Cush Wind Farm

Environmental Impact Assessment Report

Chapter 8: Air Quality & Climate

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8.1 Introduction

8.1.1 Background

This chapter comprises an assessment of the likely effect on air quality and climate associated with the project. This report provides a baseline assessment of the setting of the project in terms of air quality and climate and discusses the likely and significant effects that its construction, operation and decommissioning will have on these environmental factors. Where required, appropriate mitigation measures to limit any identified likely significant adverse effects to air quality and climate are recommended.

8.1.2 Description of the Project

In summary, the project comprises the following main components as described in **Chapter 3**:-

- 8 no. wind turbines with an overall tip height of 200m, and all associated ancillary infrastructure;
- All associated and ancillary site development, excavation, construction, landscaping and reinstatement works, including provision of site drainage infrastructure and forestry felling.
- Temporary alterations to the turbine component haul route; and,
- Construction of an electricity substation, Battery Electricity Storage System and installation of 5.6km of underground grid connection to facilitate connection of the proposed electricity substation to the existing 110kV substation at Clondallow, County Offaly;

The project site is located in rural County Offaly, approximately 4km north of the town of Birr and c. 28km south-west of Tullamore, County Offaly. Off-site and secondary developments; including the forestry replant lands and candidate quarries which may supply construction materials; also form part of the project.

The turbine component haul route, and associated temporary alteration works as described at **Chapter 3**, are located within counties Galway, Roscommon, Westmeath, and Offaly. It is envisaged that the turbines will be transported from the Port of Galway, through the counties of Galway, Roscommon, Westmeath and Offaly, to the project site.

A full description of the project is presented in **Chapter 3**.

8.1.3 Statement of Authority

This chapter was prepared by Dr. Avril Challoner. Avril is a Principal Consultant in the Air Quality section of AWN Consulting. She holds a BEng (Hons) in Environmental Engineering from the National University of Ireland Galway, HDip in Statistics from Trinity College Dublin and has completed a PhD in Environmental Engineering (Air Quality) in Trinity College Dublin graduating in 2013. She is a Chartered Environmentalist (CEnv), Chartered Scientist (CSci), Member of the Institute of Environmental Management and Assessment (MIEnvSc), Member of the Institute of Air Quality Management (MIAQM) and specialises in the fields of air quality, climate, EIA and air dispersion modelling.

8.2 Relevant Legislation & Guidance

8.2.1 Air Quality

The following Environmental Protection Agency (EPA) guidelines were considered in this assessment: -

- *Guidelines on the Information to be contained in Environmental Impact Statements* (EPA, 2022a).

The statutory ambient air quality standards in Ireland are outlined in S.I. No. 739 of 2022 Air Quality Standards Regulations 2022 (hereafter referred to as the Air Quality Regulations), which incorporate the ambient air quality limits set out in Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe (hereafter referred to as the CAFE Directive), for a range of air pollutants. The statutory ambient air quality guidelines are discussed in greater detail in the sections below.

In addition to the specific statutory air quality standards, the assessment has made reference to national guidelines, where available, in addition to international standards and guidelines relating to the assessment of ambient air quality impact from road schemes. These are summarised below: -

- *Guidance on the Assessment of Dust from Demolition and Construction V1.1 (IAQM 2016);*
- *PE-ENV-01106: Air Quality Assessment of Specified Infrastructure Projects (Transport Infrastructure Ireland (TII), 2022a);*
- *Guidance on the Assessment of Dust from Demolition and Construction Version 1.1 (Institute of Air Quality Management (IAQM), 2014) (hereafter referred to as the IAQM Guidelines); and*
- *A Guide to The Assessment of Air Quality Impacts on Designated Nature Conservation Sites (Version 1.1) (IAQM, 2020).*

8.2.1.1 Ambient Air Quality Standards

In order to reduce the risk to health from poor air quality, national and European statutory bodies have set limit values in ambient air for a range of air pollutants. The applicable legal standards in Ireland are outlined in the Air Quality Regulations (S.I. 739 of 2022), which incorporate the CAFE Directive (EU 2008/50/EC). The Air Quality Regulations set limit values for the pollutants nitrogen dioxide (NO_2) and nitrogen oxides (NO_X), particulate matter (PM) with an aerodynamic diameter of less than 10 microns (PM_{10}) and PM with an aerodynamic diameter of less than 2.5 microns ($PM_{2.5}$) (**Table 8.1**).

Pollutant	Regulation*	Limit Type	Value
NO_2	S.I. 739 of 2022	Hourly limit for protection of human health - not to be exceeded more than 18 times / year	200µg/m^3 NO_2
		Annual limit for protection of human health	40µg/m^3 NO_2
Nitrogen Oxides (NO + NO_2)		Critical limit for the protection of vegetation and natural ecosystems	30µg/m^3 NO + NO_2
PM (as PM_{10})	S.I. 739 of 2022	24-hour limit for protection of human health - not to be exceeded more than 35 times / year	50µg/m^3
		Annual limit for protection of human health	40µg/m^3
PM (as $PM_{2.5}$)	S.I. 739 of 2022	Annual limit for protection of human health	25µg/m^3
Dust Deposition	TA Luft (German VDI 2002)	Annual average limit for nuisance dust	350 mg/m^2/day

Table 8.1: Air Quality Regulations (based on the CAFE Directive)

**CAFE Directive replaces the previous Air Framework Directive (1996/30/EC) and daughter directives 1999/30/EC and 2000/69/EC*

In April 2023, the Government of Ireland published the *Clean Air Strategy for Ireland* (Government of Ireland 2023), which provides a high-level strategic policy framework needed to reduce air pollution. The strategy commits Ireland to achieving the 2021 WHO Air Quality Guidelines Interim Target 3 (IT3) by 2026 (shown in **Table 8.2**), the IT4 targets by 2030 and the final targets by 2040 (shown in **Table 8.2**). The strategy notes that a significant number of EPA monitoring stations observed air pollution levels in 2021 above the WHO targets; 80% of these stations would fail to meet the final $PM_{2.5}$ target of 5 µg/m^3. The strategy also acknowledges that "meeting the WHO targets will be challenging and will require legislative and societal change, especially with regard to both $PM_{2.5}$ and NO_2". Ireland will revise its air quality legislation in line with the proposed EU revisions to the CAFE Directive, which will set interim 2030 air quality standards and align the EU more closely with the WHO targets.

Pollutant	Regulation	Limit Type	IT3 (2026)	IT4 (2030)	Final Target (2040)
NO_2	WHO Air Quality Guidelines	24-hour limit for protection of human health	50µg/m^3 NO_2	50µg/m^3 NO_2	25µg/m^3 NO_2
		Annual limit for protection of human health	30µg/ m^3 NO_2	20µg/ m^3 NO_2	10µg/m^3 NO_2
PM (as PM_{10})		24-hour limit for protection of human health	75µg/ m^3 PM_{10}	50µg/m^3 PM_{10}	45µg/m^3 PM_{10}
		Annual limit for protection of human health	30µg/ m^3 PM_{10}	20µg/m^3 PM_{10}	15µg/m^3 PM_{10}
PM (as $PM_{2.5}$)		24-hour limit for protection of human health	37.5µg/m^3 $PM_{2.5}$	25µg/m^3 $PM_{2.5}$	15µg/m^3 $PM_{2.5}$
		Annual limit for protection of human health	15µg/m^3 $PM_{2.5}$5	10µg/m^3 $PM_{2.5}$	5µg/m^3 $PM_{2.5}$

Table 8.2: WHO Guidelines*

**Air Quality Guidelines - Global Update 2021 (WHO 2021)*

With regards to larger dust particles that can give rise to nuisance dust, there are no statutory guidelines regarding the maximum dust deposition levels that may be generated during the construction phase of a development in Ireland. Dublin City Council (DCC) has published a guidance document titled *Air Quality Monitoring and Noise Control Unit's Good Practice Guide for Construction and Demolition* however this guidance does not specify a guideline value (DCC 2018). Applicable guidance from other county councils within Ireland is not available.

The German TA-Luft standard for dust deposition (Verein Deutscher Ingenieure (VDI) 2002) (non-hazardous dust) sets a maximum permissible emission level for dust deposition of 350mg/(m_2*day) averaged over a one-year period at any receptors outside a project's boundary. Recommendations from the Department of the Environment, Heritage and Local Government (DEHLG 2004) apply the Bergerhoff limit of 350mg/(m_2*day) to the site boundary of quarries. This guidance value can be implemented with regard to dust impacts from the construction of the project.

The appropriate limits for the construction and operational phase assessment of air quality impacts from the project are the Air Quality Regulations, which incorporate the CAFE Directive.

8.2.1.2 Gothenburg Protocol

In 1999, Ireland signed the Gothenburg Protocol to the 1979 UN Convention on Long Range Transboundary Air Pollution. In 2012, the Gothenburg Protocol was revised to include national emission reduction commitments for the main air pollutants to be achieved in 2020 and beyond and to include emission reduction commitments for $PM_{2.5}$. In relation to Ireland, 2020 emission targets are 25 kt for SO_2 (65% below 2005 levels), 65 kt for NO_X (49% reduction), 43 kt for VOCs (25% reduction), 108 kt for NH_3 (1% reduction) and 10 kt for $PM_{2.5}$ (18% reduction).

European Commission Directive 2001/81/EC and the National Emissions Ceiling Directive (NECD), prescribes the same emission limits as the 1999 Gothenburg Protocol. A National EPA Programme for the progressive reduction of emissions of these four transboundary pollutants has been in place since April 2005. The data available from the EPA in 2021 indicated that Ireland complied with the emissions ceiling for SO_2 in recent years but failed to comply with the ceilings for NH_3, NO_X and NMVOCs. Directive (EU) 2016/2284 "On the Reduction of National Emissions of Certain Atmospheric Pollutants and Amending Directive 2003/35/EC and Repealing Directive 2001/81/EC" was published in December 2016. The Directive will apply the 2010 NECD limits until 2020 and establish new national emission reduction commitments which will be applicable from 2020 and 2030 for SO_2, NO_X, NMVOC, NH_3, $PM_{2.5}$ and CH_4. In relation to Ireland, 2020-29 emission targets are 25 kt for SO_2 (65% on 2005 levels), 65 kt for NO_X (49% reduction on 2005 levels), 43 kt for VOCs (25% reduction on 2005 levels), 108 kt for NH_3 (1% reduction on 2005 levels) and 10 kt for $PM_{2.5}$ (18% reduction on 2005 levels). In relation to 2030, Ireland's emission targets are 10.9 kt (85% below 2005 levels) for SO_2, 40.7 kt (69% reduction) for NO_X, 51.6 kt (32% reduction) for NMVOCs, 107.5 kt (5% reduction) for NH_3 and 11.2 kt (41% reduction) for $PM_{2.5}$.

8.2.2 Climate

The assessment has made reference to national guidelines, where available, in addition to international standards and guidelines relating to the assessment of GHG emissions and associated climatic impact from road schemes. These are summarised below: -

- Climate Action and Low Carbon Development Act 2015 (Act. No. 46 of 2015);
- DCCAE (2022) Climate Action Plan 2023;
- Climate Action and Low Carbon Development (Amendment) Act 2021 (No. 32 of 2021) ('the 2021 Climate Act');
- Climate Action and Low Carbon Development (Amendment) Bill 2021 (No. 46 of 2015) (hereafter referred to as the 2021 Climate Bill);
- PE-ENV-01104: Climate Guidance for National Roads, Light Rail and Rural Cycleways (offline & Greenways) – Overarching Technical Document (TII 2022b);
- PE-ENV-01105: Climate Assessment of Proposed National Roads – Standard (TII 2022c);
- GE-ENV-01106: TII Carbon Assessment Tool for Road and Light Rail Projects and User Guidance Document (TII 2022d);
- Assessing Greenhouse Gas Emissions and Evaluating their Significance (IEMA, 2022);
- Technical guidance on the climate proofing of infrastructure in the period 2021-2027 (European Commission 2021a);
- IEMA Environmental Impact Assessment Guide to: Climate Change Resilience and Adaptation (hereafter referred to as the IEMA 2020 EIA Guide) (IEMA, 2020a);
- IEMA GHG Management Hierarchy (hereafter referred to as the IEMA 2020 GHG Management Hierarchy) (IEMA, 2020b);
- IEMA Principles Series: Climate Change Mitigation & EIA (IEMA, 2010);

- Publicly Available Specification (PAS) 2080:2016 on Carbon Management in Infrastructure (BSI, 2016); and
- Technical guidance on the Climate Proofing of Infrastructure in the Period 2021-2027 (European Commission, 2021a).

The climate assessment in this Chapter is divided into two distinct sections – a greenhouse gas assessment (GHGA) and a climate change risk assessment (CCRA).

- Greenhouse Gas Emissions Assessment (GHGA) – Quantifies the GHG emissions from a project over its lifetime. The assessment compares these emissions to relevant carbon budgets, targets and policy to contextualise magnitude.
- Climate Change Risk Assessment (CCRA) – Identifies the impact of a changing climate on a project and receiving environment. The assessment considers a projects vulnerability to climate change and identifies adaptation measures to increase project resilience.

8.2.2.1 International & National Guidelines, Policy and Legislation

In 2015, the Climate Action and Low Carbon Development Act 2015 (No. 46 of 2015) (Government of Ireland, 2015) was enacted (the Act). The purpose of the Act was to enable Ireland '*to pursue, and achieve, the transition to a low carbon, climate resilient and environmentally sustainable economy by the end of the year 2050'* (3. (1) of No. 46 of 2015). This is referred to in the Act as the 'national transition objective'. The Act made provision for a national mitigation plan, and a national adaptation framework. In addition, the Act provided for the establishment of the Climate Change Advisory Council with the function to advise and make recommendations on the preparation of the national mitigation and adaptation plans and compliance with existing climate obligations.

The first Climate Action Plan (CAP) was published by the Irish Government in June 2019 (Government of Ireland, 2019). The Climate Action Plan 2019 outlined the current status across key sectors including electricity, transport, built environment, industry and agriculture and outlined the various broadscale measures required for each sector to achieve ambitious decarbonisation targets. The 2019 CAP also detailed the required governance arrangements for implementation including carbon-proofing of policies, establishment of carbon budgets, a strengthened Climate Change Advisory Council and greater accountability to the Oireachtas. The Government published the second Climate Action Plan in November 2021 (Government of Ireland, 2021a) and a third update in December 2022 (Government of Ireland, 2022) with an Annex of Action published in March 2023.

Following on from Ireland declaring a climate and biodiversity emergency in May 2019, and the European Parliament approving a resolution declaring a climate and environment emergency in Europe in November 2019, the Government approved the publication of the General Scheme in December 2019, followed by the publication of the Climate Action and Low Carbon Development (Amendment) Act 2021 in March 2021. The 2021Climate Act was signed into Law on 23 July 2021, giving statutory effect to the core objectives stated within the CAP.

The purpose of the 2021 Climate Act is to provide for the approval of plans "for the purpose of pursuing the transition to a climate resilient, biodiversity rich and climate neutral economy by no later than the end of the year 2050". The 2021 Climate Act will also "provide for carbon budgets and a decarbonisation target range for certain sectors of the economy". The 2021 Climate Act defines the carbon budget as "the total amount of greenhouse gas emissions that are permitted during the budget period".

In relation to carbon budgets, the 2021 Climate Action and Low Carbon Development (Amendment) Act states that 'a carbon budget, consistent with furthering the achievement of the national climate objective, shall be proposed by the Climate Change Advisory Council, finalised by the Minister and approved by the Government for the period of 5 years commencing on the 1 January 2021 and ending on 31 December 2025 and for each subsequent period of 5 years (in this Act referred to as a 'budget period')'. The carbon budget is to be produced for 3 sequential budget periods, as shown in **Table 8.3**. The carbon budget can be revised where new obligations are imposed under the law of the European Union or international agreements or where there are significant developments in scientific knowledge in relation to climate change. In relation to the sectoral emissions ceiling, the Minister for the Environment, Climate and Communications (the Minister for the Environment) shall prepare and submit to government the maximum amount of Greenhouse Gas (GHG) emissions that are permitted in different sectors of the economy during a budget period and different ceilings may apply to different sectors. The sectorial emission ceilings for 2030 were published in July 2022 and are shown in **Table 8.4**. Electricity has a 75% reduction requirement and a 2030 emission ceiling of 3 $MtCO_2eq$[1].

Sector	Reduction Required	2018 Emissions ($MtCO_2eq$)
2021-2025	295 Mt CO_2eq	Reduction in emissions of 4.8% per annum for the first budget period.
2026-2030	200 Mt CO_2eq	Reduction in emissions of 8.3% per annum for the second budget period.
2031-2035	151 Mt CO_2eq	Reduction in emissions of 3.5% per annum for the third provisional budget.

Table 8.3: 5-Year Carbon Budgets: 2021-2025, 2026-2030 and 2031-2025

[1] Mt CO_2eq denotes million tonnes carbon dioxide equivalent.

Sector	Baseline (MtCO2eq)	Carbon Budgets (MtCO2eq)		2030 Emissions (MtCO2eq)	Indicative Emissions % Reduction in Final Year of 2025- 2030 Period (Compared to 2018)
	2018	2021-2025	2026-2030		
Transport	12	54	37	6	50
Electricity	10	40	20	3	75
Built Environment - Residential	7	29	23	4	40
Built Environment - Commercial	2	7	5	1	45
Agriculture	23	106	96	17.25	25
LULUCF[Note 1]	5	-	-	-	-
Industry	7	30	24	4	35
Other (F-gases, waste, petroleum refining)	2	9	8	1	50
Unallocated Savings	-	7	5	-5.25	-
Total	68	xxx	xxx	-	-
Legally Binding Carbon Budgets and 2030 Emission Reduction Targets	-	295	200	-	51

[Note 1] No targets for Land Use, Land-use Change and Forestry (LULUCF) published.

Table 8.4: Sectoral Emission Ceilings 2030

In December 2022, CAP23 was published (Government of Ireland, 2022). This is the first CAP since the publication of the carbon budgets and sectoral emissions ceilings, and it aims to implement the required changes to achieve a 51% reduction in carbon emissions by 2030. The CAP has six vital high impact sectors where the biggest savings can be made: renewable energy, energy efficiency of buildings, transport, sustainable farming, sustainable business and change of land-use. CAP23 states that the decarbonisation of Ireland's manufacturing industry is key for Ireland's economy and future competitiveness. There is a target to reduce the embodied carbon in construction materials by 10% for materials produced and used in Ireland by 2025 and by at least 30% for materials produced and used in Ireland by 2030. CAP23 states that these reductions can be brought about by product substitution for construction materials and reduction of clinker content in cement. Cement and other high embodied carbon construction elements can be reduced by the adoption of the methods set out in the Construction Industry Federation 2021 report Modern Methods of Construction (Construction Industry Federation, 2021). In order to ensure economic growth can continue alongside a reduction in emissions, the IDA Ireland will also seek to attract businesses to invest in decarbonisation technologies.

CAP23 aims to bring 9 GW onshore wind, 8 GW solar, at least 7 GW of offshore wind and 2 GW green hydrogen into Irish energy production by 2030. In addition, the CAP aims to increase micro-generation and small-scale generation of renewables. CAP23 aims to phase out and end the use of coal and peat in electricity generation by 2030.

In April 2023 the Government published a draft Long-term Strategy on Greenhouse Gas Emissions Reductions (Government of Ireland, 2023). This strategy provides a long-term plan on how Ireland will transition towards net carbon zero by 2050, achieving the interim targets set out in the Climate Action Plan. The strategy will be updated on the basis of a second round of public consultation throughout 2023 with an updated strategy published after this is complete.

8.2.2.2 Local Policy and Guidelines

The Offaly County Council Climate Adaptation Strategy 2019 – 2024 (Offaly County Council 2019) is the council's first step in increasing knowledge and understanding of changing climate, growing resilience, and enabling effective responses to the threats posed by climate change. Offaly County Council notes that consideration of potential adverse cumulative and in-combination environmental effects must be accounted for in selecting and implementing specific actions. Actions would be examined in the context of potential co-benefits including measures such as human health, biodiversity enhancement and protection, improvement in water quality, management of areas at risk of flooding and sustainable land-use zoning and development practices. The climate adaptation strategy provides climate adaptation targets for six thematic areas; these goals are designed to guide a planned and coherent response to the effects of climate change.

8.3 Methodology

The methodology employed as part of this assessment comprised a desktop appraisal and evaluation of existing environmental conditions; the likely impacts which may arise during the construction, operational and decommissioning phases; and identification of measures to off-set or reduce any likely significant adverse effects. The following sections set out the methodology utilised to assess air quality and climate in respect of the construction and operational phases.

8.3.1 Construction & Decommissioning Phase

8.3.1.1 Air Quality – Construction Dust

The assessment of air quality has been carried out using a phased approach as recommended by the UK DEFRA (UK DEFRA 2016). The phased approach recommends that the complexity of an air quality assessment be consistent with the risk of failing to achieve the air quality standards.

The current assessment thus focused firstly on identifying the existing baseline levels of NO_2 and PM_{10} in the region of the project by an assessment of EPA monitoring data. Thereafter, the impact of the development on air quality at the neighbouring sensitive receptors during the construction and decommissioning phases was determined by an assessment of the dust generating construction activities associated with the project based on the guidance issued by the IAQM (2014). The impacts of dust from the construction and decommissioning phases will be short-term in nature and are assessed at **Section 8.5.1.1** and **Section 8.5.3.1** respectively.

8.3.1.2 Air Quality – Construction Traffic

Construction phase traffic also has the potential to impact air quality. The TII guidance *Air Quality Assessment of Specified Infrastructure Projects – PE-ENV-01106* (TII, 2022a), states that road links meeting one or more of the following criteria can be defined as being 'affected' by a project and should be included in the local air quality assessment. While the guidance is specific to infrastructure projects the approach can be applied to any development that causes a change in traffic.

- Annual average daily traffic (AADT) changes by 1,000 or more;
- Heavy duty vehicle (HDV) AADT changes by 200 or more;
- Daily average speed change by 10 kph or more;
- Peak hour speed change by 20 kph or more;
- A change in road alignment by 5m or greater.

GES have reviewed traffic data for the project and prepared **Chapter 13** of this EIAR, it has been determined that the construction stage traffic will not increase by 1,000 AADT or 200 HDV AADT, the project will not result in speed changes or changes in public road alignment; therefore the traffic does not meet the above scoping criteria. **Chapter 13** estimates that the project would generate an average 150-160 HGV deliveries per day during peak construction. As a result a detailed air quality assessment of construction stage traffic emissions has been scoped out from any further assessment as there is no potential for likely significant impacts to air quality. Effects are considered temporary and imperceptible and do not require further assessment.

8.3.1.3 Climate – Embodied Energy Assessment

Climate change is a result of increased levels of carbon dioxide and other GHGs in the atmosphere causing the heat trapping potential of the atmosphere to increase. GHGs can be emitted from vehicles and embodied energy associated with materials used in the construction of a development. Embodied energy refers to the sum of the energy needed to produce a good or service. It incorporates the energy needed in the mining or processing of raw materials, the manufacturing of products and the delivery of these products to site. There is the potential for a number of embodied GHGs and GHG emissions during the construction phase of the project. Construction vehicles, generators etc. may give rise to CO_2 and N_2O emissions as well as the large quantities of material such as stone, concrete and steel that will be required for a project of this scale.

As per the EU guidance document *Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment* (European Commission, 2013) the climate baseline is first established with reference to EPA data on annual GHG emissions (see **Section 8.4.3**). The impact of the project on climate is determined in relation to this baseline. As per the IEMA guidance (2022) where expected emissions will not increase by over 1% compared with the baseline scenario then no further assessment is required as there is no potential for significant impacts to climate. However, the construction stage activities and potential for GHG emissions have been reviewed as part of the construction stage climate assessment and a quantitative assessment conducted.

PE-ENV-01104 (TII, 2022b) recommends the calculation of the construction stage embodied carbon using the TII Online Carbon Tool (TII, 2022d). Embodied carbon refers to the sum of the carbon needed to produce a good or service. It incorporates the energy needed in the mining or processing of raw materials, the manufacturing of products and the delivery of these products to site. The TII Online Carbon Tool (TII, 2022d) uses emission factors from recognised sources including the Civil Engineering Standard Method of Measurement (CESSM) Carbon and Price Book database (CESSM, 2013), UK National Highways Carbon Tool v2.4 and UK Government 2021 Greenhouse Gas Reporting Conversion Factors. The tool aligns with PAS 2080. The carbon emissions are calculated by multiplying the emission factor by the quantity of the material that will be used over the entire construction / maintenance phase.

The GHG assessment commences with the high-level design, through the pre-construction (site clearance) stage, followed by the assessment of the embodied carbon associated with all materials used in the construction of the project, the emissions during the construction phase activities and additionally emissions related to waste generated during the construction phase. As part of the project, Construction Phase embodied GHG emissions are categorised under the following headings:

- Land clearance activities (i.e. peat movement, tree felling);
- Transport of excavated material within the site;
- Manufacture of materials and transport to site;
- Construction works; and
- Construction waste products (including transport off-site).

Detailed information for the project, including volumes of materials, were obtained from the Project Team. All peat and spoil material will remain within the site boundary.

As part of the project, a quantity of peat will be removed. As discussed in the *Best Practice Guidelines for the Irish Wind Energy Industry* (IWEA, 2012), excavation of peat can be a contributor to carbon losses associated with wind farm construction. The guidance states "*it is good practice to undertake a calculation of the carbon costs of the construction and operation of a wind farm. The carbon release associated with the excavation and oxidization of peat soils can be relatively significant and should be included in any carbon calculation*" (IWEA, 2012). Carbon emissions from peat loss have been included in the calculations for the project.

8.3.1.4 Climate – Forest Loss

Forests are an important part of the global carbon cycle and effective management at a regional scale can help to reduce GHG concentrations (UK Forestry Commission, 2012). Trees have the ability to sequester carbon with the peak CO_2 uptake rate for tree stands of the order of 5–20 tonnes of CO_2/hectare/year with CO_2 uptake rates declining before stand maturity. Additionally, after afforestation on mineral soils, there will be an increase of soil carbon soon after planting of the order of 0.2–1.7 tonnes of CO_2/hectare/year (UK Forestry Commission 2012 and Intergovernmental Panel on Climate Change (IPCC) 2006). Therefore, there is the potential for the loss of up to 21.7 tonnes of CO_2/hectare/year.

Based on this analysis, the GHG emissions associated with the loss of 23 hectares of forestry as a result of the project has been assessed. However, it should be noted that the project also provides for the planting of an equivalent area of forestry which will offset the loss of carbon sink.

8.3.1.5 Climate – Turbine Manufacture Lifecycle Assessment

A lifecycle assessment was undertaken to determine the payback period for the proposed wind turbines. The wind turbine model proposed for installation at the Cush Wind Farm is the V172-7.2MW. Information on the life cycle assessment undertaken for Vestas Wind Systems A/S, who are a major supplier of wind turbines, has been reviewed in order to develop a site-specific lifecycle assessment for the project and is considered appropriate for a project of this type and scale (Elsam 2004, Vestas Wind Systems A/S 2013). Where site specific information was not available indicative information from the Vestas assessment was used. The life cycle assessment quantifies the associated power consumption associated with the production, operation, transport and end-of-life of the wind turbines.

The assessment also quantifies the associated GHG emissions associated with the production, operation, transport and end-of-life of the wind turbines. The energy balance associated with the wind power production during its lifetime (assumed to be 35-years) and the energy associated with the manufacturing, operation, transport, dismantling and disposal was also calculated on a site-specific basis as the energy balance is based on the expected GWh of production during its lifetime. The energy balance is expressed in terms of the time taken for the energy consumed by the turbine through its full life cycle to be repaid in terms of wind energy exported to the electricity grid.

8.3.1.6 Climate – Climate Change Risk Assessment

In addition to assessing the impacts of the project on climate change in the form of a GHGA, the impact of climate change on the project must be considered. This is completed by CCRA which considers a project's vulnerability to climate change and identifies adaptation measures.

The climate vulnerability and risk assessment helps to identify the significant climate risks. It is the basis for identifying, appraising and implementing targeted adaptation measures. This will help reduce the residual risk to an acceptable level.

8.3.2 Operation Phase

8.3.2.1 Air Quality

An assessment of baseline air quality in the region has been conducted to determine whether current levels of key pollutants are significantly lower than their limit values. The savings in NOx emissions arising from the production of electricity using renewable sources have been compared against those produced using non-renewable sources. The calculations were carried out using SEAI published emission rates from non-renewable energy sources. The total NO_X savings, annually and over the lifespan of the project relative to NO_X emissions from power generation, was then established to determine the overall impact of the project on air quality.

As per the construction phase scoping criteria detailed in **Section 8.3.1** and *PE-ENV-01106* (TII, 2022a), traffic effects have been scoped out of the operational phase as they are considered insignificant.

8.3.2.2 Climate – GHGA

There will be no greenhouse gas emissions from the operation of the proposed wind turbines. However, due to the displacement of electricity which otherwise would have been produced from fossil fuels, there will be a net benefit in terms of GHG emissions. The savings have been calculated and compared to Ireland's 2030 commitment target for gross electricity consumption from renewable energy sources.

Vehicular traffic is often a dominant source of GHG emissions as a result of proposed developments. However, there is no predicted likley significant operational phase vehicle effect due to the relatively low volume of vehicles required during operation.

8.3.2.3 Climate – CCRA

PE-ENV-01104 (TII 2022b) states that the CCRA is guided by the principles set out in the overarching best practice guidance documents:

- EU (2021) Technical guidance on the climate proofing of Infrastructure in the Period 2021-2027 (European Commission, 2021); and
- The Institute of Environmental Management and Assessment, Environmental Impact Assessment Guide to: Climate Change Resilience and Adaptation (2nd Edition) (IEMA, 2020).

The baseline environment information provided in **Section 8.4.3**, future climate change modelling and input from other experts working on the project (i.e. hydrologists) should be used in order to assess the likelihood of a climate hazard.

The initial stage of an assessment is to establish a scope and boundary for the assessment taking into account the following criteria:

- Spatial boundary: As per PE-ENV-01104 (TII 2022b), the study area with respect to the GHGA is Ireland's Climate budget. The study area with respect to the CCRA can be considered the project boundary and its assets that are considered within the methodology. The study area will be influenced by current and future baselines (**Section 8.4.3**). This study area is influenced by the input of other experts within the EIAR team;
- Climate hazards: The outcomes of the climate screening i.e. vulnerability assessment and baseline assessment; and
- Project receptors: TII state that the project receptors are the asset categories considered in the climate screening. In addition, any critical connecting infrastructure and significant parts of the surrounding environment e.g. water bodies that should be considered as a part of the indirect, cumulative and in combination impact assessment should also be considered project receptors (i.e. the turbines, access roads).

Technical guidance on the climate proofing of infrastructure in the period 2021-2027 (European Commission 2021a) outlines an approach for undertaking a climate change risk assessment where there is a potentially significant impact on the project due to climate change. The risk assessment assesses the likelihood and consequence of the impact occurring, leading to the evaluation of the significance of the impact. The role of the climate consultant in assessing the likelihood and impact is often to facilitate the climate change risk assessment process with input from the project design team or specific specialists such as hydrology.

Examples of climate hazards which are considered in the risk assessment include:

- Flooding (coastal) – including sea level rise and storm surge.
- Flooding (pluvial);
- Flooding (fluvial);
- Extreme heat – including extreme heat events and increasing temperatures overtime;
- Extreme cold – including frost and snow;
- Wildfire;
- Drought;
- Extreme wind;
- Lightning and hail;
- Landslides; and,
- Fog.

The climate screening risk assessment comprises of a sensitivity analysis which is intended to evaluate the project's vulnerability to climate change. This is completed by combining a sensitivity (**Table 8.5**) and exposure (**Table 8.6**) analysis. The sensitivity analysis identifies the climate hazards relevant to the specific project type irrespective of its location (example: sea level rise will affect seaport projects regardless of location). Sensitivity ratings are classed as:

- High Sensitivity: the climate hazard may have a significant impact on assets and processes, inputs, outputs and transport links. This is a sensitivity score of 3;
- Medium Sensitivity: the climate hazard may have a slight impact on assets and processes, inputs, outputs and transport links. This is a sensitivity score of 2; and
- Low Sensitivity: the climate hazard has no (or insignificant) impact. This is a sensitivity score of 1.

The European Commission assessment states that there are four themes to sensitivity analysis. Transport links may be outside the direct control of the project but still should be considered. TII (TII 2022b) set out the following as potential sensitive receptors: drainage, structures, earthworks, geotechnical, utilities, landscaping, turbines, or access roads.

Sensitive Receptors	Sensitivity to Climate Hazards (No consideration of site location)								
	Flood (Fluvial/Pluvial)	Extreme Heat	Extreme Cold	Drought	Wind	Wildfire	Fog	Lightning & Hail	Landslides
Drainage									
Structures / Turbines									
Earthworks									
Utilities									
Turbines									
Access Roads									

Table 8.5: Screening Assessment: Sensitivity Categories

The exposure analysis identifies the climate hazards relevant to the planned project location irrespective of the project type for example: flooding could be a risk if the project location is next to a river in a floodplain. Exposure may be classed as high, medium or low:

- High exposure: It is almost certain or likely this climate hazard will occur at the project location i.e. might arise once to several times per year. This is an exposure score of 3;
- Medium exposure: It is possible this climate hazard will occur at the project location i.e. might arise a number of times in a decade. This is an exposure score of 2; and,
- Low exposure: It is unlikely or rare this climate hazard will occur at the project location i.e. might arise a number of times in a generation or in a lifetime. This is an exposure score of 1.

Climate Exposure	Exposure Risk to Climate Variable (Consider the site location)								
	Flood pluvial	Extreme Heat	Extreme Cold	Drought	Wind	Wildfire	Fog	Lightning & Hail	Landslides
Without exposure at project location									

Table 8.6: Screening Assessment: Exposure Assessment

Once sensitivity and exposure are categorised, a vulnerability analysis is conducted using **Table 8.7.** If the project scores a high or medium vulnerability, the project should proceed to add further mitigation measures including management for vulnerabilities that cannot be fully mitigated.

		Exposure (current + future climate)		
		High	Medium	Low
Sensitivity (highest across the four themes)	High	High	High	Medium
	Medium	High	Medium	Low
	Low	Medium	Low	Low

Table 8.7: Screening Assessment: Vulnerability Analysis

8.3.3 Significance Criteria Air Quality

The TII document Air Quality Assessment of Specified Infrastructure Projects – PE-ENV-01106 (TII, 2022a) details a methodology for determining air quality impact significance criteria for road schemes which can be applied to any project that causes a change in traffic. The degree of impact is determined based on the percentage change in pollutant concentrations relative to the do-nothing scenario. The TII significance criteria are outlined in Table 4.9 of Air Quality Assessment of Specified Infrastructure Projects – PE-ENV-01106 (TII, 2022) and reproduced in **Table 8.8** below. These criteria have been adopted for the proposed scheme to predict the impact of NO_2, PM_{10} and $PM_{2.5}$ emissions as a result of the proposed scheme.

Long term average concentration at receptor in assessment year	% Change in concentration relative to Air Quality Standard Value (AQLV)			
	1%	2-5%	6-10%	>10%
75% or less of AQLV	Neutral	Neutral	Slight	Moderate
76 – 94% of AQLV	Neutral	Slight	Moderate	Moderate
95 – 102% of AQLV	Slight	Moderate	Moderate	Substantial
103 – 109% of AQLV	Moderate	Moderate	Substantial	Substantial
110% or more of AQLV	Moderate	Substantial	Substantial	Substantial

Table 8.8: Air Quality Significance Criteria

Source: TII (2022a) Air Quality Assessment of Specified Infrastructure Projects – PE-ENV-01106

8.3.4 Significance Criteria Climate

8.3.4.1 Significance Criteria for GHGA

The Transport Infrastructure Ireland (TII) guidance document entitled PE-ENV-01104 Climate Guidance for National Roads, Light Rail and Rural Cycleways (Offline & Greenways) – Overarching Technical Document (TII, 2022b) outlines a recommended approach for determining the significance of both the construction and operational phases of a development. The approach is based on comparing the 'Do Something' scenario and the net project GHG emissions (i.e. Do Something – Do Minimum) to the relevant carbon budgets (Department of the Taoiseach 2022). With the publication of the Climate Action Act in 2021, sectoral carbon budgets have been published for comparison with the Net CO_2 project GHG emissions from the project. Electricity has a 75% reduction requirement and a 2030 emission ceiling of 3 $MtCO_2eq$ (see **Section 8.4.3**).

The significance of GHG effects set out in PE-ENV-01104 (TII, 2022b) is based on IEMA guidance (IEMA, 2022) which is consistent with the terminology contained within Figure 3.4 of the EPA's (2022a) 'Guidelines on the information to be contained in Environmental Impact Assessment Reports'.

The 2022 IEMA Guidance (IEMA, 2022) sets out the following principles for significance:

- When evaluating significance, all new GHG emissions contribute to a negative environmental impact; however, some projects will replace existing development or baseline activity that has a higher GHG profile. The significance of a project's emissions should therefore be based on its net impact over its lifetime, which may be positive, negative or negligible;
- Where GHG emissions cannot be avoided, the goal of the EIA process should be to reduce the project's residual emissions at all stages; and
- Where GHG emissions remain significant, but cannot be further reduced, approaches to compensate the project's remaining emissions should be considered.

TII (TII 2022b) states that professional judgement must be taken into account when contextualising and assessing the significance of a project's GHG impact. In line with IEMA Guidance (IEMA, 2022), TII state that the crux of assessing significance is "*not whether a project emits GHG emissions, nor even the magnitude of GHG emissions alone, but whether it contributes to reducing GHG emissions relative to a comparable baseline consistent with a trajectory towards net zero by 2050*".

Significance is determined using the criteria outlined in **Table 8.9** (derived from Table 6.7 of PE-ENV-01104 (TII 2022b)) along with consideration of the following two factors:

- The extent to which the trajectory of GHG emissions from the project aligns with Ireland's GHG trajectory to net zero by 2050; and
- The level of mitigation taking place.

Effects	Significance level Description	Description
Significant adverse	Major adverse	The project's GHG impacts are not mitigated. The project has not complied with do-minimum standards set through regulation, nor provided reductions required by local or national policies; and No meaningful absolute contribution to Ireland's trajectory towards net zero.

Effects	Significance level Description	Description
	Moderate adverse	The project's GHG impacts are partially mitigated. The project has partially complied with do-minimum standards set through regulation, and have not fully complied with local or national policies; and Falls short of full contribution to Ireland's trajectory towards net zero.
Not significant	Minor adverse	The project's GHG impacts are mitigated through 'good practice' measures. The project has complied with existing and emerging policy requirements; and Fully in line to achieve Ireland's trajectory towards net zero.
	Negligible	The project's GHG impacts are mitigated beyond design standards. The project has gone well beyond existing and emerging policy requirements; and Well 'ahead of the curve' for Ireland's trajectory towards net zero.
Beneficial	Beneficial	The project's net GHG impacts are below zero and it causes a reduction in atmosphere GHG concentration. The project has gone well beyond existing and emerging policy requirements; and Well 'ahead of the curve' for Ireland's trajectory towards net zero, provides a positive climate impact.

Table 8.9: Air Quality GHGA Significance Criteria for GHGA

8.3.4.2 Significance Criteria for CCRA

The CCRA involves an initial screening assessment to determine the vulnerability of the project to various climate hazards. The vulnerability is determined by combining the sensitivity and the exposure of the project to various climate hazards.

Vulnerability = Sensitivity x Exposure

The vulnerability assessment takes any proposed mitigation into account. **Table 8.10** details the vulnerability matrix; vulnerabilities are scored on a high, medium and low scale. Where residual medium or high vulnerabilities exist the assessment may need to be progressed to a detailed climate change risk assessment and further mitigation implemented to reduce risks.

		Exposure		
		High (3)	Medium (2)	Low (1)
Sensitivity	High (3)	9 - High	6 – High	3 - Medium
	Medium (2)	6 - High	4 - Medium	2 - Low
	Low (1)	3 - Medium	2 – Low	1 - Low

Table 8.10: Vulnerability Matrix

8.4 Description of the Existing Environment

8.4.1 Meteorological Data

A key factor in assessing temporal and spatial variations in air quality are the prevailing meteorological conditions. Depending on wind speed and direction, individual receptors may experience very significant variations in pollutant levels under the same source strength (i.e. traffic levels) (WHO 2006). Wind is of key importance in dispersing air pollutants and for ground level sources, such as traffic emissions, pollutant concentrations are generally inversely related to wind speed. Thus, concentrations of pollutants derived from traffic sources will generally be greatest under very calm conditions and low wind speeds when the movement of air is restricted. In relation to PM_{10}, the situation is more complex due to the range of sources of this pollutant. Smaller particles (less than $PM_{2.5}$) from traffic sources will be dispersed more rapidly at higher wind speeds. However, fugitive emissions of coarse particles ($PM_{2.5}$–PM_{10}) will actually increase at higher wind speeds. Thus, measured levels of PM_{10} will be a non-linear function of wind speed.

The nearest representative weather station collating detailed weather records is Mullingar Meteorological Station, County Westmeath, which is located approximately 57km north-east of the site. Data from Mullingar Meteorological Station has been examined to identify the prevailing wind direction and average wind speeds over the period 2018-2022 (see **Figure 8.1**). Wind frequency is important as dust can only be dispersed by winds, and deposition of dust is a simple function of particle size, wind speed and distance. The closer the source of dust is to a receptor the higher the potential risk of impact of dust blow. The prevailing winds in the area are southerly in direction, thereby predominantly dispersing any potential dust emissions to the north of the site.

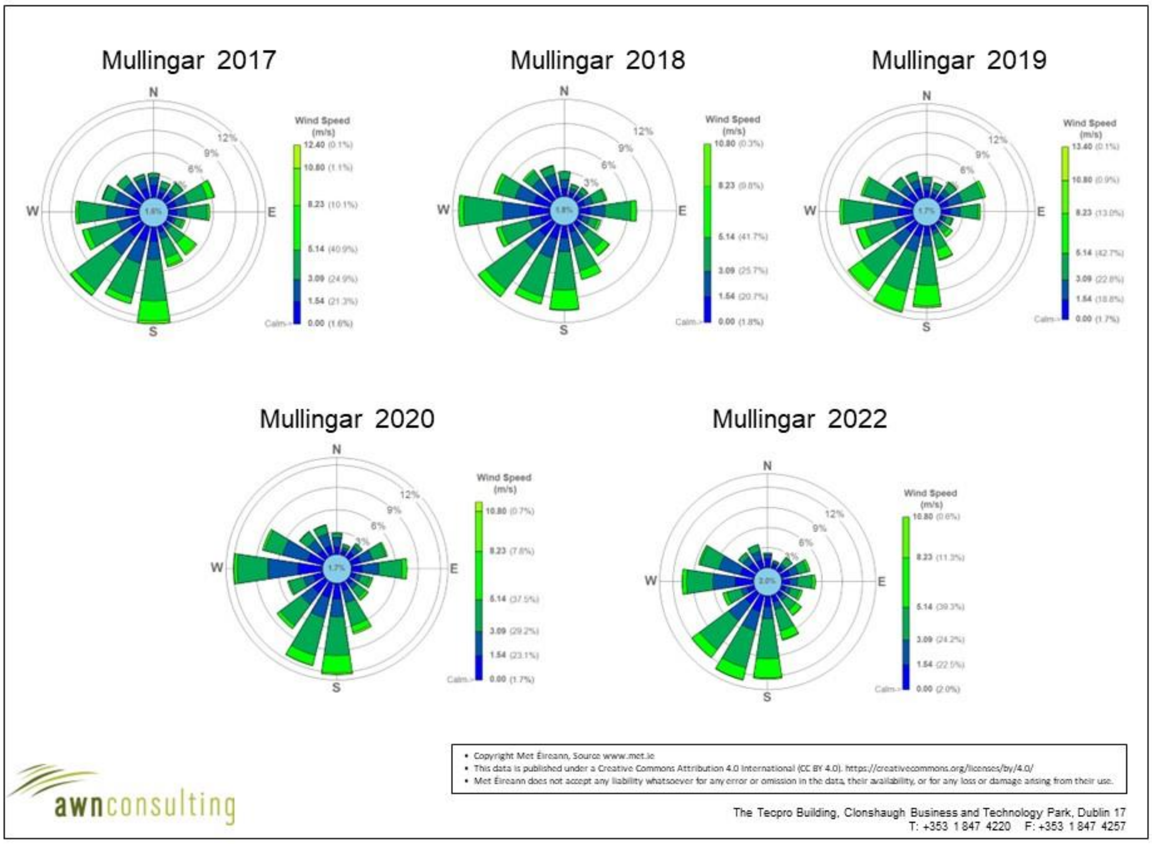

Figure 8.1: Mullingar Windroses 2018 – 2022 (Met Éireann, 2023)

Dust emissions are dramatically reduced where rainfall has occurred due to the cohesion created between dust particles and water and the removal of suspended dust from the air. It is typical to assume that no dust is generated under 'wet day' conditions where rainfall greater than 0.2mm has fallen. Shannon Airport Meteorological Station (the closest station with long-term historical data) identified that typically 199-days per annum are 'wet' (Met Eireann 2023, 30-year averages 1991–2020). Thus, in excess of 55% of the time no significant dust generation will be likely due to meteorological conditions. Long-term information collected from Casement Aerodrome Meteorological Station (the second closest station with long-term historical data) identified that typically 193-days per annum are 'wet' (Met Eireann 2023, 30-year averages). Thus, in excess of 53% of the time no significant dust generation will be likely due to meteorological conditions.

8.4.2 Review of EPA Monitoring Data

Dust is present naturally in the air from a number of sources including weathering of minerals, pick-up across open land, and dust generated from fires. Monitoring of dust deposition is not undertaken in the vicinity of the project and therefore background levels for the immediate vicinity of the project site are not available.

However, a study by the UK ODPM (UK ODPM, 2002) gives estimates of likely dust deposition levels in specific types of environments. In open country, a level of 39mg/m^2/day is typical, rising to 59mg/m^2/day on the outskirts of towns, and peaking at 127mg/m^2/day for a purely industrial area. A level of 39mg/m^2/day can be estimated as the background dust deposition level for the project due to its rural location.

Air quality monitoring programmes have been undertaken in recent years by the EPA. The most recent annual report on air quality in Ireland is *Air Quality In Ireland 2021* (EPA, 2022b). The EPA website details the range and scope of monitoring undertaken throughout Ireland and provides both monitoring data and the results of previous air quality assessments (EPA, 2023).

As part of the implementation of the Air Quality Standards Regulations 2011 (S.I. No. 180 of 2011), as amended, four air quality zones have been defined in Ireland for air quality management and assessment purposes (EPA, 2023). Dublin is defined as Zone A and Cork as Zone B. Zone C is composed of 23 no. towns with a population of greater than 15,000. The remainder of the country, which represents rural Ireland but also includes all towns with a population of less than 15,000, is defined as Zone D.

In terms of air monitoring and assessment, the project is within Zone D (EPA, 2023). Long-term monitoring data has been used to determine background concentrations for the key pollutants at the project site. It should be noted that background concentration accounts for all non-traffic derived emissions (e.g. natural sources, industry, home heating etc.).

In 2020, the EPA reported (EPA, 2022b) that Ireland was compliant with EU legal air quality limits at all locations; however this was largely due to the reduction in traffic due to Covid-19 restrictions. The EPA *Air Quality in Ireland 2020* report details the effect that the Covid-19 restrictions had on air monitoring stations, which included reductions of up to 50% at some monitoring stations which have traffic as a dominant source. The report also notes that CSO figures show that while traffic volumes are still slightly below 2019 levels, they have significantly increased since 2020 levels. 2020 concentrations are therefore predicted to be an exceptional year and not consistent with long-term trends. For this reason, they have been included in the baseline section for representative purposes only and previous long-term data has been used to determine baseline levels of pollutants in the vicinity of the project.

NO_2 monitoring was carried out at two rural Zone D locations over the period 2017-2021, Emo and Kilkitt, and the urban sites of Castlebar (EPA 2022b). Over the 2017-2021 period, annual mean concentrations ranged from 2–5µg/m³ for the rural sites and 6–8µg/m³ for the urban site (**Table 8.11**). Hence, long-term average concentrations measured at all locations were significantly lower than the annual average limit value of 40µg/m³. There is a new monitoring station in Birr since 2019 however, while close in proximity it is not representative as it is an urban traffic location rather than urban background location. The hourly limit value of 200µg/m³ was not exceeded in any year, albeit 18 no. exceedances are permitted per year. The average results over the last 5-years at the rural Zone D locations suggest an upper average of no more than 3 µg/m³ as a background concentration. Based on the above information, a conservative estimate of the background NO_2 concentration in the region of the project is 5µg/m³.

Station	Averaging Period Notes 1, 2	Year				
		2017	2018	2019	2020	2021
Castlebar	Annual Mean NO_2 (µg/m³)	7	8	8	6	6
	99.8th %ile 1-hr NO_2 (µg/m³)	60	60	59	76	73
Kilkitt	Annual Mean NO_2 (µg/m³)	2	3	5	2	2
	99.8th %ile 1-hr NO_2 (µg/m³)	17	22	42	18	15
Emo	Annual Mean NO_2 (µg/m³)	3	3	4	3	4
	99.8th %ile 1-hr NO_2 (µg/m³)	28	42	28	38	47

Note 1 *Annual average limit value – 40 µg/m³ (EU Council Directive 2008/50/EC & S.I. No. 739 of 2022).*

Note 2 *Hourly limit value – 200 µg/m³ measured as a 99.8th percentile (EU Council Directive 2008/50/EC & S.I. No. 739 of 2022).*

Table 8.11: Trends in Zone D Air Quality – Nitrogen Dioxide (NO_2)

Long-term PM_{10} monitoring was carried out at the Zone D locations of Castlebar, Kilkitt and Claremorris over the period 2017–2021 (EPA, 2022b). Annual mean concentrations range from 7–12µg/m³ for the urban site (Castlebar) and 11–16µg/m³ for the rural site at Kilkitt (**Table 8.12**). Hence, long-term average PM_{10} concentrations measured at these locations were significantly lower than the annual average limit value of 40µg/m³. There is a new monitoring station in Birr since 2019 however, while close in proximity it is not representative as it is an urban traffic location rather than urban background location. The 90.4th percentile of 24-hour values was well below the limit value of 50µg/m³ at the Zone D monitoring locations. Data for the rural site at Claremorris suggests an upper average annual mean of no more than 10µg/m³ as a background value. Based on the above data, a conservative estimate of the current background PM_{10} concentration in the region of the project is 12µg/m³.

Station	Averaging Period Notes 1, 2	Year				
		2017	2018	2019	2020	2021
Castlebar	Annual Mean PM_{10} (µg/m^3)	11	11	16	14	14
	90th %ile 24-hr PM_{10} (µg/m^3)	19	20	24	22	22
Kilkitt	Annual Mean PM_{10} (µg/m^3)	8	9	7	-	-
	90th %ile 24-hr PM_{10} (µg/m^3)	14	15	13	-	-
Claremorris	Annual Mean PM_{10} (µg/m^3)	11	12	11	10	8
	90th %ile 24-hr PM_{10} (µg/m^3)	17	20	20	16	13

Note 1 *Annual average limit value - 40 µg/m^3 (EU Council Directive 2008/50/EC & S.I. No. 739 of 2022).*

Note 2 *Daily limit value - 50 µg/m^3 measured as a 90.4th percentile (EU Council Directive 2008/50/EC & S.I. No. 739 of 2022).*

Table 8.12: Trends in Zone D Air Quality – PM_{10}

The results of $PM_{2.5}$ monitoring at Claremorris over the period 2017–2021 ranged from 4-8µg/m^3 (EPA, 2022b), with an average $PM_{2.5}$/PM_{10} ratio between 0.4–1, with an average of 0.6. Long-term average $PM_{2.5}$ concentrations measured at this location were significantly lower than the annual average limit value of 25µg/m^3. Based on this information, a conservative ratio of 0.7 was used to generate a rural background $PM_{2.5}$ concentration of 8.4µg/m^3.

In summary, existing baseline levels of NO_2, PM_{10} and $PM_{2.5}$ based on extensive long-term data from the EPA are well below ambient air quality limit values in the vicinity of the project.

8.4.2.1 Sensitivity of the Air Quality Receiving Environment

In accordance with the UK Institute of Air Quality Management (IAQM) guidance document *Guidance on the Assessment of Dust from Demolition and Construction* (2014), prior to assessing the effect of dust from a project, the sensitivity of the area must first be assessed as outlined below. Both receptor sensitivity and proximity to construction works areas are taken into consideration. For the purposes of this assessment, high sensitivity receptors are regarded as residential properties where people are likely to spend the majority of their time. Commercial properties and places of work are regarded as medium sensitivity, while low sensitivity receptors are places where people are present for short periods or do not expect a high level of amenity.

In terms of receptor sensitivity to dust soiling, there are less than 10 no. high sensitivity residential properties within 50m of the project (e.g. wind farm, access tracks, site entrances, forestry re-plant lands) with a further 11 no. high sensitivity residential properties within 50m of the project grid connection route.

Due to the linear nature of the grid connection works, not all properties will be impacted at once, therefore it is considered that there will be more than 10 no. but less than 100 no. receptors affected at any given time and within 50m. There are less than 10 total sensitive receptors within 20m of the site and grid connection route. The worst-case sensitivity of the area to dust soiling is considered medium as per **Table 8.13**.

Receptor Sensitivity	Number Of Receptors	Distance from source (m)			
		<20	<50	<100	<350
High	>100	High	High	Medium	Low
	10-100	High	**Medium**	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

Source: Guidance on the Assessment of Dust from Demolition and Construction (IAQM, 2014)

Table 8.13: Sensitivity of the Area to Dust Soiling Effects on People and Property

In addition to sensitivity to dust soiling, the IAQM guidelines also outline the assessment criteria for determining the sensitivity of the area to human health effects. The criteria take into consideration the current annual mean PM_{10} concentration, receptor sensitivity and the number of receptors affected within various distance bands from the construction works. A conservative estimate of the current annual mean PM_{10} concentration in the vicinity of the project is 12µg/m³. The worst-case sensitivity of the area to human health impacts is considered low as per **Table 8.14**.

Receptor Sensitivity	Annual Mean PM_{10} Concentration	Number Of Receptors	Distance from source (m)			
			<20	<50	<100	<200
High	< 24 µg/m³	>100	Medium	Low	Low	Low
		10-100	Low	**Low**	Low	Low
		1-10	Low	Low	Low	Low
Medium	< 24 µg/m³	>10	Low	Low	Low	Low
		1-10	Low	Low	Low	Low
Low	< 24 µg/m³	>1	Low	Low	Low	Low

Source: Guidance on the Assessment of Dust from Demolition and Construction (IAQM, 2014)

Table 8.14: Sensitivity of the Area to Human Health Impacts

The IAQM guidelines also outline the assessment criteria for determining the sensitivity of the area to ecological effects from dust. The criteria takes into consideration whether the receiving environment is classified as a Special Area of Conservation (SAC), a Special Protected Area (SPA), a Natural Heritage Area (NHA) or a proposed Natural Heritage Area (pNHA) or whether the site is a local nature reserve or home to a sensitive plant or animal species. Ross And Glenns Eskers pNHA (Site code 000920) and Dovegrove Callows SPA (Site code 004137) are within 20m of the grid connection route. The project site is located in the immediate vicinity of designated sites therefore the area is considered of high sensitivity to dust related ecological impacts.

8.4.3 Climate

8.4.3.1 Climate Pollutants

Climate is defined as the average weather over a period of time, whilst climate change is a significant change to the average weather. Climate change is a natural phenomenon but in recent years human activities, through the release of GHGs, have impacted on the climate (IPCC, 2022). The release of anthropogenic GHGs is altering the Earth's atmosphere resulting in a 'Greenhouse Effect'. This effect is causing an increase in the atmosphere's heat trapping abilities resulting in increased average global temperatures over the past number of decades. The release of CO_2 as a result of burning fossil fuels, has been one of the leading factors in the creation of this 'Greenhouse Effect'. The most significant GHGs are CO_2, methane (CH_4) and nitrous oxide (N_2O).

CO_2 accounted for 60.5% of total GHG emissions in Ireland in 2020 CH_4 and N_2O contributing 28.4% and 9.9%, respectively. The main source of CH_4 and N_2O is from the agriculture sector (~93%) (EPA, 2023).

GHGs have different efficiencies in retaining solar energy in the atmosphere and different lifetimes in the atmosphere. In order to compare different GHGs, emissions are calculated on the basis of their Global Warming Potential (GWPs) over a 100-year period, giving a measure of their relative heating effect in the atmosphere. The IPCC Sixth Assessment Report (AR6) (IPCC, 2021) sets out the global warming potential for 100-year time period (GWP100) for CO_2 as the basic unit (GWP = 1) whereas methane gas (CH_4) has a global warming potential equivalent to 25 units of CO_2 and N_2O has a GWP100 of 310.

8.4.3.2 Baseline Climate

Ireland declared a climate and biodiversity emergency in May 2019 and in November 2019 there was European Parliament approval of a resolution declaring a climate and environment emergency in Europe. This, in addition to Ireland's current failure to meet its EU binding targets under Regulation 2018/842 (European Union, 2018) results in changes in GHG emissions either beneficial or adverse being of more significance than previously considered prior to these declarations.

Data published in 2022 (EPA, 2023) predicts that Ireland exceeded (without the use of flexibilities) its 2021 annual limit set under EU's Effort Sharing Decision (ESD) (EU 2018/842) by 3.29 Mt CO_2eq as shown in Table 8.15. The sector with the highest emissions in 2021 (of total excluding LULUCF) was agriculture at 38% of the total, followed by transport at 17.7%. For 2021 total national emissions (excluding LULUCF) were estimated to be 62.11 Mt CO_2eq as shown in **Table 8.15** (EPA, 2023).

The future baseline with respect to the GHGA can be considered in relation to the future climate targets which the assessment results will be compared against. In line with TII (TII, 2022b) and IEMA Guidance (IEMA, 2022) the future baseline is a trajectory towards net zero by 2050, "*whether it* [the project] *contributes to reducing GHG emissions relative to a comparable baseline consistent with a trajectory towards net zero by 2050*".

The future baseline will be determined by Ireland meeting its targets set out in the CAP23, and future CAPs, alongside binding 2030 EU targets. In order to meet the commitments under the Paris Agreement, the European Union (EU) enacted '*Regulation (EU) 2018/842 on binding annual GHG emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No. 525/2013*' (hereafter referred to as the Regulation) (European Union, 2018). The Regulation aims to deliver, collectively by the EU in the most cost-effective manner possible, reductions in GHG emissions from the Emission Trading Scheme (ETS) and non-ETS sectors amounting to 43% and 30%, respectively, by 2030 compared to 2005. The ETS is an EU-wide scheme which regulates the GHG emissions of larger industrial emitters including electricity generation, cement manufacturing and heavy industry. The non-ETS sector includes all domestic GHG emitters which do not fall under the ETS scheme and thus includes GHG emissions from transport, residential and commercial buildings and agriculture.

Category	2021 Kilotonnes CO_2eq	% of Total GHG Emissions Excluding LULUCF	% of Total GHG Emissions Including LULUCF
Waste	943	1.5%	1.4%
Energy Industries	10,272	16.5%	14.8%
Residential	6,917	11.1%	10.0%
Manufacturing Combustion	4,624	7.4%	6.7%
Commercial Services	836	1.3%	1.2%
Public Services	659	1.1%	0.9%
Transport	10,989	17.7%	15.8%
Industrial Processes	2,477	4.0%	3.6%
F-gases	766	1.2%	1.1%
Agriculture	23,626	38.0%	34.0%
Total excluding LULUCF	**62,109**	**100%**	**89%**
Land use, land-use change and forestry (LULUCF)	7,338	N/A	10.6%
Total including LULUCF	**69,448**	**N/A**	**100%**

Table 8.15: Total National GHG Emissions in 2021

8.4.3.3 Climate Vulnerability Baseline

Impacts as a result of climate change will evolve with a changing future baseline; changes have the potential to include increases in global temperatures and increases in the number of rainfall days per year. Therefore, it is expected that the baseline climate will evolve over time and consideration of this is needed within the design of the Proposed Project.

Ireland has seen increases in the annual rainfall in the north and west of the country, with small increases or decreases in the south and east including in the region where the Proposed Project will be located (EPA, 2021b). The EPA have compiled a list of potential adverse impacts as a result of climate change including the following which may be of relevance to the Proposed Project (EPA, 2021a):

- More intense storms and rainfall events;

- Increased likelihood and magnitude of river and coastal flooding;
- Water shortages in summer in the east;
- Adverse impacts on water quality; and
- Changes in distribution of plant and animal species.

The EPA's State of the Irish Environment Report (Chapter 2: Climate Change) (EPA, 2020b) notes that projections show that full implementation of additional policies and measures, outlined in the 2019 Climate Action Plan, will result in a reduction in Ireland's total GHG emissions by up to 25% by 2030 compared with 2020 levels. Climate change is not only a future issue in Ireland, as a warming of approximately 0.8°C since 1900 has already occurred. The EPA state that it is critically important for the public sector to show leadership and decarbonise all public transport across bus and rail networks to the lowest carbon alternatives. The report (EPA, 2020b) underlines that the next decade needs to be one of major developments and advances in relation to Ireland's response to climate change in order to achieve these targets. Ireland must accelerate the rate at which it implements GHG emission reductions. The report states that mid-century mean annual temperatures in Ireland are projected to increase by between 1.0°C and 1.6°C (subject to the emissions trajectory). In addition, heat events are expected to increase by mid-century (EPA, 2020b). While individual storms are predicted to have more severe winds, the average wind speed has the potential to decrease (EPA, 2020b).

TII's Guidance document PE-ENV-01104 (TII, 2022b) states that for future climate change moderate to high Representative Concentration Pathways (RCP) should be adopted. RPC4.5 is considered moderate while RPC8.5 is considered high. Representative Concentration Pathways (RCPs) describe different 21st century pathways of GHG emissions depending on the level of climate mitigation action undertaken.

Future climate predictions undertaken by the EPA have been published in 'Research 339: High-resolution Climate Projections for Ireland – A Multi-model Ensemble Approach (EPA, 2020a). The future climate was simulated under both Representative Concentration Pathway 4.5 (RCP4.5) (medium-low) and RCP8.5 (high) scenarios. This study indicates that by the middle of this century (2041–2060), mid-century mean annual temperatures are projected to increase by 1 to 1.2°C and 1.3 to 1.6°C for the RCP4.5 and RCP8.5 scenarios, respectively, with the largest increases in the east. Warming will be enhanced at the extremes (i.e. hot days and cold nights), with summer daytime and winter night-time temperatures projected to increase by 1 to 2.4°C. There is a projected substantial decrease of approximately 50%, for the number of frost and ice days. Summer heatwave events are expected to occur more frequently, with the largest increases in the south. In addition, precipitation is expected to become more variable, with substantial projected increases in the occurrence of both dry periods and heavy precipitation events. Climate change also has the potential to impact future energy supply which will rely on renewables such as wind and hydroelectric power. More frequent storms have the potential to damage the communication networks requiring additional investment to create resilience within the network.

The EPA's Critical Infrastructure Vulnerability to Climate Change report (EPA, 2021b) assesses the future performance of Irelands critical infrastructure when climate is considered. With respect to road infrastructure, fluvial flooding and coastal inundation/coastal flooding are considered the key climate change risks with snowstorm and landslides being medium risks. Extreme winds and heatwaves/droughts are considered low risk to road infrastructure. One of the key outputs of the research was a framework that will provide quantitative risk-based decision support for climate change impacts and climate change adaptation analysis for infrastructure.

National Framework for Climate Services (NFCS) was founded in June 2022 to streamline the provision of climate services in Ireland and will be led by Met Éireann. The aim of the NFCS is to enable the co-production, delivery and use of accurate, actionable and accessible climate information and tools to support climate resilience planning and decision making. In addition to the NFCS, further work has been ongoing into climate projects in Ireland through research under the TRANSLATE project. TRANSLATE (Met Éireann, 2023) has been led by climate researchers from University of Galway – Irish Centre for High End Computing (ICHEC), and University College Cork – SFI Research Centre for Energy, Climate and Marine (MaREI), supported by Met Éireann climatologists. TRANSLATE's outputs are produced using a selection of internationally reviewed and accepted models from both CORDEX and CMIP5. Representative Concentration Pathways (RCPs) provide a broad range of possible futures based on assumptions of human activity. The modelled scenarios include for "least" (RCP2.6), "more" (RCP4.5) or "most" (RCP8.5) climate change (see **Figure 8.2**:

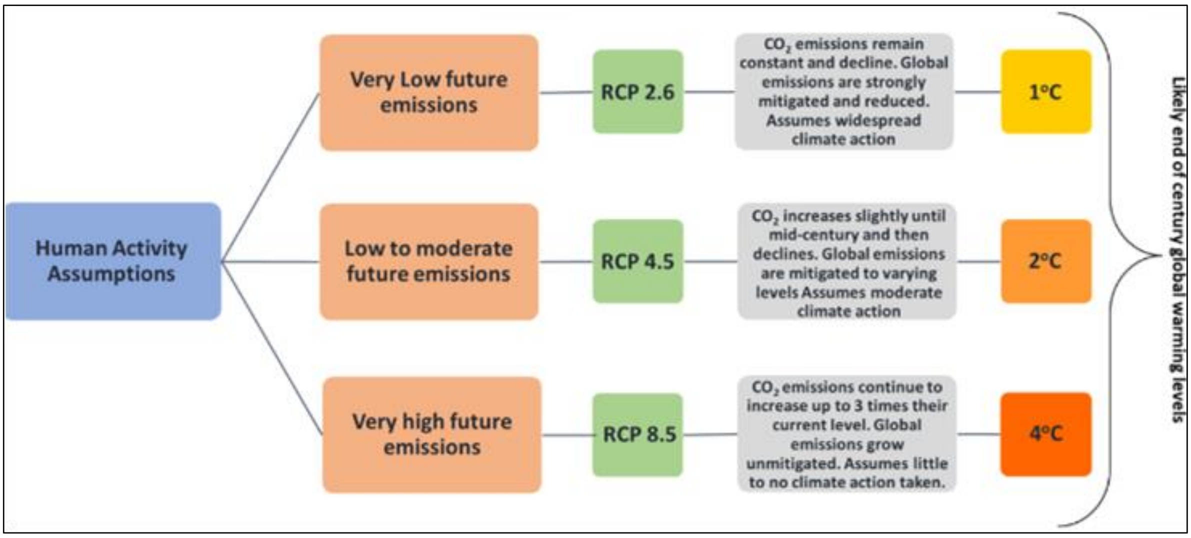

Figure 8.2: Representative Concentration Pathways associated emission levels

Source: TRANSLATE project storymap (Met Éireann 2023)

TRANSLATE (Met Éireann, 2023) provides the first standardised and bias-corrected national climate projections for Ireland to aid climate risk decision making across multiple sectors (for example, transport, energy, water), by providing information on how Ireland's climate could change as global temperatures increase to 1.5˚C ,2˚C, 2.5˚C, 3˚C or 4˚C. Projections broadly agree with previous projections for Ireland. Ireland's climate is dominated by the Atlantic Meridional Overturning Circulation (AMOC), a large system of ocean currents – including the Gulf Stream – characterised by a northward flow of warm water and a southward flow of cold water. Due to the AMOC, Ireland does not suffer from the extremes of temperature experienced by other countries at a similar latitude. Recent studies have projected that the AMOC could decline by 30 – 40 % by 2100, resulting in cooler North Atlantic Sea surface temperatures (SST)s (Met Éireann, 2023). Met Éireann projects that Ireland will nevertheless continue to warm, although the AMOC cooling influence may lead to reduced warming compared with continental Europe. AMOC weakening is also expected to lead to additional sea level rise around Ireland. With climate change Ireland's temperature and rainfall will undergo more and more significant changes e.g. on average summer temperature could increase by more than 2°C, summer rainfall could decrease by 9% while winter rainfall could increase by 24%. Future projects also include a 10-fold increase in the frequency of summer nights (values > 15°C) by the end of the century, a decrease in the frequency of cold winter nights and an increase in the number of heatwaves. A heatwave in Ireland is defined as a period of 5 consecutive days where the daily maximum temperature is greater than 25°C.

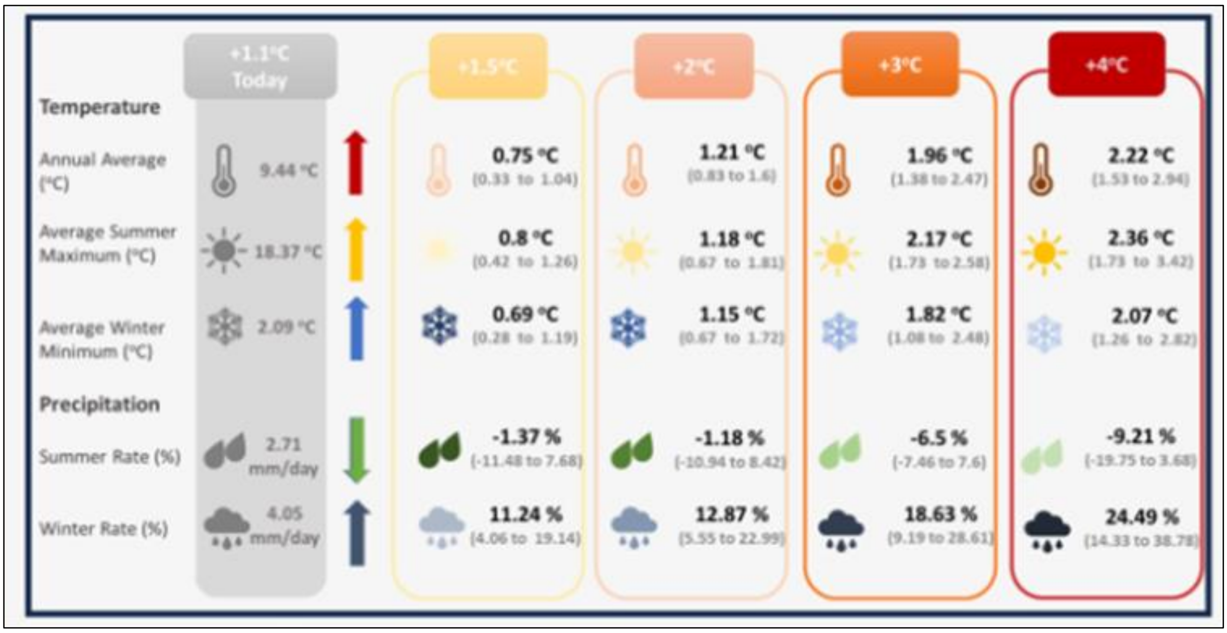

Figure 8.3: Change of climate variables for Ireland for different Global warming thresholds

Source: TRANSLATE project storymap (Met Éireann, 2023)

8.5 Description of Likely Effects

8.5.1 Construction Phase

8.5.1.1 Air Quality

In terms of air quality, the greatest likelihood of effects during the construction stage will be from dust emissions associated with the construction works. The key works likely to be associated with dust emissions include earthworks and excavation activities, construction of hardstanding areas and movement of vehicles on and off site.

During construction, the primary source of dust emissions likely to affect sensitive receptors will be movement of vehicles on and off site. Materials with the highest likelihood of dust emissions will be concrete and aggregates for the construction of the hardstanding areas and access tracks. There is no demolition associated with the proposed works.

Earthworks will result in some dust emissions, particularly during excavations. However, the majority of sensitive properties are located a significant distance from the most extensive excavations (e.g. turbine foundations); while works to be undertaken at closer proximity to properties are of a reduced scale (e.g. site entrances) and/or of a transitory nature (e.g. grid connection). The magnitude of dust emissions according to IAQM guidance (IAQM 2014) is Large; and when combined with the previously established sensitivity of the area (Medium sensitivity to dust soiling, Low sensitivity in terms of human health impacts, High sensitivity in terms of ecology), there is a likelihood of adverse dust effects. The likelihood of a significant nuisance arising from dust effects as a result of earthworks, prior to mitigation is, Medium. With respect to human health and ecology effects, the likely effect is assessed to be low and high risk respectively (see **Table 8.16**).

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table 8.16: Likelihood of Dust Effects – Earthworks

Construction works taking place within the project (wind farm) site will result in some dust emissions. However, the majority of properties which border the site are a significant distance from the actual works areas. Work areas that are in closer proximity to sensitive receptors along the grid connection route will have more limited activities and short construction periods. The magnitude of dust emissions according to IAQM guidance (IAQM 2014) is Small; and when combined with the previously established sensitivity of the area (Medium sensitivity to dust soiling, Low sensitivity in terms of human health, High sensitivity in terms of ecology), there is a likelihood of adverse dust effects. The likelihood of significant nuisance or ecology dust effects as a result of construction, prior to mitigation, is Low. With respect to human health effects, the likely effect is assessed as Negligible (**Table 8.17**).

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table 8.17: Likelihood of Dust Effects – Construction

The likelihood of trackout for vehicles leaving the site has also been assessed. According to the IAQM guidance (2014), the number of vehicle movements per day is classified as Large in terms of potential dust emission magnitude. There will be up to 160 vehicle movements per day during peak construction. As a result, a worst case Large classification has been selected for this assessment.

When combined with the previously established sensitivity of the area (Medium sensitivity to dust soiling, Low sensitivity in terms of human health impacts, High sensitivity in terms of ecology) the likelihood of significant nuisance dust effects, prior to mitigation, is Medium with the overall likelihood of human health impacts predicted to be Low (see **Table 8.18**). The impact due to ecology is considered high risk.

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table 8.18: Likelihood of Dust Effects - Trackout

8.5.1.2 Climate

Construction Materials & Forestry

The construction phase of the project will result in a number of GHG emissions from various sources. Embodied carbon is carbon dioxide emitted during the manufacture, transport and construction of building materials, together with end-of-life emissions. In terms of this project, construction stage embodied GHG emissions are categorised under the following headings:-

- Manufacture of materials;
- Materials transport to site; and
- Construction works (including personnel travel and project size).

Detailed project information including volumes of materials was obtained from the Developer and project design engineers for the purposes of this assessment. For the purposes of this assessment, it has been assumed that quarried material and concrete will be sourced from one of the following suppliers:

- Whytes Concrete, Mackney (Kelly), Co. Galway;
- McKeons Sand and Gravel - Culliaghbeg, Co. Roscommon;
- Banagher Concrete, Banagher, Co. Offaly;
- Smyths Sand and Gravel, Whigsborough, Fivealley, Co. Offaly;
- Smyths Sand and Gravel, Lelagh, Co. Tipperary;
- Loughnane Concrete, Ballynaguilsha, Birr, Co. Offaly; or
- Carroll Quarries, Bohernaghty, Portlaoise, Co. Laois.

The average distance to these quarries and concrete suppliers is just under 22 km. While these are the most likely sources of materials, other suppliers may also need to be utilised to source materials during the construction stage.

The selected quarries have been chosen to provide an estimate of the distance likely to be travelled to the wind farm site for materials. Estimates have been made of the required construction phase materials (turbine foundations, electricity substation, grid connection, and haul route upgrades), these include:

- 804 Stone (15,225m³)
- Tar/Chips(1,920m³)
- Sand (2,170m³)
- Rough (Capping) Stone (97,255m³)
- Concrete (13,050m³)

Table 8.19 details the embodied carbon emissions associated with each category. The project is expected to have a construction phase of approximately 15-18 months and an operational lifespan of 35-years. The predicted embodied emissions can be averaged over the full construction phase and the lifespan of the project to give the predicted annual emissions to allow for direct comparison with national annual emissions and targets. Emissions have been compared against Ireland's EU 2030 target of a 30% reduction in non-ETS sector emissions based on 2005 levels (33.3Mt CO_2eq) (set out in Regulation EU 2018/842 of the European Parliament and of the Council).

The GHG emissions associated with the loss of 23 ha of forestry and 20 ha of peat has been calculated and amounts to 9,984 tonnes of CO_2. Any emissions due to forestry loss will be offset by the replanting the equivalent area of forestry. During construction the loss of peat will be minimised where possible.

The total construction phase embodied emissions totals 12,594 tonnes CO_2eq; which equates to 0.038% of Ireland's 2030 GHG emission target. The embodied carbon associated with materials, which would fall under the industry carbon budget equates to 0.108%. The likely effect on climate will be considered cumulatively across the lifespan of the project.

Source	Construction Phase Embodied Emissions (tonnes CO_2eq)
Pre-Construction	10,021
Embodied Carbon	4,319
Construction Activities	517
Construction Waste	14
Operational Use Note 1	-2,277
Total	12,594
Total Annual Emissions as % of Irelands 2030 GHG emission target	0.038%
Total Embodied Carbon Emissions as % of the 2030 Industry budget	0.108%
Total Construction Waste Emissions as % of the 2030 Waste budget	0.001%

Note 1: Emissions from forestry loss will be offset by replanting the equivalent area of forestry – this value does not include for energy generation from turbines

Table 8.19: Predicted Construction Stage GHG Emissions

Wind Turbine Manufacture

The project will involve the erection of 8 no. wind turbines with an export capacity of 57.6 MW. For the purposes of this assessment, a capacity factor for wind generation of 37% was used, based on future capacity factors for wind farms in this region provided in the EirGrid report *Enduring Connection Policy 2 Constraints Report for Area 1 Solar and Wind* (EirGrid, 2022). On this basis, the expected electricity production is c. 187GWh per annum.

Information on the life cycle assessment undertaken for Vestas Wind Systems A/S, who are a major supplier of wind turbines, has been reviewed (Vestas 2023a, Vestas 2023b). A lifecycle assessment is currently not yet available for the likely turbine for this project however it would be expected to be similar to previous payback periods reported by Vestas. Life cycle assessment produced by Vestas include:

- Production of all parts of the wind plant: This includes parts that are manufactured by Vestas' factories as well as supplier fabricated parts. Most of the information on parts and components (materials, weights, manufacturing operations, scrap rates) was obtained from bills of materials, design drawings and supplier data, covering over 99.4% of the turbine mass. Manufacturing

processes at Vestas' sites: which includes both the Vestas global production factories (i.e. for casting, machining, tower production, generator production, nacelle assembly and blades production), as well as other Vestas activities (e.g. sales, servicing, etc.);
- Transport: of turbine components to wind plant site and other stages of the life cycle including incoming raw materials to production and transport from the power plant site to end-of-life disposal;
- Installation and erection: of the turbines at the wind power plant site, including usage of cranes, onsite vehicles, diggers and generators; Site servicing and operations (including transport): serviced parts, such as oil and filters, and replaced components (due to wear and tear of moving parts within the lifetime of a wind turbine);
- Use-phase electricity production: including wind turbine availability (the capability of the turbine to operate when wind is blowing), wake losses (arising from the decreased wind power generation capacity of wind a certain distance downwind of a turbine in its wake) and transmission losses; and
- End-of-life treatment: of the entire power plant including decommissioning activities.

A full lifecycle assessment for the EnVentus V162-6.2 MW (Vestas 2023a) power plant has assessed the turbine's entire bill-of-materials accounting for around 25,000 parts that make up the turbine. The complete wind power plant is assessed up to the point of the electricity grid, including the turbine itself, foundations, site cabling that connects the turbines together and other site parts such as the transformer station. The 6.2 MW (Vestas 2023) was considered to return 37 times more energy back than it consumed over the plant life cycle with a 6.2-month payback period in low wind conditions.

A full lifecycle assessment for the EnVentus V150-6.0 MW (Vestas 2023b) power plant has assessed the turbine's entire bill-of-materials accounting for around 25,000 parts that make up the turbine. The complete wind power plant is assessed up to the point of the electricity grid, including the turbine itself, foundations, site cabling that connects the turbines together and other site parts such as the transformer station. The payback period for the 6 MW (Vestas 2023b) is 5.6 months for medium (IECS) wind conditions. This may be interpreted that over the life cycle of the EnVentus V150-6.0 MW wind power plant will return 41 times more energy back than it consumed over the plant life cycle.

It can therefore be assumed that the likely payback period for the full turbine life cycle is a maximum of 6.5 months based on previous Vestas assessments.

<u>Climate Change Risk Assessment</u>

Examples of potential climate impacts during operation are included in Annex D (Climate Proofing and Environmental Impact Assessment) of the Technical Guidance on the Climate Proofing of Infrastructure (European Commission, 2021a). Potential impacts of climate change on the project include:

- Flood risk due to increased precipitation, and intense periods of rainfall. This includes fluvial and pluvial flooding;
- Increased temperatures potentially causing drought, wildfires and prolonged periods of hot weather;
- Reduced temperatures resulting in ice or snow;
- Geotechnical impacts; and

- Major storm damage – including wind damage.

Each of these potential risks are considered with respect to the operational phase of the project as detailed in **Section 8.5.3.2**. During the construction phase no assessment is required, however, consideration will be given to the project's vulnerability to climate impacts. During construction, the Contractor appointed by the Developer will be required to mitigate against the effects of extreme rainfall/flooding through site risk assessments and method statements. The Contractor will also be required to mitigate against the effects of extreme wind/storms, temperature extremes through site risk assessments and method statements. All materials used during construction will be accompanied by certified datasheets which will set out the limiting operating temperatures. Temperatures can affect the performance of some materials; this will require consideration during construction.

During construction, the Contractor will be required to mitigate against the effects of fog, lighting and hail through site risk assessments and method statements.

8.5.2 Operational Phase

8.5.2.1 Air Quality

The assessment of baseline air quality in the region of the project has shown that current levels of key pollutants are significantly lower than their limit values. Due to the size, nature and remote location of the project, the minor associated increase in road traffic emissions is assessed as having an imperceptible effect on air quality during the operational phase. The grid connection element of the project will have a neutral impact on air quality during the operational phase as it will be buried underground and there will be no significant operational emissions associated with it.

The project is predicted to cause a net loss of approximately 23 hectares of forestry. This area includes conifer plantation and pockets of woodland (mixed). However, replanting of an equivalent area of forestry will be conducted to prevent a significant loss of forestry.

As described above, the power generation from the project is assessed to be approximately 187GWh per annum. The supply of c. 187GWh of renewable electricity to the national grid will lead to a net saving in terms of NO_X emissions which may have been emitted from fossil fuels to produce electricity. Results, outlined in **Table 8.20**, indicate that the effect of the project on Ireland's obligations under the Gothenburg Protocol and the Directive (EU) 2016/2284 targets are positive. The annual impact of the project is to decrease annual NO_X emission levels by 0.43% of the ceiling levels (relative to the NO_X emissions associated with power generation in Ireland 2020 (EPA, 2022)). The total NO_X emissions savings over its 35-year lifespan will amount to 899 tonnes of NO_X which is equivalent to 15% of the total NO_X emissions from power generation in 2020. This is assessed as a slight positive, long-term effect on air quality.

Scenario	NOX (tonnes/annum)
Emissions Saved Due to Wind Farm Note 1	25.7
NO_X from Irish Power Total Emissions 2020	5,980
Positive Impact of Wind farm (%) (as a percentage of annual NO_X from Irish Power Total Emissions 2020)	0.43%
Total NO_X Saving (%) Over 35-Years Relative to NO_X Emissions from Power Generation in 2020	15%

Note 1 For NO_X emissions associated with power generation in Ireland (taken from EPA (2021) Ireland's Air Pollutant Emissions 1990-2030

Table 8.20: Predicted Impact of Cush Wind Farm on Ireland's National Emissions Ceiling Obligations

8.5.2.2 Climate GHGA

During the operational phase, there will be no GHG emissions from the operation of the project. However, due to the displacement of c. 187GWh of electricity per annum which would otherwise have been produced from fossil fuels, there will be a net benefit in terms of GHG emissions.

The generation of c. 187GWh of renewable electricity to the national grid will result in a net saving in terms of GHG emissions. The carbon budget (see **Table 8.21**) states reduction of 75% in GHG emissions from electricity by 2030 (2018 base year) with wind energy being the primary source in achieving this target.

In order to calculate the net benefit in terms of GHG emissions, the GHG emissions from the provisional average fossil fuel electricity mix (electricity consumption carbon intensity, 330.4 gCO_2/kWh) in 2022 (SEAI 2023) has been calculated (**Table 8.21**). The production of wind energy for export to the national grid transforms the project from negative in terms of GHGs (associated with embodied energy from construction) to having a net positive annual impact on GHG emissions of the order of 0.19% of the annual Total 2030 GHG Emissions target for Ireland in 2030. The total annual GHG emission savings will amount to approximately 63,032 tonnes of CO_2eq which is equivalent to 2.1% of the energy sector budget in 2030. This is a slight, positive, long-term effect on climate.

	CO_2	N_2O	CH_4	% Of Irelands Total 2030 Target (1)
CCGT Producing 187 GWh (tonnes)	61,695	2.69	20.16	-
CCGT Producing 187 GWh (tonnes CO_2 Equivalent)	61,695	833.4	504.1	-
Annum (tonnes CO_2 Equivalent) Savings Due to Wind farm	63,032			0.19%
Annual GHG Saving (%) Relative To 2030 Carbon Budget for Electricity	2.1%			-

(1) Based on an electricity generation of 0.330 tonnes CO_2/MWh (SEAI, 2023)

(2) N_2O & CH_4 based on Volume 2 Table 2.2 of IPCC Guidelines (2006)

Table 8.21: GHG Benefit from Project as A Result of Exporting 187 GWh per annum.

8.5.2.3 Climate CCRA

A risk assessment has been conducted for potentially significant impacts on the project associated with climate change during the Operational Phase. The risk assessment assesses the likelihood and consequence of potential impacts occurring and then provides an evaluation of the significance of the impact using the framework set out in **Section 8.3.4**.

Potential sensitivities (**Table 8.22**) are considered in accordance with the likelihood categories set out in **Section 8.3.2** (**Table 8.7**), which take account of designed-in (embedded) mitigation, in combination with the exposure analysis (**Table 8.23**) in order to assess the significance conclusion (**Table 8.24**).

Examples of potential climate impacts during operation are included in Annex D (Climate proofing and environmental impact assessment) of the technical guidance on the climate proofing of infrastructure (European Commission 2021a). Potential impacts of climate change of the project include:

- Flood Risk due to increased precipitation, and intense periods of rainfall. This includes fluvial and pluvial flooding;
- Increased temperatures potentially causing drought, wildfires and prolonged periods of hot weather;
- Reduced temperatures resulting in ice or snow;
- Geotechnical impacts; and
- Major Storm Damage – including wind damage.

Each of these potential risks are considered with respect to the operational phase of the project. An initial scoping of the risk assessments has been conducted, in line with technical guidance on the climate proofing of infrastructure in the period 2021-2027 (European Commission 2021) and PE-ENV-01104 (TII 2022b).

Sensitive Receptors (Project Assets)	Sensitivity to Climate Hazards (No consideration of site location)								
	Flood (coastal, pluvial or fluvial)	Extreme Heat	Extreme Cold	Drought	Wind	Wildfire	Fog	Lightning & Hail	Landslides
Turbines	1	1	1	1	1	1	1	1	1
Drainage	1	1	1	1	1	1	1	1	1
Access Tracks	1	1	1	1	1	1	1	1	1
Buildings	1	1	1	1	1	1	1	1	1
Underground Utilities	1	1	1	1	1	1	1	1	1

Table 8.22: Sensitivity to Climate Hazards (with design mitigation in place)

Climate Exposure	Exposure Risk to Climate Variable (Consider the site location)								
	Flood (coastal, pluvial or fluvial)	Extreme Heat	Extreme Cold	Drought	Wind	Wildfire	Fog	Lightning & Hail	Landslides
Without exposure at project location	1	1	1	1	1	1	1	1	1

Table 8.23: Exposure Risk to Climate Hazards

Assets	Vulnerability Analysis								
	Flood (coastal, pluvial or fluvial)	Extreme Heat	Extreme Cold	Drought	Wind	Wildfire	Fog	Lightning & Hail	Landslides
	1 (Low Risk)	1 (Low Risk)	1 (Low Risk)	1 (Low Risk)	1 (Low Risk)	1 (Low Risk)	1 (Low Risk)	1 (Low Risk)	1 (Low Risk)

Table 8.24: Vulnerability Analysis to Climate Hazards

The EPA's Critical Infrastructure Vulnerability to Climate Change report (EPA 2021) assesses the future performance of Irelands critical infrastructure when climate is considered. Wind farms are considered to be vulnerable to a medium risk of wind related impacts, with flooding and snowstorms being a low risk.

Wind turbines are vulnerable to extreme storms because the maximum wind speeds in those storms can exceed the design limits of wind turbines – the likelihood of such events occurring will be increased with future climate change. The foundations and turbines will be designed to withstand the severe wind loads. The following design codes will be integrated into the design as provided by the turbine manufacturer:

- Nacelle and Hub IEC 61400-1 Edition 4: EN 50308;
- Tower (IEC) IEC 61400-1 Edition 4: IEC 61400-6 Edition 1;
- Tower (DIBt): Richtlinie für Windenergieanlagen, DIBt, Ausgabe: Oktober 2012
- Blades: IEC 61400-5:2020, IEC 1024-1, IEC 60721-2-4, IEC 61400 (Part 1, 12 and 23), DEFU R25 and DS/EN ISO 12944-2;
- Gearbox: IEC 61400-4;
- Generator: IEC 60034 (relevant parts);
- Transformer: IEC 60076-11, IEC 60076-16, CENELEC HD637 S1;
- Lightning Protection: IEC 61400-24:2019;
- Safety of Machinery, Safety-related Parts of Control Systems: EN ISO 13849-1:2015; and
- Safety of Machinery – Electrical, Equipment of Machines: EN 60204-1:2018.

With these design measures in place to ensure additional wind loading due to climate change are considered the sensitivity reduces to medium, the vulnerability decreases.

To investigate the potential for flooding within the project site, modelling of design flood volumes (i.e. 100-yr and 1000-yr) was undertaken for the watercourses and flood plains with allowance for climate change (20%, a Mid-Range future scenario flood extent). A Stage 3 FRA for the project site was prepared to inform the wind farm layout design at an early stage and to keep as much of the proposed high infrastructure outside of fluvial flood zones as possible. The site specific flood zone modelling shows that proposed turbine location T2 is located outside the 100-year and 1000-year flood zones. Two short sections of access road at watercourse crossing locations between turbine locations T2 and T4 (which amounts to approximately 100m of access road) are located within the 100-year and 1000-year flood zone.

Therefore, with the exception of 100m of proposed on-site access track, the majority of the project site and proposed infrastructure are mapped in Flood Zone C (Low Risk).

Surface water drainage design has been prepared for the project and incorporates the principles of Sustainable Drainage Systems (SuDS) to reduce any residual risk.

The risk of wildfires is negligible for the turbines due to areas of hardstanding surrounding them. However, the proposed structure will be designed in accordance with IS-EN 1991-1-5 (temperature loads) and will include additional temperature due to climate change (2 degrees Celsius).

The proposed structure will include additional measures to increase its durability (including protecting against the effects of freeze/thaw action). These include structural waterproofing, increased concrete cover to reinforcement and designing for temperature extremes. All materials used during construction will be accompanied by certified datasheets which will set out the limiting operating temperatures.

Drought is considered to have a low potential for risk; however it may impact soil stability however this has been considered within the design. A Geotechnical and Peat Stability Risk Assessment carried out for the project (**Annex 6.1**)

Hail is not deemed to pose an unusual risk to the structure.

Fog is unlikely to have an adverse effect on the turbines however lighting of the turbines will be required to ensure no impacts with low flying aviation.

Design mitigation has been put in place in order to alleviate the known vulnerability to future climate change increasing lightning storms. EC 61400-24:2019 provides guidance regarding to lightning protection of wind turbine generators and wind power systems. It defines requirements for protection of blades, other structural components and electrical and control systems against both direct and indirect effects of lightning. Test methods to validate compliance are included.

Where additional information becomes available, such as updated Eurocodes of design practices these will be followed during detailed design to ensure the project is robust in its residual climate vulnerability.

8.5.3 Decommissioning Phase

8.5.3.1 Air Quality

The decommissioning phase will involve the removal of the project infrastructure. Vehicles and generators associated with the removal of infrastructure are likely to result in a temporary negative impact on local air quality. However, due to the short-term nature of any associated works and low background pollutant concentrations in the vicinity of the project site, decommissioning is assessed as likely to have an imperceptible, temporary, negative impact on local air quality.

8.5.3.2 Climate

The Vestas lifecycle assessment (Vestas 2023a and 2023b) include for decommissioning within the lifecycle assessment and therefore is included within the estimated 6.5-month payback period.

Decommissioning will be undertaken in accordance with the methods set out at Chapter 3 and given the significant potential for recycling of materials, the climatic impact will likely be temporary.

8.5.3 Cumulative Effects

8.5.3.1 Air Quality

During the construction and decommissioning phases, there is potential for cumulative effects to arise in relation to dust. This effect is only likely to arise if these phases of the project run concurrently with the construction of another project. However, while significant cumulative effects are not assessed as likely to occur;

following the implementation of the measures set out at **Section 8.6**, dust emissions from the project will be wholly contained within the project site and are unlikely, in combination with other construction activities, to adversely affect sensitive receptors.

During the operational phase, it is assessed that there is no likelihood of significant adverse cumulative effects. The project will, in combination with other wind energy developments, result in long-term beneficial effects on air quality.

8.5.3.2 Climate

With respect to the requirement for a cumulative assessment PE-ENV-01104 (TII, 2022b) states that "for GHG Assessment is the global climate and impacts on the receptor from a project are not geographically constrained, the normal approach for cumulative assessment in EIA is not considered applicable."

However, by presenting the GHG impact of a project in the context of its alignment to Ireland's trajectory of net zero and any sectoral carbon budgets, this assessment will demonstrate the potential for the project to affect Ireland's ability to meet its national carbon reduction target. Therefore, the assessment approach is considered to be inherently cumulative.

8.6 Mitigation & Monitoring Measures

The preceding sections have determined that the project is not assessed as likely to result in any significant adverse impacts on air quality and climate. Notwithstanding this, and in order to sufficiently ameliorate the effects which are likely to arise, a schedule of air quality control measures has been formulated for both the construction and operational phases of the project. It should be noted that measures implemented during the construction phase are also relevant for the decommissioning phase.

8.6.1 Construction Phase

8.6.1.1 Air Quality

The greatest likelihood of effects on air quality during the construction and decommissioning phases is from dust emissions and nuisance dust. In order to minimise dust emissions during construction, a series of mitigation measures have been prepared in the form of an outline Dust Management Plan (see **Annex 8.1**).

A detailed Dust Management Plan will be formulated prior to the construction phase of the project, and will include the following: -

- On-site access tracks and public roads in the vicinity of the site shall be regularly cleaned to remove mud, aggregates and debris and maintained as appropriate. All road sweepers shall be water assisted;
- Any road that has the potential to give rise to fugitive dust shall be regularly watered, as appropriate, during dry and/or windy conditions;
- Public roads in the vicinity of the site shall be regularly inspected for cleanliness and cleaned as necessary;
- In the event of dust nuisance occurring outside the site boundary, movement of materials will be immediately terminated, and satisfactory procedures implemented to rectify the problem before the resumption of operations;
- If issues persist and the above measures are not satisfactorily control dust emissions, a wheel washing system with rumble grids to dislodge accumulated dust and mud prior to leaving the site should be installed;

- During movement of materials both on and off-site, trucks will be stringently covered with tarpaulin at all times. Before entrance onto public roads, trucks will be adequately inspected to ensure no potential for dust emissions;
- Material handling systems and site stockpiling of materials will be designed and laid out to minimise exposure to wind. Water misting or sprays will be used as required if particularly dusty activities are necessary during dry or windy periods; and
- The Dust Management Plan shall be reviewed at regular intervals during the construction phase to ensure the effectiveness of the procedures in place and to maintain the goal of minimisation of dust through the use of best practice and procedures.

At all times, these procedures will be strictly monitored and assessed. In the event of dust nuisance occurring outside the site boundary, movements of materials likely to raise dust will be curtailed and satisfactory procedures implemented to rectify the problem before the resumption of construction operations.

8.6.1.2 Climate

Embodied carbon of materials and construction activities will be the primary source of climate impacts during the construction phase. Measures to reduce the embodied carbon of the construction works include:

- Creating a construction program which allows for sufficient time to determine reuse and recycling opportunities;
- Following IEMA mitigation hierarchy;
- Appointing a suitably competent contractor who will undertake waste audits detailing resource recovery best practice and identify materials can be reused/recycled;
- Materials will be reused on site within the new build areas where possible;
- Prevention of on-site or delivery vehicles from leaving engines idling, even over short periods;
- Ensure all plant and machinery are well maintained and inspected regularly;
- Minimising waste of materials due to poor timing or over ordering on site will aid to minimise the embodied carbon footprint of the site; and
- Sourcing materials locally where possible to reduce transport related CO_2 emissions.

8.6.2 Operational Phase

8.6.2.1 Air Quality

The project will not result in any significant adverse air quality effects during the operational phase and no mitigation measures are proposed. Effects on local air quality as a result of emissions associated with site maintenance vehicles are predicted to be neutral and imperceptible in the long-term as the number of vehicles is predicted to be low and infrequent in nature.

8.6.2.2 Climate

The project will have a positive and beneficial effect on climate through the reduction of GHG emissions associated with energy generation and will make a substantial contribution to Ireland's GHG abatement commitments. Thus, no mitigation measures are necessary in terms of the operational phase.

8.7 Residual Effects

8.7.1 Construction & Decommissioning Phase

8.7.1.1 Air Quality

With effective implementation of the Dust Management Plan, outlined in **Section 8.6.1** and **Annex 8.1**, the project is assessed as likely to have an imperceptible, not significant, short-term effect on air quality during the construction and decommissioning phases.

8.7.1.2 Climate

No significant residual impacts from the project are assessed as likely for the construction or decommissioning phases as any effects will be off set during the operational phase. The payback period is expected to be a maximum of 6.5 months.

8.7.2 Operational Phase

8.7.2.1 Air Quality

No significant residual effects from the project are assessed as likely for the operational phase. As the project causes a reduction in atmosphere NOx emissions through the provision of non-fossil fuel-based electricity, its effect can be considered beneficial, long-term, slight and not-significant (as Ireland is currently below its NO_x emission targets so receiving environment is not considered as sensitive).

8.7.2.2 Climate

No significant adverse residual effects from the project are assessed as likely for the operational phase. Residual effects are assessed to be positive and long term due to the production of 187 GWh of renewable electricity per annum which will lead to a net saving in terms of CO_2 emissions which may have been emitted from fossil fuels to produce electricity.

As per **Section 8.3.4.1** as the project's net GHG impacts are below zero and it causes a reduction in atmosphere GHG concentration, its effect can be considered beneficial, long-term and significant.

8.8 Summary

An assessment of the likely air quality and climate effects associated with the project has been undertaken. The project will comprise 8 no. wind turbines with an export capacity of 57.6 MW. The wind farm design life is 35-years after which the turbines will be decommissioned. The assessment of baseline air quality in the region has shown that current levels of key pollutants are significantly lower than their limit values.

During the construction phase of the project, appropriate mitigation measures will be implemented to minimise any likely adverse effects on air quality and climate. During the operational phase, the project will result in a long-term positive effect on both air quality and climate. The generation of c. 187 GWh of electricity from the project will lead to a net saving in terms of greenhouse gas emissions. The production of this renewable electricity results in the project having a net positive annual effect on GHG emissions of the annual total GHG emissions in Ireland in 2030

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