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ENVIRONMENTAL IMPACT ASSESSMENT REPORT (EIAR) FOR THE PROPOSED FAHY BEG WIND FARM,CO. CLARE

VOLUME 2 – MAIN EIAR

CHAPTER 6 – AIR AND CLIMATE

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6. AIR AND CLIMATE

6.1 Introduction

This chapter identifies, describes and assesses the potential significant direct, indirect and cumulative effects on air quality and climate arising from the construction, operation and decommissioning of the proposed Fahy Beg Wind Farm project.

The proposed wind farm site is located within the jurisdiction of Clare County Council. The proposed wind farm site is located approximately 4.7km north west of O'Briens Bridge and 14km north east of Limerick city.

The proposed wind farm site is located in a rural area. Settlement in the area is made up of one-off rural housing and farmyards generally located along the road network of the area (linear settlement pattern). The primary land-uses within and in the vicinity of the site comprise of commercial forestry and agricultural lands. Due to the non-industrial nature of the proposed project and the general character of the surrounding environment, air quality sampling was deemed to be unnecessary for this EIAR. It is expected that air quality in the existing environment is good, since there are no major sources of air pollution (e.g. heavy industry) in the vicinity of the site.

The production of energy from wind turbines has no direct emissions as is expected from fossil fuel based power generating stations. Harnessing more energy by means of renewable sources will reduce dependency on fossil fuels, thereby resulting in a reduction in harmful emissions that can be damaging to human health and the environment. As discussed later in this chapter there will be some minor short term or temporary indirect emissions associated with the construction of the proposed project including vehicular and dust emissions.

A detailed description of the proposed project assessed in the EIAR is contained in Chapter 3.

The key elements of the proposed project as described in Chapter 3 are referred to as follows throughout this chapter:

- The wind farm site **(referred to in this EIAR as** 'the Site');
- The grid connection route (**referred to in this EIAR as** the 'GCR');
- The turbine delivery route **(referred to in this EIAR as** the 'TDR');

The wind farm site includes the wind turbines, internal access tracks, hard standings, a permanent meteorological mast, onsite substation, internal electrical and communications cabling, temporary construction compound, drainage infrastructure and all associated works related to the construction of the wind farm.

6.1.1 Air Quality – Overview

In order to protect our health, vegetation and ecosystems, EU Directives have set out air quality standards for Ireland and the other member states for a wide variety of pollutants. These Directives include how we should monitor, assess and manage ambient air quality. The European Commission set down the principles to this approach in 1996 with its Air Quality Framework Directive (96/62/EC). Four "daughter" directives lay down limits for specific pollutants:

- 1st Daughter Directive (99/30/EC): Sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead;
- 2nd Daughter Directive (2000/69/EC): Carbon monoxide and benzene;
- 3rd Daughter Directive (2002/69/EC): Ozone;
- 4th Daughter Directive (2001/107/EC): Polyaromatic hydrocarbons, arsenic, nickel, cadmium and mercury in ambient air.

The Ambient Air Quality and Cleaner Air for Europe (CAFE) Directive (2008/50/EC) was published in May 2008. It replaced the Framework Directive and the first, second and third Daughter Directives. The fourth Daughter Directive (2004/107/EC) will be included in CAFE at a later stage. The limit and target values for both Directives are outlined below.

The CAFE Directive was transposed into Irish legislation by the Air Quality Standards Regulations 2011 (S.I. No. 180 of 2011). It replaces the Air Quality Standards Regulations 2002 (S.I. No. 271 of 2002), the Ozone in Ambient Air Regulations 2004 (S.I. No. 53 of 2004) and the Environmental Protection Agency Act, 1992 (Ambient Air Quality Assessment and Management) Regulations, 1999 (S.I. No. 33 of 1999). The fourth Daughter Directive was transposed into Irish legislation by the Arsenic, Cadmium, Mercury, Nickel and Polycyclic Aromatic Hydrocarbons in Ambient Air Regulations 2009 (S.I. No. 58 of 2009). Table 12.1 details the limit values for pollutants as per the CAFÉ Directive.

Table 6-1: Limit Values of CAFE Directive 2008/50/EC

Pollutant	Limit Value Objective	Averaging Period	Limit Value (ug/m3)	Limit Value (ppb)	Basis of Application of the Limit Value
SO_2	Protection of human health	1 hour	350	132	Not to be exceeded more than 24 times in a calendar year
SO_2	Protection of human health	24 hours	125	47	Not to be exceeded more than 3 times in a calendar year
SO_2	Protection of vegetation	calendar year	20	7.5	Annual mean
SO_2	Protection of vegetation	1 Oct to 31 Mar	20	7.5	Winter mean
NO_2	Protection of human health	1 hour	200	105	Not to be exceeded more than 18 times in a calendar year
NO_2	Protection of human health	calendar year	40	21	Annual mean

Pollutant	Limit Value Objective	Averaging Period	Limit Value (ug/m3)	Limit Value (ppb)	Basis of Application of the Limit Value
$NO + NO_2$	Protection of ecosystems	calendar year	30	16	Annual mean
PM_{10}	Protection of human health	24 hours	50		Not to be exceeded more than 35 times in a calendar year
$PM_{2.5}$	Protection of human health	calendar year	40		Annual mean
$PM_{2.5}$ - stage 1	Protection of human health	calendar year	25		Annual mean
$PM_{2.5}$ - stage 2	Protection of human health	calendar year	20		Annual mean
Lead	Protection of human health	calendar year	0.5		Annual mean
Carbon Monoxide	Protection of human health	8 hours	10,000	8620	Not to be exceeded
Benzene	Protection of human health	calendar year	5	1.5	Annual mean

There are no statutory limits for dust deposition, however, the TA Luft (German Government 'Technical Instructions on Air Quality') state a guideline value of maximum 350 mg/m^2/day.

There are no limit values in relation to ozone, however, the Ozone Daughter Directive sets target values. These are detailed in Table 6.2 along with information threshold and alert threshold values.

Table 6-2: Target Values for Ozone

Objective	Calculation	Target Value for 2020
Protection of Human Health	Maximum daily 8-hour mean	120 µg/m^3
Protection of vegetation	AOT40*, calculated from 1-hour values from May to July	6000 µg/m^3-h
Information threshold	1-hour average	180 µg/m^3
Alert Threshold	1-hour average	240 µg/m^3
*The sum of the differences between hourly ozone concentration and 40 ppb for each hour when the concentration exceeds 40 ppb during a relevant growing season, e.g. for forest and crops.		

Air Quality and Health

According to the EPA (Irelands Environment 2020 – Chapter 14 – Environment, Health and Wellbeing), the number of deaths directly linked to air pollution is estimated at 1,300 premature deaths in Ireland annually due to poor air quality (predominantly due to PM2.5), with a figure of 6 to 7 million premature deaths worldwide(UN Environment, 2019)[1].

[1] EPA, 2020, cited in' Irelands Environment 2020 – Chapter 14 – Environment, Health and Wellbeing', p. 364.

Generally, air quality in Ireland is acceptable. However, in the short term, when compared with WHO guideline values and EEA reference level values; ozone, particulate matter and PHAs are of concern and NO2 is expected to increase as traffic on our roads increase.

The use of fossil fuel-based electricity generation leads to NOx and SOx emissions; however, wind generation does not produce any NOx or SOx emissions.

6.1.2 Climate - Overview

Carbon dioxide (CO_2) is a greenhouse gas which, if released in excessive amounts, can lead to increases in global temperatures known as 'global warming' or the 'greenhouse effect' which can influence climate change. Once the proposed wind farm is constructed there will be no resultant negative impacts on climate change. The provision of the project will have a long-term positive impact by providing a sustainable energy source as discussed in Section 6.4.2 of this chapter. Should the project not be developed, fossil fuel power stations will be the primary alternative to provide the required quantities of electricity. This will further contribute to greenhouse gas and other emissions, and hinder Ireland in its commitment to meet its target to increase electricity production from renewable sources and to reduce greenhouse gas emissions.

At the Paris climate conference (COP21) in December 2015, 195 countries adopted the first-ever universal, legally binding global climate deal. The agreement sets out a global action plan to put the world on track to avoid dangerous climate change by limiting global warming to well below 2°C above pre-industrial levels and to limit the increase to 1.5°C. Under the agreement, Governments also agreed on the need for global emissions to peak as soon as possible, recognising that this will take longer for developing countries and to undertake rapid reductions thereafter in accordance with the best available science.

The International Panel on Climate Change (IPCC) has put forward its clear assessment that the window for action on climate change is rapidly closing and that renewable energy sources such as wind will have to grow from 30% of global electricity at present to 80% by 2050 if we are to limit global warming. In this regard the Government enacted the Climate Action and Low Carbon Development Act 2015 which provides for the approval of plans by the Government in relation to climate change for the purpose of pursuing the transition to a low carbon, climate resilient and environmentally sustainable economy.

Under the Kyoto Protocol and the Doha Amendment, during the first commitment period, 37 industrialized countries and the European Community committed to reduce GHG emissions to an average of five percent below 1990 levels. During the second commitment period, Parties committed to reduce GHG emissions by at least 18 percent below 1990 levels in the eight-year period from 2013 to 2020.

In December 2018, the revised Energy Efficiency Directive, the revised Renewable Energy Directive and the new Governance Regulation were formally adopted. The new regulatory framework includes a binding renewable energy target for the EU for 2030 of 32% with an upwards revision clause by 2023. This agreement will help the EU meet the Paris Agreement goals. The commission has also indicated an intention to adopt the increased target of 55% at the EU's Nationally Determined Contribution (NDC) under the Paris Agreement by the end of 2020. As well as the target being given legislative force in the EU through the proposed EU Climate Law, it will oblige all EU institutions across all areas of competence, and the Member States, to work collectively to achieve the target of 55%[2].

[2] https://ec.europa.eu/commission/presscorner/detail/en/IP_20_1599

The main achievements of this agreement in terms of renewable energy production are:

- Sets a new, binding renewable energy target for the EU for 2030 of 32%, including a review clause by 2023 for an upward revision of the EU level target;
- A financial framework for investors is to be established to facilitate investment in renewable energy projects;
- Increases competition and market integration of renewable electricity;
- Will reduce dependence on energy imports and increase energy security;
- Improves the design and stability of support schemes for renewables.

The Irish government has recently published the Climate Action Plan 2021 (CAP) which sets out a plan of action to address climate change and sets decarbonisation targets. In terms of renewable energy, an increase in electricity generated from renewable sources is to increase to up to 80% by 2030, with up to 8GW of onshore wind capacity and at least 5GW of installed offshore wind capacity which has recently been updated to 7GW.

Chapter 1 of the CAP sets out the nature of the challenge which Ireland faces over the coming years. The CAP notes that the evidence for warming of our climate system is beyond dispute with observations showing that global average temperatures have increased by more than 1°C since preindustrial times. These changes will cause extensive direct and indirect harm to Ireland and its people, as well as to other countries more exposed and less able than we are to withstand the associated environmental impacts such as extremes in weather, flooding, displacement of population by the creation of climate refugees, poorer water quality and poorer air quality.

6.1.2.1 Climate Action Network Europe Off Target Report 2018

The June 2018 'Off Target Report' published by the Climate Action Network (CAN) Europe which ranks EU countries ambition and progress in fighting climate change listed Ireland as the second worst performing EU member state in tackling climate change. It also stated that Ireland is set to miss its 2020 climate (20% reduction in greenhouse gases) and renewable (40% increase in overall energy from renewable electricity sources) energy targets. Additionally, it was noted that Ireland is also off course for its 2030 emissions target.

In July 2021 the Climate Action and Low Carbon Development (Amendment) Act was signed. This supports Irelands transition to Net Zero by 2050 which sets legally binding commitments and targets. Actions for each sector will be detailed in the Climate Action Plan that is to be updated annually. The Climate Action Plan 2021 was recently published. It set the following targets for Ireland to achieve by 2030:

- Deliver an early and complete phase-out of coal and peat-fired electricity generation.
- Increase electricity generated from renewable sources to up to 80%, indicatively comprised of:
- at least 5 GW of offshore renewable energy;
- between 1.5 – 2.5 GW of indicative solar PV capacity
- up to 8 GW total of onshore wind capacity.

Achieving up to 80% renewable electricity generation by 2030 will involve phasing out coal and peat-fired electricity generation plants, increasing our renewable electricity production, reinforcing our grid (including greater interconnection to allow electricity to flow between Ireland and other countries), and putting systems in place to manage intermittent sources of power, from renewable energy resources.

6.1.2.2 Climate Change Performance Index

The Climate Change Performance Index (CCPI) is an independent monitoring tool which tracks countries climate protection performance. It assesses individual countries based on climate policies, energy usage per capita, renewable energy implementation and Greenhouse Gas Emissions (GHG) and ranks their performance in each category and overall.

The 2022 CCPI was published in December 2021. While the 2022 CCPI indicated signs of potential reductions in global emissions, no country achieved a "very high" and therefore the first three places of the ranking system remain unoccupied.

Ireland has fallen 7 places from its 2021 rank to 46th out of 64 globally ranked countries and remains at "low" in international performance. Ireland is ranked as "very low" in Green House Gas Emissions and "low" in climate policy.

6.1.3 Carbon Emissions

CO_2 emissions occur naturally in addition to being released with the burning of fossil fuels. All organic material is composed of carbon, which is released as CO_2 when the material decomposes. Organic material acts as a store of carbon. Peatland habitats are significant stores of organic carbon. The vegetation on a peat bog slowly absorbs CO_2 from the atmosphere when it is alive and converts it to organic carbon. When the vegetation dies, in the acidic waterlogged conditions of bogs and peatlands, the organic material does not decompose fully and the organic carbon is retained in the ground.

The carbon balance of proposed wind farm developments in peatland habitats has attracted significant attention in recent years. When developments such as wind farms are proposed for peatland areas, there will be direct impacts and loss of peat in the area of the development footprint. There may also be indirect impacts where it is necessary to install drainage in certain areas to facilitate construction. The works can either directly or indirectly allow the peat to dry out, locally, which permits the full decomposition of the stored organic material with the associated release of the stored carbon as CO_2. It is essential therefore that any wind farm development in a peatland area displaces more CO_2 produced from fossil fuel sources than it releases during the construction, operation and restoration of the wind farm site. There is approximately 0.1 m - 0.2 m of peat on site.

The site is not located on active bog or fen habitats. Site walkovers found limited areas of shallow peat present with thickness of 0.1m – 0.2m. This is considered to be a highly organic Topsoil with Peaty appearance. Much of the site has been cultivated and forestry dominates the site. These habitats have been found to have limited carbon storage value as a result of the draining of the lands (Jovani-Sancho, Cummins and Byrne, 2021). The proposed project has been sensitively situated within an upland environment of limited carbon storage habitat value.

The Scottish Carbon Calculator Tool[3] was used to calculate whole life carbon emissions and carbon savings as a result of the proposed wind farm. Input data used in the calculations is presented in Appendix 6.1.

[3] https://informatics.sepa.org.uk/CarbonCalculator/index.jsp

Ireland's Carbon Emissions

Ireland's greenhouse gas (GHG) emissions are tracked and projected by the EPA for submission to the EU UNFCCC annually. Carbon dioxide emissions are reported alongside methane (CH4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6), and nitrogen trifluoride (NF_3).

For 2019, the total national greenhouse gas emissions was estimated to be 59.78 million tonnes carbon dioxide equivalent (Mt CO_{2eq}) (EPA, 2021). This is a 4.4% reduction on 2018 levels. Emissions reductions have been recorded in 6 of the last 10 years.

Emissions in the Energy Industries sector showed a decrease of 11.2% between 2018 and 2019 which is attributable to decreases in the consumption of coal and peat while there were increases in renewable electricity generation. In 2019, electricity generated from wind increased by 16% (EPA 2021)

SEAI estimate that 42% of electricity generation was from renewable sources in 2020 (SEAI, 2021). The estimated amount of CO_2 avoided through the use of renewable energy sources reached 6.6 Mt CO_2 in 2020. The use of renewables in electricity generation in 2017 reduced CO_2 emissions by 3.3 Mt and avoided €278 million in fossil fuel imports. Over 180 MW of wind generation was installed during 2020 and wind generation now accounts for 36.1% of all electricity generated (SEAI, 2021).

The EPA's latest projections report, 'Ireland's Greenhouse Gas Emissions Projections 2020-2040' (June 2021[4]) projected Ireland's greenhouse gas emissions under two scenarios: The With Existing Measures scenario and the With Additional Measures scenario. The With Existing Measures (WEM) scenario incorporates the anticipated impact of policies and measures that were in place (and legislatively provided for) by the end of 2018. The With Additional Measures (WAM) scenario is primarily based on SEAI's Advanced energy projection (which includes existing and planned policies and measures) and anticipated progress in the implementation of Government renewable and energy efficiency policies and measures including those set out in the National Renewable Energy Action Plan (NREAP), the National Energy Efficiency Action Plan (NEEAP) and Ireland's National Development Plan 2018 - 2027. Plate 6.1 illustrates the WEM and WAM projected emissions in relation to Energy Industries.

[4] EPA '2020 Greenhouse Gas Emissions Projections' 2020-2040.

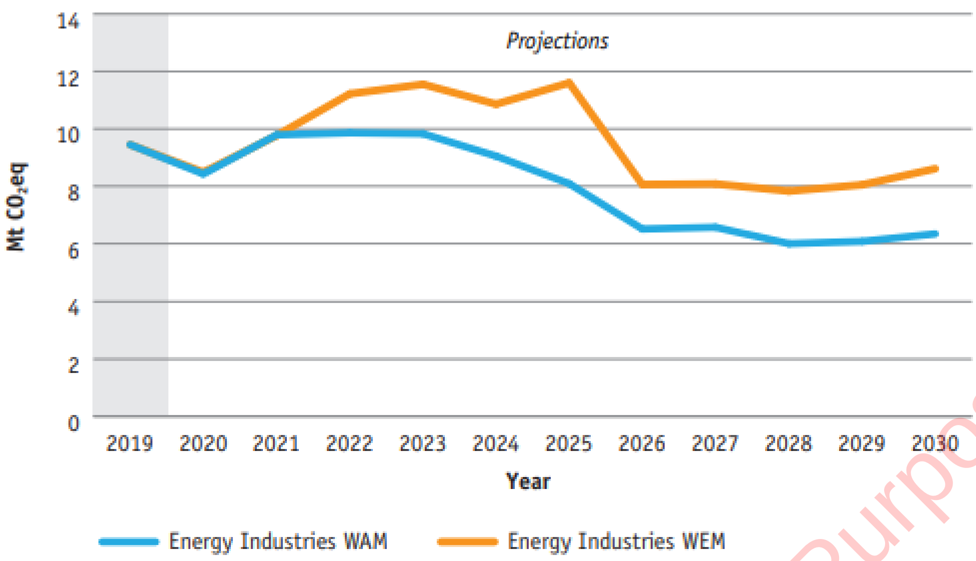

Plate 6-1: Greenhouse Gas Emissions Projections from the Energy Industries Sector under the WEM and WAM scenarios out to 2030

A new Effort Sharing Regulation setting out 2030 targets for EU Member States has recently been adopted by the European Council. Irelands 2030 target is a 30% reduction of emissions compared to 2005 levels by 2030 with binding annual limits over the 2021-2030 period to meet that target. Over the longer-term, Ireland's National Policy Position on Climate change has set a target of an aggregate reduction in carbon dioxide (CO_2) emissions of at least 80% (compared to 1990 levels) by 2050 across the electricity generation, built environment and transport sectors.

According to '*Ireland's Greenhouse Gas Emissions Projections 2020-2040*' (EPA, 2020), Ireland is projected to save 6.3 Mt CO_2 equivalent over the period 2020-2030 with the implementation of the 'With Additional Measures' scenario when compared to the 'With Existing Measures' scenario. This represents a reduction of 24.8% over that period.

On 14th May 2018, the European Council adopted a regulation on greenhouse gas emission reductions. The regulation sets out binding emission reduction targets for Member States in sectors falling outside the scope of the EU emissions trading system for the period 2021- 2030. In the National Energy and Climate Plan 2020, the results of the government projections show that, Ireland will exceed the carbon budget over the period 2021 – 2030 by approximately 32 Mt CO_2 equivalent with full use of the ETS and LULUCF flexibilities (DoECC, 2020).

6.2 Methodology

As the operation of wind turbines does not give rise to emissions (with the exception of back-up generators which will not be in use regularly), in respect of air and climate, this chapter focuses on the potential emissions which may arise during the construction and decommissioning phases of the proposed wind farm and associated grid connection.

The Scottish Windfarm Carbon Assessment Tool was also used to predict the carbon savings for the wind farm for an operational period of 35 years and includes all activities and associated potential impacts during the construction, operation and decommissioning phase.

6.2.1 Air Quality

A review of existing air quality monitoring data undertaken by the Environmental Protection Agency (EPA) was reviewed and used to characterise the existing environment.

The impact assessment methodology involved the review and assessment of the construction methods for the proposed wind farm and associated infrastructure to identify the potential for air emissions during construction and decommissioning.

To assess the impacts of construction dust emissions, the NRA's *Assessment Criteria for the Impact of Dust Emissions from Construction Activities with Standard Mitigation In Place* was used. This table is provided in Appendix 8 of the National Roads Authority (NRA) *Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes* (NRA, 2011) and reproduced below in Table 6.3.

Table 6.4 details the definitions of impact magnitude for changes in ambient pollutant concentrations and Table 6.5 details the descriptors for changes in annual mean nitrogen dioxide, PM10 and PM2.5 at receptors.

Table 6-3: Assessment Criteria for the Impact of Dust Emissions from Construction Activities, with Standard Mitigation in Place

Source		Potential Distance for Significant Effects (Distance from source)		
Scale	**Description**	**Soiling**	**PM_{10}**	**Vegetation Effects**
Major	Large construction sites, with high use of haul routes	100m	25m	25m
Moderate	Moderate sized construction sites, with moderate use of haul routes	50m	15m	15m
Minor	Minor construction sites, with limited use of haul routes	25m	10m	10m

(source: NRA/TII, 2011)

Table 6-4: Definition of Impact Magnitude

Magnitude of Change	Annual Mean NO_2/PM_{10}	No. Days with PM_{10} conc. >50µg/m^3	Annual Mean PM_{10}
Large	Increase/Decrease ≥4µg/m^3	Increase/Decrease > 4 days	Increase/Decrease ≥2.5 µg/m^3
Medium	Increase/Decrease 2-< 4µg/m^3	Increase/Decrease 3 or 4 days	Increase/Decrease 1.25 - <2.5 µg/m^3
Small	Increase/Decrease 0.4 - <2 µg/m^3	Increase/Decrease 1 or 2 days	Increase/Decrease 0.25 - <1.25 µg/m^3
Imperceptible	Increase/Decrease <0.4 µg/m^3	Increase/Decrease <1 day	Increase/Decrease <0.25 µg/m^3

(source: NRA/TII, 2011)

Table 6-5: Air Quality Impact Descriptors for Changes to Annual Mean Nitrogen Dioxide and PM_{10} and $PM_{2.5}$ Concentrations at a Receptor

Absolute Concentration In relation to Objective/Limit Value	Change in Concentration		
	Small	**Medium**	**Large**
Increase with Scheme			
Above Objective/Limit Value with Scheme (≥40µg/m^3 of NO_2 or MP_{10}) (≥25µg/m^3 of $PM_{2.5}$)	Slight adverse	Moderate adverse	Substantial adverse
Just below objective /limit value with scheme (36- <40 µg/m^3 of NO_2 or PM_{10}) (22.5 - <25 $^{\mu}$g/m^3 of $PM_{2.5}$)	Slight adverse	Moderate adverse	Moderate adverse
Below objective / limit value with scheme (30- <36 µg/m^3 of NO_2 or PM_{10}) (18.75 - < 22.5 µg/m^3 of $PM_{2.5}$)	Negligible	Slight adverse	Slight adverse
Well below objective /limit value (<30 µg/m^3 of NO_2 or PM_{10}) (<18.75 µg/m^3 of $PM_{2.5}$)	Negligible	Negligible	Slight adverse
Decrease with Scheme			
Above objective/limit value without scheme (≥40 µg/m^3 of NO_2 or PM_{10}) (≥25 µg/m^3 of $PM_{2.5}$)	Slight beneficial	Moderate beneficial	Substantial beneficial
Just below objective / limit value without scheme (36 - <40 µg/m^3 of NO_2 or PM_{10}) (22.5 - <25 µg/m^3 of $PM_{2.5}$)	Slight beneficial	Moderate beneficial	Moderate beneficial
Below objective/limit value without scheme (30 - <36 µg/m^3 of	Negligible	Slight beneficial	Slight beneficial

Absolute Concentration In relation to Objective/Limit Value	Change in Concentration		
	Small	Medium	Large
NO_2 or PM_{10}) (18.75 - <22.5 µg/m^3 of $PM_{2.5}$)			
Well below objective/limit value without scheme (<30 µg/m^3 of NO_2 or PM_{10}) (<18.75 µg/m^3 of $PM_{2.5}$)	Negligible	Negligible	Slight beneficial

(source: NRA/TII, 2011)

6.2.2 Climate

A desk-top study assessment was undertaken of available climatic information to characterise the existing environment. In terms of climatic impact, the appraisal considered the net impact that operating the proposed wind farm will have in terms of CO_2 and its displacement of CO_2 from other energy sources over the carbon losses caused by its manufacturing, transportation, construction and decommissioning using the Scottish Carbon Calculator tool.

In addition to the CO_2 factored for emissions purposes, greenhouse gas (GHG) emissions are also factored into the overall carbon calculation. GHG are associated with the manufacture, transport, construction, operation (linked to backup generation) and decommissioning of wind turbines.

The impact assessment considered the positive impacts the proposed wind farm will have on contributing to national targets for the reduction of greenhouse gas emissions. The results are described below and in summary the proposed project will result in the production of energy from a renewable source which, once fed into the National Grid, has the potential to avoid several thousand tonnes of carbon dioxide (CO_2) annually that would have been released had the energy been generated by the average Irish power generation mix.

The Intergovernmental Panel on Climate Change (IPCC) in 'Renewable Energy Sources and Climate Change Mitigation' (2014) state that 50 estimates from 20 studies indicate that emissions "are small compared to the energy generated and emissions avoided over the lifetime of wind power plants [farms]: the GHG [greenhouse gas] emissions intensity of wind energy is estimated to range from 8 to 20g CO_2/kWh in most instances". The IPCC (2010) report that the energy payback time, based on lifecycle assessment procedures, per turbine vary between 0.25 years and 0.65 years for onshore developments. A more recent study in 2019 by Dammeier, Loriaux, Steinmann, Smits, Wijnant, van den Hurk and Huijbregts found the greenhouse gas payback time of a wind turbine in Northwestern Europe was between 1.8 and 22.5 months with an average of 5.3 months.

The amount of CO_2 that could potentially be avoided on an annual basis due to the proposed wind farm is estimated based on the expected output of the wind farm. The net displacement value may increase or decrease somewhat, as the generation mix in Ireland develops, under different fuel price scenarios and as demand changes over time, and as more storage, interconnection and demand side management (smart meters) come online. Refer to Section 6.4.4 for details of the calculations for carbon saving as a result of the proposed wind farm.

Monthly meteorological data from Met Eireann was reviewed to gain an understanding of the existing climatic condition of the site. The Scottish National Heritage carbon calculator which accounts for all stages of the project, was used to determine the long term effect of the project on climate. The impact assessment also involved a review of activities associated with the construction, operational and decommissioning phases to determine impacts on both the micro and macro climates of the site.

6.2.3 Carbon Emissions

Previously, guidance produced by Scottish Natural Heritage in 2003 had been widely employed to determine carbon payback in the absence of any more detailed methods. Concerns were raised about the methods of calculating carbon savings for large scale wind farms being developed in Scotland as many of the developments were located on peatlands and forestry which can contain large carbon stocks and which are poorly protected. The methodology for calculating carbon losses was created in 2008 by scientists at the University of Aberdeen and the Macauley Institute with support from the Rural and Environment Research and Analysis Directorate of the Scottish Government, Science Policy and Co-ordination Division. The document, 'Calculating Carbon Savings from Wind Farms on Scottish Peat Lands', was developed to calculate the impact of wind farm developments on the soil carbon stocks held in peat. This methodology was refined and updated in 2011 based on feedback from users of the initial methodology and further research in the area. The web-based version of the carbon calculator, which supersedes the excel based versions of the tool, was released in 2016. The tool provides a straightforward method for estimating the impacts of wind farms on the carbon dynamics of peatlands. The tool also provides guidance when figure inputs are unknown. The carbon calculator, whilst designed for Scottish wind farm developments is used for assessing Irish wind farm developments due to the similarity in development sites, i.e. high ground on peatlands which contain forestry in a similar climate.

The calculator was created to calculate the loss of carbon from acidic bog or fen habitat and defines peat soils as soils with a surface horizon of peat greater than 50cm deep.

The calculator takes into account the carbon fixing potential from peatland plants (which is small) and calculates the total area of peat excavation and the total area of peat affected by drainage, using the annual gains due to carbon fixing potential and the time required for any habitat restoration. Carbon stored within the peat itself represents a large potential source of carbon which can be lost during excavation and drainage. Carbon losses as a result of felling are calculated from the area to be felled, the average carbon sequestered annually, and the lifetime of the wind farm. The calculator also takes into account the carbon emissions from the life cycle analysis of the wind turbines and the backup source in order to calculate carbon savings and carbon payback times of a wind farm. A capacity factor is also required to provide a realistic payback time for a site. The capacity factor is a factor applied to the rated output of a wind turbine to give a more accurate indication of the amount of power a turbine will generate. It takes into account the intermittent nature of wind and for this project it is taken as 35% or 0.35, this value was provided by the client.

In keeping with guidance, specific figures have been inputted wherever possible and where this information was not available the guidance provided by the calculator was used. The assumption to use the fossil fuel generation emission factor was made based on the reality that additional wind generation will displace fossil fuel generation (Scot. Gov., 2018).

With regard to the windfarm characteristics the following presumptions for the proposed 8 turbine wind farm were made: the lifetime of the windfarm is 35 years and the MEC is between 31.2 – 38.4MW, the capacity factor is 35% and the fraction of output to back up is between 1.56MW and 1.92MW (i.e. 5% of capacity).

With regards to the characteristics of the 'peatland' before development, approximately half of the site has been cultivated and contains significant conifer plantation meaning that the carbon content of the peat present is much lower than that of an uncultivated peatland habitat, with carbon having been released during the drainage and cultivation of the site.

An average depth of peatland was provided for the development footprint of 0.1m turbine areas of 0.2m. Whilst the carbon content for dry peat, dry bulk density and extent of drainage around drainage features were unknown, worst case scenario figures were taken to ensure a conservative approach. Also, whilst 14.2 ha of forestry is to be clear felled, an equivalent area of forestry will be replanted and the carbon calculator does not take this replanting elsewhere into account. Therefore, the carbon loss figure for the proposed project will be slightly higher than the actual carbon loss for the project. Replacement replanting of forestry in Ireland is subject to license in compliance with the Forestry Act 2014 as amended. The consent for such replanting is covered by the Forestry Regulations 2017 (S.I. No. 191 of 2017). It should be noted that the clearfelling of trees in the State requires a felling licence. The associated afforestation of alternative lands equivalent in area to those lands being permanently clearfelled is also subject to licensing ('afforestation licensing').

The Scottish Government online carbon calculator as outlined above, was used to assess the impacts of the proposed wind farm in terms of potential carbon losses and savings taking into account the whole life of the wind farm development including materials manufacture, transport and installation and all construction activities including peat removal, drainage, and forestry felling. A copy of the outputs is provided as Appendix 6.1 of this EIAR. A summary of the main CO_2 losses due to the proposed wind farm project are summarised in Table 6.12.

6.3 Existing Environment

6.3.1 Air Quality

European air quality legislation requires that each member state be defined in terms of Zones and Agglomerations for air quality, with Ireland divided into four zones. The EPA has designated four zones within Ireland[5]:

- Zone A: Dublin City and its environs
- Zone B: Cork City and its environs
- Zone C: 24 cities and towns (such as Galway, Limerick and Waterford cities and towns such as Naas, Newbridge, Celbridge, Leixlip) with a population of greater than 15,000
- Zone D covers the remainder of the country.

These zones were defined to meet the criteria for air quality monitoring, assessment and management described in the Framework Directive and Daughter Directives. The proposed wind farm and grid connection are located in Zone D. The majority of the Turbine delivery route is in Zone D. A very small section of it is in Zone C where the route takes the N18 in the south of Limerick city.

The air quality in each zone is monitored by the EPA and classified with respect to upper and lower assessment thresholds based on measurements over the previous five years. The number of monitoring locations required is dependent on population size and whether ambient air quality concentrations exceed the upper assessment threshold, are between the upper and lower assessment thresholds, or are below the lower assessment threshold. The Air Quality In Ireland 2019 – Indicators of Air Quality (EPA 2020) noted that Ireland's overall air quality was good, however there are localised issues across the country with multiple air pollutants. Ireland exceeded the EU limit value for NO_2 at one monitoring location in Dublin in 2019. This

[5] EPA. Air Quality Zones

exceedance was due to high levels of traffic. Ireland is also above the WHO guidelines for PM2.5 at 33 monitoring stations and the EEA reference level for PAH, a toxic chemical at 4 monitoring locations due to the residential burning of solid fuels such as coal, peat and wood. $PM_{2.5}$ has been highlighted by the EEA as being predominantly responsible an estimated 1,300 premature deaths that occurred Ireland in 2017 alone, outlined in the The Air Quality In Ireland 2019 report. The Air Quality Index for Health map on the EPA website, shows that the current air quality within the proposed wind farm, grid connection and turbine delivery route is classed as Good.

An assessment of air quality was carried out in Limerick City from 26th January 2000 – 13th November 2000[6]. The monitoring assessment at Limerick City is the closest site to the application site and provides an environmental baseline of air quality conditions in the region. A summary of findings for sulphur dioxide, Particulate Matter (PM_{10}), Nitrogen Dioxide (NO_2) and Carbon Monoxide (CO) is found in the following sections.

6.3.1.1 Sulphur Dioxide (SO_2)

Sulphur Dioxide for the period of January 2000 to November 2000 recorded at the Limerick City air monitoring station is presented in Table 6.6. The hourly limit value was not exceeded during the measurement period. There was one exceedance of the 50 µg.m-3 lower assessment threshold. The directive stipulates that the lower assessment threshold should not be exceeded more than three times in a calendar year.

Table 6-6: Sulphur Dioxide Data for Limerick City 2000

Parameter	Measurement
Number of Hours	6840
No. of measured values	6812
Percentage Coverage	99.6%
Maximum hourly value	235.1 $\mu g.m^{-3}$
98 percentile for hourly values	50.5 $\mu g.m^{-3}$
Mean hourly value	10.4 $\mu g.m^{-3}$
Maximum 24 hour mean	51.2 $\mu g.m^{-3}$
98 percentile for 24-hour mean	29.5 $\mu g.m^{-3}$

6.3.1.2 Particulate Matter (PM_{10})

Particulate matter are very small particles which can be either solid or liquid. Some of these particles occur naturally, while many are man-made. Particulate matter is referred to as PM. The number following the PM is used to show how small the PM is. The EPA monitors two types of PM and compare levels to limit values in the CAFE (Clean Air for Europe) Directive and WHO guidelines. These are PM_{10} and $PM_{2.5}$.

Particulate matter (PM_{10}) data for the year 2000 monitoring period in Limerick City is presented in Table 6.7.

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[6]EPA. Ambient Air Monitoring in Limerick City. https://www.epa.ie/publications/monitoring--assessment/air/ambient-air-monitoring/EPA_air_assessment_Limerick.pdf

The 24-hour limit value for the protection of human health (50 µg.m-3) was not exceeded during the measurement period. The directive stipulates that the limit value should not be exceeded more than 35 times in a calendar year. The upper assessment threshold was exceeded on 52 days, the lower assessment threshold was exceeded on 122 days. The directive stipulates that each of the assessment thresholds should not be exceeded more than 7 times in a calendar year. The mean of the daily values during the measurement period (24 µg.m-3) is below the annual limit value for the protection of human health (40 µg.m-3).

Table 6-7: Particular Matter (PM_{10}) data Limerick City

Parameter	Measurement
No. of Days	291
No of missing values	84
Percentage coverage	71.1%
Maximum daily value	49.5 $\mu g.m^{-3}$
Mean daily value	24 $\mu g.m^{-3}$

6.3.1.3 Nitrogen Dioxide (NO_2)

Nitrogen dioxide and oxides of nitrogen data for the year 2000 monitoring period in Limerick City is presented in Table 6.8. No hourly mean NO_2 values were above the lower assessment for the protection of human health (Figure 6). The directive stipulates that the lower assessment threshold should not be exceeded more than 18 times in a calendar year. The mean hourly NO_2 value (22 µg.m-3) during the measurement period was below the annual lower assessment threshold for the protection of human health (26 µg.m-3).

Table 6-8: Nitrogen Dioxide and Oxides of Nitrogen Limerick City

Parameter	Measurement
No. of Hours	6840
No of measure values	6809
Percentage coverage	99.5%
Maximum hourly value (NO_2)	243.2 $\mu g.m^{-3}$
98 percentile for hourly rates (NO_2)	57.6 $\mu g.m^{-3}$
Mean hourly value (NO_2)	22 $\mu g.m^{-3}$
Mean hourly value (NO_x)	34.1 $\mu g.m^{-3}$

6.3.1.4 Carbon Monoxide (CO)

Carbon Monoxide data for the year 2000 monitoring period in Limerick City is presented in Table 6.9. The mean hourly concentration of carbon monoxide recorded was 0.3 mg/m^3. The CO limit value for the protection of human health is 10 mg/m^3.

Table 6-9: Carbon Monoxide Data for Limerick City 2000

Parameter	Measurement
No of hours	6840
No. of measured values	6829
Percentage coverage	99.8%
Maximum hourly value	2.3 $mg.m^{-3}$
98 percentile for hourly values	0.9 $mg.m^{-3}$
Mean hourly value	0.3 $mg.m^{-3}$
Maximum 8 hour mean	1.8 $mg.m^{-3}$
98 percentile for 8 hour mean	0.9 $mg.m^{-3}$

6.3.1.5 Dust

The WHO[7] defines dust as: "*Airborne contaminants (which) occur in the gaseous form (gases and vapours) or as aerosols. In scientific terminology, an aerosol is defined as a system of particles suspended in a gaseous medium, usually air in the context of occupational hygiene, is usually air. Aerosols may exist in the form of airborne dusts, sprays, mists, smokes and fumes*". In more general terms, dust is an airborne particulate matter ranging in diameter from 10 to 50 microns which is generated by organic and inorganic matter such as coal, grain, metal, ore, rock and wood. Dust can be generated by activities which process organic and inorganic matter. Dust can be stirred up from inert states through weather and wind conditions and deposit on all parts of the surrounding environment.

There are no statutory limits for dust deposition in Ireland. However, EPA guidance suggests that a deposition of 10 mg/m^2/hour can generally be considered as posing a soiling nuisance. This equates to 240 mg/m^2/day. The EPA recommends a maximum daily deposition level of 350 mg/m^2/day when measured according to the TA Luft Standard 2002.

Construction dust has the potential to be generated from on-site activities such as excavation and backfilling. The extent of dust generation at any site depends on the type of activity undertaken, the location, the nature of the dust, (i.e. soil, sand, peat) and the weather. In addition, dust dispersion is influenced by external factors such as wind speed and direction and/or, periods of dry weather. Construction traffic movements also have the potential to generate dust as they travel along the haul route.

6.3.2 Climate

Climate is defined by the EPA as "*the average weather over a period of time*". Climate change is a term that is used to describe a "*significant change in the measures of climate, such as temperature, rainfall, or wind, lasting for an extended period – decades or longer.* [8]" There is scientific evidence[9] which suggests that the current climate is rapidly warming, having reached approximately 1°C above pre-industrial levels in 2017, increasing at a rate of 0.2 °C per decade.

[7] https://www.who.int/occupational_health/publications/en/oehairbornedust3.pdf
[8] https://www.epa.ie/climate/communicatingclimatescience/whatisclimatechange/
[9] IPCC Special Report "Global Warming of 1.5°C": https://www.ipcc.ch/sr15/download/#chapter

Warmer weather places pressure on flora and fauna which cannot adapt to a rapidly changing environment. In Ireland, the pressure on flora and fauna is mitigated due to the dominant influence of the Gulf Stream on Ireland's climate. Consequently, Ireland does not suffer from the extremes of temperature experienced by many other countries at similar latitudes.

The climatic conditions for the wider geographical area have been derived from historical meteorological measurements compiled by Met Éireann, the national meteorological service of Ireland. The nearest weather station to the proposed project is the Shannon Airport weather station which is approximately 27km south west of the proposed wind farm and associated infrastructure. These meteorological conditions are presented in Table 6.6 for the period January 2019 – June 2022 (source www.met.ie/climate).

Table 6-10: Climate Records January 2019- July 2022

Total rainfall in millimetres for SHANNON AIRPORT

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2022	46.6	146.1	41.3	48.2	51.9	76.3	10.8						421.2
2021	105.5	82.6	82.6	15.4	91.6	17.3	85.3	80.5	72	131.7	53.6	112.3	930.4
2020	74.8	244.5	97.4	39.6	16.2	84	130.6	174.8	41.6	114.8	102.2	131	1251.5
2019	71.4	58.4	177.2	68.2	30.8	55.8	51	167.2	108.1	101.9	104.9	117.1	1112
LTA	102.3	76.2	78.7	59.2	64.8	69.8	65.9	82	75.6	104.9	94.1	104	977.5

Mean temperature in degrees Celsius for SHANNON AIRPORT

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2022	6.8	7.7	7.7	9.7	13.1	14.2	16.8						10.8
2021	4.5	6.7	8	8.7	10.4	14.2	17.8	16.3	15.7	12.4	9	7.8	11
2020	6.7	6.7	6.9	10.4	13	14.2	14.9	16.3	14.1	10.3	8.7	5.8	10.7
2019	6.8	8.4	7.8	10.1	11.8	13.6	16.8	15.9	13.8	10	6.7	6.6	10.7
LTA	6	6.2	7.7	9.4	12	14.5	16.3	16	14.1	11.1	8.3	6.3	10.7

Mean 10cm soil temperature for SHANNON AIRPORT at 0900 UTC

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2022	7.3	7.7	7.2	9.5	13.4	14.9	n/a						10
2021	4.2	5.9	7.5	9.1	11.7	15.2	18.2	17.1	16.5	13.4	10.3	7.9	11.4
2020	5.9	5.7	6.1	10	13	15	16	17	14.6	10.8	9	6.2	10.8
2019	6.2	6	7	9.3	12.2	13.5	17.3	16.4	14.6	10.6	6.8	6	10.5
LTA	4.8	4.8	6.3	8.5	12.1	15.1	16.6	16.1	13.6	10.3	7.4	5.5	10.1

Potential Evapotranspiration (mm) for SHANNON AIRPORT

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2022	13.6	22.5	44.3	62.8	85.2	83.2	82.6						394.2
2021	8.7	23.6	34.7	68.2	80.9	89.2	96.2	72.9	47.6	28.8	13.3	13.4	577.5
2020	15.6	24.1	40.2	65.2	101.6	81.8	80.5	71.9	49.5	29.4	14.7	11.1	585.6
2019	13.1	25.1	38.4	64.4	88.2	86.8	96.3	72.7	48.5	29.3	13.7	14	590.5
LTA	15.7	22.8	36.2	57.9	78.5	87.3	84.3	71.3	50.7	29	16	12.9	562.6

Evaporation (mm) for SHANNON AIRPORT

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2022	18	32.5	62.9	90.8	124.9	120.3	113.3						562.7
2021	12.2	32.7	50.7	98	119.2	127.2	129	101	64.1	39.5	17.8	16.7	808.1
2020	20	35.1	59.5	92.4	145.3	116.2	117.1	101.1	69	41.1	19.7	13.9	830.4
2019	17.4	34.1	57.1	95.4	127.2	124.9	133.4	104.4	69.3	40.6	18.1	17.9	839.8
LTA	20.6	32.1	53.1	85.1	114	123.8	117.7	98.7	70.2	39.5	21	16.4	792.2

Degree Days Below 15.5 Degree Celsius for SHANNON AIRPORT

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2022	270	219	245	177	87	58	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2021	340	247	232	207	162	63	18	24	33	104	196	237	1864
2020	272	256	266	162	106	64	44	28	68	161	203	300	1930
2019	269	199	240	168	124	82	22	29	67	172	264	275	1912
Mean	294	262	241	186	121	58	28	32	64	139	218	285	1929

6.4 Impact Assessment

6.4.1 Do-Nothing Impact

If the proposed wind farm does not proceed, local air quality and the microclimate will remain unchanged. On a national scale, there will be an increase in greenhouse gas emissions if increasing future electricity needs are not met by alternative renewable sources which has the potential to contribute to air pollution and climate change. The opportunity to contribute to Ireland's commitments under the Kyoto Protocol and to meet national targets as set out in the Climate Action Plan would also be lost.

6.4.2 Air Quality

6.4.2.1 Construction Phase Impacts

The principal sources of potential air emissions during the construction of the proposed project will be from the wind farm, grid connection route and turbine delivery route; from dust arising from earthworks, tree felling activities, trench excavation along cable routes, construction of the new access tracks, the temporary storage of excavated materials, the construction of the proposed substation, the movement of construction vehicles, loading and unloading of aggregates/materials and the movement of material around the site.

Dust emissions arise when particulate matter becomes airborne making it available to be carried downwind from the source. Dust emissions can lead to elevated PM_{10} and $PM_{2.5}$ concentrations and may also cause dust soiling. The amount of dust generated and emitted from a working site and the potential impact on the surrounding areas varies according to:

- The type and quantity of material and working methods
- Distance between site activities and sensitive receptors
- Climate/local meteorology and topography

Table 6.11 details the NRA assessment criteria used for assessing the impact of dust from construction activities sites of varying scale.

Table 6-11: NRA Assessment Criteria for the Impact of Dust Emissions from Construction Activities with Standard Mitigation in Place

Source		Potential Distance for Significant Effects (Distance from source)		
Scale	**Description**	**Soiling**	**PM_{10}**	**Vegetation Effects**
Major	Large construction sites, with high use of haul roads	100 m	25 m	25 m
Moderate	Moderate construction sites, with moderate use of haul roads	50 m	15 m	15 m
Minor	Minor construction sites, with limited use of haul roads	25 m	10 m	10 m

Source: NRA / TII, 2011[10]

Applying the NRA criteria in Table 6.11, the overall construction of the proposed wind farm is considered a major construction site as it will result in soiling effects which have the potential to occur up to 100m from the source, with PM_{10} deposition and vegetation effects occurring up to 25m from the source due to the quantity of construction works which are involved in the development of a wind farm. The nearest receptor is c. 640m from the site boundary and therefore will not experience the soiling, deposition or vegetation effects. Construction vehicles and plant emissions have the potential to increase concentrations of compounds such as NO_2, Benzene and PM_{10} in the receiving environment. Due to distance between the nearest receptor and source of emissions the impact from these emissions will be imperceptible.

The construction of the proposed grid connection route is considered a moderate construction site as it will result in soiling effects which have the potential to occur up to 50m from the source, with PM_{10} deposition and vegetation effects occurring up to 15m from the source. There are 87 residential dwellings located along the proposed 10.6 km grid connection route. Some houses may experience soiling and deposition of vegetation effects depending on how close to the road corridor they are located. Construction vehicles and plant emissions have the potential to increase concentrations of compounds such as NO_2, Benzene and PM_{10} in the receiving environment. However, due to the nature of construction along the proposed grid connection as described in Chapter 3, which works as a "rolling" construction site, meaning that these works will not be concentrated in any one area of the route, these effects in relation to dust and air pollutants are considered to be short term, temporary and slight.

The construction of temporary accommodation associated with the proposed turbine delivery route is considered a small isolated construction site, it will result in soiling effects which have the potential to occur up to 50m from the source, with PM_{10} deposition and vegetation effects occurring up to 15m from the source. Many of the TDR work areas are very small and require minor works such as tree trimming or street furniture removal. The impacts on air quality are due to air pollutants from plant and vehicles and the potential for dust when setting up the staging area. These impacts are considered to be short term and slight in significance.

It is not predicted that an air quality impact will occur due to traffic at the proposed wind farm as the impacts will fall below the screening criteria set out in the UK DMRB guidance (UK Highways Agency 2007), on which the TII guidance is based. This UK DMRB guidance states that road links meeting one or more of the following criteria can be defined as being 'affected' by a proposed development and should be included in the local air quality assessment:

- Road alignment change of 5 metres or more;
- Daily traffic flow changes by 1,000 AADT or more;
- HGVs flows change by 200 vehicles per day or more;
- Daily average speed changes by 10 km/h or more; or
- Peak hour speed changes by 20 km/h or more.

On the surrounding road network as detailed in Chapter 13 Traffic and Transportation, there will be an average daily increase of 114 HGV trips per day over a construction period of 12 months. This includes 10 average daily HGV trips for the construction of the grid connection over the course of the construction programme. LGV traffic generated by the construction of the project will average 36 daily trips per day.

10 https://www.tii.ie/technical-services/environment/planning/Guidelines-for-the-Treatment-of-Air-Quality-during-the-Planning-and-Construction-of-National-Road-Schemes.pdf

The combined HGV and LGV average daily increase is 150 trips per day. None of the other criteria are met either. Therefore, the model is not required in this instance.

Some receptors have the potential for dust soiling due to trucks travelling along local routes. This is a temporary, moderate impact. Mitigation measures for this are described in Section 6.5.1.

Plant and machinery such as generators, excavators etc. will be required at various stages of the construction works. These will be relatively small units which will be operated on an intermittent basis. Although there will be an emission from these units, given their scale and the length of operation time, the impacts of emissions from these units will be imperceptible.

6.4.2.2 Operational Phase Impacts

Once the proposed wind farm and grid connection are constructed there will be no significant direct emissions to atmosphere. A diesel generator will be located at the proposed wind farm substation; however, this will only be operated as a back-up/emergency power supply.

Emissions from the diesel generator will therefore be infrequent. During use, a diesel generator will emit carbon dioxide, nitrogen oxide and particulate matter, however, due to the low usage, the impact will be imperceptible.

Maintenance vehicles will access the proposed wind farm site during the operational period, however, due to the low traffic movements involved (See Chapter 13, Section 13.5, the impact will be imperceptible. The operational phase of the wind farm will result in positive impacts on air quality due to the displacement of fossil fuels as an energy source.

Maintenance vehicles will also access the joint bays for periodic maintenance and carry out point works along the proposed grid connection route to address any issues during the operational period. However, given the low and infrequent traffic movements involved, the impact will be imperceptible. Non routine maintenance to turbines may also be required. A small team may be deployed to site in a crane and maintenance vehicles. Given the low and infrequent traffic movements involved, the impact will be imperceptible. The operational phase of the grid connection which connects to and operates the proposed wind farm will result in positive impacts on air quality due to the displacement of fossil fuels as an energy source.

6.4.2.3 Decommissioning Phase Impacts

In terms of decommissioning, there will be truck movements associated with removing the wind turbines, earthmoving to cover foundations and landscaping resulting in vehicular emissions and also dust. However, the number of truck movements will be significantly less than the construction phase and will potentially result in a slight temporary impact. There will also be emissions from machinery on site including for the movement of soil to cover the foundations, however, this is not likely to result in significant impacts.

During the decommissioning phase, the proposed grid connection infrastructure including substations and ancillary electrical equipment will form part of the national grid and shall be left in situ. The internal ducts of the proposed project, all internal access roads, and turbine hardstandings will be left in situ, resulting in no additional truck movements and no impact from emissions from machinery along the grid connection route.

6.4.3 Climate

There is the potential for greenhouse gas emissions to the atmosphere during the construction, operation and decommissioning phases of the proposed wind farm and proposed grid connection such as those arising from construction vehicles, the use of on-site generators, pumps, back-up generators and excavation works. The potential climatic impacts arising from these emissions are assessed hereunder with respect to micro and macro climates.

Microclimate

The significance of impacts associated with the conversion of vegetated surfaces to un-vegetated surfaces is assessed through the consideration of the area of the land experiencing such a change.

The proposed wind farm site is predominately an upland location with the exception of existing public road ways and internal track ways. The total area of proposed new permanent hardstanding surface is approximately 3% of the wind farm site and consequently there will be no direct or indirect impact on air temperature and microclimate because of the relatively small proportion of new permanent hardstanding surface.

There will also be the loss of 14.2 ha of conifer plantation within the site, clear felling will be dispersed over several areas and will not consist of a single clear fell area and there will be no direct or indirect impact on site temperature and microclimate due to clear felling because clear felling forms part of the cycle of commercial forestry and without the proposed project clear felling would occur as normal.

Macroclimate

Carbon dioxide (CO_2) is a greenhouse gas which if released in excessive amounts can lead to increases in global temperatures known as 'global warming' or 'greenhouse effect' which can influence climate change. Section 6.4.4.1 details the carbon savings that have been calculated for the proposed wind farm.

Should the proposed wind farm and proposed grid connection (i.e. the Fahy Beg Project) not be developed, fossil fuel power stations will be the primary alternative to provide the required quantities of electricity. This will further contribute to greenhouse gas and other air pollutant emissions, as well as hindering Ireland in its commitment to meet its target to increase electricity production from renewable sources and to reduce greenhouse gas emissions.

The proposed wind farm project offers Ireland an indigenous form of sustainable electricity and would provide for security of supply against our dependence on imports in addition to the positive impact on the macroclimate.

6.4.4 Carbon Balance

In terms of carbon losses and savings, the online Scottish Windfarm Carbon Assessment Tool (https://informatics.sepa.org.uk/CarbonCalculator/index.jsp) was used to estimate carbon savings as a result of the proposed construction and operation of the wind farm. The assumptions are located in Section 6.2.3 and Appendix 6.1 details the inputs to the model.

Based on the Scottish Windfarm Carbon Assessment Tool, during the manufacturing and transportation of turbines, and construction and decommissioning of the turbines, approximately 34,667 tonnes of CO_2 will be lost to the atmosphere. This represents approximately 1.9% of the total amount of CO_2 emissions that will be offset by the proposed wind farm project. Losses during the construction and decommissioning phases will be due to reduced carbon fixing potential, losses from soil organic matter and losses due to felling forestry. Values for turbine life and felling of forestry are presented in Table 6-12.

In total, it is estimated that approximately 1,780,135 tonnes of CO_2 will be displaced over the proposed thirty five-year lifetime of the wind farm i.e. **50,861** tonnes of CO_2 per annum, which assists in realising the ambitious goals of the Climate Action Plan 2021. From an operational perspective, the proposed wind farm project will displace the emission of CO_2 from other less clean forms of energy generation and will assist Ireland in meeting its renewable energy targets and obligations. The burning of fossil fuels for energy creates greenhouse gases, which contributes significantly to climate change. These and other emissions also create acid rain and air pollution.

For the proposed wind farm development with 8 no. turbines assuming a turbine power rating of between 3.9MW and 4.8MW, and operational period of 35 years, the payback time for the manufacture, construction and decommissioning phases (including carbon losses from soil, felling of forestry etc.) of the Fahy Beg Project is estimated at approximately 1 year regardless of the MW's installed at the site within the range identified. Should further restoration measures be put in place, the total carbon emissions and carbon payback time would be reduced.

As discussed in Section 6.1.3, the carbon calculator was created to calculate carbon loss from acid bog and fen habitats and the proposed wind farm site does not meet the 0.5m depth of peat required for it to be categorised as peatland. The site does not function as acid bog or fen habitat and therefore does not contain the same high levels of carbon. It should be noted that the values for carbon loss for the project will be inflated as the Carbon Calculator was designed for assessing impacts on peatlands and there is no peat on this site which means the actual carbon emissions from this project will be lower than the calculator outputs.

In addition, the calculator only takes into account the loss of forestry on site from felling (carbon release) and the loss of forestry growth (carbon sequestration) on site for the lifetime of the project and does not take into account the replanting of forestry outside of the site (there is no option of including external replant lands). Therefore, the carbon loss calculations for the project are slightly overestimated.

Table 6-12: Carbon Balance Results

	Lower Range 3.9MW	Higher Range 4.8MW
Origin of Losses	**Total CO_2 Losses (tonnes $C0_2$ equivalent)**	
Turbine manufacture, construction and decommissioning	27,939	34,667
Losses due to Backup	20,662	25,431
Losses from soil organic matter	371	371
Felling of Forestry	6,560	6,560
Other	93	93
Total Expected Losses	55,626	67,122
Emissions Savings	**Expected $C0_2$ emission savings (tonnes CO_2 per Annum)**	
fossil fuel mix electricity generation	41,325	50,861
Energy output from windfarm	**MWh**	
Estimated Annual Output	95,659	117,734
Carbon payback time	**Years**	
Fossil fuel mix of electricity generation	1.3	1.3

6.4.5 Cumulative Impacts

The geographic extent of the cumulative assessment is considered on a case-by-case basis, in line with the Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions (European Commission, 1999).

Projects within 20km of the proposed wind farm site and grid connection have been considered for cumulative impacts in relation to air quality and climate as the majority of impacts identified are relating to the construction phase dust and traffic emissions.

A 20km distance is considered a suitable zone of influence considering the emissions associated with proposed project will be focused on the construction site and significant emissions beyond the construction site are not envisaged. Emissions relating to the TDR have been considered, however, these have been screened out of the cumulative assessment as emissions associated with the transport of turbines and construction works relating to the upgrade of TDR nodes are non-significant.

There are a number of projects and activities which are planned, consented, ongoing or operational within the vicinity of the Fahy Beg Wind Farm Project. These are listed in Table 6-12 below. A full list of all proposed and consented projects considered for the cumulative assessment are contained in Appendix 1.2 of Volume 3 of this EIAR.

Table 6-13: Cumulative Impacts

Development Name	Grant Date	Planning Ref. No.	Development Description	Conditions of Note	Address	No. of Turbines	Distance from Project
Carrownagowan Wind Farm	February 2022 - Request for Further Information (RFI) submitted to An Bord Pleanála	Ref. ABP-303105-18	Application to An Bord Pleanala under Section 37E of the Planning and Development Act 2000 (as amended) for the following: 19 No. Wind Turbines (blade tip height up to 169m). 19 No. Wind Turbine foundations and associated Hardstand areas. 1 No. Permanent Meteorological Mast (100m height) and associated foundation and hardstand area. 1 No. Substation (110kV) including associated ancillary buildings, security fencing and all associated works. Upgraded Site Entrance. New and upgraded internal site service roads. Construction of new roadways and localised widening along turbine delivery route. 2 No. All associated site development works. A 10 year planning permission, and 30 year operational life from the date of commissioning is sought.	Consented with conditions	Townlands of Ballydonaghan, Caherhurley, Coumnagun, Carrownagowan, Inchalughoge, Killokennedy, Kilbane, Coolready and Drummed Co. Clare.	19	4.6km

For Carrownagowan Wind Farm there will be no carbon dioxide or any other GHG emissions once the Wind Farm is operational, with the exception of occasional operational and maintenance vehicles exhausts. Therefore, there will be no measurable adverse cumulative effect with the this proposed development. There will be no cumulative impact to air quality with ongoing forestry operations associated with the Carrownagowan Wind Farm as there is no emission to atmosphere.

Cumulative impacts may arise if the construction, operational and maintenance period of these projects occurs simultaneously with the construction of the proposed wind farm and grid connection development. This could result in slight increased traffic emissions, however, provided the mitigation measures as detailed in Section 6.5 are implemented and the mitigation measures proposed for other developments are implemented, there will be no significant cumulative effects on air quality.

There will be no net carbon dioxide (CO_2) emissions from operation of the proposed wind farm. Emissions of carbon dioxide (CO_2), oxides of nitrogen (NOx), sulphur dioxide (SO_2) or dust emissions during the operational phase of the Proposed Project will be minimal, relating to the use of operation and maintenance vehicles onsite, and therefore there will be no measurable negative cumulative effect with other developments on air quality and climate.

The nature of the Proposed Project and other energy developments within 20 kilometres are such that, once operational, they will have a cumulative long-term, significant, positive effect on the air quality and climate.

Should this Wind Farm and other renewable electricity generation projects become operational, the combined beneficial cumulative effects will be greater than those described in this chapter. The tonnes of CO2 emissions avoided and the improvement to air quality, especially in our towns and cities will be greatly enhanced.

6.5 Mitigation Measures

6.5.1 Air Quality

6.5.1.1 Construction Phase

Construction Environmental Management Plan (CEMP) has been prepared and is included in Volume 3, Appendix 3.1. This includes for the following mitigation measures during the construction phase of the proposed wind farm relevant to air quality:

- The internal access roads will be constructed prior to the commencement of other major construction activities. These roads will be finished with graded aggregate which compacts, preventing dust;
- A water bowser will be available to spray work areas (wind turbine area and grid connection route) and haul roads, especially during periods of excavations works coinciding with dry periods of weather, in order to suppress dust migration from the site;
- All loads which could cause a dust nuisance will be covered to minimise the potential for fugitive emissions during transport;
- Earthworks and exposed areas/soil stockpiles will be re-vegetated to stabilise surfaces as soon as practicable;
- The access and egress of construction vehicles will be controlled and directed to designated locations, along defined routes, with all vehicles required to comply with onsite speed limits;

- Construction vehicles and machinery will be serviced and in good working order;
- Wheel washing facilities will be provided at the two main entrance/exit points of the proposed wind farm site as described in Chapter 3;
- The developer in association with the contractor will be required to implement the dust control plan as part of the CEMP (a CEMP is contained in Volume 3, Appendix 3.1). In the event the Planning Authority decides to grant permission for the proposed wind farm, the final CEMP will address the requirements of any relevant planning conditions, including any additional mitigation measures which are conditioned by the Planning Authority.
- Receptors which have the potential to receive dusting and soiling from local routes entering the site; and dwellings directly adjacent to the grid connection route construction that experience dust soiling, where appropriate, and with the agreement of the landowner, will have the facades of their dwelling cleaned if required should soiling occur;
- Ensure all vehicles switch off engines when stationary – no idling vehicles; and
- Exhaust emissions from vehicles operating within the site, including trucks, excavators, diesel generators or other plant equipment, will be controlled by the contractor by ensuring that emissions from vehicles are minimised through regular servicing of machinery.

6.5.1.2 Operational Phase

As the operation of the proposed wind farm will have positive impacts on air quality, mitigation measures are considered unnecessary.

6.5.1.3 Decommissioning Phase

Mitigation measures for the removal of wind turbines and all other site works from the proposed development site will be the same as the construction phase with respect to dust control and minimisation. The proposed access tracks across the proposed wind farm site will be left in situ and utilised as forest roads following decommissioning and no mitigation measures are proposed. In terms of the underground grid cable, this will be left in situ and so no mitigation measures are proposed.

6.5.2 Climate

It is considered that the proposed wind farm project will have an overall positive impact in terms of carbon reduction and climate change. It will assist Ireland in meeting the new binding renewable energy target for the EU of 32% by 2030. Also, it will aid in increasing the onshore wind capacity, as per the Climate Action Plan 2021. In terms of renewable energy, an increase in electricity generated from renewable sources is to increase to up to 80% by 2030, with up to 8GW of increased onshore wind capacity. This will be achieved by:

- Phasing out fossil fuels
- Harnessing renewable energy
- Micro-generation; and
- Other measures.

As no significant impacts on climate are predicted during construction, operation and decommissioning no mitigation measures are necessary or proposed. In terms of the operational phase, the operation of the proposed wind farm project will have a positive effect on climate due to the displacement of fossil fuels.

6.6 Residual Impacts

6.6.1 Air Quality

Following the implementation of the above mitigation measures, the proposed wind farm, proposed grid connection and turbine delivery route work areas will result in slight to moderate residual impacts arising from fugitive dust emissions during construction activities involving excavations, felling or earthmoving. These will be localised in nature and as they will be associated with particular elements of the construction phase, they will be temporary in nature and will not result in any permanent residual impacts.

Impacts related to vehicle emissions will reduce significantly following construction and no significant impacts are anticipated. There will be a low level of maintenance traffic during the operational period, which will have an imperceptible impact.

Impacts on air quality due to vehicle emissions and dust during the decommissioning phase are expected to be similar in nature to the construction phase but of a smaller magnitude. They will be temporary in nature and result in slight to moderate residual impacts. There will be no permanent residual impacts due to the decommissioning phase.

During operations, the proposed wind farm will result in the avoidance of emissions from fossil fuel generators which is a positive effect on air quality.

6.6.2 Climate

There will be positive residual impacts from the operation of the proposed wind farm project in terms of the displacement of fossil fuel energy generation with renewable energy.

Section 6.4.3 assessed the potential impacts on climate as a result of the development of the proposed Fahy Beg Wind Farm Project through microclimate and macroclimate. At the microclimate level, the proposed development encompasses approximately 3% of the entire site area with hardstanding surfaces (hardstandings, access tracks, structures). The assessment found that a 3% increase in hardstanding area would not negatively impact the vegetation necessary to maintain a microclimate.

In terms of macroclimate, it is estimated that an annual average output[11] of between 31.2MW – 38.4MW for the proposed wind farm development will result in the net displacement of between 41,325 and 50,861 tonnes of CO_2 per annum. This results in a positive impact by removing the GHG emissions that would have otherwise been part of the output of traditional energy generation (i.e. biomass, peat, etc). Potential impacts to climate can have the potential to affect human health and the environment.

No direct or indirect impact on air temperature, microclimate or macroclimate has been associated with the development of the proposed Fahy Beg Wind Farm Project due to the location of the site which is

[11] Per Scottish Wind Farm Calculation Tool

predominately an upland agricultural and commercial forestry location with the exception of existing public road ways and internal track ways.

There are no potential direct or indirect impacts on air temperature, microclimate and macroclimate associated with the proposed grid connection. Due to the nature of construction along the proposed grid route which works as a “rolling” construction site, no works will be concentrated in any one area of the route. Therefore, the construction phase of the Fahy Beg Wind Farm will not have a significant impact on climate.

Should the Fahy Beg Project not be developed, fossil fuel power stations will likely be the primary alternative to provide the required quantities of electricity. This will further contribute to greenhouse gas and other air pollutant emissions, as well as hindering Ireland in its commitment to meet its target to increase electricity production from renewable sources and to reduce greenhouse gas emissions.

It is therefore considered that there will be a net positive residual impact on climate as a result of the development of the proposed Fahy Beg Project due to the displacement of between 41,325 and 50,861 tonnes of CO_2 per annum.

6.7 Conclusion

There are no significant impacts expected on Air Quality or Climate as a result of the construction, operation and decommissioning of the proposed project.

There are no significant cumulative impacts expected on Air Quality and Climate as a result of other existing or proposed projects.

There will be a long term positive residual impact on air quality and climate as a result of the development due to the displacement of fossil fuels.

The mitigation measures identified in this Chapter will be adopted and implemented by the Contractor and have been incorporated into the construction stage CEMP included in Appendix 3.1.

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