

Core input data

ENTER INPUT DATA HERE! VALUES SHOULD ONLY BE CHANGED ON THIS SHEET. DO NOT USE EXAMPLE VALUES AS DEFAULTS! ENTER YOUR OWN VALUES THAT ARE SPECIFIC TO YOUR PARTICULAR SITE.

Note: The input parameters include some variables that can be specified by default values, but others that must be site specific. Variables that can be taken from defaults are marked with purple tags on left hand side.

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Input data	Expected values	Record source of data	Possible range of values			Record source of data
	Enter expected value here		Enter minimum value here	Enter maximum value here		
Windfarm characteristics						
Dimensions						
No. of turbines	3	Fixed	3	3		Chapter 2: Project Description
Lifetime of windfarm (years)	40		40	40		
Performance						
Power rating of turbines (turbine capacity) (MW)	4		4	4		Chapter 2: Project Description
Capacity factor	Direct input of capacity fac		Direct input of capacity fac	Direct input of capacity fac		
Enter estimated capacity factor (percentage efficiency)	35.0		31.5	38.5		
Backup						
Extra capacity required for backup (%)	5		5	5		All - Island Generation Capacity Statement 2021 - 2030
Additional emissions due to reduced thermal efficiency of the reserve generation (%)	10		10	10		Fixed
Carbon dioxide emissions from turbine life - (eg. manufacture, construction, decommissioning)	Calculate wrt installed cap		Calculate wrt installed cap	Calculate wrt installed cap		
Characteristics of peatland before windfarm development						
Type of peatland	Add b		Add b	Add b		Chapter 6: Biodiversity
Average annual air temperature at site (°C)	1		6.1	16.2		Chapter 10: Air & Climate (Edenderry Monitoring Station)
Average depth of peat at site (m)	1.34		0.00	5.00		Chapter 7: Soils and Geology
C Content of dry peat (%) by weight)	55		50	60		
Average extent of drainage around drainage features at site (m)	15.00		5.00	15.00		
Average water table depth at site (m)	0.50		0.10	1.00		
Dry soil bulk density (g cm ⁻³)	0.10		0.09	0.11		Chapter 8: Hydrology & Hydrogeology
Characteristics of bog plants						
Time required for regeneration of bog plants after restoration (years)	10		5	15		
Carbon accumulation due to C fixation by bog plants in undrained peats (tC ha ⁻¹ yr ⁻¹)	0.25		0.24	0.26		
Forestry Plantation Characteristics						
Method used to calculate CO ₂ loss from forest felling	Enter simple data		Enter simple data	Enter simple data		
Area of forestry plantation to be felled (ha)	0.85		0.85	0.85		Chapter 2: Project Description
Average rate of carbon sequestration in timber (tC ha ⁻¹ yr ⁻¹)	3.60		3.50	3.70		
Counterfactual emission factors						
To update counterfactual emission factors from the web	Click here (not yet operational)					
Coal-fired plant emission factor (t CO ₂ MWh ⁻¹)	1.002		1.002	1.002		
Grid-mix emission factor (t CO ₂ MWh ⁻¹)	0.19338		0.19338	0.19338		
Fossil fuel-mix emission factor (t CO ₂ MWh ⁻¹)	0.432		0.432	0.432		
Borrow pits						
Number of borrow pits	0		0	0		Chapter 2: Project Description
Average length of pits (m)	0		0	0		Chapter 2: Project Description
Average width of pits (m)	0		0	0		Chapter 2: Project Description
Average depth of peat removed from pit (m)	0.00		0.00	0.00		Chapter 2: Project Description
Foundations and hard-standing area associated with each turbine						
Method used to calculate CO ₂ loss from foundations and hard-standing	Rectangular with vertical v		Rectangular with vertical v	Rectangular with vertical v		
Average length of turbine foundations (m)	20.9		20.9	20.9		Chapter 2: Project Description - Largest foundation presumed for all turbines (worst case)
Average width of turbine foundations (m)	25		25	25		Chapter 2: Project Description - Largest foundation presumed for all turbines (worst case)
Average depth of peat removed from turbine foundations (m)	1.10		1.10	1.10		Chapter 2: Project Description - Largest foundation presumed for all turbines (worst case)
Average length of hard-standing (m)	100		100	100		Chapter 2: Project Description - Largest hardstand presumed for all turbines (worst case)
Average width of hard-standing (m)	49.07		49.07	49.07		Chapter 2: Project Description - Largest hardstand presumed for all turbines (worst case)
Average depth of peat removed from hard-standing (m)	1.10		1.10	1.10		Chapter 2: Project Description
Access tracks						
Total length of access track (m)	1625		1625	1625		Chapter 2: Project Description
Existing track length (m)	400		400	400		Chapter 2: Project Description
Length of access track that is floating road (m)	560		560	560		
Floating road width (m)	4.5		4.5	4.5		Chapter 2: Project Description
Floating road depth (m)	0.45		0.45	0.45		Chapter 2: Project Description
Length of floating road that is drained (m)	560		560	560		Chapter 2: Project Description
Average depth of drains associated with floating roads (m)	0.10		0.00	0.10		Chapter 2: Project Description
Length of access track that is excavated road (m)	1225		1225	1225		
Excavated road width (m)	4.5		4.5	4.5		Chapter 2: Project Description
Average depth of peat excavated for road (m)	0.10		0.10	0.10		Chapter 2: Project Description
Length of access track that is rock filled road (m)	0		0	0		
Rock filled road width (m)	0		0	0		Chapter 2: Project Description
Rock filled road depth (m)	0		0	0		Chapter 2: Project Description
Length of rock filled road that is drained (m)	0		0	0		Chapter 2: Project Description
Average depth of drains associated with rock filled roads (m)	0.50		0.50	0.50		Chapter 2: Project Description
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)	0.00		0.00	0.00		Chapter 7: Soils and Geology
Average depth of peat cut for cable trenches (m)	0.00		0.00	0.00		Chapter 7: Soils and Geology
Additional peat excavated (not already accounted for above)						
Volume of additional peat excavated (m ³)	7539		7539	7539		Chapter 7: Soils and Geology
Area of additional peat excavated (m ²)	7539.0		7539.0	7539.0		Chapter 7: Soils and Geology
Peat Landslide Hazard						
Weblink: Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments	negligible		negligible	negligible		Chapter 7: Soils and Geology
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		Chapter 6: Biodiversity 1.09ha of degraded bog for the HMP drains will not have its drained blocked so is omitted from this calculation
Water table depth in degraded bog before improvement (m)	0.1		0	0.2		Chapter 6: Biodiversity 1.09ha of degraded bog for the HMP drains will not have its drained blocked so is omitted from this calculation
Water table depth in degraded bog after improvement (m)	0		0	0		Chapter 6: Biodiversity 1.09ha of degraded bog for the HMP drains will not have its drained blocked so is omitted from this calculation
Time required for hydrology and habitat of bog to return to its previous state on improvement (years)	10		5	20		Chapter 6: Biodiversity 1.09ha of degraded bog for the HMP drains will not have its drained blocked so is omitted from this calculation
Period of time when effectiveness of the improvement in degraded bog can be guaranteed (years)	15		5	15		Chapter 6: Biodiversity 1.09ha of degraded bog for the HMP drains will not have its drained blocked so is omitted from this calculation
Improvement of felled plantation land						
Area of felled plantation to be improved (ha)	0		0	0		Chapter 6: Biodiversity
Water table depth in felled area before improvement (m)	0		0	0		Chapter 6: Biodiversity
Water table depth in felled area after improvement (m)	0		0	0		Chapter 6: Biodiversity
Time required for hydrology and habitat of felled plantation to return to its previous state on improvement (years)	10		5	20		
Period of time when effectiveness of the improvement in felled plantation can be guaranteed (years)	25		20	30		
Restoration of peat removed from borrow pits						
Area of borrow pits to be restored (ha)	0		0	0		Chapter 7: Soils and Geology
Depth of water table in borrow pit before restoration with respect to the restored surface (m)	0.00		0.00	0.00		Chapter 7: Soils and Geology
Depth of water table in borrow pit after restoration with respect to the restored surface (m)	0.00		0.00	0.00		Chapter 7: Soils and Geology
Time required for hydrology and habitat of borrow pit to return to its previous state on restoration (years)	0		0	0		
Period of time when effectiveness of the restoration of peat removed from borrow pits can be guaranteed (years)	0		0	0		
Early removal of drainage from foundations and hardstanding						
Water table depth around foundations and hardstanding before restoration (m)	0.00		0.00	0.00		Chapter 6: Biodiversity
Water table depth around foundations and hardstanding after restoration (m)	0.00		0.00	0.00		Chapter 6: Biodiversity
Time to completion of backfilling, removal of any surface drains, and full restoration of the hydrology (years)	2.5		1	1		Chapter 6: Biodiversity
Restoration of site after decommissioning						
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?	Not apply		Not apply	Not apply		
Will you attempt to block all artificial ditches and facilitate revegetation?	Not apply		Not apply	Not apply		
Will the habitat of the site be restored on decommissioning?	Yes		Yes	Yes		
Will you control grazing on degraded areas?	Not apply		Not apply	Not apply		
Will you manage areas to favour reintroduction of species	Not apply		Not apply	Not apply		
Choice of methodology for calculating emission factors						
IPCC default						

Note: Capacity factor. The capacity factor of any power plant is the proportion of energy produced during a given period with respect to the energy that would have been produced had the windfarm been running continually and at maximum output (DECC, 2004). See also www.bwe.com/uk/capacityfactors.html.

Capacity factor = Electricity generated during the period [MWh] (installed capacity [kW] x number of hours in the period [h]).

We recommend that a site-specific capacity factor should be used (as measured during planning stage), and should represent the average emission factor expected over the lifetime of the windfarm, accounting for decline in efficiency with age (Hughes, 2012). The 5 year average capacity factor (or 'load factor') for UK onshore wind between 2010 and 2014, based on average beginning and end of year capacity, was 29.2% (DUKES, 2015).

Note: Extra capacity required for backup. If 20% of national electricity is generated by wind energy, the extra capacity required for backup is 5% of the rated capacity of the wind plant (Dale et al 2004). We suggest this should be 5% of the actual output. If it is assumed that less than 20% of national electricity is generated by wind energy, a lower percentage should be entered (0%). The House of Lords Economic Affairs Committee report on The Economics of Renewable Energy (Parliamentary Business, 2008) notes that the UK's peak demand is a 20% margin of extra capacity has been sufficient to keep the risk of a power cut due to insufficient generation at a very low level. The estimate provided by BEFR was a range of 10% to 20% of installed capacity of wind energy. E.ON is reported as proposing that the capacity credit of wind power should be 8%, and The Renewable Energy Foundation proposed the use of the square root of the wind capacity (in GW) as conventional capacity (e.g. 36 GW of wind plant is much less than 6 GW of conventional plant).

Note: Extra emissions due to reduced thermal efficiency of the reserve power generation = 10%

Note: Emissions from turbine life. If total emissions for the windfarm are unknown, emissions should be calculated according to turbine capacity. The normal range of CO₂ emissions is 394 to 8147 t CO₂ / MW (White & Kulcinski, 2000; White, 2007).

Note: Type of peatland. An 'acid bog' is fed primarily by rainwater and often inhabited by sphagnum moss, thus making it acidic (Stoneman & Brooks 1997).

A 'fen' is a type of wetland fed by surface and/or groundwater (McBride et al., 2011).

Note: Time required for regeneration of previous habitat. Loss of fixation should be assumed to be over lifetime of windfarm only. This time could be longer if plants do not regenerate. The requirements for after-use planning include the provision of suitable refugia for peat-forming vegetation, the removal of structures, or an assessment of the impact of leaving them in situ. Methods used to reinstate the site will affect the likely time for regeneration of the previous habitat. This time could also be shorter if plants regenerate during lifetime of windfarm. If so, enter number of years estimated for regeneration.

Note: Carbon fixation by bog plants

Apparent C accumulation rate in peatland is 0.12 to 0.31 t C ha⁻¹ yr⁻¹ (Turunen et al., 2001; Botch et al., 1995). The SNH guidance uses a value of 0.25 t C ha⁻¹ yr⁻¹.

Note: Area of forestry plantation to be felled. If the forestry was planned to be removed, with no further rotations planned, before the windfarm development, the area to be felled should be entered as zero.

Note: Plantation carbon sequestration. This is dependent on the yield class of the forestry. The SNH technical guidance assumed yield class of 16 m³ ha⁻¹ yr⁻¹, compared to the value of 14 m³ ha⁻¹ yr⁻¹ provided by the Forestry Commission. Carbon sequestered for yield class 16 m³ ha⁻¹ yr⁻¹ = 3.6 t C ha⁻¹ yr⁻¹ (Cannell, 1999).

Note: Coal-Fired Plant and Grid-Mix Emission Factors. Coal-fired plant emission factor (EF) from electricity supplied in 2014 = 0.093 t CO₂ MWh⁻¹ Grid-Mix EF for 2014 = 0.394 t CO₂ MWh⁻¹ Source = DUKES, 2015b.

Note: Fossil Fuel-Mix Emission Factor. The emission factor from electricity supplied in 2014 from all fossil fuels = 0.642 t CO₂ MWh⁻¹. Source = DUKES, 2015b.

Note: Total length of access track. If areas of access track overlap with hardstanding area, exclude these from the total length of access track to avoid double counting of land area lost.

Note: Floating road depth. Accounts for sinking of floating road. Should be entered as the average depth of the road expected over the lifetime of the windfarm. If no sinking is expected, enter as zero.

Note: Length of floating road that is drained. Refers to any drains running along the length of the

Note: Rock filled roads. Rock filled roads are assumed to be roads where no peat has been removed and rock has been placed on the surface and allowed to settle.

Note: Depth of peat cut for cable trenches. In shallow peats, the cable trenches may be cut below the peat. To avoid overestimating the depth of peat affected by the cable trenches, only enter the depth of the peat that is cut.

Note: Peat Landslide Hazard. It is assumed that measures have been taken to limit damage (Scottish Executive, 2006, Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments, Scottish Executive, Edinburgh, pp. 34-38) so that C losses due to peat landslides can be assumed to be negligible. LINK: <http://www.scotland.gov.uk/Publications/2006/12/16230351>.

How much???

Note: Period of time when improvement can be guaranteed. This guarantee should be absolute. Therefore, if you enter a value beyond the lifetime of the windfarm you should provide strong supporting evidence that this improvement can be guaranteed for the full period given. This includes the time requirement for the improvement to become effective. For example if time required for hydrology and habitat to return to its previous state is 10 years and the restoration can be guaranteed over the lifetime of the windfarm (25 years), the period of time when the improvement can be guaranteed should be entered as 25 years, and the improvement will be effective for (25 - 10) = 15 years.

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Note: Restoration of site. If the water table at the site is returned to its original level or higher on decommissioning, and habitat at the site is restored, it is assumed that C losses continue only over the lifetime of the windfarm. Otherwise, C losses from drained peat are assumed to be 100%.

Note: Choice of methodology for calculating emission factors. The IPCC default methodology is the internationally accepted standard (IPCC, 1997). However, it is stated in IPCC (1997) that these are rough estimates, and 'these rates and production periods can be used if countries do not have more appropriate estimates'. Therefore, we have developed more site specific estimates for use here based on work from the Scottish Government funded ECOSSE project (Smith et al., 2007, ECOSSE: Estimating Carbon in Organic Soils - Sequestration and Emissions, Final Report, SERAD Report, ISBN 978 0 7559 1498 2, 166pp.).

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