

**MWP**

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## **Appendix 10B – Carbon Calculations**

**Ballynisky Wind Farm**

**Ballynisky Green Energy Ltd.**

**December 2025**

**Core input data**  
 ENTER INPUT DATA HERE! VALUES SHOULD ONLY BE CHANGED ON THIS SHEET. **DO NOT USE EXAMPLE VALUES AS DEFAULTS!** ENTER YOUR OWN VALUES THAT ARE SPECIFIC TO YOUR PARTICULAR SITE.  
 Note: The input parameters include some variables that can be specified by default values, but others that must be site specific. Variables that can be taken from defaults are marked with purple tags on left hand side.

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Input data	Expected values		Possible range of values		Record source of data
	Enter expected value here	Record source of data	Enter minimum value here	Enter maximum value here	
<b>Windfarm characteristics</b>					
<b>Dimensions</b>					
No. of turbines	6	Planning Permission Request	6	6	
Lifetime of windfarm (years)	35	Planning Permission Request	35	35	
<b>Performance</b>					
Power rating of turbines (turbine capacity) (MW)	4.5		4.5	4.5	
Capacity factor	Direct input of capacity fa		Direct input of capacity fa	Direct input of capacity fa	
Enter estimated capacity factor (percentage efficiency)	30.0	Long term average capacity factor (WEA)	30.0	30.0	
Backup	5	Value from SNH guidance	5	5	
Extra capacity required for backup (%)	10	Value from SNH guidance. Over 20% of national electricity is from renewables.	10	10	
Additional emissions due to reduced thermal efficiency of the reserve generation (%)	Calculate wrt installed ca		Calculate wrt installed ca	Calculate wrt installed ca	
Carbon dioxide emissions from turbine life - (eg. manufacture, construction, decommissioning)					
<b>Forestry Plantation Characteristics</b>					
<b>Method used to calculate CO<sub>2</sub> loss from forest felling</b>					
Area of forestry plantation to be felled (ha)	Enter simple data	Provided	Enter simple data	Enter simple data	
Average rate of carbon sequestration in timber (tC ha <sup>-1</sup> yr <sup>-1</sup> )	0.00	Value from SNH guidance	0.00	0.00	
<b>Counterfactual emission factors</b>					
<b>To update counterfactual emission factors from the web</b>					
Coal-fired plant emission factor (t CO <sub>2</sub> MWh <sup>-1</sup> )	0.093	Dukes, 2015b	0.093	0.093	
Grid-mix emission factor (t CO <sub>2</sub> MWh <sup>-1</sup> )	0.375	Energy Related CO <sub>2</sub> emissions Ireland 2005 to 2018, SEAI	0.375	0.39	
Fossil fuel-mix emission factor (t CO <sub>2</sub> MWh <sup>-1</sup> )	0.642	Dukes, 2015b	0.642	0.642	
<b>Borrow pits</b>					
Number of borrow pits	0	No borrow pits	0	0	
Average length of pits (m)	0	No borrow pits	0	0	
Average width of pits (m)	0	No borrow pits	0	0	
Average depth of peat removed from pit (m)	0.00	No borrow pits	0.00	0.00	
<b>Improvement of C sequestration at site by blocking drains, restoration of habitat etc</b>					
<b>Improvement of degraded bog</b>					
Area of degraded bog to be improved (ha)	0	Assumed to be nil			
Water table depth in degraded bog before improvement (m)	0.00				
Water table depth in degraded bog after improvement (m)	0.00				
Time required for hydrology and habitat of bog to return to its previous state on improvement (years)	0				
Period of time when effectiveness of the improvement in degraded bog can be guaranteed (years)	0				
<b>Improvement of felled plantation land</b>					
Area of felled plantation to be improved (ha)	0	Assumed to be nil			
Water table depth in felled area before improvement (m)	0.00		0.00	0.00	
Water table depth in felled area after improvement (m)	0.00		0.00	0.00	
Time required for hydrology and habitat of felled plantation to return to its previous state on improvement (years)	0		0	0	
Period of time when effectiveness of the improvement in felled plantation can be guaranteed (years)	0		0	0	
<b>Restoration of peat removed from borrow pits</b>					
Area of borrow pits to be restored (ha)	0	N/A	0	0	
Depth of water table in borrow pit before restoration with respect to the restored surface (m)	0.00	N/A	0.00	0.00	
Depth of water table in borrow pit after restoration with respect to the restored surface (m)	0.00	N/A	0.00	0.00	
Time required for hydrology and habitat of borrow pit to return to its previous state on restoration (years)	0	N/A	0	0	
Period of time when effectiveness of the restoration of peat removed from borrow pits can be guaranteed (years)	0	N/A	0	0	
<b>Early removal of drainage from foundations and hardstanding</b>					
Water table depth around foundations and hardstanding before restoration (m)	0.00		0.00	0.00	
Water table depth around foundations and hardstanding after restoration (m)	0.00		0.00	0.00	
Time to completion of backfilling, removal of any surface drains, and full restoration of the hydrology (years)	0		0	0	
<b>Restoration of site after decommissioning</b>					
Will the hydrology of the site be restored on decommissioning?	Yes		Yes	Yes	
Will you attempt to block any gullies that have formed due to the windfarm?	No		Not appli	Not appli	
Will you attempt to block all artificial ditches and facilitate rewetting?	No		Not appli	Not appli	
Will the habitat of the site be restored on decommissioning?	Yes		Yes	Yes	
Will you control grazing on degraded areas?	Not appli		Not app	Not app	
Will you manage areas to favour reintroduction of species	Not appli		Not appli	Not appli	

**Note: Capacity factor.** The capacity factor of any power plant is the proportion of energy produced during a given period with respect to the energy that would have been produced had the wind farm been running continuously and at maximum output (DECC 2004); see also [www.breese.com/infocapacity/capacity.html](http://www.breese.com/infocapacity/capacity.html).  
 Capacity Factor = Electricity generated during the period [kWh] / (Installed capacity [kW] x number of hours in the period [h]).  
 We recommend that a site-specific capacity factor should be used (as measured during planning stage), and should represent the average emission factor expected over the lifetime of the windfarm, accounting for decline in efficiency with age (Hughes, 2012). The 5 year average capacity factor (or "load factor") for UK onshore wind between 2010 and 2014, based on average beginning and end of year capacity, was 22.2% (DUKES, 2015).

**Note: Extra capacity required for backup.** If 20% of national electricity is generated by wind energy, the extra capacity required for backup is 5% of the rated capacity of the wind plant (Dale et al 2004). We suggest this should be 5% of the actual output. If it is assumed that less than 20% of national electricity is generated by wind energy, a lower percentage should be entered (0%). The House of Lords Economic Affairs Committee report on The Economics of Renewable Energy (Parliamentary Business, 2008) notes that to cover peak demand a 20% margin of extra capacity has been sufficient to keep the risk of a power cut due to insufficient generation at a very low level. The estimate provided by BERR was a range of 10% to 15% of installed capacity of wind energy. E.ON is reported as proposing that the capacity credit of wind power should be 8%, and the Renewable Energy Foundation proposed the use of the square root of the wind capacity (in GW) as conventional capacity (e.g. 36 GW of wind plant to match 6 GW of conventional plant).

**Note: Extra emissions due to reduced thermal efficiency of the reserve power generation.** 10%  
**Note: Time required for re-occupation of previous habitat.** Loss of fraction should be as a guide to the time required for re-occupation of previous habitat.

**Note: Carbon fixation by bog plants.**  
 Apparent C accumulation rate in peatland is 0.12 to 0.31 t C ha<sup>-1</sup> yr<sup>-1</sup> (Turunen et al., 2001; Botch et al., 1995). The SNH guidance uses a value of 0.25 t C ha<sup>-1</sup> yr<sup>-1</sup>.

**Note: Area of forestry plantation to be felled.** If the forestry was planned to be removed, with no further rotations planted, before the windfarm development, the area to be felled should be entered as zero.

**Note: Plantation carbon sequestration.** This is dependent on the yield class of the forestry. The SNH technical guidance assumed yield class of 16 m<sup>3</sup> ha<sup>-1</sup> yr<sup>-1</sup>, compared to the value of 14 m<sup>3</sup> ha<sup>-1</sup> yr<sup>-1</sup> provided by the Forestry Commission. Carbon sequestered for yield class 16 m<sup>3</sup> ha<sup>-1</sup> yr<sup>-1</sup> = 3.6 tC ha<sup>-1</sup> yr<sup>-1</sup> (Cannell, 1999).

**Note: Coal-Fired Plant and Grid-Mix Emission Factors.** Coal-fired plant emission factor (EF) from electricity supplied in 2014 = 0.093 t CO<sub>2</sub> MWh<sup>-1</sup>; Grid-Mix EF for 2014 = 0.394 t CO<sub>2</sub> MWh<sup>-1</sup>. Source = DUKES, 2015b.

**Note: Fossil Fuel-Mix Emission Factor.** The emission factor from electricity supplied in 2014 from all fossil fuels = 0.642 t CO<sub>2</sub> MWh<sup>-1</sup>. Source = DUKES, 2015b.

**Note: Period of time when improvement can be guaranteed.** This guarantee should be absolute. Therefore, if you enter a value beyond the lifetime of the windfarm you should provide strong supporting evidence that this improvement can be guaranteed for the full period given. This includes the time requirement for the improvement to become effective. For example if time required for hydrology and habitat to return to its previous state is 10 years and the restoration can be guaranteed over the lifetime of the windfarm (25 years), the period of time when the improvement can be guaranteed should be entered as 25 years, and the improvement will be effective for (25 - 10) = 15 years.

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**Note: Period of time when improvement can be guaranteed.** This is assumed to be the lifetime of the windfarm as restoration after windfarm decommissioning is already accounted for in restoration of the site.

**Note: Restoration of site.** If the water table at the site is returned to its original level or higher on decommissioning, and habitat at the site is restored, it is assumed that C losses continue only over the lifetime of the windfarm. Otherwise, C losses from drained peat are assumed to be 100%.

**Note: Choice of methodology for calculating emission factors.** The IPCC default methodology is the internationally accepted standard (IPCC, 1997). However, it is stated in IPCC (1997) that these are rough estimates, and "these rates and production periods can be used if countries do not have more appropriate estimates". Therefore, we have developed more site specific estimates for use here based on work from the Scottish Government funded ECOSSE project (Smith et al. 2007; ECOSSE: Estimating Carbon in Organic Soils - Sequestration and Emissions. Final Report. SEERAD Report. ISBN 978 0 7559 1488 2. 166pp.).

**Choice of methodology for calculating emission factors**  
 IPCC default

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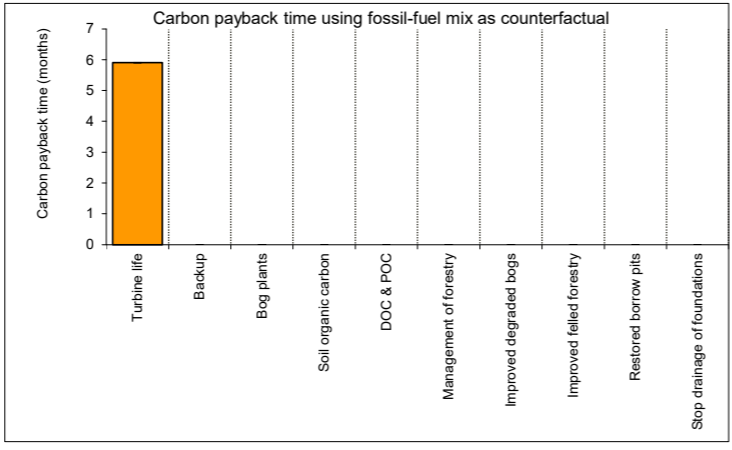
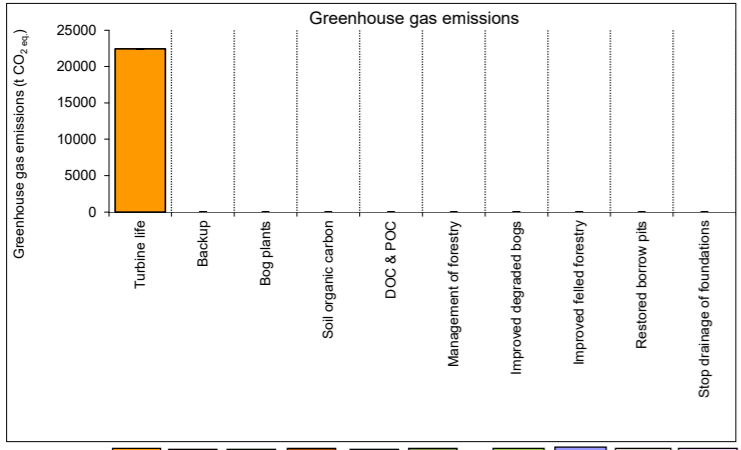
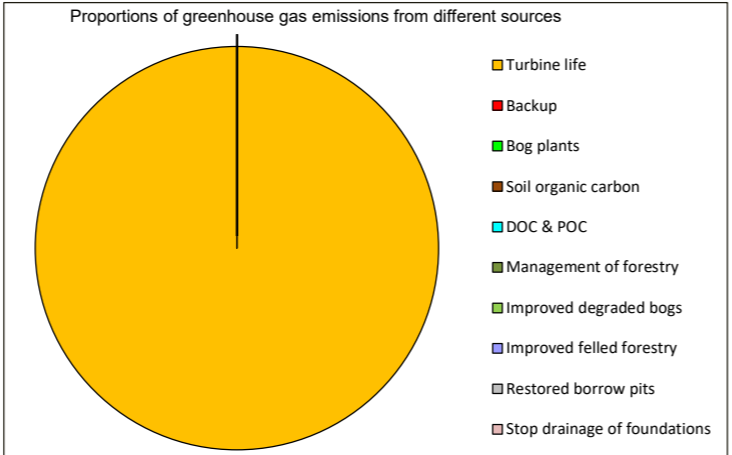
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**Results**  
**PAYBACK TIME AND CO<sub>2</sub> EMISSIONS**  
 Note: The carbon payback time of the windfarm is calculated by comparing the loss of C from the site due to windfarm development with the carbon-savings achieved by the windfarm while displacing electricity generated from coal-fired capacity or grid-mix.

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	Exp.	Min.	Max.
<b>1. Windfarm CO<sub>2</sub> emission saving over...</b>			
...coal-fired electricity generation (tCO <sub>2</sub> yr <sup>-1</sup> )	6599	6599	6599
...grid-mix of electricity generation (tCO <sub>2</sub> yr <sup>-1</sup> )	26609	26609	27957
...fossil fuel - mix of electricity generation (tCO <sub>2</sub> yr <sup>-1</sup> )	45554	45554	45554
Energy output from windfarm over lifetime (MWh)	2483460	2483460	2483460
<b>Total CO<sub>2</sub> losses due to wind farm (t CO<sub>2</sub> eq.)</b>			
2. Losses due to turbine life (eg. manufacture, construction, decommissioning)	22422	22422	22422
3. Losses due to backup	0	0	0
4. Losses due to reduced carbon fixing potential	0	0	0
5. Losses from soil organic matter	0	0	0
6. Losses due to DOC & POC leaching	0	0	0
7. Losses due to felling forestry	0	0	0
Total losses of carbon dioxide	22422	22422	22422
<b>8. Total CO<sub>2</sub> gains due to improvement of site (t CO<sub>2</sub> eq.)</b>			
8a. Change in emissions due to improvement of degraded bogs	0	0	0
8b. Change in emissions due to improvement of felled forestry	0	0	0
8c. Change in emissions due to restoration of peat from borrow pits	0	0	0
8d. Change in emissions due to removal of drainage from foundations & hardstanding	0	0	0
Total change in emissions due to improvements	0	0	0

<b>RESULTS</b>	Exp.	Min.	Max.
<b>Net emissions of carbon dioxide (t CO<sub>2</sub> eq.)</b>	22422	22422	22422
<b>Carbon Payback Time</b>			
...coal-fired electricity generation (years)	3.4	3.4	3.4
...grid-mix of electricity generation (years)	0.8	0.8	0.8
...fossil fuel - mix of electricity generation (years)	0.5	0.5	0.5
<b>Ratio of soil carbon loss to gain by restoration (TARGET ratio (Natural Resources Wales) &lt; 1.0)</b>	No gains!	No gains!	No gains!
<b>Ratio of CO<sub>2</sub> eq. emissions to power generation (g / kWh) (TARGET ratio by 2030 (electricity generation) &lt; 50 g / kWh)</b>	9	9	9



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**Results**  
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Data used in barchart of carbon payback time using fossil-fuel mix as counterfactual

Greenhouse gas emissions	Exp.	Min.	Max.
Turbine life	22422	0	0
Backup	0	0	0
Bog plants	0	0	0
Soil organic carbon	0	0	0
DOC & POC	0	0	0
Management of forestry	0	0	0
Improved degraded bogs	0	0	0
Improved felled forestry	0	0	0
Restored borrow pits	0	0	0
Stop drainage of foundations	0	0	0

Data used in barchart of carbon payback time using fossil-fuel mix as counterfactual

Greenhouse gas emissions	Exp.	Min.	Max.	Carbon payback time (months)	Exp.	Min.	Max.
Turbine life	22422	0	0	6	0	0	
Backup	0	0	0	0	0	0	
Bog plants	0	0	0	0	0	0	
Soil organic carbon	0	0	0	0	0	0	
DOC & POC	0	0	0	0	0	0	
Management of forestry	0	0	0	0	0	0	
Improved degraded bogs	0	0	0	0	0	0	
Improved felled forestry	0	0	0	0	0	0	
Restored borrow pits	0	0	0	0	0	0	
Stop drainage of foundations	0	0	0	0	0	0	
	22422			6			