New Technical Appendix AI 18.2
Carbon Calculator Inputs And Results

MODEL INPUT DATA				
Input Data	*Expected Value*	*Minimum Value*	*Maximum Value*	*Source of Data*
Windfarm characteristics				
No. of turbines	11	11	11	Chapter 4: Description of the Proposed Development
Duration of consent (years)	50	50	50	Chapter 4: Description of the Proposed Development
Power rating of 1 turbine (MW)	7.2	7.2	7.2	Chapter 4: Description of the Proposed Development
Capacity factor (%)	35.1	31.6	38.6	Developer (Galileo 04 Ltd) projection based on onsite wind monitoring
Fraction of output to backup (%)	5	5	5	Default value for future projection of >20 % wind energy proportion in the mix
Additional emissions due to reduced thermal efficiency of the reserve generation (%)	10	10	10	Fixed
Total CO2 emission from turbine life (tCO2 MW-1)	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	Refer Chapter 9 'Ecology'
Average annual air temperature at site (°C)	12.96	11.664	14.256	Average temp at closest metoffice met station - Dunstaffnage 1991-2020 (https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages/gfh1hk7v1) +/- 10%
Average depth of peat at site (m)	0.48	0.43	0.53	Site survey, see TA 11.1, +/- 10%
C Content of dry peat (% by weight)	55	49.5	60.5	industry standard, +/- 10%
Average extent of drainage around drainage features at site (m)	10	5	50	Default values: Carbon Calculator User Guidance
Average water table depth at site (m)	0.5	0.25	0.75	Heavily drained site, restoration survey observations, see Technical Appendix 9.7 appendix 1 page 7
Dry soil bulk density (g cm-3)	0.16	0.15	0.175	Lab. analysis, see Appendix 11.5, +/- SEM
Characteristics of bog plants				
Time required for regeneration of bog plants after restoration (years)	15	10	25	Expert estimates, see Appendix 9.7 appendix 1 page 16
Carbon accumulation due to C fixation by bog plants in undrained peats (tC ha-1 yr-1)	0.25	0.12	0.31	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.
Forestry Plantation Characteristics				
Method used to calculate CO2 loss from forest felling	Simple Data	Simple Data	Simple Data	From drop down
Area of forestry plantation to be felled (ha)	16.68	15.012	18.348	Chapter 13 Forestry - 27.44ha to be felled with 10.76ha being restocked so nett loss is 16.68ha. Compensatory offsite planting proposed by no fixed locations at this stage. +/- 10%

Average rate of carbon sequestration in timber (tC ha-1 yr-1)	3.6	3.15	3.96	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 y-1 = 3.6 tC ha-1 yr-1 (Cannell, 1999). SNH value taken as expected, FC taken as minimum, SNH +10% taken as maximum
Counterfactual emission factors				
Coal-fired plant emission factor (t CO2 MWh-1)	0.919	0.919	0.919	As per most recent online version of the Carbon Calculator
Grid-mix emission factor (t CO2 MWh-1)	0.177	0.177	0.177	As per most recent online version of the Carbon Calculator
Fossil fuel-mix emission factor (t CO2 MWh-1)	0.448	0.448	0.448	As per most recent online version of the Carbon Calculator
Borrow pits				
Number of borrow pits	2	2	2	Chapter 4: Description of the Proposed Development
Average length of pits (m)	65	65	65	Design, see Figure 4.12
Average width of pits (m)	75	75	75	Design, see Figure 4.12
Average depth of peat removed from pit (m)	0.2	0.18	0.22	TA 11.3 OPMP. Soils below 0.5m are not referred to as peat following Nature Scots peat definition. +/- 10%
Access Tracks				
Total length of access track (m)	20390	18351	22429	Sum of the lengths of different track types (CEMP), +/- 10%
Existing track length (m)	5870	5283	6457	Existing track length stated in CEMP, +/- 10%
Length of access track that is floating road (m)	300	270	330	Pell Frischmann' calcs +/-10%
Floating road width (m)	6	6	10	CEMP
Floating road depth (m)	0.43	0.387	0.473	Calculations of anticipated strip divided by total road surface (Techical Appendix 11.3 OPMP) +/- 10%
Length of floating road that is drained (m)	0	0	0	Standard best practice according to SNH 2010 'Floating Roads on Peat' - drainage will cause settlement issues. +/-10%
Average depth of drains associated with floating roads (m)	0.2	0.18	0.22	See Corr Chnoc Construction Drawings, Figure 9, +/- 10%
Length of access track that is excavated road (m)	14220	12798	15642	Pell Frischmann calcs +/- 10%
Excavated road width (m)	9	8.1	9.9	6m road width + 2m verge (1m on either side) + the varying width of embankment/ cutting (est 0.5 either side), +/- 10 %
Average depth of peat excavated for road (m)	1	0.9	1.1	3D model from peat surveys, depth back calculated from the total volume of peat disturbed to construct the track and its average dimensions, +/- 10%
Length of access track that is rock filled road (m)	14220	12798	15642	Pell Frischmann calcs +/- 10%
Rock filled road width (m)	6	6	10	CEMP
Rock filled road depth (m)	0.4	0.36	0.44	Figure 4.9, +/- 10%
Length of rock filled road that is drained (m)	14220	12798	15642	Pell Frischmann calcs, assuming drains on all non-floating roads as per cross-section, +/- 10%
Average depth of drains associated with rock filled roads (m)	0.2	0.18	0.22	Figure 4.9, +/- 10%

Cable trench				
Length of any cable trench on peat that does not follow access tracks and is lined with a permeable medium (e.g., sand) (m)	0	0	0	All cable trenches follow access tracks and would be lined with permeable medium (e.g., sand)
Average depth of peat cut for cable trenches (m)	0	0	0	All cable trenches follow access tracks and would be lined with permeable medium (e.g., sand)
Foundations and hard-standing area associated with each turbine				
Method used to calculate CO2 loss from foundations and hard-standing	see detail below	see detail below	see detail below	
Average depth of peat removed from turbine foundations (m)	0.75	0.675	0.825	Refer to Techncial Appendix 13.2: OPMP, +/- 10%
Average depth of peat removed from hard-standing (m)	0.75	0.675	0.825	Refer to Techncial Appendix 13.2: OPMP, +/- 10%
Additional peat excavated (not already accounted for above)				
Volume of additional peat excavated (m3)	260	234	286	Construction compounds, substation and battery storage, design, 3D model from peat surveys, +/- 10%
Area of additional peat excavated (m2)	525	472.5	577.5	See Technical Appendix 11.3: OPMP, +/- 10%
Peat Landslide Hazard				
Peat Landslide Hazard and RiskAssessments: Best Practice Guide forProposed Electricity GenerationDevelopments	Negligible	Negligible	Negligible	Fixed
Improvement of C sequestration				
Area of degraded bog to be improved (ha)	6.3	5.67	6.93	Technical Appendix 11.3, within site boundary, +/- 10%
Water table depth in degraded bog before improvement (m)	0.25	0.225	0.275	see Technical Appendix 11.1 Maximum depth of acrotelmic/peat
Water table depth in degraded bog after improvement (m)	0.15	0.135	0.165	Typical target of peatland restoration
Time required for hydrology and habitat of bog to return to its previous state on improvement (years)	5	5	5	Expert judgement, see Technical Appendix 9.7 page 16, +/- 1 year
Period of time when effectiveness of the improvement in degraded bog can be guaranteed (years)	50	50	50	Lifetime of the Proposed Development (see Project Description, Chapter 4)
Area of felled plantation to be improved (ha)	27.44	24.696	30.184	Chapter 13 Forestry (para 13.5.5) - felling of 10m around infrastructure and advance felling, 30m around track, +/- 10%
Water table depth in felled area before improvement (m)	0.25	0.225	0.275	see Technical Appendix 11.1 Maximum depth of acrotelmic/peat
Water table depth in felled area after improvement (m)	0.15	0.135	0.165	Typical target of peatland restoration
Time required for hydrology and habitat of felled plantation to return to its previous state on improvement (years)	7.5	5	10	Same as expert judgement for the reminder of the Site, see Chapter 13 - Forestry para 13.8.10 - 5-10yrs for broadleaf
Period of time when effectiveness of the improvement in felled plantation can be guaranteed (years)	50	50	50	Lifetime of the Proposed Development (see Project Description, Chapter 4)
Restoration of peat removed from borrow pit				
Area of borrow pits to be restored (ha)	1.015	0.9135	1.1165	Borrow pit located primarily in area of peaty gleys (see Figure 11.3) and likely to be restored with peat (TA 11.3 OPMP)
Depth of water table in borrow pit before restoration with respect to the restored surface (m)	0.25	0.225	0.275	see Technical Appendix 11.1 Maximum depth of acrotelmic/peat

Depth of water table in borrow pit after restoration with respect to the restored surface (m)	0.15	0.135	0.165	Typical target of peatland restoration
Time required for hydrology and habitat of borrow pit to return to its previous state on restoration (years)	2	1	3	n/a Borrow pit located primarily in area of brown earths (see Figure 11.4) and likely not restored with peat
Period of time when effectiveness of the restoration of peat removed from borrow pits can be guaranteed (years)	2	2	3	n/a Borrow pit located primarily in area of brown earths (see Figure 11.4) and likely not restored with peat
Early removal of drainage from foundations and hardstanding				
Water table depth around foundations and hardstanding before restoration (m)	0.25	0.225	0.275	see Technical Appendix 11.1 Maximum depth of acrotelmic/peat
Water table depth around foundations and hardstanding after restoration (m)	0.15	0.135	0.165	Typical target of peatland restoration
Time to completion of backfilling, removal of any surface drains, and full restoration of the hydrology (years)	1.5	1	2	Estimated based on expected construction programme, see Chapter 4
Restoration of site after decomissioning				
Will the hydrology of the site be restored on decommissioning?	y	y	y	Technical Appendix 11.3: OPMP
Will you attempt to block any gullies that have formed due to the windfarm?	y	y	y	Technical Appendix 11.3: OPMP
Will you attempt to block all artificial ditches and facilitate rewetting?	y	y	y	Technical Appendix 11.3: OPMP
Will the habitat of the site be restored on decommissioning?	y	y	y	Technical Appendix 11.3: OPMP
Will you control grazing on degraded areas?	y	y	y	Technical Appendix 9.6: OHMP
Will you manage areas to favour reintroduction of species?	y	y	y	Technical Appendix 9.6: OHMP
FORESTRY INPUT DATA				
Input Data	*Expected Value*	*Minimum Value*	*Maximum Value*	*Source of Data*
Windfarm Characteristics				
Location				
Distance to nearest biofuel plant (km)	54.1	54.1	54.1	Corr Chnoc to Acharn Forest Killin Biomass Plant via Google Maps (Acharn identified from Renewable Energy Planning Database - https://data.barbour-abi.com/smart-map/repd/desnz/?type=repd)
Dimensions				
Total wind farm area (ha)	35.4	35.4	35.4	Area under earthworks footprint (i.e. also includes temporary land take area)
Performance				
Height of turbines (m)	200	200	200	As provided by Developer (Galileo 04 Ltd) based on the models being considered
Average site windspeed (ms-1)	8.97	8.073	9.867	Estimated from NOABL average across site. with logarthmic wind speed up, +/- 10%

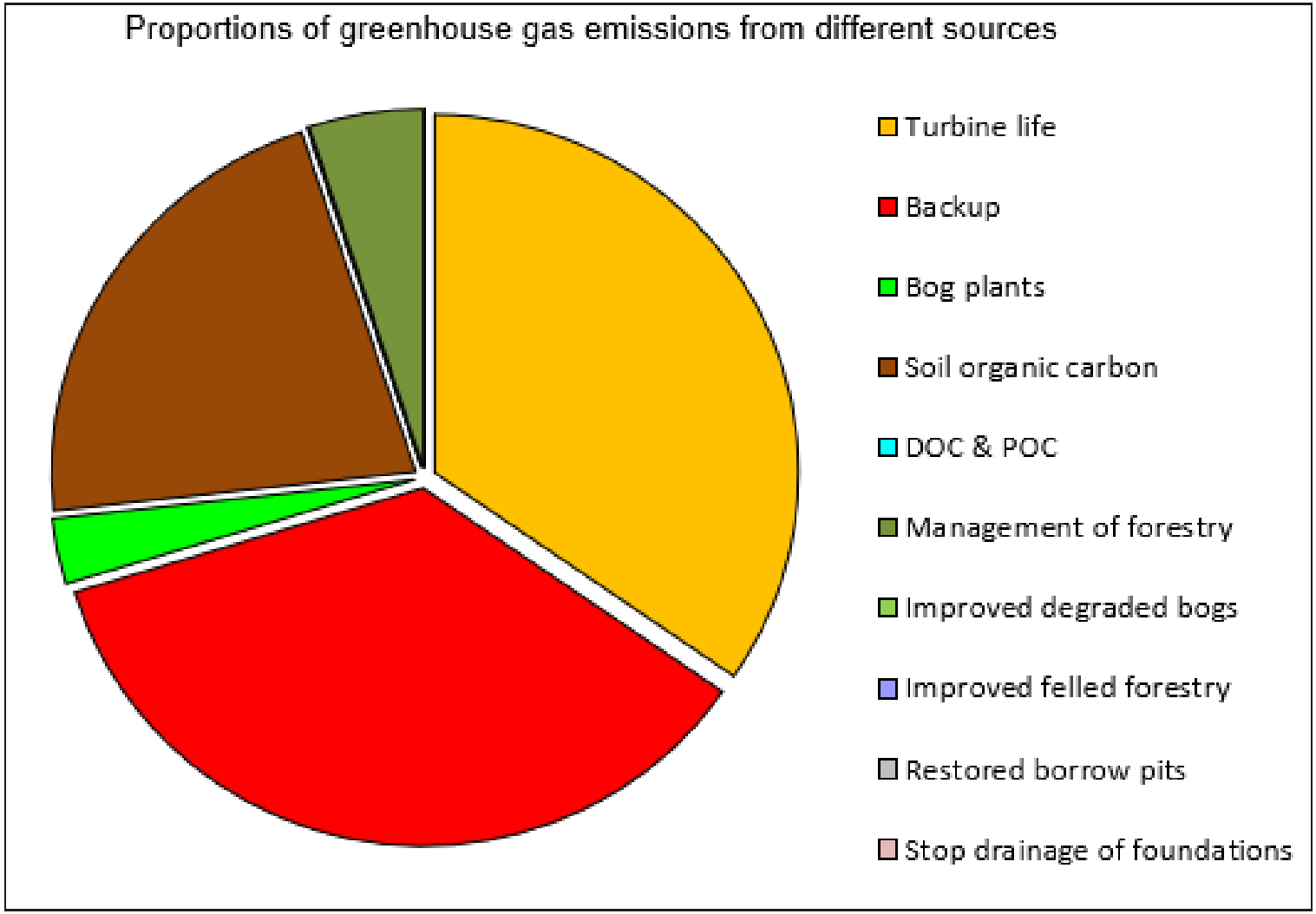
Estimated downtime for maintenance etc (%)	2	2	3	OEM's incentivised to minimise downtime
Emissions due to forestry operations				
Emissions from felling (g CO2 m-3)	6675	6675	6675	Based on emissions factors from UK taken from Morison et al (2011), if clearfelling assumed to be performed by harvester and timber is assumed extracted with forwarder, the emissions are 6675 g CO2 m-3
Emissions of CO2 associated with transportation (g CO2 km-1 t-1)	39.33	38.5	40.15	Assuming transportation by trucks running on diesel and 20% of journey taken on forest roads, emissions factor obtained from Morison et al (2011) is 39.33 g CO2 km-1 t-1 (range 38.5 - 40.15 g CO2 km-1 t-1 - average = 39.33 g CO2 km-1 t-1)
Forest plantation area				
Number of turbines in this area	0	0	0	Refer to Chapter 4 - Proposed Site Plan, Ref 107751.
Major soil sub-group	Peaty Gleys	Peaty Gleys	Peaty Gleys	Refer Figure 11.3
Species	Sitka spruce	Sitka spruce	Sitka spruce	Refer Chapter 13: Forestry
Felled Forest Biomass used as biofuel?	No	No	No	Only a small percentage (10-20%) of the felled forest biomass will be used as biofuel
Felling regime				
Age of forestry when felled for windfarm (yr)	20	10	40	Refer Chapter 13: Forestry, estimated from Tree Survey plan, Appendix 13.1, -50%, +100%
Forest plantation area				
Area felled around each turbine (ha)	0	0	0	Refer to Proposed Site Plan, Ref 107751, dated 20/08/2026.
Width of forest around felled area (m)	0	0	0	Refer to Chapter 13 - Forestry
Value of felled forestry as a biomass fuel (MWh t-1)	3	2.3	3.8	J. D. Walmsley, D. L. Godbold, Stump Harvesting for Bioenergy - A Review of the Environmental Impacts, Forestry: An International Journal of Forest Research, Volume 83, Issue 1, January 2010
(Carbon : Biomass) ratio of felled forestry	0.5	0.5	0.5	Default values
Years after felling when replanting occurs	5	5	5	To be confirmed but estimated
Age of seedlings on planting (yr)	1	1	1	Assumed to be 1 year
Area replanted around each turbine (ha)	0	0	0	No planting proposed around turbines.

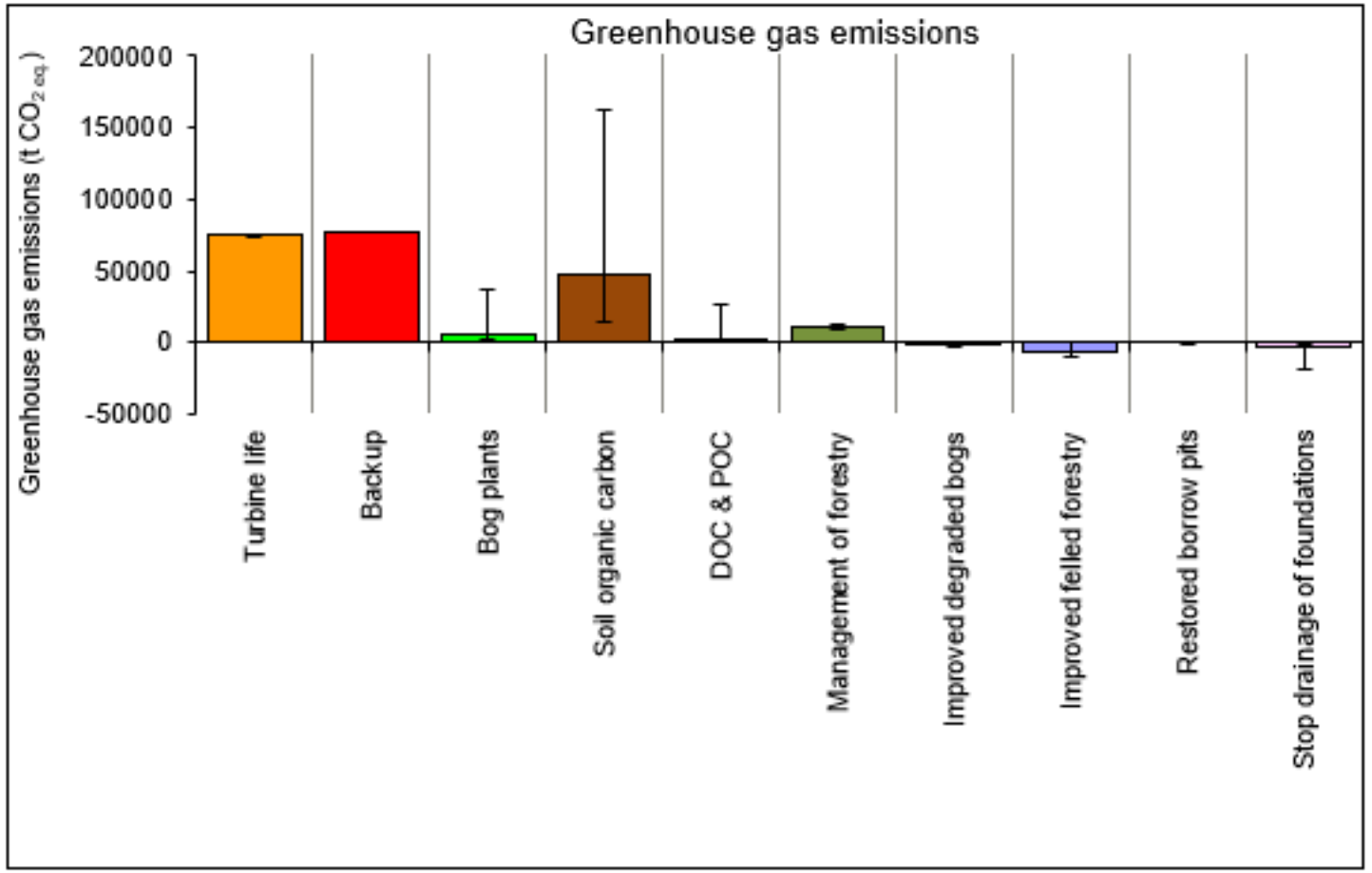
CONSTRUCTION INPUT DATA				
Input Data	*Expected Value*	*Minimum Value*	*Maximum Value*	*Source of Data*
Corr Chnoc Wind Farm				
Number of turbines in Corr Chnoc Wind Farm area	11	11	11	Refer to Proposed Site Plan, Ref 107751, dated 20/08/2026.
Average depth of peat removed when constructing foundations (m)	0.75	0.675	0.825	Refer to Techncial Appendix 13.2: OPMP, +/- 10%
Approximate geometric shape of hole dug when constructing turbine foundations	Rectangular	Rectangular	Rectangular	Note - the foundations are designed to be circular but the offline carbon calculator can not model this shape so square foundations have had to be used as a proxy instead.

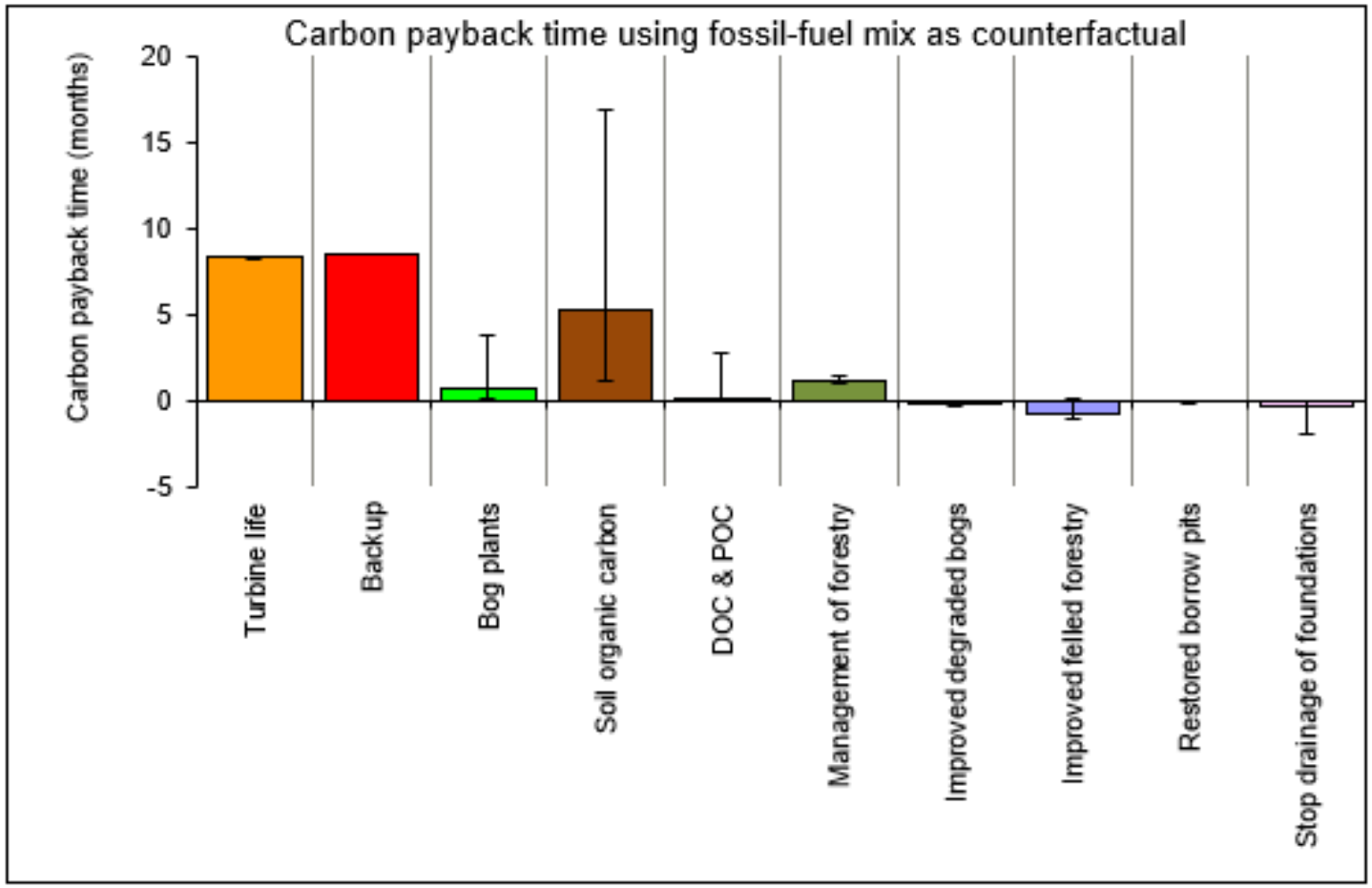
Length at surface when constructing turbine foundations (m)	42	37.8	46.2	22m diameter turbine slab, plus additional excavation and enineering fill (estimate 10m extra dig all around top of hole) approximated by 42m square hole. Design, see Construction Details Drawing, Chapter 4 - Figure 4.4, +/- 10%
Width at surface of hole dug when constructing turbine foundations (m)	42	37.8	46.2	22m diameter turbine slab, plus additional excavation and enineering fill (estimate 10m extra dig all around top of hole) approximated by
Length at bottom of hole dug when constructing turbine foundations (m)	32	28.8	35.2	22m diameter turbine slab, plus additional excavation and enineering fill (estimate 5m extra dig all around top of hole) approximated by 32m square hole. Design, see Construction Details Drawing, Chapter 4 - Figure 4.4, +/- 10%
Width at bottom of hole dug when constructing turbine foundations (m)	32	28.8	35.2	22m diameter turbine slab, plus additional excavation and enineering fill (estimate 5m extra dig all around top of hole) approximated by 32m square hole. Design, see Construction Details Drawing, Chapter 4 - Figure 4.4, +/- 10%
Average depth of peat removed when constructing hardstanding (m)	0.75	0.675	0.825	Refer to Techncial Appendix 13.2: OPMP, +/- 10%
Approximate geometric shape of hole dug when constructing hardstanding	Rectangular	Rectangular	Rectangular	Permanent hardstanding is approx rectangular, Temporary hardstanding is irregular but very approx rectangular. See Construction Details Drawing, Chapter 4 - Figure 4.5
Length at surface of hole dug when constructing hardstanding (m)	215	193.5	236.5	See Construction Details Drawing, Chapter 4 - Figure 4.5 (estimate 5m extra dig around top of the hole), +/- 10%
Width at surface of hole dug when constructing hardstanding (m)	85	76.5	93.5	See Construction Details Drawing, Chapter 4 - Figure 4.5 (estimate 5m extra dig around top of the hole), +/- 10%
Length at bottom of hole dug when constructing hardstanding (m)	205	184.5	225.5	See Construction Details Drawing, Chapter 4 - Figure 4.5, +/- 10%
Width at bottom of hole dug when constructing hardstanding (m)	75	67.5	82.5	See Construction Details Drawing, Chapter 4 - Figure 4.5, +/- 10%
Is piling used?	No	No	No	No mention of piling in construction drawings or CEMP
Volume of concrete used (m3) in the entire area	20,900	18,810	22,990	Pell Frischmann estimate based on civil engineering design, +/- 10%

CALCULATOR OUTPUTS

	Exp.	Min.	Max.
1. Windfarm CO2 emission saving over…			
…coal-fired electricity generation (tCO2 yr-1)	223,796	201,480	246,112
…grid-mix of electricity generation (tCO2 yr-1)	43,103	38,805	47,401
…fossil fuel - mix of electricity generation (tCO2 yr-1)	109,097	98,219	119,976
Energy output from windfarm over lifetime (MWh)	12,176,050	10,961,914	13,390,186
Total CO2 losses due to wind farm (t CO2 eq.)			
2. Losses due to turbine life (eg. manufacture, construction, decomissioning)	75,462	74,801	76,122
3. Losses due to backup	77,705	77,705	77,705
4. Losses due to reduced carbon fixing potential	6,454	1,716	36,518
5. Losses from soil organic matter	47,173	14,193	163,429
6. Losses due to DOC & POC leaching	73	4	27,469
7. Losses due to felling forestry	11,010	8,670	13,322
Total losses of carbon dioxide	217,876	177,090	394,565
8. Total CO2 gains due to improvement of site (t CO2 eq.)			
8a. Change in emissions due to improvement of degraded bogs	- 1,677	- 1,155	- 2,257
8b. Change in emissions due to improvement of felled forestry	- 6,896	-	- 9,833
8c. Change in emissions due to restoration of peat from borrow pits	-	-	- 10
8d. Change in emissions due to removal of drainage from foundations & hardstanding	- 2,297	- 764	- 18,666
Total change in emissions due to improvements	- 10,870	- 1,918	- 30,767
RESULTS			
	Exp.	Min.	Max.
Net emissions of carbon dioxide (t CO2 eq.)	207,007	146,323	392,647
Carbon Payback Time			
…coal-fired electricity generation (years)	0.9	0.6	1.9
…grid-mix of electricity generation (years)	4.8	3.1	10.1
…fossil fuel - mix of electricity generation (years)	1.9	1.2	4.0
Ratio of soil carbon loss to gain by restoration (*TARGET ratio (Natural Resources Wales) < 1.0*)	4.3	7.4	6.2
Ratio of CO2 eq. emissions to power generation (g / kWh) (TARGET ratio by 2030 (electricity generation) < 50 g /kWh)	17	11	36


Proportions of greenhouse gas emissions from different sources
Turbine life
Backup
Bog plants
Soil organic carbon
DOC & POC
Management of forestry
Improved degraded bogs
Improved felled forestry
Restored borrow pits
Stop drainage of foundations


Greenhouse gas emissions
Greenhouse gas emissions (t $CO_{2\,eq.}$)
200000
150000
100000
50000
0
-50000
Turbine life
Backup
Bog plants
Soil organic carbon
DOC & POC
Management of forestry
Improved degraded bogs
Improved felled forestry
Restored borrow pits
Stop drainage of foundations


Carbon payback time using fossil-fuel mix as counterfactual
Carbon payback time (months)
20
15
10
5
0
-5
Turbine life
Backup
Bog plants
Soil organic carbon
DOC & POC
Management of forestry
Improved degraded bogs
Improved felled forestry
Restored borrow pits
Stop drainage of foundations