Appendix 16.1 Scottish Government – Carbon Calculator Input and Output Data

COVER

CARBON CALCULATOR TOOL v1.7.0

Help About...

Scottish Government and SEPA users only:

Application Status Control

Start Carbon Calculator

This tool calculates payback time for windfarm sited on peatlands using methods given in Nayak et al, 2008 (http://www.gov.scot/Publications/2008/06/25114657/0) and revised equations for GHG emissions (Nayak, D.R., Miller, D., Nolan, A., Smith, P. and Smith, J.U., 2010, Calculating carbon budgets of wind farms on Scottish peatland. Mires and Peat 4: Art. 9. Online: http://mires-and-peat.net/pages/volumes/map04/map0409.php

Start

CARBON CALCULATOR TOOL v1.7.0

- Will the site be drained on construction of the windfarm?
- Is the soil at the site highly organic?
- Does windfarm construction require a significant amount of deforestation?
  i.e. is removal in excess of keyholing the turbines within the forest boundary?

New application

If you already have an Application Reference, type it here (or paste it in the first box):

D09B VJCI SK6J Search

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View Edit...

Core Input

Core input data

Input data	Expected value	Minimum value	Maximum value	Source of data
Windfarm characteristics				
Dimensions				
No. of turbines	12	12	12	Chapter 2: Development Description
Duration of consent (years)	40	40	40	Chapter 2: Development Description
Performance				
Power rating of 1 turbine (MW)	7.2	6	7.2	Chapter 2: Development Description
Capacity factor	35	34	36	Chapter 16: Air & Climate
Backup				
Fraction of output to backup (%)	5	5	5	SNH Calculator Guidance
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	Fen	Fen	Fen	Chapter 6 : Biodviersity
Average annual air temperature at site (°C)	10.4	10.3	10.5	Chapter 16: Air & Climate
Average depth of peat at site (m)	0.1	0.09	0.11	Chapter 8: Soils & Geology
C Content of dry peat (% by weight)	55	50	60	Default Valvue
Average extent of drainage around drainage features at site (m)	10	5	15	Chapter 9 : Hydrology & Hyrdogeology
Average water table depth at site (m)	1	0.99	1	Chapter 9 : Hydrology & Hyrdogeology
Dry soil bulk density (g cm^{-3})	0.1	0.09	0.3	Defualt Value
Characteristics of bog plants				
Time required for regeneration of bog plants after restoration (years)	10	5	15	Best Practice in Bog Restoration Ireland
Carbon accumulation due to C fixation by bog plants in undrained peats (tC ha^{-1} yr^{-1})	0.25	0.24	0.26	Default Value
Forestry Plantation Characteristics				
Area of forestry plantation to be felled (ha)	7.9	7.8	8	Chapter 12: Material Assets
Average rate of carbon sequestration in timber (tC ha^{-1} yr^{-1})	3.6	3.5	3.7	Cannell, 1999
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	

Core Input

Borrow pits				
Number of borrow pits	1	1	1	Chapter 2: Development Description
Average length of pits (m)	127	127	127	Chapter 2: Development Description
Average width of pits (m)	127	127	127	Chapter 2: Development Description
Average depth of peat removed from pit (m)	2	2	2	Chapter 2: Development Description
Foundations and hard-standing area associated with each turbine				
Average length of turbine foundations (m)	25.5	25.4	25.6	Chapter 2: Development Description
Average width of turbine foundations (m)	25.5	25.4	25.6	Chapter 2: Development Description
Average depth of peat removed from turbine foundations(m)	0.1	0.1	0.1	Chapter 8: Soils & Geology
Average length of hard-standing (m)	97	97	97	Chapter 2: Development Description
Average width of hard-standing (m)	35	35	35	Chapter 2: Development Description
Average depth of peat removed from hard-standing (m)	0.1	0.1	0.1	Chapter 8: Soils & Geology
Volume of concrete used in construction of the ENTIRE windfarm				
Volume of concrete (m^3)	9798	9797	9799	Chapter 14: Traffic & Transport
Access tracks				
Total length of access track (m)	12540	12538	12542	Chapter 2: Development Description
Existing track length (m)	1780	1779	1781	Chapter 2: Development Description
Length of access track that is floating road (m)	0	0	0	na
Floating road width (m)	5	5	5	na
Floating road depth (m)	0	0	0	na
Length of floating road that is drained (m)	0	0	0	na
Average depth of drains associated with floating roads (m)	0	0	0	na
Length of access track that is excavated road (m)	10760	10759	10761	Chapter 2: Development Description
Excavated road width (m)	5	5	6	Chapter 2: Development Description
Average depth of peat excavated for road (m)	0.1	0.1	0.1	Chapter 2: Development Description
Length of access track that is rock filled road (m)	0	0	0	na
Rock filled road width (m)	5	5	5	na
Rock filled road depth (m)	0	0	0	na
Length of rock filled road that is drained (m)	0	0	0	na
Average depth of drains associated with rock filled roads (m)	0	0	0	na

Core Input

Length of rock filled road that is drained (m)	0	0	0	na
Average depth of drains associated with rock filled roads (m)	0	0	0	na
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	na
Average depth of peat cut for cable trenches (m)	0	0	0	na
Additional peat excavated (not already accounted for above)				
Volume of additional peat excavated (m^3)	0	0	0	na
Area of additional peat excavated (m^2)	0	0	0	na
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	na
Water table depth in degraded bog before improvement (m)	0	0	0	na
Water table depth in degraded bog after improvement (m)	0	0	0	na
Time required for hydrology and habitat of bog to return to its previous state on improvement (years)	10	5	20	Bog Restoration Ireland
Period of time when effectiveness of the improvement in degraded bog can be guaranteed (years)	25	20	30	na
Improvement of felled plantation land				
Area of felled plantation to be improved (ha)	0	0	0	na
Water table depth in felled area before improvement (m)	0	0	0	na
Water table depth in felled area after improvement (m)	0	0	0	na
Time required for hydrology and habitat of felled plantation to return to its previous state on improvement (years)	2	2	2	Bog Restoration Ireland
Period of time when effectiveness of the improvement in felled plantation can be guaranteed (years)	25	20	30	Best Practice in Bog Restoration Ireland
Restoration of peat removed from borrow pits				
Area of borrow pits to be restored (ha)	0	0	0	na
Depth of water table in borrow pit before restoration with respect to the restored surface (m)	0	0	0	na
Depth of water table in borrow pit after restoration with respect to the restored surface (m)	0	0	0	na
Time required for hydrology and habitat of borrow pit to return to its previous state on restoration (years)	1	1	2	na
Period of time when effectiveness of the restoration of peat removed from borrow pits can be guaranteed (years)	25	20	30	na
Early removal of drainage from foundations and hardstanding				
Water table depth around foundations and hardstanding before restoration (m)	0	0	0	na
Water table depth around foundations and hardstanding after restoration (m)	0	0	0	na
Time to completion of backfilling, removal of any surface drains, and full restoration of the hydrology (years)	0.1	0.1	0.1	na

Core Input

restoration of the hydrology (years)				
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?	n/a	n/a	n/a	na
Will you attempt to block all artificial ditches and facilitate rewetting?	n/a	n/a	n/a	na
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	na
Will you manage areas to favour reintroduction of species	n/a	n/a	n/a	na
Methodology				
Choice of methodology for calculating emission factors	Site specific (required for planning applications)			

Forestry input data

N/A

Construction input data

N/A

Payback Time

Payback Time and CO_2 emissions • D09B-VJCI-SK6J v12

MENU

1. Windfarm CO2 emission saving over...	Exp.	Min.	Max.
...coal-fired electricity generation (t CO2 / yr)	265,432	214,874	273,016
...grid-mix of electricity generation (t CO2 / yr)	51,227	41,469	52,690
...fossil fuel-mix of electricity generation (t CO2 / yr)	114,438	92,640	117,707
Energy output from windfarm over lifetime (MWh)	10,596,096	8,577,792	10,898,842

Total CO2 losses due to wind farm (tCO2 eq.)	Exp.	Min.	Max.
2. Losses due to turbine life (eg. manufacture, construction, decomissioning)	78,213	64,758	78,214
3. Losses due to backup	65,393	54,494	65,393
4. Lossess due to reduced carbon fixing potential	1,778	997	2,818
5. Losses from soil organic matter	-29,958	-27,614	-17,520
6. Losses due to DOC & POC leaching	0	0	0
7. Losses due to felling forestry	4,171	4,004	4,341
Total losses of carbon dioxide	119,598	96,640	133,246

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	0	0	0
Total change in emissions due to improvements	0	0	0

RESULTS	Exp.	Min.	Max.
Net emissions of carbon dioxide (t CO2 eq.)	119,598	96,640	133,246
Carbon Payback Time			
...coal-fired electricity generation (years)	0.5	0.4	0.6
...grid-mix of electricity generation (years)	2.3	1.8	3.2
...fossil fuel-mix of electricity generation (years)	1.0	0.8	1.4
Ratio of soil carbon loss to gain by restoration (not used in Scottish applications)	No gains!	No gains!	No gains!
Ratio of CO2 eq. emissions to power generation (g/kWh) (for info. only)	11.29	8.87	15.53

Payback Charts