16 AIR QUALITY

16.1 INTRODUCTION

This chapter assesses the impacts of the Development (**Figure 1.2**) on air and on climate in Section 10.2 and 10.3 respectively. The Development refers to all elements of the application for the construction of Dyrick Hill Wind Farm (**Chapter 2: Development Description**). Where negative effects are predicted, the chapter identifies appropriate mitigation strategies therein. The assessment considers the potential effects during the following phases of the Development:

- Construction of the Development
- Operation of the Development
- Decommissioning of the Development

Common acronyms used throughout this EIAR can be found in **Appendix 1.2.** This chapter of the EIAR is supported by Figures provided in Volume III and by the following Appendix documents provided in Volume IV of this EIAR:

- **Appendix 16.1 Scottish Government – Carbon Calculator Input and Output Data**

Air quality issues associated with wind farms generally relate to dust and vehicle exhaust emissions during construction and decommissioning. A wind farm has little potential for impact on air quality when operational, the main potential effect is generally dust emissions from site access tracks. The potential for impacts therefore comes during the construction and decommissioning phases and the significance of the impact is influenced by its proximity to any sensitive receivers.

The production of energy from wind turbines has no direct emissions unlike fossil fuel-based power stations. Harnessing more energy by means of wind farms will reduce dependency on fossil fuels, thereby resulting in a reduction in harmful emissions that can be damaging to human health and the environment. Some minor short-term or temporary indirect emissions associated with the construction of the wind farm include vehicular and dust emissions.

The site of the proposed wind farm development Dyrick Hill Wind Farm is located in County Waterford. The Site is located 43km west of Waterford City, 55km northeast of Cork City, and 12.9km northwest of Dungarvan. The townlands in which the Proposed Development site is located, including ancillary works, are listed in Chapter 1 and 2 of this EIAR.

The primary land-uses within and in the vicinity of the site comprise agriculture and forestry. Due to the non-industrial nature of the Proposed Development 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.

16.1.1 Statement of Authority

Jennings O'Donovan & Partners Ltd (JOD) have extensive experience in all aspects of wind farm development, from design and planning stages through to construction. JOD have been active as engineering consultants in the wind energy market in Ireland since 1998 and have completed numerous wind farm projects, varying from single wind turbine installations to large-scale, multi-turbine developments with over 2,000MW generation capacity.

This chapter has been prepared by Mr. Ryan Mitchell and Mr. Justin Lohan of JOD. Mr. Mitchell has a Bachelors' Degree in Animal conservation and Biodiversity, has a strong proven background in ecology with 5 years' of experience working in the sector. He is experienced in report writing, EIAR chapter writing and project management working on EIARs for wind farm developments in Ireland.

Mr. Lohan has a Bachelors' Degree in Environmental Science and Technology. He also has almost 20 years' experience working in the construction and environmental sectors. He is experienced in report writing, EIAR chapter writing and project management working on EIARs for wind farm developments in Ireland.

The chapter has been reviewed by Mr. David Kiely of JOD. Mr. Kiely has 35 years' experience in the civil engineering and environmental sector. He has obtained a Bachelor's degree in Civil Engineering and a Masters 'in Environmental Protection, has overseen the construction of over 40 wind farms and has carried out numerous soils and geology assessments for EISs. He has been responsible in the overall preparation of more than 20 EIA Reports (EIARs).

16.1.2 Background and Objectives

Air quality in Ireland is generally of a high standard across the country and is amongst the best in Europe; however, levels of some pollutants remain of concern, with those produced by traffic approaching limit values in urban areas.. The combustion of fossil fuels for energy results in the release of several gases which contribute to climate change and acid rain, including carbon dioxide (CO_2), sulphur dioxide (SO_2), nitrogen oxides (NOx), and Particulate Matter (PM_{10} and $PM_{2.5}$).

The factors that indicate climate change are well established in Ireland, with increased air temperatures, sea levels and changes in precipitation patterns. In 2005, greenhouse gas emissions data estimated that Ireland was 25.4 % above 1990 levels. Emissions data from 2007 show that Ireland was 24.6 % above the level for 1990 (the base year for Kyoto targets). By 2013, total emission levels in Ireland had dropped back almost to 1990 levels, largely as a result of the economic downturn, with indications that individual households had reduced their emissions (EPA, 2014)[1]. However latest EPA greenhouse gas emissions projections indicate an overall increase in greenhouse gas emissions from most sectors. The projected growth in emissions is largely underpinned by projected strong economic growth and relatively low fuel prices leading to increasing energy demand over the period[2]. The EU Commission has also imposed targets on Ireland's emissions. Ireland's target is to reduce ESR emissions by 30% by 2030 compared with 2005 levels, with a number of flexibilities available to assist in achieving this. This value is the national total emissions less emissions generated by stationary combustion and aviation operators that are within the EU's emissions trading scheme. This indicates that Ireland is not in compliance with its 2021 Effort Sharing Regulation annual limit, exceeding the allocation by 1.38 Mt CO2eq after using the ETS flexibility[3].

This chapter assesses the air quality environment of the area of the Proposed Development site and the potential effects on air quality during the construction, operation and decommissioning phases of the wind farm. Mitigation measures are then recommended which can reduce effects and residual effects are then assessed. This chapter also quantifies the emissions avoidance levels of the Proposed Development.

16.2 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

16.2.1 Assessment Methodology

This assessment of air quality and climate involved the following:

[1] Environmental Protection Agency "Air Quality in Ireland 2014 - Key Indicators of Ambient Air Quality" www.epa.ie
[2] Environmental Protection Agency "2018 GHG Emissions Projections Report http://www.epa.ie/pubs/reports/air/airemissions/ghgprojections2017-2035/EPA_2018_GHG_Emissions_Projections_Summary_Report.pdf [Accessed: 09th March 2023]
[3] Environmental Protection Agency "Latest emissions data https://www.epa.ie/our-services/monitoring--assessment/climate-change/ghg/latest-emissions data/#:~:text=Ireland's%20ESR%20emissions%20annual%20limit,the%20annual%20limit%20for%202021[Accessed: 09th March 2023]

- A desk study of the air quality / climate baseline in the area of the Proposed Development site area and nationally;
- Evaluation of potential effects;
- Evaluation of the significance of effects; and
- Identification of measures to avoid and mitigate potential effects.

16.2.2 Relevant Legislation and Policy

The Ambient Air Quality and Clean Air for Europe (CAFE) Directive (Directive 2008/50/EC) incorporates revised provisions for sulphur dioxide (SO_2), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (PM_{10} and $PM_{2.5}$), benzene (C_6H_6) and carbon monoxide (CO). This replaced the Air Quality Framework Directive (96/62/EC) and first three Daughter Directives (1999/30/EC, 2000/69/EC, 2002/3/EC). The Fourth Daughter Directive (2004/107/EC) will be incorporated into the CAFE Directive at a later date and stands alone as a separate EU Directive.

The Fourth Daughter Directive (2004/107/EC) relates to arsenic (As), cadmium (Cd), nickel (Ni), and mercury (Hg)_and polycyclic aromatic hydrocarbons (PAH) in ambient air and has been 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)'.

The CAFE Directive was transposed into Irish legislation by the Air Quality Standards Regulations 2022 (S.I. No. 739 of 2022) as amended by the Air Quality Standards (Amendments) and Arsenic, Cadmium, Mercury, Nickel and Polycyclic Aromatic Hydrocarbons in Ambient Air Regulations, 2016 (S.I. 659 2016).

The Clean Air for Europe (CAFE) Directive (Directive 2008/50/EC on ambient air quality), (as amended by Directive EU 2015/1480) encompasses the following elements:

- The merging of most of the existing legislation into a single Directive (except for the Fourth Daughter Directive) with no change to existing air quality objectives.
- New air quality objectives for $PM_{2.5}$ (fine particulate matter) including the limit value and exposure concentration reduction target.
- The possibility to discount natural sources of pollution when assessing compliance against limit values.

The possibility for time extensions of three years (for particulate matter PM_{10}) or up to five years (nitrogen dioxide, benzene) for complying with limit values, based on conditions and the assessment by the European Commission

Table 16.1a below sets out the limit values of The Clean Air for Europe (café) Directive, as derived from the Air Quality Framework Daughter Directives. Limit values are presented in micrograms per cubic metre (µg/m^3) and parts per billion (ppb). The notation PM_{10} is used to describe particulate matter or particles of ten micrometres or less in aerodynamic diameter. $PM_{2.5}$ represents particles measuring less than 2.5 micrometres in aerodynamic diameter. The CAFE Directive was transposed into Irish legislation by the Air Quality Standards Regulations 2011 (S.I. No. 180 of 2011) as amended. These regulations were subsequently revoked by Ambient Air Quality Standards Regulations 2022 (S.I. 739 2022).

Table 16.1a Limit values of Directive 2008/50/EC, 1999/30/EC and 2000/69/EC (Source: EPA)

Pollutant	Limit Value Objective	Averaging Period	Limit Value (µg/m^3)	Limit Value (ppb)	Basis of Application of Limit Value	Attainment Date
SO_2	Protection of human health	1 hour	350	132	Not to be exceeded more than 24 times in a calendar year	1 Jan 2005
SO_2	Protection of human health	24 hours	125	47	Not to be exceeded more than 3 times in a calendar year	1 Jan 2005
SO_2	Protection of vegetation	Calendar year	20	7.5	Annual mean	19 July 2001
SO_2	Protection of vegetation	1 Oct to 31 Mar	20	7.5	Winter mean	19 July 2001
NO_2	Protection of human health	1 hour	200	105	Not to be exceeded more than 18 times in a calendar year	1 Jan 2010
NO_2	Protection of human	Calendar year	40	21	Annual mean	1 Jan 2010

Pollutant	Limit Value Objective	Averaging Period	Limit Value ($\mu g/m^3$)	Limit Value (ppb)	Basis of Application of Limit Value	Attainment Date
	health					
$NO + NO_2$	Protection of ecosystems	Calendar year	30	16	Annual mean	19 July 2001
PM_{10}	Protection of human health	24 hours	50	-	Not to be exceeded more than 35 times in a calendar year	1 Jan 2005
PM_{10}	Protection of human health	Calendar year	40	-	Annual mean	1 Jan 2005
$PM_{2.5}$ - Stage 1	Protection of human health	Calendar year	25	-	Annual mean	1 Jan 2015
$PM_{2.5}$ - Stage 2	Protection of human health	Calendar year	20	-	Annual mean	1 Jan 2020
Lead	Protection of human health	Calendar year	0.5	-	Annual mean	1 Jan 2005
Carbon Monoxide	Protection of human health	8 hours	10,000	8620	Not to be exceeded	1 Jan 2005
Benzene	Protection of human health	Calendar year	5	1.5	Annual mean	1 Jan 2010

Table 16.1b presents the limit and target values for ozone as per the Ambient Air Quality and Cleaner Air for Europe (CAFÉ) Directive (2008/50/EC).

Table 16.1b Target values for Ozone Defined in Directive 2008/50/EC

Objective	Parameter	Target Value for 2010	Target Value for 2020 onwards
Protection of human health	Maximum daily 8- hour mean	120 mg/m^3 not to be exceeded more than 25 days per calendar year averaged over 3 years	120 mg/m^3
Protection of vegetation	*AOT_{40} calculated from 1 hour values from May to July	18,000 mg/m^3 h^{-1} averaged over 5 years	6,000 mg/m^3 h^{-1}
Information Threshold	1-hour average	180 mg/m^3	180 µg /m^3
Alert Threshold	1-hour average	240 mg/m^3	240 µg /m^3

*AOT40 is a measure of the overall exposure of plants to ozone. It is the sum of the excess hourly concentrations greater than 80 µg/m^3 and is expressed as µg/m^3 hours.

16.2.3 Air Quality & Health

Environmental Protection Agency (EPA, 2020)[4], European Environmental Protection Agency (EEA, 2020)[5] and World Health Organisation (WHO, 2014)[6] reports estimate that poor air quality accounted for premature deaths of approximately 600,000 people in Europe in 2012, with 1,300 Irish deaths predominantly due to fine particulate matter (PM2.5) in 2020 and 30 Irish deaths attributable to Ozone (O3) in 2016[7]. Fine particulate matter, ozone, along with others including carbon dioxide (CO2), nitrogen oxides (NOx) and sulphur oxides (SOx) are produced during the burning of fossil fuels for energy generation, transport or home heating. There are no such emissions associated with the operation of wind turbines. Therefore, the construction of wind turbines such as in the Development will result in lower environmental levels of such parameters, and consequential beneficial effects on human health.

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[4] Ireland's Environment – An Integrated Assessment 2020, EPA, 2020, [Accessed 9th March 2023]
[5] EEA (European Environment Agency), 2020b. Air Quality in Europe 2020. EEA Report No. 09/2020. EEA, Copenhagen, [Accessed 9th March 2023]
[6] https://www.euro.who.int/en/health-topics/environment-and-health/air-quality/news/news/2014/03/almost-600-000-deaths-due-to-air-pollution-in-europe-new-who-global-report, [Accessed 9th March 2023]
[7] Irelands Environment 2016 – An Assessment', EPA, 2016, [Accessed 9th March 2023]
https://www.epa.ie/publications/monitoring--assessment/air/Air-Quality-in-Ireland-2020.pdf [Accessed 9th March 2023]

16.2.4 Air Quality Zones

The EPA has designated four Air Quality Zones for Ireland:

- Zone A: Dublin City and environs
- Zone B: Cork City and environs
- Zone C: 16 urban areas with population greater than 15,000
- Zone D: Remainder of the country.

These zones were defined to meet the criteria for air quality monitoring, assessment and management described in the Air Quality Framework Directive and Daughter Directives. The site of the Proposed Development lies within Zone D, which represents rural areas located away from large population centers.

16.2.5 Existing Climate

The Irish climate is defined as a temperate oceanic climate on the Köppen climate classification system. Ireland's climate is mild, moist, and changeable with abundant rainfall and a lack of temperature extremes. The country generally receives cool summers and mild winters and it is considerably warmer than other areas on the same latitude. Ireland's land mass is warmed by the North Atlantic Current all year and, as a result, does not experience a great annual range of air temperatures.

Nationally, the mean air temperature is generally between 9 and 11 degrees. Annual rainfall totals on the West coast generally average between 1000 and 1400 mm with the wettest months being December and January and April being the driest month. The prevailing wind direction is between South and West. Average wind speed ranges from 3 m/s in south Leinster to 8 m/s in the extreme North.

Fermoy Moorepark, Co Cork is the closest Met Eireann climate station to the Proposed Development. The mean annual air temperature between 2020 and 2022 was 10.4°. Mean monthly temperatures over the same period ranged from 4.3° in December 2022 to 17.2° in July 2022. Mean annual rainfall over the same period was 1070.4mm, with a maximum monthly mean rainfall of 146.5 mm in February and a minimum monthly mean rainfall of 52.2mm in April[8].

[8] https://www.met.ie/climate/available-data/monthly-data [Accessed 9th March 2023]

16.2.6 Existing Air Quality Conditions

Generally, Ireland is recognised as having some of the best air quality in Europe. However, from time to time, and under certain weather conditions, it is possible to experience some air pollution in the larger towns and cities.

The most recent published report on air quality in Ireland is the 'Air Quality in Ireland 2021' report published by the EPA in 2022[9]. This report provides an overview of the ambient air quality in Ireland in 2021. It is based on monitoring data from 30 stations across Ireland. The measured concentrations are compared with both EU legislative standards and WHO air quality guidelines for a range of air pollutants. The closest monitoring sites to the Proposed Development within the same air quality zone were Clonmel and Waterford. There is a local monitoring station at Dungarvan however no data was available for analysis. Results from the monitoring campaign during 2021 show:

- No levels above the EU limit value (in **Table 16.1a**) were recorded at any of the ambient air quality network monitoring sites in Ireland in 2021[10].
- WHO guideline values were exceeded at a number of monitoring sites for fine particulate matter ($PM_{2.5}$) and (PM_{10}), ozone (O_3), NO_2. WHO guideline values for Sulphur dioxide (SO_2) were exceeded at one monitoring station. PAHs exceeded the European Environment Agency reference level at 3 monitoring sites.
- Askeaton exceeded WHO 24-hour mean guideline (15µg/m^3 24-hour mean) for ($PM_{2.5}$) on 8 occasions in 2021 and exceeded the annual mean (5µg/m^3) guideline with a mean of (5.7µg/m^3) for 2021. Askeaton did not exceed any WHO guidelines for any other parameter in 2021.
- The annual mean PM_{10} and $PM_{2.5}$ levels for Askeaton were (8.7 µg/m^3) and (5.7 µg/m^3) respectively. These values are below the limit values set out by Directive 2008/50/EC as per **Table 16.1a**.

According to the report, no data for pollutants was available for Dungarvan. However data was available for Clonmel and Waterford and the data shows some pollutants exceeded WHO guidelines. The previous 2020 report noted that concentrations of Ozone at Waterford breached the WHO air quality guideline values 143 days 2020[11] and 162 days in 2021[12]. This guideline value is exceeded if any maximum 8-hour concentration at a

[9] Monitoring & Assessment: Air Publications | Environmental Protection Agency (epa.ie) [Accessed 9th March 2023]
[10] https://www.epa.ie/publications/monitoring--assessment/air/EPA-Air_Quality_in-Ireland-Report_2021_-flat.pdf.pdf [Accessed: 9th March 2023]
[11] https://www.epa.ie/publications/monitoring--assessment/air/air-quality-in-ireland-2020.php [Accessed 9th March 2023]
[12] https://www.epa.ie/publications/monitoring--assessment/air/air-quality-in-ireland-2021.php [Accessed 9th March 2023]

monitoring site exceeds 100 µg/m^3. Ozone is readily transported from Atlantic and European regions due to the natural movement of air masses. Ground-level ozone is depleted through reactions with traffic-emitted pollutants; therefore, levels of ozone are higher in rural areas than in urban areas. The Clonmel monitoring station also exceeded the daily WHO air quality guideline value for $PM_{2.5}$ (which states there should be no daily average value above 25µg/m^3) on seven occasions during 2021[13] and nine occasions in 2020[14]. The Waterford monitoring station recorded fourteen occasions where the daily WHO air quality guideline value for PM_2 which exceeded the daily average of 25µg/m^3 in 2020[15] and nine occasions during 2021[16]. It must be noted that $PM_{2.5}$ is an excellent indicator for solid fuel combustion and the exceedance was most likely due to domestic coal and peat fires.

16.3 DO NOTHING IMPACT

If the Proposed Development were not to proceed, the opportunity to reduce emissions of carbon dioxide, oxides of nitrogen (NOx), and sulphur dioxide (SO_2) to the atmosphere would be lost due to the continued dependence on electricity derived from coal, oil, and gas-fired power stations, rather than renewable energy sources such as the proposed wind farm. This would result in an indirect, negative impact on air quality.

16.4 POTENTIAL IMPACTS OF THE PROPOSED EIA DEVELOPMENT

16.4.1 Construction Phase

16.4.1.1 Dust Emissions

The main potential source of impacts on air quality during construction is dust. There is potential for the generation of dust from excavations and from construction of access tracks and hardstands and the trench for the cable ducting for the grid connection. The potential nuisance issues arising from this are dependent on the terrain, weather conditions (i.e, dry and windy conditions) and the proximity of receptors. Dust from cement can cause ecological damage if allowed to migrate to water courses, though it is proposed that ready-mix concrete will be used with no on-site batching taking place, and therefore this will not be a potential source of emissions. Potentially dust generating activities are as follows:

- Earth moving and excavation plant and equipment for handling and storage of soils and subsoils;
- Transport and unloading of stone materials for access track construction;

[13] https://www.epa.ie/publications/monitoring--assessment/air/air-quality-in-ireland-2021.php [Accessed 9th March 2023]
[14] https://www.epa.ie/publications/monitoring--assessment/air/air-quality-in-ireland-2020.php [Accessed 9th March 2023]
[15] https://www.epa.ie/publications/monitoring--assessment/air/air-quality-in-ireland-2020.php [Accessed 9th March 2023]
[16] https://www.epa.ie/publications/monitoring--assessment/air/air-quality-in-ireland-2021.php [Accessed 9th March 2023]

- Rock will be extracted from turbine foundation construction and this will be used for subsequent use in construction of tracks and hardstands as needed; and
- Vehicle movements over dry surfaces such as access tracks.

The potential impact from dust becoming friable and being a nuisance to workers, residents and local road users is considered, a slight, negative, short-term, direct impact during the construction phase.

16.4.1.2 Sensitive Receptors

Friable dust cannot remain airborne for a very long time. The distance it can travel depends on the particle sizes, disturbance activities and weather conditions. Larger dust particles tend to travel shorter distances than smaller particles. Particle sizes greater than 30 µm will generally deposit within approximately 100 m of its source, while particles between 10-30 µm travel up to approximately 250-500 m and particle sizes of less than 10 µm can travel up to approximately 1 km[17].

Generally (depending on the conditions outlined), dust nuisance is most likely to occur at sensitive receptors within approximately 100 m of the source of the dust. It is considered that the principal sites of friable dust generation will be the turbine bases and hardstands, and also along new access roads. All turbines are situated > 500 m away from dwelling houses and therefore these principal sites of dust generation are greater than 100 m distant from these sensitive receptors. The 112 Dwellings are generally situated along existing public roads within 1.8km from the site (Figure 2.1 Proposed Turbine Locations & Existing House Locations). It is important therefore that the mitigation measures for dust suppression during construction phase, outlined in section 8.4.1 below are adhered to. In addition, vegetation such as trees and hedgerows in the vicinity will help to mitigate any airborne dust migrating off site. Any effects of dust on vegetation will be confined to the construction and possibly the decommissioning phases and be short-term in duration.

Impacts from dust deposition at sensitive receptors would give rise to nuisance issues for residents of those properties. However, with strict adherence to mitigation measures and the distance from the main sites of dust generation, the impacts would be predicted to be slight to moderate and short-term.

[17] http://www.dustscan.co.uk/Dust-Info/Definitions [Accessed 9th March 2023]

16.4.1.3 Exhaust Emissions

Emissions from plant and machinery, including trucks, during the construction of the proposed Dyrick Hill Wind Farm are a potential impact. The engines of these machines produce emissions such as carbon dioxide (CO_2), carbon monoxide (CO), Nitrogen Oxides (NO_x), and Particulate Matter (PM_{10} and $PM_{2.5}$).

Particulate Matter ("PM") less than ten micrometres in size (PM_{10}) can penetrate deep into the respiratory system increasing the risk of respiratory and cardiovascular disorders. PM_{10} arises from direct emissions of primary particulate such as black smoke and formation of secondary PM in the atmosphere by reactions of gases such as sulphur dioxide and ammonia. The main sources of primary PM_{10} are incomplete burning of fossil fuels such as coal, oil and peat and emissions from road traffic, in particular diesel engines. Other sources of particulates include re-suspended dust from roads. Natural PM includes sea-salt and organic materials such as pollens. The diverse sources and impacts of PM make it one of the most challenging issues to address.

Nitrogen oxides (NO_x), includes the two pollutants, nitric oxide (NO) and nitrogen dioxide (NO_2). Power-generation plants and motor vehicles are the principal sources of NOx, through high temperature combustion. NO_x contributes to the formation of acid rain and is also a recognised ozone precursor. Short-term exposure to NO_2 is associated with reduced lung function and airway responsiveness, and increased reactivity to natural allergens. Long-term exposure is associated with increased risk of respiratory infection in children. The construction phase is likely to lead to small localised increases in these emission levels which is likely to lead to a temporary imperceptible effect.

16.4.1.4 Construction Carbon Footprint

16.4.1.5 Carbon Calculator

To assess the impact of the Development on the climate, the carbon emitted or saved as a result of the Development was determined using a carbon calculator. The Scottish Government have produced an online carbon calculator which aims to assess, in a comprehensive and consistent way, the carbon impact of wind farm developments. This is done by comparing the carbon costs of wind farm developments with the carbon savings attributable to the wind farm. The carbon calculation takes into account the carbon released from a number of sources during the construction, operational and decommissioning stages. These include the effects of drainage works on peat soils, forestry felling, losses associated with harvesting and transport of felled trees, changes in land use and wind turbine manufacture, transportation and construction. Also included in the assessment tool is the assessment of peat disturbance. It is important to note however No peat was encountered during the ground investigations on the site, although peaty topsoil was observed to a maximum depth of 0.4m (**Chapter 8: Soils and Geology**). The proposed development will not directly or indirectly disturb any peat.

Assessments are also carried out to estimate the carbon saving over the lifetime of the wind farm, compared to electricity produced using fossil fuel. The assessment of carbon savings relates to the capacity of the wind farm over the number of years for which it is operational, site improvement works, (i.e., peatland improvement, habitat creation, etc.), forestry felling, and site restoration works, (i.e., removal of infrastructure and restoration of previous site conditions), when the wind farm will be decommissioned.

The completed worksheet, including the assumptions used in the model, is provided in **Appendix 16.1** of this EIAR. The model calculates the total carbon emissions associated with the Development including manufacturing of the turbine technology, transport, construction of the Development and tree felling. The model, which is assessed for both the lower range (6.0MW) and the higher range (7.2MW), accounts for improvement works (see **Appendix 5.5 Habitat Enhancement Plan**) and the years taken for the site to return to its original characteristics but does not factor in the potential re-use of turbine components. All metal components can be recycled, while there is limited potential for the recycling/reuse of the fibreglass blades.

The model also calculates the carbon savings associated with the Development against three comparators:

i. Coal fired Electricity Generation
ii. Grid mix of Electricity Generation
iii. Fossil fuel mix of Electricity Generation (oil, gas and coal)[18].

This is to compare this renewable source of electricity generation to traditional methods of electricity generation to assess the carbon savings and losses.

[18] Ireland's energy imports comprise oil (56%), gas (31%) and coal (10%). http://ireland2050.ie/present/oil-and-gas/?q=where-does-ireland-get-its-electricity#:~:text=Ireland%20has%20only%20small%20proven,%25)%20and%20coal%20(10%25, Accessed 25 March 2022

16.4.2 Carbon Losses

The potential carbon losses were assessed for the Development.

The main CO_2 losses due to the Development are summarised in **Table 16.2**. A copy of the input and output data is provided in the completed worksheet in **Appendix 16.1**.

Table 16.2: Carbon losses

Origin of Losses	Total CO_2 Losses (tonnes CO_2 equivalent)	
	Lower Range Output	Higher Range Output
Turbine manufacture, construction and decommissioning	64,758	78,214
Losses due to Backup	54,494	65,393
Losses due to reduced carbon fixing potential	997	2,818
Losses due to DOC and POC leaching	0	0
Felling of Forestry	4,004	4,341
Total Expected Losses	124,253	150,776

During the site investigation work in **Chapter 8: Soils and Geology** it was concluded that no peat was onsite. There was a peaty soil onsite which averaged 0.1m in depth across the development site. The carbon calculator has been run with a worst case 0.1m depth of peat across the site.

The worksheet model calculated that the Development is expected to give rise to up to 98,640 tonnes of CO_2 equivalent losses at the lower range (6.0MW) and 133,7246 tonnes of CO2 equivalent losses at the higher range (7.2MW) over its 40-year life. Of this total figure, the proposed wind turbines directly account for 64,758 tonnes, or 34% at the lower range and 78,214 tonnes or 36% at the higher range. Of the expected total CO_2 losses.

Losses due to back up[19] at Fraction of output backup of 5% account for 54,494 tonnes at the lower range and 65,393 tonnes, at the higher range of the expected total CO_2 losses.

Losses reduced carbon fixing potential and the felling of forestry accounting for the 5,001 tonnes at the lower range and 35 % or 7,159 tonnes at the higher range. The estimated CO_2 arising from ground activities associated with the proposed development is calculated based on the entire Development footprint being "*Fen*", as this is one of only two choices, the other being fen. The main difference between a fen and a bog is that fens have greater water exchange and are less acidic, so their soil and water are richer in nutrients. Fens are often found near bogs and over time most fens become bogs. There are two identified wetlands within the planning boundary which are provisionally classified as fen habitats.

The habitat that will be impacted by the Development footprint comprises predominantly agricultural land, commercial forestry, and Dry Heathland rather than Fen which is assumed by the model. The carbon calculator estimates there to be no overall carbon losses from soil organic matter and is predicted to lock in carbon over the duration of the project. This is partly due to revegetation and habitat restoration on the site during in the commercial operation, these figures are included in **Appendix 16.1**.

The figures discussed above are based on the assumption that the hydrology of the Site and habitats within the site are not restored on decommissioning after its expected 40-year useful life. However, at the end of the 40-year lifespan of the Development, the turbines may be replaced with newer models subject to a consent for the same being obtained. This would mean the carbon losses associated with not restoring the habitats hydrology at the Site would be offset by the carbon-neutral energy that the new turbines would generate.

16.4.3 Carbon savings

The habitat that will be impacted by the Development footprint comprises predominantly agricultural land and dry heathland, no peatland will be affected.

However, the carbon calculator is pre-loaded with information specific to the CO2 emissions from the United Kingdom's electricity generation plant, which is used to calculate emissions savings from proposed wind farm projects in the UK and similar data

[19] CO_2 loss due to back up is calculated from the extra electricity production baseload capacity required for backup of the windfarm to meet net generation demands when the wind farm is non-generating.

was not available for the Irish electricity generation plant. Therefore, these CO2 emissions savings from the Development were calculated separately from the worksheet.

According to the model described above, the Development will give rise to total losses of 122,328 tonnes (lower range) or 167,744 (higher range) tonnes of carbon dioxide.

A simple formula is used to calculate carbon dioxide emissions reductions resulting from the generation of electricity from wind power rather than from carbon-based fuels such as peat, coal, gas and oil. The formula is:

$$CO2 \text{ (in tonnes)} = \frac{(A \times B \times C \times D)}{1000}$$

where:

A = The maximum capacity of the wind energy development in MW

B = The capacity or load factor, which takes into account the availability of wind turbines and array losses etc.

C = The number of hours in a year

D = Carbon load in grams per kWh (kilowatt hour) of electricity generated and distributed via the national grid.

For the purposes of this calculation, the rated capacity of the Development is assumed to be approximately 78.4MW at the lower range and 86.4.4MW at the higher range. A load factor of 0.35 (or 35%) has been used for the Development.

There has been a strong reduction in the CO2 intensity of electricity generation, especially after 2016, with intensity falling below 300g CO2/kWh for the first time in 2020.

The best and worst case (i.e. Assuming an output of just 86.4MW) calculation for carbon savings is therefore, as follows:

$$CO2 \text{ (in tonnes)} = \frac{(72 \times 0.35 \times 8{,}760 \times 381)}{1000}$$

= 84,106.5 tonnes per annum at the lower range

$$CO2 \text{ (in tonnes)} = \frac{(86.4 \times 0.322 \times 8{,}760 \times 381)}{1000}$$

= 92,853.6 tonnes per annum at the higher range

Based on this calculation, approximately 84,106.5 (lower range) or 92,853.6 (higher range) tonnes of carbon dioxide will be displaced per annum from the largely carbon-based traditional energy mix by the Development.

In total, it is estimated that 3,364,260 tonnes (lower range) or 3,714,144 tonnes (higher range) of carbon dioxide will be displaced over the proposed 40-year lifetime of the wind farm.

16.4.4 Operational Phase

16.4.4.1 Dust Emissions

There will be a small number of light vehicles accessing the site during the operational phase. This could lead to some localised dust being generated though this will be small and sporadic as only approximately one to two site visits per week will occur at the EIA Development. This will be an imperceptible negative impact.

16.4.4.2 Reduction in Greenhouse Gas Emissions

The proposed development does not contain any element, which will produce greenhouse gaseous emissions or odorous emissions (excluding low levels of greenhouse gaseous emissions during the construction/decommissioning phases). Indeed, the development will contribute to a net national reduction in the emissions of greenhouse and other gases resulting from the combustion of fossil fuels. The gases of main concern are those that contribute to an increase of the Greenhouse Effect (Carbon dioxide, Methane, Nitrous oxide and other Nitrogen oxides) and those that contribute to Acid Rain (principally Sulphur dioxide). The degree to which wind energy reduces levels of emissions depends on the method of electricity generation which it is replacing. This assessment assumes a scenario of a 72 MW – 86.4 MW output for the Proposed Development if the Vestas 162 turbine variant is selected (12 x 6.0 - 7.2MW turbines).

Table 16.3 shows the approximate emission savings that can be achieved each year through running at 30% capacity, instead of the equivalent output from the current mix of generating fuel in Ireland.

Table 16.3: Statistics relating to Emissions Avoidance of the EIA Development

Factor	Contribution (6.0 MW – 7.2 MW)
Energy Produced (MWh per annum)	201,830 - 242,196[20]
Number of Homes Powered (per annum)	43,610 - 52,332[21]
CO_2 offset (tonnes per annum)	97,396 - 116,980[22]
Nitrous oxides offset (tonnes per annum)	605 - 726 [23]
Sulphur dioxide offset (tonnes per annum)	2,018 - 2,421 [24]

No appreciable effect on the air quality in the immediate environs of the Proposed Development is expected from the construction and operation of the EIA Development. However, the relative reductions in greenhouse gas emissions in the energy sector will serve to reduce the effects of climate change on a national and global level, albeit at a small scale. This will be a small positive impact in the medium term in helping Ireland reduce its greenhouse gas emissions and meet its international obligations.

16.4.5 Decommissioning Phase

Impacts during the decommissioning phase of the EIA Development are anticipated to be similar to those arising during the construction phase depending on the scenario chosen. The turbines will be dismantled and removed from site, and it is assumed that the reinforced concrete bases and hardstands will be left in situ, covered in topsoil and revegetated. This option has less environmental impacts than complete removal of the bases and hardstands. Similar to the bases and hardstands it is intended that the site access tracks will be left in-situ, however they will not be covered in topsoil and remain in use for local residents. The decommissioning phase would be expected to last approximately 4 weeks in the scenario described above. There will be an increase in

[20] 72 MW x 0.32 x 365 x 24 (12 x 6.0 MW turbines x 0.32 (32% capacity factor average) x no. of days x no. of hours) = 201,830.4
86.4 MW x 0.32 x 365 x 24 (12 x 7.2 MW turbines x 0.32 (32% capacity factor) x no. of days x no. of hours) = 242,196.48

[21] Sustainable Energy Authority of Ireland (2018) 'Energy in the Residential Sector 2018 Report'. Page 45, Table 19 shows "In *2016, the average dwelling consumed 18,325 kWh of energy, based on climate corrected data, indicating 4.2% annual growth. This comprised 13,697 kWh (74.7 %) of non-electric and 4628 kWh (25.2%) of electricity*." Therefore, the proposed development can be expected to meet the average electricity consumption of (201,830.4 MWh x 1000 = 201,830,400 kWh / 4628 kWh) = 43,610.7 homes. (242,196.48 MWh x 1000 = 242,196,480 kWh / 4628 kWh) = 52,332.8 homes.

[22] Sustainable Energy Authority of Ireland (2018) '*Energy in the Residential Sector 2018 Report*'. Page 49 highlights *"between 2000 and 2016 the CO_2 emissions per unit of electricity decreased by 37 %".* In 2016 the carbon intensity of grid electricity was calculated as *483g CO_2/kWh* (Table 21 Pg 50) The expected generation (201,830,000 - 242,196,000 kWh) is multiplied by 0.483 to calculate the kg of CO_2 equivalent saved per year.
(201,830,000 kWh x 0.483)/1000 = 97,396.7 tonnes/annum CO_2 equivalent. (242,196,000 kWh x 0.483)/1000 = 116,980.8tonnes/annum CO_2 equivalent.

[23] 201,830,000 kWh x 0.003kg / 1000 = 605.4 t 242,196,000 kWh x 0.003kg / 1000 = 726.5 t (based on British Wind Energy Association figure of 3g NO_x/kW/h http://www.bwea.org/edu/calcs.html).

[24] 201,830,000 kWh x 0.010kg / 1000 = 2,018 t / 242,196,000 kWh x 0.010kg / 1000 = 2,421 t (based on British Wind Energy Association figure of 10g SO_2/kW/h (http://www.bwea.org/edu/calcs.html)

vehicle journeys on site as materials will require to be transported off site. The air quality impacts would be predicted to be **slightly negative** in the **short-term** .

16.5 MITIGATION MEASURES AND RESIDUAL EFFECTS

16.5.1 Construction Phase Mitigation

The main potential impact during the construction phase of the EIA Development will be from dust nuisance at sensitive receptors close to the site. Good practice site procedures will be followed by the appointed contractor to prevent dirt and dust being transported onto the local road network. Good practice site control measures are likely to include the following:

- Approach roads and construction areas will be cleaned on a regular basis to prevent build-up of mud and prevent it from migrating around the site and off-site onto the public road network;
- Wheel wash facilities will be provided near the site entrances to prevent mud/dirt being transferred from the site to the public road network;
- 'Damping down' will be used if dust becomes an issue on any part of the site. For example, weather will be monitored, to predict the need for damping down activities during periods of dry weather when dust is likely to become airborne;
- Vehicles delivering materials to the site will be covered appropriately when transporting materials that could result in dust, e.g. crushed rock or sand;
- Ready-mix concrete will be delivered to site and it is envisaged that no batching of concrete will take place on site. Only washing out of chutes will take place on site and this will be undertaken at a designated concrete washout facility at the site compounds;
- Speed restrictions on access tracks will be implemented to reduce the likelihood of dust becoming airborne;
- Public roads along the construction haul route will be inspected regularly and if dirt/mud is identified that could result in dust generation, then the road will be cleaned as necessary;
- Stockpiling of materials will be carried out in such a way as to minimise their exposure to wind where possible and damping down or covering of the stockpiles will be carried out where needed; and
- A complaints procedure will be implemented on site where complaints will be reported to the site manager, logged and appropriate action taken.

16.5.2 Operational Phase Mitigation

During the operational phase there will be limited site visits for maintenance purposes and therefore, no mitigation is proposed for the operational phase.

16.5.3 Decommissioning Phase Mitigation

Mitigation measures during the decommissioning phase will be similar to those employed during the construction phase as outlined above.

16.5.4 Cumulative Effects

The wind farm construction is a short-term activity, so the potential cumulative impact could be predicted to be slight, negative, temporary/short-term, direct, medium probability given the distance of the proposed wind farm to sensitive receptors.

16.6 RESIDUAL IMPACTS OF THE PROPOSED DEVELOPMENT

The use of plant and machinery will impact air quality in the area, both in terms of dust generation and exhaust emissions. Overall, this impact is assessed as slight/imperceptible, negative, direct and temporary/short-term in nature.

The appointed contractor responsible for the detailed design of the project will provide details to the planning authority for agreement in writing prior to the commencement of development of environmental safety methodology including best practice procedures to manage construction activities. It is recommended that the methodology statement should be signed off by a suitably qualified geotechnical engineer/engineering geologist. An independent, qualified geotechnical engineer/engineering geologist should be contracted for the detailed design stage of the project and geotechnical services should be retained throughout the construction phase, including monitoring and supervision of construction activities on a regular basis.

During the operational phase of the proposed development the effects are assessed as being slight, positive and long-term in nature. This is in line with the Strategic Environmental Objective ENV 04, 'We will contribute towards compliance with air quality legislation; greenhouse gas emission targets; management of noise levels; and reductions in energy usage ' as stated in the Waterford County Development Plan 2022-2028[25]

[25] https://consult.waterfordcouncil.ie/en/consultation/waterford-city-county-development-plan-2022-%E2%80%93-2028 [Accessed 9th March 2023]

(p253) thus supporting the National Climate Change Strategy and promoting renewable energy.

16.7 SUMMARY OF SIGNIFICANT EFFECTS

This assessment has identified no potentially significant effects, given the mitigation measures embedded in the design and recommended for the implementation of the Proposed Development.

16.8 STATEMENT OF SIGNIFICANCE

This Chapter has assessed the significance of potential effects of the Proposed Development on air quality. The Proposed Development has been assessed as having the potential to result in slight, negative, temporary/short-term effects during construction and decommissioning. There will be a slight, positive, long-term effect in terms of helping Ireland meet its international obligations to reduce greenhouse gas emissions.

Potential cumulative effects were assessed as being of a slight, negative, short-term impact.

Given that only effects of significant impact or greater are considered "significant" in terms of the EIA Regulations, the potential effects of the Proposed Development on air quality and climate are considered not significant.