Input data

Note: The input parameters include some variables that can be specified by default values, but others that must be site specific.

Note: <u>Capacity factor</u>. The average capacity factor between 1998 and 2004 for Scotland was 30% (DTL 2006, Energy Trends,

March 2006). We recommend that a site-specific capacity Variables that can be taken from defaults are marked with purple tags on left hand side. factor site should be used (as measured during planning stage). However, if this is unknown, the best (34%) and worst case capacity factors for Scotland (27%) should be used to determine the likely range of the results . Uncertanities Record comments or Input data assumptions here Min Мах Enter your values here Wind farm characteristics Note: Extra capaticity required for backup. If 20% of national electricity is generated by wind energy, the extra Dimensions capacity required for backup is 5% of the rated capacity of 150 No. of turbines the wind plant (Dale et al 2004, Energy Policy, 32, 1949-56). We Life time of wind farm (vears) 25 suggest this should be 5% of the actual output. If it is Performance assumed that less than 20% of national electricity is Turbine capacity (MW) 3.6 20 30 generated by wind energy, a lower percentage should be optorod (0%) Capacity factor (percentage efficiency) 45 27 34 Note: Extra emissions due to reduced thermal efficiency of Backup the reserve power generation $\approx 10\%$ (Dale et al 2004, Energy Extra capacity required for backup (%) Policy, 32, 1949-56) Additional emissions due to reduced thermal efficiency of the Note: Emissions from turbine life. Note, if total emissions for reserve generation (%) the windfarm are unknown, emissions will be calculated Carbon dioxide emissions from turbine life -(eg. Calculate wrt installed capacity according to turbine capacity. The normal range of CO₂ manufacture, construction, decommissioning) emissions is 394 to 8147 t CO₂ MW (White & Kulcinski, 2000. Total CO₂ emission from turbine life (tCO₂ wind farm⁻¹) Fusion Eng. Des. 48, 473-48; White, 2007, Natural Resources Research. 15, 271 - 281.) (if known use direct input of emissions from turbine life) Characteristics of peatland before wind farm Note: A fen is a type of wetland fed by surface and/or development groundwater. A bog is fed primarily by rainwater and often inhabited by sphagnum moss, making it acidic. Type of peatland Acid boa Note: Time required for regeneration of previous habitat. It Average air temperature at site (°C) is suggested that loss of fixation should be assumed to be Average depth of peat at site (m) 1.60 over lifetime of windfarm only. C Content of dry peat (% by weight) 55 From MLURI (1991) This time could longer if plants do not regenerate. The Average extent of drainage around drainage features at site requirements for after-use planning include the provision of 10 suitable refugia for peat forming vegetation, the removal of (m) structures, or an assessment of the impact of leaving them Average water table depth at site (m) 0.50 in situ. Methods used to reinstatement the site will affect to Dry soil bulk density (a cm⁻³) 0.60 likely time for regeneration of the previous habitat. Average soil pH 4.0 This time could also be shorter if plants regenerate Characteristics of bog plants during lifetime of windfarm. If so, enter number of years estimated for regeneration. Time required for regeneration of bog plants after restoration 10 4 (vears) Carbon accumulation due to C fixation by bog plants in Note: Carbon fixation by bog plants. Apparent C 0.25 👞 0.12 0.31 undrained peats (tC ha⁻¹ vr⁻¹) accumulation rate in peatland is 0.12 to 0.31 tC ha⁻¹ yr⁻¹ **Forestry Plantation Characteristics** (Turunen et al., 2001, Global Biogeochemical Cycles, 15, 285-296; Botch et Area of forestry plantation to be felled (ha) 0 🔨 al., 1995, Global Biogeochemical Cycles, 9, 37-46). The SNH guidance uses a value of 0.25 tC ha⁻¹ yr⁻¹. 0.00 🔨 Average rate of carbon sequesteration in timber (tC ha⁻¹ yr⁻¹) Counterfactual emission factors Note: Area of forestry plantation to be felled. If the forestry

Input data

Cad-lifed plant emission factor (LCO2, MWh ⁻¹) 0.86 Grid mix emission factor (LCO2, MWh ⁻¹) 0.43 Pressil fuel- mix emission factor (LCO2, MWh ⁻¹) 0.607 Number of borrow pits 14 Average length of plats (m) 97 Average length of plats (m) 126 Average length of plats (m) 25 Average length of fuels (m) 25 Average length of fuels (m) 25 Average length of fuels (m) 25 Average length of hard-standing (m) 43.06 Average length of hard-standing (m) 1.6 Average length of access track (m) 0.5 Existing track length (m) 0.607 Average length of access track (m) 0.5 Diating track length (m) 0.607 Average length of access track (m) 0.5 Diating track length (m) 0.607 Average length of access track (m) 0.5 Diating track length (m) 0.607 Length of access track (m) 0.5 Diating track length (m) 0.607 Length of access track (m) 0.607 Diating trac			· · ·			Note: Area of forestry plantation to be felled. If the forestry
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Borrow pits 14 Average length of pits (m) 126 Average length of pits (m) 126 Average depth of pots (m) 126 Average depth of number foundations (m) 25 Average depth of bots (m) 160 Average depth of bots (m) 25 Average depth of bots (m) 25 Average depth of hard-standing reassociated with each turbine 30.6 Average depth of post removed from turbine foundations(m) 1.6 Hard-standing reassociated with each turbine 43.06 Average depth of past removed from turbine foundations(m) 43.06 Average depth of past removed from hard-standing (m) 1.6 Average depth of draces track (m) 0 Existing track (kepth (m) 0.5 Length of cacess track (m) 0 Existing track (kepth (m) 0.5 Length of caces track (m) 0 Length of caces track (linel road (m)	Fossil fuel- mix emission factor (t CO ₂ MWh ⁻¹)	0.607				
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Average depth of peat removed from turbine foundations(m) 1.6 MWh "Source = DEFPA_3026, dtabilite for the masurement and advertige deptine of the matching in the formation of the matching in the matching of the	Average width of turbine foundations(m)	25		\setminus	\backslash	fired plant EF = $0.86 \text{ t CO}_2 \text{ MWh}^{-1}$ Grid-Mix EF = 0.43 t CO_2
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Excavated road depth (m) 1 Note: Bock filled roads, Rock filled roads are assumed to be roads where no peat has been removed and rock has 0 Rock-filled road width (m) 0 0 be roads where no peat has been removed and rock has 0 Rock-filled road depth (m) 0 0 0 be roads where no peat has been removed and rock has 0 Rock-filled road depth (m) 0 0 0 0 0 Length of rock-filled road that is drained (m) 0 0 0 0 0 Average depth of drains associated with rock-filled roads (m) 0 0 0 0 0 0 Length of any cable trench that does not follow access tracks and is lined with a permeable medium (eg. sand) (m) 0	Excavated road width (m)	9.25				
Length of access track that is rock filled road (m) 0 be roads where no peat has been removed and rock has been removed and rock has been removed and rock has been placed on the surface and allowed to settle. Rock-filled road depth (m) 0 0 be roads where no peat has been removed and rock has been removed and rock has been placed on the surface and allowed to settle. Rock-filled road depth (m) 0 0 0 be roads where no peat has been removed and rock has been removed and rock has been placed on the surface and allowed to settle. Average depth of rock-filled road that is drained (m) 0 0 0 Average depth of drains associated with rock-filled roads (m) 0 0 0 Length of any cable trench that does not follow access tracks and is lined with a permeable medium (eg. sand) (m) 0 0 0 Depth of cable trench (m) 0.0 0.0 Peat Landslide Hazard. It is assumed that measures have been taken to may limit damage (south Executive, 2006, Peat Landslide Hazard and Risk Assessments. Best Practice Guide for Proposed Electricity Generation Developments. South Executive, Edinburgh, pp. 34-36) so that C losses due to peat landslide can be assumed to be negligible. Link: http://www.sociland.gov.uk/Publications/2006/1221162303/1	Excavated road depth (m)	1				Note: Rock filled roads. Rock filled roads are assumed to
Hock-tilled 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 0 0 0 0 Length of any cable trench that does not follow access tracks and is lined with a permeable medium (eg. sand) (m) 0 0 0 Depth of cable Trenches 0 0 0 0 0 0 Weblink: Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation 0 0 Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation 0 Edinburgh, pp. 34-36) so that C losses due to peat landslide can be assumed to be negligible. Link: http://www.scoland.gov.uk/Publications/2006/12/21162203/1	Length of access track that is rock filled road (m)	0 -				be roads where no peat has been removed and rock has
Hock-tilled road depth (m) 0 Length of rock-filled road that is drained (m) 0 Average depth of drains associated with rock-filled roads (m) 0 Cable Trenches 0 Length of any cable trench that does not follow access tracks and is lined with a permeable medium (eg. sand) (m) 0 Depth of cable trench (m) 0.0 Peat Landslide Hazard 0.0 Weblink: Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation 0 Practice Guide for Proposed Electricity Generation 0 Developments 0 0	Rock-filled road width (m)	0				been placed on the sunace and allowed to settle.
Length of rock-filled road that is drained (m) 0 Average depth of drains associated with rock-filled roads (m) 0 Cable Trenches 0 Length of any cable trench that does not follow access tracks and is lined with a permeable medium (eg. sand) (m) 0 Depth of cable trench (m) 0.0 Peat Landslide Hazard 0.0 Weblink: Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation. 0 Developments 0	Rock-filled road depth (m)	0				
Average depth of drains associated with rock-filled roads (m) 0 Image: Cable Trenches Length of any cable trench that does not follow access tracks and is lined with a permeable medium (eg. sand) (m) 0 Image: Cable Trenches Image: Cable Trenches Depth of cable trench (m) 0.0 Image: Cable Trenches Image: Cable	Length of rock-filled road that is drained (m)	0				
Cable Trenches Image: Cable Trenches Length of any cable trench that does not follow access tracks and is lined with a permeable medium (eg. sand) (m) 0 Image: Cable Trench (m) Note: Peat Landslide Hazard. It is assumed that measures have been taken to may limit damage (Socttish Executive, 2006, Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Image: Cable Trench (m) Note: Peat Landslide Hazard. It is assumed that measures have been taken to may limit damage (Socttish Executive, 2006, Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments. Sottish Executive, Edinburgh. pp. 34-35) so that C losses due to peat landslide can be assumed to be negligible. Link: http://www.soctland.gov.uk/Publications/2006/12/21162303/1 Developments 0 Image: Cable Trenches	Average depth of drains associated with rock-filled roads (m)	0				
Length of any cable trench that does not follow access tracks and is lined with a permeable medium (eg. sand) (m) 0 Note: Peat Landslide Hazard. It is assumed that measures have been taken to may limit damage (Scottish Executive, 2006, Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments. Sottish Executive, Edinburgh. pp. 34-35) so that C losses due to peat landslide can be assumed to be negligible. Link: http://www.scotland.gov.uk/Publications/2006/12/21162303/1	Cable Trenches					
and is lined with a permeable medium (eg. sand) (m) 0 Depth of cable trench (m) 0.0 Peat Landslide Hazard 0.0 Weblink: Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments. Sottish Executive, Edinburgh. pp. 34-35) so that C losses due to peat landslide can be assumed to be negligible. Link: http://www.scotland.gov.uk/Publications/2006/12/21162303/1	Length of any cable trench that does not follow access tracks	0				
Depth of cable trench (m) 0.0 Instruction of reading in the security, 2006, 2007, 2007, 2006, 2007, 2006, 2007, 2006, 2007, 2006, 2007, 2007, 2006, 2007, 2	and is lined with a permeable medium (eg. sand) (m)	U				Note: Peat Landslide Hazard, It is assumed that measures
Peat Landslide Hazard Peat Landslide Hazard and Risk Assessments. Best Practice Guide for Weblink: Peat Landslide Hazard and Risk Assessments: Best Proposed Electricity Generation Developments. Sottish Executive, Practice Guide for Proposed Electricity Generation 0 Edinburgh. pp. 34-35) so that C losses due to peat landslide can be assumed to be negligible. Link: Developments 0 http://www.scotland.gov.uk/Publications/2006/12/21162303/1	Depth of cable trench (m)	0.0				have been taken to may limit damage (Scottish Executive, 2006,
Weblink: Peat Landslide Hazard and Risk Assessments: Best Edinburgh. pp. 34-35) so that C losses due to peat landslide can be assumed to be negligible. Link: Practice Guide for Proposed Electricity Generation 0 Developments http://www.scotland.gov.uk/Publications/2006/12/21162303/1	Peat Landslide Hazard					Peat Landslide Hazard and Risk Assessments. Best Practice Guide for Proposed Electricity Generation Developments. Scottish Executive.
Practice Guide for Proposed Electricity Generation 0 be assumed to be negligible. Link: Developments http://www.scotland.gov.uk/Publications/2006/12/21162303/1 http://www.scotland.gov.uk/Publications/2006/12/21162303/1	Weblink: Peat Landslide Hazard and Risk Assessments: Best					Edinburgh. pp. 34-35) so that C losses due to peat landslide can
Developments	Practice Guide for Proposed Electricity Generation	0				be assumed to be negligible. Link:
	Developments					http://www.scotland.gov.uk/Publications/2006/12/21162303/1

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)	394		
Water table depth in degraded bog before improvement (m)	0.50		
Water table depth in degraded bog after improvement (m)	0.50		
Time required for hydrology and habitat of bog to return to its	10		
previous state on improvement (years)	10		
Improvement of felled plantation land			
Area of felled plantation to be improved (ha)	0		
Water table depth in felled area before improvement (m)	0.00		
Water table depth in felled area after improvement (m)	0.00		
Time required for hydrology and habitat of felled plantation to	0		
return to its previous state on improvement (years)	0		
Restoration of peat removed from borrow pits			
Area of borrow pits to be restored (ha)	15.19		
Water table depth in borrow pit after restoration (m)	0.50		
Time required for hydrology and habitat of borrow pit to return	10		
to its previous state on restoration (years)	10		
Removal of drainage from foundations and hardstanding			
Water table depth around foundations and hardstanding after	0.5		
restoration (m)	0.0		
I me to completion of backfilling, removal of any surface	25		
drains, and full restoration of the hydrology (years)	23		Note: <u>Restoration of site</u> . If the water table at the site is
Restoration of site after decomissioning	←		- returned to its original level or higher on decomissioning,
Will the hydrology of the site be restored on	Yos 🔻		losses continue only over the lifetime of the windfarm
decommissioning?	Tes 🗸		Otherwise, C losses from drained peat are assumed to b
Will the habitat of the site be restored on decommissioning?	Yes 🔻		100%
			Note: Choice of methodology for calculating emission
Choice of methodology for calculating emission factors	Site specific 🖉 🗲		tactors. The IPPC default methodology is the internation
energe et methodology for ourounding emission fuctors			national greenhouse gas inventories. Vol 3, table 5-13) However it is
			stated in IPCC (1997) that these are rough estimates, ar
			"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 SEERAD funded ECOSSE project (Smith et al, 2007. ECOSSE: Estimating Carbon in Organic Soils - Sequestration and Emissions. Final Report. SEERAD Report. ISBN 978 0 7559 1498 2. 166pp.)

Note: The carbon payback time of the wind farm is calculated by comparing the loss of C from the site due to windfarm development with the carbon-savings achieved by the windfarm while displacing electricity generated from coal-fired capacity or Grid-mix.

1. Wind farm CO₂ emission saving

	Carbon dioxide
	saving (tCO ₂ yr ⁻¹)
coal-fired electricity generation	1830665
grid-mix of electricity generation	915332
fossil fuel-mix of electricity generation	1292109

Total CO₂ losses due to wind farm

	Carbo	Carbon dioxide losses (t CO _{2 eq.})		Payback time (months)			
	coal-fired electricity generation	grid-mix of electricity generation	fossil fuel-mix of electricity generation	coal-fired electricity generation	grid-mix of electricity generation	fossil fuel-mix of electricity generation	
2. Losses due to turbine life (eg. manufacture, construction, decomissioning)	175140	175140	175140	1.1	2.3	1.6	
3. Losses due to backup	358919	358919	358919	2.4	4.7	3.3	
 Losses due to reduced carbon fixing potential 	8973	8973	8973	0.1	0.1	0.1	
5. Losses from soil organic matter	1983248	1983248	1983248	13.0	26.0	18.4	
6. Losses due to DOC & POC leaching	503678	503678	503678	3.3	6.6	4.7	
7. Losses due to felling forestry	0	0	0	0.0	0.0	0.0	
Total losses of carbon dioxide	3029959	3029959	3029959	19.9	39.7	28.1	

Total CO₂ gains due to improvement of site

	Carbon dioxide gains (tCO _{2 eq.})	Reduction in payback time (months)			
		coal-fired electricity generation	grid-mix of electricity generation	fossil fuel-mix of electricity generation	
8. Gains due to improvement of degraded bogs	60757	0.4	0.8	0.6	
 8. Gains due to improvement of felled forestry 8. Gains due to restoration of peat from 	0	0.0	0.0	0.0	
borrow pits 8. Gains due to removal of drainage from	6763	0.0	0.1	0.1	
foundations & hardstanding	0	0.0	0.0	0.0	
Total gains	67520	0.4	0.9	0.6	

 Net emissions of carbon dioxide
 (t

 CO2 eq.)
 2962439

Payback time

Payback Time



Note: The total emission savings are given by estimating the	total possible electrical output of the wind
multiplied by the emission factor for the counterfactual case (coal-fire generation and electricity from gr
Power Generation Characteristics	
No. of turbines	150
Turbine capacity (MW)	3.6
Power of wind farm (MW)	540
Capacity factor (percentage efficiency)	45
Annual energy output from wind farm (MWh yr ⁻¹)	2128680
	•
Counterfactual emission factors	
Coal-fired plant emission factor (t CO ₂ MWh ⁻¹)	0.86
Grid-mix emission factor (t CO ₂ MWh ⁻¹)	0.43
Fossil fuel- mix emission factor (t CO2 MWh ⁻¹)	0.607
	Carbon Dioxide Saving (ICO ₂
Wind farm CO ₂ emission saving over	yr')
coal-fired electricity generation	1830665
grid-mix of electricity generation	915332
fossil fuel - mix of electricity generation	1292109

2. CO2 loss due to turbine life



Uncertainty due to estimated CO2 emissions due to turbine life

0.6

Note: CO2 loss due to back up is calculated from the extra capacity required for backup of the wind farm given in the input data.

Reserve capacity required for backup		
No. of turbines	150	
Turbine capacity (MW)	3.6	
Power of wind farm (MW h ⁻¹)	540	
Rated capacity (MW yr-1)	4730400	
Extra capacity required for backup (%)	5	
Additional emissions due to reduced thermal		
efficiency of the reserve generation (%)	10	
Reserve capacity (MWh yr ⁻¹)	23652	Ī

Carbon dioxide emissions due to backup		7
power generation		
Coal-fired plant emission factor (t CO ₂ MWh ⁻¹)	0.86	
Grid-mix emission factor (t CO ₂ MWh ⁻¹)	0.43	
Fossil fuel- mix emission factor (t CO ₂ MWh ⁻¹)	0.607	
Life time of wind farm (years)	25	
Annual emissions due to backup from coal-fired electricity generation grid-mix of electricity generation	20340.72 10170.36	
fossil fuel - mix of electricity generation	14356.764	Assumption: Backup ass
Total emissions due to backup from coal-fired electricity generation grid-mix of electricity generation fossil fuel - mix of electricity generation	508518 254259 358919	by fossil-fuel-mix of elect generation. Note that hyo may also be used for bac assumption may make th backup generation too hi assumptions should be r technology develops.
Wind farm CO ₂ emission saving over	Carbon Dioxide Saving (tCO ₂ yr ⁻¹)]
coal-fired electricity generation grid-mix of electricity generation fossil fuel - mix of electricity generation	1830665 915332 1292109	

	Assumption: Backup assumed to be
	by fossil-fuel-mix of electricity
	generation. Note that hydroelectricity
	may also be used for backup, so this
	assumption may make the value for
	backup generation too high. These
1	assumptions should be revisited as
	technology develops.

Additional CO ₂ payback time of wind farm due to backup	Additional payback time (yr)	Additional payback time (months)
Coal-fired electricity generation	0.20	2.4
Grid-mix of electricity generation	0.39	4.7
Fossil fuel-mix of electricity generation	0.28	3.3

Note: Annual C fixation by the site is calculated by multiplying area of the wind farm by the annual C accumulation due to bog plant fixation

Area where carbon accumulation by bog plants is lost		
Total area of land lost due to wind farm construction (m ²)	1630043	Assumptions: 1. Bog plants are 100% lost from the
Total area affected by drainage due to wind farm construction (m ⁻²)	1166600	area where peat is removed for
Total area where fixation by plants is lost (m ²)	2796643	construction.
-		area where peat is drained.
Total loss of carbon accumulation		3. The recovery of carbon
Carbon accumulation in undrained peats (tC ha ⁻¹ yr ⁻¹)	0.25	accumulation by plants on restoration
Life time of wind farm (years)	25	or land is as given in inputs
Time required for regeneration of bog plants after restoration (years)	10	
Carbon accumulation up to time of restoration (tCO ₂ eq. ha ⁻¹)	32	
Total loss of carbon accumulation by bog plants		

Total loss of carbon accumulation by bog plants	
Total area where fixation by plants is lost (ha)	280
Carbon accumulation over lifetime of wind farm $(tCO_2 eq. ha^{-1})$	32
Total loss of carbon fixation by plants at the site (t CO_2)	8973

Windfarm CO ₂ emission saving over	Carbon Dioxide Saving (tCO ₂ yr ⁻¹)
coal-fired electricity generation	1830665
grid-mix of electricity generation	915332
fossil fuel - mix of electricity generation	1292109

Additional CO ₂ payback time of windfarm due to loss of CO ₂	Additional payback time (years)	Additional payback time (months)	
lixation			
Coal-fired electricity generation	0.005	0.1	
Grid-mix of electricity generation	0.010	0.1	
Fossil fuel - mix of electricity generation	0.007	0.1	

Note: Loss of C stored in peatland is estimated from % site lost by peat removal (sheet 5a), CO₂ loss from removed peat (sheet 5b), % site affected by drainage (sheet 5c), and the CO2 loss from drained peat (sheet 5d).

CO ₂ loss due to wind farm construction		
CO_2 loss from removed peat (t CO_2 equiv)	1885395	
CO_2 loss from drained peat (t CO_2 equiv)	97853	
Total CO ₂ loss from peat (removed+ drained) (t CO ₂ equiv)	1983248	

Note: % sele lost by peat removal is estimated from peat removed in borrow pis, further toundations, hard-standing and % site lost at the bottom of this worksheet. Peat removed for any other reason, this must be added in to the volume of peat removed, area of land lost and % site lost at the bottom of this worksheet. Peat removed from borrow pits 14 Average length of pits (m) 126 Average depth of peat removed from pit (m) 1.6 Area of land lost in borrow pits (m ⁵) 273772.8 Peat removed from turbine foundations 150 Average length of turbine foundations (m) 25 Average length of turbine foundations (m) 25 Average depth of peat removed from turbine foundations(m) 1.6 Average length of turbine foundations (m) 25 Average length of turbine foundations (m) 25 Average length of turbine foundations (m) 1.6 Average length of hard-standing 150 No. of turbines 150 Average length of hard-standing (m) 43.06 Average length of hard-standing (m) 1.6 Average length of hard-standing (m) 278124.54 Volume of peat removed from hard-standing (m) 2.6 Average length of hard-standing (m ³) 278124.54
If peak removed for any other reason, the must be added in to the volume of peak removed, area of land lost and % site lost at the bottom of the worksheet. Peak removed for porce pits 14 Average depth of pits (m) 97 Average depth of peak removed from pit (m) 1.6 Area of land lost in borrow pits (m ²) 171108 Volume of peak removed from borrow pits (m ²) 273772.8 Peak removed from turbine foundations 150 Average width of turbine foundations (m) 25 Average depth of peak removed from turbine foundations(m) 1.6 Average width of turbine foundations (m ²) 93750 Volume of peak removed from turbine foundations(m) 2.5 Average width of hard-standing (m) 43.06 Average width of hard-standing (m) 43.06 Average depth of peak removed from hard-standing (m) 1.6 Average depth of peak removed from hard-standing (m) 2.5 Average width of hard-standing (m) 43.06 Average depth of peak removed from hard-standing (m) 2.6 Average depth of peak removed from hard-standing (m ³) 2.75 Volume of peak removed from hard-standing (m ³) 2.5 Average width of hard-standing (m ³) 2.5
Peat removed from borrow pits 14 Number of borrow pits 14 Average length of pits (m) 97 Average elength of pits (m) 126 Average depth of peat removed from pit (m) 1.6 Area of land lost in borrow pits (m ³) 171108 Volume of peat removed from borrow pits (m ³) 273772.8 Peat removed from turbine foundations 150 Average length of turbine foundations(m) 25 Average eight of peat removed from turbine foundations(m) 25 Average eight of peat removed from turbine foundations(m) 1.6 Area of land lost in foundations (m ³) 93750 Volume of peat removed from hard-standing 150 Average eight of hard-standing (m) 43.06 Average eight of past removed from hard-standing (m) 43.06 Average depth of peat removed from hard-standing (m) 1.6 Area of land lost in hard-standing (m ³) 278124.54 Volume of peat removed from hard-standing (m) 1.6 Area of land lost in hard-standing (m ³) 278124.54 Volume of peat removed from hard-standing (m ³) 278124.54 Volume of peat removed from hard-standing (m ³) 0.5
Peat removed from borrow pits 14 Number of borrow pits 14 Average length of pits (m) 97 Average width of pits (m) 126 Average length of peat removed from pit (m) 1.6 Area of land lost in borrow pits (m ³) 171108 Volume of peat removed from borrow pits (m ³) 273772.8 Peat removed from turbine foundations 150 Average width of turbine foundations (m) 25 Average depth of peat removed from turbine foundations(m) 1.6 Area of land lost in forow pits (m ³) 93750 Volume of peat removed from foundation area (m ³) 150000 Peat removed from hard-standing (m) 43.06 Average width of hard-standing (m) 1.6 Average length of hard-standing (m) 1.6 Average depth of peat removed from hard-standing (m) 1.6 Average depth of peat removed from hard-standing (m ⁵) 278124.54 Volume of peat removed from hard-standing area (m ³)
Number of borrow pits 14 Average length of pits (m) 97 Average depth of pits (m) 126 Average depth of peat removed from pit (m) 1.6 Are a of land lost in borrow pits (m ³) 171108 Volume of peat removed from borrow pits (m ³) 273772.8 Peat removed from turbine foundations 150 No. of turbines 150 Average length of turbine foundations (m) 25 Average depth of peat removed from turbine foundations(m) 1.6 Average depth of peat removed from turbine foundations(m) 1.6 Average depth of peat removed from turbine foundations(m) 1.6 Average depth of peat removed from turbine foundations(m) 1.6 Average depth of peat removed from turbine foundation area (m ³) 1500000 Peat removed from hard-standing (m) 43.06 Average width of hard-standing (m) 1.6 Average length of peat removed from hard-standing (m) 1.6 Average length of peat removed from hard-standing (m) 1.6 Average width of hard-standing (m) 2.78124.54 Volume of peat removed from hard-standing (m ³) 278124.54 Volume of peat removed from hard-standing area (m ³) 36010 Floating road width (m) 9.25 Floating road depth (m) 0.5 Ar
Average length of pits (m) 97 Average depth of pet removed from pit (m) 1.6 Area of land lost in borrow pits (m ³) 171108 Volume of peat removed from borrow pits (m ³) 273772.8 Peat removed from turbine foundations 150 Average width of trib refoundations (m) 25 Average depth of turbine foundations(m) 1.6 Average ength of turbine foundations(m) 25 Average depth of peat removed from turbine foundations(m) 1.6 Area of land lost in fourdations 33750 Volume of peat removed from foundation area (m ³) 150000 Peat removed from hard-standing 150 Average length of hard-standing (m) 43.06 Average depth of peat removed from hard-standing (m) 1.6 Area of land lost in hard-standing (m) 278124.54 Volume of peat removed from hard-standing (m ³) 278124.54 Volume of peat removed from hard-standing main (m ³) 278124.54 Volume of peat removed from hard-standing main (m ³) 925 Floating roads 393766.25 Length of access track that is floating roads (m ³) 795592.5 Volume of peat removed from loads 393796.25 Length of access track that is excavated road (m) 31510 Excavated road depth (m) 1 <
Average width of pits (m) 126 Average width of pits (m) 1.6 Area of land lost in borrow pits (m ³) 171108 Volume of peat removed from burrow pits (m ³) 273772.8 Peat removed from turbine foundations 150 No. of turbines 150 Average length of turbine foundations (m) 25 Average depth of peat removed from turbine foundations(m) 26 Average depth of peat removed from turbine foundations(m) 1.6 Average depth of peat removed from turbine foundations(m) 1.6 Average depth of peat removed from turbine foundation area (m ³) 150000 Peat removed from hard-standing 150 No. of turbines 150 Average width of hard-standing (m) 43.06 Average depth of peat removed from hard-standing (m) 1.6 Area of land lost in hard-standing (m ²) 278124.54 Volume of peat removed from hard-standing (m ³) 126010 Peat removed from access tracks 86010 Floating roads 397796.25 Length of access track that is floating roads (m ²) 9.25 Floating road depth (m) 0.5 Area of land lost in floating roads (m ²)
Average depth of peat removed from pit (m) 1.6 Area of land lost in borrow pits (m ⁵) 171108 Volume of peat removed from borrow pits (m ³) 273772.8 Peat removed from turbine foundations 150 No. of turbines 150 Average length of turbine foundations (m) 25 Average depth of peat removed from turbine foundations(m) 1.6 Area of land lost in foundations (m ⁵) 93750 Volume of peat removed from foundation area (m ³) 150000 Peat removed from hard-standing 1.5 No. of turbines 150 Average length of hard-standing (m) 43.06 Average length of peat removed from hard-standing (m) 1.6 Average width of hard-standing (m) 1.6 Average depth of peat removed from hard-standing (m) 43.06 Average width of hard-standing (m ³) 278124.54 Volume of peat removed from hard-standing (m ³) 444999.264 Peat removed from access tracks 1.6 Eloating roads 397796.25 Length of access tracks (m ⁵) 9.25 Floating road depth (m) 0.5 Area of land lost in floating roads (m ⁵) 397796.25
Area of land lost in borrow pits (m ³) 171108 Volume of peat removed from borrow pits (m ³) 273772.8 Peat removed from turbine foundations 150 Average length of turbine foundations(m) 25 Average width of turbine foundations(m) 25 Average depth of peat removed from turbine foundations(m) 1.6 Area of land lost in foundations (m ⁷) 93750 Volume of peat removed from foundation area (m ³) 150000 Peat removed from hard-standing 150 No. of turbines 150 Average width of hard-standing (m) 43.06 Average length of peat removed from hard-standing (m) 1.6 Area of land lost in hard-standing (m ⁷) 278124.54 Volume of peat removed from hardstandingarea (m ³) 278124.54 Volume of peat removed from hardstandingarea (m ³) 444999.264 Peat removed from access tracks 86010 Floating road width (m) 9.25 Floating road width (m) 0.5 Area of land lost in floating roads (m ²) 795592.5 Volume of peat removed from floating roads 397796.25 Excavated roads 397796.25 Excavated roads <td< td=""></td<>
Volume of peat removed from borrow pits (m ³) 273772.8 Peat removed from turbine foundations 150 Average length of turbine foundations (m) 25 Average depth of peat removed from turbine foundations(m) 1.6 Area of land lost in foundations (m ²) 93750 Volume of peat removed from turbine foundation area (m ³) 150000 Peat removed from hard-standing 150 No. of turbines 150 Average length of hard-standing (m) 43.06 Average width of hard-standing (m) 43.06 Average depth of peat removed from hard-standing (m) 1.6 Average width of hard-standing (m) 44.06 Average depth of peat removed from hard-standing (m) 1.6 Average depth of peat removed from hard-standing (m ³) 278124.54 Volume of peat removed from hardstandingarea (m ³) 278124.54 Volume of peat removed from hardstanding road (m) 86010 Floating roads 86010 Floating road width (m) 0.5 Area of land lost in floating roads (m ²) 795592.5 Volume of peat removed for floating roads 397796.25 Excavated roads 397796.25 Excavated ro
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Peat removed from turbine foundations 150 No. of turbines 150 Average length of turbine foundations (m) 25 Average width of turbine foundations (m ²) 93750 Volume of peat removed from turbine foundation area (m ³) 150000 Peat removed from hard-standing 150 No. of turbines 150 Average width of hard-standing (m) 43.06 Average width of hard-standing (m) 43.06 Average width of hard-standing (m) 1.6 Average width of hard-standing (m) 44.06 Average width of hard-standing (m) 1.6 Average width of hard-standing (m) 44.06 Average width of hard-standing (m ²) 278124.54 Volume of peat removed from hard-standing area (m ³) 444999.264 Peat removed from access tracks Eloating roads Eloating road so the floating road (m) 9.25 Floating road width (m) 0.5 Area of land lost in floating roads (m ²) 795592.5 Volume of peat removed for floating roads 397796.25 Excavated roads 31510 Excavated roads 31510 Excavated roads with (m)
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Peat removed from access tracks Image: Provide the provided tracks Floating roads 86010 Length of access track that is floating road (m) 9.25 Floating road width (m) 0.5 Floating road depth (m) 0.5 Area of land lost in floating roads (m ²) 795592.5 Volume of peat removed for floating roads 397796.25 Excavated roads 31510 Excavated road width (m) 9.25 Excavated road width (m) 1 Area of land lost in excavated roads (m ²) 291467.5
Peat removed from access tracks Floating roads Elength of access track that is floating road (m) 86010 Floating road width (m) 9.25 Floating road depth (m) 0.5 Area of land lost in floating roads (m ²) 795592.5 Volume of peat removed for floating roads 397796.25 Excavated roads 31510 Excavated road width (m) 9.25 Excavated road width (m) 9.25 Volume of peat removed for floating roads (m ²) 291467.5 Volume of peat removed for gravated roads (m ²) 291467.5
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Area of land lost in excavated roads (m ²) 291467.5
Volume of post removed for excepted reads
Rock-filled roads
Length of access track that is rock filled road (m) 0
Rock-filled road width (m) 0
Rock-filled road depth (m) 0
Area of land lost in excavated roads (m ²) 0
Volume of peat removed for rock-filled roads 0
Total area of land lost in access tracks (m ²) 1087060
Total volume of peat removed due to access tracks (m ³) 689263.75
Total volume of peat removed (m ³) due to wind farm construction 1558035.814
Total area of land lost due to wind farm construction (m ²) 1630042.54

Note: If peat is treated in such a way that it is permanently restored, so that less than 100% of the C is lost to the atmosphere, a lower percentage can be entered in cell C10

		7	
CO ₂ loss from removed peat			
C Content of dry peat (% by weight)	55		
Dry soil bulk density (g cm ⁻³)	0.60		
% C contained in removed peat that is lost as CO_2	100	Assumption	If peat is not restored, 100% of the
Total volume of peat removed (m ³) due to wind farm construction	1558035.814	Carbon conta	alled in the removed peak is lost as OO_2
CO ₂ loss from removed peat (t CO ₂)	1885395		
	1	1	
CO ₂ loss from undrained peat left in situ			
Total area of land lost due to wind farm construction (ha)	163		
CO_2 loss from undrained peat left in situ (t CO_2 ha ⁻¹)	150		
CO ₂ loss from undrained peat left in situ (t CO ₂)	24386]	
CO. loss attributable to peat removal only		1	
$CO_2 \log from removed post (t CO_2)$	1885205		
OO_2 loss from removed pear (i OO_2)	1885395		
CO_2 loss from undrained peat left in situ (t CO_2)	24386		
CO ₂ loss attributable to peat removal only (t CO ₂)	1861009		
	Carbon Dioxide Saving	1	
Wind farm CO ₂ emission saving over	$(tCO_2 vr^{-1})$		
coal fired electricity generation	1830665		
arid-mix of electricity generation	915332		
fossil fuel - mix of electricity generation	1292109		
		•	
Additional CO ₂ payback time of wind farm due to removal of	Additional payback time	Additional	
peat during construction	(vears)	payback time	
	() ,	(months)	
Coal-fired electricity generation	1.03	12.4	
Grid-mix of electricity generation	2.06	24.7	
Fossil tuel - mix of electricity generation	1.46	17.5	

Note: Extent of site affected by drainage is calculated assuming an average extent of drainage around each drainage feature as given in the input data.

Extent of drainage around each metre of drainage ditch		
Average extent of drainage around drainage features at site (m)	10	
		-
Peat affected by drainage around borrow pits		_
Number of borrow pits	14	
Average length of pits (m)	97	
Average width of pits (m)	126	
Average depth of peat removed from pit (m)	1.6	Note: Borrow pit area itself not counted
Area anected by drainage per borrow pit	4060	in drained area because C losses have
I otal area affected by drainage around borrowpits (m ⁻)	68040	aiready been accounted for in removed
Total volume affected by drainage around borrowpits (m ³)	108864	pear
Deat affected by drainage around turbing foundation and bardstanding		Assumption: Depth peat affected due
No. of turbines	150	peat removed
Average length of turbine foundations (m)	25	
Average width of turbine foundations (m)	25	
Average depth of peat removed from turbine foundations(m)	2	
Average length of bard-standing (m)	43	
Average width of hard-standing (m)	43	
Average depth of peat removed from hard-standing (m)	1.6	Noto: Hardetanding and turbina
Total length of foundation and hardstaning area (m)	68	foundations. These are counted
Total width of foundation and hardstanding area (m)	68	together to avoid double counting of
Area affected by drainage of foundation and hardstanding area (m^2)	3122	edges. If hardstanding is sited away
Total area affected by drainage of foundation and hardstanding area (m ²)	468360	from turbine foundations, additional
Total area anected by drainage of foundation and hardstanding area (m)	7/0376	Hardstanding and turbine foundation
Total volume anected by dramage of foundation and hardstanding area (m.)	149370	area itself not counted in drained area
Peat affected by drainage of access tracks		because C losses have already been
Floating roads		accounted for in removed pear
Length of floating road that is drained (m)	0	
Floating road width (m)	9.3	Assumption: Peat under floating road is
Average depth of drains associated with floating roads (m)	0.00	also drained when drains are installed
Area affected by drainage of floating roads (m ²)	0	
Volume affected by drainage of floating roads (m ³)	0 +	Assumption: Depth peat affected due of
Excavated Road		drainage is equal to the depth of peat
Length of access track that is excavated road (m)	31510	removed
Excavated road width (m)	9	Note: Road area itself not counted in
Excavated road depth (m)	1.0	drained because C losses have already
Area affected by drainage of excavated roads (m ²)	630200 🖌	been accounted for in removed peat
Volume affected by drainage of excavated roads (m ³)	630200	
Rock-filled roads		Assumption: Depth peat affected due of
Length of rock-filled road that is drained (m)	0	removed
Rock-filled road width (m)	0	Assumption: Dept. under soil, filled read
Average depth of drains associated with rock-filled roads (m)	0.0	is compacted and looses water, but
Area affected by drainage of rock-filled roads (m ²)	0 🖌	remains anaerobic. Therefore, the area
Volume affected by drainage of rock-filled roads (m ²)	0	of the rock-filled road iteself is not
Total area affected by drainage of access track (m ²)	630200	included in the drained area.
Total volume affected by drainage of access track (m ³)	630200	
Total volume and ted by dramage of access mask (m)	000200	Assumption: Depth peat affected due of
Peat affected by drainage of cable trenches		drainage is equal to the depth of peat
Length of any cable trench that does not follow access tracks and is lined with a	0	
permeable medium (eg. sand) (m)	U U	
Depth of cable trench (m)	0.0	
Total area affected by drainage of cable trenches (m ²)	0	
Total volume affected by drainage of cable trenches (m ³)	0.00	
Total area affected by drainage due to wind farm (m ²)	1166600	
Total volume affected by drainage due to wind farm (m ³)	1488440	

Note: Note, CO ₂ losses are calculated using two approaches: IPCC default	methodology and more site sp	ecific equations derived for th	s project. The IPCC methodology is
included because it is the established approach, although it contains no site	e detail. The new equations hav	e been derived directly from e	xperimental data for acid bogs and fens
(see Nayak et al, 2008 - Final report).			
Drained Land			
Total area affected by drainage due to wind farm			
construction (ha)	117		
Will the hydrology of the site be restored on	¥		
decommissioning?	Yes		
Will the habitat of the site be restored on	Vee		
decommissioning?	res		
Calculations of C Loss from Drained Land if Site is NO	T Restored after Deco	mmissioning	
Total volume affected by drainage due to wind farm (m ³)	1488440		
C Content of dry peat (% by weight)	55		
Dry soil bulk density (g cm °)	0.60		
Total GHG emissions from Drained Land (t CO ₂	1801176		
equiv.)	1001170		Assumption: Losses of GHG from
Total GHG Emissions from Undrained Land (t CO ₂	272625	•	drained and undrained land have the
equiv.)			emission period.
Calculations of C loss from Drained Land if Site IS Res	stored after Decommiss	sioning	
	<u>^</u>	1	Assumption: The drained soil is not
Flooded period (days year)	0	4	flooded at any time of the year.
Life unite of Wind farm (years)	25		
Time required for regeneration of bog plants after	10		
Testoration (years)			
Appual rate of methane emission (t CH $_{-}$ C ha ⁻¹ yr ⁻¹)	1.00		
	-1.30		Note:Conversion - (23 x 16/12) -
Conversion factor: CH ₄ -C to CO ₂ equivalents	30.67		30.67 CO ₂ equiv. (CH ₄ -C) ⁻¹
CH ₄ emissions from drained land (t CO ₂ equiv.)	0		
Carbon Dioxide Emissions from Drained Land			
Annual rate of carbon dioxide emission (t CO ₂ ha ⁻¹ yr ⁻¹)	28.2		
CO ₂ emissions from drained land (t CO ₂)	115306		
Total GHG emissions from Drained Land (t CO ₂			
equiv.)	115306		
2. Losses if Land is Undrained			
Flooded period (days year ⁻¹)	178		
Life time of wind farm (years)	25		
Time required for regeneration of bog plants after	40		
restoration (years)	10		
Methane Emissions from Undrained Land			
Annual rate of methane emission (t CH ₄ -C ha ⁻¹ yr ⁻¹)	-0.21		
Conversion factor: CH ₄ -C to CO ₂ equivalents	30.67		Note:Conversion = (23 x 16/12) =
CH, emissions from undrained land (t CO, equiv.)	40004		30.67 CO ₂ equiv. (CH ₄ -C) ⁻¹
	-12994		
Carbon Dioxide Emissions from Undrained Land			
Annual rate of carbon dioxide emission (t CO ₂ ha ⁻¹ yr ⁻¹)	14.6		
CO ₂ emissions from undrained land (t CO ₂)	30447		
Total GHG Emissions from Undrained Land (t CO ₂	17/53		
equiv.)	17400		
		-	
3. CO ₂ Losses due to Drainage			
Total GHG emissions from Drained Land (t CO ₂ equiv.)	115306		
Total GHG Emissions from Undrained Land (t CO ₂ equiv.)	17453		
Total CO ₂ losses due to Drainage (t CO ₂ equiv.)	97853		
	Carbon Dioxide Saving	1	
Wind farm CO ₂ emission saving over.	(tCO ₂ vr ⁻¹)		
coal-fired electricity generation	1830665		
grid-mix of electricity generation	915332		
fossil fuel - mix of electricity generation	1292109		
generation			
Additional CO anadarah (1 1 1 1 1 1 1	Addistant	A dallate and the second	
Additional CO_2 payback time of wind farm due to	Additional payback	Additional payback	
Additional CO ₂ payback time of wind farm due to drainage of peat	Additional payback time (years)	Additional payback time (months)	
Additional CO ₂ payback time of wind farm due to drainage of peat Coal-fired electricity generation	Additional payback time (years) 0.05	Additional payback time (months) 0.6	
Additional CO ₂ payback time of wind farm due to drainage of peat Coal-fired electricity generation Grid-mix of electricity generation	Additional payback time (years) 0.05 0.11	Additional payback time (months) 0.6 1.3	

Note: Note, CO_2 losses are calculated using two approaches: IPCC default methodology and more sit it is the established approach, although it contains no site detail. The new equations have been thorous	te specific equations derived f ughly tested against experiment	or this project. The IPCC methodology is included because tal data (see Nayak et al, 2008 - Final report).
Selected Methodology =	Site specific	
Calculations following IPCC default methodology		
Type of peatland	Acid Bog	
Emission characteristics of acid bogs (IPCC, 1997)	178	
Annual rate of methane emission (t CH $_{-}$ C ha ⁻¹ vr ⁻¹)	0.04015	
Annual rate of methane emission ($t O I_4 O I a^{-1} yr^{-1}$)	25.2	
	33.2	Assumption: The period of flooding is
Emission characteristics of fens (IPCC, 1997)		taken to be 178 days yr ⁻¹ for acid bogs
Flooded period (days year ⁻¹)	169	and 169 days yr ⁻¹ based on the monthly
Annual rate of methane emission (t CH ₄ -C ha ⁻¹ yr ⁻¹)	0.219	mean temperature and the lengths of inundation (IPCC, 1997, Revised 1996 IPCC
Annual rate of carbon dioxide emission (t CO_2 ha ⁻¹ yr ⁻¹)	35.2	guidelines for national greenhouse gas inventories, Vol
· - · ·		3, table 5-13)
Selected emission characteristics (IPCC, 1997)		Assumption: The CH ₄ emission rate
looded period (days year ⁻¹)	178	CH_{4} C m ⁻² dav ⁻¹ x 365 davs; and for
Annual rate of methane emission (t CH ₄ -C ha ⁻¹ yr ⁻¹)	0.04015	fens is 60 (21-162) mg CH ₄ -C m ⁻² day ¹
Annual rate of carbon dioxide emission (t CO_2 ha ⁻¹ yr ⁻¹)	35.2	x 365 days (Aselmann & Crutzen ,1989.
Colouistions following ECOSSE based methodology		
Drained Land		drainage of organic soils for upland
Total area affected by drainage due to wind farm construction (ha)	117	crops (e.g., grain, vegetables) are
Total volume affected by drainage due to wind farm construction (m ³)	1488440	3.667x9.6 (7.9-11.3) t CO ₂ ha ⁻¹ yr ⁻¹ in temperate climates (Armentano and Mennes
		1986. J. Ecol. 74, 755-774).
Soil Characteristics that Determine Emission Rates	7	1
Average annual air temperature at the site ('C)	1 60	
Average soil pH	4	
Average water table depth at site (cm)	0.5	Note: Equation derived by regression analysis against experimental data from 50 experiments. 41 case
Average water table depth of drained land (m)	1.275878622	were used and 9 included missing data values. The equation derived was $R_{CO2} = (3.667/1000) \times (547 + (71.7 T) + (322 D) + (4810 W))$
Annual Englacion Batas (allanging ECOCOE have deveathed at any		where R_{CO2} is the annual rate of CO ₂ emissions (t CO ₂ (ha) ⁻¹ yr ⁻¹), T = average annual air temperature
Annual Emission Rates following ECOSSE based methodology	00.04	<i>D</i> is the peat depth (m), and <i>W</i> is the water table depth (m). The equation has a P^2 value of 52 0% <i>R</i> = 0.0001 Ry statistical convertion if <i>P</i> = 0.001 this relationship
Hate of carbon dioxide emission in drained soli ($1 CO_2$ na yr ²)	28.24	be considered to be highly significant.
Hate of carbon dioxide emission in undrained soil (t UU_2 ha ⁻¹ yr ⁻¹)	14.55	Nato Ferration derived by segmentian application or structure statistics (see 00 sec. 1) and (0
Rate of methane emission in drained soil ((t CH_4 -C) ha ⁻¹ yr ⁻¹)	-1.38	Note: Equation derived by regression analysis against experimental data from 66 experiments. 40 case were used and 26 included missing data values. The equation derived was
Rate of methane emission in undrained soil ((t CH ₄ -C) ha ' yr ')	-0.21	$R_{CH4} = (3.667/1000) \times (58.4 + (3.11 T) + (16.7 pH) - (410 W))$
Selected Emission Rates		where R_{CH4} is the annual rate of CH ₄ emissions (t CO ₂ (ha) ⁻¹ yr ⁻¹), T = average annual air temperature <i>pH</i> is the soil pH and <i>W</i> is the water table depth (m).
Rate of carbon dioxide emission in drained soil (t CO ₂ ha ⁻¹ vr ⁻¹)	28,24	The equation has a R ² value of 52.7%, P <0.0001. By statistical convention, if P<0.001 this relationship
Rate of carbon dioxide emission in undrained soil (t CO_2 ha ⁻¹ vr ⁻¹)	14.55	be considered to be highly significant.
Bate of methane emission in drained soil ((t CH_4 -C) ha ⁻¹ vr ⁻¹)	-1.38	
Rate of methane emission in undrained soil (($t CH_4 C$) ha ⁻¹ yr ⁻¹)	-0.21	
	-0.21	

Total C loss		
Gross CO ₂ loss from removed peat (t CO ₂)	1885395	
Gross CO_2 loss from drained land (t CO_2)	84859	
Gross CH_4 loss from drained land (t CO_2 equiv.)	12994	
Gross CO ₂ loss from improved land (t CO ₂)	44034	Assumption: The export from temperate and boreal
Gross CH ₄ loss from flooded land (t CO ₂ equiv.)	0	peatlands ranges between 10 and 500 kg DOC ha ' yr
Conversion factor: CH ₄ -C to CO ₂ equivalents	30.6667	2591–2600), which typically represents around 10% of the
% total soil C losses, lost as DOC	10	total C release.
% DOC loss emitted as CO ₂ over the long term	100	Assumption: In the long term, 100% of leached DOC is
% total soil C losses, lost as POC	15	assumed to be lost as CO2
% POC loss emitted as CO ₂ over the long term	100	Assumption: The export from temperate and boreal
Total gaseous loss of C (t C)	550468	peatlands ranges between 12 and 15% of the total
Total C loss as DOC (t C)	55047	gaseous C loss (Worrall, F., Reed, M., Warburton, J., Burt, T., 2003.
Total C loss as POC (t C)	82570	Environment, 312, 133–146.) Tables 1 and 2.
		_ \ L
Total CO ₂ loss due to DOC leaching (t CO ₂)	201471	Assumption: In the long term, 100% of leached DOC is
Total CO ₂ loss due to POC leaching (t CO ₂)	302207	assumed to be lost as CO ₂
Total CO ₂ loss due to DOC & POC leaching (t CO ₂)	503678	

Note: Note, CO2 losses from DOC are calculated using a simple approach derived from estimates of the total C loss leached as DOC and the percentage of leached DOC lost as CO2

	Carbon Dioxide Saving
Wind farm CO ₂ emission saving over	(tCO ₂ yr ⁻¹)
coal-fired electricity generation	1830665
grid-mix of electricity generation	915332
fossil fuel - mix of electricity generation	1292109

Additional CO_2 payback time of wind farm due to DOC and POC leaching	Additional payback time (years)	Additional payback time (months)
Coal-fired electricity generation	0.28	3.3
Grid-mix of electricity generation	0.55	6.6
Fossil fuel - mix of electricity generation	0.39	4.7

Note: Emissions due to forestry felling are calculated from the reduced carbon sequestered per crop rotation. If the forestry was due to be removed before the planned development, this C loss is not attributable to the wind farm and so the area of forectry to be felled should be entered as zero.

Emissions due to forestry felling	
Area of forestry plantation to be felled (ha)	0
Carbon sequestered (tC ha ⁻¹ yr ⁻¹)	0
Life time of wind farm (years)	25
Carbon sequestered over the lifetime of the wind farm (t C ha ⁻¹)	0
Total carbon loss due to felling of forestry (t CO ₂)	0

Wind farm CO ₂ emission saving over	Carbon dioxide saving (tCO ₂ yr ⁻¹)
coal-fired electricity generation	1830665
grid-mix of electricity generation	915332
fossil fuel - mix of electricity generation	1292109

Additional CO ₂ payback time of wind farm due to felling of forestry	Additional payback time (yr)	Additional payback time (months)		
Coal-fired electricity generation	0.00	0.0		
Grid-mix of electricity generation	0.00	0.0		
Fossil fuel - mix of electricity generation	0.00	0.0		

Note: Note, CO₂ losses are calculated using two approaches: IPCC default methodology and more site specific equations derived for this project. The IPCC methodology is included because it is the established approach, although it contains no site detail. The new equations have been thoroughly tested against experimental data (see Nayak et al, 2008 - Final report).

Choice of methodology for calculating emission factors	Site specific

Reduction in GHG emissions due to improvement of site						
Improvement of	Degraded Bog	Felled Forestry	Borrow Pits	Foundations & Hardstanding		
1. Description of site						
Life time of wind farm (years)	25	25	25	25		
Area to be improved (ha)	394	0	15.19	47		
Average air temperature at site (°C)	7	7	7	7		
Average soil pH	4	4	4	4		
Average depth of peat at site (m)	1.60	1.60	1.60	1.60		
Water table depth before improvement (m)	0.50	0.00	0.50	0.50		
2. Losses with improvement	0.50	0.00	0.50	0.50		
Flooded period (days year ⁻¹)	178	178	178	178		
Time required for hydrology and habitat to return to its previous state on		_				
restoration (years)	10	0	10	25		
Improved period (years)	15	25	15	0		
Methane emissions from improved land						
Site specific annual rate of methane emission (t CO ₂ ha ⁻¹ yr ⁻¹)	-6.53	16.53	-6.53	-6.53		
IPCC annual rate of methane emission (t CO ₂ ha ⁻¹ yr ⁻¹)	1.23	1.23	1.23	1.23		
Selected annual rate of methane emission (t CO ₂ ha ⁻¹ yr ⁻¹)	-6.53	16.53	-6.53	-6.53		
CH ₄ emissions from improved land (t CO ₂ equiv.)	-18808	0	-725	0		
Carbon dioxide emissions from improved land						
Site specific annual rate of carbon dioxide emission (t CO ₂ ha ⁻¹ yr ⁻¹)	14.6	5.7	14.6	14.6		
IPCC annual rate of carbon dioxide emission (t CO ₂ ha ⁻¹ yr ⁻¹)	35.2	35.2	35.2	35.2		
Selected annual rate of carbon dioxide emission (t CO ₂ ha ⁻¹ yr ⁻¹)	14.6	5.7	14.6	14.6		
CO ₂ emissions from improved land (t CO ₂)	44070	0	1699	0		
Total GHG emissions from improved land (t CO ₂ equiv.)	25262	0	974	0		
3. Losses without improvement						
Flooded period (days year ⁻¹)	0	0	0	0		
Time required for hydrology and habitat to return to its previous state on	10	0	10	25		
restoration (years)	15	05	15	0		
Methane emissions from unimproved land	15	25	15	0		
Site specific annual rate of methane emission (t CO ₂ ha ⁻¹ vr ⁻¹)	-6.53	16.53	-57.24	-57.24		
IPCC annual rate of methane emission (t CO ₂ ha ⁻¹ yr ⁻¹)	1.23	1.23	1.23	1.23		
Selected annual rate of methane emission (t CO ₂ ha ⁻¹ yr ⁻¹)	-6.53	16.53	-57.24	-57.24		
CH ₄ emissions from unimproved land (t CO ₂ equiv.)	0	0	0	0		
Carbon dioxide emissions from unimproved land						
Site specific annual rate of carbon dioxide emission (t CO ₂ ha ⁻¹ yr ⁻¹)	14.6	5.7	34.0	34.0		
IPCC annual rate of carbon dioxide emission (t CO ₂ ha ⁻¹ yr ⁻¹)	35.2	35.2	35.2	35.2		
Selected annual rate of carbon dioxide emission (t CO ₂ ha ⁻¹ yr ⁻¹)	14.6	5.7	34.0	34.0		
CO ₂ emissions from unimproved land (t CO ₂)	86018	0	7737	0		
Total GHG emissions from unimproved land (t CO ₂ equiv.)	86018	0	7737	0		
4. Reduction in GHG emissions due to improvement of site						
Total GHG emissions from improved land (t CO2 equiv.)	25262	0	974	0		
Total GHG emissions from unimproved land (t CO ₂ equiv.)	86018	0	7737	0		
Reduction in GHG emissions due to improvement (t CO ₂ equiv.)	60757	0	6763	0		

Deduction in CO	nouhook timo o	uning forms dure	improvement	of oite
neulocilon in CO	раураск шпе о	wind farm due	improvement	or site

	Carbon Dioxide
Wind farm CO ₂ emission saving over	Saving (tCO ₂ yr ⁻¹)
coal-fired electricity generation	1830665
grid-mix of electricity generation	915332
fossil fuel - mix of electricity generation	1292109

Reduction in CO_2 payback time of wind farm due improvement of	Degraded Bog	Felled Forestry	Borrow Pits	Foundations & Hardstanding	Total
	Reduction in payback time (years)				
Coal-fired electricity generation	0.03	0.00	0.00	0.00	0.04
Grid-mix of electricity generation	0.07	0.00	0.01	0.00	0.07
Fossil fuel - mix of electricity generation	0.05	0.00	0.01	0.00	0.05
	Reduction in payback time (months)				
Coal-fired electricity generation	0.40	0.00	0.04	0.00	0.44
Grid-mix of electricity generation	0.80	0.00	0.09	0.00	0.89
Fossil fuel - mix of electricity generation	0.56	0.00	0.06	0.00	0.63