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3. Scheme Need, Alternatives and Iterative Design Process

3.1 Need for the Project

Climate change

3.1.1 The Welsh Government Net Zero Carbon Budget, 2021[1] reports upon past progress and future ambition towards combatting climate change:

> *"In the last six years, we have laid the legislative foundations for a cleaner, fairer, stronger Wales, including through the Well-being of Future Generations (Wales) Act 2015 and the Environment (Wales) Act 2016. Wales has consistently followed the science, starting in 2016 with a target for an 80% reduction in our emissions by 2050. In 2019 we accepted the CCC's recommendation to increase our ambition to 95% shortly after the Senedd became the first Parliament in the world to declare a climate emergency in 2019. On accepting the recommendation, we were clear our ambition should be in line with the spirit of the Paris Agreement in which richer, developed nations should set in law a net zero target by the middle of this century".*

3.1.2 The Climate Change (Wales) Regulations 2021[2] reiterates the dangers posed by climate change and the response of Welsh Government: "*climate science continues to demonstrate that human activity is warming the planet and that the resulting effect on weather patterns is having increasingly negative consequences for ecosystems, economies, and people. The Welsh Government is proposing to increase Wales's climate targets in response to the latest climate science and the recommendations of the Climate Change Committee (CCC)*". This includes:

- "Carbon Budget 2 (2021-2025): an average of 37% below the baseline with a credit ('offset') limit of 0%;
- Carbon Budget 3 (2026-2030): an average of 58% below the baseline;
- 2030 target for an emissions reduction of 63% against the baseline;
- A 2040 target for an emissions reduction of 89% against the baseline; and
- A 2050 target for an emissions reduction of at least 100% against the baseline ('net zero')"[2].

3.1.3 The 'sustainable development principle' established by the Welsh Government in the Well-being of Future Generations (Wales) Act (2015)[3] was introduced to ensure public bodies act in a manner which seeks to ensure that the needs of the present are met without compromising the ability of future generations to meet their own needs. A key element of this is stated as "*tackling climate change by reducing the greenhouse gas*

[1] Welsh Government (2021). Net Zero Wales Carbon Budget 2 (2021 to 2025). (c. 1), pp. 10. (Online). Available at: https://gov.wales/sites/default/files/publications/2021-10/net-zero-wales-carbon-budget-2-2021-25.pdf (Accessed October 2022).
[2] Welsh Government (2021). The Climate Change (Wales) Regulations 2021: integrated impact assessment. (c1), pp. 3. (Online). Available from: https://gov.wales/sites/default/files/pdf-versions/2021/7/5/1625823413/climate-change-wales-regulations-2021-integrated-impact-assessment.pdf (Accessed October 2022).
[3] Welsh Government (2015). Well-being of Future Generations (Wales) Act 2015. (c. 1). (Online). Available at: https://www.futuregenerations.wales/wp-content/uploads/2017/01/WFGAct-English.pdf (Accessed October 2022).

emissions that cause climate change and ensuring that places are resilient to the consequences of climate change".

3.1.4 In 2021, Future Wales: The National Plan 2040 (Future Wales) was introduced as a national development framework to combat the *"climate emergency which is actively changing our environment and directly affecting communities"*. Future Wales aims to help plan new development and manage land use through enhancing the economic, social, environmental, and cultural well-being of Wales. Future Wales builds on the well-being goals set out in the Future Generations (Wales) Act (2015) to create a Prosperous, Resilient, Healthier, More Equal, Cohesive, Globally Responsible and Vibrant and Thriving Wales.

3.1.5 Future Wales also specifies:

> *"It is vital that we reduce our emissions to protect our own well-being and to demonstrate our global responsibility. Future Wales together with Planning Policy Wales will ensure the planning system focuses on delivering a decarbonised and resilient Wales through the places we create the energy we generate, the natural resources and materials we use and how we live and travel".*[4]

3.1.6 Future Wales identifies renewable energy generation as key to the delivery of its carbon budgets. Policy 17 and 18 set out Future Wales' approach to renewable energy with Policy 17 stating that the Welsh Government strongly supports the principle of developing renewable and low carbon energy from all technologies and at all scales to meet future energy needs.

3.1.7 The latest version of Planning Policy Wales (Edition 11) [5] (PPW11) acknowledges Wales has been set a 95% net zero target for 2050 by the CCC and how nationally, the intention is to go beyond this to become fully net zero. PPW11 outlines:

> *"Climate change is a global challenge, with impacts felt at the local level presenting a significant risk to people, property, infrastructure and natural resources. We need to plan for these impacts, reducing the vulnerability of our natural resources and build an environment which can adapt to climate change. The planning system plays a significant role in managing this risk. Development allowed today will be around for decades to come. The most important decision the planning system makes is to ensure the right developments are built in the right places".*

3.1.8 National policy and legislation is drafted in recognition of the need to tackle climate change, with renewable energy developments seen as a key means by which present and future carbon budgets can be achieved.

Renewable energy and energy security

3.1.9 Renewable energy produces energy without burning fossil fuels that release CO_2 and contribute to climate change. Renewable energy also provides a new and alternative energy source to tackle energy security issues. Increased use of renewable energy is therefore a key part of European, UK and Welsh energy strategy.

3.1.10 In September 2017, the Welsh Government Cabinet Secretary for Environment and Rural Affairs announced to the Welsh Assembly that it was setting a target of Wales generating

[4] Welsh Government (2021). Future Wales the National Plan 2040. (c. 2), pp. 45. (Online). Available at: https://gov.wales/sites/default/files/publications/2021-02/future-wales-the-national-plan-2040.pdf (Accessed October 2022).
[5] Welsh Government (2021). Planning Policy Wales 11th Ed. (c. 3), pp. 31. (Online). Available at: https://gov.wales/sites/default/files/publications/2021-02/planning-policy-wales-edition-11_0.pdf (Accessed October 2022).

70 per cent of its electricity consumption from renewable energy by 2030 and a target for one Gigawatt of renewable electricity capacity in Wales to be locally owned by 2030[6].

3.1.11 Future Wales (page 48) also maintains "*Wales can become a world leader in renewable energy technologies. Our wind and tidal resources, our potential for solar generation, our support for both large and community scaled projects and our commitment to ensuring the planning system provides a strong lead for renewable energy development, mean we are well placed to support the renewable sector, attract new investment and reduce carbon emissions*".

3.1.12 Key targets for renewable energy are set out below in **Table 3.1**.

Table 3.1 Key renewable energy targets

Consideration	Target
Greenhouse gas reduction	34% by 2020, 60% by 2030, 80% by 2050[7]
CO_2 reduction	26% by 2020[7]
Electricity from renewable sources	70% by 2030[5]

3.1.13 PPW11[5] states that "*Local authorities should facilitate all forms of renewable and low carbon energy development and should seek cross-department co-operation to achieve this. In doing so, planning authorities should seek to ensure their area's full potential for renewable and low carbon energy generation is maximised and renewable energy targets are achieved. Planning authorities should seek to maximise the potential of renewable energy by linking the development plan with other local authority strategies, including Local Well-being plans and Economic/Regeneration strategies".*

3.1.14 Onshore wind power is recognised as being a deliverable, mature technology. Wind power is one of the few energy technologies that is both low in CO_2 emissions, helping to tackle climate change, yet can also be delivered quickly, affordably and is domestically secure thereby addressing the key energy security challenges. It is this critical ability to address both issues that makes wind power a central feature in Welsh Energy policy.

3.1.15 PPW11 also states that "*The government has committed to expand renewable energy generation by public bodies and community enterprises in Wales by over 100 MW between 2021 and 2026. This will put Wales on the path to meet the longer-term target of 1 GW of renewable energy generation capacity to be locally owned by 2030. As part of the government's forthcoming consultation on meeting Wales' electricity demand from renewable generation there will also be a review of the target for local ownership*".[5]

3.1.16 Wales has one of the windiest climates in the UK, giving the country great potential to use this resource to generate electricity.

3.2 Site Selection Process and Consideration of Alternatives

3.2.1 In 2019, the Applicant undertook a regional site finding exercise to identify areas with the greatest potential for wind energy development in south Wales guided by the emerging draft of Future Wales which outlined Pre-Assessed Areas (PAAs) for onshore wind

[6] Welsh Parliament (2017). Lesley Griffiths high on ambition for clean energy. Available at: https://record.senedd.wales/Plenary/4644#C26839 (Accessed October 2022)
[7] UK Government (2008). Climate Change Act 2008. (online) Available at: https://www.legislation.gov.uk/ukpga/2008/27/contents (Accessed October 2022).

development and for areas outside of PAAs, provided a positive policy framework for large-scale on-shore wind energy subject to policy considerations. South Wales was chosen because it has some of the highest wind speeds within Europe and within the UK. Furthermore, south Wales also benefits from an existing, comprehensive electricity distribution network, particularly in the former coal mining valleys, something which is absent from large parts of the more remote areas of Wales. The Applicant's existing presence within south Wales was also a determining factor in this selection process as it has developed and now operates six onshore wind farms within the south Wales coalfield.

3.2.2 The Site identification process included a high-level sieving exercise to identify broad areas of interest and then a more detailed review to identify specific potential sites within or close to PAAs. This was followed by a land ownership investigation. The sieving exercise took wind speed as its starting point and excluded any areas where the ETSU NOABL database did not have a mean annual average wind speed above 7 metres per second (considered by the Applicant to be the minimum required for a commercially viable scheme).

3.2.3 There are several areas of south Wales with an average wind speed well above 7m/s. Those areas with wind speeds above 7m/s within the Brecon Beacons National Park, and any other national landscape designations were excluded from the search exercise. Those areas within TAN 8 Area F that have already been developed for wind farms were also excluded. The eastern limb of PAA 10 (Future Wales 2021) resulted in three sites coming forward, Mynydd Carn y Cefn, Mynydd Llanhilleth and Trecelyn.

3.2.4 Discussions with the land agents of relevant land holders in this region indicated that land at Mynydd Llanhilleth was available to wind farm developers.

3.2.5 The original process of choosing possible sites also included a review of technical factors and a high-level assessment of the landscape impact of each development. The factors the Applicant considered in selecting the site are presented in **Table 3.2.**

Table 3.2 A summary of main factors considered in site selection

Assessment Category	Specific factor	Site performance
Wind resource	Average annual wind speed Wind direction	7m/s Predominantly southwest
Electronic Infrastructure	Proximity of transmission lines Proximity of grid connection points	66kv sufficiently close to the site Nearby to the Site, towards the southeast.
Land Value	Land ownership Ecological value Archaeological value Landscape value (and designations)	Willingness of landowner Low/moderate – not within any designations Low/moderate – not within any designations. Partially within PAA 10 but outside any sensitive landscape designations; sufficiently distant from Brecon Beacons National Park and Blaenavon World Heritage Site.

Assessment Category	Specific factor	Site performance
Land Form	Size of site, useable area Steepness of terrain Smoothness of hill tops Alignment of high ground to prevailing wind	Predominantly flat ridge areas Plateau on steep sided banks Good Very Good
Land use/Land cover	Road network and access Radio-telecommunications masts Current land use Nearby land use Proximity of urban settlements	Existing highway access via British Road and access routes within the Site. No existing infrastructure, site used for grazing mixed livestock. Designated as Common Land. Wind Turbines within 1km Llanhilleth to the west and Pontnewynydd to the east.

3.2.6 The Proposed Development site was considered to offer a good combination of the assessment factors:

- Excellent wind resource;
- Partially within Future Wales PAA 10 and as such subject to Policy 17 and 18;
- Large usable area;
- Low vulnerability to major accidents and disasters arising from, for example, flooding or sea level rise, due to location on high ground plus an absence of existing infrastructure;
- Good potential highway access;
- Nearby wind farm developments where cumulative visual effects could likely be accommodated;
- Available existing electrical infrastructure; and
- Likely low impact on ecology, archaeology (including the Site being suitably south of the Blaenavon Industrial World Heritage Site to avoid impacts), geology etc. given the baseline conditions, both from the Proposed Development and from potential major accidents and disasters.

3.2.7 As a general point, the spatial approach to onshore wind set out in Future Wales has significant limitations because of the high-level approach to constraints mapping, an issue consistently set out by the sector / RenewableUK Cymru (and others). RenewableUK Cymru undertook detailed analysis of the PAAs in Wales and concluded that only ~5% is suitable for onshore wind and are theoretically deliverable once suitable constraints are applied and operational wind farms have been excluded. Therefore, the PAAs are only a starting point for projects greater than 10MW, which is what Policies 17 and 18 of Future Wales articulates.

3.2.8 In considering the location of the proposed Mynydd Llanhilleth Wind Farm, which is partly within the relevant pre-assessed area (PAA 10), we have sought to ensure it is sufficiently distanced from Blaenavon Industrial Landscape World Heritage Site (BILWHS), to avoid any potential visual effects upon the settings of this designated historic assets. The location of the wind farm seeks to avoid this potential impact whilst also maintaining a position on higher ground where there is better wind generation.

3.2.9 The intention of the PAAs is as a starting point and, therefore, any assessment of feasibility is undertaken in the context of Policies 17 and 18 of Future Wales, as informed by more detailed consideration of constraints, including constraints not considered for the PAAs

3.2.10 For the above reasons, the Site was considered suitable for detailed investigation as a wind farm location.

3.2.11 A number of design iterations for the Site were prepared, which are discussed in **Section 3.3**.

Design principles

3.2.12 Wind turbines convert the kinetic energy of the wind into electrical energy. Air passing over the blades of a wind turbine causes them to rotate. This low speed rotational motion is stepped up via a gearbox and converted into electrical energy at a voltage of 690V by a generator located inside the nacelle, which is then converted to a high voltage (132kV) by a unit transformer, located either at the base of the turbine or within the nacelle, for transmission across the wind farm. A diagram showing the structure of a typical wind turbine is shown in **Figure 4.4**.

3.2.13 Underground cables link all the turbine unit transformers to a dedicated substation on the Site where the electricity generated by the wind farm is metered, and, if necessary transformed to the same voltage as the electricity grid system to which the wind farm will be connected.

Design criteria

3.2.14 Once a site has been selected, the design of the wind farm is optimised to produce a design which maximises the use of the land available for wind power generation whilst minimising the overall environmental impact of the development. The optimal layout of a wind farm depends on a range of technical, economic and environmental criteria as follows:

- Ground conditions – ground conditions must be suitable for the installation of wind turbines, access tracks and cables;
- Site topography – the site topography is computer modelled to establish the wind flow on and around the site to provide guidance on the best locations for the wind turbines;
- Distance between turbines – to minimise turbulence interaction between wind turbines (wake effect), turbines should be separated by set distances both perpendicular to, and in line with, the prevailing wind direction. This design feature is a key factor in maximising the overall power generating capacity of a site. Spacing requirements may vary between turbine manufacturers and are also subject to wind conditions;
- Proximity to occupied dwellings – wind turbines have to be located sufficiently far away from houses to protect local amenity;
- Environmental constraints – features and areas of local environmental sensitivity (ecology, archaeology, hydrology etc.) are identified and their implications considered;
- Landscape and visual design considerations are taken into account and the layout modified accordingly;
- Existing land use – whilst the wind turbines and their associated infrastructure typically occupy no more than 2% of the site, the existing use of the land is considered in the

layout of tracks and turbines. For example, existing track lines are used where practicable;

- The presence and magnitude of woodland is also important, as these can reduce energy production from wind turbines;
- Proximity to obstructions – such as tall trees or buildings;
- Available spare capacity of the electricity grid to take power from the wind farm; and
- Proximity to a road network suitable to allow the transport of construction plant, equipment and wind turbine components to the site.

3.2.15 In addition to the above considerations, planning guidance and discussions with statutory and non-statutory consultees and the landowners have an influence over the evolution of the design.

Energy yield

3.2.16 It is important that wind turbines are sited to capture the best available wind resource. This means maximising exposure to the prevailing winds, consideration of predicted turbulence levels, and appropriately spacing the turbines to minimise wake effects. In converting the energy from wind into electricity, there is a reduction in wind speed and an increase in turbulence immediately behind each turbine. This 'wake effect' can reduce the output of subsequent turbines in downwind locations, thus reducing the overall output of a wind farm. The wake effect can also impact on the reliability and longevity of turbine components and appropriate spacing is therefore an important consideration to ensure that manufacturers will warrant the turbines once procured. The Proposed Development has therefore been designed with appropriate wake separation spacing.

3.3 Design Evolution of the Proposed Development

3.3.1 The Applicant and its consultants have undertaken a number of discussions with statutory and non-statutory consultees, the local community (see **Chapter 2, Section 2.4** and **Chapter 6-16**) and the landowners, with the accumulated findings all having an influence over the evolution of the design and the scope of the EIA process.

Table 3.3 sets out the primary design iterations.

Table 3.3 Design Iterations

Design Iteration	Rationale / Summary
Layout 1 **January 2020**	Initial layout based on known information and good design practice. This layout served as a starting point for consideration of the Proposed Development.
Layout 2 **April 2021**	This iteration was prepared following some initial constraints identification and mapping including national and international designations, existing infrastructure, woodland and waterbodies.

Design Iteration	Rationale / Summary
Layout 3 **May 2021**	This design iteration included the minimisation of tracks within area denoted as Common Land, to reduce the overall impact on the designated area.
Layout 4 **March 2022**	Following the review of engineering feasibility, this iteration included the relocation of a turbine due to technical constraints, as well as the addition of the finalised access tracks and crane pads to the layout. .
Layout 5 **May 2022**	This iteration was for the inclusion of the permanent met mast location (which was the subject of a separate application) and the onsite substation.
Layout 6 **Revised layout** **June 2022**	This iteration updated the layout as follows: • Relocation of the substation due to the requirements of the underground grid connection; • Including the grid connection indicative routing to the point of connection; and • Amended access track between Turbine 4 and 8, due to constraints highlighted by the swept path analysis.
Layout 7 **Red line boundary amended** **June 2022**	Following Layout 6, the red line boundary of the Site was modified to remove any areas not required for the infrastructure but to allow for micrositing distances of up to 50m for each turbine, whilst also including the access route and grid connection corridor within the redline.
Layout 8 **Design chill for Draft ES** **August 2022**	Following an engineering review, the changes from the previous layout include: • Addition of crane pads and storage areas; • Minor changes to access track layouts; and • Movement of electrical substation. The non-turbine infrastructure required on site was designed and arranged in such a way as to avoid the identified on-site constraints where possible. Whilst the majority of the infrastructure layout was designed following the turbine layout design, some minor iterations to turbine locations and track alignments were necessary to facilitate the optimum on-site infrastructure requirements. Access track routes in particular were designed to follow existing tracks where possible and to avoid potentially sensitive areas.