Galileo 05 Limited

Lynemore Wind Farm

Additional Information Volume 4

Appendix 13.1 The Scottish Government's Carbon Assessment Tool

663991 (02)

DECEMBER 2025

GALILEO EMPOWER

RSK

1 REVISED IMPACT ASSESSMENT

The Revised Proposed Development input parameters and results outputs are displayed below, in **Table 1.1** Input Parameter Data for the Scottish Government's Carbon Assessment Tool and **Table 1.2**. For further information, please refer to **Additional Information Chapter 13 Other Issues-Climate in Volume 2**.

Table 1.1 Input Parameter Data for the Scottish Government's Carbon Assessment Tool

CARBON ASSESSMENT TOOL v2.14.1				
1. Input data	**Expected value**	**Minimum value**	**Maximum value**	**Source of data**
Wind farm characteristics				
Dimensions				
No. of turbines	12	12	12	Chapter 2: Proposed Development
Duration of consent (years)	50	50	50	Chapter 2: Proposed Development
Performance				
Power rating of 1 turbine (MW)	7.2	7.2	7.2	Chapter 2: Proposed Development
Capacity factor	25	22.5	27.5	DUKES (2025) Load factors for renewable energy generation
Backup				
Fraction of output to backup (%)	0%	0%	0%	Standard value recommended by the carbon calculator (BESS present)
Additional emissions due to reduced thermal efficiency of the reserve generation (%)	10%	10%	10%	Default value of carbon calculator - (Dale *et al.*, 2004)
Total CO_2 emission from turbine life (tCO_2 MW^{-1}) (e.g. manufacture, construction, decommissioning)	Calculate wrt installed capacity	Calculate wrt installed capacity	Calculate wrt installed capacity	This is the option selected in the Scottish Government Carbon Calculator
Characteristics of peatland before wind farm development				
Type of peatland	Acid Bog			Chapter 8: Hydrology, Geology, Hydrogeology and Peat (Technical Specialist)
Average annual air temperature at site (°C)	9.17	5.66	12.68	Met office weather station: Inverness
Average depth of peat at site (m)	1.10	0.95	1.17	Chapter 8: Hydrology, Geology, Hydrogeology and Peat (Technical Specialist)

Content of dry peat (% by weight)	55	49	61	Default value of carbon calculator - (Birnie et al., 1991)
Average extent of drainage around drainage features at site (m)	28	17	39	Chapter 8: Hydrology, Geology, Hydrogeology and Peat (Technical Specialist)
Average water table depth at site (m)	0.085	0.06	0.11	Chapter 8: Hydrology, Geology, Hydrogeology and Peat (Technical Specialist)
Dry soil bulk density (g cm^{-3})	0.20	0.18	0.22	Default value of carbon calculator - (Lilly et al., 2010)
Characteristics of bog plants				
Time required for regeneration of bog plants after restoration (years)	22.5	15	30	Chapter 8: Hydrology, Geology, Hydrogeology and Peat (Technical Specialist)
Carbon accumulation due to C fixation by bog plants in undrained peats (tC ha^{-1} yr^{-1})	0.25	0.225	0.275	Default value of carbon calculator - (SNH Guidance (Lilly et al., 2010))
Forestry Plantation Characteristics				
Area of forestry plantation to be felled (ha)	0.74	0.74	0.74	Chapter 13: Other Issues (13.8.2), and AI Chapter 12 (12.1.10)-Forestry (Technical Specialist)
Average rate of carbon sequestration in timber (tC ha^{-1} yr^{-1})	3.60	3.24	3.96	Default value of carbon calculator - (Cannell, 1999)
Counterfactual emission factors				
Coal-fired plant emission factor (t CO_2 MWh^{-1})	0.945	0.945	0.945	Default value (Scottish Government Carbon Calculator)
Grid-mix emission factor (t CO_2 MWh^{-1})	0.207	0.207	0.207	Default value (Scottish Government Carbon Calculator)
Fossil fuel-mix emission factor (t CO_2 MWh^{-1})	0.424	0.424	0.424	Default value (Scottish Government Carbon Calculator)
Borrow pits				
Number of borrow pits	1	1	1	Chapter 8: Hydrology, Geology, Hydrogeology and Peat (Technical Specialist)
Average length of pits (m)	165	150	180	Chapter 8: Hydrology, Geology, Hydrogeology and Peat (Technical Specialist)
Average width of pits (m)	120	110	130	Chapter 8: Hydrology, Geology, Hydrogeology

				and Peat (Technical Specialist)
Average depth of peat removed from pit (m)	0.78	0.70	0.86	Chapter 8: Hydrology, Geology, Hydrogeology and Peat (Technical Specialist)
Foundations and hard-standing area associated with each turbine				
Shape (circular/octagonal/hexagonal)	Circular			Chapter 2: Proposed Development
Diameter/side at surface (m)	12	12	12	Chapter 2: Proposed Development
Diameter/side at bottom (m)	25	25	25	Chapter 2: Proposed Development
Average depth of peat removed from turbine foundations [m]	0.99	0.89	1.09	Chapter 8: Hydrology, Geology, Hydrogeology and Peat (Technical Specialist)
Average length of hard-standing at surface [m]	215	215	215	Chapter 2: Proposed Development
Average length of hard-standing at bottom [m]	215	215	215	Chapter 2: Proposed Development
Average width of hard-standing at surface [m]	61.5	61.5	61.5	Chapter 2: Proposed Development
Average width of hard-standing at bottom [m]	61.5	61.5	61.5	Chapter 2: Proposed Development
Average depth of peat excavated when constructing hard-standing [m]	0.99	0.89	1.09	Chapter 8: Hydrology, Geology, Hydrogeology and Peat (Technical Specialist)
Is piling used? (Yes/No)	No			Chapter 2: Proposed Development
Volume of concrete (m^3)	20,160	20,160	20,160	Chapter 2: Proposed Development
Access tracks				
Total length of access track (m)	11,060	9,954	12,166	Infrastructure design and aggregate estimates
Existing track length (m)	0	0	0	Infrastructure design and aggregate estimates
Length of access track that is floating road (m)	800	720	880	Infrastructure design and aggregate estimates
Width of access track that is floating road (m)	6	5.4	6.6	Infrastructure design and aggregate estimates
Depth of floating road (m)	0.80	0.72	0.88	Infrastructure design and aggregate estimates
Length of floating road that is drained (m)	800	720	880	Infrastructure design and aggregate estimates

Average depth of drains associated with floating roads (m)	0.21	0.16	0.26	Infrastructure design and aggregate estimates
Length of access track that is excavated road (m)	10,260	9,234	11,286	Infrastructure design and aggregate estimates
Excavated road width (m)	6	5.4	6.6	Infrastructure design and aggregate estimates
Average depth of peat excavated for road (m)	0.97	0.87	1.07	Chapter 8: Hydrology, Geology, Hydrogeology and Peat (Technical Specialist)
Length of access track that is rock filled road (m)	0	0	0	Infrastructure design and aggregate estimates
Rock filled road width (m)	0	0	0	Infrastructure design and aggregate estimates
Rock filled road depth (m)	0	0	0	Infrastructure design and aggregate estimates
Length of rock filled road that is drained (m)	0	0	0	Infrastructure design and aggregate estimates
Average depth of drains associated with rock filled roads (m)	0	0	0	Infrastructure design and aggregate estimates
Cable trenches				
Length of any cable trench on peat that does not follow access tracks and is lined with a permeable medium (e.g. sand) (m)	0	0	0	Infrastructure design and aggregate estimates
Average depth of peat cut for cable trenches (m)	0	0	0	Chapter 8: Hydrology, Geology, Hydrogeology and Peat (Technical Specialist)
Additional peat excavated (not already accounted for above)				
Volume of additional peat excavated (m^3)	248,903	224,013	273,793	Chapter 8: Hydrology, Geology, Hydrogeology and Peat (Technical Specialist)
Area of additional peat excavated (m^2)	223,556	201,200	245,912	Chapter 8: Hydrology, Geology, Hydrogeology and Peat (Technical Specialist)
Peat Landslide Hazard				
Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments	Negligible			Chapter 8: Hydrology, Geology, Hydrogeology and Peat (Technical Specialist)

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)	218.0	196.2	239.8	Chapter 8: Hydrology, Geology, Hydrogeology and Peat /Chapter 6: Ecology (Technical Specialist)
Water table depth in degraded bog before improvement (m)	0.30	0.23	0.38	Chapter 8: Hydrology, Geology, Hydrogeology and Peat (Technical Specialist)
Water table depth in degraded bog after improvement (m)	0.10	0.09	0.11	Chapter 8: Hydrology, Geology, Hydrogeology and Peat (Technical Specialist)
Time required for hydrology and habitat of bog to return to its previous state on improvement (years)	12.5	10	15	Chapter 8: Hydrology, Geology, Hydrogeology and Peat /Chapter 6: Ecology (Technical Specialist)
Period of time when effectiveness of the improvement in degraded bog can be guaranteed (years)	40	40	40	Chapter 8: Hydrology, Geology, Hydrogeology and Peat /Chapter 6: Ecology (Technical Specialist)
Improvement of felled plantation land				
Area of felled plantation to be improved (ha)	0.74	0.74	0.74	Chapter 13: Other Issues (13.8.2), and AI Chapter 12 (12.1.10)- Forestry (Technical Specialist)
Water table depth in felled area before improvement (m)	0.5	0.2	1.0	Chapter 8: Hydrology, Geology, Hydrogeology and Peat (Technical Specialist)
Water table depth in felled area after improvement (m)	0.2	0.1	0.3	Chapter 8: Hydrology, Geology, Hydrogeology and Peat (Technical Specialist)
Time required for hydrology and habitat of felled plantation to return to its previous state on improvement (years)	15	15	15	Chapter 8: Hydrology, Geology, Hydrogeology and Peat /Chapter 13: Other Issues- Forestry (Technical Specialist)
Period of time when effectiveness of the improvement in felled plantation can be guaranteed (years)	25	25	25	Chapter 8: Hydrology, Geology, Hydrogeology and Peat /Chapter 13: Other Issues- Forestry (Technical Specialist)
Restoration of peat removed from borrow pits				
Area of borrow pits to be restored (ha)	0	0	0	Chapter 8: Hydrology, Geology, Hydrogeology

				and Peat (Technical Specialist)
Depth of water table in borrow pit before restoration with respect to the restored surface (m)	0	0	0	Chapter 8: Hydrology, Geology, Hydrogeology and Peat (Technical Specialist)
Depth of water table in borrow pit after restoration with respect to the restored surface (m)	0	0	0	Chapter 8: Hydrology, Geology, Hydrogeology and Peat (Technical Specialist)
Time required for hydrology and habitat of borrow pit to return to its previous state on restoration (years)	0	0	0	Chapter 8: Hydrology, Geology, Hydrogeology and Peat (Technical Specialist)
Period of time when effectiveness of the restoration of peat removed from borrow pits can be guaranteed (years)	0	0	0	Chapter 8: Hydrology, Geology, Hydrogeology and Peat (Technical Specialist)
Early removal of drainage from foundations and hardstanding				
Water table depth around foundations and hard standing before restoration (m)	0.3	0.1	0.5	Chapter 8: Hydrology, Geology, Hydrogeology and Peat (Technical Specialist)
Water table depth around foundation and hard standing after restoration (m)	0.4	0.2	0.6	Chapter 8: Hydrology, Geology, Hydrogeology and Peat (Technical Specialist)
Time to completion of backfilling, removal of any surface drains, and full restoration of hydrology (years)	5	2	10	Chapter 8: Hydrology, Geology, Hydrogeology and Peat (Technical Specialist)
Early removal of drainage from foundations and hardstanding				
Will you attempt to block any gullies that have formed due to the windfarm?	Yes			Chapter 8: Hydrology, Geology, Hydrogeology and Peat (Technical Specialist)
Will you attempt to block all artificial ditches and facilitate rewetting?	Yes			Chapter 8: Hydrology, Geology, Hydrogeology and Peat (Technical Specialist)
Will you control grazing on degraded areas?	Yes			Chapter 8: Hydrology, Geology, Hydrogeology and Peat (Technical Specialist)
Will you manage areas to favour reintroduction of species	Yes			Chapter 8: Hydrology, Geology, Hydrogeology and Peat (Technical Specialist)
Methodology				
Choice of methodology for calculating emission factors	Site specific (required for planning applications)			

Table 1.2: Output Parameter Data for the Scottish Government's Carbon Assessment Tool

CARBON ASSESSMENT TOOL v2.14.1			
Output data	**Expected value**	**Minimum value**	**Maximum value**
1. Wind farm CO_2 emission saving over...			
...coal-fired electricity generation (t CO_2 / yr)	178,809	160,928	196,690
...grid-mix of electricity generation (t CO_2 / yr)	39,168	35,251	43,084
...fossil fuel-mix of electricity generation (t CO_2 / yr)	80,228	72,205	88,250
Energy output from windfarm over lifetime (MWh)	9,460,800	8,514,720	10,406,880
2. Total CO_2 losses due to wind farm (tCO_2e)			
2. Losses due to turbine life (e.g. manufacture, construction, decommissioning)	81,488	81,488	81,488
3. Losses due to backup	0	0	0
4. Losses due to reduced carbon fixing potential	9,454	5,158	15,728
5. Losses from soil organic matter	201,982	133,213	288,900
6. Losses due to DOC & POC leaching	19,562	2,738	53,422
7. Losses due to felling forestry	488	440	537
8. Losses due to BESS	10,000	9,000	11,000
Total losses of carbon dioxide*	**322,974**	**232,036**	**451,075**
9. Total CO_2 changes due to improvement of site (tCO_2e)			
9a. Change in emissions due to improvement of degraded bogs	-47,174	-21,869	-81,504
9b. Change in emissions due to improvement of felled forestry	-107	0	-151
9c. Change in emissions due to restoration of peat from borrow pits	0	0	0
9d. Change in emissions due to removal of drainage from foundations & hardstanding	0	0	-26,692
Total change in emissions due to improvements	**-47,280**	**-21,869**	**-108,346**
Results			
Net emissions of carbon dioxide (tCO_2e)*	**275,693**	**123,690**	**429,205**
...coal-fired electricity generation (years)*	1.5	0.6	2.7

...grid-mix of electricity generation (years)*	7.0	2.9	12.2
...fossil fuel-mix of electricity generation (years)*	3.4	1.4	5.9
Ratio of soil carbon loss to gain by restoration (not used in Scottish applications)	**No gains!**	**No gains!**	**No gains!**
* Blue shaded cells denote those that have been modified from the carbon calculator output due to the inclusion of embodied emissions from BESS			