TECHNICAL APPENDIX 14.5.1

Carbon Calculator Input Parameters

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1 Carbon Calculator Input Parameters

1.1.1 The Scottish Government Carbon Calculator Online Tool Version 1.6.0 was used to assess the carbon impact of the proposed Development. The input parameters are outlined below.

1.2 Bulk Density

1.2.1 Maximum input values were input for bulk density in the carbon calculator for the proposed Development. Site specific bulk density values returned from the lab were atypically high, however this does not reflect the observed peat conditions on site which were considered to be typical of blanket bog. Typical carbon content and moisture content values were recorded by the lab in all samples except a small number which can be argued to be mainly mineral soil and not peat.

1.3 Water Table Depth

1.3.1 For the purpose of the carbon calculator, an assumption of water table depth was made based on site observations. A high water table close to the ground surface (0.1m) was used to reflect a worst case scenario.

Carbon Calculator v1.6.0
Clauchrie Windfarm Location: 55.161807 -4.678376
ScottishPower Renewables

Core input data

Input data	Expected value	Minimum value	Maximum value	Source of data
Windfarm characteristics				
Dimensions				
No. of turbines	18	18	18	EIAR Vol1, Chapter 4
Duration of consent (years)	40	40	40	EIAR Vol1, Chapter 4. Application is for consent in perpetuity, 40 years used for the purpose of this assessment
Performance				
Power rating of 1 turbine (MW)	5.6	5.6	5.6	EIAR Vol1, Chapter 4
Capacity factor	26.6	23.94	29.26	BEIS Onshore Wind Standard.
Backup				
Fraction of output to backup (%)	5	5	5	Standard value
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	EIAR Vol 1, Chapter 7
Average annual air temperature at site (°C)	9.95	8.955	10.945	Annual met station data
Average depth of peat at site (m)	0.71	0.639	0.781	EIAR Vol 1, Chapter 7
C Content of dry peat (% by weight)	42.71	19	56	Lab data from survey samples. EIAR Vol1 Chapter 7
Average extent of drainage around drainage features at site (m)	10	9	11	EIAR Vol1 Chapter 8
Average water table depth at site (m)	0.1	0.05	0.3	Observed during survey
Dry soil bulk density ($g\ cm^{-3}$)	0.3	0.29	0.3	Maximum value allowed. EIAR Vol 1, Chapter 7.
Characteristics of bog plants				
Time required for regeneration of bog plants after restoration (years)	10	5	15	Standard value
Carbon accumulation due to C fixation by bog plants in undrained peats ($tC\ ha^{-1}\ yr^{-1}$)	0.25	0.12	0.31	Value from SNH guidance.
Forestry Plantation Characteristics				
Area of forestry plantation to be felled (ha)	121.6	109.44	133.76	EIAR Vol4, TA 14.4
Average rate of carbon sequestration in timber ($tC\ ha^{-1}\ yr^{-1}$)	3.6	3.24	3.96	SNH guidance. EIAR Vol 1 Chapter 14

Input data	Expected value	Minimum value	Maximum value	Source of data
Counterfactual emission factors				
Coal-fired plant emission factor (t CO2 MWh^{-1})	0.92	0.92	0.92	
Grid-mix emission factor (t CO2 MWh^{-1})	0.25358	0.25358	0.25358	
Fossil fuel-mix emission factor (t CO2 MWh^{-1})	0.45	0.45	0.45	
Borrow pits				
Number of borrow pits	8	8	8	EIAR Vol 1, Chapter 4
Average length of pits (m)	65.86	59.274	72.446	EIAR Vol 1, Chapter 4
Average width of pits (m)	65.86	59.274	72.446	EIAR Vol 1, Chapter 4
Average depth of peat removed from pit (m)	0.54	0.486	0.594	EIAR Vol 4, TA 7.1
Access tracks				
Total length of access track (m)	25582	24282.8	26881.2	EIAR Vol1, Chapter 4
Existing track length (m)	12590	12590	12590	EIAR Vol 1, Chapter 4
Length of access track that is floating road (m)	4335	3901.5	4768.5	EIAR Vol 1, Chapter 4
Floating road width (m)	5	5	5	EIAR Vol 1, Chapter 4
Floating road depth (m)	0	0	0	EIAR Vol 1, Chapter 4
Length of floating road that is drained (m)	2167.5	1734	2601	EIAR Vol1, Chapter 4
Average depth of drains associated with floating roads (m)	0.3	0	0.3	EIAR Vol1, Chapter 4
Length of access track that is excavated road (m)	8657	7791.3	9522.7	EIAR Vol 1, Chapter 4
Excavated road width (m)	5	5	5	EIAR Vol1, Chapter 4
Average depth of peat excavated for road (m)	0.57	0.513	0.627	EIAR Vol 4, TA 7.1
Length of access track that is rock filled road (m)	0	0	0	EIAR Vol1, Chapter 4
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	EIAR Vol1, Chapter 4
Average depth of peat cut for cable trenches (m)	0	0	0	EIAR Vol1, Chapter 4
Additional peat excavated (not already accounted for above)				
Volume of additional peat excavated (m^3)	3522.5	3170.25	3874.75	EIAR Vol 4 TA 7.1 Includes permanent control compound and met mast hardstanding
Area of additional peat excavated (m^2)	6125	5512.5	6737.5	EIAR Vol 4 TA 7.1 Includes permanent control compound and met mast hardstanding
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				

Input data	Expected value	Minimum value	Maximum value	Source of data
Improvement of degraded bog				
Area of degraded bog to be improved (ha)	45	40.5	49.5	EIAR Vol 4, TA 8.7 Habitat Management Plan
Water table depth in degraded bog before improvement (m)	0.1	0.05	0.3	observed in site survey
Water table depth in degraded bog after improvement (m)	0.09	0.04	0.29	EIAR Vol 1 Chapter 7
Time required for hydrology and habitat of bog to return to its previous state on improvement (years)	10	5	15	Standard Value
Period of time when effectiveness of the improvement in degraded bog can be guaranteed (years)	40	40	40	EIAR Vol 1 Chapter 4
Improvement of felled plantation land				
Area of felled plantation to be improved (ha)	0	0	0	EIAR Vol 1, Chapter 14
Water table depth in felled area before improvement (m)	0	0	0	n/a
Water table depth in felled area after improvement (m)	0	0	0	n/a
Time required for hydrology and habitat of felled plantation to return to its previous state on improvement (years)	10	5	15	Standard value
Period of time when effectiveness of the improvement in felled plantation can be guaranteed (years)	40	40	40	EIAR Vol1 Chapter 4
Restoration of peat removed from borrow pits				
Area of borrow pits to be restored (ha)	3.47	3.123	3.817	EIAR Vol 1 Chapter 4
Depth of water table in borrow pit before restoration with respect to the restored surface (m)	0.1	0.05	0.3	Observed in site survey
Depth of water table in borrow pit after restoration with respect to the restored surface (m)	0.09	0.04	0.29	EIAR Vol 1 Chapter 7
Time required for hydrology and habitat of borrow pit to return to its previous state on restoration (years)	10	5	15	Standard value
Period of time when effectiveness of the restoration of peat removed from borrow pits can be guaranteed (years)	40	40	40	EIAR Vol 1 Chapter 4 - total lifetime of windfarm
Early removal of drainage from foundations and hardstanding				
Water table depth around foundations and hardstanding before restoration (m)	0	0	0	N/A no early removal
Water table depth around foundations and hardstanding after restoration (m)	0	0	0	N/A no early removal
Time to completion of backfilling, removal of any surface drains, and full restoration of the hydrology (years)	2	2	2	EIAR Vol 1 Chapter 4
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	CEMP
Will you attempt to block all artificial ditches and facilitate rewetting?	Yes	Yes	Yes	CEMP

Input data	Expected value	Minimum value	Maximum value	Source of data
Will the habitat of the site be restored on decommissioning?	Yes	Yes	Yes	
Will you control grazing on degraded areas?	n/a	n/a	n/a	EIAR Vol 1, Chapter 4
Will you manage areas to favour reintroduction of species	Yes	Yes	Yes	EIAR Vol 1, Chapter 7
Methodology				
Choice of methodology for calculating emission factors	Site specific (required for planning applications)			

Forestry input data

N/A

Construction input data

Input data	Expected value	Minimum value	Maximum value	Source of data
Site				
Number of turbines in this area	18	18	18	EIAR Vol 1 Chapter 4
Turbine foundations				
Depth of hole dug when constructing foundations (m)	0.769	0.6921	0.8459	EIAR Vol 4, TA 7.1
Aproximate geometric shape of whole dug when constructing foundations	Circular	Circular	Circular	EIAR Vol 1 Chapter 4
Diameter at bottom	30	30	30	
Diameter at surface	37	37	37	
Hardstanding				
Depth of hole dug when constructing hardstanding (m)	0.786	0.7074	0.8646	EIAR Vol 4, TA 7.1
Aproximate geometric shape of whole dug when constructing hardstanding	Rectangular	Rectangular	Rectangular	EIAR Vol 1 Chapter 4. hardstanding plus laydown
Length at surface	80	80	80	
Width at surface	55	55	55	
Length at bottom	80	80	80	
Width at bottom	55	55	55	
Piling				
Is piling used?	No	No	No	EIAR Vol 1 Chapter 4
Volume of Concrete				
Volume of concrete used (m^3) in the entire area	15000	13500	16500	EIAR Vol 1 Chapter 4

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