Appendix 14-1 - Carbon Calculation Worksheet

Carbon Calculator v1.6.1
Cloghercor Wind Farm Location: 54.862789 -8.233978
Cloghercor Wind Farm Limited

Core input data

Input data	Expected value	Minimum value	Maximum value	Source of data
Windfarm characteristics				
Dimensions				
No. of turbines	19	19	19	Project Description
Duration of consent (years)	35	35	35	Project Description
Performance				
Power rating of 1 turbine (MW)	6	5	7.2	Project Description
Capacity factor	33	32	34	https://www.eirgridgroup.com/site-files/library/EirGrid/ECP-2-1-Solar-and-Wind-Constraints-Report-Area-I-v1.0.pdf
Backup				
Fraction of output to backup (%)	5	5	5	SNH
Additional emissions due to reduced thermal efficiency of the reserve generation (%)	10	10	10	Fixed
Total CO2 emission from turbine life (tCO2 MW^{-1}) (eg. manufacture, construction, decommissioning)	Calculate wrt installed capacity	Calculate wrt installed capacity	Calculate wrt installed capacity	
Characteristics of peatland before windfarm development				
Type of peatland	Acid bog	Acid bog	Acid bog	Description
Average annual air temperature at site (°C)	9.8	8.8	10.8	Description
Average depth of peat at site (m)	1.2	0	4	Description
C Content of dry peat (% by weight)	62	55	65	Description
Average extent of drainage around drainage features at site (m)	5	1	10	Description
Average water table depth at site (m)	0.5	0.4	1	Description
Dry soil bulk density (g cm^{-3})	0.3	0.2	0.3	Description
Characteristics of bog plants				
Time required for regeneration of bog plants after restoration (years)	3	2	4	Description
Carbon accumulation due to C fixation by bog plants in undrained peats (tC ha^{-1} yr^{-1})	0.25	0.24	0.26	Description
Forestry Plantation Characteristics				
Area of forestry plantation to be felled (ha)	89.9	68.2	90	Description
Average rate of carbon sequestration in timber (tC ha^{-1} yr^{-1})	3.6	3.5	3.7	Description
Counterfactual emission factors				
Coal-fired plant emission factor (t CO2 MWh^{-1})	1.002	1.002	1.002	
Grid-mix emission factor (t CO2 MWh^{-1})	0.19338	0.19338	0.19338	
Fossil fuel-mix emission factor (t CO2 MWh^{-1})	0.432	0.432	0.432	
Borrow pits				
Number of borrow pits	4	4	4	Description
Average length of pits (m)	176	176	176	Description
Average width of pits (m)	135	135	135	Description

Input data	Expected value	Minimum value	Maximum value	Source of data
Average depth of peat removed from pit (m)	0.7	0.25	1.5	Soils & Geo Chapter
Access tracks				
Total length of access track (m)	16200	15900	16500	Description
Existing track length (m)	1510	1400	1600	Description
Length of access track that is floating road (m)	5600	5500	5700	Description
Floating road width (m)	6	5	6	Description
Floating road depth (m)	0	0	0	Description
Length of floating road that is drained (m)	0	0	0	Description
Average depth of drains associated with floating roads (m)	0.3	0.3	0.5	Description
Length of access track that is excavated road (m)	9090	9000	9200	Description
Excavated road width (m)	6	5	6	Description
Average depth of peat excavated for road (m)	0.6	0.1	1	Description
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	
Length of rock filled road that is drained (m)	0	0	0	
Average depth of drains associated with rock filled roads (m)	0	0	0	
Cable trenches				
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	Description
Average depth of peat cut for cable trenches (m)	0	0	0	Description
Additional peat excavated (not already accounted for above)				
Volume of additional peat excavated (m^3)	14000	12000	15000	Description
Area of additional peat excavated (m^2)	14000	12000	15000	Description
Peat Landslide Hazard				
Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments	negligible	negligible	negligible	Fixed
Improvement of C sequestration at site by blocking drains, restoration of habitat etc				
Improvement of degraded bog				
Area of degraded bog to be improved (ha)	0	0	0	n/a
Water table depth in degraded bog before improvement (m)	0	0	0	n/a
Water table depth in degraded bog after improvement (m)	0	0	0	n/a
Time required for hydrology and habitat of bog to return to its previous state on improvement (years)	2	2	2	n/a
Period of time when effectiveness of the improvement in degraded bog can be guaranteed (years)	2	2	2	n/a
Improvement of felled plantation land				
Area of felled plantation to be improved (ha)	1.4	1.2	1.5	Description
Water table depth in felled area before improvement (m)	0.5	0.4	0.6	Hydro chapter

Input data	Expected value	Minimum value	Maximum value	Source of data
Water table depth in felled area after improvement (m)	0.2	0.1	0.4	Hydro chapter
Time required for hydrology and habitat of felled plantation to return to its previous state on improvement (years)	5	2	8	Hydro chapter
Period of time when effectiveness of the improvement in felled plantation can be guaranteed (years)	7	5	10	Hydro chapter
Restoration of peat removed from borrow pits				
Area of borrow pits to be restored (ha)	0	0	0	Description
Depth of water table in borrow pit before restoration with respect to the restored surface (m)	0	0	0	
Depth of water table in borrow pit after restoration with respect to the restored surface (m)	0	0	0	
Time required for hydrology and habitat of borrow pit to return to its previous state on restoration (years)	0	0	0	
Period of time when effectiveness of the restoration of peat removed from borrow pits can be guaranteed (years)	0	0	0	
Early removal of drainage from foundations and hardstanding				
Water table depth around foundations and hardstanding before restoration (m)	0	0	0	Description
Water table depth around foundations and hardstanding after restoration (m)	0	0	0	
Time to completion of backfilling, removal of any surface drains, and full restoration of the hydrology (years)	0	0	0	
Restoration of site after decomissioning				
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?	Yes	Yes	Yes	Description
Will you attempt to block all artificial ditches and facilitate rewetting?	Yes	Yes	Yes	Description
Will the habitat of the site be restored on decommissioning?	No	No	No	
Will you control grazing on degraded areas?	No	No	No	Description
Will you manage areas to favour reintroduction of species	No	No	No	Description
Methodology				
Choice of methodology for calculating emission factors	Site specific (required for planning applications)			

Construction input data

Input data	Expected value	Minimum value	Maximum value	Source of data
Cloghercor				
Number of turbines in this area	19	19	19	Description Chapter
Turbine foundations				
Depth of hole dug when constructing foundations (m)	1	0.5	1.2	Description Chapter
Aproximate geometric shape of whole dug when constructing foundations	Circular	Circular	Circular	Description Chapter
Diameter at bottom	25	23	26	
Diameter at surface	26	25	28	
Hardstanding				
Depth of hole dug when constructing hardstanding (m)	1	0.9	1.2	Description Chapter
Aproximate geometric shape of whole dug when constructing hardstanding	Rectangular	Rectangular	Rectangular	Description Chapter
Length at surface	110	100	120	
Width at surface	55	55	55	
Length at bottom	110	100	120	
Width at bottom	55	55	55	
Piling				
Is piling used?	No	No	No	Description Chapter
Volume of Concrete				
Volume of concrete used (m^3) in the entire area	1000	750	1050	Description Chapter

Payback Time and CO_2 emissions • QEOY-18KK-BX24 v7

1. Windfarm CO2 emission saving over...	Exp.	Min.	Max.
...coal-fired electricity generation (t CO2 / yr)	330,210	266,837	408,260
...grid-mix of electricity generation (t CO2 / yr)	63,729	51,498	78,792
...fossil fuel-mix of electricity generation (t CO2 / yr)	142,366	115,043	176,016
Energy output from windfarm over lifetime (MWh)	11,534,292	9,320,640	14,260,579

Total CO2 losses due to wind farm (tCO2 eq.)	Exp.	Min.	Max.
2. Losses due to turbine life (eg. manufacture, construction, decomissioning)	97,948	80,117	119,267
3. Losses due to backup	75,497	62,914	90,597
4. Lossess due to reduced carbon fixing potential	1,635	1,045	2,389
5. Losses from soil organic matter	139,526	30,656	258,088
6. Losses due to DOC & POC leaching	0	0	1
7. Losses due to felling forestry	41,534	30,633	42,735
Total losses of carbon dioxide	356,141	205,366	513,078

8. Total CO2 gains due to improvement of site (t CO2 eq.)	Exp.	Min.	Max.
8a. Change in emissions due to improvement of degraded bogs	0	0	0
8b. Change in emissions due to improvement of felled forestry	-40	0	-206
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	-40	0	-206

RESULTS	Exp.	Min.	Max.
Net emissions of carbon dioxide (t CO2 eq.)	356,101	205,160	513,078
Carbon Payback Time			
...coal-fired electricity generation (years)	1.1	0.5	1.9
...grid-mix of electricity generation (years)	5.6	2.6	10.0
...fossil fuel-mix of electricity generation (years)	2.5	1.2	4.5
Ratio of soil carbon loss to gain by restoration (not used in Scottish applications)	3446.03	148.81	No gains!
Ratio of CO2 eq. emissions to power generation (g/kWh) (for info. only)	30.87	14.39	55.05