Appendix 11A

Carbon Calculator

Input data	Expected values: Enter expected value here	Record source of data
Windfarm characteristics		
Dimensions		
No. of turbines	17	Fixed
Lifetime of windfarm (years)	35	Fixed
Performance		
Power rating of turbines (turbine capacity) (MW)	4.5	Average
Capacity factor	Direct input of capacity fac: 1	
Enter estimated capacity factor (percentage efficiency)	37.0	Eirgrid Report
Backup		
Extra capacity required for backup (%)	5	Value from SNH guidance
Additional emissions due to reduced thermal efficiency of the reserve generation (%)	10	Value from SNH guidance. Over 20% of national electricity is from renewables.
Carbon dioxide emissions from turbine life - (eg. manufacture, construction, decommissioning)	Calculate wrt installed cap: 2	
Characteristics of peatland before windfarm development		
Type of peatland	Acid b: 1	None listed on maps but assumed to be Blanket based on proximity to other identified Blanket Bog Areas
Average annual air temperature at site (^{o}C)	10.7	From Climate Table
Average depth of peat at site (m)	0.40	Avegage depth of peat during survey
C Content of dry peat (% by weight)	55	The carbon content of dry peat is assumed to be 55% (the carbon content of dry peat ranges fro 49 to 62% (MLURI et al., 1991 cited by Nayak et al, 2008)
Average extent of drainage around drainage features at site (m)	10.00	assumption
Average water table depth at site (m)	1.80	SI Report average
Dry soil bulk density (g cm^{-3})	0.10	Default Value
Characteristics of bog plants		
Time required for regeneration of bog plants after restoration (years)	10	Assumption
Carbon accumulation due to C fixation by bog plants in undrained peats (tC ha^{-1} yr^{-1})	0.25	Value from SNH guidance
Forestry Plantation Characteristics		
Method used to calculate CO_2 loss from forest felling	Enter simple data: 1	
Area of forestry plantation to be felled (ha)	14.56	Chapter 2.
Average rate of carbon sequestration in timber (tC ha-1 yr-1)	3.60	Value from SNH guidance
Counterfactual emission factors		
Coal-fired plant emission factor (t CO_2 MWh^{-1})		
Grid-mix emission factor (t CO_2 MWh^{-1})	0.375	Energy Related Co2 emissions I Ireland 2005 to 2018. SEAI.
Fossil fuel-mix emission factor (t CO_2 MWh^{-1})		
Foundations and hard-standing area associated with each turbine		
Method used to calculate CO_2 loss from foundations and hard-standing	Rectangular with verti: 1	
Average length of turbine foundations (m)	26.6	Chapter 2 Circular hardstand.
Average width of turbine foundations (m)	21.5	Circular hardstand.
Average depth of peat removed from turbine foundations (m)	0.00	Potential peat to be removed is in cell C75
Average depth of peat removed from hard-standing (m)	0.00	
Access tracks		
Total length of access track (m)	10800	Civils Chapter
Existing track length (m)	500	Civils Chapter
Length of access track that is floating road (m)	2000	Combination of floated and excavated. Lengths and Areas 2020-12-09. Split evenly.
Floating road width (m)	5.5	Chapter 2 Section 2.5.7
Floating road depth (m)	1.00	Estimate from previous projects
Length of floating road that is drained (m)	0	Combination of floated and excavated. Lengths and Areas
Length of access track that is excavated road (m)	8800	Civils Chapter
Additional peat excavated (not already accounted for above)		
Volume of additional peat excavated (m^3)	4351	Civils Calcs

	Exp.
1. Windfarm CO_2 emission saving over…	
…coal-fired electricity generation (tCO_2 yr^{-1})	0
…grid-mix of electricity generation (tCO_2 yr^{-1})	92982
…fossil fuel - mix of electricity generation (tCO_2 yr^{-1})	0
Energy output from windfarm over lifetime (MWh)	8678313
Total CO_2 losses due to wind farm (t CO_2 eq.)	
2. Losses due to turbine life (eg. manufacture, construction, decomissioning)	63529
3. Losses due to backup	0
4. Losses due to reduced carbon fixing potential	867
5. Losses from soil organic matter	14846
6. Losses due to DOC & POC leaching	76
7. Losses due to felling forestry	6727
Total losses of carbon dioxide	86046
RESULTS	*Exp.*
Net emissions of carbon dioxide (t $CO_{2\ eq.}$)	**86046**
Carbon Payback Time	
…grid-mix of electricity generation (years)	0.9
Ratio of CO_2 eq. emissions to power generation (g / kWh) (TARGET ratio by 2030 (electricity generation) < 50 g /kWh)	**10**