



## APPENDIX 11-2

### CARBON CALCULATIONS



256398-06/11/2025-EIAR Volume 3B Appdx. 11-2 Carbon Calculations

REG. No. \_\_\_\_\_  
PLANNING (WEST) DEPT

06 NOV 2025

**CORK COUNTY COUNCIL**  
NORTON HOUSE, SKIBBEREEN, Co. CORK

**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	Record source of data	Enter maximum value here	
<b>Windfarm characteristics</b>						
Dimensions						
No. of turbines	3	Fixed	3		3	
Lifetime of windfarm (years)	35		35		35	
Performance						
Power rating of turbines (turbine capacity) (MW)	4.8		4.7		4.9	
Capacity factor						
Enter estimated capacity factor (percentage efficiency)	Direct input of capacity fac		Direct input of capacity fac		Direct input of capacity fac	
Backup	0.37		0.37		0.37	
Extra capacity required for backup (%)	5		5		5	
Additional emissions due to reduced thermal efficiency of the reserve generation (%)	10		10		10	
Carbon dioxide emissions from turbine life (eg. manufacture, construction, decommissioning)	Calculate self installed cap		Calculate self installed cap		Calculate self installed cap	
<b>Characteristics of peatland before windfarm development</b>						
Type of peatland	Blank		Blank		Blank	
Average annual air temperature at site (°C)	10		9.7		10.2	
Average depth of peat at site (m)	0.400		0.40		0.40	
C Content of dry peat (% by weight)	53.23		52		53.48	
Average extent of drainage around drainage features at site (m)	15.00		10.00		20.00	
Average water table depth at site (m)	0.50		0.10		1.00	
Dry soil bulk density (g cm <sup>-3</sup> )	0.13		0.11		0.16	
<b>Characteristics of bog plants</b>						
Time required for regeneration of bog plants after restoration (years)	10		5		10	
Carbon accumulation due to C fixation by bog plants in undrained peats (C ha <sup>-1</sup> yr <sup>-1</sup> )	0.25		0.2		0.3	
<b>Forestry Plantation Characteristics</b>						
Method used to calculate CO <sub>2</sub> loss from forest felling	Enter sample data		Enter sample data		Enter sample data	
Area of forestry plantation to be felled (ha)	8.3		8.75		8.85	
Average rate of carbon sequestration in timber (C ha <sup>-1</sup> yr <sup>-1</sup> )	3.80		3.50		3.70	
<b>Counterfactual emissions factors</b>						
To update counterfactual emissions factors from the web	Blank		Blank		Blank	
Coal-fired plant emission factor (t CO <sub>2</sub> MWh <sup>-1</sup> )	0.945		0.945		0.945	
Grid-mix emission factor (t CO <sub>2</sub> MWh <sup>-1</sup> )	0.207		0.207		0.207	
Oil-fuel-mix emission factor (t CO <sub>2</sub> MWh <sup>-1</sup> )	0.424		0.424		0.424	
<b>Borrow pits</b>						
Number of borrow pits	1		1		1	
Average length of pits (m)	92.75		92.5		93	
Average width of pits (m)	46.25		46		46.5	
Average depth of peat removed from pit (m)	0.40		0.40		0.40	
<b>Foundations and hard-standing areas associated with each turbine</b>						
Method used to calculate CO <sub>2</sub> loss from foundations and hard-standing	Rectangular with vertical w		Rectangular with vertical w		Rectangular with vertical w	
Average length of turbine foundations (m)	25		25		25	
Average width of turbine foundations (m)	25		25		25	
Average depth of peat removed from turbine foundations (m)	0.400		0.40		0.40	
Average length of hard-standing (m)	50		50		50	
Average width of hard-standing (m)	35		35		35	
Average depth of peat removed from hard-standing (m)	0.400		0.40		0.40	
<b>Access tracks</b>						
Total length of access track (m)	8100		6100		8100	
Existing track length (m)	4800		4800		4800	
Length of access track that is floating road (m)						
Floating road width (m)						
Floating road depth (m)						
Length of floating road that is drained (m)						
Average depth of drains associated with floating roads (m)						
Length of access track that is excavated road (m)	1500		1500		1500	
Excavated road width (m)	5		5		5	
Average depth of peat excavated for road (m)	0.40		0.40		0.40	
Length of access track that is rock filled road (m)						
Rock filled road width (m)						
Rock filled road depth (m)						
Length of rock filled road that is drained (m)						
Average depth of drains associated with rock filled roads (m)						
<b>Cable trenches</b>						
Length of any cable trench on peat that does not follow access tracks and is lined with a permeable medium (eg. sand) (m)						
Average depth of peat cut for cable trenches (m)						
Additional peat excavated (not already accounted for above)						
Volume of additional peat excavated (m <sup>3</sup> )	850		850		850	
Area of additional peat excavated (m <sup>2</sup> )	1100.0		1100.0		1100.0	
<b>Peat Landfill Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments</b>						
<b>Improvement of C sequestration at sites by blocking drains, restoration of habitat etc.</b>						
<b>Improvement of degraded bog</b>						
Area of degraded bog to be improved (ha)						
Water table depth in degraded bog before improvement (m)						
Water table depth in degraded bog after improvement (m)						
Time required for hydrology and habitat of bog to return to its previous state on improvement (years)						
Period of time when effectiveness of the improvement in degraded bog can be guaranteed (years)						
<b>Improvement of felled plantation land</b>						
Area of felled plantation to be improved (ha)						
Water table depth in felled area before improvement (m)						
Water table depth in felled area after improvement (m)						
Time required for hydrology and habitat of felled plantation to return to its previous state on improvement (years)						
Period of time when effectiveness of the improvement in felled plantation can be guaranteed (years)						
<b>Restoration of peat removed from borrow pits</b>						
Area of borrow pits to be restored (ha)						
Depth of water table in borrow pit before restoration with respect to the restored surface (m)						
Depth of water table in borrow pit after restoration with respect to the restored surface (m)						
Time required for hydrology and habitat of borrow pit to return to its previous state on restoration (years)						
Period of time when effectiveness of the restoration of peat removed from borrow pits can be guaranteed (years)						
<b>Early removal of drains from foundations and hard-standing</b>						
Water table depth around foundations and hard-standing before restoration (m)						
Water table depth around foundations and hard-standing after restoration (m)						
Time to completion of backfilling, removal of any surface drains, and full restoration of the hydrology (years)						
<b>Restoration of site after decommissioning</b>						
Will the hydrology of the site be restored on decommissioning?	No		No		No	
Will you attempt to block any gullies that have formed due to the windfarm?	No		No		No	
Will you attempt to block all artificial ditches and facilitate flooding?	No		No		No	
Will the habitat of the site be restored on decommissioning?	No		No		No	
Will you control grazing on degraded areas?	No		No		No	
Will you manage areas to favour reintroduction of species?	No		No		No	
<b>Choice of methodology for calculating emission factors</b>						
Methodology	Site specific (required for planning application)					

**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 plant been running continuously at its maximum output (DECC 2009). It is assumed that less than 20% of national electricity is generated by wind energy, a lower percentage should be entered.

**Note: Capacity Factor:** Capacity generated during the period (MWh) (installed capacity (MW) x number of hours in the period).

**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 (this is at 2000). We suggest this should be 5% of the actual output. It is assumed that less than 20% of national electricity is generated by wind energy, a lower percentage should be entered.

**Note: Data on carbon sequestration in timber:** The House of Lords Economic Affairs Committee report on the Economics of Renewable Energy (Parliamentary Session, 2006) notes that to cover peak demand a 20% margin of extra capacity has been sufficient to have the risk of a power out due to insufficient generation at a very low level. The estimate provided by BEIS for a range of 10% to 20% of installed capacity of wind energy. DEH 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 MW) as conventional capacity (eg. 36 GW of wind plant to match 6 GW of conventional plant).

**Note: Estimation from IPCC:** Total emissions for the windfarm are unknown, emissions should be calculated according to turbine capacity. The normal range of CO<sub>2</sub> emissions is 194 to 314 t CO<sub>2</sub> MWh (White & Baskin, 2000; White, 2007).

**Note: Type of peatland:** An 'open bog' is fed primarily by rainwater and often inhabited by sphagnum moss, thus making it acidic (Stewart & Brown, 1997). A 'fen' is a type of wetland fed by surface and/or groundwater (Holdren et al., 2011).

**Note: Time required for regeneration of borrow pits:** Loss of peat should be assumed to be over lifetime of windfarm only. This time could be longer if plants do not regenerate. The requirements for after-use planning include the provision of suitable habitat for peat-forming vegetation, the removal of structures, or an assessment of the impact of leaving them in situ. Methods used to calculate the area will affect the time for regeneration of the peatland. This time could also be shorter if plants regenerate during lifetime of windfarm. For example, number of years required for regeneration.

**Note: Carbon fixation by trees/woods:** Approximate accumulation rate in peatland is 0.12 to 0.31 C ha<sup>-1</sup> yr<sup>-1</sup> (Turner et al., 2001; Bush et al., 1995). The SHV guideline uses a value of 0.23 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 planned, before the windfarm development, the area to be felled should be entered as zero.

**Note: Carbon sequestration in timber:** This is dependent on the peat class of the forestry. The SHV (technical guideline assumed peat class of 18 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 sequestration by peat class 18 m<sup>3</sup> yr<sup>-1</sup> = 3.8 C ha<sup>-1</sup> yr<sup>-1</sup> (Carver, 1999).

**Note: Coal-Fired Plant and Oil-Mix Emission Factors:** Coal-fired plant emission factor (t CO<sub>2</sub> MWh<sup>-1</sup>) from electricity supplied in 2014 = 0.961 t CO<sub>2</sub> MWh<sup>-1</sup>; Oil-Mix Emission Factor (t CO<sub>2</sub> MWh<sup>-1</sup>) from electricity supplied in 2014 = 0.461 t CO<sub>2</sub> MWh<sup>-1</sup> (Source = DECC, 2015).

**Note: Peat Filled Roads:** The emission factor from electricity supplied in 2014 from that of peat class = 0.461 t CO<sub>2</sub> MWh<sup>-1</sup> (Source = DECC, 2015).

**Note: Total length of access track:** If areas of access track overlap with hard-standing area, exclude those from the total length of access track to avoid double counting of land area lost.

**Note: Floating road depth:** Accounts for sinking of floating road. Should be entered as the average depth of the road expected over the lifetime of the windfarm. If no sinking is expected, enter as zero.

**Note: Length of floating road that is drained:** Refers to any drains running along the length of the road.

**Note: Rock filled roads:** Rock filled roads are assumed to be made where no peat has been removed and rock has been placed on the surface and allowed to settle.

**Note: Depth of peat cut for cable trenches:** In shallow peats, the cable trenches may be cut below the peat. To avoid overestimating the depth of peat affected by the cable trenches, only enter the depth of the peat that is cut.

**Note: Peat Landfill Hazard:** It is assumed that measures have been taken to limit damage (Source: Stewart & Brown, 1997). Peat removal and the assessment of the Proposed Development, before removal, drainage as well as the C losses due to peat landfills can be assumed to be negligible. URL: <http://www.doh.gov.uk/peatlandfillhazard/>

**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 the improvement to 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 used in IPCC (1997) that there are rough estimates, and these rates and production periods can be used if countries do not have more precise estimates. Therefore, we have developed more site specific estimates. The use here based on work from the Scottish Government funded ECOSSE project (Brown & van Soest, 2009) (http://www.ecosse.gov.uk/). Separation and Estimation. Final Report. ECOSSE Project. 2009. 919 & 920 (Table 1.10).

**Core Input data**  
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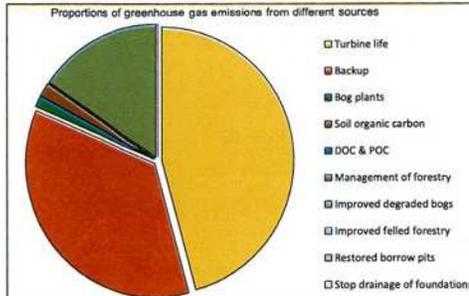
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**Results**  
**PAYBACK TIME AND CO<sub>2</sub> EMISSIONS**  
 Note: The carbon payback time of the windfarm is calculated by comparing the loss of C from the site due to windfarm development with the carbon-savings achieved by the windfarm while displacing 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> )	441	432	450
...grid-mix of electricity generation (tCO <sub>2</sub> yr <sup>-1</sup> )	97	95	99
...fossil fuel - mix of electricity generation (tCO <sub>2</sub> yr <sup>-1</sup> )	198	194	202
Energy output from windfarm over lifetime (MWh)	16336	15995	16676
<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)	12052	11772	12332
3. Losses due to backup	9360	9165	9555
4. Losses due to reduced carbon fixing potential	361	188	615
5. Losses from soil organic matter	436	-20	1451
6. Losses due to DOC & POC leaching	0	0	0
7. Losses due to felling forestry	4066	3931	4203
Total losses of carbon dioxide	28275	25035	28158
<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

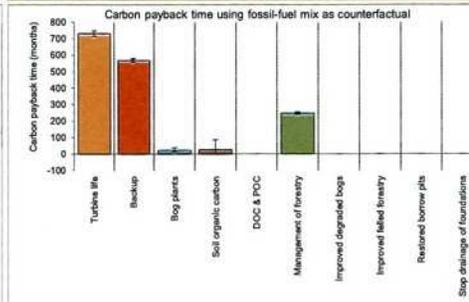
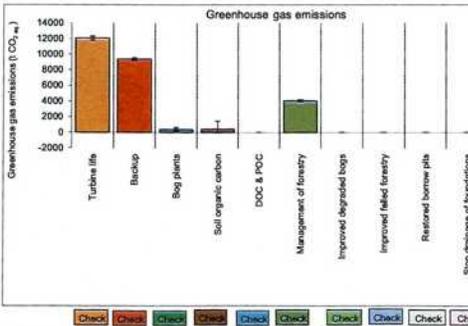
	Exp.	Min.	Max.
<b>RESULTS</b>			
<b>Net emissions of carbon dioxide (t CO<sub>2</sub> eq.)</b>			
	28275	25035	28158
<b>Carbon Payback Time</b>			
...coal-fired electricity generation (years)	59.6	55.9	65.2
...grid-mix of electricity generation (years)	272.0	253.6	297.6
...fossil fuel - mix of electricity generation (years)	132.8	123.9	146.3
<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>	1698	1501	1760



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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	12052	280	280
Backup	9360	195	195
Bog plants	361	173	255
Soil organic carbon	436	456	1015
DOC & POC	0	0	0
Management of forestry	4066	135	137
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.	Exp.	Min.	Max.
Turbine life	12052	280	280	731	17	17
Backup	9360	195	195	568	12	12
Bog plants	361	173	255	22	11	15
Soil organic carbon	436	456	1015	26	28	60
DOC & POC	0	0	0	0	0	0
Management of forestry	4066	135	137	247	8	8
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
	26275			1593		

**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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**Windfarm CO<sub>2</sub> emission saving**

Note: The total emission savings are given by estimating the total possible electrical output of the windfarm multiplied by the emission factor for the counterfactual case (coal-fire generation and electricity from grid)

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Values taken from input sheet	Total			Forestry Area 1			Forestry Area 2			Forestry Area 3			Forestry Area 4			Forestry Area 5		
	Exp	Min	Max	Exp	Min	Max	Exp	Min	Max	Exp	Min	Max	Exp	Min	Max	Exp	Min	Max
<b>Power Generation Characteristics</b>																		
No. of turbines	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Power rating of turbines (turbine capacity) (MW)	4.8	4.7	4.9	4.8	4.7	4.9	4.8	4.7	4.9	4.8	4.7	4.9	4.8	4.7	4.9	4.8	4.7	4.9
Power of windfarm (MW)	14.4	14.1	14.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Estimated downtime for maintenance etc (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>Counterfactual emission factors</b>																		
Coal-fired plant emission factor (t CO <sub>2</sub> MWh <sup>-1</sup> )	0.945	0.945	0.945	0.945	0.945	0.945	0.945	0.945	0.945	0.945	0.945	0.945	0.945	0.945	0.945	0.945	0.945	0.945
Grid-mix emission factor (t CO <sub>2</sub> MWh <sup>-1</sup> )	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207
Fossil fuel-mix emission factor (t CO <sub>2</sub> MWh <sup>-1</sup> )	0.424	0.424	0.424	0.424	0.424	0.424	0.424	0.424	0.424	0.424	0.424	0.424	0.424	0.424	0.424	0.424	0.424	0.424

Calculation of capacity factor		Direct input of capacity factor		
	Exp	Min	Max	
Entered capacity factor (%)	0.37	0.37	0.37	

Parameters	Slope (a)			Intercept (b)		
	Exp	Min	Max	Exp	Min	Max
<b>Partial power curves for different turbines</b>						
User-defined	0.0	0.0	0.0	0.0	0.0	0.0
Vestas 2.0 MW Optispeed C2	1392.5	1392.5	1392.5	-4291.9	-4291.9	-4291.9

Calculation of capacity factor from forestry management	Total			Forestry Area 1			Forestry Area 2			Forestry Area 3			Forestry Area 4			Forestry Area 5		
	Exp	Min	Max	Exp	Min	Max	Exp	Min	Max	Exp	Min	Max	Exp	Min	Max	Exp	Min	Max
Wind speed ratio calculated in 7d	0	0	0	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####
Average site windspeed (m s <sup>-1</sup> )	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual theoretical energy output from turbine (MW turbine <sup>-1</sup> yr <sup>-1</sup> )	42048	41172	42924	42048	41172	42924	42048	41172	42924	42048	41172	42924	42048	41172	42924	42048	41172	42924
Power curve				User-defined	User-defined	User-defined	Partial power curves for different turbines											
(Power curve code)				1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Slope (a)				0	0	0	Exp	Min	Max									
Intercept (b)				0	0	0	Exp	Min	Max									
Annual power output from an individual turbine (MW turbine <sup>-1</sup> yr <sup>-1</sup> )				#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####
Calculated capacity factor (%)				#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####

RESEARCH & ANALYSIS  
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Total				Forestry Area 1			Forestry Area 2			Forestry Area 3			Forestry Area 4			Forestry Area 5		
<b>Calculation of annual energy output from wind farm</b>																		
Direct input of capacity factor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capacity factor(%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>Annual energy output from windfarm (MW yr<sup>-1</sup>)</b>	<b>467</b>	<b>457</b>	<b>476</b>	<b>0</b>	<b>0</b>	<b>0</b>												

Total				Area 1			Area 2			Area 3			Area 4			Area 5		
<b>RESULTS</b>																		
<b>Windfarm CO<sub>2</sub> emission saving over...</b>																		
...coal-fired electricity generation (tCO <sub>2</sub> yr <sup>-1</sup> )	441	431.874	450.251	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
...grid-mix of electricity generation (tCO <sub>2</sub> yr <sup>-1</sup> )	97	94.6009	98.6265	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
...fossil fuel - mix of electricity generation (tCO <sub>2</sub> yr <sup>-1</sup> )	198	193.772	202.018	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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**Windfarm CO<sub>2</sub> emission saving**  
 Note: The total emission savings are given by estimating the total possible electrical output of the windfarm multiplied by the emission factor for the counterfactual case (coal-fire generation and electricity from grid)

REG. No. \_\_\_\_\_  
 PLANNING (WEST) DEPT  
 06 NOV 2025  
 CORK COUNTY COUNCIL  
 NORTON HOUSE, SKIBBEREEN, Co. CORK

**Emissions due to turbine life**  
 Note: The carbon payback time of the windfarm due to turbine life (eg. manufacture, construction, decommissioning) is calculated by comparing the emissions due to turbine life with carbon savings achieved by the windfarm while dispatching electricity generated from coal-fired capacity or grid-mix.

**Method used to estimate CO<sub>2</sub> emissions from turbine life (eg. manufacture, construction, decommissioning)**  
 Calculate wt installed capacity

<b>Direct input of emissions due to turbine life (t CO<sub>2</sub> windfarm<sup>1</sup>)</b>	Exp	Min	Max
0	0	0	0
<b>Calculation of emissions due to turbine life from energy output (CO<sub>2</sub> emissions due to turbine life (tCO<sub>2</sub> turbine<sup>1</sup>))</b>	Exp	Min	Max
4017	3924	4111	
<b>No. of turbines</b>	3	3	3
<b>Total calculated CO<sub>2</sub> emission of the windfarm due to turbine life (t CO<sub>2</sub> windfarm<sup>1</sup>)</b>	12052	11772	12332

<b>Calculation of emissions due to cement used in construction</b>	Exp	Min	Max									
0	0	0	0	0	0	0	0	0	0	0	0	0
<b>CO<sub>2</sub> emission rate (t CO<sub>2</sub> m<sup>3</sup> cement)</b>	0.316	0.316	0.316	0.316	0.316	0.316	0.316	0.316	0.316	0.316	0.316	0.316
<b>Total CO<sub>2</sub> emissions due to cement used</b>	0	0	0	0	0	0	0	0	0	0	0	0

<b>RESULTS</b>	12052	11772	12332
<b>Additional CO<sub>2</sub> payback time due to turbine life (eg. manufacture, construction, decommissioning)</b>	328	327	329
<b>...grid-mix of electricity generation (months)</b>	1497	1403	1500
<b>...total fuel - mix of electricity generation (months)</b>	731	728	733

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**Emissions due to turbine life**  
 Note: The carbon payback time of the windfarm due to turbine life (eg. manufacture, construction, decommissioning) is calculated by comparing the emissions due to turbine life with carbon savings achieved by the windfarm while dispatching electricity generated from coal-fired capacity or grid-mix.

[http://www.concretecentre.com/PDF/SCF\\_Table%20%20Embedded%20CO2\\_Apn%202013.pdf](http://www.concretecentre.com/PDF/SCF_Table%20%20Embedded%20CO2_Apn%202013.pdf)



**Embedded carbon dioxide (CO<sub>2</sub>) of concrete used in buildings**

<b>CO<sub>2</sub> (kgCO<sub>2</sub>/m<sup>3</sup>)</b>	<b>CEM I</b>	<b>CEM II</b>	<b>CEM III</b>	<b>CEM IV</b>	<b>CEM V</b>	<b>CEM VI</b>	<b>CEM VII</b>	<b>CEM VIII</b>	<b>CEM IX</b>	<b>CEM X</b>	<b>CEM XI</b>	<b>CEM XII</b>	<b>CEM XIII</b>	<b>CEM XIV</b>	<b>CEM XV</b>	<b>CEM XVI</b>	<b>CEM XVII</b>	<b>CEM XVIII</b>	<b>CEM XIX</b>	<b>CEM XX</b>
277	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125
<b>CO<sub>2</sub> (kgCO<sub>2</sub>/m<sup>3</sup>)</b>	<b>CEM I</b>	<b>CEM II</b>	<b>CEM III</b>	<b>CEM IV</b>	<b>CEM V</b>	<b>CEM VI</b>	<b>CEM VII</b>	<b>CEM VIII</b>	<b>CEM IX</b>	<b>CEM X</b>	<b>CEM XI</b>	<b>CEM XII</b>	<b>CEM XIII</b>	<b>CEM XIV</b>	<b>CEM XV</b>	<b>CEM XVI</b>	<b>CEM XVII</b>	<b>CEM XVIII</b>	<b>CEM XIX</b>	<b>CEM XX</b>
111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111
<b>CO<sub>2</sub> (kgCO<sub>2</sub>/m<sup>3</sup>)</b>	<b>CEM I</b>	<b>CEM II</b>	<b>CEM III</b>	<b>CEM IV</b>	<b>CEM V</b>	<b>CEM VI</b>	<b>CEM VII</b>	<b>CEM VIII</b>	<b>CEM IX</b>	<b>CEM X</b>	<b>CEM XI</b>	<b>CEM XII</b>	<b>CEM XIII</b>	<b>CEM XIV</b>	<b>CEM XV</b>	<b>CEM XVI</b>	<b>CEM XVII</b>	<b>CEM XVIII</b>	<b>CEM XIX</b>	<b>CEM XX</b>
111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111
<b>CO<sub>2</sub> (kgCO<sub>2</sub>/m<sup>3</sup>)</b>	<b>CEM I</b>	<b>CEM II</b>	<b>CEM III</b>	<b>CEM IV</b>	<b>CEM V</b>	<b>CEM VI</b>	<b>CEM VII</b>	<b>CEM VIII</b>	<b>CEM IX</b>	<b>CEM X</b>	<b>CEM XI</b>	<b>CEM XII</b>	<b>CEM XIII</b>	<b>CEM XIV</b>	<b>CEM XV</b>	<b>CEM XVI</b>	<b>CEM XVII</b>	<b>CEM XVIII</b>	<b>CEM XIX</b>	<b>CEM XX</b>
111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111
<b>CO<sub>2</sub> (kgCO<sub>2</sub>/m<sup>3</sup>)</b>	<b>CEM I</b>	<b>CEM II</b>	<b>CEM III</b>	<b>CEM IV</b>	<b>CEM V</b>	<b>CEM VI</b>	<b>CEM VII</b>	<b>CEM VIII</b>	<b>CEM IX</b>	<b>CEM X</b>	<b>CEM XI</b>	<b>CEM XII</b>	<b>CEM XIII</b>	<b>CEM XIV</b>	<b>CEM XV</b>	<b>CEM XVI</b>	<b>CEM XVII</b>	<b>CEM XVIII</b>	<b>CEM XIX</b>	<b>CEM XX</b>
111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111
<b>CO<sub>2</sub> (kgCO<sub>2</sub>/m<sup>3</sup>)</b>	<b>CEM I</b>	<b>CEM II</b>	<b>CEM III</b>	<b>CEM IV</b>	<b>CEM V</b>	<b>CEM VI</b>	<b>CEM VII</b>	<b>CEM VIII</b>	<b>CEM IX</b>	<b>CEM X</b>	<b>CEM XI</b>	<b>CEM XII</b>	<b>CEM XIII</b>	<b>CEM XIV</b>	<b>CEM XV</b>	<b>CEM XVI</b>	<b>CEM XVII</b>	<b>CEM XVIII</b>	<b>CEM XIX</b>	<b>CEM XX</b>
111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111
<b>CO<sub>2</sub> (kgCO<sub>2</sub>/m<sup>3</sup>)</b>	<b>CEM I</b>	<b>CEM II</b>	<b>CEM III</b>	<b>CEM IV</b>	<b>CEM V</b>	<b>CEM VI</b>	<b>CEM VII</b>	<b>CEM VIII</b>	<b>CEM IX</b>	<b>CEM X</b>	<b>CEM XI</b>	<b>CEM XII</b>	<b>CEM XIII</b>	<b>CEM XIV</b>	<b>CEM XV</b>	<b>CEM XVI</b>	<b>CEM XVII</b>	<b>CEM XVIII</b>	<b>CEM XIX</b>	<b>CEM XX</b>
111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111
<b>CO<sub>2</sub> (kgCO<sub>2</sub>/m<sup>3</sup>)</b>	<b>CEM I</b>	<b>CEM II</b>	<b>CEM III</b>	<b>CEM IV</b>	<b>CEM V</b>	<b>CEM VI</b>	<b>CEM VII</b>	<b>CEM VIII</b>	<b>CEM IX</b>	<b>CEM X</b>	<b>CEM XI</b>	<b>CEM XII</b>	<b>CEM XIII</b>	<b>CEM XIV</b>	<b>CEM XV</b>	<b>CEM XVI</b>	<b>CEM XVII</b>	<b>CEM XVIII</b>	<b>CEM XIX</b>	<b>CEM XX</b>
111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111
<b>CO<sub>2</sub> (kgCO<sub>2</sub>/m<sup>3</sup>)</b>	<b>CEM I</b>	<b>CEM II</b>	<b>CEM III</b>	<b>CEM IV</b>	<b>CEM V</b>	<b>CEM VI</b>	<b>CEM VII</b>	<b>CEM VIII</b>	<b>CEM IX</b>	<b>CEM X</b>	<b>CEM XI</b>	<b>CEM XII</b>	<b>CEM XIII</b>	<b>CEM XIV</b>	<b>CEM XV</b>	<b>CEM XVI</b>	<b>CEM XVII</b>	<b>CEM XVIII</b>	<b>CEM XIX</b>	<b>CEM XX</b>
111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111
<b>CO<sub>2</sub> (kgCO<sub>2</sub>/m<sup>3</sup>)</b>	<b>CEM I</b>	<b>CEM II</b>	<b>CEM III</b>	<b>CEM IV</b>	<b>CEM V</b>	<b>CEM VI</b>	<b>CEM VII</b>	<b>CEM VIII</b>	<b>CEM IX</b>	<b>CEM X</b>	<b>CEM XI</b>	<b>CEM XII</b>	<b>CEM XIII</b>	<b>CEM XIV</b>	<b>CEM XV</b>	<b>CEM XVI</b>	<b>CEM XVII</b>	<b>CEM XVIII</b>	<b>CEM XIX</b>	<b>CEM XX</b>
111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111
<b>CO<sub>2</sub> (kgCO<sub>2</sub>/m<sup>3</sup>)</b>	<b>CEM I</b>	<b>CEM II</b>	<b>CEM III</b>	<b>CEM IV</b>	<b>CEM V</b>	<b>CEM VI</b>	<b>CEM VII</b>	<b>CEM VIII</b>	<b>CEM IX</b>	<b>CEM X</b>	<b>CEM XI</b>	<b>CEM XII</b>	<b>CEM XIII</b>	<b>CEM XIV</b>	<b>CEM XV</b>	<b>CEM XVI</b>	<b>CEM XVII</b>	<b>CEM XVIII</b>	<b>CEM XIX</b>	<b>CEM XX</b>
111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111
<b>CO<sub>2</sub> (kgCO<sub>2</sub>/m<sup>3</sup>)</b>	<b>CEM I</b>	<b>CEM II</b>	<b>CEM III</b>	<b>CEM IV</b>	<b>CEM V</b>	<b>CEM VI</b>	<b>CEM VII</b>	<b>CEM VIII</b>	<b>CEM IX</b>	<b>CEM X</b>	<b>CEM XI</b>	<b>CEM XII</b>	<b>CEM XIII</b>	<b>CEM XIV</b>	<b>CEM XV</b>	<b>CEM XVI</b>	<b>CEM XVII</b>	<b>CEM XVIII</b>	<b>CEM XIX</b>	<b>CEM XX</b>
111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111
<b>CO<sub>2</sub> (kgCO<sub>2</sub>/m<sup>3</sup>)</b>	<b>CEM I</b>	<b>CEM II</b>	<b>CEM III</b>	<b>CEM IV</b>	<b>CEM V</b>	<b>CEM VI</b>	<b>CEM VII</b>	<b>CEM VIII</b>	<b>CEM IX</b>	<b>CEM X</b>	<b>CEM XI</b>	<b>CEM XII</b>	<b>CEM XIII</b>	<b>CEM XIV</b>	<b>CEM XV</b>	<b>CEM XVI</b>	<b>CEM XVII</b>	<b>CEM XVIII</b>	<b>CEM XIX</b>	<b>CEM XX</b>
111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111
<b>CO<sub>2</sub> (kgCO<sub>2</sub>/m<sup>3</sup>)</b>	<b>CEM I</b>	<b>CEM II</b>	<b>CEM III</b>	<b>CEM IV</b>	<b>CEM V</b>	<b>CEM VI</b>	<b>CEM VII</b>	<b>CEM VIII</b>	<b>CEM IX</b>	<b>CEM X</b>	<b>CEM XI</b>	<b>CEM XII</b>	<b>CEM XIII</b>	<b>CEM XIV</b>	<b>CEM XV</b>	<b>CEM XVI</b>	<b>CEM XVII</b>	<b>CEM XVIII</b>	<b>CEM XIX</b>	<b>CEM XX</b>
111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111
<b>CO<sub>2</sub> (kgCO<sub>2</sub>/m<sup>3</sup>)</b>	<b>CEM I</b>	<b>CEM II</b>	<b>CEM III</b>	<b>CEM IV</b>	<b>CEM V</b>	<b>CEM VI</b>	<b>CEM VII</b>	<b>CEM VIII</b>	<b>CEM IX</b>	<b>CEM X</b>	<b>CEM XI</b>	<b>CEM XII</b>	<b>CEM XIII</b>	<b>CEM XIV</b>	<b>CEM XV</b>	<b>CEM XVI</b>	<b>CEM XVII</b>	<b>CEM XVIII</b>	<b>CEM XIX</b>	<b>CEM XX</b>
111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111
<b>CO<sub>2</sub> (kgCO<sub>2</sub>/m<sup>3</sup>)</b>	<b>CEM I</b>	<b>CEM II</b>	<b>CEM III</b>	<b>CEM IV</b>	<b>CEM V</b>	<b>CEM VI</b>	<b>CEM VII</b>	<b>CEM VIII</b>	<b>CEM IX</b>	<b>CEM X</b>	<b>CEM XI</b>	<b>CEM XII</b>	<b>CEM XIII</b>	<b>CEM XIV</b>	<b>CEM XV</b>	<b>CEM XVI</b>	<b>CEM XVII</b>	<b>CEM XVIII</b>	<b>CEM XIX</b>	<b>CEM XX</b>
111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111
<b>CO<sub>2</sub> (kgCO<sub>2</sub>/m<sup>3</sup>)</b>	<b>CEM I</b>	<b>CEM II</b>	<b>CEM III</b>	<b>CEM IV</b>	<b>CEM V</b>	<b>CEM VI</b>	<b>CEM VII</b>	<b>CEM VIII</b>	<b>CEM IX</b>	<b>CEM X</b>	<b>CEM XI</b>	<b>CEM XII</b>	<b>CEM XIII</b>	<b>CEM XIV</b>	<b>CEM XV</b>	<b>CEM XVI</b>	<b>CEM XVII</b>	<b>CEM XVIII</b>	<b>CEM XIX</b>	<b>CEM XX</b>
111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111
<b>CO<sub>2</sub> (kgCO<sub>2</sub>/m<sup>3</sup>)</b>	<b>CEM I</b>	<b>CEM II</b>	<b>CEM III</b>	<b>CEM IV</b>	<b>CEM V</b>	<b>CEM VI</b>	<b>CEM VII</b>	<b>CEM VIII</b>	<b>CEM IX</b>	<b>CEM X</b>	<b>CEM XI</b>	<b>CEM XII</b>	<b>CEM XIII</b>	<b>CEM XIV</b>	<b>CEM XV</b>	<b>CEM XVI</b>	<b>CEM XVII</b>	<b>CEM XVIII</b>	<b>CEM XIX</b>	<b>CEM XX</b>
111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111
<b>CO<sub>2</sub> (kgCO<sub>2</sub>/m<sup>3</sup>)</b>	<b>CEM I</b>	<b>CEM II</b>	<b>CEM III</b>	<b>CEM IV</b>	<b>CEM V</b>	<b>CEM VI</b>	<b>CEM VII</b>	<b>CEM VIII</b>	<b>CEM IX</b>	<b>CEM X</b>	<b>CEM XI</b>	<b>CEM XII</b>	<b>CEM XIII</b>	<b>CEM XIV</b>	<b>CEM XV</b>	<b>CEM XVI</b>	<b>CEM XVII</b>	<b>CEM XVIII</b>	<b>CEM XIX</b>	<b>CEM XX</b>
111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111
<b>CO<sub>2</sub> (kgCO<sub>2</sub>/m<sup>3</sup>)</b>	<b>CEM I</b>	<b>CEM II</b>	<b>CEM III</b>	<b>CEM IV</b>	<b>CEM V</b>	<b>CEM VI</b>	<b>CEM VII</b>	<b>CEM VIII</b>	<b>CEM IX</b>	<b>CEM X</b>	<b>CEM XI</b>	<b>CEM XII</b>	<b>CEM XIII</b>	<b>CEM XIV</b>	<b>CEM XV</b>	<b>CEM XVI</b>	<b>CEM XVII</b>	<b>CEM XVIII</b>	<b>CEM XIX</b>	<b>CEM XX</b>
111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111
<b>CO<sub>2</sub> (kgCO<sub>2</sub>/m<sup>3</sup>)</b>	<b>CEM I</b>	<b>CEM II</b>	<b>CEM III</b>	<b>CEM IV</b>	<b>CEM V</b>	<b>CEM VI</b>	<b>CEM VII</b>	<b>CEM VIII</b>	<b>CEM IX</b>	<b>CEM X</b>	<b>CEM XI</b>	<b>CEM XII</b>	<b>CEM XIII</b>	<b>CEM XIV</b>	<b>CEM XV</b>	<b>CEM XVI</b>	<b>CEM XVII</b>	<b>CEM XVIII</b>	<b>CEM XIX</b>	<b>CEM XX</b>
111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111
<b>CO<sub>2</sub> (kgCO<sub>2</sub>/m<sup>3</sup>)</b>	<b>CEM I</b>	<b>CEM II</b>	<b>CEM III</b>	<b>CEM IV</b>	<b>CEM V</b>	<b>CEM VI</b>	<b>CEM VII</b>	<b>CEM VIII</b>	<											

**Emissions due to backup power generation**

Note: CO<sub>2</sub> loss due to back up is calculated from the extra capacity required for backup of the windfarm given in the input data.

	Expected	Minimum	Maximum
<b>Reserve capacity required for backup</b>			
No. of turbines	3	3	3
Power rating of turbines (turbine capacity) (MW)	4.8	4.7	4.9
Power of wind farm (MW h <sup>-1</sup> )	14.4	14.1	14.7
Rated capacity (MW yr <sup>-1</sup> )	126144	123516	128772
Extra capacity required for backup (%)	5	5	5
Additional emissions due to reduced thermal efficiency of the reserve generation (%)	10	10	10
Reserve capacity (MWh yr <sup>-1</sup> )	631	618	644

<b>Carbon dioxide emissions due to backup power generation</b>			
Coal-fired plant emission factor (t CO <sub>2</sub> MWh <sup>-1</sup> )	0.945	0.945	0.945
Grid-mix emission factor (t CO <sub>2</sub> MWh <sup>-1</sup> )	0.207	0.207	0.207
Fossil fuel- mix emission factor (t CO <sub>2</sub> MWh <sup>-1</sup> )	0.424	0.424	0.424
Lifetime of windfarm (years)	35	35	35
Annual emissions due to backup from...			
...coal-fired electricity generation (tCO <sub>2</sub> yr <sup>-1</sup> )	596	584	608
...grid-mix of electricity generation (tCO <sub>2</sub> yr <sup>-1</sup> )	131	128	133
...fossil fuel - mix of electricity generation (tCO <sub>2</sub> yr <sup>-1</sup> )	267	262	273

<b>RESULTS</b>			
<b>Total emissions due to backup from...</b>			
...coal-fired electricity generation (tCO <sub>2</sub> )	20861	20426	21296
...grid-mix of electricity generation (tCO <sub>2</sub> )	4570	4474	4665
...fossil fuel - mix of electricity generation (tCO <sub>2</sub> )	9360	9165	9555
<b>Additional CO<sub>2</sub> payback time of windfarm due to backup</b>			
...coal-fired electricity generation (months)	568	568	568
...grid-mix of electricity generation (months)	568	568	568
...fossil fuel - mix of electricity generation (months)	568	568	568

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**Emissions due to backup power generation**

Note: CO<sub>2</sub> loss due to back up is calculated from the extra capacity required for backup of the windfarm given in the input data.

Note: Wind generated electricity is inherently variable, providing unique challenges to the electricity generating industry for provision of a supply to meet consumer demand (Netz, 2004). Backup power is required to accompany wind generation to stabilise the supply to the consumer. This backup power will usually be obtained from a fossil fuel source. At a high level of wind power penetration in the overall generating mix, and with current grid management techniques, the capacity for fossil fuel backup may become strained because it is being used to balance the fluctuating consumer demand with a variable and highly unpredictable output from wind turbines (White, 2007). The Carbon Trust (Carbon Trust/DTI, 2004) concluded that increasing levels of intermittent generation do not present major technical issues at the percentages of renewables expected by 2010 and 2020, but the UK renewables target at the time of that report was only 20%. When national reliance on wind power is low (less than ~20%), the additional fossil fuel generated power requirement can be considered to be insignificant and may be obtained from within the spare generating capacity of other power sectors (Dale et al, 2004). However, as the national supply from wind power increases above 20%, without improvements in grid management techniques, emissions due to backup power generation may become more significant. The extra capacity needed for backup power generation is currently estimated to be 5% of the rated capacity of the wind plant if wind power contributes more than 20% to the national grid (Dale et al 2004). Moving towards the SG target of 50% electricity generation from renewable sources, more short-term capacity may be required in terms of pumped-storage hydro-generated power, or a better mix of offshore and onshore wind generating capacity. Grid management techniques are anticipated to reduce this extra capacity, with improved demand side management, smart meters, grid reinforcement and other developments. However, given current grid management techniques, it is suggested that 5% extra capacity should be assumed for backup power generation if wind power contributes more than 20% to the national grid. At lower contributions, the extra capacity required for backup should be assumed to be zero. These assumptions should be revisited as technology improves.

Assumption: Backup assumed to be by fossil-fuel-mix of electricity generation. Note that hydroelectricity may also be used for backup, so this assumption may make the value for backup generation too high. These assumptions should be revisited as technology develops.

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**Emissions due to loss of bog plants**

Note: Annual C fixation by the site is calculated by multiplying area of the windfarm by the annual C accumulation due to bog plant fixation

	Expected	Minimum	Maximum
<b>Area where carbon accumulation by bog plants is lost</b>			
Total area of land lost due to windfarm construction (m <sup>2</sup> )	20015	19980	20050
Total area affected by drainage due to windfarm construction (m <sup>2</sup> )	67390	43960	91788
Total area where fixation by plants is lost (m <sup>2</sup> )	87405	63940	111838
<b>Total loss of carbon accumulation</b>			
Carbon accumulation in undrained peats (tC ha <sup>-1</sup> yr <sup>-1</sup> )	0.25	0.2	0.3
Lifetime of windfarm (years)	35	35	35
Time required for regeneration of bog plants after restoration (years)	10	5	15
Carbon accumulation up to time of restoration (tCO <sub>2</sub> eq. ha <sup>-1</sup> )	41	29	55

**Assumptions:**

1. Bog plants are 100% lost from the area where peat is removed for construction.
2. Bog plants are 100% lost from the area where peat is drained.
3. The recovery of carbon accumulation by plants on restoration of land is as given in inputs.

<b>RESULTS</b>			
<b>Total loss of carbon accumulation by bog plants</b>			
Total area where fixation by plants is lost (ha)	9	6	11
Carbon accumulation over lifetime of windfarm (tCO <sub>2</sub> eq. ha <sup>-1</sup> )	41	29	55
<b>Total loss of carbon fixation by plants at the site (t CO<sub>2</sub>)</b>	<b>361</b>	<b>188</b>	<b>615</b>
<b>Additional CO<sub>2</sub> payback time of windfarm due to loss of CO<sub>2</sub> fixing potential</b>			
...coal-fired electricity generation (months)	10	5	16
...grid-mix of electricity generation (months)	45	24	75
...fossil fuel - mix of electricity generation (months)	22	12	37

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**Emissions due to loss of bog plants**

Note: Annual C fixation by the site is calculated by multiplying area of the windfarm by the annual C accumulation due to bog plant fixation

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**Emissions due to loss of soil organic carbon**

Note: Loss of C stored in peatland is estimated from % site lost by peat removal (sheet 5a), CO<sub>2</sub> loss from removed peat (sheet 5b), % site affected by drainage (sheet 5c), and the CO<sub>2</sub> loss from drained peat (sheet 5d).

	Expected result	Minimum result	Maximum result
<b>CO<sub>2</sub> loss due to windfarm construction</b>			
<input type="checkbox"/> Check CO <sub>2</sub> loss from removed peat (t CO <sub>2</sub> equiv)	436	-20	1451
<input type="checkbox"/> Check CO <sub>2</sub> loss from drained peat (t CO <sub>2</sub> equiv)	0	0	0
<b>RESULTS</b>			
<b>Total CO<sub>2</sub> loss from peat (removed + drained) (t CO<sub>2</sub> equiv)</b>	<b>436</b>	<b>-20</b>	<b>1451</b>
<b>Additional CO<sub>2</sub> payback time of windfarm due to loss of soil CO<sub>2</sub></b>			
...coal-fired electricity generation (months)	12	-1	39
...grid-mix of electricity generation (months)	54	-2	177
...fossil fuel - mix of electricity generation (months)	26	-1	86

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**Emissions due to loss of soil organic carbon**

Note: Loss of C stored in peatland is estimated from % site lost by peat removal (sheet 5a), CO<sub>2</sub> loss from removed peat (sheet 5b), % site affected by drainage (sheet 5c), and the CO<sub>2</sub> loss from drained peat (sheet 5d).

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**Volume of Peat Removed**

Note: % site lost by peat removal is estimated from peat removed in borrow pits, turbine foundations, hard-standing and access tracks.  
If peat is removed for any other reason, this must be added in as additional peat excavated in the core input sheet.

Peat removed from borrow pits	Total		
	Exp	Min	Max
Number of borrow pits	1	1	1
Average length of pits (m)	92.75	92.5	93
Average width of pits (m)	46.25	46	46.5
Average depth of peat removed from pit (m)	0.4	0.4	0.4
Area of land lost in borrow pits (m <sup>2</sup> )	4289.69	4255	4324.5
Volume of peat removed from borrow pits (m <sup>3</sup> )	1715.88	1702	1729.8

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Peat removed from turbine foundations	Total			Construction Area 1			Construction Area 2			Construction Area 3			Construction Area 4			Construction Area 5		
	Exp	Min	Max	Exp	Min	Max	Exp	Min	Max	Exp	Min	Max	Exp	Min	Max	Exp	Min	Max
Method used to calculate CO <sub>2</sub> loss from foundations	Rectangular with vertical walls																	
Calculation method code	1																	
No. of turbines	3	3	3	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Diameter at surface (m)				25	25	25	0	0	0	0	0	0	0	0	0	0	0	0
Diameter at bottom (m)				25	25	25	0	0	0	0	0	0	0	0	0	0	0	0
Depth of foundations (m)				25	25	25	0	0	0	0	0	0	0	0	0	0	0	0
"Area" of land lost in hard-standing (m <sup>2</sup> )	1875	1875	1875	1875	1875	1875	0	0	0	0	0	0	0	0	0	0	0	0
Volume of peat removed from foundation area (m <sup>3</sup> )	750	750	750	750	750	750	0	0	0	0	0	0	0	0	0	0	0	0

Peat removed from hard-standing	Total			Construction Area 1			Construction Area 2			Construction Area 3			Construction Area 4			Construction Area 5		
	Exp	Min	Max	Exp	Min	Max	Exp	Min	Max	Exp	Min	Max	Exp	Min	Max	Exp	Min	Max
Method used to calculate CO <sub>2</sub> loss from foundations	Rectangular with vertical walls																	
Calculation method code	1																	
No. of turbines	3	3	3	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Diameter at surface (m)				50	50	50	0	0	0	0	0	0	0	0	0	0	0	0
Diameter at bottom (m)				35	35	35	0	0	0	0	0	0	0	0	0	0	0	0
Depth of hardstanding (m)				50	50	50	0	0	0	0	0	0	0	0	0	0	0	0
				35	35	35	0	0	0	0	0	0	0	0	0	0	0	0
Depth of hardstanding (m)				0	0.4	0.4	0	0	0	0	0	0	0	0	0	0	0	0
Area of land lost in hard-standing (m <sup>2</sup> )	5250	5250	5250	5250	5250	5250	0	0	0	0	0	0	0	0	0	0	0	0
Volume of peat removed from hardstanding area (m <sup>3</sup> )	2100	2100	2100	2100	2100	2100	0	0	0	0	0	0	0	0	0	0	0	0

Peat removed from access tracks	Total		
	Exp	Min	Max
<u>Floating roads</u>			
Length of access track that is floating road (m)	0	0	0
Floating road width (m)	0	0	0

Floating road depth (m)	0	0	0
Area of land lost in floating roads (m <sup>2</sup> )	0	0	0
Volume of peat removed for floating roads	0	0	0
<b>Excavated roads</b>			
Length of access track that is excavated road (m)	1500	1500	1500
Excavated road width (m)	5	5	5
Average depth of peat excavated for road (m)	0.4	0.4	0.4
Area of land lost in excavated roads (m <sup>2</sup> )	7500	7500	7500
Volume of peat removed for excavated roads	3000	3000	3000
<b>Rock-filled roads</b>			
Length of access track that is rock filled road (m)	0	0	0
Rock filled road width (m)	0	0	0
Rock filled road depth (m)	0	0	0
Area of land lost in excavated roads (m <sup>2</sup> )	0	0	0
Volume of peat removed for rock-filled roads	0	0	0
Total area of land lost in access tracks (m <sup>2</sup> )	7500	7500	7500
Total volume of peat removed due to access tracks (m <sup>3</sup> )	3000	3000	3000

<b>Additional peat excavated -</b> (not already accounted for above)			
Volume of additional peat excavated (m <sup>3</sup> )	650	650	650
Area of additional peat excavated (m <sup>2</sup> )	1100	1100	1100

RESULTS	Exp	Total	
		Min	Max
<b>Total volume of peat removed (m<sup>3</sup>) due to windfarm construction</b>	<b>8215.88</b>	<b>8202</b>	<b>8229.8</b>
<b>Total area of land lost due to windfarm construction (m<sup>2</sup>)</b>	<b>20015</b>	<b>19980</b>	<b>20049.5</b>

Click here to move to 5b. CO2 loss from removed peat

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#### Volume of Peat Removed

Note: % site lost by peat removal is estimated from peat removed in borrow pits, turbine foundations, hard-standing and access tracks.  
If peat is removed for any other reason, this must be added in to the volume of peat removed, area of land lost and % site lost at the bottom of this worksheet.

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**CO<sub>2</sub> loss from removed peats**

Note: If peat is treated in such a way that it is permanently restored, so that less than 100% of the C is lost to the atmosphere, a lower percentage can be entered in cell C10

	Expected	Minimum	Maximum
<b>CO<sub>2</sub> loss from removed peat</b>			
C Content of dry peat (% by weight)	53.23	52	53.46
Dry soil bulk density (g cm <sup>-3</sup> )	0.13	0.11	0.15
% C contained in removed peat that is lost as CO <sub>2</sub>	100	100	100
Total volume of peat removed (m <sup>3</sup> ) due to windfarm construction	8216	8202	8230
CO <sub>2</sub> loss from removed peat (t CO <sub>2</sub> )	2117	1752	2452

Check

Assumption: If peat is not restored, 100% of the carbon contained in the removed peat is lost as CO<sub>2</sub>

<b>CO<sub>2</sub> loss from undrained peat left in situ</b>			
Total area of land lost due to windfarm construction (ha)	2	2	2
CO <sub>2</sub> loss from undrained peat left in situ (t CO <sub>2</sub> ha <sup>-1</sup> )	840	887	499
CO <sub>2</sub> loss from undrained peat left in situ (t CO <sub>2</sub> )	1681	1771	1001

<b>CO<sub>2</sub> loss attributable to peat removal only</b>			
CO <sub>2</sub> loss from removed peat (t CO <sub>2</sub> )	2117	1752	2452
CO <sub>2</sub> loss from undrained peat left in situ (t CO <sub>2</sub> )	1681	1771	1001
<b>RESULTS</b>			
<b>CO<sub>2</sub> loss attributable to peat removal only (t CO<sub>2</sub>)</b>	<b>436</b>	<b>-20</b>	<b>1451</b>

Click here to move to 5. Loss of soil CO<sub>2</sub>

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**CO<sub>2</sub> loss from removed peats**

Note: If peat is treated in such a way that it is permanently restored, so that less than 100% of the C is lost to the atmosphere, a lower percentage can be entered in cell C10

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**Volume of peat drained**

Note: Extent of site affected by drainage is calculated assuming an average extent of drainage around each drainage feature as given in the input data.

Extent of drainage around each metre of drainage ditch	Total		
	Exp	Min	Max
Average extent of drainage around drainage features at site (m)	15	10	20

Peat affected by drainage around borrow pits	Total		
	Exp	Min	Max
Number of borrow pits	1	1	1
Average length of pits (m)	93	93	93
Average width of pits (m)	46	46	47
Average depth of peat removed from pit (m)	0.4	0.4	0.4
Area affected by drainage per borrow pit (m <sup>2</sup> )	5070	3170	7180
Total area affected by drainage around borrowpits (m <sup>2</sup> )	5070	3170	7180
Total volume affected by drainage around borrowpits (m <sup>3</sup> )	1014	634	1436

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Peat affected by drainage around turbine foundation and hardstanding	Total			Construction Area 1			Construction Area 2			Construction Area 3			Construction Area 4			Construction Area 5		
	Exp	Min	Max	Exp	Min	Max	Exp	Min	Max	Exp	Min	Max	Exp	Min	Max	Exp	Min	Max
No. of turbines	3	3	3	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Average length of turbine foundations at base (m)				25	25	25	0	0	0	0	0	0	0	0	0	0	0	0
Average width of turbine foundations at base(m)				25	25	25	0	0	0	0	0	0	0	0	0	0	0	0
Average depth of peat removed from turbine foundations (m)				0.4	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average length of hard-standing at base (m)				50	50	50	0	0	0	0	0	0	0	0	0	0	0	0
Average width of hard-standing at base (m)				35	35	35	0	0	0	0	0	0	0	0	0	0	0	0
Average depth of peat removed from hard-standing (m)				0.4	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum depth of drains (m)				0.4	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total length of foundation and hardstanding (m)				75	75	75	0	0	0	0	0	0	0	0	0	0	0	0
Total width of foundation and hardstanding (m)				60	60	60	0	0	0	0	0	0	0	0	0	0	0	0
Area affected by drainage of foundation and hardstanding area (m <sup>2</sup> )	4950	3100	7000	4950	3100	7000	0	0	0	0	0	0	0	0	0	0	0	0
Total area affected by drainage of foundation and hardstanding area (m <sup>2</sup> )	14850	9300	21000	14850	9300	21000	0	0	0	0	0	0	0	0	0	0	0	0
Total volume affected by drainage of foundation and hardstanding area (m <sup>3</sup> )	2970	1860	4200	2970	1860	4200	0	0	0	0	0	0	0	0	0	0	0	0

Peat affected by drainage of access tracks	Total		
	Exp	Min	Max
<b>Floating roads</b>			
Length of floating road that is drained (m)	0	0	0
Floating road width (m)	0.0	0.0	0.0
Average depth of drains associated with floating roads (m)	0.00	0.00	0.00
Area affected by drainage of floating roads (m <sup>2</sup> )	0	0	0
Volume affected by drainage of floating roads	0	0	0
Excavated Road			

Length of access track that is excavated road (r	1500	1500	1500
Excavation width (m)	5	5	5
Average depth of peat excavated for road (m)	0.4	0.4	0.4
Area affected by drainage of excavated roads (m <sup>2</sup> )	45000	30000	60000
Volume affected by drainage of excavated roads (m <sup>3</sup> )	9000	6000	12000
<b>Rock-filled roads</b>			
Length of rock filled road that is drained (m)	0	0	0
Rock filled road width (m)	0	0	0
Average depth of drains associated with rock filled roads (m)	0.0	0.0	0.0
Area affected by drainage of rock-filled roads (m <sup>2</sup> )	0	0	0
Volume affected by drainage of rock-filled roads (m <sup>3</sup> )	0	0	0
Total area affected by drainage of access track (m <sup>2</sup> )	45000	30000	60000
Total volume affected by drainage of access track (m <sup>3</sup> )	9000	6000	12000

<b>Peat affected by drainage of cable trenches</b>	<b>Exp</b>	<b>Total Min</b>	<b>Max</b>
Length of any cable trench on peat that does not follow access tracks and is lined with a permeable medium (eg. sand) (m)	0	0	0
Average depth of peat cut for cable trenches (m)	0.0	0.0	0.0
Total area affected by drainage of cable trenches (m <sup>2</sup> )	0	0	0
Total volume affected by drainage of cable trenches (m <sup>3</sup> )	0.00	0.00	0.00

<b>Drainage around additional peat excavated</b>	<b>Exp</b>	<b>Total Min</b>	<b>Max</b>
Volume of additional peat excavated (m <sup>3</sup> )	650.0	650.0	650.0
Area of additional peat excavated (m <sup>2</sup> )	1100.0	1100.0	1100.0
Average depth of excavated peat (m)	1	1	1
Radius of area excavated (m)	19	19	19
Radius of excavated and drained area (m)	34	29	39
Total area affected by drainage (m <sup>2</sup> )	2470	1490	3608
Total volume affected by drainage (m <sup>3</sup> )	1459.80	880.38	2132.04

Assumption: Area excavated is assumed to be a circle

<b>RESULTS</b>	<b>Exp</b>	<b>Total Min</b>	<b>Max</b>
Total area affected by drainage due to windfarm (m <sup>2</sup> )	67390	43960	91788
Total volume affected by drainage due to windfarm (m <sup>3</sup> )	14443.8	9374.379	19768.04

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#### Volume of peat drained

Note: Extent of site affected by drainage is calculated assuming an average extent of drainage around each drainage feature as given in the input data.

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**CO<sub>2</sub> loss due to drainage**

Note: Note, CO<sub>2</sub> losses are calculated using two approaches: IPCC default methodology and more site specific equations derived for this project. The IPCC methodology is included because it is the established approach, although it contains no site detail. The new equations have been derived directly from experimental data for acid bogs and fens (see Nayak et al, 2008 - Final report).

Click here to move to 5. Loss of soil CO<sub>2</sub> [Click here](#)  
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	Expected	Minimum	Maximum
<b>Drained Land</b>			
Total area affected by drainage due to wind farm construction (ha)	7	4	9
Will the hydrology of the site be restored on decommissioning?	No	No	No
Will the habitat of the site be restored on decommissioning?	No	No	No

**Calculations of C Loss from Drained Land if Site is NOT Restored after Decommissioning**

	Expected	Minimum	Maximum
<input type="checkbox"/> Total volume affected by drainage due to wind farm (m <sup>3</sup> )	14444	9374	19768
C Content of dry peat (% by weight)	53	52	53
Dry soil bulk density (g cm <sup>-3</sup> )	0.13	0.11	0.15
<b>Total GHG emissions from Drained Land (t CO<sub>2</sub> equiv.)</b>	<b>3722</b>	<b>2002</b>	<b>5890</b>
<b>Total GHG Emissions from Undrained Land (t CO<sub>2</sub> equiv.)</b>	<b>3722</b>	<b>2002</b>	<b>5518</b>

Assumption: Losses of GHG from drained and undrained land have the same proportion throughout the emission period.

**Calculations of C loss from Drained Land if Site IS Restored after Decommissioning**

**1. Losses if Land is Drained**

Flooded period (days year <sup>-1</sup> )	0	0	0
Lifetime of windfarm (years)	35	35	35
Time required for regeneration of bog plants after restoration (years)	10	5	15
<b>Methane Emissions from Drained Land</b>			
<input type="checkbox"/> Rate of methane emission in drained soil ((t CH <sub>4</sub> -C) ha <sup>-1</sup> yr <sup>-1</sup> )	0.000	-0.017	0.052
Conversion factor: CH <sub>4</sub> -C to CO <sub>2</sub> equivalents	30.67	30.67	30.67
CH <sub>4</sub> emissions from drained land (t CO <sub>2</sub> equiv.)	-3	-89	732
<b>Carbon Dioxide Emissions from Drained Land</b>			
<input type="checkbox"/> Rate of carbon dioxide emission in drained soil (t CO <sub>2</sub> ha <sup>-1</sup> yr <sup>-1</sup> )	18.67	22.67	9.07
CO <sub>2</sub> emissions from drained land (t CO <sub>2</sub> )	5662	3986	4162
<b>Total GHG emissions from Drained Land (t CO<sub>2</sub> equiv.)</b>	<b>5659</b>	<b>3897</b>	<b>4895</b>

Assumption: The drained soil is not flooded at any time of the year.

Note: Conversion = (23 x 16/12) = 30.67 CO<sub>2</sub> equiv. (CH<sub>4</sub>-C)<sup>-1</sup>

**2. Losses if Land is Undrained**

Flooded period (days year <sup>-1</sup> )	178	178	178
Lifetime of windfarm (years)	35	35	35
Time required for regeneration of bog plants after restoration (years)	10	5	15
<b>Methane Emissions from Undrained Land</b>			
<input type="checkbox"/> Rate of methane emission in undrained soil ((t CH <sub>4</sub> -C) ha <sup>-1</sup> yr <sup>-1</sup> )	0.00	-0.02	0.16
Conversion factor: CH <sub>4</sub> -C to CO <sub>2</sub> equivalents	30.67	30.67	30.67
CH <sub>4</sub> emissions from undrained land (t CO <sub>2</sub> equiv.)	-3	-89	1491
<b>Carbon Dioxide Emissions from Undrained Land</b>			
<input type="checkbox"/> Rate of carbon dioxide emission in undrained soil (t CO <sub>2</sub> ha <sup>-1</sup> yr <sup>-1</sup> )	18.67	22.67	4.30
CO <sub>2</sub> emissions from undrained land (t CO <sub>2</sub> )	5662	3986	3094
<b>Total GHG Emissions from Undrained Land (t CO<sub>2</sub> equiv.)</b>	<b>5659</b>	<b>3897</b>	<b>4585</b>

Note: Conversion = (23 x 16/12) = 30.67 CO<sub>2</sub> equiv. (CH<sub>4</sub>-C)<sup>-1</sup>

**3. CO<sub>2</sub> Losses due to Drainage**

Total GHG emissions from drained land (t CO <sub>2</sub> equiv.)	3722	2002	5890
Total GHG emissions from undrained land (t CO <sub>2</sub> equiv.)	3722	2002	5518
<b>RESULTS</b>			
<b>Total GHG emissions due to drainage (t CO<sub>2</sub> equiv.)</b>	<b>0</b>	<b>0</b>	<b>0</b>

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**CO<sub>2</sub> due to drainage**

Note: Note, CO<sub>2</sub> losses are calculated using two approaches: IPCC default methodology and more site specific equations derived for this project. The IPCC methodology is included because it is the established approach, although it contains no site detail. The new equations have been derived directly from experimental data for acid bogs and fens (see Nayak et al, 2008 - Final report).

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**Emission rates from soils**

Note: Note, CO<sub>2</sub> losses are calculated using two approaches: IPCC default methodology and more site specific equations derived for this project. The IPCC methodology is included because it is the established approach, although it contains no site detail. The new equations have been thoroughly tested against experimental data (see Nayak et al, 2008 - Final report).

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**Selected Methodology = Site specific (required for planning applications)**  
**Type of peatland = Acid Bog**

**Calculations following IPCC default methodology**

**Emission characteristics of acid bogs (IPCC, 1997)**

	Expected	Minimum	Maximum
Flooded period (days year <sup>-1</sup> )	178	178	178
Annual rate of methane emission (t CH <sub>4</sub> -C ha <sup>-1</sup> yr <sup>-1</sup> )	0.04015	0.04015	0.04015
Annual rate of carbon dioxide emission (t CO <sub>2</sub> ha <sup>-1</sup> yr <sup>-1</sup> )	35.2	35.2	35.2

**Emission characteristics of fens (IPCC, 1997)**

	Expected	Minimum	Maximum
Flooded period (days year <sup>-1</sup> )	169	169	169
Annual rate of methane emission (t CH <sub>4</sub> -C ha <sup>-1</sup> yr <sup>-1</sup> )	0.219	0.219	0.219
Annual rate of carbon dioxide emission (t CO <sub>2</sub> ha <sup>-1</sup> yr <sup>-1</sup> )	35.2	35.2	35.2

**Selected emission characteristics (IPCC, 1997)**

	Expected	Minimum	Maximum
Flooded period (days year <sup>-1</sup> )	178	178	178
Annual rate of methane emission (t CH <sub>4</sub> -C ha <sup>-1</sup> yr <sup>-1</sup> )	0.04015	0.04015	0.04015
Annual rate of carbon dioxide emission (t CO <sub>2</sub> ha <sup>-1</sup> yr <sup>-1</sup> )	35.2	35.2	35.2

**Calculations following ECOSSE based methodology**

**Drained Land**

	Expected	Minimum	Maximum
Total area affected by drainage due to wind farm construction (ha)	7	4	9
Total volume affected by drainage due to wind farm construction (m <sup>3</sup> )	14444	9374	19768

**Soil Characteristics that Determine Emission Rates**

	Expected	Minimum	Maximum
Average annual air temperature at the site (°C)	10	5.7	15.2
Average water table depth at site (m)	0.50	1.00	0.10
Average water table depth of drained land (m)	0.50	1.00	0.22

**Annual Emission Rates following site specific methodology**

**Acid bogs**

	Expected	Minimum	Maximum
Rate of carbon dioxide emission in drained soil (t CO <sub>2</sub> ha <sup>-1</sup> yr <sup>-1</sup> )	18.67	22.67	9.07
Rate of carbon dioxide emission in undrained soil (t CO <sub>2</sub> ha <sup>-1</sup> yr <sup>-1</sup> )	18.67	22.67	4.30
Rate of methane emission in drained soil ((t CH <sub>4</sub> -C) ha <sup>-1</sup> yr <sup>-1</sup> )	0.000	-0.017	0.052
Rate of methane emission in undrained soil ((t CH <sub>4</sub> -C) ha <sup>-1</sup> yr <sup>-1</sup> )	0.00	-0.02	0.16

**Fens**

	Expected	Minimum	Maximum
Rate of carbon dioxide emission in drained soil (t CO <sub>2</sub> ha <sup>-1</sup> yr <sup>-1</sup> )	55.58	62.50	22.88
Rate of carbon dioxide emission in undrained soil (t CO <sub>2</sub> ha <sup>-1</sup> yr <sup>-1</sup> )	55.58	62.50	10.69
Rate of methane emission in drained soil ((t CH <sub>4</sub> -C) ha <sup>-1</sup> yr <sup>-1</sup> )	0.001	-0.006	0.070
Rate of methane emission in undrained soil ((t CH <sub>4</sub> -C) ha <sup>-1</sup> yr <sup>-1</sup> )	0.00	-0.01	0.21

**Selected emission characteristics following site specific methodology**

	Expected	Minimum	Maximum
Rate of carbon dioxide emission in drained soil (t CO <sub>2</sub> ha <sup>-1</sup> yr <sup>-1</sup> )	18.67	22.67	9.07
Rate of carbon dioxide emission in undrained soil (t CO <sub>2</sub> ha <sup>-1</sup> yr <sup>-1</sup> )	18.67	22.67	4.30
Rate of methane emission in drained soil ((t CH <sub>4</sub> -C) ha <sup>-1</sup> yr <sup>-1</sup> )	0.000	-0.017	0.052
Rate of methane emission in undrained soil ((t CH <sub>4</sub> -C) ha <sup>-1</sup> yr <sup>-1</sup> )	0.00	-0.02	0.16

**RESULTS**

**Selected Emission Rates**

	Expected	Minimum	Maximum
Rate of carbon dioxide emission in drained soil (t CO <sub>2</sub> ha <sup>-1</sup> yr <sup>-1</sup> )	18.67	22.67	9.07
Rate of carbon dioxide emission in undrained soil (t CO <sub>2</sub> ha <sup>-1</sup> yr <sup>-1</sup> )	18.67	22.67	4.30
Rate of methane emission in drained soil ((t CH <sub>4</sub> -C) ha <sup>-1</sup> yr <sup>-1</sup> )	0.000	-0.017	0.052
Rate of methane emission in undrained soil ((t CH <sub>4</sub> -C) ha <sup>-1</sup> yr <sup>-1</sup> )	0.00	-0.02	0.16

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**Emission rates from soils**

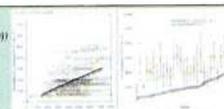
Note: Note, CO<sub>2</sub> losses are calculated using two approaches: IPCC default methodology and more site specific equations derived for this project. The IPCC methodology is included because it is the established approach, although it contains no site detail. The new equations have been thoroughly tested against experimental data (see Nayak et al, 2008 - Final report).

Assumption: The period of flooding is taken to be 178 days yr<sup>-1</sup> for acid bogs and 169 days yr<sup>-1</sup> based on the monthly mean temperature and the lengths of inundation (IPCC, 1997, Revised 1998 IPCC guidelines for national greenhouse gas inventories, Vol 3, table 5-1)

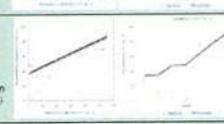
Assumption: The CH<sub>4</sub> emission rate provided for acid bogs is 11 (1-38) mg CH<sub>4</sub>-C m<sup>-2</sup> day<sup>-1</sup> x 365 days, and for fens is 60 (21-162) mg CH<sub>4</sub>-C m<sup>-2</sup> day<sup>-1</sup> x 365 days (Austman & Oudem, 1985, J. Adv. Chem. 8, 361-368)

Assumption: CO<sub>2</sub> emissions on drainage of organic soils for upland crops (e.g. grain, vegetables) are 3.867x10<sup>6</sup> (7.8-11.3) t CO<sub>2</sub> ha<sup>-1</sup> yr<sup>-1</sup> in temperate climates (Amundson and Healy, 1985, Soil, 79, 166-174)

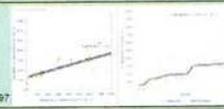
Note: Carbon dioxide emissions from acid bogs. Equation derived by regression analysis against 60 measurements (Nayak et al, 2008). The equation derived was  $R_{CO_2} = (3.667/1000) \times (6700 \times \exp(-0.26 \times \exp(-0.0515 \times ((W \times 100) - 50)))) - ((72.84 \times T) - 600)$  where  $R_{CO_2}$  is the annual rate of CO<sub>2</sub> emissions (t CO<sub>2</sub> ha<sup>-1</sup> yr<sup>-1</sup>), T = average annual peat temperature (°C) and W is the water table depth (m). The equation shows a significant correlation with measurements (r<sup>2</sup> = 0.63, P < 0.06). Evaluation against 39 independent experiments shows a significant association (r<sup>2</sup> = 0.21, P < 0.06) and an average error of 5023 t CO<sub>2</sub> ha<sup>-1</sup> yr<sup>-1</sup> (significance not defined due to lack of replicates - Smith et al, 1997)



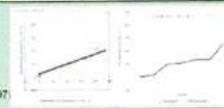
Note: Carbon dioxide emissions from fens. Equation derived by regression analysis against 44 measurements (Nayak et al, 2008). The equation derived was  $R_{CO_2} = (1/1000) \times (1500 \times \exp(-0.1284 \times ((W \times 100) - (3.519 \times T) - 36.67)))$  where  $R_{CO_2}$  is the annual rate of CO<sub>2</sub> emissions (t CO<sub>2</sub> ha<sup>-1</sup> yr<sup>-1</sup>), T = average annual air temperature (°C) and W is the water table depth (m). The equation shows a significant correlation with measurements (r<sup>2</sup> = 0.64, P < 0.06). Evaluation against 7 independent experiments shows a significant association (r<sup>2</sup> = 0.31, P < 0.06) and an average error of 27 t CO<sub>2</sub> ha<sup>-1</sup> yr<sup>-1</sup> (significance not defined due to lack of replicates - Smith et al, 1997)



Note: Carbon dioxide emissions from fens. Equation derived by regression analysis against 44 measurements (Nayak et al, 2008). The equation derived was  $R_{CO_2} = (3.667/1000) \times (3244 \times \exp(-0.375 \times \exp(-0.073 \times ((W \times 100) - 50)))) + (153.23 \times T)$  where  $R_{CO_2}$  is the annual rate of CO<sub>2</sub> emissions (t CO<sub>2</sub> ha<sup>-1</sup> yr<sup>-1</sup>), T = average annual peat temperature (°C) and W is the water table depth (m). The equation shows a significant correlation with measurements (r<sup>2</sup> = 0.42, P < 0.06). Evaluation against 18 independent experiments shows a significant association (r<sup>2</sup> = 0.66, P < 0.06) and an average error of 2108 t CO<sub>2</sub> ha<sup>-1</sup> yr<sup>-1</sup> (significance not defined due to lack of replicates - Smith et al, 1997)



Note: Methane emissions from fens. Equation derived by regression analysis against experimental data from 36 measurements (Nayak et al, 2008). The equation derived was  $R_{CH_4} = (1/1000) \times (10 + 685.82 \times \exp(-0.097 \times ((W \times 100) - 0.662 \times T)))$  where  $R_{CH_4}$  is the annual rate of CH<sub>4</sub> emissions (t CH<sub>4</sub>-C ha<sup>-1</sup> yr<sup>-1</sup>), T = average annual air temperature (°C) and W is the water table depth (m). The equation shows a significant correlation with measurements (r<sup>2</sup> = 0.41, P < 0.06). Evaluation against 7 independent experiments shows a significant association (r<sup>2</sup> = 0.66, P < 0.06) and an average error of 164 t CH<sub>4</sub>-C ha<sup>-1</sup> yr<sup>-1</sup> (significance not defined due to lack of replicates - Smith et al, 1997)



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**Emissions due to loss of DOC and POC**

Note: Note, CO<sub>2</sub> losses from DOC and POC are calculated using a simple approach derived from generic estimates of the percentage of the total CO<sub>2</sub> loss that is due to DOC or POC leaching

No POC losses for bare soil included yet. If extensive areas of bare soil is present at site need modified calculation (Birnie et al, 1991)

	Expected	Minimum	Maximum
<b>Total C loss</b>			
Gross CO <sub>2</sub> loss from restored drained land (t CO <sub>2</sub> )	0	0	0
Gross CH <sub>4</sub> loss from restored drained land (t CO <sub>2</sub> equiv.)	0	0	0
Gross CO <sub>2</sub> loss from improved land (t CO <sub>2</sub> )			
Degraded Bog	0	0	0
Felled Forestry	0	0	0
Borrow Pits	0	0	0
Foundations & Hardstanding	0	0	0
Gross CH <sub>4</sub> loss from improved land (t CO <sub>2</sub> equiv.)			
Degraded Bog	0	0	0
Felled Forestry	0	0	0
Borrow Pits	0	0	0
Foundations & Hardstanding	0	0	0
Conversion factor: CH <sub>4</sub> -C to CO <sub>2</sub> equivalents	30.6667	30.6667	30.6667
% total soil C losses, lost as DOC	26	7	40
% DOC loss emitted as CO <sub>2</sub> over the long term	100	100	100
% total soil C losses, lost as POC	8	4	10
% POC loss emitted as CO <sub>2</sub> over the long term	100	100	100
Total gaseous loss of C (t C)	0	0	0
Total C loss as DOC (t C)	0	0	0
Total C loss as POC (t C)	0	0	0

Note: Only restored drained land included because if land is not

Assumption: DOC loss ranges between 7 - 40% of the total gaseous loss if calculated from the reported (minimum and maximum) values in Worrall 2009 and is 26% of the total gaseous loss if calculated from the mean of reported maximum and minimum value in Worrall 2009. These DOC values are flux based on soil water concentration (i.e. 12.5 - 85.9 MgC/KM<sup>2</sup>/yr) and not on flux at catchment outlet (i.e. 10.3 - 21.8 MgC/KM<sup>2</sup>/yr)  
Worrall, F. et al., 2009. The multi-annual carbon budget of a peat-covered catchment. *Science of The*

Assumption: In the long term, 100% of leached DOC is assumed to be lost as CO<sub>2</sub>

Assumption: POC loss ranges between 4-10% of the total gaseous loss if calculated from the reported values and is 8% of the total gaseous loss if calculated from the mean of reported maximum and minimum value in Worrall 2009. POC range is (7 - 22.4 MgC/KM<sup>2</sup>/yr) (Worrall et al, 2009).

Assumption: In the long term, 100% of leached POC is assumed to be lost as CO<sub>2</sub>

<b>RESULTS</b>			
Total CO <sub>2</sub> loss due to DOC leaching (t CO <sub>2</sub> )	0	0	0
Total CO <sub>2</sub> loss due to POC leaching (t CO <sub>2</sub> )	0	0	0
<b>Total CO<sub>2</sub> loss due to DOC &amp; POC leaching (t CO<sub>2</sub>)</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Additional CO<sub>2</sub> payback time of windfarm due to DOC &amp; POC</b>			
...coal-fired electricity generation (months)	0	0	0
...grid-mix of electricity generation (months)	0	0	0
...fossil fuel - mix of electricity generation (months)	0	0	0

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**Emissions due to loss of DOC and POC**

Note: Note, CO<sub>2</sub> losses from DOC and POC are calculated using a simple approach derived from generic estimates of the percentage of the total CO<sub>2</sub> loss that is due to DOC or POC leaching

No POC losses for bare soil included yet. If extensive areas of bare soil is present at site need modified calculation (Birnie et al, 1991)

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**Emissions due to forest felling - calculation using simple management data**

Note: Emissions due to forestry felling are calculated from the reduced carbon sequestered per crop rotation. If the forestry was due to be removed before the planned development, this C loss is not attributable to the wind farm and so the area of forestry to be felled should be entered as zero.

	Expected	Minimum	Maximum
<b>Emissions due to forestry felling</b>			
Area of forestry plantation to be felled (ha)	8.8	8.75	8.85
Carbon sequestered (tC ha <sup>-1</sup> yr <sup>-1</sup> )	3.6	3.5	3.7
Lifetime of windfarm (years)	35	35	35
Carbon sequestered over the lifetime of the windfarm (t C ha <sup>-1</sup> )	126	122.5	129.5
<b>RESULTS</b>			
<b>Total carbon loss due to felling of forestry (t CO<sub>2</sub>)</b>	<b>4066</b>	<b>3931</b>	<b>4203</b>
<b>Additional CO<sub>2</sub> payback time of windfarm due to management of forestry</b>			
...coal-fired electricity generation (months)	111	109	112
...grid-mix of electricity generation (months)	505	499	511
...fossil fuel - mix of electricity generation (months)	247	243	250

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**Emissions due to forest felling - calculation using simple management data**

Note: Emissions due to forestry felling are calculated from the reduced carbon sequestered per crop rotation. If the forestry was due to be removed before the planned development, this C loss is not attributable to the wind farm and so the area of forestry to be felled should be entered as zero.

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**Gain due to site improvement**

Note: Risk, CO<sub>2</sub> losses are calculated using best approaches IPCC default methodology and more site specific equations derived for this project. The IPCC methodology is included because it is the established approach, although it contains no site detail. The new equations have been thoroughly tested against experimental data (see Hayes et al, 2008 - Final report)

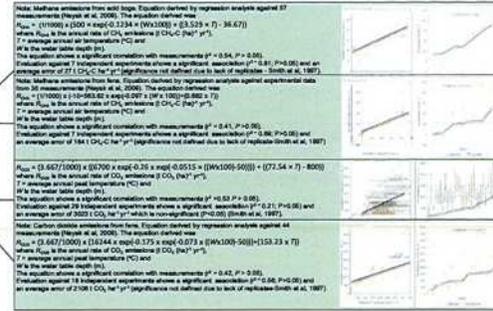
**Selected Methodology - Site specific (required for planning applications)**  
Type of peatland = Acid Bog

Improvement in GHG emissions due to improvement of site	Expected result				Minimum result				Maximum result			
	Degraded Bog	Failed Forestry	Borrow Pits	Foundations & Hardstanding	Degraded Bog	Failed Forestry	Borrow Pits	Foundations & Hardstanding	Degraded Bog	Failed Forestry	Borrow Pits	Foundations & Hardstanding
<b>I. Description of site</b>												
Period of time when effectiveness of the improvement can be guaranteed (years)	0	0	0	35	0	0	0	35	0	0	0	35
Area to be improved (ha)	0	0	0	0	0	0	0	0	0	0	0	0
Average air temperature at site (°C)	10	10	10	10	5.7	5.7	5.7	15.2	15.2	15.2	15.2	15.2
Depth of peat (drained) (m)	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Depth of peat above water table before improvement (m)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Depth of peat above water table after improvement (m)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>II. Losses with improvement</b>												
Flooded period (days year <sup>-1</sup> )	178	178	178	178	178	178	178	178	178	178	178	178
Time required for hydrology and habitat to return to its previous state on restoration (years)	0	0	0	0	0	0	0	0	0	0	0	0
Improved period (years)	0	0	0	35	0	0	0	35	0	0	0	35
<b>Methane emissions from improved land</b>												
Site specific methane emission from improved soil on acid bogs (I CH <sub>4</sub> -C ha <sup>-1</sup> yr <sup>-1</sup> )	0.499	0.499	0.499	0.499	0.483	0.483	0.483	0.483	0.517	0.517	0.517	0.517
Site specific methane emission from improved soil on fens (I CH <sub>4</sub> -C ha <sup>-1</sup> yr <sup>-1</sup> )	0.560	0.560	0.560	0.560	0.557	0.557	0.557	0.557	0.564	0.564	0.564	0.564
IPCC annual rate of methane emission on acid bogs (I CH <sub>4</sub> -C ha <sup>-1</sup> yr <sup>-1</sup> )	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040
IPCC annual rate of methane emission on fens (I CH <sub>4</sub> -C ha <sup>-1</sup> yr <sup>-1</sup> )	0.219	0.219	0.219	0.219	0.219	0.219	0.219	0.219	0.219	0.219	0.219	0.219
Selected annual rate of methane emission (I CH <sub>4</sub> -C ha <sup>-1</sup> yr <sup>-1</sup> )	0.499	0.499	0.499	0.499	0.483	0.483	0.483	0.483	0.517	0.517	0.517	0.517
<b>Carbon dioxide emissions from improved land</b>												
Site specific CO <sub>2</sub> emission from improved soil on acid bogs (I CO <sub>2</sub> ha <sup>-1</sup> yr <sup>-1</sup> )	0.53	0.53	0.53	0.53	-0.61	-0.61	-0.61	-0.61	1.91	1.91	1.91	1.91
Site specific CO <sub>2</sub> emission from improved soil on fens (I CO <sub>2</sub> ha <sup>-1</sup> yr <sup>-1</sup> )	5.68	5.68	5.68	5.68	3.26	3.26	3.26	3.26	8.60	8.60	8.60	8.60
IPCC annual rate of carbon dioxide emission on acid bogs (I CO <sub>2</sub> ha <sup>-1</sup> yr <sup>-1</sup> )	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IPCC annual rate of carbon dioxide emission on fens (I CO <sub>2</sub> ha <sup>-1</sup> yr <sup>-1</sup> )	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Selected annual rate of carbon dioxide emission (I CO <sub>2</sub> ha <sup>-1</sup> yr <sup>-1</sup> )	0.53	0.53	0.53	0.53	-0.61	-0.61	-0.61	-0.61	1.91	1.91	1.91	1.91
<b>CO<sub>2</sub> emissions from improved land (I CO<sub>2</sub> equiv.)</b>												
	0	0	0	0	0	0	0	0	0	0	0	0
<b>III. Losses without improvement</b>												
Flooded period (days year <sup>-1</sup> )	0	0	0	0	0	0	0	0	0	0	0	0
Time required for hydrology and habitat to return to its previous state on restoration (years)	0	0	0	0	0	0	0	0	0	0	0	0
Improved period (years)	0	0	0	35	0	0	0	35	0	0	0	35
<b>Methane emissions from unimproved land</b>												
Site specific methane emission from unimproved soil on acid bogs (I CH <sub>4</sub> -C ha <sup>-1</sup> yr <sup>-1</sup> )	0.499	0.499	0.499	0.499	0.483	0.483	0.483	0.483	0.517	0.517	0.517	0.517
Site specific methane emission from unimproved soil on fens (I CH <sub>4</sub> -C ha <sup>-1</sup> yr <sup>-1</sup> )	0.560	0.560	0.560	0.560	0.557	0.557	0.557	0.557	0.564	0.564	0.564	0.564
IPCC annual rate of methane emission on acid bogs (I CH <sub>4</sub> -C ha <sup>-1</sup> yr <sup>-1</sup> )	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
IPCC annual rate of methane emission on fens (I CH <sub>4</sub> -C ha <sup>-1</sup> yr <sup>-1</sup> )	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Selected annual rate of methane emission (I CH <sub>4</sub> -C ha <sup>-1</sup> yr <sup>-1</sup> )	0.499	0.499	0.499	0.499	0.483	0.483	0.483	0.483	0.517	0.517	0.517	0.517
<b>Carbon dioxide emissions from unimproved land</b>												
Site specific CO <sub>2</sub> emission from unimproved soil on acid bogs (I CO <sub>2</sub> ha <sup>-1</sup> yr <sup>-1</sup> )	0.53	0.53	0.53	0.53	-0.61	-0.61	-0.61	-0.61	1.91	1.91	1.91	1.91
Site specific CO <sub>2</sub> emission from unimproved soil on fens (I CO <sub>2</sub> ha <sup>-1</sup> yr <sup>-1</sup> )	5.68	5.68	5.68	5.68	3.26	3.26	3.26	3.26	8.60	8.60	8.60	8.60
IPCC annual rate of carbon dioxide emission on acid bogs (I CO <sub>2</sub> ha <sup>-1</sup> yr <sup>-1</sup> )	35.20	35.20	35.20	35.20	35.20	35.20	35.20	35.20	35.20	35.20	35.20	35.20
IPCC annual rate of carbon dioxide emission on fens (I CO <sub>2</sub> ha <sup>-1</sup> yr <sup>-1</sup> )	35.20	35.20	35.20	35.20	35.20	35.20	35.20	35.20	35.20	35.20	35.20	35.20
Selected annual rate of carbon dioxide emission (I CO <sub>2</sub> ha <sup>-1</sup> yr <sup>-1</sup> )	0.53	0.53	0.53	0.53	-0.61	-0.61	-0.61	-0.61	1.91	1.91	1.91	1.91
<b>CO<sub>2</sub> emissions from unimproved land (I CO<sub>2</sub> equiv.)</b>												
	0	0	0	0	0	0	0	0	0	0	0	0
<b>RESULTS</b>												
<b>A. Reduction in GHG emissions due to improvement of site</b>												
Total GHG emissions from improved land (I CO <sub>2</sub> equiv.)	0	0	0	0	0	0	0	0	0	0	0	0
Total GHG emissions from unimproved land (I CO <sub>2</sub> equiv.)	0	0	0	0	0	0	0	0	0	0	0	0
Reduction in GHG emissions due to improvement (I CO <sub>2</sub> equiv.)	0	0	0	0	0	0	0	0	0	0	0	0
<b>B. Additional CO<sub>2</sub> payback time of windfarm due to site improvement</b>												
... qualified electricity generation (months)	0	0	0	0	0	0	0	0	0	0	0	0
... grid-mix of electricity generation (months)	0	0	0	0	0	0	0	0	0	0	0	0
... local fuel - mix of electricity generation (months)	0	0	0	0	0	0	0	0	0	0	0	0

Click here to move to Payback Time [Click here](#)

**Gain due to site improvement**

Note: Risk, CO<sub>2</sub> losses are calculated using best approaches IPCC default methodology and more site specific equations derived for this project. The IPCC methodology is included because it is the established approach, although it contains no site detail. The new equations have been thoroughly tested against experimental data (see Hayes et al, 2008 - Final report)



Note: Methane emissions from acid bogs. As above  
Note: Methane emissions from fens. As above

Note: CO<sub>2</sub> emissions from acid bogs. As above  
Note: CO<sub>2</sub> emissions from fens. As above

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# TII CARBON TOOL

Ch 15: Material Assets, Section 15.1, Table 15-8					Distance Assumptions	TII Embodied Carbon Tool Inputs ( <a href="https://web.tii.ie/index.html">https://web.tii.ie/index.html</a> )						TII Transport Inputs ( <a href="https://web.tii.ie/index.html">https://web.tii.ie/index.html</a> )		
Material	Total no. Truck Loads	Truck Types	TII Embodied Carbon	TII Traffic	Distance (km)	Category	Sub-Category	Material	Quantity	Unit	Embodied tCO2e	Transport Type	Distance (km)	Transport TCO2e
Concrete	321	Concrete mixer	✓	✓	23.05	Series number 1700 - Structural Concrete	In Situ Concrete - General	In-Situ Concrete, General	5,760,024.00	kg	595.36	HGV - Rigid - All	7399.05	7.603
Delivery of plant	21	Large artic		✓	23.05							HGV - ALL - Average	484.05	0.525
Fencing & gates	2	Large artic	✓	✓	23.05				1	Nr	0.25	HGV - ALL - Average	46.1	0.05
Compound setup	28	Large artic		✓	23.05							HGV - ALL - Average	645.4	0.6999
Steel	8	Large artic	✓	✓	23.05	Other	Structural Steelwork	Anchorage and holding down bolt assemblies	160	tonnes	286.9	HGV - ALL - Average	184.4	0.2
Ducting and cabling (internal)	72	Large artic		✓	23.05							HGV - ALL - Average	1659.6	1.7998
Tree felling	68	Large artic		✓	23.05							HGV - ALL - Average	1567.4	1.6998
Crane (to lift steel)	1	Large artic		✓	107.6							HGV - ALL - Average	107.6	0.1167
Road construction	230	Truck		✓	23.05							HGV - Articulated - All	5301.5	5.9631
Cranes for turbines	12	Large artic		✓	107.6							HGV - ALL - Average	1291.2	1.4003
Refuelling for plant	62	Large artic		✓	23.05							HGV - ALL - Average	1429.1	1.5499
Site maintenance	45	Large artic		✓	23.05							HGV - ALL - Average	1037.25	1.1249
Miscellaneous	30	Large artic		✓	23.05							HGV - ALL - Average	691.5	0.7499
<b>Total</b>											<b>882.51</b>			<b>23.48</b>

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## List of Assumptions

Embodied Carbon Assumptions		
Item	Description	Assumption
Volume of Concrete Mixer	Calculation completed based on the average concrete mixer holding 8m3 of concrete. To complete the carbon calculations the TII carbon tool requires concrete units to be in kg.	8
Volume of Average Artic Truck	Calculation completed based on the average artic truck having a carrying capacity of 20 tonnes	20
Volume of Concrete Material	The density of concrete to be used at the Proposed Development is assumed to have average density of approximately 2,243m3/kg. Based on an assumed 2,568m3 of concrete being required (based on 321 truckloads of concrete with a 8m3 carrying capacity) this would result in approximately 5,760,024kg being used for the Proposed Development	5760024
Number of Gates	As stated in Section 4.5.1 of Chapter 4, there is 1 no. site entrance which will be reduced in size and gated for security post-construction for use as an operational phase entrance. It is assumed that there will be 1 no. steel gate	1
Ducting and cabling (internal)	Embodied carbon of electrical equipment not included as an option in TII Carbon Tool	-
Grid connection cable laying	Embodied carbon of electrical equipment not included as an option in TII Carbon Tool	-
Tree Felling	Embodied carbon of tree felling is included in the Macauley Institute Carbon Calculator for Wind Farms on Peatland	-
Turbine Lifecycle	Embodied carbon of the overall turbine lifecycle is included in the Macauley Institute Carbon Calculator for Wind Farms on Peatland	-

Please note that the assumptions for the embodied carbon and traffic assumptions are made based on best estimates of material sources. In reality the location of material sources will be dependent on what is available at the time of construction. The implications of distance variations on the estimation for carbon calculations is of a very low magnitude within the context of the overall carbon calculations and considered appropriate for the purposes of assessment in the EIAR.

Traffic Assumptions		
Item	Description	Assumption
Quarry (Q) Distance	For modelling purposes, the average distance from Kealkill, Co. Cork, Bantry, Co. Cork, Dunmanway, Co. Cork, and Coolea Co. Cork was used to determine the distance of transportation of all materials for Proposed Development	23.05
Import (P) Distance	For modelling purposes, the average distance from Cork Harbour and Shannon Foynes for transport of all other materials for the site	107.6
Concrete Mixer Emission factor	Calculated from an HGV - Rigid - All emission factor as provided in the TII Carbon Tool. Source: 2024 DEZLN emission factors - 'Delivery vehicles' tab, All Rigid HGVs and used Average laden weight. 2024 DEZLN emission factors - 'WTT' - delivery vehs & freight' tab, all Rigid HGVs and used Average laden weight.	1.02756
Large Artic Emission Factor	Calculated from an HGV - All - Average emission factor as provided in the TII Carbon Tool. Source: 2024 DEZLN emission factors - 'Delivery vehicles' tab, All artic HGVs and used Average laden weight. 2024 DEZLN emission factors - 'WTT' - delivery vehs & freight' tab, all artic HGVs and used Average laden weight.	1.0845
Truck Emissions Factor	Calculated from an HGV - Articulated - Average emission factor as provided in the TII Carbon Tool	1.30212

Please note that the assumptions for the embodied carbon and traffic assumptions are made based on best estimates of material sources. In reality the location of material sources will be dependent on what is available at the time of construction. The implications of distance variations on the estimation for carbon calculations is of a very low magnitude within the context of the overall carbon calculations and considered appropriate for the purposes of assessment in the EIAR.

Carbon Fixing Vegetation Assumptions		
Item	Description	Assumption
Calculation of Carbon Storage Potential in Enhancement Measures	The carbon storage capacity of restored habitats will vary over time as vegetation matures and land use and the baseline environment change. Therefore, while it can be assumed that native woodland replanting and enhancement of wet heath habitat on the Site will result in an increased capacity of carbon storage due to the carbon storage potential that exists within these habitats, to ensure the assessment below is identified under a theoretical precautionary scenario the quantification of these potential carbon savings (via an increase in carbon storage potential) associated with these measures has not been included in the carbon savings assessment. Please note, the carbon sequestration potential associated with the replanting of native woodland will be able to be determined in the future via the Teagasc Forest Carbon Tool ; currently this is not able to be completed due to Teagasc carrying out further analysis and validation on current data and the sequestration potential not being available in the public domain.	Not considered in assessment or quantified
Calculation of Carbon Loss from removal of carbon fixing vegetation	Carbon losses associated with the removal of other carbon-fixing vegetation will result in additional carbon losses. These have not been quantified as the lack of consistent national-level field data and methodologies limits the ability to make accurate projections on carbon sequestration potential for other carbon fixing habitat types, i.e., hedgerow, grassland, etc., and therefore carbon loss associated with removal. While it can be assumed that loss of carbon fixing vegetation will occur as part of the Proposed Development due to the removal of these habitat types, the exact carbon loss is not quantifiable.	Not considered in assessment or quantified

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