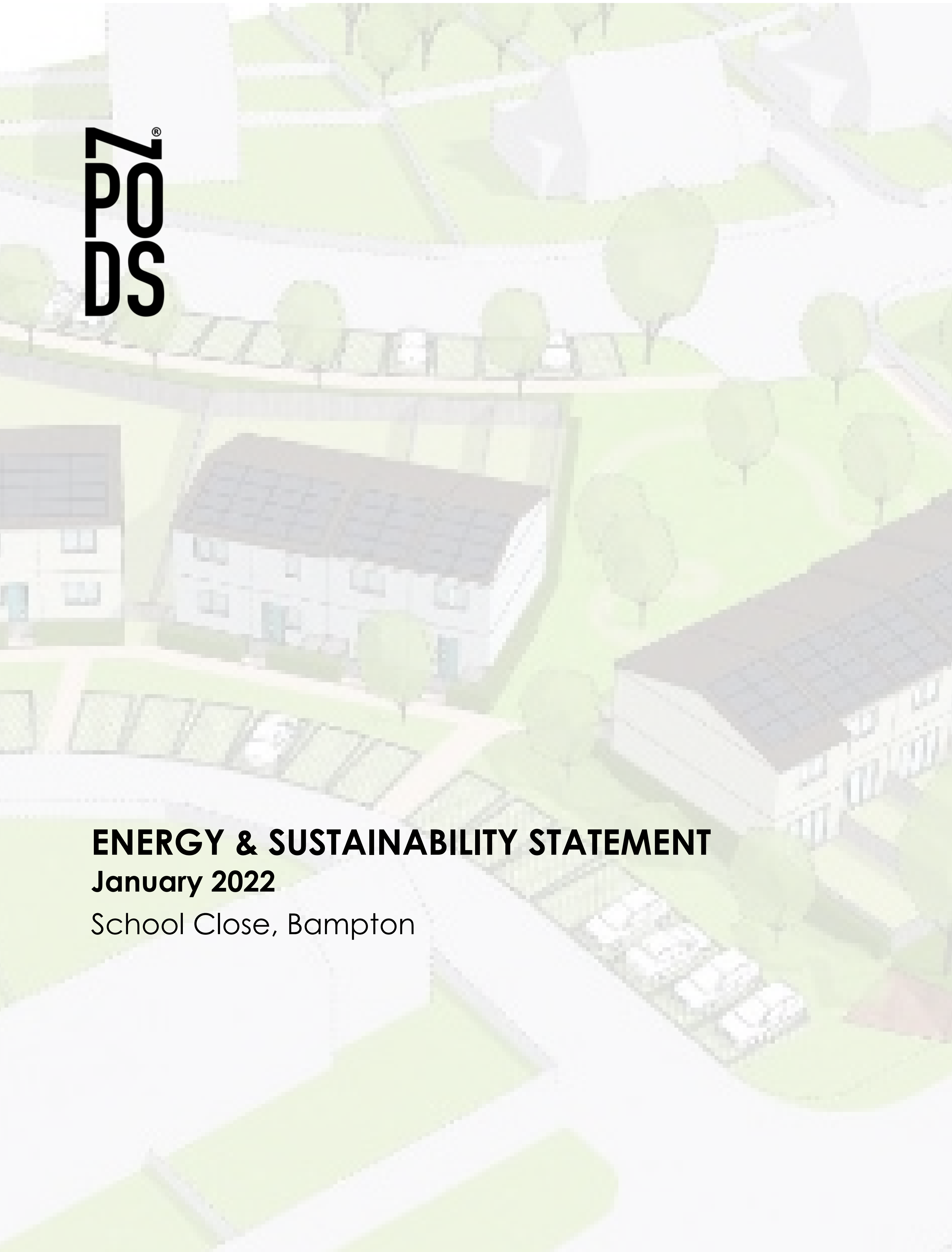


ENERGY & SUSTAINABILITY STATEMENT

January 2022

School Close, Bampton

Executive Summary

This report details the 'Sustainability and Energy Strategy' for the Proposed Development of 18 new net Zero Operational Carbon modular dwellings in Bampton, Mid-Devon.

This document outlines the anticipated energy and associated emissions performance of the proposed dwellings in addition to other aspects of the proposals sustainability including water efficiency, sustainable transport strategies, internal daylight levels, indoor air quality and embodied Carbon impacts. This report should be read in conjunction with other submitted materials as part of the proposed application.

The key objective of ZED PODs sustainability strategy is to maximize reductions in CO2 emissions through a primarily fabric first approach followed on by deployment of on site renewable technologies through the process of careful selection to ensure the most economically viable and technically appropriate solutions are deployed to achieve Net Zero Operational Carbon. All units in the proposed development have been benchmarked to achieve 'A' rated *'Energy Efficiency Ratings'* and *'Environmental Impact Ratings'* performance, far in excess of the Building Regulations baseline requirements resulting in significant savings of both greenhouse gas emissions and energy bills for occupants than from typical new build developments. This will establish the development as achieving one of the highest levels of energy performance and an exemplar of sustainable design and construction within the Mid-Devon area.

The report has been structured around the 'Be Lean, Be Clean, Be Green' hierarchy of energy efficiency measures and has been developed in accordance with the Mid-Devon Local plan 2013-2033 policies S1 and S9, 'Preparing Environmental Performance Statements: A guide for applicants and agents' and 'Approved Document L: conservation of fuel and power in new dwellings (2021 edition)'. Approved licensed software (SAP version 10) has been used by an accredited third party consultant to produce energy calculations in accordance with government requirements to demonstrate the simulated energy performance of each dwelling type.

BE LEAN Use Less Energy	**BE CLEAN** Supply Energy Efficiency	**BE GREEN** Use Renewable Energy
Firstly, the building fabric has been optimised to be as lean as possible ***'Be Lean'***, the ZED PODs modular system features standardized fabric construction with high levels of insulation and triple glazing to ensure low U-values, High levels of Airtightness and Reduced thermal bridging through modelling and development of robust detailing	Secondly to further reduce the heat losses from infiltration as part of ***'Be Clean'*** Mechanical ventilation combined with heat recovery has been specified which recycle the heat from outgoing stale air and reduce the heating requirements from fresh incoming air to further reduce space heating demands and improve building energy efficiency.	The remaining energy demands are supplied through the use of on-site renewable generation technologies in accordance to '***Be Green'***. Solar 'photovoltaic' panels are provided to meet electrical demands and Air Source Heat Pumps (ASHPs) are deployed to meet hot water demands .

The analysis provided in this report details this proposal performance through comparison of the proposed Dwelling Emissions Rates (DER) versus Typical Emissions Rates (TER) and Fabric energy efficiency ratings providing evidence of the schemes sustainability credentials and it's compliance as a Net Zero Operation Carbon development. The proposed development is designed to act as an exemplar of sustainable design, far in excess of National and Local requirements helping towards Mid-Devon's and the UKs goal of becoming Net Zero Carbon

Operational Carbon

	Operational Carbon (kg/yr)	Operational Carbon (Tonne/yr)	Carbon Savings (Tonnes/Yr)	Carbon Savings Over 30 Years (Tonnes)	Social Value Added
Proposal	-77.85	**-0.1**			
2021 Baseline Part L	17674.51	**17.7**	18	532.57	£ 36,933.79

*Calculated using 2021 carbon costing, price of carbon will rise in future increasing value

Introduction and Proposal

This document has been prepared by ZED PODS Ltd, a specialist turnkey modular and Zero Carbon housing manufacturer, in support of the planning application for the proposed development of 18 new residential housing units at 1-12 School Close, Bampton, Devon. The application site is located in full within Mid-Devon council. The scheme has been designed to meet Net Zero operational Carbon targets in respect to anticipated 'regulated' operational energy demands but also provides an insight into unregulated energy demands and approach to reducing embodied Carbon.

The proposed development comprises of mixture of terraced and semi detached two story housing blocks on ground level with a mixture of 1,2,3 and 4 bedroom homes. The proposed development replaces existing on site dwellings and parking provision and features the provision of new parking capacity in addition to EVCPs.

Policy Review

A policy appraisal has been undertaken prior to the design of the development to ensure that the proposed development delivers upon the goals set out by both national and local planning requirements, the latest applicable policies and their relevance to the nature of the proposed development have been summarized below:

Climate Change Act 2008 (2050 Target Amendment)

The Climate Change Act 2008 required that the UK government to *"ensure that the net UK carbon account for year 2050 is at least 80% lower than the 1990 baseline".* This legal commitment sets the overriding objective for sustainability: the reduction of CO2 emissions. This was later followed up in 2019 with 2050 target Amendment order where the minimum amount that Carbon emissions must be lowered has been increase from 80% to 100% by 2050.

Although not policy statement the strategy to achieve these Carbon reduction was outlined by the government in the 'Net Zero Strategy: Build Back Greener' report published in 2021 which sets out the framework for all sectors of the economy to decarbonize including in section 3iv) Heat & Buildings

National Planning Policy Framework (2021)

The new National Planning Policy Framework published in 2021 sets out core ambitions to direct all new developments towards more sustainable priorities as one of the first principles of the UK planning system 2(7) *'The purpose of the planning system is to contribute to the achievement of sustainable development. At a very high level, the objective of sustainable development can be summarised as meeting the needs of the present without compromising the ability of future generations to meet their own needs'*
Outlined is the preference to encourage and approve sustainable developments in priority over those with conventionally built standards.

2(10) *'So that sustainable development is pursued in a positive way, at the heart of the Framework is a presumption in favour of sustainable development'*

a) all plans should promote a sustainable pattern of development that seeks to: meet the development needs of their area; align growth and infrastructure; improve the environment; mitigate climate change (including by making effective use of land in urban areas) and adapt to its effects;
b) strategic policies should, as a minimum, provide for objectively assessed needs for housing and other uses, as well as any needs that cannot be met within neighbouring areas

The NPPF sets out the governments vision for holistic suitability emphasizing that developments are to be considered sustainable only when they are economically, socially and environmentally sustainable, failure to meet any of these core objectives would result in the creation of unsuitable and unsustainable places.

Mid Devon Local Plan 2013-2033

The priorities for local development have been clearly set out within the Mid Devon local plan 2013-2033.

ZED PODs Ltd are committed to help deliver the Councils vision for 'a prosperous and sustainable rural district' which is 'Promoting the use of sustainable energy and power'. Specifically to support the councils objectives for sustainable development set out in Policy S1 - Sustainable development priorities and Policy S9 - Environment

Although there are not additional polices that regulate energy requirements but refer to the framework set out in the NPPF 2012 and building regulations part-L to provide the required performance levels.

The local plan also highlights the NPPFs model of the Economic, social and environmental roles of sustainability which are not to be considered on isolation. The following local policies have been identified as having significant effect on the requirements of the proposed development

Policy S1 - Sustainable development priorities

The council have set out key priorities for sustainable development of the Mid-Devon area, the following policies have been identified as having an impact on the nature of the proposed development, particularly as Collumpton is one of the three key areas set out for sustainable development by the council, as follows:

- *A development focus at Tiverton, Cullompton and Crediton as Mid Devon's most sustainable settlements, with long-term growth to the east of Cullompton and a limited level of development in identified villages;*
- *Promoting sustainable transport by delivering appropriate infrastructure, reducing the need to travel by car, integrating public transport and other forms of sustainable travel such as walking and cycling, and providing safe environments while recognising Mid Devon's rural locality;*
- *Supporting high quality communications infrastructure by supporting the expansion of telecommunications and high speed broadband throughout Mid Devon;*
- *Delivering a wide choice of high quality homes through a diverse housing mix and by meeting the housing needs of all sectors of the community including the provision of accessible housing for the elderly and disabled, those wishing to build their own home, affordable housing and gypsy and traveller pitches;*
- *Requiring good sustainable design that respects local character, heritage, surroundings and materials, creates safe and accessible environments, designs out crime and establishes a strong sense of place;*
- *Meeting the challenge of climate change by supporting a low carbon future, energy efficiency, increasing the use and supply of renewable and low carbon energy, managing flood risk and conserving natural resources. Encourage the effective use of land, taking into account the economic and other benefits of the best and most versatile agricultural land;*

- *Minimising impacts on biodiversity and geodiversity by recognising the wider benefits of ecosystems, delivering natural environment objectives, providing a net gain in biodiversity and by the protection of international, European, national and local designated wildlife sites; and*
- *23*
- *Conserving and enhancing the historic environment through the identification and protection of designated and non-designated heritage assets and assessing the impact of new development on the historic character of Mid Devon's landscapes and townscapes.*

Policy S9 - Environment

Policy S9 relates to the proposals fitting within the wider local and historical context to ensure minimal negative impacts are produced

- *High quality sustainable design which reinforces the character and distinctiveness of Mid Devon's historic built environment, mitigates and adapts to climate change and creates attractive places;*
- *The efficient use and conservation of natural resources of land, water and energy, minimising pollution and preserving the quality and productivity of the best and most versatile agricultural land wherever possible;*
- *The provision of measures to reduce the risk of flooding to life and property, requiring sustainable drainage systems including provisions for future maintenance, guiding development to locations of lowest flood risk by applying a sequential test where appropriate, and avoiding an increase in flood risk elsewhere;*
- *Renewable energy development in locations where there is an acceptable local impact, including visual, on nearby residents, landscape character and wildlife, balanced with the wider sustainability benefits of renewable energy;*
- *The protection and enhancement of designated sites of international, national and local biodiversity and geodiversity importance. On both designated and undesignated sites, development will support opportunities for protecting and enhancing species populations and linking habitats. If significant harm resulting from development cannot be avoided impacts should be adequately mitigated. Compensation measures will only be considered where appropriate as a last resort; and*
- *The preservation and enhancement of Mid Devon's cultural and historic environment, and the protection of sites, buildings, areas and features of recognised national and local importance such as listed buildings, conservation areas, scheduled monuments and local heritage assets.*
- *2.56 The environmental qualities of the district are highly valued by the community and the preservation and enhancement of*

In addition to these specific policies the council also sets out the importance of Sustainable Urban Drainage Systems (SUDS) throughout the local plan, a detailed SUDs design and calculations has been produced as part of the drainage design strategy provided alongside this application.

Devon county council have declared a climate emergency as of 2019 and have committed to reducing the carbon emissions of the county, including Mid-Devon, to net zero by 2050. As will be evidenced in this report the proposed development meets this Net Zero target today negating the burden for further emissions reduction by the council to meet this ambitious climate target.

Baseline Target Emission Rates (TERs) and Part-L 2021 Methodology

A baseline assessment of the energy demands and associated CO2 emissions for the development have been established using Approved Document L: Conservation of fuel and power in new dwellings, (2021 Edition). As Part of this assessment the Target Emissions Rates for the proposed units are determined which set out a minimum level of performance that must be achieved for legal compliance

These estimated energy demands for the proposed development has been calculated using Standard Assessment Procedure (SAP 10) methodology. SAP calculates the 'Regulated' Energy demands and emissions associated with providing hot water, space heating and fixed electrical items and applies standardized fuel factors for the supply of this required energy types to calculate the anticipated emissions of the building in operation. These energy demand do not include however demands from 'unregulated' sources including home appliances, external uses or electric vehicle charging making it a useful baseline to compare the proposed schemes performance against but limited in it's scope of assessing the overall impacts of the proposed development. In addition Fabric efficiency standards are also set out by Part-L which set out a maximum amount of thermal loss through a building envelope know as the Target Fabric Energy Efficiency (TFEE)

The TER and TFEE rated required to be achieved for the proposed development are presented in the following table itemized into the individual housing units that make up the scheme:

Unit Information				Building Regs Baseline	
Plot No	Unit Type	GIFA (m2)	Floor	TER (kg/m2/Yr)	TFEE (Kwh/m2/Yr)
1	4B Semi	124.88	Ground	10.49	42.05
2	4B Semi	124.88	Ground	10.49	42.05
3	4B Semi	124.88	Ground	10.49	42.05
4	4B Semi	124.88	Ground	10.49	42.05
5	1B end	60.00	Ground	15.06	47.07
6	1B mid	60.00	Ground	13.32	38.7
7	3B End	106.34	Ground	11.63	44.2
8	1B end	60.00	Ground	15.06	47.07
9	1B mid	60.00	Ground	13.32	38.7
10	3B End	106.34	Ground	11.63	44.2
11	2B End	71.00	Ground	13.74	44.54
12	1B mid	60.00	Ground	12.79	35.89
13	1B mid	60.00	Ground	12.79	35.89
14	1B mid	60.00	Ground	12.79	35.89
15	1B mid	60.00	Ground	12.79	35.89
16	1B mid	60.00	Ground	12.79	35.89
17	1B mid	60.00	Ground	12.79	35.89
18	2B End	71.00	Ground	13.74	44.54
				Average	Average
TOTALS		1454.2		12.57	40.70

Baseline energy performance and fabric efficiency rates and emission for the scheme as set out by Part-L Requirements

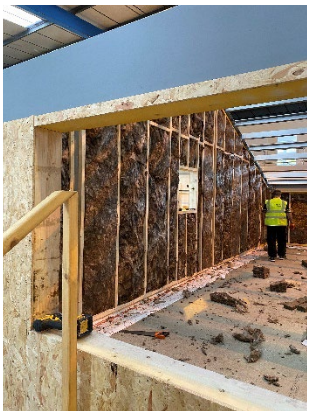
Energy Efficiency Measures (Be Lean)

The core component of the energy strategy for the ZED PODs system is reduction in energy demands. A fabric first approach has been adopted so that the loads are reduced and the residual energy demand is minimised. Offsetting the remaining load should therefore be possible by onsite generation of renewable energy if the '**Be lean'** approach is implemented at an early stage.

The following energy efficiency measures form a key part of the design to reduce energy demand beyond the requirements of Part L. The proposed development is to be composed of fully fitted factory built volumetric modules, these modules have standard assemblies ensuring the same level of fabric efficiency if deployed regardless of the proposed archetype or scheme location. The system has been developed and enhanced for several years and has already demonstrated as built performance exceeding as designed targets across several schemes. This same modular system is to be deployed for the proposed development

Insulation Standards

Super insulated wall build ups composed of dual layers of mineral wool insulation combine with close attention to thermal bridging to create a high performance building fabric which minimize conductive heat losses. Using Build Desk software these assemblies have U-values calculated as follows:



- Triple Glazing with a U-value on Average below 0.9 W/m^2.K (soft low E-coating and G-value)
- External walls with a U-value of 0.15 W/m^2.K;
- Party floors will be fully insulated and sealed (achieving an effective U-value of 0.00 W/m^2.K);
- Exposed Floor U-value of 0.15 W/m^2.K;
- Roof U-value of 0.11 W/m^2.K.

These values are not only in excess of the 2021 Part-L standards but are also complaint with the early stage consultation of the Future Homes Standard due to be published in 2025

Air Tightness

Air tightness standards will exceed the Approved Document Part L requirements by a large margin. Every unit is fully fitted with airtightness membranes and tapping installed by trained contractors reducing air leakage through the buildings fabric and resulting in an improvement of the air permeability rate from maximum allowed value of 5m3/hr.m2 to less than 1m3/hr.m2 (near passive standard), reducing space heating demands significantly as a result. This performance can be evidenced by the air testing results of previous schemes.

Thermal Bridging

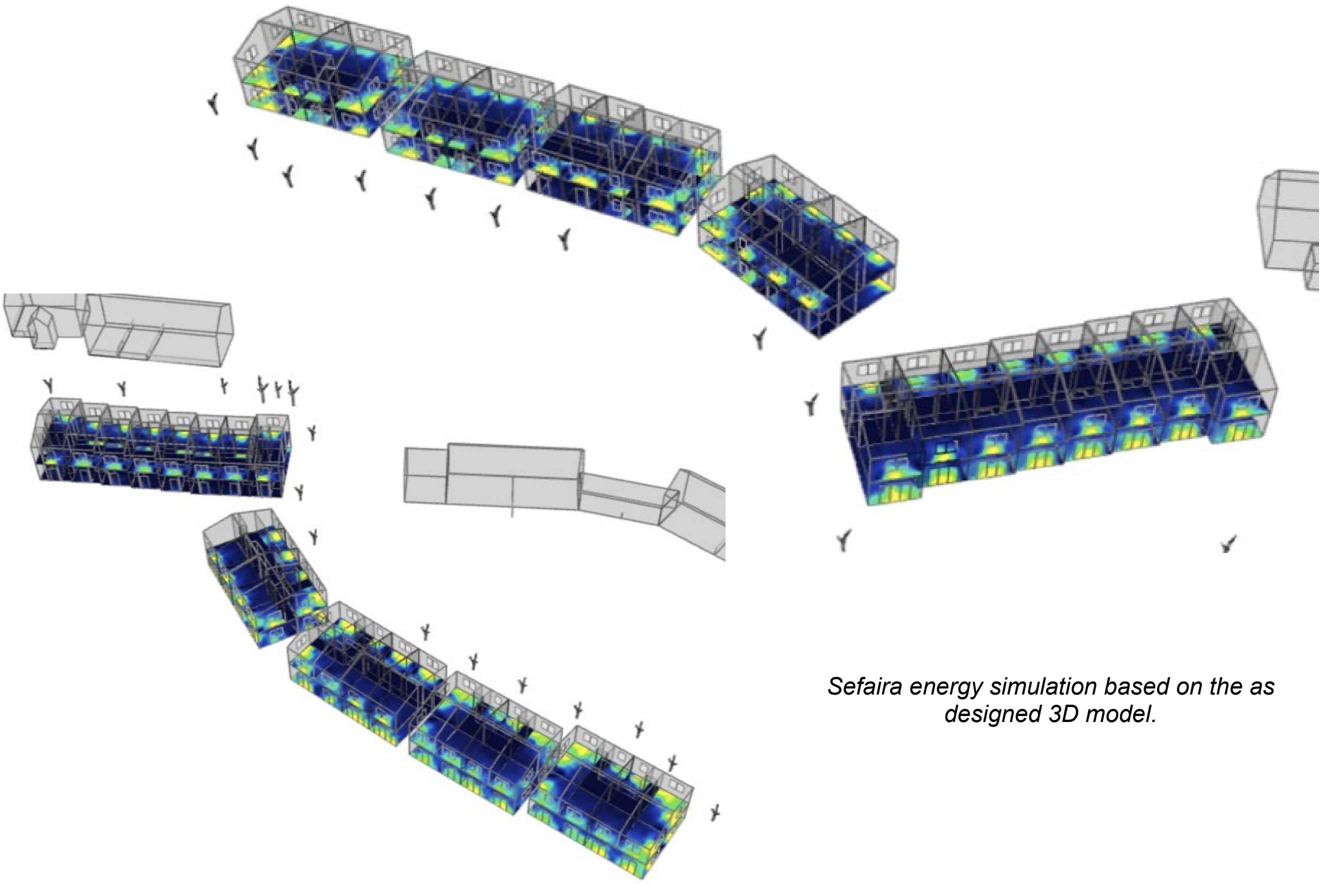
Up 30% of heat loss can occur through thermal bridges in low energy buildings. These bridges happen at conductive elements in the wall/roof/floor construction and create an escape route for heat. Improvement over the SAP default y-value will be demonstrated, however, a default value (y-value: 0.15) is used in the sample SAP calculations to demonstrate improvements over part L in a worst-case scenario. The detailing of the proposed modular system has been developed to reduce thermal bridging effects by ensuring continuous insulation lines and limiting the perforations through the buildings façade. The quality of these junction assemblies is closely monitored in accordance with Part-L 2021 requirements

Daylighting and Solar Gains

The space heating requirement of the proposed development will be further reduced by the adoption of passive design principles to maximise internal daylighting and winter solar gains and reduce unwanted excess summer thermal gains.

These principles have been incorporated early on in the design process by use of 3D modelling and simulation tools to provide an iterative approach informing the position and size of glazing on the proposed façades. Although a modular system, the design flexibility of the ZED PODs system allows each development to be designed specific to the site location to take advantage of the available aspects.

A daylight analysis has been performed on the proposed development which demonstrates that recommended daylight factors have been achieved in accordance with BS EN 17037:2019 in the proposed habitable room spaces. This will reduce the amount of artificial lighting use throughout the year and also increase the wellbeing of occupants. All walls and interior finishes have also been designed with light colour tones and kitchen gloss finished to maximise the amount of times that light bounces in internal spaces upon entering and further increase internal levels and balance daylighting across all areas of the plan.



Sefaira energy simulation based on the as designed 3D model.

Energy Supply *(Be Clean)*

The second stage of the sustainability strategy is to provide energy efficiency measures which further reduce the final building energy demands. Part-L requires that an analysis of different technologies to achieve these be undertaken and implemented, given the location of the site it has been determined that site based scale technologies are appropriate as there are no viable local district energy networks. The Modular nature of the scheme is also suited to independent systems that can be fully fitted in the factory prior to delivery on site. These technologies also contribute towards regulated energy demands as they are defined as 'fixed' loads meaning that selecting the most efficient systems is key to overall reduction of demands.

Furthermore, the density, energy strategy, modelling and loads show this development is better suited to small 'Passive Haus' type combined MVHR/Heating/HW systems negating the needs for district heating as there will be long periods of very low heat demand with two sharp peaks in demand in the morning and evening which is not suitable to the design, running and maintenance of district heating systems. Installed cots, maintenance costs and running costs of district heating would be prohibitive of a scheme of this size and design.

The following systems have been specified for us in the proposed development:

Mechanical Ventilation and Heat Recovery (MVHR)

Due to the high levels of airtightness within the building it is a requirement to employ a mechanical ventilation system in addition to any natural ventilation methods in order to ensure that an adequate supply of fresh air is supplied to all spaces. The ZED PODs system used mechanical ventilation as the mains means of providing fresh air intake and exhausting stale air with Parts L & F compliant *'Mechanical Ventilation Heat Recovery (MVHR)'* units installed in all units in order to reduce the amount of heat lost when exhausting stale air from the building and still providing continuous background fresh air supply. These systems will provide at least 75% heat recovery even in worst case scenarios with a selected Specific Fan Power (SFP) of < 0.55 SFP. 1 Bed units will use a centralized Vectair Studio MVHR unit for ventilation and heat recovery functions alone whilst 2 Bed units will use the Nilan Compact-P

All homes will still have openable windows to provide cross and nighttime purge ventilation capability to prevent summer overheating. Convective ventilation and night purging of heat will therefore be facilitated.

Example Interior lighting and fittings of Pods installed at Bristol Hope Rise Project

Lighting and Appliances

Energy efficient (LED) lighting will be installed in 100% of dwellings that exceeds what is considered complaint with the required lumens per watt specified in Part L. All appliances specified within the proposed dwellings by ZED PODs will be within the highest 2 categories of energy efficiency according to the UK ENERG rating system.

Regulated Energy Demands

Based on the fabric first approach and installation of energy efficient appliances the measured 'regulated' energy demands in accordance with the SAP10 methodology can now be calculated. These are demands that result from the requirement for space heating, hot water demand, ventilation and lighting within the building (without the provision of any renewable technologies contained within '*be green'*) as a measure of the total predicted energy use of the proposal. These are calculated from the SAP 10 methodology and are based on historical average data of utilisation factors. For the purpose of this energy statement these demands have been designed and considered as the primary focus.

As per the table to the left, for the proposed development it has been calculated that the average 'regulated' energy demand will be an average of **38.39kWh/m2.Yr** for the proposed units resulting in a total demand of **83,575kWh** across the proposal.

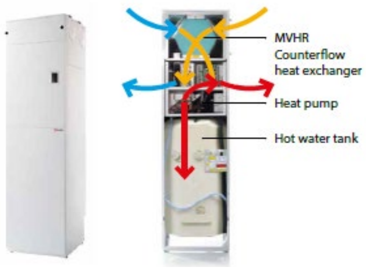
Unit Information				Predicted Energy Consumption		
Plot No	Unit Type	GIFA (m2)	Floor	Regulated Energy Density (kWh/m2/yr)	Regulated Energy Consumption (kWh/yr)	Total Energy Consumption (kWh/Yr)
1	4B Semi	124.88	Ground	33.81	4,222	**6,720**
2	4B Semi	124.88	Ground	33.81	4,222	**6,720**
3	4B Semi	124.88	Ground	33.81	4,222	**6,720**
4	4B Semi	124.88	Ground	33.81	4,222	**6,720**
5	1B end	60.00	Ground	44.10	2,646	**3,846**
6	1B mid	60.00	Ground	39.97	2,398	**3,598**
7	3B End	106.34	Ground	36.20	3,850	**5,976**
8	1B end	60.00	Ground	44.10	2,646	**3,846**
9	1B mid	60.00	Ground	39.97	2,398	**3,598**
10	3B End	106.34	Ground	36.20	3,850	**5,976**
11	2B End	71.00	Ground	41.00	2,911	**4,331**
12	1B mid	60.00	Ground	38.87	2,332	**3,532**
13	1B mid	60.00	Ground	38.87	2,332	**3,532**
14	1B mid	60.00	Ground	38.87	2,332	**3,532**
15	1B mid	60.00	Ground	38.87	2,332	**3,532**
16	1B mid	60.00	Ground	38.87	2,332	**3,532**
17	1B mid	60.00	Ground	38.87	2,332	**3,532**
18	2B End	71.00	Ground	41.00	2,911	**4,331**
Totals		1454.2		38.39	**54,491**	**83,575.39**

Roof Mounted Photovoltaic Panels and Solar Assisted heat pump panels at the ZED PODs scheme in Newport, Wales

Renewable Energy (Be Green)

Finally now that the energy demands have been reduced as much as economically viable renewable energy technologies are deployed on site to meet all of the proposals electricity demands and offset any emissions that would result from the buildings energy consumption in order to achieve Net Zero Operational Carbon as part of the ***Be Green*** strategy. An assessment has been carried out to determine which technologies are most geographically, economically and environmentally suitable to provide this supply.

Air Source Heat Pumps (ASHPs)



Heat Pumps upgrade energy from the ground or air and utilise it for space heating and hot water demands. Heat Pumps are able to provide substantial reductions in energy. GSHPs which require boreholes have been discounted from this development due to the high space requirements, economic considerations and intrusive ground works required for their operation. ASHPs work by by using an electrically powered fan passing external air over a cold refrigerant that is cycled through the unit to carry extracted heat to an insulated water cylinder.

Air Source Heat Pumps are a more economical alternative and better suited to the needs of the dwellings on this site. On this basis Heat pumps have been used on larger units to replace gas as the heating fuel with electricity on this site given the low space heating demands. A combined heat pump system that can provide the MVHR/space heating/ DHW heating has been used on this site as illustrated which combines the functions of an ASHP with an MVHR unit described in be clean, this allows maximum efficiency of heat recovery

Micro Wind Turbines

Small rooftop wind turbines are designed to generate electricity from the wind for use within each dwelling.

Urban rooftop wind turbines do not perform well enough to warrant their installation, due to the low and turbulent wind conditions present in the open urban environment of the site and would also present a visual pollution to closely located neighbours. They are therefore likely to remain technically unfeasible.

Solar Thermal (hot water) Panels

Solar thermal evaporator panels use the sun's energy to generate hot water for each dwelling. Due to the seasonality of solar radiation, solar thermal panels can provide up to ~60% of a dwellings hot water demand, with the remainder being provided as top-up by the heat pump. Solar thermal panels are installed on the roofs of dwellings and compete with the space available for solar electric panels. Solar thermal panels would be unable to provide sufficient CO_2 reductions alone and would complicate the M&E connections and user-ability of the dwellings. The strategy adopted for this development is 'fit and forget' technology for ease of use and maintenance. When this is combinedwith the fabric energy performance and fully electric nature of the strategy, maximizing PV panels represent a more appropriate use of solar technology.

Solar Photovoltaic (PV) Panels

PV panels represent the most viable renewable energy technology for the proposed development. They are technically and economically viable for the development size, scale and density and enable the most substantial reductions in CO_2 emissions given the fully electric nature of the development able to offset all of the remaining building emissions.

Using the online PVGIS tool It has been calculated that a total of 61,835 kWh/yr (equivalent to more than 2kWp per dwelling) of energy will be produced by the separate PV arrays on from the rooftops of all units. This is utilizing 10-16 roof mounted polycrystalline panels per unit with a peak output of 365Wp or more per panel. This represents more than the predicted energy demands from the scheme resulting in a net output of energy to the local grid. The Extent of these calculations can be found in Appendix B.

Energy Production Calculations

*Data from PVGIS Calculations

Array	Description	Panel No	Panel Capacity (Wp)	Array Capacity (kWp)	Roof Angle	Azimuth	System Loss (%)	Production (kWh/Year)
1	1 Bed Mid (12-17)	10	365	3650	15	-6.35	15	**3039.92**
1S	S	6	365	2190	15	-6.35	15	1027.15
1N	N	4	365	1460	15	173.65	15	2012.77
2	2 Bed End (11 & 18)	12	395	4740	15	-6.35	15	**3845.57**
2S	S	6	395	2370	15	-6.35	15	2178.21
2N	N	6	395	2370	15	173.65	15	1667.36
3	1 Bed End and Mid SW (5-9)	12	365	4380	15	28.5	15	**3557.31**
3S	S	6	365	2190	15	28.5	15	1988.84
3N	N	6	365	2190	15	-151.5	15	1568.47
4	4 Bed End (1-4)	16	395	6320	15	28.5	15	**5132.94**
4S	S	8	395	3160	15	28.5	15	2869.75
4N	N	8	395	3160	15	-151.5	15	2263.19
5	3 Bed End (7 & 10)	16	375	6000	15	28.5	15	**4873.03**
5S	S	8	375	3000	15	28.5	15	2724.44
5N	N	8	375	3000	15	-151.5	15	2148.59
Totals								
Totals		**66**		**25090**		kWh/Year		**61835.35**
Average Per Unit		2.28		**865.17**	15.00	kWh/Yr/Unit		**3435**

PVGis Calculations based on 5 different unit types across the scheme

Predicted Building Emissions (DERs)

Unit Information				Building Regs Baseline		Estimated Performance	
Plot No	Unit Type	GIFA (m2)	Floor	TER (kg/m2/Yr)	TFEE (Kwh/m2/Yr)	DER (kg/m2/Yr)	DFEE (Kwh/m2/Yr)
1	4B Semi	124.88	Ground	10.49	42.05	-0.04	37.37
2	4B Semi	124.88	Ground	10.49	42.05	-0.04	37.37
3	4B Semi	124.88	Ground	10.49	42.05	-0.04	37.37
4	4B Semi	124.88	Ground	10.49	42.05	-0.04	37.37
5	1B end	60.00	Ground	15.06	47.07	-0.11	40.95
6	1B mid	60.00	Ground	13.32	38.7	-0.04	34.35
7	3B End	106.34	Ground	11.63	44.2	-0.13	38.93
8	1B end	60.00	Ground	15.06	47.07	-0.11	40.95
9	1B mid	60.00	Ground	13.32	38.7	-0.04	34.35
10	3B End	106.34	Ground	11.63	44.2	-0.13	38.93
11	2B End	71.00	Ground	13.74	44.54	-0.01	38.56
12	1B mid	60.00	Ground	12.79	35.89	-0.03	32.06
13	1B mid	60.00	Ground	12.79	35.89	-0.03	32.06
14	1B mid	60.00	Ground	12.79	35.89	-0.03	32.06
15	1B mid	60.00	Ground	12.79	35.89	-0.03	32.06
16	1B mid	60.00	Ground	12.79	35.89	-0.03	32.06
17	1B mid	60.00	Ground	12.79	35.89	-0.03	32.06
18	2B End	71.00	Ground	13.74	44.54	-0.01	38.56
				Average	Average	Average	Average
TOTALS		1454.2		12.57	40.70	-0.05	35.97

Unit Energy Performance using SAP data

Based on the calculated Regulated energy consumption combined with the proposed renewable on site energy production the total Dwelling Emission Rates (the amount of greenhouse gasses associated with the proposed units) can be calculated according to the SAP 10 methodology, and the total carbon footprint of the proposed scheme can be calculated as per the below table. Both tables demonstrates the proposals estimated performance values in comparison to the typical emissions rates required by Part-L 2021 baseline to demonstrate the overall emission.

The overriding objective of the energy strategy is to maximise the reductions in CO2 emissions in a cost-effective, technically viable and ultimately deliverable approach. The Scheme demonstrates that it is possible to reduce the DER by up to 15kg/m2/yr over the basline Part-L requirements. This results in negative Dwelling Emissions Rates for all of the proposed units and evidences that the overall scheme will result in net negative emission and compliance as a Net Zero Operational Carbon Development this results in savings of 17.7 Tonnes of Carbon Emissions for every year that the building is in operation.

Unit Information				Carbon Emissions		
Plot No	Unit Type	GIFA (m2)	Floor	Baseline CO2 (kg/Yr)	Proposed CO2 (kg/Yr)	CO2 Savings (Kg/Yr)
1	4B Semi	124.88	Ground	1310.0	-5.0	1315.0
2	4B Semi	124.88	Ground	1310.0	-5.0	1315.0
3	4B Semi	124.88	Ground	1310.0	-5.0	1315.0
4	4B Semi	124.88	Ground	1310.0	-5.0	1315.0
5	1B end	60.00	Ground	903.6	-6.6	910.2
6	1B mid	60.00	Ground	799.2	-2.4	801.6
7	3B End	106.34	Ground	1236.7	-13.8	1250.6
8	1B end	60.00	Ground	903.6	-6.6	910.2
9	1B mid	60.00	Ground	799.2	-2.4	801.6
10	3B End	106.34	Ground	1236.7	-13.8	1250.6
11	2B End	71.00	Ground	975.5	-0.7	976.3
12	1B mid	60.00	Ground	767.4	-1.8	769.2
13	1B mid	60.00	Ground	767.4	-1.8	769.2
14	1B mid	60.00	Ground	767.4	-1.8	769.2
15	1B mid	60.00	Ground	767.4	-1.8	769.2
16	1B mid	60.00	Ground	767.4	-1.8	769.2
17	1B mid	60.00	Ground	767.4	-1.8	769.2
18	2B End	71.00	Ground	975.5	-0.7	976.3
				Total	Total	Total
TOTALS		1454.2		17674.5	-77.8	17752.4

Carbon Emissions of the proposed scheme vs Baseline emissions

Water Consumption Strategy

Unit Type	GIFA (m2)	Persons	W/Cs	Shower Rooms	Family Baths	Unit No	Baseline Water Consumption: Water Use Density (L/Person/Day)	Baseline Water Consumption: Total Consumption (L/Day)	Estimated Water Consumption: Water Use Density (L/Person/Day)	Estimated Water Consumption: Total Consumption (L/Day)	Total Water Savings (L/Day)
1 Bed	60	2	1	0	1	10	125	250	92.23	184.45	65.55
2 Bed	71	3	1	0	1	2	125	375	92.23	276.68	98.32
3 Bed	104	6	1	0	1	4	125	750	92.23	553.36	196.64
4 Bed	126	8	1	1	1	2	125	1000	92.23	737.82	262.18
Total Water Consumption (L/Day)								14,125		10,422	3,703
Total Water Consumption (L/Year)								5,159,156		3,806,512	1,352,644

Based on the requirements for a focus on water efficiency set out in the approved document G of the building regulations 2010 which set out a maximum water consumption of 125L/Person/Day, the units have been designed to utilize a range of water saving technologies including efficient faucets and fixtures which help to reduce consumption by producing a lower flow of water, enabling dual-flush options and aerating the supply to reduce total volume of water in the flow.

The table above illustrates the anticipated water consumption for each of the unit types within the scheme is less than 95L/Person/Day achieved across the scheme providing evidence for compliance with the Building Regulation part G levels. These will be enabled via specification of minimum performance levels of the appliances prior to procurement. The water calculator only provides a limited scope, actual levels of consumption are expected to be lower.

This results in a total estimated consumption of **3,806,515L** of water every year at full occupancy. This is in comparison to **5,159,156L** that would be consumed from a baseline requirement resulting in up to **1,352,644L** of water savings every year.

These calculations are based on an in house water calculator using utilisation rates from the energy savings trusts water at home report. The below table outlines the consumption calculations from a single unit of the proposed development. All ZED PODs units are fitted with the same specification of wet goods. As principal designer and contractor, ZED PODs are able to ensure that design and technical specifications are fully implemented in construction.

Appliance Data			Consumption		Usage Data			Daily Water Consumption (L/Day/Person)
Element	No	Brand and Model	Average Flow Rate (L/min)	Consumption per Use (L)	Uses Per Day	Duration of Use (min)	Utilisation Factor	
Basin Tap (Kitchen)	1	Hansgrohe Focus M512 9L	9	N/A	N/A	N/A	N/A	14.87
Basin Tap	2	Hansgrohe Focus 70 5L	5.7	N/A	N/A	2.91	2.91	16.58
Toilet (Dual Flush)	2	Durvait Durastyle 3L / 4.5L Dual Flush	N/A	3.36	5.25	N/A	5.25	17.64
Shower	2	Hansgrohe Croma 100 Ecosmart Dual 9L	6	N/A	0.63	7.5	4.71	28.28
Bath	1	160L Basin	N/A	80	0.19	N/A	0.19	14.86
Total Consumption (L/Person/Day)								92.23

*Data from Energy saving trust water at home report

ZED PODs Water Calculator for the proposed unts

Anticipated Carbon Savings

Based on all of the measures and strategies previously discussed it is now possible to estimate the total operational carbon footprint of the scheme and to make comparisons about how much carbon could be saved in comparison to a part-L complaint new build. Using the social TOMS model for social value it is also possible to calculate how much value the environmental protections are estimated to bring to local society.

The below table illustrates that the scheme is estimated to save **17.7 tonnes** of carbon per year over the building regs baseline. This means the scheme is actually a net offset of total emissions for the area helping to reduce the areas overall emissions by **532 tonnes** over the next 30 years. Using the National TOMS social value calculations of £86 per tonne of CO2 it is possible to estimate that the scheme will save the area **£37K** over the next 30 years by reducing the damages caused by global warming effects.

In conclusion it is clear from the analysis conducted during the design and planning stages of the scheme that the scheme would act as an exemplary example of low carbon development and would help to council to achieve their Net Zero Carbon targets by 2050 ad hopefully inspire similar low carbon developments in the local area and beyond.

Operational Carbon

	Operational Carbon (kg/yr)	Operational Carbon (Tonne/yr)	Carbon Savings (Tonnes/Yr)	Carbon Savings Over 30 Years (Tonnes)	Social Value Added
Proposal	-77.85	**-0.1**			
2021 Baseline Part L	17674.51	**17.7**	18	532.57	£ 36,933.79

*Calculated using 2021 carbon costing, price of carbon will rise in future increasing value

Overheating Mitigation

The risk of summer overheating is important to ensure that homes are suitably protected against overheating and are suited to climate change adaptation given the predicted UK 2080 climate models showcase in most global warming scenarios that peak summer temperatures will rise between 2 and 6 degrees over the next 50 years. All dwellings have been designed with a low risk of summer overheating by utilizing the measures below:

- Openable windows
- Cross - ventilation
- Convective - ventilation
- Night purging
- MVHR summer bypass mode
- Cooling provision when hot water is being generated from the integrated MVHR/Heat pump/DHW solution

All windows will be SBD compliant to provide additional security measures to enable all dwellings to safely open their windows and all glazing used will provide appropriately specified 'Solar Control' G-Values in the development to avoid common overheating risks associated with the most-affected flats.

On this basis the proposed development has been qualified as suitable for the simplified model of overheating as per the requirements of the Part-O 2021 meaning that a dedicated overheating analysis report is not required to demonstrate that no overheating will occur.

Unregulated demands

Whilst it is acknowledged that unregulated demands rely on the user efforts, all efforts have been made to enable the residents to minimize their unregulated electricity consumption thought he use of A rated appliances and low energy fixtures and fittings. Passive techniques to encourage reduced energy demands are deployed such as provision for air drying of clothes in the proposed development

Advice will be provided to all occupants via the *'Home User Guide'* to help minimize electricity consumption. This will ensure that the renewable systems are properly maintained and operated over time. Post occupancy measures influenced by the soft landings framework will also be carried out to reduce teething problems.

Appendix 1: As Designed SAP Summary for Each House-Type in the Development

Property Reference	22273 End 1B			Issued on Date	22/12/2022
Assessment Reference	end 1B		Prop Type Ref	End house 1B	
Property	End 1B, School Close, TIVERTON, EX16 9NN				
SAP Rating	93 A	DER	-0.11	TER	15.06
Environmental	100 A	% DER < TER			100.73
CO_2 Emissions (t/year)	-0.07	DFEE	40.95	TFEE	47.07
Compliance Check	See BREL	% DFEE < TFEE			13.00
% DPER < TPER	69.21	DPER	24.41	TPER	79.30
Assessor Details	Mr. Robert Atherton			Assessor ID	F291-0001
Client					

Property Reference	22273 Mid 1B			Issued on Date	22/12/2022
Assessment Reference	Mid 1B_North		Prop Type Ref	Mid house 1B	
Property	Mid 1B, School Close, TIVERTON, EX16 9NN				
SAP Rating	94 A	DER	-0.03	TER	12.79
Environmental	100 A	% DER < TER			100.23
CO_2 Emissions (t/year)	-0.05	DFEE	32.06	TFEE	35.89
Compliance Check	See BREL	% DFEE < TFEE			10.66
% DPER < TPER	68.66	DPER	21.02	TPER	67.07
Assessor Details	Mr. Robert Atherton			Assessor ID	F291-0001
Client					

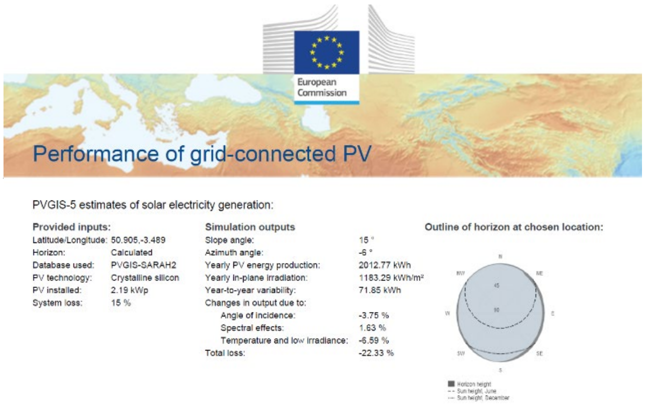
Property Reference	22273 Mid 1B			Issued on Date	22/12/2022
Assessment Reference	Mid 1B		Prop Type Ref	Mid house 1B	
Property	Mid 1B, School Close, TIVERTON, EX16 9NN				
SAP Rating	94 A	DER	-0.04	TER	13.32
Environmental	100 A	% DER < TER			100.30
CO_2 Emissions (t/year)	-0.06	DFEE	34.35	TFEE	38.70
Compliance Check	See BREL	% DFEE < TFEE			11.23
% DPER < TPER	68.78	DPER	21.84	TPER	69.95
Assessor Details	Mr. Robert Atherton			Assessor ID	F291-0001
Client					

Property Reference	22273 End 2B			Issued on Date	22/12/2022
Assessment Reference	end 2B		Prop Type Ref	End house 2B	
Property	End 12B, School Close, TIVERTON, EX16 9NN				
SAP Rating	93 A	DER	-0.01	TER	13.74
Environmental	100 A	% DER < TER			100.07
CO_2 Emissions (t/year)	-0.07	DFEE	38.56	TFEE	44.54
Compliance Check	See BREL	% DFEE < TFEE			13.42
% DPER < TPER	68.15	DPER	22.98	TPER	72.15
Assessor Details	Mr. Robert Atherton			Assessor ID	F291-0001
Client					

Property Reference	22273 End 3B			Issued on Date	22/12/2022
Assessment Reference	End 3B	Prop Type Ref	End house 3B		
Property	End 3B, School Close, TIVERTON, EX16 9NN				
SAP Rating	93 A	DER	-0.13	TER	11.63
Environmental	100 A	% DER < TER			101.12
CO_2 Emissions (t/year)	-0.11	DFEE	38.93	TFEE	44.20
Compliance Check	See BREL	% DFEE < TFEE			11.94
% DPER < TPER	67.59	DPER	19.73	TPER	60.87
Assessor Details	Mr. Robert Atherton			Assessor ID	F291-0001
Client					

Property Reference	22273 Semi 4B			Issued on Date	22/12/2022
Assessment Reference	Semi 4B	Prop Type Ref	Semi 4B		
Property	Semi 4B, School Close, TIVERTON, EX16 9NN				
SAP Rating	93 A	DER	-0.04	TER	10.49
Environmental	100 A	% DER < TER			100.38
CO_2 Emissions (t/year)	-0.1	DFEE	37.37	TFEE	42.05
Compliance Check	See BREL	% DFEE < TFEE			11.13
% DPER < TPER	65.80	DPER	18.80	TPER	54.97
Assessor Details	Mr. Robert Atherton			Assessor ID	F291-0001
Client					

Appendix B: PVGis (Solar Panel Generation) Calculations

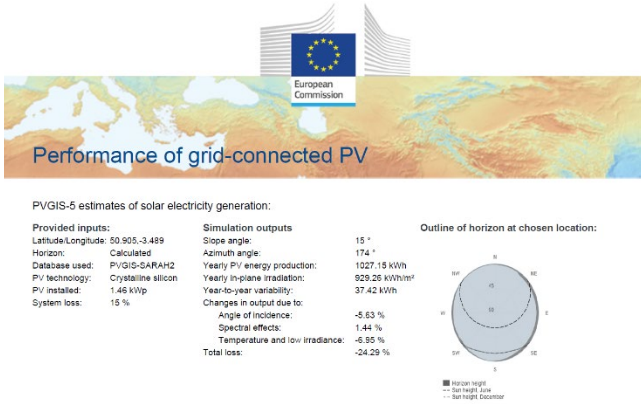


European Commission

Performance of grid-connected PV

PVGIS-5 estimates of solar electricity generation:

Provided inputs:		Simulation outputs	
Latitude/Longitude:	50.905,-3.489	Slope angle:	15 °
Horizon:	Calculated	Azimuth angle:	-6 °
Database used:	PVGIS-SARAH2	Yearly PV energy production:	2012.77 kWh
PV technology:	Crystalline silicon	Yearly in-plane irradiation:	1183.29 kWh/m²
PV installed:	2.19 kWp	Year-to-year variability:	71.85 kWh
System loss:	15 %	Changes in output due to:	
		Angle of incidence:	-3.75 %
		Spectral effects:	1.63 %
		Temperature and low irradiance:	-6.59 %
		Total loss:	-22.33 %

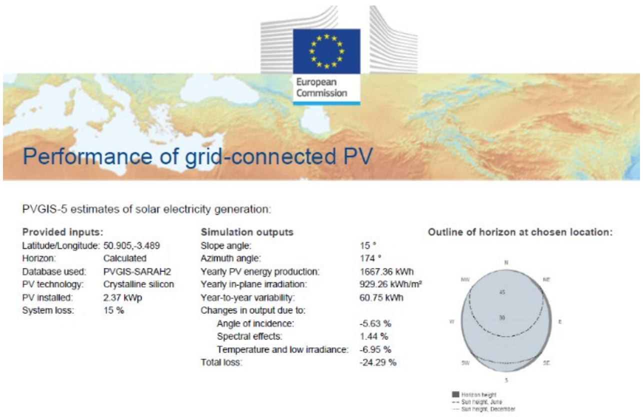


European Commission

Performance of grid-connected PV

PVGIS-5 estimates of solar electricity generation:

Provided inputs:		Simulation outputs	
Latitude/Longitude:	50.905,-3.489	Slope angle:	15 °
Horizon:	Calculated	Azimuth angle:	174 °
Database used:	PVGIS-SARAH2	Yearly PV energy production:	1027.15 kWh
PV technology:	Crystalline silicon	Yearly in-plane irradiation:	929.26 kWh/m²
PV installed:	1.46 kWp	Year-to-year variability:	37.42 kWh
System loss:	15 %	Changes in output due to:	
		Angle of incidence:	-5.63 %
		Spectral effects:	1.44 %
		Temperature and low irradiance:	-6.95 %
		Total loss:	-24.29 %

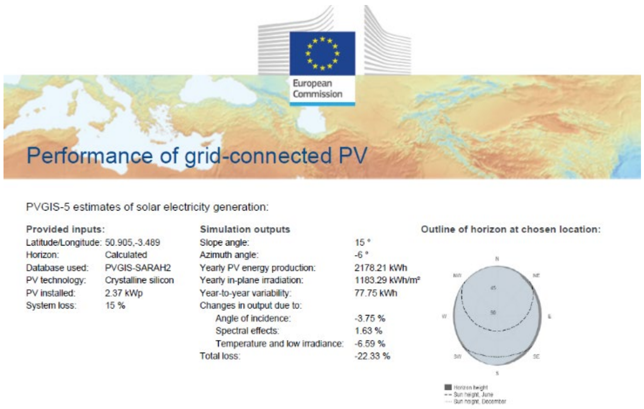


European Commission

Performance of grid-connected PV

PVGIS-5 estimates of solar electricity generation:

Provided inputs:		Simulation outputs	
Latitude/Longitude:	50.905,-3.489	Slope angle:	15 °
Horizon:	Calculated	Azimuth angle:	174 °
Database used:	PVGIS-SARAH2	Yearly PV energy production:	1667.36 kWh
PV technology:	Crystalline silicon	Yearly in-plane irradiation:	929.26 kWh/m²
PV installed:	2.37 kWp	Year-to-year variability:	60.75 kWh
System loss:	15 %	Changes in output due to:	
		Angle of incidence:	-5.63 %
		Spectral effects:	1.44 %
		Temperature and low irradiance:	-6.95 %
		Total loss:	-24.29 %

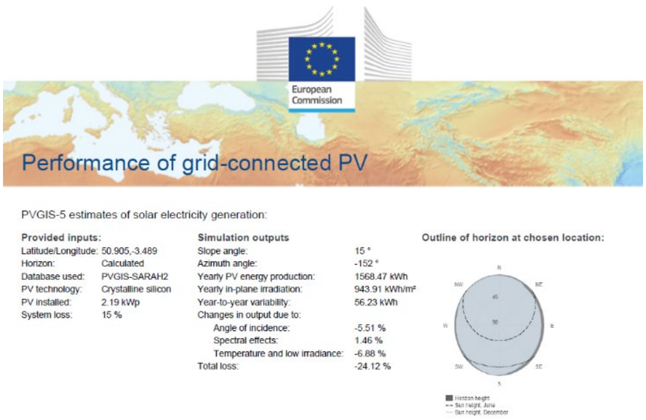


European Commission

Performance of grid-connected PV

PVGIS-5 estimates of solar electricity generation:

Provided inputs:		Simulation outputs	
Latitude/Longitude:	50.905,-3.489	Slope angle:	15 °
Horizon:	Calculated	Azimuth angle:	-6 °
Database used:	PVGIS-SARAH2	Yearly PV energy production:	2178.21 kWh
PV technology:	Crystalline silicon	Yearly in-plane irradiation:	1183.29 kWh/m²
PV installed:	2.37 kWp	Year-to-year variability:	77.75 kWh
System loss:	15 %	Changes in output due to:	
		Angle of incidence:	-3.75 %
		Spectral effects:	1.63 %
		Temperature and low irradiance:	-6.59 %
		Total loss:	-22.33 %

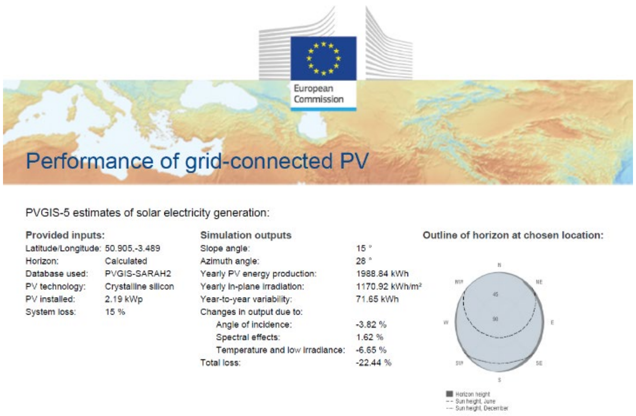


European Commission

Performance of grid-connected PV

PVGIS-5 estimates of solar electricity generation:

Provided inputs:		Simulation outputs	
Latitude/Longitude:	50.905,-3.489	Slope angle:	15 °
Horizon:	Calculated	Azimuth angle:	-152 °
Database used:	PVGIS-SARAH2	Yearly PV energy production:	1568.47 kWh
PV technology:	Crystalline silicon	Yearly in-plane irradiation:	943.91 kWh/m²
PV installed:	2.19 kWp	Year-to-year variability:	56.23 kWh
System loss:	15 %	Changes in output due to:	
		Angle of incidence:	-5.51 %
		Spectral effects:	1.46 %
		Temperature and low irradiance:	-6.88 %
		Total loss:	-24.12 %

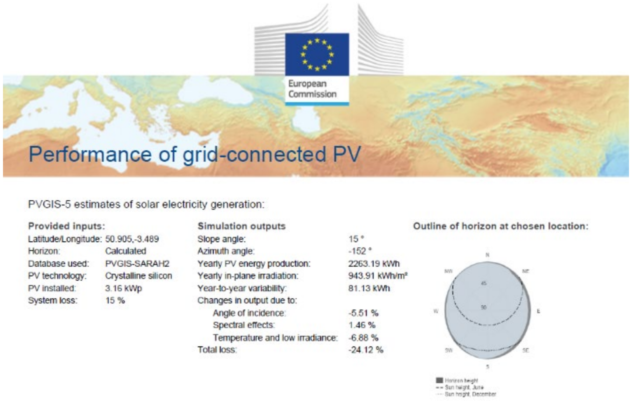


European Commission

Performance of grid-connected PV

PVGIS-5 estimates of solar electricity generation:

Provided inputs:		Simulation outputs	
Latitude/Longitude:	50.905,-3.489	Slope angle:	15 °
Horizon:	Calculated	Azimuth angle:	28 °
Database used:	PVGIS-SARAH2	Yearly PV energy production:	1988.84 kWh
PV technology:	Crystalline silicon	Yearly in-plane irradiation:	1170.92 kWh/m²
PV installed:	2.19 kWp	Year-to-year variability:	71.65 kWh
System loss:	15 %	Changes in output due to:	
		Angle of incidence:	-3.82 %
		Spectral effects:	1.62 %
		Temperature and low irradiance:	-6.65 %
		Total loss:	-22.44 %



Performance of grid-connected PV

European Commission

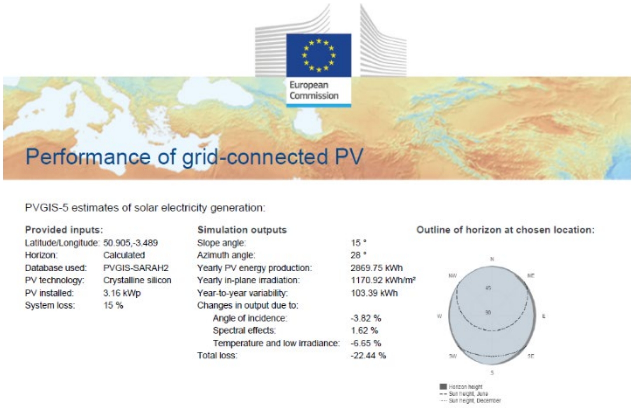
PVGIS-5 estimates of solar electricity generation:

Provided inputs:	
Latitude/Longitude:	50.905,-3.489
Horizon:	Calculated
Database used:	PVGIS-SARAH2
PV technology:	Crystalline silicon
PV installed:	3.16 kWp
System loss:	15 %

Simulation outputs	
Slope angle:	15 °
Azimuth angle:	-152 °
Yearly PV energy production:	2263.19 kWh
Yearly in-plane irradiation:	943.91 kWh/m²
Year-to-year variability:	81.13 kWh
Changes in output due to:	
Angle of incidence:	-5.51 %
Spectral effects:	1.46 %
Temperature and low irradiance:	-6.88 %
Total loss:	-24.12 %

Outline of horizon at chosen location:

Horizon height
Sun height, June
Sun height, December



Performance of grid-connected PV

European Commission

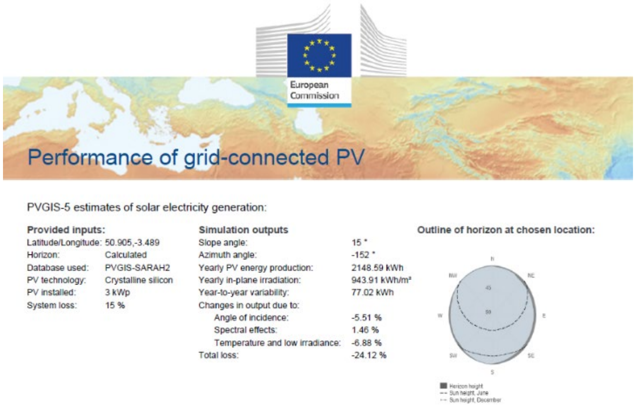
PVGIS-5 estimates of solar electricity generation:

Provided inputs:	
Latitude/Longitude:	50.905,-3.489
Horizon:	Calculated
Database used:	PVGIS-SARAH2
PV technology:	Crystalline silicon
PV installed:	3.16 kWp
System loss:	15 %

Simulation outputs	
Slope angle:	15 °
Azimuth angle:	28 °
Yearly PV energy production:	2869.75 kWh
Yearly in-plane irradiation:	1170.92 kWh/m²
Year-to-year variability:	103.39 kWh
Changes in output due to:	
Angle of incidence:	-3.82 %
Spectral effects:	1.62 %
Temperature and low irradiance:	-6.65 %
Total loss:	-22.44 %

Outline of horizon at chosen location:

Horizon height
Sun height, June
Sun height, December



Performance of grid-connected PV

European Commission

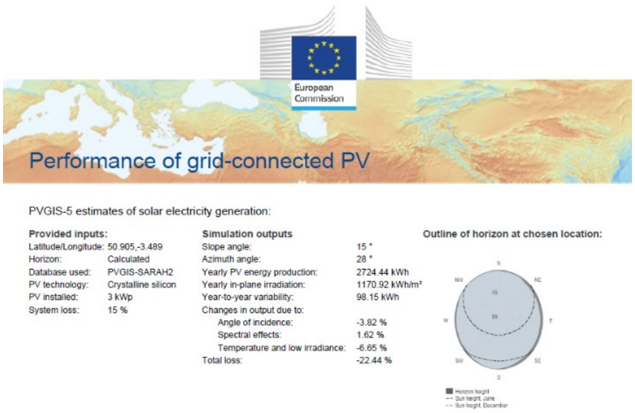
PVGIS-5 estimates of solar electricity generation:

Provided inputs:	
Latitude/Longitude:	50.905,-3.489
Horizon:	Calculated
Database used:	PVGIS-SARAH2
PV technology:	Crystalline silicon
PV installed:	3 kWp
System loss:	15 %

Simulation outputs	
Slope angle:	15 °
Azimuth angle:	-152 °
Yearly PV energy production:	2148.59 kWh
Yearly in-plane irradiation:	943.91 kWh/m²
Year-to-year variability:	77.02 kWh
Changes in output due to:	
Angle of incidence:	-5.51 %
Spectral effects:	1.46 %
Temperature and low irradiance:	-6.88 %
Total loss:	-24.12 %

Outline of horizon at chosen location:

Horizon height
Sun height, June
Sun height, December



Performance of grid-connected PV

European Commission

PVGIS-5 estimates of solar electricity generation:

Provided inputs:	
Latitude/Longitude:	50.905,-3.489
Horizon:	Calculated
Database used:	PVGIS-SARAH2
PV technology:	Crystalline silicon
PV installed:	3 kWp
System loss:	15 %

Simulation outputs	
Slope angle:	15 °
Azimuth angle:	28 °
Yearly PV energy production:	2724.44 kWh
Yearly in-plane irradiation:	1170.92 kWh/m²
Year-to-year variability:	98.15 kWh
Changes in output due to:	
Angle of incidence:	-3.82 %
Spectral effects:	1.62 %
Temperature and low irradiance:	-6.65 %
Total loss:	-22.44 %

Outline of horizon at chosen location:

Horizon height
Sun height, June
Sun height, December