Appendix 11-1: GHG Background Data

Calderdale Energy Park

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A11 Appendix 11-1: GHG Background Data

A11.1.1 This appendix sets out the data and assumptions used to calculate the GHG footprint for the Proposed Development. The GHG footprint results and context is available in **Chapter 11: Carbon and Climate Change**.

A11.2 Material Embodied Carbon

A11.2.1 Turbines: Material type and weight for the Turbines were taken from Data Table 6 of the Vestas V162-6.2MW Life Cycle Assessment Study[1], with weights scaled to the 34 turbines that constitute the Proposed Development (the Vestas study assumes 16 turbines).

A11.2.2 Foundations: Steel and concrete quantities for the Foundations were provided by the Applicant.

A11.2.3 Substation: Material type and weight for the substation was taken from Data Table 6 (for onshore substation) of the Vestas V236-15MW Life Cycle Assessment Study[2]. The Vestas study is for a 990MW windfarm, versus the 240MW of the Proposed Development. As such, the substation materials were scaled down by a factor of 240/900.

A11.2.4 Onsite Cables: Cable weights for HV (772t), Fibre Optic (4t), and Earthing (copper) cables (49t) were provided by the Applicant.

A11.2.5 Bradford West Cable Corridor: Cable weights for HV (1166t) and Fibre Optic (6t) were provided by the Applicant.

A11.2.6 Meteorological Mast: The met mast is assumed to be 100% steel, with a 100% concrete foundation. Weights were estimated based on met mast design specifications (120m height) (283t of steel and of concrete).

A11.2.7 The weight of aggregates used in tracks was taken from **Chapter 14: Transport and Access** (616,000).

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[1] Vestas (2023) Life Cycle Assessment of electricity production from an onshore V162-6.2MW wind plant. Available at: https://www.vestas.com/content/dam/vestas-com/global/en/sustainability/reports-and-ratings/lcas/LCA%20of%20Electricity%20Production%20from%20an%20onshore%20EnVentus%20V162-6.2.pdf.coredownload.inline.pdf

[2] Vestas (2024) Life Cycle Assessment of electricity production from an offshore V236-15MW wind plant. Available at: https://www.vestas.com/content/dam/vestas-com/global/en/sustainability/environment/LCA%20of%20Electricity%20Production%20from%20an%20offshore%20V236-15MW.pdf.coredownload.inline.pdf

A11.2.8 Emission Factors are used to evaluate the cradle-to-gate (embodied) emissions associated with these materials, taken from two sources: the Circular Ecology ICE v4 Database[3] and DESNZ[4], as shown in **Table A11-1** below. Should there be lower carbon updates to the materials used, for example using low carbon concrete (if determined feasible), the emission factors would be updated at ES.

Table A11-1: Emission Factors to Calculate Material Embodied Carbon

Material	Emission Factor Name	Emission Factor Value (tCO_2e/t)	Emission Factor Source
Unalloyed/low alloyed steel	Steel, Plate	2.38	ICE v4
High alloyed steel	Steel, hot dipped galvanized	2.62	ICE v4
Cast iron	Steel, Section	1.61	ICE v4
Aluminium	Aluminium, cast, European Mix, Inc Imports	6.72	ICE v4
Copper	EU Tube & Sheet	2.71	ICE v4
Polymer	High Density Polyethylene (HDPE) Resin	1.93	ICE v4
Ceramic/glass	Glass, General, per kg	1.44	ICE v4
Electronics and electrics	Electrical items - IT	24.87	DESNZ 25
Lubricant	Lubricants (WTT)	1.12	DESNZ 25
Unspecified materials	General (Plastics)	3.31	ICE v4
Modified organic materials	Biodiesel HVO (WTT)	0.72	DESNZ 25
Concrete	GEN 2 (12/15 MPa)	0.09	ICE v4

[3] Circular Ecology (2024) *ICE Database Advanced V4.0 – Dec 2024* Available at: https://circularecology.com/embodied-carbon-footprint-database.html
[4] DESNZ (2025) UK Government GHG Conversion Factors for Company Reporting. Available at: https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2025

A11.3 Transport to the Proposed Development

A11.3.1 The windfarm components, as well as the materials used for temporary construction compounds and access roads, are transported to the Proposed Development, resulting in transport-related emissions. Transport distance and means was taken from the Vestas 162 Study, and from **Chapter 14: Trasport and Access**, as appropriate:

- Shipping distances for the Wind Turbine components (Nacelles, Hubs, Blades, Towers) taken from Vestas Study (800-9,000km depending on location of manufacture).
- Other windfarm component and construction aggregates assumed transport via truck from national and local sources (250km for components, 50km for aggregates).

A11.3.2 Emission Factors are used to evaluate the transport to the Proposed Development are taken from DESNZ, as shown in **Table A11-2**.

Table A11-2: Emission Factors to Calculate Material Transport

Transport Means	Emission Factor Name	Emission Factor Value (tCO_2e/t)
Ship (Fuel Use Emissions)	Average container ship	0.000016
Ship (WTT)	Average container ship	0.000004
HGV (Fuel Use Emissions)	All HGVs (50% laden)	0.000122
HGV (WTT)	All HGVs (50% laden)	0.000029

A11.4 Installation Activities

A11.4.1 Installation activities include energy use in construction site activities, staff travel to and from the Proposed Development, and embodied emissions in temporary construction compounds and access roading.

Construction Site Activities

A11.4.2 The number, type and time on-Site of each machine/plant are taken from the Plant and Labour schedules of the construction works and Bradford West Cable Corridor. Each machine is assumed to operate for 50% of the weekly construction hours for the time it is on-site.

A11.4.3 Fuel consumption for each machine/plant has been obtained from data in the European Environment Agency/EMEP emissions inventory guidebook[5]. The data provides fuel consumption per hour.

A11.4.4 Diesel consumed by construction site plant and machinery has been estimated based on the types of machinery to be used for the construction works.

A11.4.5 Emissions factors for diesel fuel consumption have been obtained from DESNZ.

Staff Travel

A11.4.6 Staff travel volumes (38 720 2-way trips) are taken from **Chapter 14: Transport and Access.** DESNZ Average car (unknown fuel) emission factors have been used to calculate emissions.

Embodied Emissions

A11.4.7 Weights and materials used in temporary construction compounds and access roads are taken from **Chapter 14:Transport and Access.** Emission factors are as per **Table A11-1**.

A11.5 Operation (and maintenance)

11.1.1 Operational emission sources are the embodied emissions in replacement parts, transport of replacement and damaged parts, staff travel, changes in peat carbon levels, and SF_6 emissions.

Replacement Parts

11.1.2 Each turbine (excluding the towers and foundations) was assumed to be replaced an average of once over the 35-year lifetime, as a reasonable worst-case assumption, using the same emission factors and data as in material embodied carbon, above.

Material Transport

11.1.3 The transport of the damaged components from the Proposed Developement was assumed to be 250km by truck, The new (replacement) components were assumed to have the same transport distances, modes, and emission factors as the original transport to the Proposed Development.

Peat

[5] EEA/EMEP (2019) Air pollutant emissions inventory guidebook 2019, Part 1.A.4 Non road mobile machinery.

11.1.4 The total excavated volume of peat is taken from the **oPMP** (and is 559,645m^3). 10% of this volume is assumed to be lost during temporary storage. The emission factor for peat loss is 0.04t/m^3, taken from the Forest Research climate change factsheet on peat[Error! Bookmark not defined.6].

SF_6 Emissions

11.1.5 A loss rate of 0.1% w/w per year is assumed for SF_6 emissions, with total SF_6 present as per table 6 of the two Vestas LCA studies for the turbines and substation.

11.1.6 Note that the Proposed Development may not use SF_6 in the final design, in which case SF_6 emissions would not occur.

A11.6 Decommissioning

11.1.7 Decommissioning emission sources consist of on-Site decommissioning activities, staff travel, and waste transport.

11.1.8 Note that:

- No emissions are calculated for waste treatment. This is because decommissioning occurs post-2050, where the UK is expected to have reached net zero, and waste treatment technology should be at or near zero emissions.
- No credit is given for avoided emissions from recycling and recovery of end-of-life materials. This is again because the UK is expected to have reached net zero emissions, and so the primary production that is avoided thanks to the recycle of the windfarm components, is expected to be at or near zero emissions. There is therefore no net credit from recycling.

On-Site Activities and Staff Travel

11.1.9 As decommissioning is assumed to last 24 months, versus the 30 months of construction, on-site activities and staff travel for decommissioning are scaled to 24/30 of construction site activities and construction staff travel, respectively.

Waste Transport

- All on-site materials are assumed to be transported via truck a distance of 250km for treatment. The emission factor for the HGV is 0.000078 tCO_2e/tkm. This is an adapted emission factor to allow for decarbonisation of transport between now and 2067 when decommissioning occurs, in line with the Department for Transport's (DfT's) WebTAG data book.

[6] Forest research (2020) Peatlands, forestry and climate change. What role can forest-to-bog restoration play?

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