Sheirdrim Renewable Energy Development

EIA Report Technical Appendix 15.1: Carbon Calculator October 2019

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Sheirdrim Renewable Energy Development Location: -19 66
ScottishPower Renewables Ltd

Core input data

Input data	Expected value	Minimum value	Maximum value	Source of data
Windfarm characteristics				
Dimensions				
No. of turbines	19	19	19	ES Chapter 2
Duration of consent (years)	40	40	40	ES Chapter 2
Performance				
Power rating of 1 turbine (MW)	6	6	6	ES Chapter 2
Capacity factor	35.8	33	39	ES Chapter 2
Backup				
Fraction of output to backup (%)	5	5	5	ES Chapter 2
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	ES Chapter 8
Average annual air temperature at site (°C)	5	4	6	ES Chapter 10-
Average depth of peat at site (m)	0.68	0.6799	0.6801	ES Chapter 10 TA10.1
C Content of dry peat (% by weight)	55	49	62	ES Chapter 10 TA 10.1
Average extent of drainage around drainage features at site (m)	5	4	6	ES Chapter 10
Average water table depth at site (m)	0.2	0.1	0.3	ES Chapter 10
Dry soil bulk density (g cm^{-3})	0.2	0.18	0.22	ES Chapter 10
Characteristics of bog plants				
Time required for regeneration of bog plants after restoration (years)	2	2	2	ES Chapter 8
Carbon accumulation due to C fixation by bog plants in undrained peats (tC ha^{-1} yr^{-1})	0.25	0.24	0.26	ES Chapter 8
Forestry Plantation Characteristics				
Area of forestry plantation to be felled (ha)	49	48.999	49.001	ES Chapter 15
Average rate of carbon sequestration in timber (tC ha^{-1} yr^{-1})	3.6	3.599	3.601	ES Chapter 15
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	5	5	5	ES Chapter 10 TA 10.5
Average length of pits (m)	100	100	100	ES Chapter 10 TA 10.5
Average width of pits (m)	90	90	90	ES Chapter 10 TA 10.5
Average depth of peat removed from pit (m)	0.18	0.18	0.18	ES Chapter 10 mTA 10.5
Access tracks				
Total length of access track (m)	20650	20649.8	20650.2	ES Chapter 2
Existing track length (m)	14820	14820	14820	ES Chapter 2
Length of access track that is floating road (m)	1410	1409.9	1410.1	ES Chapter 2
Floating road width (m)	7	7	7	ES Chapter 2
Floating road depth (m)	0	0	0	ES Chapter 2
Length of floating road that is drained (m)	1410	1409.9	1410.1	ES Chapter 2
Average depth of drains associated with floating roads (m)	0.3	0.3	0.3	ES Chapter 2 CEMP
Length of access track that is excavated road (m)	4420	4419.9	4420.1	ES Chapter 2
Excavated road width (m)	5	5	5	ES Chapter 2

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Excavated road width (m)	5	5	5	ES Chapter 2
Average depth of peat excavated for road (m)	0.64	0.64	0.64	ES Chapter 10 TA 10.1
Length of access track that is rock filled road (m)	0	0	0	ES
Rock filled road width (m)	5	5	5	ES
Rock filled road depth (m)	0	0	0	ES
Length of rock filled road that is drained (m)	0	0	0	ES
Average depth of drains associated with rock filled roads (m)	1	1	1	ES Chapter 10
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	ES Chapter 2
Average depth of peat cut for cable trenches (m)	1	1	1	ES Chapter 2
Additional peat excavated (not already accounted for above)				
Volume of additional peat excavated (m^3)	0	0	0	ES Chapter 10 TA 10.2
Area of additional peat excavated (m^2)	0	0	0	ES Chapter 10.2
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	ES Chapter 8
Water table depth in degraded bog before improvement (m)	0	0	0	ES Chapter 8
Water table depth in degraded bog after improvement (m)	0	0	0	ES Chapter 8
Time required for hydrology and habitat of bog to return to its previous state on improvement (years)	2	2	2	ES Chapter 8
Period of time when effectiveness of the improvement in degraded bog can be guaranteed (years)	2	2	2	ES Chapter 8
Improvement of felled plantation land				
Area of felled plantation to be improved (ha)	20	20	20	ES Chapter 15
Water table depth in felled area before improvement (m)	0.2	0.19999	0.2001	ES Chapter 15
Water table depth in felled area after improvement (m)	0.1999	0.1998	0.20009	ES Chapter 15
Time required for hydrology and habitat of felled plantation to return to its previous state on improvement (years)	2	2	2	ES Chapter 15
Period of time when effectiveness of the improvement in felled plantation can be guaranteed (years)	2	2	2	ES Chapter 15
Restoration of peat removed from borrow pits				
Area of borrow pits to be restored (ha)	15	15	15	ES Chapter 10 TA 10.5
Depth of water table in borrow pit before restoration with respect to the restored surface (m)	2	1.999	2.001	ES Chapter 10 TA 10.5
Depth of water table in borrow pit after restoration with respect to the restored surface (m)	0.3	0.2999	0.3001	ES Chapter 10 TA 10.5
Time required for hydrology and habitat of borrow pit to return to its previous state on restoration (years)	2	2	2	ES Chapter 10 TA 10.5
Period of time when effectiveness of the restoration of peat removed from borrow pits can be guaranteed (years)	2	2	2	ES Chapter 10 TA 10.2
Early removal of drainage from foundations and hardstanding				
Water table depth around foundations and hardstanding before restoration (m)	0.3	0.2999	0.3001	ES Chapter 10
Water table depth around foundations and hardstanding after restoration (m)	0.2	0.1999	0.2001	ES Chapter 10
Time to completion of backfilling, removal of any surface drains, and full restoration of the hydrology (years)	2	2	2	ES Chapter 10
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	ES Chapter 8
Will you attempt to block all artificial ditches and facilitate rewetting?	Yes	Yes	Yes	ES Chapter 8
Will the habitat of the site be restored on decommissioning?	No	No	No	
Will you control grazing on degraded areas?	No	No	No	ES Chapter 8
Will you manage areas to favour reintroduction of species	Yes	Yes	Yes	ES Chapter 8
Methodology				
Choice of methodology for calculating emission factors	Site specific (required for planning applications)			

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Time required for hydrology and habitat of felled plantation to return to its previous state on improvement (years)	2	2	2	ES Chapter 15
Period of time when effectiveness of the improvement in felled plantation can be guaranteed (years)	2	2	2	ES Chapter 15
Restoration of peat removed from borrow pits				
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Time required for hydrology and habitat of borrow pit to return to its previous state on restoration (years)	2	2	2	ES Chapter 10 TA 10.5
Period of time when effectiveness of the restoration of peat removed from borrow pits can be guaranteed (years)	2	2	2	ES Chapter 10 TA 10.2
Early removal of drainage from foundations and hardstanding				
Water table depth around foundations and hardstanding before restoration (m)	0.3	0.2999	0.3001	ES Chapter 10
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Time to completion of backfilling, removal of any surface drains, and full restoration of the hydrology (years)	2	2	2	ES Chapter 10
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	ES Chapter 8
Will you attempt to block all artificial ditches and facilitate rewetting?	Yes	Yes	Yes	ES Chapter 8
Will the habitat of the site be restored on decommissioning?	No	No	No	
Will you control grazing on degraded areas?	No	No	No	ES Chapter 8
Will you manage areas to favour reintroduction of species	Yes	Yes	Yes	ES Chapter 8
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	19	19	19	ES Chapter 2
Turbine foundations				
Depth of hole dug when constructing foundations (m)	0.64	0.64	0.64	ES Chapter 2
Aproximate geometric shape of whole dug when constructing foundations	Rectangular	Rectangular	Rectangular	ES Chapter 2
Length at surface	28	28	28	
Width at surface	28	28	28	
Length at bottom	22	22	22	
Width at bottom	22	22	22	
Hardstanding				
Depth of hole dug when constructing hardstanding (m)	0.63	0.63	0.63	ES Chapter 2
Aproximate geometric shape of whole dug when constructing hardstanding	Rectangular	Rectangular	Rectangular	ES Chapter 2
Length at surface	72	72	72	
Width at surface	30	30	30	
Length at bottom	70	70	70	
Width at bottom	28	28	28	
Piling				
Is piling used?	No	No	No	ES Chapter 2
Volume of Concrete				
Volume of concrete used (m^3) in the entire area	9120	9120	9120	ES Chapter 2

Payback Time and CO_2 emissions • 3G17-2RPY-IEN5 v8

1. Windfarm CO2 emission saving over...	Exp.	Min.	Max.
...coal-fired electricity generation (t CO2 / yr)	328,912	303,187	358,312
...grid-mix of electricity generation (t CO2 / yr)	90,658	83,568	98,762
...fossil fuel-mix of electricity generation (t CO2 / yr)	160,881	148,298	175,261
Energy output from windfarm over lifetime (MWh)	14,300,525	13,182,048	15,578,784

Total CO2 losses due to wind farm (tCO2 eq.)	Exp.	Min.	Max.
2. Losses due to turbine life (eg. manufacture, construction, decomissioning)	100,514	100,514	100,514
3. Losses due to backup	89,878	89,878	89,878
4. Lossess due to reduced carbon fixing potential	905	796	1,021
5. Losses from soil organic matter	19,350	12,432	26,087
6. Losses due to DOC & POC leaching	1	0	2
7. Losses due to felling forestry	25,872	25,865	25,880
Total losses of carbon dioxide	236,521	229,484	243,382

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	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	-769	-600	-946
Total change in emissions due to improvements	-769	-600	-946

RESULTS	Exp.	Min.	Max.
Net emissions of carbon dioxide (t CO2 eq.)	235,752	228,538	242,782
Carbon Payback Time			
...coal-fired electricity generation (years)	0.7	0.6	0.8
...grid-mix of electricity generation (years)	2.6	2.3	2.9
...fossil fuel-mix of electricity generation (years)	1.5	1.3	1.6
Ratio of soil carbon loss to gain by restoration (not used in Scottish applications)	25.16	13.14	43.48
Ratio of CO2 eq. emissions to power generation (g/kWh) (for info. only)	16.49	14.67	18.42