



Carbon Reduction Statement

Lockup,
Pen Y Groes.

28th October 2021



Quality Management

Issue/ Revision	Issue 1	Revision 1	Revision 2	Revision 3
Remarks	First issue			
Date	28/10/2021			
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Project Number	806			



Contents

1.0	Executive Summary	1
2.0	Introduction	2
3.0	Performance Requirements	3
4.0	Baseline Assessment	6
5.0	Energy Efficiency Measures	7
6.0	LZC Technologies	7
7.0	Sustainable Design and Construction	10
8.0	Conclusion	12

Appendix 1: Calculations

1.0 EXECUTIVE SUMMARY

- 1.1 This statement outlines the estimated energy and CO₂ emissions performance of the proposed Lockup Self Storage in Pen-Y-Groes, Caernarfon including features that have been incorporated to the building design and building systems to minimise energy demand, energy use and resultant carbon dioxide emissions.
- 1.2 The Statement presents the commitments to meet the CO₂ emissions savings and energy generation in accordance with policies PS5, PS6 and PCYFF 5 set out within the Anglesey and Gwynedd Joint Local Development Plan 2011 – 2026 (adopted July 2017).
- 1.3 The proposed development has targeted meeting the energy demand as efficiently as possible through passive design, fabric energy efficiency improvements and the use of LZC technologies, as the main component of the energy strategy. This will be done in conjunction with key measures including improved fabric U-values and air-permeability.
- 1.4 Through the energy efficiency and sustainability measures identified, the proposed development achieves a total annual CO₂ reduction figure of 38.10%, demonstrating compliance with policies PS5, PS6 and PCYFF 5 set out within the Anglesey and Gwynedd Joint Local Development Plan 2011 – 2026 (adopted July 2017).

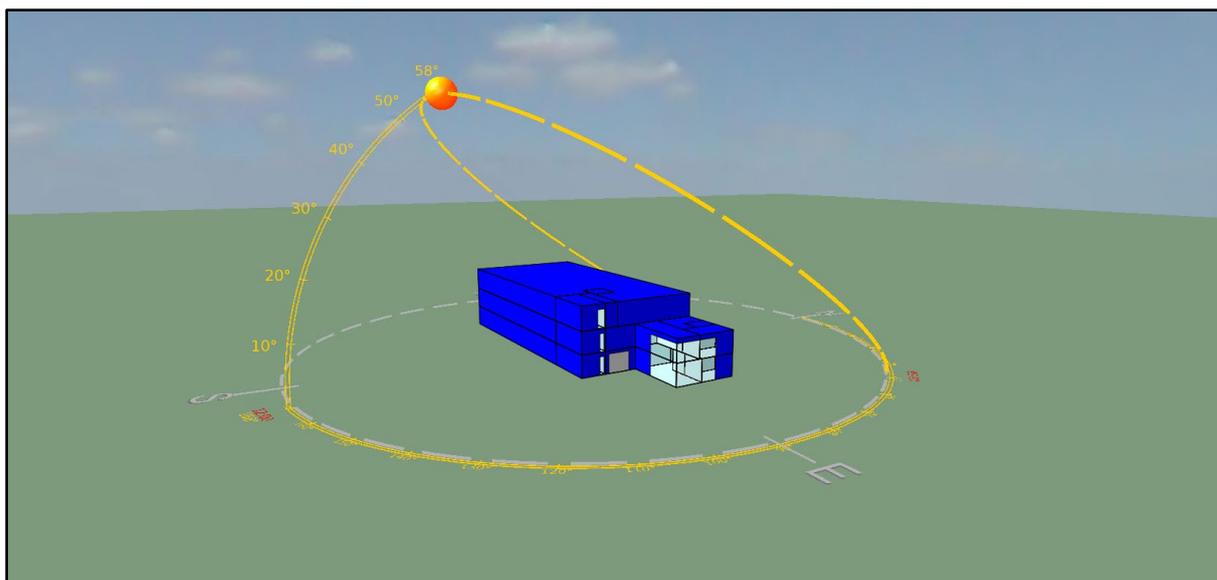
2.0 INTRODUCTION

- 2.1 RedSix were commissioned to prepare a Carbon Reduction Statement for the proposed development for the Lockup Self Storage in Pen-Y-Groes, Caernarfon.
- 2.2 This report presents the outcome of the energy appraisal of the proposed development and details the approach that the design team have collectively taken towards achieving a high standard of operational energy performance. This Statement outlines the features that have been incorporated into the design proposals which aim to reduce the energy demand, energy use, resultant carbon dioxide emissions and therefore environmental impact of the scheme.
- 2.3 The purpose of the Energy Statement is to provide an independent verification that the design of the proposed development is in accordance with objectives of relevant planning policy at all levels and is an example of good practice in low energy design.

THE PROPOSED DEVELOPMENT

- 2.4 The application site is found at Pen-Y-Groes, Caernarfon and comprises the construction of a Lockup Unit with a Consultation room, Managers Office, Accounts Room, Tea room and WC.

It is intended that the proposed development will be designed and constructed to operate with renewable energy production, specifically Solar PV Panels, to reduce the levels of carbon production.



3.0 PERFORMANCE REQUIREMENTS

ANGLESEY AND GWYNEDD JOINT LOCAL DEVELOPMENT PLAN 2011 – 2026 (Adopted July 2017)

3.1 Strategic Policy PS 5: Sustainable Development

“Development will be supported where it is demonstrated that they are consistent with the principles of sustainable development. All proposals should:

- 1. Alleviate the causes of climate change and adapting to those impacts that are unavoidable in accordance with Strategic Policy PS 6;*
- 2. Give priority to effective use of land and infrastructure, prioritizing wherever possible the reuse of previously developed land and buildings within the development boundaries of Sub Regional Centre, Urban and Local Service Centres, Villages or in the most appropriate places outside them in accordance with Strategic Policy PS 17, PS 13 and PS 14;*
- 3. Promote greater self-containment of Centres and Villages by contributing to balanced communities that are supported by sufficient services; cultural, arts, sporting and entertainment activities; a varied range of employment opportunities; physical and social infrastructure; and a choice of modes of travel;*
- 4. Protect, support and promote the use of the Welsh language in accordance with Strategic Policy PS 1;*
- 5. Preserve and enhance the quality of the built and historic environment assets (including their setting), improving the understanding, appreciation of their social and economic contribution and sustainable use of them in accordance with Strategic Policy PS 20;*
- 6. Protect and improve the quality of the natural environment, its landscapes and biodiversity assets, including understanding and appreciating them for the social and economic contribution they make in accordance with Strategic Policy PS 19;*
- 7. Reduce the effect on local resources, avoiding pollution and incorporating sustainable building principles in order to contribute to energy conservation and efficiency; using renewable energy; reducing / recycling waste; using materials from sustainable sources; and protecting soil quality;*
- 8. Reduce the amount of water used and wasted; reducing the effect on water resources and quality; managing flood risk and maximizing use of sustainable drainage schemes; and progressing the objectives of the Western Wales River Basin Water Management Plan.*

Proposals should also where appropriate:

- 9. Meet the needs of the local population throughout their lifetime in terms of their quality, types of tenure and affordability of housing units in accordance with Strategic Policy PS 16;*
- 10. Promote a varied and responsive local economy that encourages investment and that will support Centres, Villages and rural areas in accordance with Strategic Policy PS 13;*

11. *Support the local economy and businesses by providing opportunities for lifelong learning and skills development in accordance with Strategic Policy PS 13;*
12. *Reduce the need to travel by private transport and encourage the opportunities for all users to travel when required as often as possible by means of alternative modes, placing particular emphasis on walking, cycling and using public transport in accordance with Strategic Policy PS 4;*
13. *Promote high standards of design that make a positive contribution to the local area, accessible places, that can respond to future requirements and that reduce crime, antisocial behaviour and the fear of crime in accordance with Policy PCYFF 3.”*

3.2 **Strategic Policy PS 6: Alleviating and Adapting to the effects of Climate Change**

“In order to alleviate the effects of climate change, proposals will only be permitted where it is demonstrated that they have fully taken account of and responded to the following:

1. *The energy hierarchy:*
 - i. *Reducing energy demand;*
 - ii. *Energy efficiency;*
 - iii. *Using low or zero carbon energy technologies wherever practical, viable and consistent with the need to engage and involve communities; protect visual amenities, the natural, built and historic environment and the landscape*
2. *Reducing greenhouse gas emissions, help to reduce waste and encourage travel other than by car.*

In order to adapt to the effects of climate change, proposals will only be permitted where it is demonstrated with appropriate evidence that they have fully taken account of and responded to the following:

3. *Implementing sustainable water management measures in line with the objectives in the Western Wales River Basin Management Plan;*
4. *Locating away from flood risk areas, and aim to reduce the overall risk of flooding within the Plan area and areas outside it, taking account of a 100 years and 75 years of flood risk in terms of the lifetime of residential and non-residential development, respectively, unless it can be clearly demonstrated that there is no risk or that the risk can be managed;*
5. *Be able to withstand the effects of climate change as much as possible because of its high standards of sustainable design, location, layout and sustainable building methods (in line with Policy PCYFF 3);*
6. *Safeguarding the best and most versatile agricultural land, promoting allotments, support opportunities for local food production and farming in order to reduce the area’s contribution to food miles;*
7. *Ensuring that the ability of landscapes, environments and species to adapt to the harmful effects of climate change is not affected, and that compensatory environments are provided if necessary;*

8. Aim for the highest possible standard in terms of water efficiency and implement other measures to withstand drought, maintain the flow of water and maintain or improve the quality of water, including using sustainable drainage systems (in line with Policy PCYFF 6)."

3.3 **PCYFF 5: Carbon Management**

"Proposals will need to demonstrate how the energy hierarchy set out in Policy PS 6 has been applied and how the contribution from renewable or low carbon energy to satisfy the proposals need for energy and waste has been maximised. Where appropriate, the co-location of development in order to optimise opportunities to connect to renewable or low carbon energy technology will be supported. Residential development on sites for 100 housing units or more, and non-residential development of 1,000 sq. metres or more, will be required to submit a comprehensive Energy Assessment to determine the feasibility, including viability issues, of incorporating renewable or low carbon technology and/ or, where appropriate, connect to renewable or low carbon technology. The Assessment will be expected to address the following matters:

- 1. Energy efficient design – development should maximise energy efficiency through design, layout, orientation, and use of other techniques to incorporate energy efficiency methods;*
- 2. Renewable energy feasibility – full assessment of the feasibility of all on site renewable energy technologies. The response should provide details of:*
 - i. The energy generated and the CO² savings;*
 - ii. The proposed technology's capacity and size;*
 - iii. Location of the technology plotted on site plans.*

BUILDING REGULATIONS

3.4 Building Regulations exist to ensure the health, safety, welfare and convenience of people in and around buildings, and the energy efficiency of buildings. The regulations apply to most new buildings and many alterations of existing buildings in Wales, whether new residential, or non-residential.

3.5 It is expected the development be constructed to be compliant with Building Regulations Part L2a Wales 2014 (with 2016 amendments), which represent the current Regulations at the time of construction and are appropriate of the proposed works.

4.0 BASELINE ASSESSMENT

- 4.1 In order to assess the baseline and potential CO₂ emissions and potential energy demands of the proposed development, the following documents have been used:
- Creu Design Drawing No. 001, Revision F, entitled Location Plan (03.16.21).
 - Creu Design Drawing No. 002, Revision C, entitled Existing Site (07.04.21).
 - Creu Design Drawing No. 006, Revision F, entitled Proposed Site (07.04.21).
 - Creu Design Drawing No. 101, Revision G, entitled Plan Level 00 GA (16.04.21).
 - Creu Design Drawing No. 102, Revision G, entitled Plan Level 01 GA (16.04.21).
 - Creu Design Drawing No. 103, Revision E, entitled Plan Level 02 GA (16.04.21).
 - Creu Design Drawing No. 104, Revision F, entitled Plan Level Roof GA (16.04.21).
 - Creu Design Drawing No. 106, Revision F, entitled Proposed Office Layout (25.05.21).
 - Creu Design Drawing No. 201, Revision G, entitled Elevation East and South (14.04.21).
 - Creu Design Drawing No. 202, Revision G, entitled Elevation North and West (16.04.21).
 - Creu Design Drawing No. 301, Revision G, entitled Sections Proposed GA (16.04.21).
 - Creu Design Drawing No. 900, Revision E, entitled Proposed 3D (28.05.21).
- 4.2 An energy modelling exercise has been undertaken to determine the anticipated Building Regulations baseline, which indicates the minimum regulatory performance for the regulated emissions and energy demand of the proposed development.
- 4.3 The methodology used to estimate the energy demand from the building has been informed by the guidance contained in the National Calculation Methodology (NCM) modelling guide.
- 4.4 In order to assess the likely CO₂ emissions and energy demands of the proposed development, it is necessary to use appropriate simulation software in accordance with CIBSE AM11. Integrated Environmental Solutions, (IES), Virtual Environment, (VE), V2021.3.0.0 has been used to model the units.

BASELINE RESULTS

- 4.5 The regulated emissions and energy demand baseline for the proposed development is taken as the baseline compliance figures generated by the calculation software to achieve regulatory (Part L2a) compliance, as follows:

Emissions Baseline (TER) (kgCO ₂ /m ² /yr)
110.7

5.0 FABRIC EFFICIENCY MEASURES

- 5.1 The Energy Hierarchy adopts a set of principles to guide design development and decisions regarding energy, balanced with the need to optimise environmental and economic benefits.
- 5.2 Consequently, a key stage in the energy strategy for the proposed development is the consideration of fabric energy efficiency measures to ensure that the base energy demand and CO₂ emissions is minimized as far as practically possible.
- 5.3 In order to ensure the proposed development complies with 2013 Building Regulations and improves upon the baseline compliance threshold, specific fabric measures to make the building more energy efficient have been incorporated within the proposed scheme design.
- 5.4 The following key fabric energy efficiency design measures to reduce emissions and energy demand have been incorporated into the design of the project:

New Fabric Elements		Improvement over Part L2a 2013 minimum values
External walls	0.21 W/m ² k	40.00%
Ground Floor	0.22 W/m ² k	12.00%
Roof	0.18 W/m ² k	28.00%
New Glazing Parameters		
u-values	1.8 W/m ² k	18.18%
Air Permeability		
5 m ³ /hr.m ² @50Pa		50.00%

6.0 LZC TECHNOLOGIES ASSESSMENT

- 6.1 An initial assessment of feasible renewable energy sources has been carried out and the results are detailed below. The renewable energy feasibility study for the proposed development has assessed the use of solar thermal collectors, biomass heating, ground/air source heat pumps, wind turbines and photovoltaic modules.

WIND TURBINE GENERATORS

- 6.2 The wind speeds and frequencies in urban areas such are not expected to yield any significant carbon reductions. For these reasons the application of a wind turbine for the project has not been considered.

SOLAR WATER

- 6.3 Solar thermal panels are used to produce hot water and consist of roof mounted collector panels that make use of heat energy from the sun to heat water circulating in

a closed loop. Usually this heat is then transferred via a heat exchanger into a hot water storage tank that is also heated by a gas or other boiler.

- 6.4 Two main types of solar water heating system are used in the UK; flat plate collectors and evacuated glass heat tubes. Flat plate collectors circulate water around a black coloured receiver plate that is heated by direct sunlight and to some extent by indirect light; heat being retained by a thermally glazed panel above. Evacuated glass heat tubes are more efficient, particularly in the UK, as they can work more effectively at low solar radiation levels. They are however, more expensive than flat plate collectors. They consist of rows of parallel transparent glass tubes, each containing an absorber tube which converts the sunlight into heat energy.
- 6.5 At the proposed development solar hot water systems could be installed, however to achieve a reasonable reduction in CO₂ a significant amount of panels would be required, which would likely exceed the hot water demand for the building, therefore it is not recommended to install a solar hot water system at the proposed development.

GROUND SOURCE HEATING

- 6.6 Ground source heat pumps (GSHP) extract heat from the ground. GSHPs work on the principle that the below ground temperature is more constant compared to above ground. In the winter months, the below-ground temperature is warmer than above ground and the heat carrier fluid circulating within the absorber pipes absorbs the heat. This heat energy is then raised by a compressor (using the compression cycle) and through a heat exchanger, distributed via a low temperature distribution system such as under floor heating, to satisfy a proportion of space heating requirements. GSHP systems are not suitable for satisfying high temperature hot water demands.
- 6.7 In the summer months, the below-ground temperature is colder than above ground and heat carrier fluid circulating within the buried pipes rejects building heat. This heat rejecting capacity is then raised by a compressor (using the compression cycle), and through a heat exchanger, is then distributed via a chilled water distribution system to satisfy a proportion of space cooling requirements.
- 6.8 There are a number of configurations for GSHP systems, however the installation of a vertical collector system or horizontal collector system is not considered technically feasible for the project, given the restricted areas available for their installation.
- 6.9 Given the expense of installation, the number of boreholes required to meet the load requirements of the proposed development, along with a limited installation area for collectors (horizontal and vertical) it is not recommended to install a ground coupling at the proposed development.

AIR SOURCE HEATING

- 6.10 Air source heat pumps (ASHPs) utilise the outside air as a heat source or heat sink. Heat can be used to warm water for radiators or underfloor heating systems, or to warm the air within a dwelling. ASHPs work on a similar principle to a fridge, which

extracts heat from its inside. An evaporator coil mounted outside absorbs or expels the heat; a compressor unit then drives refrigerant through the heat pump and compresses it to the right level to suit the heat distribution system. Finally, a heat exchanger transfers the heat from the refrigerant for use, depending on which of the two main types of systems (identified below) is installed:

- 6.11 ASHPs can be technically integrated with the heating system at the proposed development but have not been specified for the proposed development due to the expense of their installation.

BIOMASS

- 6.12 Biomass boilers replace conventionally powered boilers with an almost carbon neutral fuel such as wood pellets or wood chips. The fuel is classed as almost carbon neutral because the CO₂ released during the burning of biomass is balanced by that absorbed by the plants during their growth.
- 6.13 Due to existing site constraints, adequate space for biomass fuel storage and safe delivery cannot be allocated.
- 6.14 Although many biomass burners will meet Clean Air Act requirements, combustion of wood biomass releases higher quantities of NO_x, SO_x and particulates (PM10 and PM2.5) compared to a comparable system fuelled by natural gas, which can adversely affect local air quality.
- 6.15 Biomass could technically be burned at the application site but is not preferred given site spatial limitations, the management burden of fuel deliveries and removal of ash and the potential impact on local air quality given the proximity of existing residential dwellings. For these reasons Biomass has been deemed unfeasible for the project.

PHOTOVOLTAIC CELLS

- 6.16 Solar Photovoltaics (PVs) are solar panels which generate electricity through photon-to-electron energy transfer, which takes place in the dielectric materials that make up the cells. The cells are made up from layers of semi-conducting silicon material which, when illuminated by the sun, produces an electrical field which generates an electrical current. PVs can generate electricity even on overcast days, requiring daylight, rather than direct sunlight. This makes them viable even in the UK, although peak output is obtained at midday on a sunny summer's day. PVs offer a simple, proven solution to generating renewable electricity.
- 6.17 The main types of commercially available PV panels on offer in the UK are constructed from cells as described below:
- Monocrystalline silicon cells are the most efficient of the PV technologies with a conversion efficiency of between 15-18% (available solar energy to electricity produced). They are cut from single ingots of silicon, have an unbroken crystal lattice and are the most expensive of PVs;

- Polycrystalline silicon cells have a conversion efficiency of between 13-16%. They are less expensive than monocrystalline cells, are constructed of a number of smaller crystals and are recognisable from a visible 'grain' on the panel; and
- 6.18 At the proposed development solar PV systems are technically feasible and 47.25kWp PV system has been specified.

C02 EMISSIONS SAVINGS

	Emissions (kgCO ₂ /m ² /yr)	Improvement (%)
Baseline	110.7	N/A
Energy & Sustainability Improvements	68.5	38.10%

- 6.17 The energy modelling of the proposed development indicates that by incorporating the fabric efficiency measures set out within section 5.0 and the addition of the 47.25kWp solar PV system, a 38.10% reduction in CO₂ emissions can be achieved, demonstrating compliance with policies PS5, PS6 and PCYFF 5 set out within the the Anglesey and Gwynedd Joint Local Development Plan 2011 – 2026 (adopted July 2017).

7.0 SUSTAINABLE DESIGN & CONSTRUCTION

In addition to making the fullest contribution to minimizing carbon dioxide emissions (in accordance with the energy hierarchy), the proposed development will also be able to withstand the effects of climate change as much as possible because of its high standards of sustainable design, location, layout and sustainable building methods as follows:

CONSTRUCTION TECHNIQUES

- 7.1 Where possible the proposed development has incorporated construction techniques that maximise sustainability and energy efficiency. The glazing of the building has a high performance and also helps with natural daylighting, therefore reducing the building's energy use demand. All materials specified have been chosen with low U-values and therefore each construction element will have a better performance and will help improve internal comfort levels and protect from the extreme weather to be expected in the future.

LOW CARBON & SUSTAINABLE MATERIALS

- 7.2 Where feasible, the selection and installation of new building materials with low embodied energy will be prioritised. This will be undertaken using the BRE Green Guide to Specification, where the team will prioritise the selection of materials with higher ratings, though the guide does not assess embodied carbon dioxide performance alone.

All timber used (temporary or permanent) will be sourced in accordance with the UK Government's Timber Procurement Policy and all timber suppliers and products will be

FSC (Forest Stewardship Council) or PEFC (Programme for the Endorsement of Forest Certification) certified.

In addition, and where feasible, all major construction materials will be sourced from suppliers who themselves have a third party certificated environmental standard in place and are sourced local to the development wherever possible. This ensures sustainability is transferred throughout the project supply chain.

CLEAN ENERGY

- 7.3 The proposed development has reduced site emissions through the generation of cleaner energy as outlined in section 6.0. This has been achieved through the use of Photovoltaic Panel's being integrated within the design, which as a form of renewable energy helps to further reduce the site's CO2 emissions through the provision of clean energy.

RAINWATER RECYCLING

- 7.4 The proposed development has reduced water use through the specification of a rainwater recycling system, which is being installed to meet the WC flush demands. The use of this system will help to reduce the development's mains water demand and help by reducing the amount of energy used to artificially draw the water from the environment.

8.0 CONCLUSION

- 8.1 This Carbon Reduction Statement has shown how the proposed development of the Lockup Self Storage in Pen-Y-Groes, Caernarfon will be designed using the Energy Hierarchy and will make the fullest contribution to minimizing carbon dioxide emissions and energy demand, as compared to a Part L2a Wales 2014 compliant, 'business as usual' building.
- 8.2 Following the energy hierarchy has enabled carbon reductions to be calculated for the proposed development. An average overall site-wide carbon reduction of 38.10% can be achieved through the energy strategy demonstrated in this report.
- 8.3 In relation to policies PS5, PS6 and PCYFF 5 set out within the Anglesey and Gwynedd Joint Local Development Plan 2011 – 2026 (adopted July 2017), the site would benefit from the installation of the proposed fabric efficiency measures outlined in Section 5.4, and the site would additionally benefit further from the installation of solar PV's outlined in section 6, which together achieve a total carbon reduction of 38.10%.
- 8.4 The result tables below provide a summary of the CO₂ emissions and energy demand savings achieved for the project, confirming the current proposals meet the requirements in policies PS5, PS6 and PCYFF 5 set out within the Anglesey and Gwynedd Joint Local Development Plan 2011 – 2026 (adopted July 2017).

CO₂ Emission Savings

	Emissions (kgCO ₂ /m ² /yr)	Improvement (%)
Baseline	110.7	N/A
Energy & Sustainability Improvements	68.5	38.10%