Carbon Calculator v1.7.0

Sheskin South Wind Farm Location: 54.161081 -9.629635

SSE

# Core input data

| Input data | Expected value | Minimum value | Maximum value | Source of data |
|---|---|---|---|---|
| Windfarm characteristics | | | | |
| Dimensions | | | | |
| No. of turbines | 21 | 21 | 21 | Chapter 4 Description |
| Duration of consent (years) | 35 | 30 | 40 | Chapter 4 Description |
| Performance | | | | |
| Power rating of 1 turbine (MW) | 7.5 | 6 | 9 | Chapter 4 Description |
| Capacity factor | 0.35 | 0.3 | 0.4 | SEAI Report |
| Backup | | | | |
| Fraction of output to backup (%) | 5 | 5 | 5 | SNH Carbon 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 | Acid bog | Acid bog | Acid bog | . |
| Average annual air temperature at site (°C) | 10.3 | 10.2 | 10.4 | Ch. 10 Air & Climate |
| Average depth of peat at site (m) | 2.2 | 2.1 | 2.3 | Geotechnical & Peat Stability Assessment |
| C Content of dry peat (% by weight) | 55 | 50 | 60 | Default Value used |
| Average extent of drainage around drainage features at site (m) | 10 | 5 | 15 | Ch. 9 Water |
| Average water table depth at site (m) | 0.5 | 0.1 | 1 | Site Specific |
| Dry soil bulk density (g $cm^{-3}$) | 0.1 | 0.09 | 0.11 | Default Value used |
| Characteristics of bog plants | | | | |

| Input data | Expected value | Minimum value | Maximum value | Source of data |
|---|---|---|---|---|
| Time required for regeneration of bog plants after restoration (years) | 10 | 5 | 15 | Best Practice in Raised Bog Restoration in Ireland |
| Carbon accumulation due to C fixation by bog plants in undrained peats (tC $ha^{-1}$ $yr^{-1}$) | 0.25 | 0.2 | 0.3 | SNH Guidance default value |
| Forestry Plantation Characteristics | | | | |
| Area of forestry plantation to be felled (ha) | 117 | 116 | 118 | Ch. 4 Description |
| Average rate of carbon sequestration in timber (tC $ha^{-1}$ $yr^{-1}$) | 3.6 | 3.5 | 3.7 | SNH Guidance default value |
| 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 | |
| Borrow pits | | | | |
| Number of borrow pits | 2 | 1 | 3 | Ch. 4 Description |
| Average length of pits (m) | 688 | 685 | 690 | Peat & Spoil Management Plan |
| Average width of pits (m) | 100 | 95 | 105 | Peat & Spoil Management Plan |
| Average depth of peat removed from pit (m) | 0.75 | 0.5 | 1 | Peat & Spoil Management Plan |
| Foundations and hard-standing area associated with each turbine | | | | |
| Average length of turbine foundations (m) | 28 | 27 | 29 | Ch. 4 Description |
| Average width of turbine foundations (m) | 28 | 27 | 29 | Ch. 4 Description |
| Average depth of peat removed from turbine foundations(m) | 2 | 1.9 | 2.1 | Geotechnical & Peat Stability Assessment Report |
| Average length of hard-standing (m) | 98 | 97 | 99 | Geotechnical & Peat Stability Assessment Report |
| Average width of hard-standing (m) | 35 | 34 | 36 | Geotechnical & Peat Stability Assessment Report |
| Average depth of peat removed from hard-standing (m) | 2 | 1.9 | 2.1 | Geotechnical & Peat Stability Assessment Report |
| Volume of concrete used in construction of the ENTIRE windfarm | | | | |

| Input data | Expected value | Minimum value | Maximum value | Source of data |
|---|---|---|---|---|
| Volume of concrete ($m^3$) | 8400 | 8000 | 9000 | Assumed to be 400m3 per foundation |
| Access tracks | | | | |
| Total length of access track (m) | 24500 | 24300 | 24700 | Ch 4 Description |
| Existing track length (m) | 7800 | 7700 | 7900 | Ch. 4 Description |
| Length of access track that is floating road (m) | 0 | 0 | 0 | |
| Floating road width (m) | 0 | 0 | 0 | |
| Floating road depth (m) | 0 | 0 | 0 | |
| Length of floating road that is drained (m) | 0 | 0 | 0 | |
| Average depth of drains associated with floating roads (m) | 0 | 0 | 0 | |
| Length of access track that is excavated road (m) | 16700 | 16600 | 16800 | Peat & Spoil Management Plan - Figure 1-1 |
| Excavated road width (m) | 5 | 5 | 5 | Peat & Spoil Management Plan - Figure 1-1 |
| Average depth of peat excavated for road (m) | 2 | 1.9 | 2.1 | Peat & Spoil Management Plan - Figure 1-1 |
| Length of access track that is rock filled road (m) | 0 | 0 | 0 | |
| Rock filled road width (m) | 0 | 0 | 0 | |
| Rock filled road depth (m) | 0 | 0 | 0 | |
| Length of rock filled road that is drained (m) | 0 | 0 | 0 | |
| Average depth of drains associated with rock filled roads (m) | 0 | 0 | 0 | |
| 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 | |
| Average depth of peat cut for cable trenches (m) | 0 | 0 | 0 | |
| Additional peat excavated (not already accounted for above) | | | | |
| Volume of additional peat excavated ($m^3$) | 145500 | 145400 | 145600 | Peat & Spoil Management Plan |
| Area of additional peat excavated ($m^2$) | 81450 | 81400 | 81500 | Peat & Spoil Management Plan |
| Peat Landslide Hazard | | | | |
| Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments | negligible | negligible | negligible | Fixed |

| Input data | Expected value | Minimum value | Maximum value | Source of data |
|---|---|---|---|---|
| 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 | N/A |
| Water table depth in degraded bog before improvement (m) | 0 | 0 | 0 | |
| Water table depth in degraded bog after improvement (m) | 0 | 0 | 0 | |
| Time required for hydrology and habitat of bog to return to its previous state on improvement (years) | 0 | 0 | 0 | |
| Period of time when effectiveness of the improvement in degraded bog can be guaranteed (years) | 0 | 0 | 0 | |
| Improvement of felled plantation land | | | | |
| Area of felled plantation to be improved (ha) | 0 | 0 | 0 | N/A |
| Water table depth in felled area before improvement (m) | 0 | 0 | 0 | |
| Water table depth in felled area after improvement (m) | 0 | 0 | 0 | |
| Time required for hydrology and habitat of felled plantation to return to its previous state on improvement (years) | 0 | 0 | 0 | |
| Period of time when effectiveness of the improvement in felled plantation can be guaranteed (years) | 0 | 0 | 0 | |
| Restoration of peat removed from borrow pits | | | | |
| Area of borrow pits to be restored (ha) | 0 | 0 | 0 | N/A |
| Depth of water table in borrow pit before restoration with respect to the restored surface (m) | 0 | 0 | 0 | |
| Depth of water table in borrow pit after restoration with respect to the restored surface (m) | 0 | 0 | 0 | |
| 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 | 0 | 0 | N/A |
| Water table depth around foundations and hardstanding after restoration (m) | 0 | 0 | 0 | |

| Input data | Expected value | Minimum value | Maximum value | Source of data |
|---|---|---|---|---|
| Time to completion of backfilling, removal of any surface drains, and full restoration of the hydrology (years) | 0 | 0 | 0 | |
| Restoration of site after decomissioning | | | | |
| Will the hydrology of the site be restored on decommissioning? | No | No | No | |
| Will you attempt to block any gullies that have formed due to the windfarm? | No | No | No | Decomm. Plan |
| Will you attempt to block all artificial ditches and facilitate rewetting? | No | No | No | Decomm. Plan |
| Will the habitat of the site be restored on decommissioning? | No | No | No | |
| Will you control grazing on degraded areas? | No | No | No | Decomm. Plan |
| Will you manage areas to favour reintroduction of species | No | No | No | Decomm. Plan |
| 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



| 1. Windfarm CO2 emission saving over... | Exp. | Min. | Max. |
|---|---|---|---|
| ...coal-fired electricity generation (t CO2 / yr) | 4,839 | 3,318 | 6,636 |
| ...grid-mix of electricity generation (t CO2 / yr) | 934 | 640 | 1,281 |
| ...fossil fuel-mix of electricity generation (t CO2 / yr) | 2,086 | 1,430 | 2,861 |
| Energy output from windfarm over lifetime (MWh) | 169,013 | 99,338 | 264,902 |

| Total CO2 losses due to wind farm (tCO2 eq.) | Exp. | Min. | Max. |
|---|---|---|---|
| 2. Losses due to turbine life (eg. manufacture, construction, decomissioning) | 139,996 | 110,438 | 169,618 |
| 3. Losses due to backup | 104,305 | 71,524 | 143,047 |
| 4. Lossess due to reduced carbon fixing potential | 3,529 | 1,371 | 7,320 |
| 5. Losses from soil organic matter | 91,374 | 55,684 | 196,099 |
| 6. Losses due to DOC & POC leaching | 0 | 0 | 0 |
| 7. Losses due to felling forestry | 54,054 | 44,660 | 64,035 |
| Total losses of carbon dioxide | 393,259 | 283,677 | 580,120 |

| 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.) | 393,259 | 283,677 | 580,120 |
| | | | |
| Carbon Payback Time | | | |
| ...coal-fired electricity generation (years) | 81.3 | 42.7 | 174.8 |
| ...grid-mix of electricity generation (years) | 421.1 | 221.5 | 906.0 |
| ...fossil fuel-mix of electricity generation (years) | 188.5 | 99.2 | 405.5 |
| | | | |
| 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) | 2326.79 | 1070.87 | 5839.84 |