Sheriffhall South East

Energy & Carbon Strategy

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1. Introduction

The Proposed Development is subject to a Hybrid Planning application for both Full Planning Permission and Planning Permission in Principle (PPiP) and is described as follows:

I. Full Planning Permission for the erection of Business (Class 4) development and ancillary Drive-Thru Coffee Shop, with associated car parking, access, infrastructure and landscaping proposals; and
II. Planning Permission in Principle for Business (Class 4), Storage & Distribution (Class 6) development with ancillary offices (detailed matters of landscaping, layout, appearance and scale are reserved for subsequent approval).

This report outlines the approach to Energy/Carbon reduction for the buildings associated with the full planning permission as shown in the extract from the site plan below.

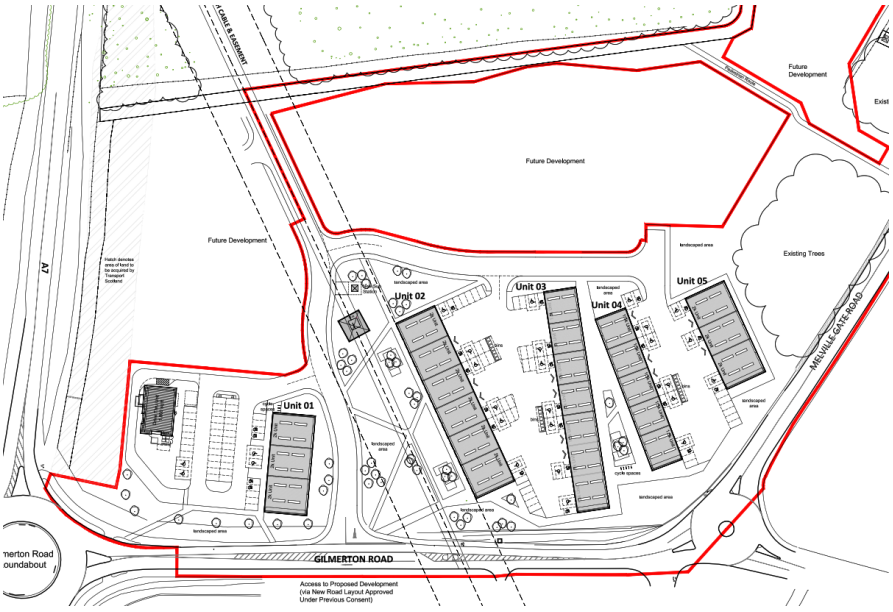


Image 1 - Site Plan of Sheriffhall South

The Developer wants to create a low energy, low carbon development, and the building designs have developed to allow a ‘Toolkit’ approach to the envelope design that allow units to be adapted to specific end user requirements. The approach to M&E services for the unit has been considered in a similar way, with different options considered as part of the early appraisal to identify how future occupiers could fit-out the units to meet low energy/carbon standards.

The development needs to meet the requirements of Midlothian Planning NrG3 / NRG4 and Scottish Technical Standards. This report outlines the approach to meeting these requirements.

The report illustrates how the proposed strategy can deliver an Energy Performance Rating ‘A’ for the buildings.

Consideration has also been given to the net zero carbon pathway defined in the London Energy Transformation Initiative (LETI) with Operational Energy, Low Carbon Heat, Building Integrated Renewables, and Embodied Carbon strategies options reviewed.

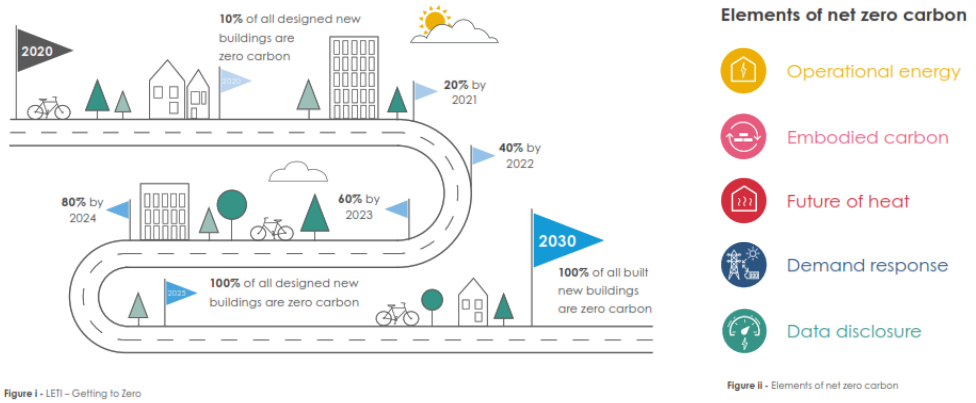


Image 2 – London Energy Transformation Initiative (LETI) – Net Zero Pathway

This report presents an overview of the typical terrace unit and focuses on the building performance implications of the proposals using a review of Building regulations section 6 compliance and Energy Performance Certificate (EPC) results when different upgrade options are considered.

We have developed seven options for the units:

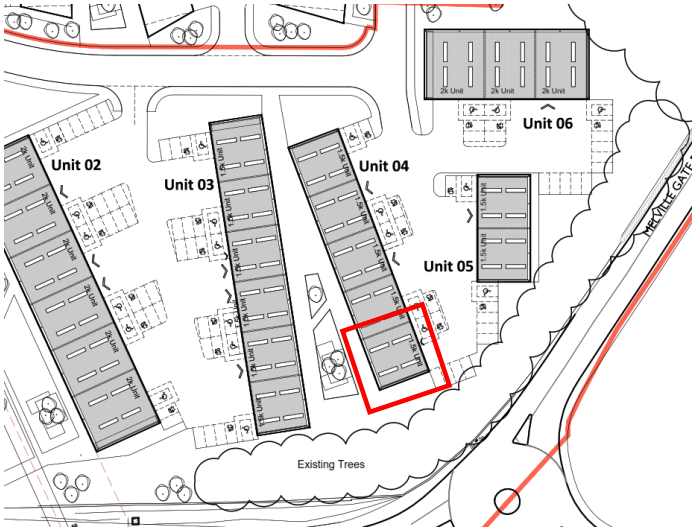
1. Backstop u-values with natural ventilation.
2. Improved u-values with mechanical ventilation and heat recovery.
3. Improved U-values, MVHR & Air Source Heat Pump
4. Good practice U-values
5. Exemplar U-values
6. Exemplar U-values & Optimal M&E services
7. Exemplar U values & Optimal M&E with PV

The breakdown of these options can be found in Section 6 - Energy Performance Improvement: Summary.

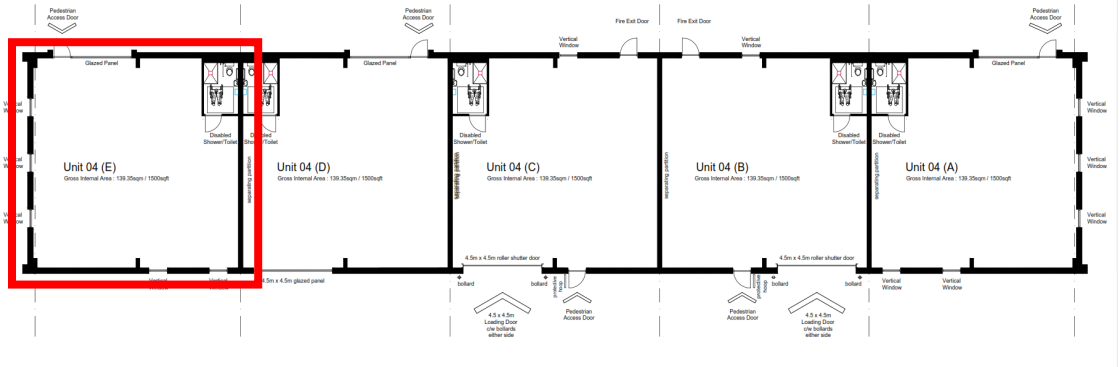
This report will focus on a typical unit in the development as a test case in which the rest of the units will be based upon. This reports information is intended to help define the strategy for the development. The strategies outlined will require further technical and financial appraisal but illustrate the range of options that can be implemented to meet the required policy and technical standards.

Unit 4 - E

The typical unit is shown below with associate ground floor layout.



Unit 4 Typical Unit Site Location



Ground Floor Plans for Unit 4

2. Compliance with Technical Standards

The Scottish Technical Standards Non-Domestic (April 2021), section 6.1 (Carbon Dioxide Emissions) states:

To comply with the requirements of Standard 6.1, designers should demonstrate that the calculated carbon dioxide emissions for the 'actual' building (Building Emissions Rate or BER) do not exceed those which are calculated for a 'notional' building (Target Emissions Rate or TER). The carbon dioxide emissions are measured in kilograms of CO2 per square metre of floor area per annum.

In addition, section 6.9 (Energy Performance Certificates) notes:

Every building must be designed and constructed in such a way that:

a. an energy performance certificate for the building is affixed to the building

The following sections of this report illustrate how the development proposals can meet the requirements of section 6.1 and deliver an EPC 'A' rating.

3. Compliance with NRG 3 and NRG4 Policy

The development needs to comply with Midlothian Council's planning policies NRG3 and NRG4.

NRG3 specifies that each new building meets the statutory requirement for a low and zero-carbon generating technology policy. The policy requires all new buildings to meet or exceed the target emissions rate of the current Building Regulations (2015).

NRG4 sets out the limitations and exceptions relative to policy NRG3.

In relation to the provisions of policy NRG4, to meet the requirements of policy NRG3 there must be a betterment of the projected carbon dioxide emission rate for the

building over the carbon dioxide emissions standard under the Building Regulations i.e. BER<TER

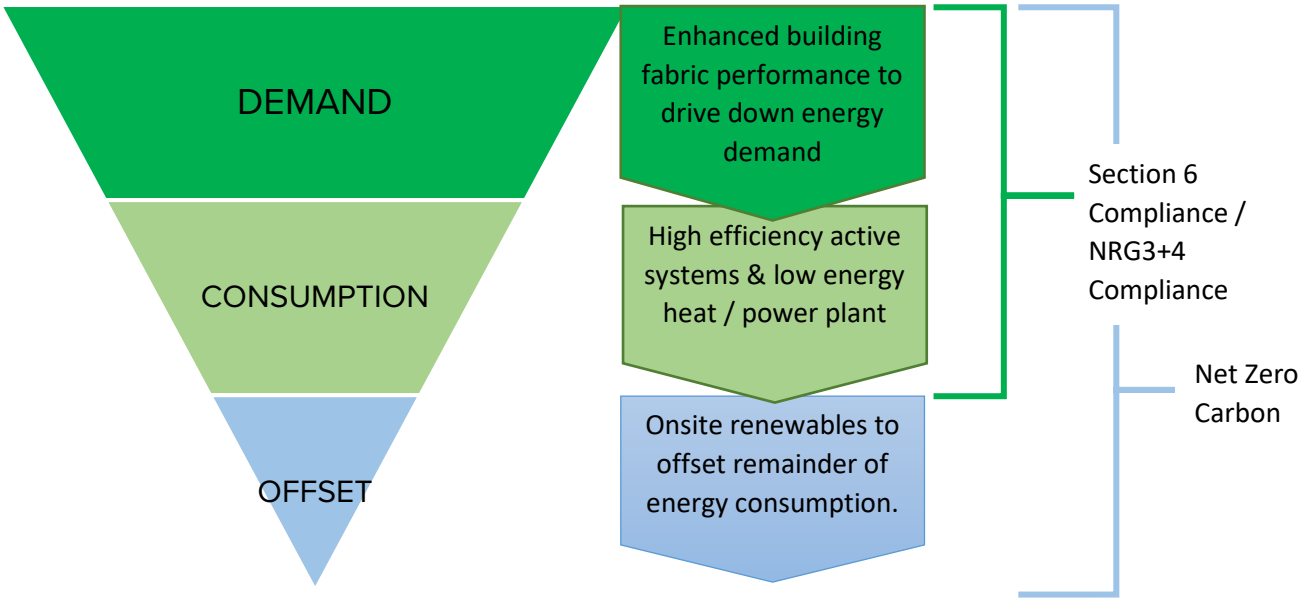
The following sections of this report illustrate how the development proposals meet the requirements of the policy.

4. Site Energy & Carbon Strategy

4.1. Energy Performance Targets and Approach

The energy strategy for the site follows the Energy Hierarchy with demand reduced via passive design measures, energy use minimised by selection of efficient services solutions and finally practical renewable solutions applied at a building level.

The diagram below shows the hierarchy of building energy elements and the approach to reduce each one.

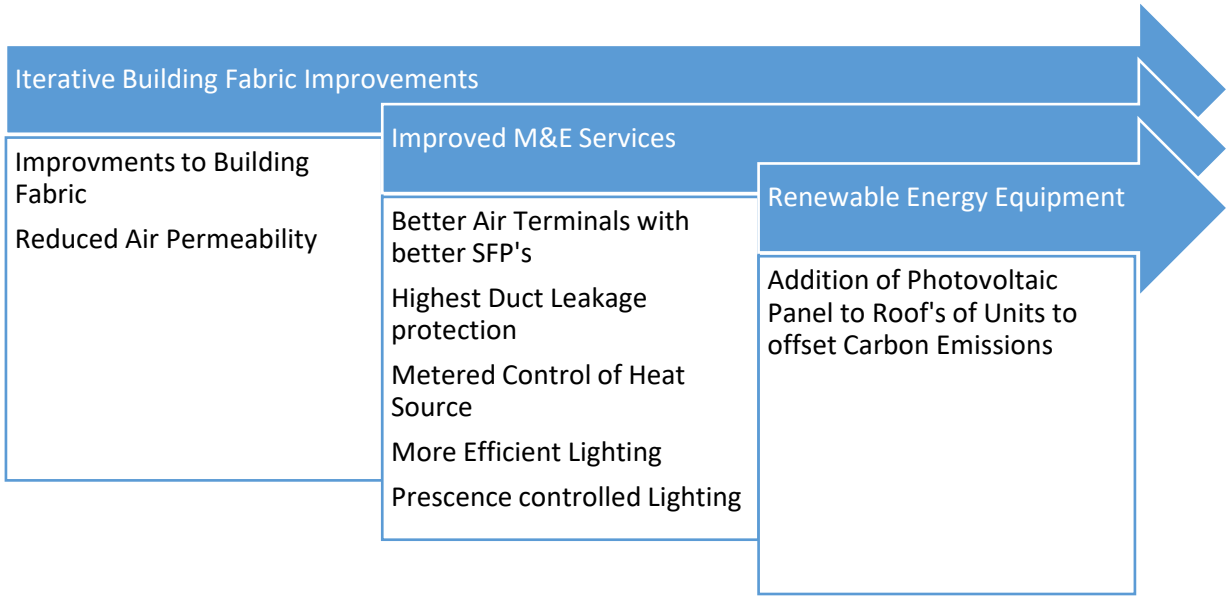


4.2. Primary Fuel Source Assessment

The primary fuel source for the development is an important consideration and a fundamental decision has been made that there will be no direct fossil fuel use within the development. The commitment to an all-electric scheme will ensure that operational carbon emissions reduce to zero as de-carbonisation of the grid

advances. On this basis, only fully electric options are considered for heating solutions for the buildings, including air source heat pumps (ASHP) solutions.

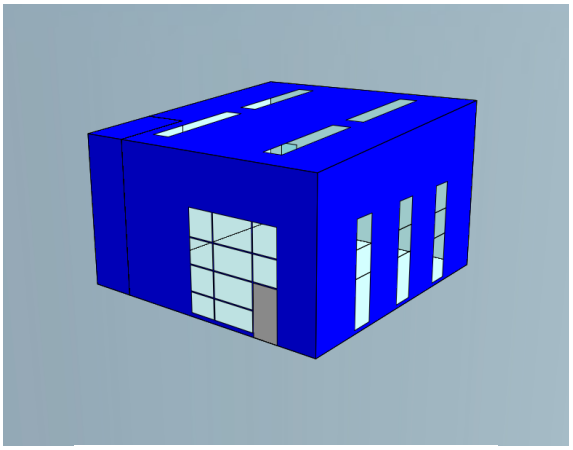
Based on the hierarchy of building energy elements, a ‘fabric first’ approach is adopted to minimise heating demand and therefore electrical usage / heat pump output. This would be followed by an ‘improved M&E’ approach and finally the addition of LZCT to offset the carbon emission from the units.



5. Energy performance improvement opportunities

This section of this report will assess the energy performance and carbon emissions benefits realised by the different development options proposed for the multi-use units. This will be accomplished via a mixture of building service and fabric upgrades as outlined previously

Simulation model geometries have been constructed based on November 2021 available floor plans. Below is an example of the model geometry for unit 4E.



Unit 4E IESVE Model

IES Virtual Environment software has been used to undertake the compliance analysis.

This investigation uses the CIBSE approved Test Reference Year (TRY) 2005 for Glasgow as per requirements of the National Calculation Methodology (NCM) Modelling Guide for Non-Domestic Buildings in Scotland. Below is a summary of the model inputs assigned to the different energy performance simulations.

5.1 Baseline Option – Backstop U-values

5.1.1 Building envelope characteristics

Element	U-value (W/m2.k)
Windows	2
Roof Lighting	1.8
External Wall	0.27
Roof	0.2
Floor	0.22
Door	2

Element	m3/hr.m2
Air permeability	7

5.1.2 Mechanical Building Services

Room Type	Heating Strategy	Auxiliary Ventilation	DHW
Main Area	Electric Panel Heaters	Natural Vent	Point of Use Electric with No Storage Losses
Toilet Area	Electric Panel Heaters	Natural Vent	

The efficiencies of the Electric Panel Heaters were assumed as 1. The Domestic hot water will be supplied using instantaneous point of use water heaters. This will reduce the heat loss in pipework throughout the unit.

5.1.3 Lighting and Electric

Room Type	Total Wattage (W/m2)	Control Method
Main Area	15	Manual Switching
Toilet Area	15	

5.1.4 EPC Results

Approximate Carbon Dioxide Emissions	87.5 $kgCO_2/m^2$.annum
Approximate Energy Use	169 kWh/m^2.annum
Rating	**F+**

5.2 Option 2 – Enhanced Building Fabric & Mechanical Ventilation with Heat Recovery (MVHR)

5.2.1 Building envelope characteristics

Element	U-value (W/m2.k)
Windows	1.6
Roof Lighting	1.8
External Wall	0.2
Roof	0.16
Floor	0.2
Door	2

Element	m3/hr.m2
Air permeability	5

5.2.2 Mechanical Building Services

Room Type	Heating Strategy	Auxiliary Ventilation	DHW
Main Area	Electric Panel Heaters	Mechanical Supply & Extract	Point of Use Electric with No Storage Losses
Toilet Area	Electric Panel Heaters	Mechanical Extract Only	

Same as Option 1 with the inclusion of mechanical ventilation. The MVHR unit has a SFP of 1.8 and a terminal SFP of 0.8.

5.2.3 Lighting and Electric

Room Type	Total Wattage (W/m2)	Control Method
Main Area	15	Manual Switching
Toilet Area	15	

5.2.4 EPC Results

Approximate Carbon Dioxide Emissions	55.5 $kgCO_2/m^2.annum$
Approximate Energy Use	107 $kWh/m^2.annum$
Rating	**D**

5.3 Option 3 – Enhanced Building Fabric & Air Source Heat Pump (ASHP)

5.3.1 Building envelope characteristics

Element	U-value (W/m2.k)
Windows	1.6
Roof Lighting	1.8
External Wall	0.2
Roof	0.16
Floor	0.2
Door	2

Element	m3/hr.m2
Air permeability	5

5.3.2 Mechanical Building Services

Room Type	Heating Strategy	Auxiliary Ventilation	DHW
Main Area	Air Source Heat Pump	Mechanical Supply & Extract	Point of Use Electric with No Storage Losses
Toilet Area	Air Source Heat Pump	Mechanical Extract Only	

Same as Option 2 with the inclusion of an Air Source Heat Pump. The efficiencies of the Air Source Heat Pump were assumed as 2.5.

5.3.3 Lighting and Electric

Room Type	Total Wattage (W/m2)	Control Method
Main Area	15	Manual Switching
Toilet Area	15	

5.3.4 EPC Results

Approximate Carbon Dioxide Emissions	31.6 $kgCO_2/m^2.annum$
Approximate Energy Use	61 $kWh/m^2.annum$
Rating	**C+**

5.4 Option 4 – Further Enhanced Building Fabric & Air Source Heat Pump (ASHP)

5.4.1 Building envelope characteristics

Element	U-value (W/m2.k)
Windows	1.2
Roof Lighting	1.8
External Wall	0.17
Roof	0.11
Floor	0.15
Door	1.2

Element	m3/hr.m2
Air permeability	3

This option focuses on the improvement of the building fabric and air leakage.

5.4.2 Mechanical Building Services

Room Type	Heating Strategy	Auxiliary Ventilation	DHW
Main Area	Air Source Heat Pump	Mechanical Supply & Extract	Point of Use Electric with No Storage Losses
Toilet Area	Air Source Heat Pump	Mechanical Extract Only	

Same as Option 3.

5.4.3 Lighting and Electric

Room Type	Total Wattage (W/m2)	Control Method
Main Area	15	Manual Switching
Toilet Area	15	

5.4.4 EPC Results

Approximate Carbon Dioxide Emissions	25.5 $kgCO_2/m^2.annum$
Approximate Energy Use	49 $kWh/m^2.annum$
Rating	**B**

5.5 Option 5 – High Performance Building Fabric & Air Source Heat Pump (ASHP)

5.5.1 Building envelope characteristics

Element	U-value (W/m2.k)
Windows	0.9
Roof Lighting	1.8
External Wall	0.12
Roof	0.08
Floor	0.1
Door	1

Element	m3/hr.m2
Air permeability	2

This option focuses on the improvement of the building fabric and air leakage.

5.5.2 Mechanical Building Services

Room Type	Heating Strategy	Auxiliary Ventilation	DHW
Main Area	Air Source Heat Pump	Mechanical Supply & Extract	Point of Use Electric with No Storage Losses
Toilet Area	Air Source Heat Pump	Mechanical Extract Only	

Same as Option 4.

5.5.3 Lighting and Electric

Room Type	Total Wattage (W/m2)	Control Method
Main Area	15	Manual Switching
Toilet Area	15	

5.5.4 EPC Results

Approximate Carbon Dioxide Emissions	21.3 $kgCO_2/m^2.annum$
Approximate Energy Use	$41kWh/m^2.annum$
Rating	**B+**

5.6 Option 6 – High Performance Building Fabric & Optimal M&E Systems

5.6.1 Building envelope characteristics

Element	U-value (W/m2.k)
Windows	0.9
Roof Lighting	1.8
External Wall	0.12
Roof	0.08
Floor	0.1
Door	1

Element	m3/hr.m2
Air permeability	2

Same as Option 5.

5.6.2 Mechanical Building Services

Room Type	Heating Strategy	Auxiliary Ventilation	DHW
Main Area	Air Source Heat Pump	Mechanical Supply & Extract	Point of Use Electric with No Storage Losses
Toilet Area	Air Source Heat Pump	Mechanical Extract Only	

Same as previous options with inclusion of better duct leakage rating, metered controls, more efficient lighting and lighting controls.

5.6.3 Lighting and Electric

Room Type	Total Wattage (W/m2)	Control Method
Main Area	5	Auto On / Off
Toilet Area	5	

5.6.4 EPC Results

Approximate Carbon Dioxide Emissions	17.6 $kgCO_2/m^2.annum$
Approximate Energy Use	34 $kWh/m^2.annum$
Rating	**B+**

5.6 Option 7 – High Performance Building Fabric, Optimal M&E Systems, Roof PV

5.7.1 Building envelope characteristics

Element	U-value (W/m2.k)
Windows	0.9
Roof Lighting	1.8
External Wall	0.12
Roof	0.08
Floor	0.1
Door	1

Element	m3/hr.m2
Air permeability	2

Same as Option 5

5.7.2 Mechanical Building Services

Room Type	Heating Strategy	Auxiliary Ventilation	DHW
Main Area	Air Source Heat Pump	Mechanical Supply & Extract	Point of Use Electric with No Storage Losses
Toilet Area	Air Source Heat Pump	Mechanical Extract Only	

Same as Option6 with 15 m^2 of PV

5.7.3 Lighting and Electric

Room Type	Total Wattage (W/m2)	Control Method
Main Area	5	Auto On / Off
Toilet Area	5	

5.7.4 EPC Results

Approximate Carbon Dioxide Emissions	10.1 $kgCO_2/m^2.annum$
Approximate Energy Use	34 $kWh/m^2.annum$

6. Energy performance improvements: Summary

		Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7
		Compliance		Building Fabric Improvement			M&E Services	LZCT
		Backstop U-Values	Enhanced U-Values & Nat Vent	Enhanced U-Values MVHR & ASHP	Further Enhanced U-Values	High Performance U-Values	High Performance U-Values & Optimal M&E	E High Performance U-Values, Optimal M&E & PV
Building U-values	Window U-Value (*W/m²K*)	2	**1.6**	1.6	**1.2**	**0.9**	**0.9**	0.9
	Door U-Value (*W/m²K*)	2	2	2	**1.2**	**1**	**1**	1
	External Wall U-Value (*W/m²K*)	0.27	**0.20**	0.20	**0.17**	**0.12**	**0.12**	0.12
	Roof U-Value (*W/m²K*)	0.2	**0.16**	0.16	**0.11**	**0.08**	**0.08**	0.08
	Floor U-Value (*W/m²K*)	0.22	**0.2**	0.2	**0.15**	**0.1**	**0.1**	0.1
Construction	Air Leakage *(m³/hr/m² @50 Pa)*	7	**5**	5	**3**	**2**	**2**	2

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M&E Services	Ventilation *Ventilation Systems and Fan SFP's assumed*	Natural Ventilation	**Extract & Supply 0.8 MVHR 1.8**	Extract & Supply 0.8 MVHR 1.8	Extract & Supply 0.8 MVHR 1.8	Extract & Supply 0.8 MVHR 1.8	Extract & Supply 0.4 MVHR 1.8	Extract & Supply 0.4 MVHR 1.8
	Heating *Heating system assumed*	Electric Panel Heating	Electric Panel Heating	**Air Source Heat Pump**	Air Source Heat Pump	Air Source Heat Pump	Air Source Heat Pump	Air Source Heat Pump
	Heating System Efficiency *Annual SEER efficiency of assumed heating source*	1	1	**2.5**	2.5	2.5	2.5	2.5
	Hot Water Generation / Storage *Hot water generation method assumed*	Point of Use Electric with No Storage Losses	Point of Use Electric with No Storage Losses	Point of Use Electric with No Storage Losses	Point of Use Electric with No Storage Losses	Point of Use Electric with No Storage Losses	Point of Use Electric with No Storage Losses	Point of Use Electric with No Storage Losses
	Fixed Internal Lighting *Quantity of dedicated low-energy fixed fittings*	15 W/m^2	15 W/m^2	15 W/m^2	15 W/m^2	15 W/m^2	**5 W/m^2**	5 W/m^2

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	Additional Renewables *Description of renewables over and above main heat source*	None	None	None	None	None	None	**PV 15m²**
Results	EPC Rating	**F+**	**D**	**C+**	**B**	**B+**	**B+**	**A**
	Building Carbon Dioxide Emissions Rate (BER) *($kgCO_2/m^2.annum$)*	87.5	55.5	31.6	25.5	21.3	17.6	10.1
	Approximate Energy Use *($kWh/m^2.annum$)*	169	107	61	49	41	34	34
	Target Carbon Dioxide Emissions Rate (TER) *($kgCO_2/m^2.annum$)*	40.8	37.9	37.9	37.9	37.9	37.9	37.9
	Section 6 Pass	No	No	Yes	Yes	Yes	Yes	Yes
	NRG3 & NRG4 Pass	No	No	Yes	Yes	Yes	Yes	Yes

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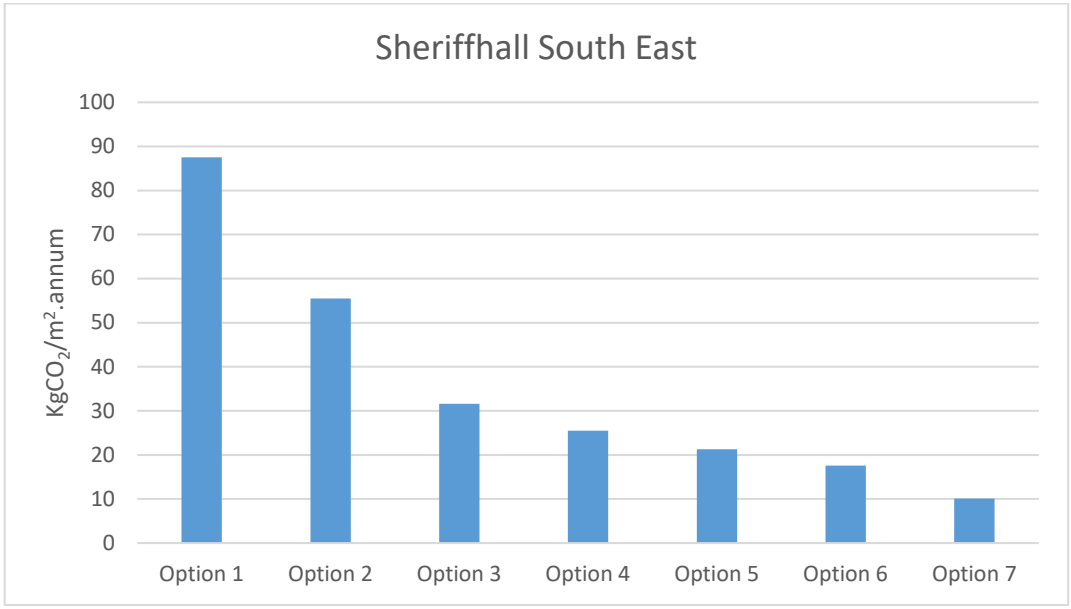
Option Summary Chart

The chart below shows each option's estimated carbon dioxide emission rates comparatively.



7. Conclusion

The analysis illustrates options 3-7 can deliver compliance with Building Regulations section 6.1 and Midlothian Council Planning policy NRG3 / NRG4. These options require improvements to the building fabric/air-tightness levels beyond the backstop values prescribed in the regulations. The adoption of electric air source heat pump solutions for these options also contribute to achieving the necessary standard.

An EPC analysis of the typical building shows that with the 7 options presented in this report a maximum EPC rating of A is achievable utilising sufficiently low building fabric u-values and building air permeability with optimal M&E services including ASHP and efficient lighting with a PV arrangement.