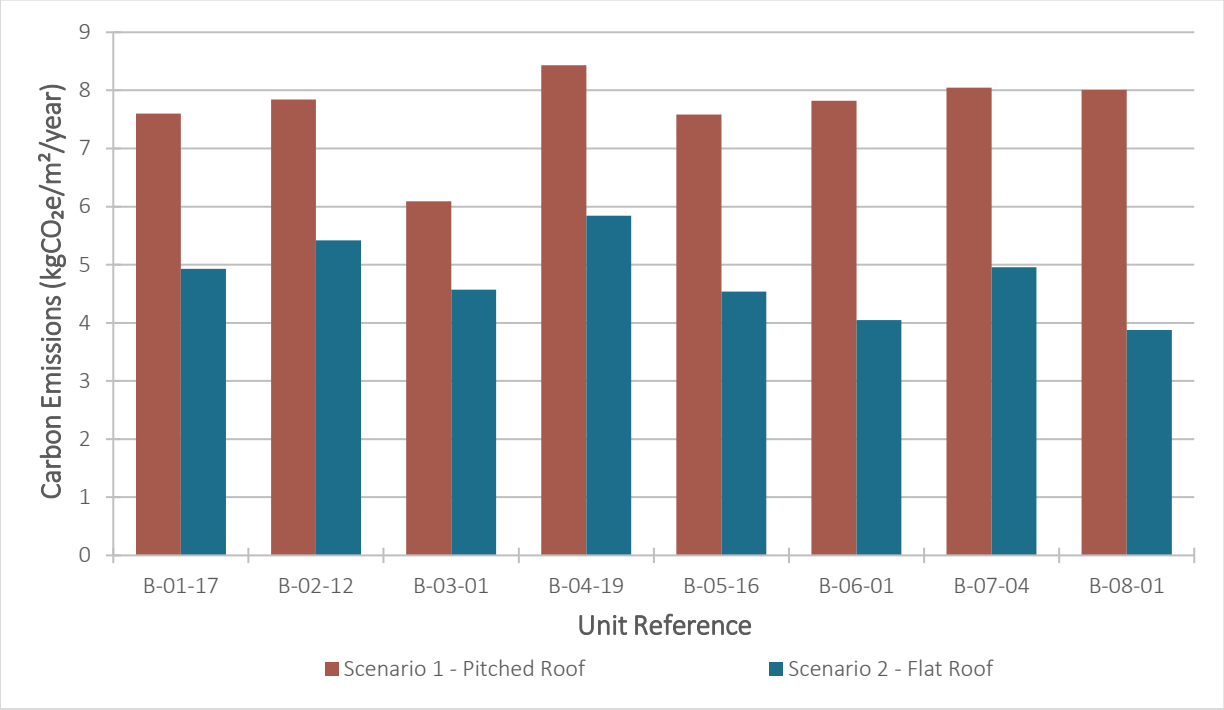

Figure 8 – Scenario comparison of normalised carbon emissions for sample units based upon NGGRCF

The carbon emission have been extrapolated across the entire block for each scenario and the results are provided in Table 10.

	Carbon Emissions						Carbon Improvement
	SAP2012		SAP10		NGGRCF		
	Scenario 1	Scenario 2	Scenario 1	Scenario 2	Scenario 1	Scenario 2	
Block Normalised Carbon Emissions ($kgCO_2e/m^2/year$)	18.98	12.41	4.97	3.25	7.57	4.95	34.61%
Block Net Carbon Emissions ($tCO_2e/year$)	129.01	84.36	33.80	22.11	51.45	33.65	

Table 10 – Block extrapolation of carbon emissions as normalised and net values based upon each assessed carbon factor

The net carbon emissions for the block for each scenario have been represented graphically in Figure 9.

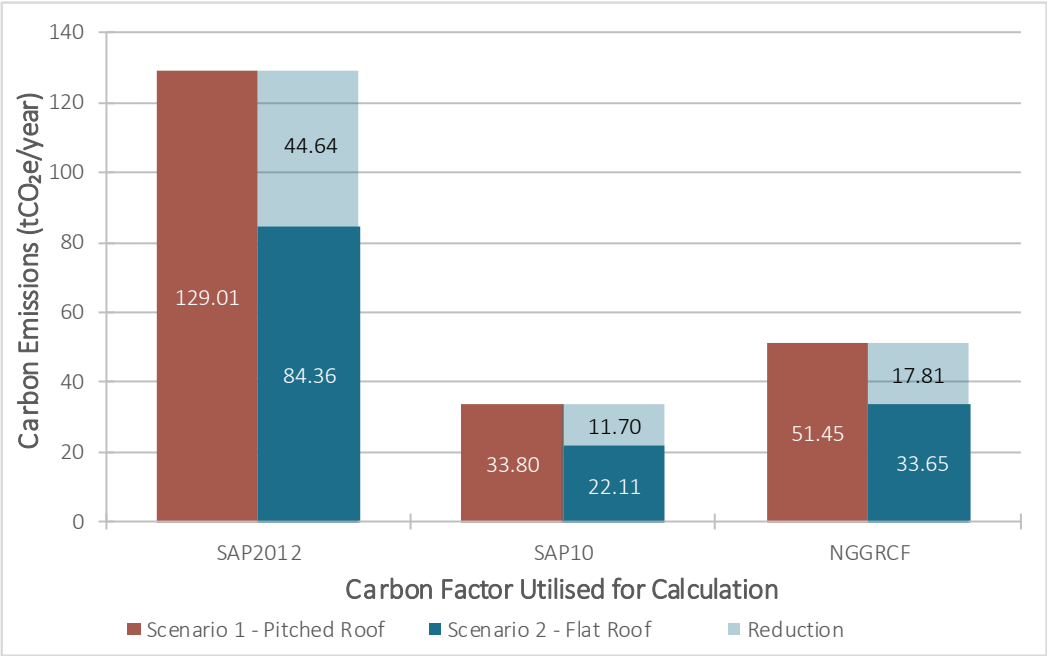

Figure 9 – Scenario comparison of net carbon emissions for the block based upon each assessed carbon factor

As anticipated due to the nature of the calculation, the net resulting carbon emissions from Scenario 2 demonstrates a 34.61% improvement over Scenario 1 in line with the EUI. When reviewing the range of assessed sample units, it is seen that the improvement is present across all units and ranges from 24.96% to 51.58%. The improvement is considered to be significant with an overall reduction in carbon emissions for the block estimated to be 17.80 tCO_2e/year.

2.3.3 Operational Energy Cost

The results of the analysis have been calculated as described in section 2.2.3. The operational energy costs calculated for each sample unit have been tabulated in Table 11.

Reference	Unit Area (m^2)	Representative Area (m^2)	Operational Cost (£/m^2/year)						Cost Improvement
			SAP2012		SAP10		Reported Pricing 2023-24		
			Scenario 1	Scenario 2	Scenario 1	Scenario 2	Scenario 1	Scenario 2	
B-01-17	74.12	1091.09	5.57	3.87	7.15	5.02	12.94	9.17	30.53%
B-02-12	54.66	1188.85	5.98	4.44	7.73	5.80	14.06	10.65	25.76%
B-03-01	87.00	1188.85	4.50	3.53	5.78	4.57	10.48	8.33	21.52%
B-04-19	51.11	1188.85	6.43	4.78	8.30	6.24	15.11	11.46	25.65%
B-05-16	85.66	1056.87	5.46	3.52	6.99	4.56	12.61	8.32	35.52%
B-06-01	72.03	655.82	5.73	3.33	7.35	4.35	13.31	7.99	41.92%
B-07-04	64.21	309.39	5.97	4.00	7.67	5.21	13.90	9.55	32.99%
B-08-01	118.48	118.48	5.56	2.93	7.06	3.77	12.69	6.86	47.35%
Block	**6798.20**	**6798.20**	**5.62**	**3.95**	**7.23**	**5.14**	**13.11**	**9.41**	**29.69%**

Table 11 – Estimated operational cost per unit based upon each assessed pricing factor

The estimated price indicated by the SAP10 projection for 2020-2025 is significantly lower than the reported values for 2023-2024. For this reason, the SAP10 projections are deemed to be statistically less contextually relevant than those determined by the 2023-2024 reporting snapshot. These values have therefore been

utilised in providing a typical annual and monthly cost per unit for each scenario in Table 12 and graphically indicated for each sample unit and an averaged typical unit for a typical year in Figure 10.

Reference	Unit Area (m^2)	Whole Unit Operational Cost (£)					
		Annual			Monthly		
		Scenario 1	Scenario 2	Cost Reduction	Scenario 1	Scenario 2	Cost Reduction
B-01-17	74.12	958.76	679.72	279.04	79.90	56.64	23.25
B-02-12	54.66	768.79	582.26	186.53	64.07	48.52	15.54
B-03-01	87.00	911.65	725.12	186.53	75.97	60.43	15.54
B-04-19	51.11	772.05	585.52	186.53	64.34	48.79	15.54
B-05-16	85.66	1,080.40	712.53	367.87	90.03	59.38	30.66
B-06-01	72.03	958.64	575.56	383.08	79.89	47.96	31.92
B-07-04	64.21	892.84	613.04	279.80	74.40	51.09	23.32
B-08-01	118.48	1,503.00	812.50	690.50	125.25	67.71	57.54
Block	6,798.20	89,113.92	63,996.07	25,117.85	7,426.16	5,333.01	2,093.15
Typical Unit	75.91	980.77	660.78	319.99	81.73	55.07	26.67

Table 12 – Annual and monthly operational costs per unit in the Proposed Development for each scenario

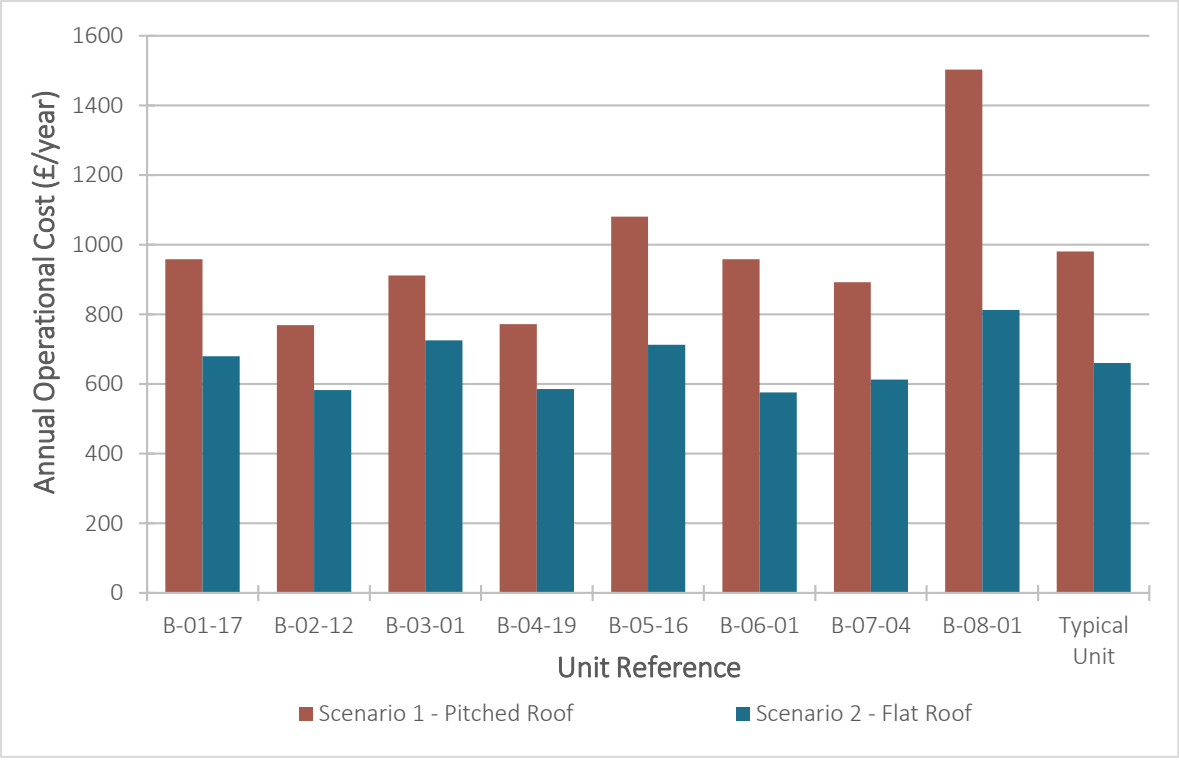

Figure 10 – Scenario comparison of annual operational costs per unit in the Proposed Development

The net impact of Scenario 2 over Scenario 1 is significant for the future residents of the Proposed Development. Each and every unit demonstrates a significant cost saving ranging from 21.52% to 47.35% with an overall saving across the whole block of 29.69% as per Table 11. Considering this in relatable cost terms, Scenario 2 would save a resident in a typical unit approximately £320 annually over Scenario 1. The impact on the whole block through block extrapolation is represented graphically in Figure 11.

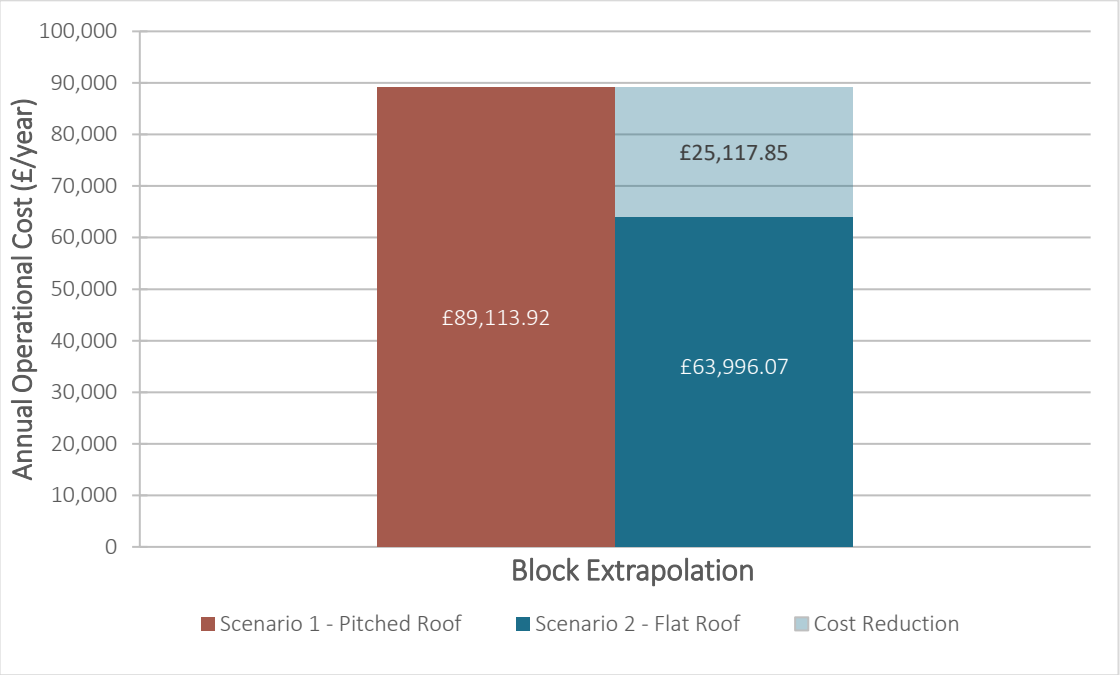

Figure 11 – Scenario comparison of annual operational cost extrapolated across the block

In comparing the results between Scenario 1 and Scenario 2 across the entire block, the significance in cost saving to the future residents is reinforced. With the reduction from Scenario 1 to 2 estimated at £25,117.85 annually for the block, it is clear that the benefits to the financial well-being of the future residents will improve the financial situation of the future tenants.

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3.0 Conclusions and Recommendations

Through this Energy Review, the performance differences between the two scenarios have been determined to be significant across each and every metric, namely EUI, carbon emissions and operational costs, and across all sample units. Due to the methods employed through this study, these results and conclusions are applicable across the entire Block B.

Through the additional PV that can be supported with the flat roof of Scenario 2, the EUI for the block is determined to reduce by 34.61%. This will reduce the energy demand on the grid and is in strong alignment with National agenda to reduce energy consumption within the built environment.

Scenario 2's additional PV also results in the same proportion of reduction to carbon emissions equating to 11.70 tonnes of CO_2e/year by SAP10 projected factors or, more likely estimated at 17.81 tonnes of CO_2e/year based upon published National factors per the NGGRCF. This is a substantial reduction offering significant benefits for the area in terms of sustainability.

Further benefits have been found directly affecting the future residents of the building in terms of reductions to the operational costs of their unit. According to the analytics, the additional PV enables units to reduce their annual operational energy bill by £186.53 for some of the smaller units, up to £690.50 in the larger units. In a typical unit, it has been found that the expected cost reduction is in the order of £319.99 per unit which equates to a 29.69% reduction. This represents a significant improvement in the lives of the future residents on a financial level.

In observations of the price trends observed from SAP2012 (2013-2015 projection published in 2012), SAP10 (2020-2025 projection published in 2021) and actual recent reported pricing from 2023-2024, the operational cost gap between the two scenarios is expected to continue to increase over the years to come. This further reinforces the benefits of the flat roof and corresponding additional PV support provided by Scenario 2.

Based upon these above findings and determinations, it is highly recommended that a flat roof (Scenario 2) is utilised within the Proposed Development as it offers significant benefits to reducing energy consumption, carbon emissions and improving the quality of life on a financial basis for the future residents.



SRE Registered Office
3 London Square | Cross Lanes
Guildford | Surrey | GU1 1UJ
T: +44 (0)1730 710044
E: info@sre.co.uk
W: www.sre.co.uk