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GLANLLYNFI GARTH WIND FARM

Draft Environmental Statement

Appendix 2A - Carbon Balance Assessment



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1. Introduction

1.1 Background

- 1.1.1 The 2017 Town and Country (Environmental Impact Assessment) (EIA) (Wales) Regulations¹ require consideration of the impact of the Proposed Development on climate (for example the nature and magnitude of greenhouse gas (GHG) emissions) and the vulnerability of the Proposed Development to climate change (climate change resilience (CCR)). In the case of Proposed Development including renewable energy generation, the assessment of impact on the climate accounts for the net benefit that the generation can bring over its lifetime (construction, operation and decommissioning) in displacing more carbon intensive forms of energy generation. This net benefit is then contextualised within the wider net zero targets and associated national carbon budgets set out by UK and devolved governments. Specifically in this case, the context are carbon budgets and targets for Wales and the United Kingdom (UK), aligned to a trajectory compatible with limiting the increase in global average temperature below 1.5°C (in accordance with the Paris Agreement).⁸
- 1.1.2 The current carbon balance calculation has been completed using the Excel-based Scottish Government Carbon Calculator Tool². The Tool is designed for assessing the net carbon benefit from the construction and operation of onshore wind farms located where peat is present. The outputs from the tool can inform design of the wind farm layout, design and construction so as to minimise peat excavation and disturbance. The Carbon Calculator Tool has been used as it is considered to be the most reliable tool for estimating the carbon payback time associated with the type of this Proposed Development.

1.2 Climate Change Resilience

- 1.2.1 As agreed with PEDW through the Scoping Direction (**Appendix 1B**), a standalone assessment of Climate Change Resilience (CCR) has not been completed as part of the EIA. The projected impacts of climate change on the Proposed Development are considered in relevant sections of the following ES chapters:
- Chapter 6: Landscape and Visual;
 - Chapter 8: Biodiversity;

¹ Town and Country Planning (Environmental Impact Assessment) (Wales) Regulations 2017 (online). Available at: <https://www.legislation.gov.uk/wsi/2017/567/contents> [Accessed June 2026]

² Scottish Government (Energy Consents Unit), 2022. Carbon calculator for wind farms on Scottish peatlands. Details available at: <https://www.gov.scot/publications/carbon-calculator-for-wind-farms-on-scottish-peatlands-factsheet/> [Accessed June 2026]

- Chapter 10: Water Environment; and
- Chapter 11: Ground Conditions.

1.2.2 The vulnerability of the Proposed Development to climate change and relevant embedded measures are summarised in **Section 5** of this appendix.

1.3 Limitations and Assumptions

- 1.3.1 Given the design stage of the Proposed Development, assumptions have been made in order to complete this carbon balance assessment, mainly regarding peat and organic soil distribution across the Development Site. To date, only a Phase 1 Soil survey has been undertaken, providing high-level indication of the location of 'High Sensitivity Soils' with the potential to contain peat, peaty soils or peat forming soils. As more detailed information becomes available through completion of further survey work the assessment will be updated and related actions included in the OSPMP, which will be provided as part of the final ES submission.
- 1.3.2 The Carbon Calculator tool provides a recognised methodology for assessing peatland-related carbon losses and carbon payback associated with wind farm development. The tool, however, does not explicitly quantify emissions from construction traffic, maintenance activities or decommissioning traffic as these sources are anticipated to be minor compared with the greenhouse gas emissions avoided through renewable electricity generation.
- 1.3.3 Despite these limitations, the methods and information used to inform the Carbon Balance Assessment are deemed suitable and appropriate to allow for a robust assessment.

1.4 Renewable Energy Policy Context

- 1.4.1 The carbon balance assessment has been completed in alignment with the relevant UK wide and Welsh legislative and policy framework for the development of renewable energy schemes. This includes consideration of:
- **Town and Country Planning (Environmental Impact Assessment) (Wales) Regulations 2017** - requires the assessment of likely significant environmental effects of development, including those relating to climate and greenhouse gas emissions, establishing a statutory basis for the assessment of carbon emissions.³
 - **Environment (Wales) Act 2016** - establishes Welsh-specific emissions reduction targets and a carbon budgeting framework reinforcing the importance of assessing greenhouse gas emissions at a project level to support delivery of Wales' statutory climate ambitions.⁴

³ UK Government. (2017) The Town and Country Planning (Environmental Impact Assessment) (Wales) Regulations 2017. Available at: <https://www.legislation.gov.uk/ksi/2017/567/contents>

⁴ UK Government. (2016) Environment (Wales) Act 2016. Available at: <https://www.legislation.gov.uk/anaw/2016/3/contents>

- **Climate Change Act 2008 (2050 Target Amendment) Order 2019** - sets a legally binding target for the UK to achieve net zero greenhouse gas emissions by 2050. It underpins the need to quantify and assess project emissions to understand their contribution to, or alignment with, this national target.⁵
- **Carbon Budgets Orders (Carbon Budgets Order 2026)** - sets legally binding limits on UK greenhouse gas emissions over successive five-year periods and provides a framework against which the carbon performance of developments can be considered.⁶

- 1.4.2 The approach taken by the UK and Welsh Governments to addressing climate change has been shaped and informed by a range of international agreements and climate change obligations including the Kyoto protocol⁷, the Paris Agreement⁸ and the 2021 Glasgow Climate Compact⁹ reflecting the UK's role as a signatory to the United Nations Framework Convention on Climate Change (UNFCCC).
- 1.4.3 UK Government action on climate change is therefore based on its net zero target which requires the UK to reduce GHG emissions by 100% below 1990 levels by 2050⁵. UK carbon budgets⁶, set in law, support the achievement of the net zero target by limiting aggregate emissions permissible in 5-year periods in line with the rate of reduction required to meet the net zero target. In the same manner, Wales is committed to achieving net zero greenhouse gas emissions by 2050, with interim targets set for 2030 and 2040, supported by a series of legally binding five-year carbon budgets.⁴

1.5 Scope and receptors

- 1.5.1 The scope of the assessment of GHG emissions associated with the Proposed Development includes GHG emissions from all activities within the Site, arising from the construction, operation & maintenance and decommissioning phases. In the case of construction, it also includes GHG emissions associated with material processing and transportation of materials and labour from outside the Site.
- 1.5.2 GHG emissions have a global effect rather than directly affecting any specific local receptor to which a level of sensitivity can be assigned. The global climate is the only single receptor for the purposes of this climate change assessment.
- 1.5.3 Given the global impacts of climate change and the globally recognised requirement to limit GHG emissions to maintain global average temperature

⁵ UK Government. (2019) The Climate Change Act 2008 (2050 Target Amendment) Order 2019. Available at: <https://www.legislation.gov.uk/uksi/2019/1056/contents/made>

⁶ UK Government. (2026) The Carbon Budget Order 2026. Available at: <https://www.legislation.gov.uk/ukdsi/2026/9780348283815>

⁷ UNFCCC (1998). Kyoto Protocol. Available at: <https://unfccc.int/resource/docs/convkp/kpeng.pdf>

⁸ UNFCCC (2015). Paris Agreement. Available at: https://unfccc.int/sites/default/files/english_paris_agreement.pdf

⁹ UNFCCC (2021). Glasgow Climate Pact [online]. Available at: https://unfccc.int/sites/default/files/resource/cop26_aup_2f_cover_decision.pdf

increase below 1.5 °C, as laid out in the Paris Agreement⁸, the receptor is considered highly sensitive to GHG emissions.

2 Potential Contribution of the Proposed Development to Government Objectives

2.1 Energy Yield

- 2.1.1 The installed capacity of a wind turbine is a measure of its maximum rated output, which in the context of the Proposed Development is an estimated 33.6 MW (assuming 8 x 4.2 MW turbines). Calculation of the likely electricity generation of the turbines is dependent on the 'capacity factor', which involves an assessment of the actual output of the Proposed Development against its installed capacity.¹⁰
- 2.1.2 On the basis of an installed capacity of 33.6 MW, the amount of electricity produced by the Proposed Development is estimated to be 76 GWh per year, using the Welsh average onshore capacity factor of 26%¹¹. This is outlined below in **Table 1**.

2.2 Carbon dioxide savings and electricity generation

- 2.2.1 It is widely accepted that electricity produced from wind energy has a positive benefit in reducing GHG (CO₂e) emissions.
- 2.2.2 In estimating the actual saving it is important to consider the mix of alternative sources of electricity generation, for example, oil and gas powered assets. Based on the Department for Energy Security and Net Zero's (DESNZ) emission statistic, Renewable UK recommend the use of a static figure of 448 g of CO₂ saved for every kWh generated.¹² A figure of 448 tonnes of CO₂ for every GWh has therefore been assumed for the purposes of this assessment.
- 2.2.3 The electricity generated by the Proposed Development will enter the National Grid and therefore cannot be tracked to the individual consumer. Therefore, it is relevant to consider electricity demand in the context of Wales as a whole, rather than within the area surrounding the Proposed Development.
- 2.2.4 DESNZ produces a range of statistics detailing electricity consumption across Great Britain. The average domestic consumption in Wales, based on sales per household, was 3,155 kWh in 2024 (compared to the average figure for Great

¹⁰ The net capacity factor of a wind farm is the ratio of its actual energy output (after energy losses within the wind farm have been accounted for) over a defined period of time (typically a year) to its energy output, had it operated at maximum power output continuously, over the same period of time.

¹¹ Department for Energy Security & Net Zero (DESNZ). (2024) Regional renewable electricity in 2024. Available at: https://assets.publishing.service.gov.uk/media/68da76bbef1c2f72bc1e4b77/Regional_renewable_electricity_in_2024.pdf

¹² RenewableUK (2026) UK wind energy database. Available at: <https://www.renewableuk.com/energypulse/ukwed/>

Britain of 3,323 kWh in 2024).¹³ This average domestic consumption figure is used as a means of describing the forecast output of the Proposed Development in terms of 'Homes Equivalent' (**Table 1**).

Table 1 - Potential electricity generation and CO₂e savings (Proposed Development)

Capacity Factor (%)	Electricity Generation (MWh per year) ¹⁴	Homes Equivalent (based on average consumption) ^{13,15,16}	Carbon dioxide savings (Tonnes of CO ₂ e per year) based on Renewable UK savings figure
26%	76,233	22,468	34,152

¹³ DESNZ (2025). Regional and local authority electricity consumption statistics. Available at:

<https://www.gov.uk/government/statistics/regional-and-local-authority-electricity-consumption-statistics>

¹⁴ Figures are derived as follows: 33.6 MW (8 × 4.2MW turbine) × 8,760 hours/year × 0.26 (capacity factor) = 76,233 MWh.

¹⁵ This is calculated using the most recent statistics from the DESNZ showing that annual average domestic household consumption for Wales 3,155 kWh

¹⁶ Homes Equivalent: An estimate of the number of average households whose annual electricity consumption could be met by a project's annual electricity generation.

3 Carbon Balance of the Proposed Development

3.1 Overview

- 3.1.1 The following sections outline the specific values for the carbon losses and carbon gains associated with the Proposed Development. For each input parameter (as outlined below in **Annex A**), an expected, minimum and maximum value is used to determine a carbon payback range.
- 3.1.2 For this application, version 2.15.0 of the Microsoft Excel, Scottish Government Carbon Calculator Tool was used.
- 3.1.3 **Table 5** containing the values for each scenario and the justification for the values used for the carbon balance calculations can be found in **Annex A**.

3.2 Carbon Losses

- 3.2.1 The manufacturing, construction and installation of the wind turbines that form the Proposed Development (including all civil works on-site) has an associated carbon cost. As a whole life assessment, impacts associated with the end-of-life decommissioning of the Proposed Development have been included.
- 3.2.2 Outputs from the Scottish Government Carbon Calculator Tool provide a central case (termed the expected case) and sensitivities in terms of minimum and maximum bounds around the central case. The expected case carbon emissions associated with the manufacture, construction and decommissioning of the 33.6 MW installed capacity, is 29,507 tCO₂ equivalent (tCO₂e), which equates to 58.5% of total calculated CO₂e losses.
- 3.2.3 Modelling also attributes carbon losses to the requirement for extra network capacity to back up wind power generation in order to maintain supply and meet demand. This is quantified as a percentage of total capacity; the recommended default value of 5% was used in this case, which equates to 19,779 t CO₂e (39.2% of total CO₂e losses).
- 3.2.4 Carbon losses associated with CO₂e release from soil organic matter in the expected case amount to 958 tCO₂e (1.9% of total CO₂e losses). These losses result from peat and or organic soil removal and drainage effects following excavation for items of infrastructure, notably turbine foundations, hard standings and access tracks. It is noted that the default value used in this calculation assumes 100% loss of CO₂e from removed/disturbed peat or organic soils.

- 3.2.5 Small carbon losses are forecast due to the loss of bog plants in construction and the associated reduction in carbon fixing potential. In the expected case, this is 213t CO₂e, which equates to 0.4% of total CO₂e losses.
- 3.2.6 There are no expected loss of forestry as a result of the Proposed Development as such carbon losses due to forestry felling are expected to be 0t CO₂e.
- 3.2.7 In summary, total CO₂e losses due to the Proposed Development are **50,457 tCO₂e**. Of these, a total of 1,171 tCO₂e are attributed to soil organic matter and carbon fixing potential impacts (2.3% of the total).

Table 2 - Summary of total carbon losses

CO ₂ Losses	Losses due to turbine life (manufacture, construction, decommissioning)	Losses due to backup	Losses due to reduced carbon fixing potential	Losses from soil organic matter	Losses due to felling forestry
t CO ₂ eq.	29,507	19,779	213	958	0

3.3 Carbon Gains

- 3.3.1 There are no carbon gains anticipated with the Proposed Development as a result of land use change.

4 Carbon Payback of the Proposed Development

4.1 Carbon Payback

- 4.1.1 To calculate the carbon payback period, the assessment uses two fossil fuel displacement scenarios, which are updated automatically using data from the Digest of United Kingdom Energy Statistics (DUKES):
- Grid mix, the mix of electricity sources supplying the UK as a whole;
 - Fossil fuel mix, for fossil fuel sourced electricity generation alone.
- 4.1.2 The grid mix scenario has been selected as the most appropriate basis for calculating carbon payback time (the counterfactual).¹⁷ As the grid decarbonises, the continued phasing out of fossil fuels will proportionately reduce the carbon benefit of the Proposed Development. Therefore, the grid mix scenario provides the most appropriate basis for comparing predicted payback. Based on this scenario, the payback for the Proposed Development is predicted to be 3.8 years in the central (expected) case. However, the payback period could be as low as 2.0 years for the minimum scenario, increasing to 4.4 years for the maximum scenario for grid mix.
- 4.1.3 The fossil fuel mix scenario has been included for reference as a conservative comparator. The carbon payback time for each scenario is shown in **Table 3**.

Table 3 - Payback in years for each Scenario used in the Carbon Calculator

Fuel Source	Carbon Payback Time (years) Expected Value	Carbon Payback Time (Years) Minimum value	Carbon Payback Time (Years) Maximum Value
Fossil Fuel Mix	1.5	0.8	1.7
Grid Mix	3.8	2.0	4.4

¹⁷ Note on limitations: wind power will not replace all forms of conventional generation equally, so the true carbon emissions displacement will be dependent on a combination of factors e.g. the types of power generation being replaced, any decrease in efficiency of conventional plant operating at part load, and the impact of any increase in frequency of start-up and shut-down of conventional plant.

5 Climate Change Resilience

- 5.1.1 According to the latest State of the UK Climate Report¹⁸, the UK's climate is changing. In general, climate change in the UK is project to lead to:
- Hotter drier summers with increased frequency and duration of heatwaves and droughts;
 - Warmer, wetter winters with reduced frequency of snow and ice, however such events and extreme cold snaps remain a risk; and
 - Increased frequency of extreme events such as heavy rainfall, resultant flooding, high winds and, potentially, lightning strikes.
- 5.1.2 The vulnerability of the Proposed Development to climate change has been considered in the design and other relevant topic chapters listed in **Section 1.2**. The environmental measures identified in topic assessments related to improving the climate change resilience of the Proposed Development have been reproduced in **Table 4**.

Table 4 – Embedded measures improving climate change resilience.

Chapter	Environmental measure	Relevance for climate change resilience
Chapter 4: Project Description	Modern wind turbines are designed to withstand high wind speeds and are normally certified against structural failure for wind speeds up to 150 mph. At high wind speeds, the wind farms will shut themselves down to avoid excessive wear.	These measures increase the resilience of the wind turbines to increasing wind speeds that may be experienced as part of storm events associated with climate change.
	The wind turbines will be fitted with a lightning protection system as part of the design.	These measures increase the resilience of the wind turbines to increasing lightning strikes that may be experienced associated with climate change.
	Occasionally very heavy snow and ice may affect the anemometer or aerodynamics of the turbine blades resulting in temporary automatic shutdown. The wind turbine would restart automatically after accumulations have naturally thawed.	Although climate change trends show increasing mean annual temperatures, cold weather events could still occur. These measures increase the resilience of the wind turbines to cold weather events.
	Turbines and High Voltage equipment (substation) would be inspected and maintained by a local team of technicians. Turbines would be typically	This allows for adaptive capacity to be built into the operation of the wind turbines. The routine maintenance would identify any impacts to the wind turbines from extreme weather associated with climate change,

¹⁸ Met Office (2026). State of the UK Climate. Available at: <https://www.metoffice.gov.uk/research/climate/maps-and-data/about/state-of-climate>

Chapter	Environmental measure	Relevance for climate change resilience
	maintained at 6 monthly intervals.	allowing for replacement or upgrades, if required.
	Site tracks are likely to be maintained annually.	Any deterioration or degradation of access track surfacing due to climate change events (i.e., increasing temperatures) will be identified during annual maintenance and rectified.
Chapter 6: Landscape and Visual Chapter 8: Biodiversity	Temporary and permanent habitat loss will be kept to a minimum. Management proposals for the replacement or enhancement planting will be set out in a Habitat Management Plan (HMP), which will be secured as a planning condition. This will be undertaken over the lifetime of the development.	Management proposals would help the replacement or enhancement planting to succeed in response to changing climatic conditions i.e., drought conditions or increasing temperatures. The management regime will be reviewed at five yearly intervals to ensure it remains suitable and effective. This will include any alterations needed to mitigate for a changing climate.
Chapter 10: Water Environment	Climate change allowances in line with Natural Resources Wales guidance have been applied to the hydrological modelling inputs to minimise vulnerability and provide resilience to the impacts of climate change.	Fluvial flood risk is considered to pose a limited risk to the Proposed Development. Further details of the allowances are contained within Chapter 10 and within Appendix 10A.
Chapter 11: Ground Conditions	The design for the Proposed Development will comply with good practice in structural design including compliance with the Eurocodes and relevant British Standards. The design will account for the expected ground conditions and design loads, accounting for the effects of climate change.	The detailed design of the foundations and supports will take into account changing ground conditions for the soil type with fluctuations in rainfall anticipated with climate change.

6 Summary

- 6.1.1 The Proposed Development is forecast to be capable of generating electricity at a supply equivalent of 22,468 homes (at 2024 average domestic consumption levels).¹³ The associated avoided potential annual CO₂e emissions, in displacing more carbon intensive generation capacity, amount to 34,152 tonnes/year (based on a figure of 448 tonnes of CO₂ savings per GWh¹² and a capacity factor of 26%). Over the 30-year operational life of the Proposed Development this could result in a total carbon saving of around 1 million tonnes.¹⁹
- 6.1.2 In the expected (central) case, the forecast carbon losses in developing the Proposed Development would be paid back in around 3.8 years (13% of the 30-year operational life) based upon the expected outcome under the grid mix scenario. Even considering the maximum scenario against the grid mix, the Proposed Development would have achieved the carbon balance within around 4.4 years (15% of the 30-year operational life).
- 6.1.3 It is concluded that the GHG impact of the Proposed Development would have a beneficial effect. The calculated carbon payback times suggest that the Proposed Development would begin to contribute to power sector reductions within the UK Sixth Carbon Budget period (2033 – 2037) and Welsh Government Carbon Budget 4 (2031 – 2035). This therefore has a positive impact on achievement of carbon budgets and targets for Wales and the UK.
- 6.1.4 The vulnerability of the Proposed Development to climate change has been addressed throughout the EIA Report in relevant topic chapters identified in **Section 1.2**. The design of the wind turbines includes measures to improve the resilience of the Proposed Development, which will continue to be developed throughout the detailed design.

¹⁹ Figures are derived as follows: 34,153 (CO₂e savings (tCO₂) per year) x 30 (Lifetime of wind farm) = 1,024,572 (CO₂e savings (tCO₂))

Annex A

Carbon Balance Calculation Assumptions

Table 5 summarises the input values used in the Carbon Balance Assessment.

Table 5 - Carbon Balance Calculation Assumptions

Input data	Glanllynfi Garth Wind Farm			Comments/Assumptions
	Expected	Minimum	Maximum	
Wind Farm Characteristics				
Dimensions				
No. of turbines	8	8	8	Information taken from - Chapter 4 Development Description.
Lifetime of wind farm (years)	30	30	30	Information taken from - Chapter 4 Development Description.
Power rating of turbines	4.2	4.2	4.2	Information taken from - Chapter 4 Development Description. Indicative output capacity of 33.6MW Output capacity / No. of turbines = turbine power rating (80/11 =7.3)"
Capacity factor	25.9%	23.3%	28.5%	Latest published Welsh Average capacity factor - 2024 ²⁰ (min, max = +/- 10%)
Extra capacity required for back up	5%	5%	5%	Following the guidance provided by Nayak et al (2013) ²¹ and the carbon calculator a 5% back up is required.
Additional emissions due to thermal inefficiency of back up generation (%)	10%	10%	10%	Extra emissions due to reduced thermal efficiency of the reserve power generation = 10% (Dale et al 2004) ²² .
Carbon dioxide emissions from turbines' life	Calculate w.r.t installed capacity			Total CO ₂ e emission calculated using installed capacity (default equation provided by carbon calculator).
Peatland Characteristics before wind development				
Type of peatland	Acid bog	Acid bog	Acid bog	An 'acid bog' is fed primarily by rainwater and often inhabited by sphagnum moss, thus making it

²⁰ Department for Energy Security & Net Zero (DESNZ). (2024) Regional renewable electricity in 2024. Available at: https://assets.publishing.service.gov.uk/media/68da76bbef1c2f72bc1e4b77/Regional_renewable_electricity_in_2024.pdf

²¹ Nayak, D.R., Miller, D., Nolan, A., Smith, P., Smith, J. 2008 (corrected in 2010) Calculating Carbon Savings from Wind Farms on Scottish Peat Lands – a New Approach, available at: : <http://www.gov.scot/Resource/Doc/917/0117390.pdf>

²² Royal Academy of Engineering 2014 Wind Energy, implications of large-scale deployment on the GB electricity system, available at: <http://www.raeng.org.uk/publications/reports/wind-energy-implications-of-large-scale-deployment>

Input data	Glanllynfi Garth Wind Farm			Comments/Assumptions
	Expected	Minimum	Maximum	
				acidic. See Stoneman & Brooks (1997)
Average annual air temperature at site (°C)	11.2	4.5	19.0	Average annual temperature taken for Mumbles head, 1991-2020 (approximately 25km away from Glanllynfi). Expected value calculated using average annual temperature. Maximum and minimum calculated using maximum summer temperatures and minimum winter temperatures.
Average peat depth at site (m)	0.36	0.32	0.40	Raw data has been extracted from Phase 1 soil survey Results. ²³ (min, max = +/- 10%)
Content of dry peat % by weight	55	49	62	No site-specific measurements available, precautionary values used.
Average extent of drainage around drainage features at site (m)	7.5	5	10	No site-specific measurements available, precautionary values used.
Average water table depth at site (m)	0.3	0.2	0.4	No site-specific measurements available, precautionary values used.
Dry soil bulk density (gcm ⁻³)	0.25	0.2	0.3	No site-specific values available. Values taken from a similar upland site with underlying peat.
Characteristics of bog plants				
Time required for regeneration of bog plants after restoration (years)	3	2	5	Estimated values, based on condition of the current vegetation.
Carbon accumulation due to C fixation by bog plants in undrained peat (tC ha ⁻¹ yr ⁻¹)	0.25	0.12	0.31	Default values provided by Turunen et al., 2001 ²⁴ ; Botch et al., 1995 ²⁵ .
Forestry Plantation Characteristics				
Method: Enter simple data				
Area of forestry plantation to be felled (ha)	0	0	0	Assumed no felling of forestry required.
Average rate of carbon sequestration in timber	3.6	3.4	3.8	Figures from Cannell, 1999 ²⁶ . min and max entered as a range.

²³ Due to the early stage of assessment and lack of detailed soil/ peat data broad assumptions have been used to derive this value. The Phase 1 soil survey identified two localised areas containing 'High Sensitivity Soils'. Average depth has been taken across this area and a 50m buffer to capture any potential peat forming soils. As a precautionary approach all soils in this area have been deemed as peat/ peaty soils for this assessment. Upon further detailed survey work this figure will be revised and updated at full EIA stage however until then the average depth of 0.36m will be used to represent average peat/ peaty soil depth across the project components.

²⁴ Turunen J., Tahvanainen T., Tolonen K. and Pitkänen A. 2001 Carbon accumulation in West Siberian mires, Russia. Global Biogeochemical Cycles 15: 285-296.

²⁵ Botch M.S., Kobak K.I. Vinson T.S. and Kolchugina T.P. 1995 carbon pools and accumulation in peatlands of the former Soviet Union. Global Biogeochemical Cycles 9: 37-46

²⁶ Cannell, M.G.R. (1999) Growing trees to sequester carbon in the UK: answers to some common questions. Forestry, 72, 238-247

Input data	Glanllynfi Garth Wind Farm			Comments/Assumptions
	Expected	Minimum	Maximum	
Counterfactual emission factors				
Coal-fired plant emission factor tCO ₂ MWh ⁻¹	0.919	0.919	0.919	Values updated annually based on DUKES (DUKES: Electricity (Table 5.14)).
Grid mix emission factor tCO ₂ MWh ⁻¹	0.154	0.154	0.154	Values updated annually based on DUKES (DUKES: Electricity (Table 5.14)).
Fossil fuel mix emission factor tCO ₂ MWh ⁻¹	0.448	0.448	0.448	Values updated annually based on DUKES (DUKES: Electricity (Table 5.14)).
Borrow Pits				
Number of Areas	0	0	0	Information taken from - Chapter 4 Development Description. No borrow pits are proposed on site, required materials will be imported to site..
Average length of area (m)	n/a	n/a	n/a	
Average width of areas (m)	n/a	n/a	n/a	
Average depth of peat removed from area (m)	n/a	n/a	n/a	
Access tracks				
Total length of access tracks (m)	879	791	967	Representing length of access tracks that fall on the identified high sensitivity soils. ²³ (min, max = +/- 10%)
Existing tracks length (m)	0	0	0	No existing access tracks on potential peat / peaty soil areas.
<u>Length of access tracks that is floating road (m)</u>	0	0	0	No floating road proposed at this stage.
Floating road width (m)	n/a	n/a	n/a	No floating road proposed at this stage.
Floating road depth (m)	n/a	n/a	n/a	No floating road proposed at this stage.
Length of floating road that is drained (m)	n/a	n/a	n/a	No floating road proposed at this stage.
Average depth of drains associated with floating roads (m)	n/a	n/a	n/a	No floating road proposed at this stage.
<u>Length of access track that is excavated road (m)</u>	879	791	967	Representing length of access tracks that fall on the identified high sensitivity soils. ²³ (min, max = +/- 10%)
Excavated road width (m)	5	5	5	Information taken from - Chapter 4 Proposed Development
Average depth of peat excavated from road (m)	0.36	0.32	0.38	Information from Phase 1 Soil Survey. ²³ (min, max = +/- 10%)
<u>Length of access track that is rock filled road (m)</u>	0	0	0	No Rock filled road proposed at this stage.

Input data	Glanllynfi Garth Wind Farm			Comments/Assumptions
	Expected	Minimum	Maximum	
Rock filled road width (m)	n/a	n/a	n/a	No Rock filled road proposed at this stage
Rock filled road depth (m)	n/a	n/a	n/a	No Rock filled road proposed at this stage
Length of rock filled road that is drained (m)	n/a	n/a	n/a	No Rock filled road proposed at this stage
Average depth of drains associated with rock filled roads (m)	n/a	n/a	n/a	No Rock filled road proposed at this stage
Cable Trenches				
Length of any cable trench on peat that does not follow access track and is lined with a permeable material (m)	0	0	0	Information taken from - Chapter 4 Proposed Development. Assume full length of cable route to follow access track.
Depth of cable trench (m)	0.36	0.34	0.38	Information taken from Phase 1 Soil Survey. ²³ (min, max = +/- 10%)
Additional peat excavated (not accounted for above)				
Volume of additional peat excavated (m ³)	1,936	1,549	2,323	Information taken from – Phase 1 Soil Survey Inclusive of Construction Compound area which is located on 'High Sensitivity Soils' Volume calculated using total area x average peat/ soil depth (0.36m). (min, max = +/- 10%)
Area of additional peat excavated (m ²)	5,478	4,382	6,574	Information taken from – Phase 1 Soil Survey Inclusive of Construction Compound area which is located on 'High Sensitivity Soils' (min, max = +/- 10%)
Peat Landslide hazard				
Peat landslide hazard risk assessment	Negligible	Negligible	Negligible	Fixed value.
Improvement of C sequestration at site by blocking drains, restoration of habitat etc.				
<u>Improvement of degraded bog</u>				
Area of degraded bog to be improved (ha)	0	0	0	No bog restoration works proposed.
Water table depth in degraded bog before improvement (m)	n/a	n/a	n/a	No bog restoration works proposed.
Water table depth in degraded bog after improvement (m)	n/a	n/a	n/a	No bog restoration works proposed.
Time required for hydrology and habitat of bog to return to its	n/a	n/a	n/a	No bog restoration works proposed.

Input data	Glanllynfi Garth Wind Farm			Comments/Assumptions
	Expected	Minimum	Maximum	
previous state on restoration (years)				
Period of time when effectiveness of the improvement in degraded bog can be guaranteed (years)	n/a	n/a	n/a	No bog restoration works proposed.
<u>Improvement of felled plantation</u>				
Area of felled plantation to be improved (ha)	0	0	0	Assumed no felling of forestry required thus no proposed plans for improvement to felled plantation.
Water table depth in felled area before improvement (m)	n/a	n/a	n/a	Assumed no felling of forestry required thus no proposed plans for improvement to felled plantation.
Water table depth in felled area after improvement (m)	n/a	n/a	n/a	Assumed no felling of forestry required thus no proposed plans for improvement to felled plantation.
Time required for hydrology and habitat of felled plantation to return to its previous state on restoration (years)	n/a	n/a	n/a	Assumed no felling of forestry required thus no proposed plans for improvement to felled plantation.
Period of time when effectiveness of the improvement in felled plantation can be guaranteed (years)	n/a	n/a	n/a	Assumed no felling of forestry required thus no proposed plans for improvement to felled plantation.
<u>Restoration of peat removed from borrow pits</u>				
Area of borrow pits to be restored (ha)	n/a	n/a	n/a	No proposed borrow pits.
Depth of water table in borrow pit before restoration with respect to the restored surface (m)	n/a	n/a	n/a	No proposed borrow pits.
Depth of water table in borrow pit after restoration with respect to the restored surface (m)	n/a	n/a	n/a	No proposed borrow pits.
Time required for hydrology and habitat of borrow pit to return to its previous state on restoration (years)	n/a	n/a	n/a	No proposed borrow pits.
Period of time when effectiveness of the restoration of peat removed from borrow pits can be guaranteed (years)	n/a	n/a	n/a	No Borrow pits
<u>Removal of drainage from foundations and hardstanding</u>				

Input data	Glanllynfi Garth Wind Farm			Comments/Assumptions
	Expected	Minimum	Maximum	
Water table depth around foundations and hardstanding before restoration	0	0	0	Assume no removal of drainage at this stage.
Water table depth around foundations and hardstanding after restoration	0	0	0	Assume no removal of drainage at this stage.
Time to completion of backfilling, removal of any surface drains and full restoration of the hydrology (years)	0	0	0	Assume no removal of drainage at this stage.
Restoration of site after decommissioning				
Will you attempt to block any gullies that have formed due to the wind farm?	Yes	Yes	No	Assumes that any gullies caused by construction of the wind farm would be blocked to maintain habitats except worst case scenario (maximum column).
Will you attempt to block all artificial ditches and facilitate rewetting?	No	No	No	
Will the habitat of the site be restored on decommissioning				
Will you control grazing on degraded areas?	Yes	Yes	Yes	If required.
Will you manage areas to favour reintroduction of species	No	No	No	
Construction Input Data				
Area 1 - Construction Input Data for turbines in organic matter <0.5m deep				
Number of turbines in this area	1	1	1	Information taken from – Phase 1 Soil Survey Result. T2 wind turbine located on 'High Sensitivity Soils'
Turbine foundations				
Depth of hole dug when constructing foundations	0.36	0.32	0.38	Information taken from – Phase 1 Soil Survey Results. ²³ (min, max = +/- 10%)
Approximate geometric shape of hole dug when constructing foundations	Rectangular	Rectangular	Rectangular	Information based on Figure 4.3 Typical windfarm foundation. Note – the Excel carbon tool does not provide a "Circular" option. Actual turbine foundation dimensions is 20m diameter circle equating to an area of 314.16m ² A rectangle of equal area has been used in substitute for this assessment with a length and width of 17.72.

Input data	Glanllynfi Garth Wind Farm			Comments/Assumptions
	Expected	Minimum	Maximum	
Length at surface (m)	17.72	17.72	17.72	Information based on Figure 4.3 Typical windfarm foundation. Note – the Excel carbon tool does not provide a “Circular” option. Actual turbine foundation dimensions is 20m diameter circle equating to an area of 314.16m² A rectangle of equal area has been used in substitute for this assessment with a length and width of 17.72.
Width at surface (m)	17.72	17.72	17.72	Information based on Figure 4.3 Typical windfarm foundation. Note – the Excel carbon tool does not provide a “Circular” option. Actual turbine foundation dimensions is 20m diameter circle equating to an area of 314.16m² A rectangle of equal area has been used in substitute for this assessment with a length and width of 17.72.
Length at bottom (m)	17.72	17.72	17.72	Information based on Figure 4.3 Typical windfarm foundation. Note – the Excel carbon tool does not provide a “Circular” option. Actual turbine foundation dimensions is 20m diameter circle equating to an area of 314.16m² A rectangle of equal area has been used in substitute for this assessment with a length and width of 17.72.
Width at bottom (m)	17.72	17.72	17.72	Information based on Figure 4.3 Typical windfarm foundation. Note – the Excel carbon tool does not provide a “Circular” option. Actual turbine foundation dimensions is 20m diameter circle equating to an area of 314.16m² A rectangle of equal area has been used in substitute for this assessment with a length and width of 17.72.
Volume of concrete used in the entire area (m ³)	5864	5278	6450	Information from – Chapter for Design Description

Input data	Glanllynfi Garth Wind Farm			Comments/Assumptions
	Expected	Minimum	Maximum	
				At this stage only tonnage values are available, the exact volume will be updated during full EIA. A precautionary value has been calculated using the total project tonnage of 1857 tons and a standard concrete density figure of 2,400kg/m³. Total volume has been included for all 8 turbines to capture carbon associate with all onsite concrete. (min, max = +/- 10%)
Hardstanding				
Depth of hole dug when constructing hardstanding	0.36	0.32	0.38	Information taken from – Phase 1 Soil Survey²³ (min, max = +/- 10%)
Approximate geometric shape of hole dug when constructing hardstanding	Rectangular	Rectangular	Rectangular	Information Based off Figure 4.4 Typical crane hardstanding layout.
Length at surface (m)	56.16	56.16	56.16	Information taken from -Phase 1 Soil Survey Calculated using approximate hard standing on high sensitivity soils with area of 3,154m² A rectangle of equal area has been used in substitute for this assessment.
Width at surface (m)	56.16	56.16	56.16	Information taken from -Phase 1 Soil Survey Calculated using approximate hard standing on high sensitivity soils with area of 3,154m² A rectangle of equal area has been used in substitute for this assessment.
Length at bottom (m)	56.16	56.16	56.16	Information taken from -Phase 1 Soil Survey Calculated using approximate hard standing on high sensitivity soils with area of 3,154m² A rectangle of equal area has been used in substitute for this assessment.
Width at bottom (m)	56.16	56.16	56.16	Information taken from -Phase 1 Soil Survey Calculated using approximate hard standing on high sensitivity soils with area of 3,154m² A rectangle of equal area has been used in substitute for this assessment.



Input data	Glanllynfi Garth Wind Farm			Comments/Assumptions
	Expected	Minimum	Maximum	
Is piling used?	No	No	No	Piling not likely to be used