Main Road, Chedworth

Energy and Sustainability Statement

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Prepared for;

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1.0 Version History

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2.0 Contents

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3.0 Executive Summary

This Statement has been prepared in support of the new residential development proposed by The Snape Group in Chedworth, Cheltenham, Gloucestershire, for the construction of a pair of semi-detached houses. The statement includes an energy and sustainability assessment showing how selected energy efficiency and low carbon measures have been utilised to ensure that the site complies with the relevant building regulation and local council energy and sustainability policies.

SAP Calculations have been prepared for the development based upon the construction specification set out within the report. This provides an accurate assessment of the carbon dioxide emissions and energy demand arising from the dwellings proposed on the site in relation to Part L and the policies and principles outlined within the Cotswold District Local Plan 2011-2031 (Adopted 3 August 2018) as well as the Cotswold District Council Net Zero Carbon Toolkit.

The project incorporates a broad range of passive measures within its design to reduce both the energy demand and carbon emissions from the dwellings which include the orientation, larger opening windows to westerly orientations and low thermal mass. These measures combine to decrease the energy demand needed by and the carbon emissions emitted from these proposed dwellings.

The proposed design also incorporates low temperature heating through Air Source Heat Pumps (ASHP), mechanical ventilation heat recovery units (MVHR) enabling the fabric of the dwellings to be built to a low air permeability level. PV panels are modelled and the results included within the report, however, it is acknowledged that this option may not be suitable within this conservation location.

The combination of passive and active solutions proposed on site (not including PV) would reduce the carbon emissions of the site by 4,676.49 $KgCO_2$/year which is a reduction of 46.2% over the notional TER carbon emissions and a reduction in energy demand of 20,114.28 KWh/year which is a reduction of 68.83% over the notional TER energy demand of the site.

The combination of passive and active solutions (including PV) would reduce the carbon emissions of the site by 7,777.77 $KgCO_2$/year which is a reduction of 77.31% over the notional TER carbon emissions and a reduction in energy demand of 25,438.18 KWh/year which is a reduction of 87.05% over the notional TER energy demand of the site.

The above results demonstrate that the project fully complies with the requirements outlined within the Cotswold District Local Plan 2011-2031 (INF10) to exceed Part L requirements and the pillar principles outlined within the Net Zero Carbon Toolkit whether PV is or is not utilised on the site.

4.0 Introduction

This Statement has been prepared in support of the new residential development proposed by The Snape Group in Chedworth, Cheltenham, Gloucestershire, for the construction of 2 semi-detached houses.

The following statement seeks to outline how this development will comply with the requirements and objectives of the Cotswold District Local Plan 2011-2031 (Adopted 3 August 2018) as well as the Cotswold District Council Net Zero Carbon Toolkit by addressing

- **INF10** – Renewable and Low Carbon Energy Development
- **Net Zero Carbon Toolkit** – Energy efficiency and carbon reduction measures

Darren Evans Limited have been commissioned to:

- Investigate the technical viability and feasibility of incorporating low or zero carbon technologies into the development
- Identify additional solutions outside the scope of renewable energy technologies which will assist in improving the energy efficiency of the proposed development
- Reduce carbon emissions associated with the development
- Address how the development will meet wider sustainable development issues

5.0 Local Planning Policy

The local planning policy outlined within the Cotswold District Local Plan 2011-2031 relevant to reducing carbon emissions and energy demand is found within policy INF10.

INF10 – Renewable and Low Carbon Energy Development

11.10.2 Reducing energy use and carbon emissions helps to limit the level of greenhouse gas emissions, and new developments should therefore be energy efficient. Renewable energy technologies, such as solar panels, can be designed into new developments. Alongside sustainable energy construction requirements new development will be expected to contribute toward the cutting of carbon emissions.

11.10.3 The policy seeks positively to encourage renewable and low carbon energy development while ensuring any adverse impact is satisfactorily addressed.

11.10.4 On 25th March 2015 the Government confirmed its policy to limit local energy requirements for residential development and continue to support low carbon energy development. New national technical standards for all new dwellings are being introduced, centred on Building Regulations, and development should be constructed in accordance with these standards and emerging government guidance. Building Regulations Part L will become the sole tool to control energy efficiency in new homes.

11.10.6 Planning plays an important role in supporting the delivery of renewable and low carbon energy and associated infrastructure. To support a move to a low carbon future, national planning policy and guidance supports local planning authorities to provide proactive strategies to mitigate and adapt to climate change. Gloucestershire County Council commissioned a Renewable Energy Study (2010 and 2011).

11.10.7 The Council will support low or zero-carbon energy generating proposals that contribute positively to the aim of reducing CO_2 emissions although this support does not automatically override environmental protections. Proposals will need to fully consider the impact of the development and any associated infrastructure on amenity and landscape (including local topography), any cumulative impact, and demonstrate engagement with local communities.

Net Zero Carbon Toolkit

The council have also published a Net Zero Carbon Tool Kit (https://www.cotswold.gov.uk/media/05couqdd/net-zero-carbon-toolkit.pdf) to further guide new development projects in the principles and decisions that need to be at the core of project design decisions to ensure that developments seek fully to reduce carbon emissions and energy demand.

The 3 pillars of a Net Zero Carbon building in operation that are outlined within the document are outlined below.

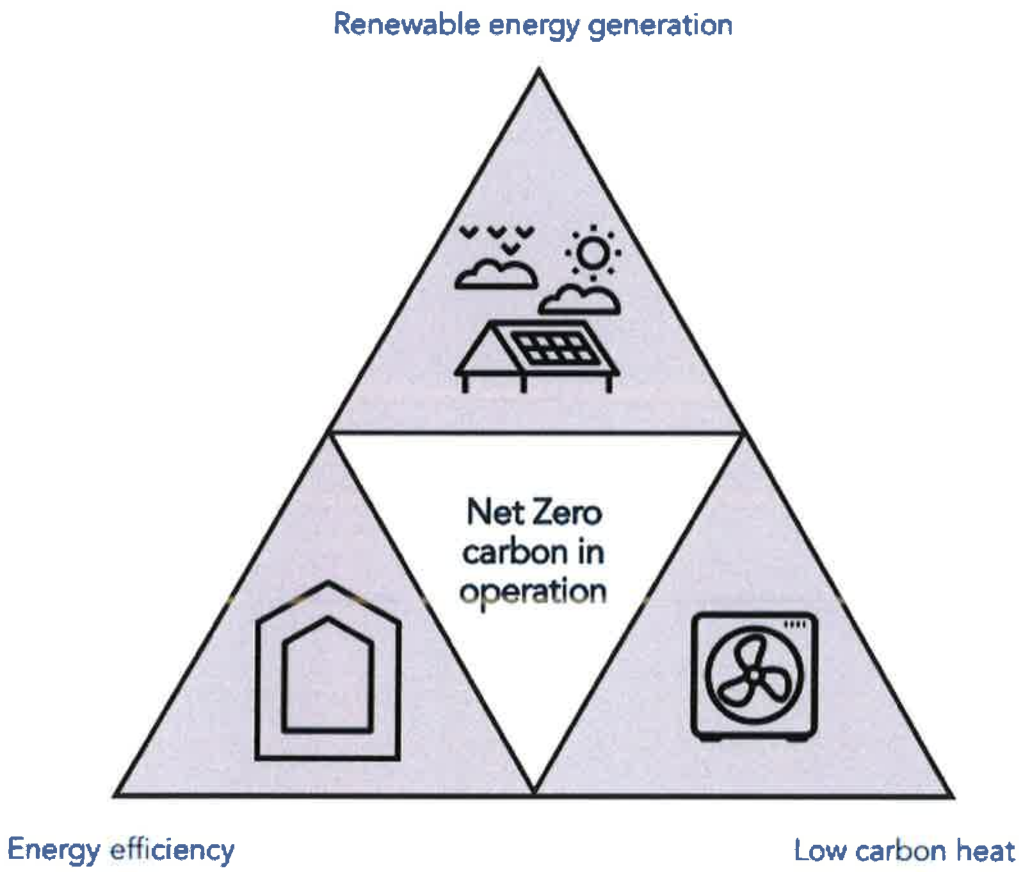
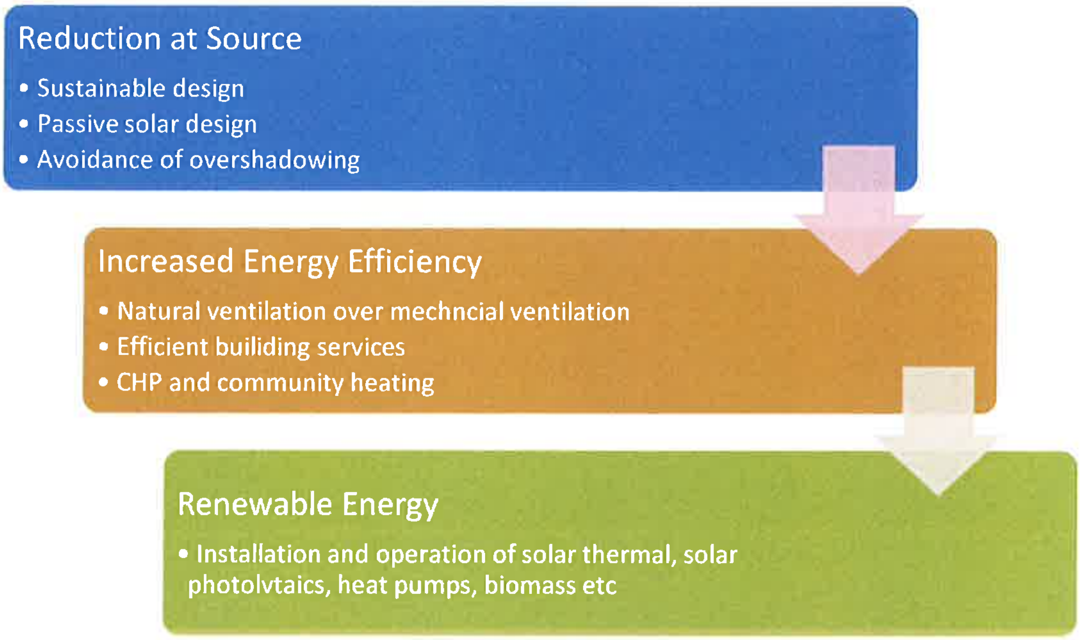


Fig 7. The 3 Pillars of a Net Zero Carbon Building (P8. Net Zero Carbon Toolkit)

6.0 The Energy Hierarchy

The Energy Hierarchy is a widely adopted and recognised set of principles to guide design, planning and development decisions to optimise energy provision. The Hierarchy prioritises minimising the need for energy consumption through firstly design and energy efficiency and then through generating the reduced energy demand via renewables. The Hierarchy can also help to balance the economic and environmental dimensions of sustainability, supporting choices which are both environmentally and economically sustainable.



It is considered that the above principles carbon reduction forms the most appropriate approach from both the practical and financial perspective. The industry is broadly in agreement that the energy efficiency and low carbon technologies have the greatest impact offsetting CO_2 emissions. Therefore, it is logical to encourage enhanced mitigation through energy efficiency and low carbon technologies in the first instance, as opposed to applying renewables as the first option at a significantly greater cost.

7.0 The Proposed Development

This Statement has been prepared in support of the new residential development proposed by The Snape Group in Chedworth, Cheltenham, Gloucestershire, for the construction of 2 semi-detached houses.

Fig 1. Street Scene Courtesy of Pegasus Design

Fig 2. Site Plan Courtesy of Pegasus Design

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Fig 3. Plot 1 Floor Plan Courtesy of Pegasus Design

Fig 4. Plot 1 Elevation Courtesy of Pegasus Design

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Fig 5. Plot 2 Floor Plan Courtesy of Pegasus Design

Fig 6. Plot 2 Elevation Courtesy of Pegasus Design

8.0 Sustainable Energy Strategy

The energy performance of a building is affected by its design, construction and use and whilst occupant behaviour is beyond the remit of this statement, better design and construction methods can significantly reduce the life cycle emissions of a building and assist the occupant to reduce consumption.

Sustainable design is not just about incorporating renewable technologies; buildings should be designed at the outset to provide suitable environmental conditions for the occupants whilst also consuming as little energy as practical. It is possible to exceed Building Regulations requirements (Part L 2013) through demand reduction measures alone, which typically include a combination of passive design measures (e.g. building design and efficient building fabric) and active design measures (e.g. Building services).

Passive Design

Passive design is a key principle of sustainable design and can be used to reduce the building's energy demand. Passive design responds to local climate and site conditions to maximise the building users' comfort and health while minimising energy use.

At the earliest stage the buildings have been designed using a fabric first approach as to initially minimise energy and resulting CO_2 emissions. Particular attention will be paid to thermal envelope and a high level of insulation will be specified to all thermal elements to minimise heat losses.

Passive solar gain reduces the amount of energy required for space heating during the winter months. The dwellings are designed to maximise passive solar gain by the specification of larger fenestrations to the south and west where possible. The specification of windows with higher window g-values on this development also assists the buildings to take advantage of potential solar gains. These larger openings also lead to higher levels of natural daylight within the dwellings reducing the need of the occupants to draw on artificial light within the internal spaces. Blinds will be installed for minimizing glare and regulating solar gains during hottest summer months.

A portion of the dwellings heat loss will occur due to air infiltration. Good construction detailing and the use of best practice construction techniques will minimise the amount of uncontrolled air infiltration. Extra attention to detail will be paid, with adequate sealing to all junctions in the thermal envelope, service penetrations and window casements.

This will ensure an air test target of $3m^3/m^2$ at 50Pa or better is achieved to enable the dwellings to benefit from the incorporation of an Mechanical ventilation Heat Recovery (MVHR) system to increase the dwellings energy efficiency through the recapture and recirculation of latent heat within the dwellings rather than using the main heating system.

The SAP calculations contain an overheating analysis to ensure that the risk is appropriately mitigated in the dwellings. The analysis demonstrates that all dwellings achieve a compliant level of overheating risk. However, it is recognized that there are now better overheating standards that exist to ensure overheating is not a risk factor within the dwellings. The risks of overheating have been mitigated through design constrains leaving the larger, rear facing fenestrations orientated North West, enabling the buildings to benefit from natural daylight and solar gains without them being southerly focused and presenting more of an overheating risk within the dwellings.

The following tables provide a summary of the energy efficient and carbon reducing design characteristics incorporated across the development.

Design SAP Data Input Table Element		Details	Comments
Floor U-Values	Ground Floors	0.14 W/m^{2}K	Screed, 120mm Insulation, B&B Floor
Wall U-Values	External Walls	0.20 W/m^{2}K	Low density blockwork cavity walls
	Dormer Cheeks	0.30 W/m^{2}K	Timber Frame
	Party Walls	0.00 W/m^{2}K	Fully filled and Sealed Cavity Wall
Roof U-Values	Warm Pitched Roof	0.16 W/m^{2}K	PIR through and under rafters
	Flat Roof	0.18 W/m^{2}K	PIR above joists
	Cold Pitched Roof	0.10 W/m^{2}K	Insulation laid between and across joists
	Dormer	0.30 W/m^{2}K	Specialist Manufacturer
Opening U-Values	Windows	1.20 W/m^{2}K	Double Glazed, Low-E Coated G Value: 0.63
	Solid Doors	1.20 W/m^{2}K	
	Roof Lights	1.3 W/m^{2}K	Double Glazed Velux Roof lights
Thermal Bridging	y - value	Various	Bespoke Construction Details Used
Ventilation	Air Tightness	3.00	-
	ventilation		MVHR
Heating and Hot Water	Primary heating system	ASHP	Make and model TBC Boiler Information: Pump in heated space, boiler Interlock, fan assisted flue
	Controls	Zone controls	Delayed Start Thermostat
			Underfloor Heating
	Water heating	From ASHP	150L Hot Water Storage Maximum Standing Heat Losses: 1.16 kWh / day Cylinder to have thermostat, all primary pipework to be insulated, and water heating on separate timer to main heating
Low Energy Lighting		100% Low-Energy Fittings	Minimum Efficiency 45 Lumens per Circuit Watt

Table 1: Energy Efficient Measures of SAP Calculations

9.0 Dwelling Emissions & Energy Demand

SAP calculations have been produced for both dwellings proposed on the site as a means of determining the Dwelling Emission Rate (DER) & annual energy demand. Approved Part L 2013 modelling software Elmhurst Design SAP 2012 has been used. The energy saving measures from the previous section have been incorporated into the SAP calculations completed. These measures reduce the sites overall energy demand and subsequent CO_2 emissions beyond the requirements of Part L Building Regulations for every dwelling on site. The following table provides a summary of the emissions and energy demand for each dwelling on the site.

Dwelling Emissions Summary – Without Renewables

Plot	DER $kgCO_2/m^2/yr$	TER $kgCO_2/m^2/yr$	Part L %	Total Emissions $kgCO_2/year$
1	11.58	21.64	46.49	2691.54
2	11.64	21.52	45.91	2691.54
			Total	**5,383.08**

Table 2: Summary of dwelling emissions

Energy Demand Summary – Without Renewables

Plot	Main Heating kWh/year	Hot Water kWh/year	Pumps & Fans kWh/year	Lighting kWh/year	Total Energy kWh/year
1	2,127.52	970.65	1,111.63	673.34	4,883.14
2	1,683.38	963.98	926.42	652.06	4,225.84
				Total	**9,108.98**

Table 3: Summary of energy demand

The emissions for the site are estimated to be **5,383.08 $kgCO_2$/Year** whilst the Energy Demand for the site is estimated to be **9,108.98 kWh** per annum.

Emissions Summary – Without Renewables

- Total Target Emission Rate: **10,059.57 $KgCO_2$/Year**
- Total Design Emission Rate: **5,383.08 $kgCO_2$ /Year**
- Total CO_2 Savings over Part L: **4,676.49 $KgCO_2$/Year**
- Average improvement over Part L: **46.2** %

Energy Demand Summary – Without Renewables

- Total TER Energy Demand: **29,223.26 kWh per annum**
- Total Design Energy Demand: **9,108.98 kWh per annum**
- Total Energy Savings over TER Energy Demand: **20,114.28 kWh per annum**
- Improvement **68.83** %

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10.0 Renewables Feasibility

Renewables are one of the 3 pillars of the Net Zero Carbon Toolkit. The following renewable technologies have been evaluated for use:

- Solar Photovoltaic Cells (PV)
- Solar Hot Water
- Wind Turbines
- Biomass
- Ground Source Heat Pump
- Air Source Heat Pump

Photovoltaics

Solar photovoltaics (PVs) convert energy from daylight into electricity using a semiconductor material such as silicon. When light hits the semiconductor, the energy in the light is absorbed, 'exciting' the electrons in the semiconductor so that they break free from their atoms. The resultant flow of electrons through the semiconductor material produces electricity.

Feasibility	Further Consideration
The proposed dwellings have south facing roof sections onto which solar PV panels could be installed onto. These panels can be largely concealed from view at street level. There are no potential over shading risks which will limit efficiency of the installed array. As PV systems have no moving parts, generate no noise or pollution, this is an attractive option. If designed and properly installed require minimal maintenance and have long service lifetimes, with in excess of 20 years of access to the feed in tariffs.	Yes

Solar Thermal (Hot Water)

Solar water heating systems convert solar radiation to heat carried by water for use in space heating or the provision of domestic hot water. Solar water heating systems normally operate with a back-up source of heat, such as gas condensing boilers. The solar water heating preheats the incoming water, which is topped up by the back-up heat source when there is insufficient solar energy to reach the target water temperature.

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Feasibility	Further Consideration
Although the buildings have an adequate area of southerly facing south roof, the hot water demand for the residential properties is minimal. Hot water requirement is at its highest during the winter, where generation is at its lowest. The roof space is limited and would only be able to accommodate a single renewable solution hence further consideration of solar hot water will not be made and PV will be given priority to utilise the available roof space.	No

Wind Turbines

Wind turbines are modern, high-technology windmills where the kinetic energy of the wind is used to turn a turbine to generate electricity. There are two types of wind turbine, the horizontal-axis type which faces up or downstream of the wind and where the rotational movement of the blade is connected to a generator to create electricity. The other is the vertical-axis design, which is by far the most flexible type of wind turbine being best suited to more urban sites as it is more cost effective and operates with wind coming from any direction.

Feasibility	Further Consideration
Owing to site-constraints, micro-wind turbines have not been considered as part of this feasibility study. Wind turbines are likely to have a significant visual impact on local environment, as well as health and safety implications for occupiers or users on-site and on adjacent areas as a result of noise and light flicker associated with the wind turbines.	No

Biomass

Biomass boilers are an alternative to conventional fossil fuel heating. They burn woodchip, wood pellets, cereal waste or a combination of organic fuels, and are a carbon neutral option. Using biomass as an energy source creates a 'closed carbon cycle' – i.e. as a biomass energy source grows it absorbs CO_2 from the atmosphere, when it is burnt the CO_2 stored by the biomass is released, making it carbon neutral.

Feasibility	Further Consideration

Consideration needs to be given to the frequent deliveries that would be required for this system as well as the size of storage. There are also potential noise, dust and odour problems associated with the deliveries as well as Air Quality issues from the burning of the fuel. The higher NOx emissions are also of concern and as a result of this and the aforementioned items; Biomass is not considered a viable option.	No

Ground Source Heat Pumps

Ground source heating takes advantage of the stable ground temperature of 12°C to heat either air or water to provide energy efficient heating (and optional comfort cooling) to a building. The energy flow is driven by the temperature difference between the ground and the circulating fluid which can then be used to deliver heating (and optional cooling) to the building.

Feasibility	Further Consideration
There is insufficient space to incorporate adequate ground loops or borehole piling to meet the full load of the heating. This is a very timely and costly exercise. Ground source heat pumps also work best when there is a constant demand for heating, where the system is not intermittently being switched off and on again. Where there is such a low heating demand on this site, ground source heat pumps are considered unfeasible.	No

Renewables Summary

The most feasible option for this development is installing solar photovoltaic panels on the southerly facing roof slopes of both dwellings.

There is adequate roof area to install 3.5Wp per dwelling. This gives a total number of 14 panels being installed on the southerly slopes of each dwelling. Based on a standard 250W PV Panel being 1m x 1.6m, this gives a total approximate panel area of 22.4m² per dwelling.

Please note the PV figures are indicative only and will need to be confirmed by a suitably qualified installer as the design progresses. Therefore, the total installed capacity is subject to change.

11.0 Incorporation of Renewables

Calculations have then been completed incorporating the renewables below into the SAP assessments. It is acknowledged that the site is in a conservation area therefore PV may not be a solution suitable for this project, however, calculations have been undertaken below to illustrate the performance / energy demand reduction / carbon emission reduction should PV be included on the southerly elevations which seem to be sheltered from view from the road.

Design SAP Renewable Input Table		
Element	**Details**	**Comments**
Renewables	PV	3.5 kWp per dwelling orientated South (Approximate area 22.4m²)

Table 4: Renewables Specification

Dwelling Emissions Summary

Plot	DER $kgCO_2/m^2/yr$	TER $kgCO_2/m^2/yr$	Part L %	Total Emissions $kgCO_2/year$
1	4.91	21.64	77.31	1,141.23
2	3.94	21.52	81.69	1,141.23
			Total	**2,282.46**

Table 5: Summary of dwelling emissions

Energy Demand Summary

Plot	Main Heating kWh/year	Hot Water kWh/year	Pumps & Fans kWh/year	Lighting kWh/year	PV kWh/year	Total Energy kWh/year
1	2,127.52	970.65	1,111.63	673.34	-2,990.6	1,892.54
2	1,683.38	963.98	926.42	652.06	-2990.6	1,892.54
				Total		**3,785.08**

Table 6: Summary of energy demand

The emissions for the site are designed to be **2,282.46 $kgCO_2$/Year** whilst the Energy Demand for the site is estimated to be **3,785.08 kWh** per annum.

Emissions Summary – With PV

- Total Target Emission Rate: **10,059.57 $KgCO_2$/Year**
- Total Design Emission Rate: **2,282.46 $kgCO_2$ /Year**
- Total CO_2 Savings over Part L: **7,777.11 $KgCO_2$/Year**
- Average improvement over Part L: **77.31** %

Energy Demand Summary – With PV

- Total TER Energy Demand: **29,223.26 kWh per annum**
- Total Design Energy Demand: **3,785.08 kWh per annum**

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- Total Energy Savings over TER Energy Demand: **25,438.18 kWh per annum**
- Improvement **87.05** %

12.0 Conclusions and Summary

This statement has reviewed the sustainability performance of the proposed development on Main Road, Chedworth, Cheltenham, Gloucestershire, for the construction of 2 semi-detached houses against the current Part L standards, the Cotswold District Councils policy INF10 and the Net Zero Carbon Toolkit.

The project incorporates a broad range of passive measures within its design to reduce both the energy demand and carbon emissions from the dwellings which include the dwelling orientations, larger opening windows to westerly orientations and low thermal mass. These measures combine to decrease the energy demand needed by and the carbon emissions emitted from these proposed dwellings.

The proposed design also incorporates low temperature heating through Air Source Heat Pumps (ASHP), mechanical ventilation heat recovery units (MVHR) enabling the fabric of the dwellings to be built to a low air permeability level. PV panels are modelled and the results included within the report, however, it is acknowledged that this option may not be suitable within this conservation location.

The combination of passive and active solutions proposed on site (not including PV) would reduce the carbon emissions of the site by 4,676.49 KgCO_2/year which is a reduction of 46.2% over the notional TER carbon emissions and a reduction in energy demand of 20,114.28 KWh/year which is a reduction of 68.83% over the notional TER energy demand of the site.

The combination of passive and active solutions (including PV) would reduce the carbon emissions of the site by 7,777.77 KgCO_2/year which is a reduction of 77.31% over the notional TER carbon emissions and a reduction in energy demand of 25,438.18 KWh/year which is a reduction of 87.05% over the notional TER energy demand of the site.

The above results demonstrate that the project fully complies with the requirements outlined within the Cotswold District Local Plan 2011-2031 (INF10) to exceed Part L requirements and the pillar principles outlined within the Net Zero Carbon Toolkit whether PV is or is not utilised on the site.

PV Cell Location Plan – Indicative