Chapter 4

Site Selection and Design Evolution

Contents

Glossary

Term	Definition
Environmental Impact Assessment	Environmental Impact Assessment (EIA) is a means of carrying out, in a systematic way, an assessment of the likely significant environmental effects from a development.
Environmental Statement	A document reporting the findings of the EIA and produced in accordance with the EIA Regulations.
North section	Section of development located north of Bryn settlement, within Penhydd forestry block.
South section	Section of development located south of Bryn settlement, within Bryn forestry block.
The proposed development	Y Bryn Wind Farm development.

List of Abbreviations

Abbreviation	Description
AIL	Abnormal Indivisible Loads
ANM	Active Network Management
BCBC	Bridgend County Borough Council
BES	Battery Energy Storage
CAA	Civil Aviation Authority
CfD	Contract for Difference
CFD	Computational Fluid Dynamics
CO_2	Carbon Dioxide
CO_2 yr^{-1} equiv	Carbon Dioxide-equivalent per year
CRoW	Countryside Rights of Way
DNS	Development of National Significance
EIA	Environmental Impact Assessment
ES	Environmental Statement
FCW	Forestry Commission Wales
GE	General Electric
GHG	Greenhouse Gas
GSP	Grid Supply Point
GWDTE	Groundwater Dependent Terrestrial Ecosystem
HGV	Heavy Goods Vehicle
km	kilometre
kWh	Kilowatt hours
LCOE	Levelised Cost of Energy
LISS	Low Impact Silviculture Systems
LPA	Local Planning Authority
m	metre
MoD	Ministry of Defence
MW	Megawatt
MWh	Megawatt hours
NATS	National Air Traffic Services
Natural Power	Natural Power Consultants Ltd
NGET	National Grid Electricity Transmission
NPTCBC	Neath Port Talbot County Borough Council
NRW	Natural Resources Wales
PAA	Pre-Assessed Area
PAC	Pre-Application Consultation
PEDW	Planning Environment Decisions Wales
PINS	Planning Inspectorate

Abbreviation	Description
PPA	Power Purchase Agreement
PPW	Planning Policy Wales
PRoW	Public Rights of Way
PyC	Pen y Cymoedd
RFC	Rugby Football Club
RVAA	Residential Visual Amenity Assessment
SAC	Special Areas of Conservation
SLVIA	Seascape, Landscape and Visual Impact Assessment
SMNR	Sustainable Management of Natural Resources
SNH	Scottish Natural Heritage now known as NatureScot
SPA	Special Protected Areas
SSA	Strategic Search Area
SSSI	Site of Special Scientific Interest
TAN	Technical Advice Note
WPD	Western Power Distribution

4.1 INTRODUCTION

4.1.1 The purpose of this chapter is to identify the steps and alternatives that have been considered in the site selection and design evolution of the proposed Y Bryn Wind Farm (the proposed development). This chapter demonstrates how the site design and the layout of the turbines evolved through the initial tender process, identification of various constraints and site-specific factors, public consultations, and highlights the key design criteria applied.

4.2 THE SITE SELECTION PROCESS

Site History

4.2.1 The development potential of the site has been appreciated by the UK wind industry and Welsh Government since at least the early 2000s, with consultants Arup employed to identify 'Strategic Search Areas' (SSAs) in 2002[1], providing a draft report in 2004[2] which included the whole of the proposed turbine development area as lying within draft SSA "F". A final report in June 2005 (Technical Advice Note 8 (TAN 8)) refined SSA F's boundaries slightly, retaining the whole of the proposed turbine development area.

4.2.2 As a result of much land within each of the SSAs forming part of the Welsh Government's woodland estate, in 2006 the Forestry Commission Wales (FCW) tendered all of their holdings within each of the SSAs to a single individual wind development partner, in order to avoid competing cumulative developments/developers emerging on the estate. At the time, developer Nuon Renewables was successful in winning the rights to develop all of FCW's land within SSA F, including the proposed development site. Earliest design evolution figures (Pen y Cymoedd ES Figure 3.2) show the successful developers plans included up to 65 turbines located on and around the areas of the proposed development (21 for the northern section, 44 for the southern section).

4.2.3 As Nuon Renewables (in common with other winners of the other six SSAs) opted to progress first the largest contiguous, most economically available site within their SSA (in the case of SSA F, this being the 'Pen y Cymoedd' (PyC) site)), the proposed development site sat without progression for the duration of PyC's development, until Nuon Renewables' (now part of Vattenfall) exclusive option of the site expired.

2018 Tender Process

4.2.4 In 2018, Natural Resources Wales (NRW) (land manager) brought the site back to market on behalf of the Welsh Ministers for tender proposals, receiving ten bids including that of the development partners for this application[3]. This high level of interest alone gives evidence for the persisting recognition of the potential for the site. As part of the tender process, bidders were required to undertake and present sufficient technical analysis across a number of topics (including: technical layout, grid proposals, access to site, impact on forestry, and impact on ecology and soils) to be scored highly enough to pass a stage-gate process and, in combination with scores in other aspects of their proposals, to place first or high enough amongst bids for final consideration.

4.2.5 As part of preparing their tender proposals, the development partners undertook reviews of energy and planning policy; various environmental and technical aspects (including landscape and visual; cultural heritage; noise; geology, hydrogeology, hydrology and flood risk; shadow flicker; wind resource; aviation and radar; telecommunications; coal mining; and construction) in developing a proposed layout. This entailed working with a number of expert consultants, carrying out site visits and surveys, the accumulation of design constraints, and the production of visualisations, which following an iterative design work-shop process resulted in a proposed scheme of 26 turbines, each of up to 200 metre (m) to blade tip, and with rotor diameters of up to 150 m (the largest then available on the market), comprising turbines of up to 4.8 megawatt (MW) in capacity. Whilst battery energy storage was incorporated into the successful plans, co-locating other technologies – including solar photovoltaic and hydropower or hydro-storage – were discounted for undue scale of impacts within the forested environment.

4.2.6 All bidders' proposals were subject to scoring by specialist external environmental consultants, with seven out of the 10 passing the stage 2 technical requirement. Of those parties - other than the development partners - who passed stage 2 and had looked at both parts of the site, the average number of turbines proposed was 23, and tip heights up to 200 m.

Post Tender

4.2.7 Following the tender award in 2019[4] the evolution of the site design and layout continued through the Environmental Impact Assessment (EIA).

4.2.8 Natural Power Consultants Ltd (Natural Power) were chosen by the applicant to manage the EIA for the Development of National Significance (DNS) wind farm application.

4.2.9 A key aim of the design process has been to limit the overall footprint of the development, whilst maximising the positive renewable energy generation and other benefits and minimising the environmental impacts wherever possible.

4.3 DESIGN CONSTRAINTS

4.3.1 The following section provides an overview of the various factors which are relevant to the design of the proposed development and can be considered the design strategy principles.

Policy Context

4.3.2 A review of planning policies at a national and local level is included in Chapter 2: Legal and Policy Context, and an evaluation of the proposed development with regards to policies is included in the Planning Statement. The policies are supportive of renewable energy developments in appropriate locations. Future Wales, 'Policy 17 – Renewable and Low Carbon Energy and Associated Infrastructure', highlights the Welsh Government have identified 10 Pre-Assessed Areas (PAAs) across Wales as benefitting from a presumption in favour of large scale onshore wind energy development and the associated landscape change, subject to specific criteria being met as set out in policy 18 of 'Future Wales: the national development plan' (Future Wales)[5]. Arup's Stage 2 report (June 2019) for refining the pre-assessed areas considered turbines of up to 250 m blade tip height '*to present a maximum height scenario in terms of turbine sizes likely to come forward in applications*'.

4.3.3 All five turbines in the northern section are located within PAA 9. In areas outside of the PAAs, and outside of National Parks and Areas of Outstanding Natural Beauty, there is generally strong (in principle) support also subject to criteria under policy 18.

Wind Resource

4.3.4 Wind turbines require sufficient wind resource, and of suitable quality, in order to be economically and technically viable. With the trend towards lowest levelised cost of energy (LCOE) competition between alternative new energy

[1] Welsh Assembly Government. *Facilitating Planning For Renewable Energy in Wales: Meeting the Target.* Available from - https://gov.wales/sites/default/files/publications/2018-10/facilitating-planning-for-renewable-energy-review-of-final-report.pdf [Accessed 29/03/2023]

[2] Welsh Assembly Government (2004). *Facilitating Planning For Renewable Energy in Wales: Meeting the Target.* Available from - https://gov.wales/sites/default/files/publications/2018-10/facilitating-planning-for-renewable-energy_1.pdf [Accessed 29/03/2023]

[3] Natural Resources Wales (ND). *Y Bryn Project Marketing Exercise.* Available from - https://gov.wales/sites/default/files/publications/2021-09/atisn15447doc3.2.pdf [Accessed 29/03/2023]

[4] Natural Resources Wales, (2019). *Plans for Port Talbot renewable energy project.* Available from - https://naturalresources.wales/about-us/news-and-events/news/plans-for-port-talbot-renewable-energy-project/?lang=en [Accessed 29/03/2023]

[5] Welsh Government, (2021). *Future Wales: The National Plan 2040.* Available from - https://gov.wales/sites/default/files/publications/2021-02/future-wales-the-national-plan-2040.pdf[Accessed 29/03/2023]

projects around the UK, the minimum required average wind speeds for projects are ever increasing, which means either – or both – concentrating on well-exposed locations and also getting the most out of such locations through layout and choice of turbines (including dimensions and capacity).

4.3.5 Initial long-term wind resource estimates were derived from multiple sources, considering measurements for the period January 2015 to January 2021 collected from a 75 m meteorological mast located 70 m north of the northern boundary, and for the period January 2021 to July 2021 from a 90 m onsite mast to the south of the site boundary. The masts were considered to be reasonably representative of the site as a whole in terms of exposure.

4.3.6 Detailed assessments have been undertaken using state of the art VENTOS Computational Fluid Dynamics (CFD) modelling in order to better understand the local wind regime, that results from the terrain and forestry surrounding the proposed development. The turbulence intensity, wind shear, inflow angle and veer across the site were assessed in order to inform the design process (along with all relevant physical, environmental, and technical constraints).

4.3.7 The onsite anemometry monitoring campaign is ongoing, using industry best practise monitoring techniques in order to capture detailed wind profiles and further refine the wind resource onsite.

4.3.8 Tree felling is required prior to the construction of the proposed development to enable the erection of turbines and for creation of access tracks and other infrastructure elements, including clear-felling an appropriate buffer around the turbines for operational maintenance and to minimise impact on wind resource and energy production. During the operational phase of the proposed development, normal productive forestry works will continue by NRW.

Grid Connection

4.3.9 Proximity to, cost and security of grid connection are vital elements of renewable energy developments. Often wind farms in more rural or wild locations may benefit from lower populations to be impacted by the new appearance of turbines, however with the trade-off being that they may necessitate significant new high-voltage overhead and//or underground cabling, and even (as in the case of mid-Wales SSAs) new major hub transmission substations, which can give rise to significant effects in their own right.

4.3.10 One key benefit of the location of the proposed development is proximity to potential grid connection options, either into existing 275 kV overhead towers running immediately to the west of the proposed turbine development area, or else a relatively short distance back to Margam 275 kV grid supply point (GSP) substation. Given the overall capacity of the scheme it would require a transmission as opposed to distribution level connection, meaning that it would consequently avoid the distribution level constraints which are currently leading to the imposition of active network management (ANM) or all new connections in the region.

4.3.11 Conversations have been ongoing with both Western Power Distribution (WPD) and National Grid Electricity Transmission (NGET) since 2018. A grid connection application has been submitted to National Grid. Indicative details are outlined in Appendix 5.1, however final plans will be subject of a separate application[6] made by NGET in due course.

Access

4.3.12 Access to site for construction, particularly of wind turbine component Abnormal Indivisible Load (AILs), is an essential element of project feasibility, and as outlined in Section 4.5 was considered in greater detail at the time of the tender in 2018.

4.3.13 An updated access study was completed in May 2022 by Pell Frischmann to confirm the feasibility of the proposed route for AIL from Swansea Docks to the proposed development (Appendix 11.2). The study assessed the delivery of wind turbine components (considering up to 86 m blades) and noted areas of necessary accommodation works including the temporary removal of signage etc. up to the point of exiting the M4. There is one access point proposed for the use of AILs only, entering the site from the M4.

4.3.14 There are two access points proposed for Heavy Goods Vehicles (HGVs) (in addition to which a further 3 potential access points; south of Maesteg golf club off an unclassified road, at Tŷ Maen off the A4107 and at Bryn village via the 'Royal Oak' pub were consulted on in November 2021 and subsequently removed in response to local feedback); one in the north section and one in the south section. In order to get turbine components to the northern section of the site, it is proposed that the AILs will travel along the forestry haulage road within the forest, then head north through the golf club on existing access tracks, cross the B4282 road, before reaching the north section. Once the AILs have been unloaded the vehicles are minimised in size and are considered HGVs so will exit the site using one of the two proposed access points.

4.3.15 The on-site and off-site access routes consist of sections on public and private roads and the creation of new tracks, and upgrades to tracks and junctions will be necessary to accommodate the construction and operational phases of the proposed development.

4.3.16 A detailed assessment of the access route to site can be found in Chapter 11: Traffic and Transport.

Land Use

4.3.17 The proposed development is located within the afforested areas that lie between Port Talbot and Maesteg. These areas of forest are managed by NRW on behalf of the Welsh Ministers as productive forestry, and the site boundary lies within the two NRW Forest Resource Plan areas of Margam and Afan. The forest areas are characterised as upland dominated by conifer tree species, the most common of which is Sitka spruce (*Picea sitchensis*). Other areas of broadleaved woodland exist within the site boundary as either productive, semi-natural or ancient semi-natural type woodland. In addition, there are areas of permanent open ground around watercourses and other features, and open ground created through the NRW felling programme.

4.3.18 The proposed development would be an asset which would significantly increase renewable energy generated on NRW land and therefore accords with the NRW 'Our corporate plan to 2030 – Nature and People Thriving Together' [7] and 'Commercial Strategy 2021-2026'[8] which has been designed with consideration for the Welsh Government's energy policy and targets including the aspirations that 70% of Wales' electricity is generated by renewables by 2030, and all new energy projects in Wales to have an element of local ownership from 2020. NRW's own guidance for development has also been considered as referred to within individual topic chapters, during the design process.

4.3.19 Other landowners have also been consulted during the EIA in particular with relation to the AIL access route off the M4, west of the proposed development and establishing appropriate areas for habitat management.

4.3.20 The route for the proposed AIL to the west of the site will mostly be new track and upgrade of existing farm track on mostly private land, however, where possible, public roads and existing wind farm and forestry tracks have been utilised. Some new tracks and widening/upgrading to existing forestry tracks will be required within the wind farm site boundary in the existing forestry; an assessment on forestry has been provided in Chapter 13: Forestry.

Proximity of Dwellings

4.3.21 Modern wind turbines of scale by their nature cannot be hidden entirely from view, especially if they are to be located in relative proximity to centre of demand. While there is the long-established principle in development

[6] Under Section 37 of the Electricity Act 1989

[7] Natural Resources Wales, (ND) *Our corporate plan to 2030 – Nature and People Thriving Together.* Available from - Natural Resources Wales / Our corporate plan to 2030 - Nature and People Thriving Together [Accessed 15/05/23]

[8] Natural Resources Wales, (ND). *Commercial Strategy 2021-2026.* Available from - Natural Resources Wales / Commercial Strategy 2021-2026 [Accessed 15/05/23]

planning that no property benefits from a right to a view, the Lavender Test (named as the Inspector for the public inquiry at Enifer Downs) has become the generally accepted methodology for the assessment of impacts on residential visual amenity:

'when turbines are present in such number, size and proximity that they represent an unpleasantly overwhelming and unavoidable presence in main views from a house or garden, there is every likelihood that the property concerned would come to be regarded as an unattractive and thus unsatisfactory (but not necessarily uninhabitable) place in which to live.'

4.3.22 As machinery with moving parts wind turbines are not silent in operation. In terms of the noise environment, guidance document ETSU-R-97 (and related Good Practice Guidance) provides the Welsh Government accepted guidance for avoiding significant adverse noise effects for dwellings.

4.3.23 Also, as tall and moving structures wind turbines can cast shadows which can be experienced from inside properties through window opening (known as 'shadow flicker') although it is generally recognised as only occurring at maximum within 10 rotor diameters distance of turbines (up to 1720 m in the case of the proposed development). Whilst in the UK there is no specific guidance in relation to acceptable limits for shadow flicker, studies recommend that shadow flicker should not exceed 30 hours per year or 30 minutes per day (see Chapter 14: Health and Public Safety for further detail).

4.3.24 From the outset therefore, proximity to residential dwellings was considered an integral part of the design. Development of turbines was not considered within 800 m from residential dwellings.

4.3.25 Potential noise, shadow flicker and visual amenity impacts have been given consideration during the site design iterations to ensure minimised effects on nearby residents. A detailed noise assessment is provided in Chapter 12: Noise. Shadow flicker is considered in Chapter 14: Health and Public Safety. Residentially Visual Amenity is considered in Chapter 8: Seascape, Landscape and Visual Impact Assessment within the ES.

Seascape, Landscape and Visual

4.3.26 As previously mentioned in this chapter, modern wind turbines cannot generally be hidden entirely from view, and it is long accepted in planning policy[9] that significant landscape and visual effects will often be found within the immediate locale surrounding any wind farm. That notwithstanding, national policy is clear that applications for large-scale wind will not be permitted in National Parks and Areas of Outstanding Natural Beauty and that all proposals should demonstrate they do not have unacceptable adverse impact on the surrounding landscape, nearby communities and individual dwellings.

4.3.27 A key aim of the design process was to avoid overly complex and visually confusing layouts, and to seek to achieve simplicity and consistency within the proposed wind farm design, whilst reducing its overall impact when viewed from local settlements.

4.3.28 Several sources of information were used to inform the design. These include, but are not limited to, the following:

- Guidelines for Landscape and Visual Impact Assessment, Third Edition. Landscape Institute with the Institute of Environmental Management and Assessment (2013);
- Assessing the Cumulative Impact of Onshore Wind Energy Developments, Scottish Natural Heritage (SNH), (March 2012);
- A Guide to the Assessment of Cumulative Effects of Wind Farm Developments, ETSU/DTI (2000);
- Siting and Designing Wind Farms in the Landscape, Version 3, SNH (2017);
- LANDMAP Information Guidance Note 3: LANDMAP, Using LANDMAP for Landscape and Visual Impact Assessment of Onshore Wind Turbines: Natural Resources Wales (2013);
- Visual Representation of Wind Farms, Version 2.2, SNH (February 2017);
- Visual Representation of Development Proposals – TAN 06/19, Landscape Institute (November 2011), including supporting Technical Information Notes 07/19, 08/19 and 09/19;
- TGN2/19 Residential Visual Amenity Assessment (RVAA), Landscape Institute, March 2019;
- The National Parks and Access to the Countryside Act 1949;
- Countryside and Rights of Way Act (CRoW) 2000;
- Planning Policy Wales (PPW) Edition 11, (February 2021);
- Future Wales: The National Plan 2040 (February 2021).
- LDPs and Supplementary Planning Guidance from;
  - Neath Port Talbot 2011-2026;
  - Bridgend 2006-2021; and
  - Other neighbouring Local Planning Authorities (LPAs).

4.3.29 Chartered Landscape Architects have worked closely with the project team from the outset, reviewing the siting and design of the wind turbines and ensuring that residual visual impacts have been reduced, that the coherence and simplicity of the layout were, maximised and that the overall visual structure of the proposed development from the surrounding communities was improved.

4.3.30 The relationship between the proposed turbines and existing turbines of operational wind farm sites in the area has been a key consideration for the design of the proposed development in landscape and visual terms. Particularly adjacent wind farms; operational Mynydd Brombil to the south and consented Foel Trawsnant to the north. Consideration was also given to other wind farms that are either operational, consented or currently in planning and the potential for cumulative effects. Consideration of the proposed development in relation to other constructed, under construction, consented and submitted developments in the area is fundamental to fully assess the potential seascape, landscape and visual effects.

Ecology & Ornithology

4.3.31 Potential impacts on species and habitats from wind turbine development must be kept within acceptable limits.

4.3.32 Desk based studies indicated that there were no designated ecological or ornithological constraints such as Sites of Special Scientific Interest (SSSI), Special Protection Areas (SPA), Special Areas of Conservation (SAC) or RAMSAR, within the proposed development. Baseline survey work indicated potential suitability for wind energy development, subject to further detailed assessment and survey data fed into the iterative design process. Potential effects upon ecology and ornithology are fully assessed in the EIA and the findings are presented in Chapter 6: Ecology and Chapter 7: Ornithology.

Hydrology, Geology & Hydrogeology

4.3.33 The protection of water and peat resources, and resilience against the impacts of climate change, are similarly sought by national policy. As part of the hydrology assessment all mapped watercourses were marked as a constraint from the outset and a 50 m buffer was applied to them to protect watercourses from disturbance and potential effects on water quality during construction and operation. Desk based surveys indicated potential for some small areas of peat. Phase 1 and Phase 2 peat surveys were completed, and results are shown on Figure

[9] Department of Energy & Climate Change, (2011). *National Policy Statement for Renewable Energy Infrastructure (EN-3).* Available from - https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/37048/1940-nps-renewable-energy-en3.pdf [Accessed 29/03/2023]

10.4, which influenced the design evolution, where areas of deep peat were avoided where practical. Use of existing access tracks was considered a key design criteria to minimise impact on peat resource. Ground Water Dependant Terrestrial Ecosystems (GWDTE) were also identified and avoided where possible. A detailed assessment of hydrological elements is provided in Chapter 10: Hydrology, Geology and Hydrogeology.

Cultural Heritage

4.3.34 National policy dictates there must be no unacceptable adverse impacts from wind farms on statutorily protected built heritage assets.

4.3.35 During the initial feasibility assessment, the presence of cultural heritage assets was investigated within and out with the proposed development. A baseline survey was undertaken which identified cultural heritage assets in the proposed development area. These were accounted for during the design evolution and direct effects thus avoided. A full cultural heritage assessment is provided in Chapter 9.

Forestry

4.3.36 Sustainable management of natural resources (SMNR) as required by the Environment (Wales) Act 2016 is a core responsibility upon Natural Resources Wales as land manager for the Welsh Government, and continuing viability and sustainable management of the woodland resource of the project area was made as a clear priority as part of the tender process.

4.3.37 From the outset therefore a key aim of the design process was to avoid unnecessary felling wherever possible, particularly in areas of Low Impact Silviculture Systems (LISS).

4.3.38 In order to integrate the proposed development into the existing woodland structure a forestry specialist from ARC Woodlands Ltd has worked closely with NRW (acting as land manager) to agree the indicative felling plan. The felling and replanting approach is explained in more detail in Chapter 13: Forestry.

4.3.39 The forest area is actively managed on either a clear felling or a continuous cover system, with some areas being subject to minimum intervention practices. The management objectives of NRW include restructuring the forests to break up even aged crops, diversifying species, restoring open habitat and ancient woodland sites, and providing recreation and community benefits including footpaths and cycle paths.

4.3.40 Early on in the design process the felling approach that was planned to be adopted was coupe felling to accommodate infrastructure for the proposed development. However, after further consideration and consultation with NRW, a key holing approach was agreed as the most appropriate felling strategy to accommodate the proposed development which minimises the forestry loss.

Existing Infrastructure and Aviation

4.3.41 The presence of existing infrastructure such as services and cables, TV transmission, mobile telephone networks and electromagnetic paths were considered. No gas or water infrastructure have been identified within the site boundary. There are electricity power lines within the north section of the site approximately 800 m south-west of Turbine 3 and the same powerline runs through the northern half of the south section ~approximately 1.1 kilometre (km) north-east of Turbine 6. There is another powerline in the south of the southern section approximately 1.7 km south-west of Turbine 17. Therefore a buffer of at least 800 m has been maintained from all turbines. There is one microwave link managed by the Joint Radio Company on behalf of Western Power Distribution which passes through the site boundary, running between Foel Fynyddau north of Cwmafan to a substation to the south of Croeserw, passing over Cefn yr Argoed and Foel Trawsnant. As the link is over 900 m from the nearest turbine on Y Bryn, beyond the 2nd Fresnel zone for separation[10], no mitigation is considered necessary.

4.3.42 There are a number of Public Rights of Way (PRoW) and recreation routes that pass through the proposed development site. Public footpaths were given a blade length (86 m) distance buffer during the design process which was agreed with the PRoW officers from both Neath Port Talbot County Borough Council (NPTCBC) and Bridgend County Borough Council (BCBC). The applicant has proposed a scheme of mitigation through appropriate condition wording for the local authority recognised North to South Dragon Ride. An Access Management and Enhancement Plan (AMEP) is also proposed to mitigate construction impacts and provide benefit for all users.

4.3.43 Initial consultations with aviation consultees included National Air Traffic Services (NATS), the Ministry of Defence (MoD) and Cardiff Airport were undertaken to assess the risk of interference with radar, traffic control or low flying practice. Following further correspondence, the MoD and NATS agreed the proposed development to be acceptable. No MoD objections have been received and there is no impact anticipated on NATS; en-route radar, en-route navigation aids and radio communication infrastructure. However, NATS did identify a potential technical impact on Cardiff Airport. The applicant is in discussions with Cardiff Airport on the nature and scale of the effects of the proposed development on their provision of air traffic services and on a range of potential mitigation measures, should these be deemed necessary.

4.3.44 Consultation was also undertaken with the helicopter operators including Wales Air Ambulance, Search and Rescue, and Police Helicopter to agree an acceptable aviation lighting scheme (visible and infra-red lighting). The aviation lighting scheme was issued to the Civil Aviation Authority (CAA) which was approved in April 2023. Further detail is provided in Chapter 15: Aviation and Existing Infrastructure and Appendix 15.

4.4 PUBLIC CONSULTATION

4.4.1 As part of the DNS process during 'Stage 1: Pre-notification' developers are encouraged to publicise draft proposals, to engage with the public and interested parties to identify issues and exchange views. This stage is voluntary and the approach that is taken to engage with the community is dictated by the developer. The developer should then notify Planning and Environment Decisions Wales (PEDW) that the submission of a DNS application is intended. Following this the developer is required to publicise the detailed DNS proposal which is out for consultation for a period of 6 weeks.[11] All information regarding pre-application consultation (PAC) can be found in the PAC Report which is a standalone document submitted alongside this ES.

4.4.2 Thirty 4/7, a specialist communications consultancy for the development and infrastructure sector, along with the applicant and Natural Power have undergone community consultation to ensure effective engagement between the developer and the local authority, local community, and consultees to help make sure that the proposal will:

- Reflect more accurately an understanding and appreciation of local interests and concerns;
- Provide a higher quality and more active and well-timed consideration of evidence of the potential benefits and impacts of the proposal (enabling better and prompt decision-making in the planning process, focusing on the material issues); and
- Ensure that, if the proposal does go ahead, local communities, the local authority and other consultees have had opportunities to shape how the development is actually realised and the continuing relationship they may have with it.

4.4.3 Thirty 4/7 coordinated two online stakeholder forums each before the public exhibition events in June 2021 and October 2021. The applicant and a representative from Natural Power attended to encourage discussions and answer questions regarding the proposed development. A list of stakeholders invited to the forums and further information can be found within the PAC Report.

[10] Bacon, F. D., (2002). *Fixed-link wind-turbine exclusion zone method.* Available from - https://www.ofcom.org.uk/__data/assets/pdf_file/0031/68827/windfarmdavidbacon.pdf [Accessed 04/08/22]

[11] The Planning Inspectorate, (2019). *An Accessible Guide to Engaging with the Process.* Available from - https://gov.wales/sites/default/files/publications/2019-07/developments-of-national-significance-dns-engaging-with-the-process.pdf [Accessed 29/03/2023]

4.4.4 There were two rounds of public exhibitions in 2021, scheduled to contribute to the design evolution process (as outlined in section 4.5); the first round in the summer was held over 5 days (21st-24th & 26th June 2021) across five venues; Maesteg Rugby Football Club (RFC), Bryn Community Centre, Cwmafan Community Engagement Centre, Cefn Cribwr Athletic Club and Taibach Community Centre. The second round was in the autumn and again held over 5 days (1st- 3rd, 4th & 5th November 2021) across five venues; four venues were the same as the summer exhibitions, with the exception of Maesteg RFC where the larger Maesteg Sports Centre was utilised instead. These exhibitions showcased the proposed development and provided a chance for the public to learn more about the proposal and provide feedback. All exhibition boards were bilingual and at least one representative from Natural Power at each event was a Welsh speaker which supports the Well-being of Future Generations (Wales) Act 2015[12] goal – '*A Wales of vibrant culture and thriving Welsh language*.' During the first round of the exhibitions the scoping layout (Design 2) was presented and during the second round, the post-survey completion layout (Design 4) was presented. All information presented at the public exhibitions has also been made available and since kept online in a virtual consultation website[13].

4.4.5 The applicant procured an interactive virtual 3D Model that was presented at each public exhibition and stakeholder forum which gave members and representatives of the public an opportunity to view the potential visual impacts from their properties and viewpoints within and around the local area.

4.4.6 Thirty4/7 produced a report following each round of public exhibitions outlining a record of attendance and analysis of feedback, these reports can be found in the PAC Report.

4.5 DESIGN EVOLUTION

4.5.1 This section describes the design evolution of the proposed development and discusses how the site layout continued to evolve throughout the EIA and public consultation process. The site design process was guided by the baseline surveys and issues raised by statutory and non-statutory consultees in line with Welsh and local planning policy. The layout evolved under guidance, requirements, and considerations from Coriolis, ESB, Natural Power and their specialist consultants, including NRW acting as land manager in respect of forestry management. Consideration has also been given to issues raised by the community at, and following, the public exhibition events. Many of the site constraints identified during the process and considered in the design evolution are illustrated in Figure 4.1.

4.5.2 A number of different wind farm layouts were devised and, following extensive investigation and consultation, an optimum layout was chosen through numerous design iterations. The site layout evolution has been illustrated in Figure 4.2 which shows the evolution from the Tender Layout (Design 1) through to the Design Freeze (Design 6) as shown in Figure 1.2.

4.5.3 The applicant and its consultants utilised the virtual interactive 3D Model continuously throughout the process, including at each design review day and public consultation events, which was extremely valuable when assessing and demonstrating potential visual impacts from different viewpoints, receptors, and designated assets.

Design 1: Tender Layout (December 2018)

4.5.4 As detailed in Section 4.2, the tender layout comprised 26 turbines with rotor diameters of up to 150 m and tip heights of up to 200 m. A preliminary full infrastructure layout was also presented.

AIL Access Alternatives

4.5.5 As part of the tender process, detailed feasibility assessments were undertaken on a number of potential routes to site for AILs – particularly, turbine blades. Certain options, including coming via Maesteg as the operational Mynydd Brombil Wind Farm had previously, were quickly ruled out as not possible for turbines any larger those already installed there (80 m rotors). Four theoretically feasible routes identified (all coming from Swansea docks) comprised:

- (1) Loads exiting the M4 at Junction 36, proceeding northwards on the A4063 via Aberkenfig/ Tondu and the Llynfi valley towards the south of Maesteg, before turning west at a point to the south of Llangynwyd to climb up to Ogwr Ridgeway and enter the site from the south;
- (2) Loads exiting the M4 at Junction 38, proceeding southwards on the A48 towards Pyle, before turning north to find a route (potentially via Dŵr Cymru land at 'Craig yr Aber') into the site from the south;
- (3) Loads exiting the M4 at Junction 40, proceeding via Pen-y-Cae and the village of Goytre, entering the site from the west; and
- (4) Loads being crane-lifted from vehicles parked on or besides the M4, onto waiting vehicles on private land, to follow the route of an existing road up Mynydd Brombil, and via the existing wind farm roads into the site from the south-west.

4.5.6 Whilst each of these options presented challenges, options 1 to 3 were all concluded as unfavourable owing to combinations of high impacts on local road networks; hard physical constraints to turbine dimensions from pinch-points; high impacts on farmland and the environment (including scheduled monuments); and need for manifold third-party land involvement.

4.5.7 Consequently, option 4 (coming directly from the M4) was put forward as preferred option. Following the tender award in 2019, and further consultations with transport engineering experts, Welsh Government Highways Department and South Wales Trunk Road Agency personnel, the creation of a new single-purpose slipway works-exit junction was identified as preferable to craning options.

Evolution of the Market for Wind Turbines

4.5.8 Following the tender submission in December 2018, at which point in time the maximum size of rotor diameters generally available on the market was 150 m (~75 m blades), and prior to EIA Scoping in January 2021, a wave of new generation wind turbines has been brought to market by the main manufacturers, reflecting the drive for lowest LCOE.

4.5.9 In January 2019, Vestas introduced their 162 m rotor machine (~81 m blade length), with 5.6 MW capacity[14] Siemens-Gamesa announced their new 155 m and 170 m rotor machines (~77.5 m and ~85 m blade length respectively) later that year in April[15], with 5.8 MW capacity (now a whole 1 MW above the highest capacity considered in the tender submission). Nordex followed suit in August, announcing a 163 m rotor machine (~81.5 m blade length) with up to 5.5 MW capacity[16].

4.5.10 Since 2019, further regular announcements can be found from these and other turbine manufacturers, for new or upgraded models. For instance, Vestas have (to date) increased the capacity of their V162 machine to up to 6.8-

[12] *Well-being of Future Generations (Wales) Act 2015.* Available from - https://www.futuregenerations.wales/wp-content/uploads/2017/01/WFGAct-English.pdf [Accessed 29/03/2023]

[13] Y Bryn Wind Farm Ltd, (2020). Available from - https://www.ybryn-windfarm.cymru/project-documents/ [Accessed 29/03/2023]

[14] Vestas, (2019). *Vestas introduces EnVentus – Vestas' innovative modular platform, starting with two new industry-leading wind turbine variants.* Available from - https://www.vestas.com/en/media/company-news/2019/vestas-introduces-enventus---vestas--innovative-modular-c2963237 [Accessed 29/03/2023]

[15] Siemens Gamesa, (2019). *Siemens Gamesa advance with its onshore portfolio, launching the new Siemens Gamesa 5.X platform, with a 170 meter rotor – the largest in the industry.* Available from - https://www.siemensgamesa.com/en-int/newsroom/2019/04/190403-siemens-gamesa-new-onshore-5-x-platform [Accessed 29/03/2023]

[16] Nordex, (2019). *Nordex launches 163 metre rotor for the Delta4000 5.X.* Available from - https://www.nordex-online.com/en/2019/08/nordex-launches-163-metre-rotor-for-the-delta4000-5-x/ [Accessed 29/03/2023]

7.2 MW[17]; Siemens-Gamesa have increased the capacity on their 155 m and 170 m machines to up to 6.6 MW[18]; Nordex have increased the capacity on their N163 machine to up to 6.5 MW[19]. General Electric (GE) unveiled their 164 m rotor machine (~82 m blade length) with 6.0 MW capacity in November 2020[20]. Vestas announced a new 172 m rotor (~86 m blade length) 7.2 MW machine in April 2022[21]. Nordex then announced their 175 m rotor (~87.5 m blade length) 6.22 MW machine in September 2022[22]. The increase in turbine size and capacities is a trend that can be reasonably expected to continue over the coming years, with up to 10MW onshore machines already in development[23] and reasonable expectation of widely available 8 MW+ onshore machines this side of 2030.

4.5.11 The history of wind turbine evolution has been that, as economics naturally favour the newer larger models, particularly now in a subsidy-free environment of competitive contract-for-difference (CfD) auctions and power purchase agreement (PPA) tenders, older smaller models quickly go out of fashion and then entirely out of production as limited factory space is given over to new lines, and given the sometimes-lengthy development process that wind farms can go through around the UK it is now not at all unusual to see 'tip-height extension' or full-scale redesign applications with larger machines being made for relatively recently consented projects that may have been first conceived in a world with subsidies and with turbine dimensions that are simply no longer viable or even being produced.

4.5.12 There is now a very clear trend in the UK, and around the world, towards new and redesigned applications in excess of 200 m to tip height. The UK's Renewable Energy Planning Database[24] shows that since the December 2018 tender submission there have been at least 44 applications submitted including turbines of 200 m to tip and above, with 17 above 220 m to tip, 3 with 250 m to tip, and 1 with 260 m to tip; 12 such applications have been consented to date. Looking around Europe there are a great many more consented and operational, at heights up to 260 m. At time of writing there are a number of scoping and pre-scoping projects being announced in the UK with tip-heights of up to 260 m[25] and taller heights still are possible with current technology, with applications of tip-heights up to 320 m and turbine capacities up to 10 MW already being lodged on the continent[26].

4.5.13 The intention of the applicant for the proposed development is to seek consent for a scheme which is both environmentally acceptable on balance, but also viable at the earliest opportunity, without need for future redesign or tip-height increases, in order to be delivering the climate change and community benefits it offers as soon as possible.

Design 2: Scoping (January 2021)

4.5.14 In January 2021 the applicant carried out an EIA scoping request, with a layout constituting the same turbine locations as Design 1 but with maximum tip-height dimensions reflecting the now current state of the turbine market (as outlined above), with all machines having indicative 170 m rotor diameters, up to 250 m to tip, and indicatively up to 6.6 MW capacities. Advances in the new wave of technology, including improved durability and algorithmic control of turbine wakes, meant that this was feasible with the previously generous inter-spacing.

4.5.15 This layout consisted of 8 turbines located in the northern section of the site in an orderly, evenly spaced grid within the eastern half of the available area; with 18 turbines located in the southern section, with an orderly, evenly spaced arrangement of south-west facing loosely linear arrays, avoiding the south-westernmost quadrant of the available area.

4.5.16 Main constraints to site design considered at the time of the 2018 tender (as updated to early 2021) were shown on Scoping Report Figure 3.1, however early ecological and forestry factors also played a key part in developing this layout. In particular though, landscape and visual and cultural heritage expert advice had established 'exclusion zones': in the northern section to the direct north of the village of Bryn so to reduce perceptions of encirclement; together with areas within roughly 1.0 km - 1.5 km from the boundary of Margam Park so to avoid any presence of turbines being sat directly behind Margam Castle in views looking back from the grassland to its south-east side. Visualisation work carried out in 2018 with 200 m turbines was revisited with 250 m tip heights to ensure this remained the case from both locations.

Scoping Responses (March 2021)

4.5.17 This 26-turbine layout was presented to the Planning Inspectorate (PINS now PEDW) and consultees in the scoping report on 7th January 2021. A copy of this can be found in Appendix 3, Volume 3. The full Scoping Direction was issued by PINS (now PEDW) on 8th March 2021 and is provided in Appendix 3 of this ES and contains a copy of all the consultee scoping responses. This consultation helped identify and clarify key issues, promoted dialogue with both consultees and stakeholders, and confirmed methods for survey, evaluation and assessment going forward. The consultee responses were reviewed in partnership with the specialist sub-consultants in order to make sure all relevant issues identified were assessed as part of the site survey work and were addressed in the relevant ES chapters.

4.5.18 In addition to the formal scoping and consultation, meetings and discussions took place with NPTCBC, BCBC and NRW (land manager) to agree the specifics of survey methodologies, potential mitigation should the proposed development gain consent and to update these consultees on progress.

Design Review Day #1 (March 2021)

4.5.19 The first formal design review day was held virtually (due to COVID-19) via Microsoft Teams in March 2021 between the applicant and specialist consultants from relevant departments of expertise including; planning, ecology and ornithology, hydrology, civils, traffic and transport, cultural heritage, landscape and visual, forestry, noise, and aviation. The aim of the design review day was to review the layout following receipt of the scoping direction, consultee responses and collection of more desk study and site survey data.

4.5.20 Ahead of the design review day consultants reviewed the proposed layout from scoping (Design 2) which included assessing the proposed turbine locations together with preliminary infrastructure locations from the 2018 tender.

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[17] Nordex, (2019). *Nordex launches 163 metre rotor for the Delta4000 5.X.* Available from: https://www.nordex-online.com/en/2019/08/nordex-launches-163-metre-rotor-for-the-delta4000-5-x/ [Accessed 29/03/2023]

[18] Siemens Gamesa, (2021). *Siemens Gamesa upgrades leading onshore turbine to deliver more competitive power output.* Available from - https://www.siemensgamesa.com/en-int/newsroom/2021/09/husum-fair-upgrade-5x [Accessed 29/03/2023]

[19] Nordex, (2021). *Nordex announces entry into the 6 MW class with the N163/6.X turbine.* Available from - https://www.nordex-online.com/en/2021/09/press-release-nordex-announces-entry-into-the-6-mw-class-with-the-n163-6-x-turbine/ [Accessed 29/03/2023]

[20] General Electric, (2020). *GE's Most Powerful Onshore Wind Turbine Gets Even More Powerful.* Available from - https://www.ge.com/news/press-releases/ge-most-powerful-onshore-wind-turbine-gets-even-more-powerful [Accessed 29/03/2023]

[21] Vestas, (2022). *Vestas introduces the V172- 7.2 MW, enhancing performance in low to medium wind conditions*. Available from - https://www.vestas.com/en/media/company-news/2022/vestas-introduces-the-v172-7-2-mw--enhancing-performanc-c3539648 [Accessed 29/03/2023]

[22] Nordex, (2022). New rotor for the energy transition: Nordex Group presents the N175/6.X. Available from - https://www.nordex-online.com/en/2022/09/new-rotor-for-the-energy-transition-nordex-group-presents-the-n175-6-x/ [Accessed 29/03/2023]

[23] ReNEWS, (2023). *Envision unveils giant 10 MW onshore turbine.* Available from - https://renews.biz/83740/envision-unveils-10mw-turbines/ [Accessed 29/03/2023]

[24] GOV.UK, (2023). *Renewable Energy Planning Database: quarterly extract.* Available from - https://www.gov.uk/government/publications/renewable-energy-planning-database-monthly-extractt [Accessed 29/03/2023]

[25] EDF Renewables, (2022). *Dunside wind farm.* Available from - https://dunsidewindfarm.co.uk [Accessed 29/03/2023]

[26] Environment.fi (ND). Available from: https://www.ymparisto.fi/fi-FI/Asiointi_luvat_ja_ymparistovaikutusten_arviointi/Ymparistovaikutusten_arviointi/YVAhankkeet/Pyoriannevan_tuulivoimahanke_Pyhanta [Accessed 29/03/2023]

Mini Design Review Day (May 2021)

4.5.21 Following the first design review day there were some outstanding issues concerning landscape and visual and cultural heritage that had not been discussed in detail due to time constraints. Therefore, in May 2021 a mini design review day was held via Microsoft Teams between the applicant, Natural Power, and landscape and visual, and cultural heritage specialists. The mini design review day focussed on 14 turbines (then numbered 13 to 26) all in the south section of the site with regards to potential impacts on Margam Country Park and associated receptors and assets.

4.5.22 The applicant used the 3D interactive virtual model and wind farm design software to pan around the landscape assessing views from a variety of viewpoints and discussing possible amendments to turbine locations and size to potentially minimise negative impacts on cultural heritage assets and landscape and visual receptors.

Public Consultation (June 2021)

4.5.23 Detailed analysis of written feedback from the 1st round of public consultations can be found in the PAC report. Key concerns raised in design terms, in summary, related to the number, size, proximity and relationship of turbines to dwellings and communities, but also possible impacts to existing on-site recreational infrastructure (including footpaths and mountain-biking trails) and ecology. Turbine noise was also a regularly raised issue.

Design 3: Post-Consultation (July 2021)

4.5.24 Based on the comments received from scoping, design reviews and public consultation, the applicant amended the layout to produce Design 3. Changes that were made are summarised:

- Five turbines were removed: T1, T2 and T9 to reduce landscape and visual impacts mainly from Bryn settlement; T22 and T23 to reduce landscape and visual impacts mainly from Margam Park, as well as Ogwr Ridgeway and scheduled monuments to the south-east of Y Bryn site boundary;
- North section: T3-T8 maximum tip heights reduced to 206 m to tip (while maintaining rotor diameter 170 m) to minimise visual impact from Bryn, Cwmafan, Maesteg and areas within the northern Afan and Llynfi valleys;
- South section: T17, T21, T24-T26 maximum tip heights reduced to 206 m to tip (rotor diameter 170 m) to minimise visibility from areas to the south including Port Talbot and Margam Park. This also reduced visibility from areas further afield such as Cefn Cribwr;
- T10, T11 and T16 reduced maximum tip height to 230 m to further reduce visual impacts from Bryn, Cwmafan, Maesteg and Llangynwyd; and
- Relocation of remaining turbines to optimise location based on feedback, including avoidance of deep peat (e.g., T7), reduce visual impact from settlements and communities surrounding the turbines, increase the spacing between turbines to enhance energy performance and output.

4.5.25 Following discussions the changes taken forward are summarised:

- Range of tip heights; 206 m, 230 m & 250 m all with rotor diameters of 170 m for the 21 turbines.
- North Section:
  - All turbines (6 in total) reduced to 206 m to tip with 170 m rotor diameter: 3, 4, 5, 6, 7 & 8 (please note this is the old turbine numbering based on design 2 and turbines do not correlate to design freeze - see Table 4.1)); and
  - The location of T6 required further investigation to consider the visual effect and stacking with other turbines (when turbines appear in front of each other). T6 was moved from design 2 to the east to increase the setback from Bryn village and was able to move into the space created by moving T7. The new position also resulted in minimising the felling area and improved energy production.
- South Section:
  - 15 turbines all with 170 m rotor diameter;
  - Turbines at 206 m to tip: 17, 21, 24, 25 & 26 (all turbine numbering are referring to old number layout);
  - Turbines at 230 m to tip: 10, 11 & 16; and
  - Turbines at 250 m to tip: 12, 13, 14, 15, 18, 19 & 20; and
  - Further investigation required to determine whether it is necessary to reduce tip height of T16.any further to improve the composition of views from Maesteg and Llangynwyd to the east.

4.5.26 Leading from the mini design review day, following the deletions of T22 and T23 the locations of T24, T25 and T26 were all shifted westward to improve views from Margam Country Park and also to minimise impacts from other viewpoints whilst considering all other constraints. Specifically, T25 was positioned so as that its hub would be screened by woodland on Mynydd y Castell in views from the grasslands to south-east of the Castle, while T26 was moved away from T19 to avoid stacking. These and other relevant design changes were later demonstrated to the NPTCBC Park Manager and Physical Activity and Cultural Services Manager[27]as part of cultural heritage and community benefit engagement.

Design Review Day #2 (August 2021)

4.5.27 The second formal design review day was held via Microsoft Teams in August 2021. Attendees included the applicant, and consultants from relevant departments of expertise including; planning, ecology and ornithology, hydrology, civils, traffic and transport, cultural heritage, landscape and visual, forestry, noise, and aviation. Members of staff from NRW (acting as land manager), also attended to be kept informed with the design evolution.

4.5.28 The aim of the day was to discuss whether further improvements could be made to the layout following further site surveys and feedback from ongoing community consultation.

Design 4: Post-Surveys (October 2021)

4.5.29 Following the second design review day and completion of all necessary on-site survey works, together with ongoing consultations with NRW's energy delivery team, a further new layout (Design 4) was produced. This layout consisted of 21 turbines (still numbered 3 to 26) at a range of three tip heights; up to 206 m, 230 m, and 250 m.

4.5.30 Changes to turbine locations that were made and reasons for changes are summarised:

- North Section
  - The only change in the section being T6 moved ~ 40 m NW to minimise the felling area by locating the crane hardstanding within a single forest coupe; and
  - Moving T6 and the associated hardstanding was checked against constraints including visual effects from key viewpoints and was able to maintain the required setback distances from constraints, including still being located on shallow peat (<0.3 m).
- South Section
  - T10 moved ~15 m E, and T11 moved ~15 m S, to pull both out of stacking alignment in views from Cwmafan (Brynna Road);
  - T12 moved ~ 30 m NE to avoid earth work impacts on LISS forestry to the west;
  - T13 moved ~ 35 m NW to reduce the extent of earthworks to the west;
  - T16 reduced tip height from 230 m to 206 m and moved ~ 55 m SE to improve views from the NE – Maesteg and E - Llangynwyd, together with views from the Ogwr Ridgeway and scheduled monuments to the south-east. The new location also minimises felling area by facilitating locating the crane hardstandings and access spur within a single forest coupe;

[27] Virtual meeting of Coriolis Energy and Headland Archaeology with Michael Wynne and Paul Walker of NPTCBC, 09/11/2021.

- T17 moved ~ 75 m W to avoid earthwork impacts on the forestry road to the east;
- T18 moved ~70m SW, to pull out of stacking alignment with T17 in views from Cwmafan (Brynna Road); and
- T24 moved ~ 100 m NE to further reduce the possibility of visibility from the grasslands at Margam Park (screening the turbine behind Mynydd y Castell).

4.5.31 Movement of all turbines listed above was again checked against constraints, and appropriates distances were maintained and the changes ensured there is no peat over 0.5 m underlying the proposed infrastructure. The placement of all built infrastructure (excluding only borrow pits) was considered during the design review day and through site visits with NRW's energy delivery team, including use of existing access tracks where possible, and location of the substation and battery energy storage (BES), main construction compounds and anemometer masts. Initial indicative tree felling plans were also outlined.

Public Consultation (November 2021)

4.5.32 Detailed analysis of written feedback from the round two public consultations can be found in the PAC report. Whilst generalised concerns, particularly around visibility, continued to be raised, with the reduction in local visual impacts from design 2 there were few tangible or actionable comments on specific turbine locations or views. Concerns around impacts on private views and amenity were often noted, as well as questions around the draft tree felling plans which were exhibited for comment.

4.5.33 Proposed transportation routes and access points for AILs and HGV were presented for consultation. There was a strong consensus against the proposed HGV access point at Royal Oak, Bryn.

Design 5: Design Chill (April 2022)

4.5.34 Following public consultations, no changes to turbine or built infrastructure locations were considered necessary. However, the identification of borrow pits for stone to use during construction, the scope of tree felling and restocking, and also habitat management and enhancement plans still needed to be worked through between the applicant, consultants and NRW (land manager).

4.5.35 The most common concerns raised by the public through consultations included the size and number of turbines as well as visual impact on surrounding settlements. By deleting five turbines, significantly reducing the tip-heights of two-thirds of those remaining and relocating multiple turbines to minimise visual impact from a number of locations these concerns were believed to have been appropriately addressed as part of earlier phases of the design evolution.

4.5.36 The only change between Design 4 and Design 5 was the renumbering of the turbines. Details of the old (Design 2) and new (Design 5) numbering and turbine tip heights are detailed in Table 4.1

Table 4.1: Design chill layout

Original Number	Number	Max Tip Height (m)	Max Rotor Diameter (m)
3	1	206	172
4	2	206	172
5	3	206	172
6	4	206	172
7	5	206	172
8	6	206	172
10	7	230	172
11	8	230	172
12	9	250	172
13	10	250	172
14	11	250	172
15	12	250	172
16	13	206	172
17	14	206	172
18	15	250	172
19	16	250	172
20	17	250	172
21	18	206	172
24	19	206	172
25	20	206	172
26	21	206	172

Source: Natural Power

Design 6: Design Freeze (January 2023)

4.5.37 Following design chill in April 2022, EIA specialists began drafting their assessments, applying appropriate methodology to identify the significance of effects upon environmental receptors. No unacceptable adverse impacts were identified from Design 5 by any topic authors. Informal consultations were then carried out on draft ES chapters with most relevant statutory consultees in August 2022. Whilst no objections were raised to Design 5, taking stock with further information and context, including further on-site wind data, at this point gave rise to the possibility of further reducing the visual impacts of the scheme for key receptors, particularly Bryn village and Margam Park.

4.5.38 Amendments to the layout include:

- Three further turbines removed: T1, T7 and T21 (Design 5 numbering), to reduce visibility from key receptors;
- Removed associated access tracks, crane pads to the deleted turbines (T1, T7 and T21);
- Tip height reductions for T9 (Design 5 numbering): 250 m reduced to 230 m, to reduce visibility from Bryn village;
- Tip height reductions for T16 and T17 (Design 5 numbering): 250 m reduced to 206 m, to reduce visibility from Margam Park;
- T8 and T9 were relocated as a result of removing T7 (Design 5 numbering), to reduce visibility from Bryn village;
- Hardstanding's and tracks to T8 and T9 were realigned, resulting in reduced new track length;
- Borrow pits around T8 and T9 were redesigned;
- Remaining turbines were renumbered; and
- Associated changes were made to the tree felling plan and habitat enhancement plans.

4.5.39 Table 4.2 details the old (Design 5) and new numbering (Design 6) and final updated turbine tip heights.

Table 4.2: Design freeze layout

Old Number	New Number	Max Tip Height (m)	Max Rotor Diameter (m)
2	1	206	172

Old Number	New Number	Max Tip Height (m)	Max Rotor Diameter (m)
3	2	206	172
4	3	206	172
5	4	206	172
6	5	206	172
8	6	230	172
9	7	230	172
10	8	250	172
11	9	250	172
12	10	250	172
13	11	206	172
14	12	206	172
15	13	250	172
16	14	206	172
17	15	206	172
18	16	206	172
19	17	206	172
20	18	206	172

4.5.40 The results of these final changes were to reduce visibility of the turbines in the southern section from lower parts of Bryn village (for example, see viewpoint 25 Bryn East at the picnic area opposite the Royal Oak pub, Figure 8.47 a-g), whilst from more elevated parts (for example, viewpoint 3 at the Bryn Play Area, off Neath Road, Figure 8.69 a-g) now all southern section turbines would be seen predominantly contained behind foreground topography in a low array against the wide forested horizon. (For figures, see Volume 2: Supporting Figures and Visualisations). At the same time, the horizontal and vertical fields of view towards northern section turbines were markedly reduced (see again viewpoint 3).

Summary of design evolution

4.5.41 As referred to above, the most common concerns raised by the public through consultations included the size and number of turbines as well as visual impact on surrounding settlements. By deleting in total eight turbines (over 30% from original proposals), reducing the tip-heights of most (by around 18%) and carefully considering the locations of all turbines, visual impacts have been noticeably reduced from a number of key locations. Additionally track lengths have been reduced as a result of turbine deletion.

4.5.42 The maximum tip height is proposed at up to 250 m for turbines 8, 9, 10 and 13; up to 230 m for turbines 6 and 7; and up to 206 m to tip for turbines 1-5, 11, 12, 14-18; all with rotor diameters of up to172 m.

4.6 ENVIRONMENTAL BENEFITS

4.6.1 The essential benefits of using wind energy for the generation of electricity are that it is renewable, safe and does not release any gaseous emissions into the atmosphere during operation. It also provides diversity and security of supply which remain part of the Government's energy policy.

4.6.2 Based on historical Government published data, it is anticipated that the proposed development could generate around 317,883 megawatt hours (MWh) of electricity per year or 317,883,000 kilowatt hours (kWh) (domestic units)[28]. This is equivalent to the annual electricity needs of over 85,700 average British homes, or approximately 68% of households in Neath Port Talbot and Bridgend council areas combined[29].

4.6.3 When generating electricity, the wind turbines would offset the generation of a similar amount of electricity that would otherwise be generated by conventional power stations. While the displacement or offset figure would change as the generation mix changes, the proposed development would, based on the current UK generation mix, offset the production of over 137,325,456 kg of carbon dioxide-equivalent per year (CO_2 yr^{-1} equiv) or 137,326 tonnes of CO_2 yr^{-1} equiv [30].

4.6.4 Based on the findings of a Carbon Balance Assessment, see Appendix 10.4, the construction, operation and decommissioning of the proposed development is expected to result in the net emissions of 263,127tonnes of carbon dioxide equivalent. The carbon payback time for the wind farm is then calculated by comparing the net loss of carbon dioxide (CO_2) from the site due to wind farm development with the carbon savings achieved by the wind farm while displacing electricity generated from coal-fired generation, grid-mix generation or fossil-fuel mix electricity generation. On the basis of the methodology used in that assessment, this could result in a carbon-payback time for the proposed development of 1.9 years (for the expected scenario based on replacement of fossil fuel-mix electricity generation).

4.6.5 The carbon dioxide offset would make an important contribution towards the government target to reduce carbon dioxide emissions by 100% by 2050. The proposed development would also offset emissions of the other greenhouse gases (GHG) from conventional power stations; in particular coal fired generating plant. These gases including sulphur dioxide and oxides of nitrogen cause environmental problems such as acid rain.

4.6.6 Onshore wind farms, particularly those close to areas of electricity demand, provide an important contribution towards making Wales and the UK more energy self-sufficient. If constructed, the proposed development would help improve this self-sufficiency and narrow the energy supply gap.

4.6.7 The proposed development could make a significant contribution towards the renewable energy objectives of NPTCBC, BCBC, and the South West Wales and Cardiff City regions (as detailed in Chapter 2: Legal and Policy Context).

4.7 SUMMARY

4.7.1 The proposed development has been located in an area long considered suitable for wind farm development by both Welsh Government and local authorities. The rigorous design evolution has taken place over a couple of years through several iterations which has evolved in response to changing market conditions, environmental assessments and consultee responses. Through balancing the various site constraints with scale of development required to be economically viable, the applicant believes that the proposed development provides optimum use

[28] Based on average capacity factor for Welsh onshore wind farm BEIS stats 2017-2021 (released in March 2022) is 28%. [last accessed 25/05/2022]. It is important to note that the capacity factors used here will not typically reflect the final capacity factor of the proposed development and are much lower than energy yield assessments for this proposed development and candidate turbines indicate. The actual capacity factor would be anticipated to be greater, as modern turbines are more efficient and taller than many of the older turbines on operational wind farms where the BEIS data is derived from. 129.6 MW x 8760 hours in a year x 28% capacity factor = 317,883 MWh / 3,709 kWh (the GB household average electricity domestic consumption figure in 2021, BEIS Energy Consumption in Great Britain) = *85,706*households. Figures all rounded.

[29] StatWales, 2020: Households by Local Authority and Year – NPTCBC = 62,768; BCBC = 63,152; combined = 125,920.

85,706 / 125,920 x 100 = 68%

[30] BEIS 'Digest of United Kingdom Energy Statistics', July 2022 Table 5.14 "Estimated carbon dioxide emissions from electricity supplied". BEIS's "all non-renewable fuels" emissions equate to 432 tonnes of carbon dioxide per GWh. This is an estimate of the current UK generating plant mix but may change over the lifetime of any project at Y Bryn.

317,883,000 kWh x 432g-CO_2/kWh = 137,325,456 kg /year. Figures all rounded to nearest 100.

of the site with respect to the potential renewable electricity generating capacity balanced against the potential environmental and other effects.

4.7.2 The overall GHG impact is considered to represent a significant beneficial and long-term climate change impact.