Drumlins Park Wind Farm

Chapter 8:
Air Quality & Climate

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8.1 Introduction

8.1.1 Background

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

8.1.2 Description of Proposed Development

The proposed development will be located in north-west County Monaghan, c. 2km south west of the village of Newbliss, c. 5km south of Clones and c. 8km northwest of Cootehill. The proposed development will comprise 8 no. wind turbines with an overall tip height of up to 180m. The proposed development also includes all ancillary infrastructure including site entrances, access tracks (including the upgrade of 2 no. local roads within the site), drainage infrastructure, internal wind farm electrical cabling, crane hardstands and turbine foundations. The proposed development also comprises a number of off-site/secondary developments including 3 no. grid connection options and upgrades to the turbine component transport/haul route. A detailed description of the proposed development is provided at **Chapter 3** of this EIAR.

8.1.3 Statement of Authority

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

8.1.4 Candidate Wind Turbine

The General Electric GE 5.5-158 (Option TU1) has been selected as the candidate turbine for the basis of this assessment due to the LIKELY greater requirement for construction activities (generation of construction traffic volumes and duration) and the greater volume of construction materials than would be required for the construction of the General Electric GE 4.0-130 (Option TU2). Due to the requirement for greater volumes of materials (embodied energy) and extended duration (emissions from plant and machinery), the General Electric GE 5.5-158 is considered to represent a ‘worst-case’ scenario.

8.2 Standards & Guidance

8.2.1 Ambient Air Quality Standards

In order to reduce the risk to health from poor air quality, national and European statutory bodies have set limit values in ambient air for a range of air pollutants. These limit values or “Air Quality Standards” are health or environmental-based levels for which additional factors may be considered. For example, natural background levels, environmental conditions and socio-economic factors may all play a part in the limit value which is set, see **Table 8.1** below.

Air quality significance criteria are assessed on the basis of compliance with the appropriate standards or limit values. The applicable standards in Ireland include the Air Quality Standards Regulations 2011, which incorporate EU Directive 2008/50/EC and combines the previous air quality framework and subsequent daughter directives (see **Table 8.1**). Although the EU Air Quality Limit Values are the basis of legislation, other thresholds outlined by the EU Directives are used which are triggers for particular actions (see **Annex 8.1**).

The focus from a health perspective is on particles of dust which are less than 10 microns. EU ambient air quality standards (Council Directive 2008/50/EC transposed into Irish law as S.I. 180 of 2011) centres on PM_{10} (particles less than 10 microns) as it is these particles which have the potential to be inhaled into the lungs and potentially cause adverse health impacts. The Directive also sets an ambient standard for $PM_{2.5}$ (particles less than 2.5 microns and form part of PM_{10}) which came into force in 2015 (see **Table 8.1**).

8.2.1.1 Gothenburg Protocol

In 1999, Ireland signed the Gothenburg Protocol to the 1979 UN Convention on Long Range Transboundary Air Pollution. The initial objective of the Protocol was to control and reduce emissions of Sulphur Dioxide (SO_2), Nitrogen Oxides (NO_X), Volatile Organic Compounds (VOCs) and Ammonia (NH_3). To achieve the initial targets, Ireland was obliged, by 2010, to meet national emission ceilings of 42kt for SO_2 (67% below 2001 levels), 65kt for NO_X (52% reduction), 55kt for VOCs (37% reduction) and 116kt for NH_3 (6% reduction). In 2012, the Gothenburg Protocol was revised to include national emission reduction commitments for the main air pollutants to be achieved in 2020 and beyond and to include emission reduction commitments for $PM_{2.5}$. In relation to Ireland, 2020 emission targets are 25kt for SO_2 (65% below 2005 levels), 65kt for NO_X (49% reduction), 43kt for VOCs (25% reduction), 108kt for NH_3 (1% reduction) and 10kt for $PM_{2.5}$ (18% reduction). COM (2013) 917 Final is the "Proposal for a Council Decision for the acceptance of the Amendment to the 1999 Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution to Abate Acidification, Eutrophication and Ground-level Ozone".

European Commission Directive 2001/81/EC and the National Emissions Ceiling Directive (NECD), prescribes the same emission limits as the 1999 Gothenburg Protocol. A National Programme for the progressive reduction of emissions of these four transboundary pollutants has been in place since April 2005. The data available from the EPA in 2019 (EPA 2019a) indicated that Ireland complied with the emissions ceilings for SO_2 and NH_3 but failed to comply with the ceiling for NO_X and NMVOCs. Directive (EU) 2016/2284 "On the Reduction of National Emissions of Certain Atmospheric Pollutants and Amending Directive 2003/35/EC and Repealing Directive 2001/81/EC" was published in December 2016. The Directive will apply the 2010 NECD limits until 2020 and establish new national emission reduction commitments which will be applicable from 2020 and 2030 for SO_2, NO_X, NMVOC, NH_3 and $PM_{2.5}$. In relation to Ireland, 2020-29 emission targets are for SO_2 (65% below 2005 levels), for NO_X (49% reduction), for VOCs (25% reduction), for NH_3 (1% reduction) and for $PM_{2.5}$ (18% reduction). In relation to 2030, Ireland's emission targets are for SO_2 (85% below 2005 levels), for NO_X (69% reduction), for VOCs (32% reduction), for NH_3 (5% reduction) and for $PM_{2.5}$ (41% reduction).

Pollutant	Regulation	Limit Type	Margin of Tolerance	Value
Nitrogen Dioxide	2008/50/EC	Hourly limit for protection of human health - not to be exceeded more than 18 times/year	None	200 µg/m³ NO_2
		Annual limit for protection of human health	None	40 µg/m³ NO_2
		Annual limit for protection of vegetation	None	30 µg/m³ $NO + NO_2$
Particulate Matter (as PM_{10})	2008/50/EC	24-hour limit for protection of human health - not to be exceeded more than 35 times/year	50%	50 µg/m³ PM_{10}
		Annual limit for protection of human health	20%	40 µg/m³ PM_{10}
$PM_{2.5}$	2008/50/EC	Annual limit for protection of human health	None	25 µg/m³ $PM_{2.5}$

Table 8.1: Air Quality Standards Regulations 2011 (Based on Directive 2008/50/EC and S.I. 180 of 2011)

8.2.2 Climate Agreements

Ireland ratified the United Nations Framework Convention on Climate Change (UNFCCC) in April 1994 and the Kyoto Protocol in principle in 1997 and formally in May 2002 (Framework Convention on Climate Change, 1999 and Framework Convention on Climate Change, 1997). For the purposes of the EU burden sharing agreement under Article 4 of the Doha Amendment to the Kyoto Protocol, in December 2012, Ireland agreed to limit the net growth of the six Greenhouse Gases (GHGs) under the Kyoto Protocol to 20% below the 2005 level over the period 2013 to 2020 (UNFCCC 2012).

The UNFCCC is continuing detailed negotiations in relation to GHGs reductions and in relation to technical issues such as Emission Trading and burden sharing. The most recent Conference of the Parties to the Convention (COP24) took place in Katowice, Poland in December 2018 and focussed on advancing the implementation of the Paris Agreement. The Paris Agreement was established at COP21 in Paris in 2015 and is an important milestone in terms of international climate change agreements. The Paris Agreement, agreed by over 200 nations, has a stated aim of limiting global temperature increases to no more than 2°C above pre-industrial levels with efforts to limit this rise to 1.5°C. The aim is to limit global GHG emissions to 40 gigatonnes as soon as possible whilst acknowledging that peaking of GHG emissions will take longer for developing countries. Contributions to greenhouse gas emissions will be based on Intended Nationally Determined Contributions (INDCs) which will form the foundation for climate action post 2020. Significant progress was also made on elevating adaption onto the same level as action to cut and curb emissions.

The EU, on the 23/24th of October 2014, agreed the "2030 Climate and Energy Policy Framework" (EU, 2014). The European Council endorsed a binding EU target of at least a 40% domestic reduction in greenhouse gas emissions by 2030 compared to 1990. The target will be delivered collectively by the EU in the most cost-effective manner possible, with the reductions in the ETS (Emissions Trading Scheme) and non-ETS sectors amounting to 43% and 30% by 2030 compared to 2005, respectively. Secondly, it was agreed that all Member States will participate in this effort, balancing considerations of fairness and solidarity. The policy also outlines, under "Renewables and Energy Efficiency", an EU binding target of at least 32% for the share of renewable energy consumed in the EU in 2030.

The EPA 2019 GHG Emissions Projections Report (EPA 2019a) notes that there is a long-term projected decrease in greenhouse gas emissions as a result of inclusion of new climate mitigation policies and measures that formed part of the National Development Plan (NDP) which was published in 2018. Implementation of these policies and measures are classed as a "*With Additional Measures scenario*" for future scenarios. A change from generating electricity using coal and peat to wind power and diesel vehicle engines to electric vehicle engines are envisaged under this scenario. While emissions are projected to decrease in these areas, emissions from agriculture are projected to grow steadily due to an increase in animal numbers. However, over the period 2013-2020 Ireland is projected to cumulatively exceed its compliance obligations with the EU's Effort Sharing Decision (Decision No. 406/2009/EC) 2020 targets by approximately 10 Mt CO_2 equivalent under the "*Without Existing Measures scenario*" and 9 Mt CO_2 equivalent under the "*With Additional Measures scenario*".

8.3 Methodology

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

8.3.1 Construction Phase

8.3.1.1 Air Quality

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

The current assessment thus focused firstly on identifying the existing baseline levels of NO_2 and PM_{10} in the region of the proposed development by an assessment of EPA monitoring data. Thereafter, the impact of the development during the construction phase of the project on air quality at the neighbouring sensitive receptors was determined by an assessment of the dust generating construction activities associated with the proposed development. The impact of dust from the construction phase will be short-term in nature and is assessed in **Section 8.5.2.1**.

Material handling activities, including excavation and backfill, on site may typically emit dust. Dust is characterised as encompassing particulate matter with a particle size of between 1 and 75 microns (1- 75 µm). Deposition typically occurs in close proximity to each site and potential impacts generally occur within 500 metres of the dust generating activity as dust particles fall out of suspension in the air. Larger particles deposit closer to the generating source and deposition rates will decrease with distance from the source. Sensitivity to dust depends on the duration of the dust deposition, the dust generating activity and the nature of the deposit. Therefore, a higher tolerance of dust deposition is likely to be shown if only short periods of dust deposition are expected and the dust generating activity is either expected to stop or move on.

The likelihood for dust to be emitted will depend on the type of activity being carried out in conjunction with environmental factors including levels of rainfall, wind speed and wind direction. Activities associated with this development such as excavation and backfill have potential to generate dust.

As indicated, dust generation rates depend on the site activity, particle size (in particular the silt content, defined as particles smaller than 75 microns in size), the moisture content of the material and weather conditions. Dust emissions are dramatically reduced where rainfall has occurred due to the cohesion created between dust particles and water and the removal of suspended dust from the air. It is typical to assume that no dust is generated under "wet day" conditions where rainfall greater than 0.2 mm has fallen. Information collected from Clones Meteorological Station (Met Eireann 2019, 30-year averages) identified that 218 days per annum are typically classed as "wet". Thus, almost 70% of the time no significant dust generation will be likely due to meteorological conditions.

Large particle sizes (greater than 75 microns) fall rapidly out of atmospheric suspension and are subsequently deposited in close proximity to the source. Particle sizes of less than 75 microns are of interest as they can remain airborne for greater distances and can give rise to the potential dust nuisance at the sensitive receptors. This size range would broadly be described as silt. Emission rates are normally predicted on a site-specific particle size distribution for each dust emission source. The nearest sensitive residential receptor is at a distance of approximately 200 m from the proposed wind farm; however there are residential receptors in closer proximity to the grid connection route options and haul route upgrade locations.

Research carried out in the United States has shown that haul trucks generate the majority of dust emissions from surface mining sites, accounting for an estimated 78 - 97% of total dust emissions (UK ODPM 2000). The Institute of Air Quality Management Construction Dust Guidance (IAQM 2014) states that the track out (the spreading of dust onto roads from the wheels of vehicles leaving construction sites) related construction dust impact increases with respect to the number of movements of HGV's per day, length of unpaved road, distance to receptors and the sensitivity of local receptors. While the dust emission magnitude can be high, due to the length of haul road, the distance to receptors and low ambient background PM_{10} concentrations, the risk of impacts with respect to health effects and dust soiling is considered low. In order to reduce dust generation, speeds shall be restricted on hard surfaced roads as site management dictates.

Whilst construction activities are likely to produce some level of dust during earth moving and excavating phases of the project, these activities are likely be confined to particles of dust greater than 10 microns. Particles of dust greater than 10 microns are considered a nuisance but are not likely to cause significant health impacts. For instance, bulldozing and compacting operations release 84% of particles which are greater than PM_{10} with only 16% of particles being less than 10 microns (IAQM 2014).

8.3.1.2 Climate – Construction Traffic and Materials

Under the EU Commission's Climate and Energy Package, Ireland is required to deliver a 20% reduction in non-ETS greenhouse gas emissions by 2020 (relative to 2005 levels). In addition, Ireland also has binding annual emission limits for the period 2013 - 2020 to ensure a gradual move towards the 2020 target. In 2014, the EU agreed the "2030 Climate and Energy Policy Framework" (EU, 2014). The European

Council endorsed a binding EU target of at least a 40% domestic reduction in greenhouse gas emissions by 2030 compared to 1990. Ireland has a target reduction of 30% in 2030 compared to 2005 levels.

The non-ETS sectors cover those that are outside the EU Emissions Trading Scheme and include the agriculture, transport, residential, commercial, waste and non-energy intensive industries. In order to assess the impact on GHG concentrations of the combined total of embodied energy from construction materials, forestry loss and peat extraction; the three are summed. This value is then compared to Ireland's 2017 total national GHG emissions and the targets which Ireland must achieve. No set guidance is available on significance of the increase in GHG emissions and therefore professional judgement must be used when reviewing this impact.

Climate change is a result of increased levels of carbon dioxide and other GHGs in the atmosphere causing the heat trapping potential of the atmosphere to increase. GHGs can be emitted from vehicles and embodied energy associated with materials used in the construction of a development. Embodied energy refers to the sum of the energy needed to produce a good or service. It incorporates the energy needed in the mining or processing of raw materials, the manufacturing of products and the delivery of these products to site. There is the potential for a number of embodied GHGs to be emitted during the construction phase of the development. For example, construction vehicles, generators etc., may give rise to CO_2 and N_2O emissions as well as the large quantities of material such as stone, concrete and steel that will be required for the project. The Institute of Air Quality Management Guidance on the Assessment of Dust from Demolition and Construction (IAQM 2014) states that site traffic and plant is unlikely to make a significant impact on climate. However, due the nature of this project, climate impacts including the embodied energy from construction materials and site vehicles will be assessed.

The construction material volumes used in the assessment were supplied by Drumlins Park Limited (DPL) and used in combination with the UK Environment Agency carbon calculator (Version 6) for construction sites (UK Environment Agency 2019) in order to calculate the predicted embodied emissions for the materials used during the construction phase. The carbon calculator uses known embodied carbon rates (expressed as CO_2eq) for materials and their associated transport to the site. The calculator also considers personal travel, site energy and waste management in its evaluation of the associated embodied energy.

As set out above and at **Chapter 3**, the specifications of the proposed turbines to be installed have not been finalised. However, the predicted electricity production is approximately 136,185 MWh per annum. The assessment will be undertaken using this value as it will provide the worst-case payback period scenario. Information on the life cycle assessment undertaken for Vestas Wind Systems A/S, who are a major supplier of the wind turbines, has been reviewed (Elsam 2004, Vestas Wind Systems A/S 2013). The life cycle assessment quantifies the associated power consumption associated with the production, operation, transport and end-of-life of the wind turbines; and also considers and quantifies the associated greenhouse gas emissions associated with the production, operation, transport and end-of-life of the wind turbines. The energy balance associated with the wind power production during its lifetime (proposed to be 30 years) and the energy associated with the manufacturing, operation, transport, dismantling and disposal was also calculated on a site-specific basis as the energy balance is based on the expected GWh of production during its lifetime. The energy balance is expressed in terms of the time taken for the energy consumed by the turbine through its full life cycle to be repaid in terms of renewable energy exported to the electricity grid.

8.3.1.3 Climate – Forestry and Peat Removal

Trees are a natural carbon sink and absorb CO_2 from the atmosphere helping in the reduction of climate change; any felling of forestry results in a loss of this carbon sink thus, increasing the levels of CO_2 in the atmosphere. However, increased planting of trees on suitable lands will, over time, help to increase the carbon sink potential of the land and benefit climate. The "Best Practice Guidelines for the Irish Wind Energy Industry" (IWEA 2012) is used for calculating the GHG sinks due to the loss of forestry.

The GHG emissions associated with this peat excavation has been assessed using the 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Other Land Use, Chapter 7 Wetlands (IPCC 2006).

8.3.2 Operational Phase

8.3.2.1 Air Quality

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

8.3.2.2 Climate

There will be no greenhouse gas emissions from the operation of the wind turbines. However, due to the displacement of 136 GWh of electricity which otherwise would have been produced from fossil fuels, there will be a net benefit in terms of greenhouse gas emissions. The savings are compared to Ireland's 2020 commitment target for gross electricity consumption in Ireland from renewable energy sources.

Vehicular traffic is often a dominant source of greenhouse gas emissions as a result of developments however; there is no predicted operational phase vehicle impact. Vehicles will give rise to CO_2 and N_2O emissions near the proposed development but this will be negligible.

8.4 Description of the Existing Environment

8.4.1 Meteorological Data

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

The nearest representative weather station collating detailed weather records is Clones, which is located approximately 5 km northwest of the site. While this station shut in 2007, the most recent 30-year average data sets include the Clones station. Clones meteorological data has been examined to identify the prevailing wind direction and average wind speeds over the long-term data set from 1981 - 2007. The average wind speed over the period 1981 – 2007 is approximately 4 m/s at ground level. Although the wind data gives an indication of the prevailing wind speed in the general area, this data is not used in the air quality and climate assessment of the proposed development.

In addition, and as set out above, 30-year average data indicates that 218 days per annum are typically classed as "wet" which would significantly curtail the likelihood for significant emissions of dust.

8.4.2 Available Background Data

8.4.2.1 Air Quality

Air quality monitoring programmes have been undertaken in recent years by the EPA and Local Authorities. The most recent annual report on air quality "*Air Quality Monitoring Report 2017*" (EPA 2018), details the range and scope of monitoring undertaken throughout Ireland. As part of the implementation of the Air Quality Standards Regulations 2002 (S.I. No. 271 of 2002), four air quality zones have been defined in Ireland for air quality management and assessment purposes (EPA, 2019b). Zone A is defined as Dublin and its environs, Zone B is defined as Cork City, Zone C is defined as 23 urban areas with a population greater than 15,000 and Zone D is defined as the remainder of the country. The rural areas within which the proposed development is located is classed as Zone D.

NO_2 monitoring was carried out at two rural Zone D locations in 2017, Emo and Kilkitt and the urban site of Enniscorthy (EPA 2018). The NO_2 annual average in 2017 for both rural sites was 2.5 µg/m^3 with the results for urban station of 7 µg/m^3. Hence, long-term average concentrations measured at all locations were significantly lower than the annual average limit value of 40 µg/m^3. The average results over the last five years at a range of rural Zone D locations suggest an upper average of no more than 3.2 µg/m^3 as a background concentration. Based on the above information, a conservative estimate of the background NO_2 concentration at the proposed development site and its environs is 4 µg/m^3; however, this will rise with the proximity to Clones.

Long-term PM_{10} monitoring was carried out at the Zone D locations of Castlebar, Kilkitt, Enniscorthy and Claremorris in 2017 (EPA 2018). The long-term average of the 90th percentile (%ile) of 24-hour concentration is 21 µg/m^3. The average annual mean concentration measured in 2017 is 14.7 µg/m^3 (EPA 2018). The average results over the last five years at a range of Zone D locations suggests an upper average of 13.0 µg/m^3 as a background concentration. Therefore, long-term average PM_{10} concentrations measured at this location were significantly lower than the annual average limit value of 40 µg/m^3.

The results of $PM_{2.5}$ monitoring at Claremorris (Zone D) in 2017 (EPA 2018) indicated an average $PM_{2.5}/PM_{10}$ ratio of 0.6. Based on this information, a ratio of 0.6 was used to generate a rural background $PM_{2.5}$ concentration of 7.8 µg/m^3. Again, long-term average $PM_{2.5}$ concentrations measured at this location were significantly lower than the annual average limit value of 25 µg/m^3.

In summary, existing baseline levels of NO_2, PM_{10} and $PM_{2.5}$ based on extensive long-term data from the EPA are well below ambient air quality limit values for Zone D, which encompasses the proposed wind farm. It is also noteworthy that the Kilkitt monitoring station is located within rural County Monaghan and is therefore considered to be particularly representative of conditions at the proposed development site.

8.4.2.2 Climate

Anthropogenic emissions of greenhouse gases in Ireland included in the EU 2020 strategy are outlined in the most recent review by the EPA which details emissions up to 2017 (EPA, 2019c). Agriculture was the largest contributor in 2017 at 33.3% of the total, with the transport sector accounting for 19.8% of emissions of CO_2 (EPA, 2019c).

2017 is the fifth year where compliance with the European Union's Effort Sharing Decision "EU 2020 Strategy" (Decision 406/2009/EC) was assessed. Ireland had total GHG emissions of 60.74 Mt CO_2eq in 2017. This is 2.94 Mt CO_2eq higher than Ireland's annual target for emissions in 2017 (EPA, 2019c). Emissions are predicted to continue to exceed the targets in future years and, therefore, reduction measures are required in all sectors.

The EPA 2019 GHG Emissions Projections Report for 2018 – 2040 (EPA 2019d) notes that there is a long-term projected decrease in greenhouse gas emissions as a result of inclusion of new climate mitigation policies and measures that form part of the National Development Plan (NDP) which was published in 2018. Implementation of these are classed as a "*With Additional Measures scenario*" for future scenarios. A change from generating electricity using coal and peat to wind power and diesel vehicle engines to electric vehicle engines are envisaged under this scenario. While emissions are projected to decrease in these areas, emissions from agriculture are projected to grow steadily due to an increase in animal numbers. However, over the period 2013 – 2020 Ireland is projected to cumulatively exceed its compliance obligations with the EU's Effort Sharing Decision (Decision No 406/2009/EC) 2020 targets by approximately 10 Mt CO_2eq under the "*With Existing Measures scenario*" and 9 Mt CO_2eq under the "*With Additional Measures scenario*" (EPA, 2019d).

8.5 Description of Likely Effects

8.5.1 Characteristics of the Proposal

From an air quality perspective, the construction phase for the proposed development will be the key aspect in relation to the generation of dust and other fugitive emissions from construction activities. Additionally, the construction phase will involve the operation of plant and machinery throughout which will result in exhaust emissions. The operational phase, although requiring some vehicular movements resulting in exhaust emissions, is not anticipated to result in significant effects.

From a climate perspective, the operational phase of the project is expected to lead to a beneficial impact on climate by displacing fossil-fuel derived electricity from the national electricity network in favour of renewably generated electricity.

8.5.2 Construction Phase

8.5.2.1 Construction Dust

In terms of receptor sensitivity to dust soiling, there are less than 10 highly sensitivity receptors (i.e. residential dwellings) which are less than 350 m from the proposed wind farm and haul route upgrade locations; however, the grid connection, depending on the selected option, has the potential to increase the proximity and number of receptors. There are less than 10 highly sensitive receptors within 20 m of the worst-case grid connection option (Option G2; see **Chapter 3**). As a result, the sensitivity rating of dust soiling effects on sensitive receptors is Medium according to the IAQM guidance in **Table 8.2** (IAQM, 2014).

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

Table 8.2: Sensitivity of the Area to Dust Soiling Effects on People and Property (IAQM, 2014)

In addition, the IAQM guidelines also outline the criteria for assessing the human health impact from PM_{10} emissions from construction activities based on the current annual mean PM_{10} concentration, receptor sensitivity and the number of receptors affected. In accordance with **Section 8.4.2.1** above, current PM_{10} concentration at the proposed development site is estimated to be 13 µg/m3. As shown in **Table 8.3**, the 'worst-case' sensitivity to human health impacts from PM_{10} (high sensitivity, distance of less than 20m to construction boundary and with receptor numbers of between 1 no. and 10 no.) is considered to be Low.

Receptor Sensitivity	Annual Mean PM_{10} Concentration	Number Of Receptors	Distance from source (m)			
			<20	<50	<100	<350
High	< 24µg/m³	>100	Medium	Low	Low	Low
		10-100	Low	Low	Low	Low
		1-10	Low	Low	Low	Low
Medium	< 24µg/m³	>10	Low	Low	Low	Low
		1-10	Low	Low	Low	Low
Low	< 24µg/m³	>1	Low	Low	Low	Low

Table 8.3: Sensitivity of the Area to Human Health Impacts (IAQM, 2014)

Dust deposition impacts on ecology can occur due to chemical or physical effects. This can include a reduction in photosynthesis due to smothering as a result of the settling of dust on plants and chemical changes such as acidity to soils. Often, impacts will be reversible once the works are completed, and dust deposition ceases. The proposed development is not located within sufficient proximity result in any impacts on highly sensitive ecological areas and these have, therefore, been screened from further assessment.

Demolition

The dust emission magnitude from demolition can be classified as small, medium or large and is described below. It is proposed to demolish 1 no. small abandoned agricultural building in the townland of Drumacreeve to facilitate the provision of appropriate visibility splays at Site Entrance 3.

- **Large:** Total building volume >50,000 m³, potentially dusty construction material (e.g. concrete), on-site crushing and screening, demolition activities >20 m above ground level.

- **Medium:** Total building volume 20,000 m³ – 50,000 m³, potentially dusty construction material, demolition activities 10-20 m above ground level.
- **Small:** Total building volume 20,000 m³, construction material with low potential for dust release, demolition activities <10 m above ground, demolition occurring during wetter months.

The dust emission magnitude for the proposed demolition activities can be classified as small, due to the volume involved. This results in an overall low risk of temporary dust soiling impacts (as it is medium sensitivity area in terms of dust soiling) and an overall negligible risk of temporary human health impacts (as it is a low sensitivity area in terms of human health) as a result of the proposed demolition activities as outlined in **Table 8.4**.

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

Table 8.4: Risk of Dust Impacts – Earthworks

Earthworks

Earthworks will primarily involve excavation, haulage, tipping, landscaping and stockpiling. The dust emission magnitude from earthworks can be classified as small, medium or large and are described as follows:-

- **Large**: Total site area > 10,000m^2, potentially dusty soil type (e.g. clay which will be prone to suspension when dry due to small particle size), >10 heavy earth moving vehicles active at any one time, formation of bunds > 8m in height, total material moved >100,000 tonnes;
- **Medium**: Total site area 2,500m^2 – 10,000m^2, moderately dusty soil type (e.g. silt), 5 - 10 heavy earth moving vehicles active at any one time, formation of bunds 4 – 8m in height, total material moved 20,000 – 100,000 tonnes; and
- **Small**: Total site area < 2,500m^2, soil type with large grain size (e.g. sand), < 5 heavy earth moving vehicles active at any one time, formation of bunds < 4m in height, total material moved < 20,000 tonnes, earthworks during wetter months.

The dust emission magnitude for the proposed earthwork activities can be classified as Large due to the site area. Combining this classification with the previously established sensitivity of the area to dust soiling and human health impacts (medium and low sensitivity respectively), an overall Medium risk of temporary dust soiling impacts and Low risk of temporary human health impacts is reached, per **Table 8.5**.

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

Table 8.5: Risk of Dust Impacts - Earthworks

Construction of Buildings

Dust emission magnitudes from the construction of buildings can be classified as small, medium or large and are described as follows:-

- **Large**: Total building volume > 100,000m^3, on-site concrete batching, sandblasting;
- **Medium**: Total building volume 25,000m^3 – 100,000m^3, potentially dusty construction material (e.g. concrete), on-site concrete batching; and
- **Small**: Total building volume < 25,000m^3, construction material with low potential for dust release (e.g. metal cladding or timber).

The dust emission magnitude for the proposed construction activities can be classified as Small. As set out at **Chapter 3**, the overall development will involve the construction of a substation, including associated building(s); however, due to the limited scale and volume of the required buildings, there is a low risk of temporary dust soiling impacts and an overall negligible risk of temporary human health impacts as a result of the proposed construction activities, as outlined in **Table 8.6**.

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

Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table 8.6: Risk of Dust Impacts - Construction

Trackout

Trackout refers to the movement of dust and dirt from a construction/demolition site onto the public road network, where it may be deposited and then re-suspended by vehicles using the network. The factors which determine the magnitude of dust emissions are vehicle size, vehicle speed, vehicle numbers, geology and duration. Dust emission magnitudes from trackout can be classified as small, medium or large and are described as follows:-

- **Large**: > 50 HGV (> 3.5t) outward movements in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length > 100m;
- **Medium**: 10 - 50 HGV (> 3.5t) outward movements in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50 - 100m; and
- **Small:** < 10 HGV (> 3.5t) outward movements in any one day, surface material with low potential for dust release, unpaved road length < 50m.

The trackout activities associated with the proposed development are classified as Large due to the length of access tracks, which will be unpaved, within the proposed development site. This results in an overall Medium risk of temporary dust soiling impacts and an overall Low risk of temporary human health impacts as a result of the proposed trackout activities, as outlined in Table **8.7**.

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

Table 8.7: Risk of Dust Impacts – Trackout

Summary of Construction Dust Emission Risk

The proposed development is not assessed as likely to result in any significant dust soiling or human health impacts as a result of fugitive construction phase dust emissions. As set out at **Table 8.7**, the magnitude of effects range from Medium to Negligible. While these magnitude ranking are on the lower end of the significance spectrum, a suite of mitigation measures have been proposed at **Section 8.6** to further reduce any effects. The overall impacts of construction phase dust emissions are direct, short-term and low.

.Potential Impact	Dust Emission Magnitude			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling	Low	Medium	Low	Medium
Human Health	Negligible	Low	Negligible	Low

Table 8.8: Summary of Construction Dust Impact Magnitudes

8.5.2.2 Climate – Construction Traffic and Materials

Construction traffic and embodied energy are expected to be the dominant source of greenhouse gas emissions as a result of the proposed development. Construction related vehicles will give rise to greenhouse gas emissions during trips to/from the site. Due to the absence of suitable materials on-site (**Chapter 6**), there will be no processing of materials on site including crushing, or screening of aggregates or batching of concrete and all such materials will be transported to site. In total, it is estimated that 92,050 tonnes of aggregate/fill material will be imported for use in the construction of access roads, hardstanding, grid connection[1] and other site activities. The worst-case (i.e. furthest distance) candidate quarry (see **Chapter 3**) for the supply of aggregates, Pitwood Quarries, is located approximately 30 km from the proposed development site (via R212, L2010, R188, and R189).

The construction phase will also require the importation of 17,250 tonnes of concrete (C30/37) for the construction of turbine foundations and the 110kV substation. The worst-case candidate quarry for the supply of concrete is B.D. Flood (Concrete) and is located approximately 32km from the proposed development site(via N3, R165, R188, and R189).

Where possible, excavated material will be temporarily stockpiled on-site and used for landscaping or reinstatement. Where material is not to be used for reinstatement or landscaping or reinstatement, it is will stored at the spoil deposition areas.

Emissions with the potential to cause climate change will arise from embodied carbon dioxide in site materials, as well as the kilometres travelled by vehicles delivering/removing this material to and from the construction site. These emissions have been quantified using the UK Environment Agency carbon calculator for construction sites (V6). It is predicted that up to 120 people could be on site at any time during peak construction. Emission estimates from staff transportation, site works, concrete, crushed stone and the associated road emissions of the HGV transporting them is 4,660 tonnes CO_{2eq}. These impacts are negative and are 0.008% of Irelands 2017 total national greenhouse gas emissions. This impact is classified as likely to be a direct, short-term, imperceptible impact.

8.5.2.3 Climate – Forest Loss

[1] In this case, the 110kV grid connection option (**Option G3**) has been selected as it represents the greatest usage of imported materials.

As discussed in the "*Best Practice Guidelines for the Irish Wind Energy Industry (2012),* forest loss can be a contributor to carbon losses associated with the construction of wind farm developments. The Guidance states that "*the carbon impact of proposed tree felling i.e. loss of carbon sink should be included in any carbon calculations" (IWEA 2014)*.

The proposed development does not require the felling or loss of forestry and, therefore, there will be no carbon losses due to forestry loss.

8.5.2.4 Climate - Wind Turbine Manufacture

As set out above, the expected electricity production is approximately 136,185 MWh per annum.

Using the data contained in the life cycle assessments (Elsam 2004, Vestas Wind Systems A/S 2013), a site-specific assessment of the energy balance for the current project has been undertaken:

- Annual expected MWh production = 136,185 MWh / Year
- Expected GWh production during lifetime (30 years) = 4,086 GWh
- Expected Energy Consumed / Turbine Life Cycle = 3,636 MWh (Elsam 2004, Vestas Wind Systems A/S 2013).
- Total Energy Consumed / 8 Turbines Life Cycle = 29,088 MWh
- Energy balance assessment period = 30 years
- Energy balance = (29,088 MWh /2,500,000 MWh)*360 months =2.5 months

Thus, the site-specific energy balance gives a payback period for the proposed wind turbines of 2.5 months.

8.5.2.5 Climate – Peat Extraction

As discussed in the "*Best Practice Guidelines for the Irish Wind Energy Industry (2012)* (IWEA 2014)*,* the excavation of peat can be a contributor to carbon losses associated with wind farm construction. The Guidance states "*it is good practice to undertake a calculation of the carbon costs of the construction and operation of a wind farm. The carbon release associated with the excavation and oxidization of peat soils can be relatively significant and should be included in any carbon calculation*" (IWEA 2014).

There is no loss of peat associated with proposed development; therefore the impact associated with peat loss is assessed to be neutral.

8.5.3 Operational Phase

8.5.3.1 Air Quality

The assessment of baseline air quality in the region of the proposed development has shown that current levels of key pollutants are significantly lower than their limit values. The proposed development has no potential to result in any emissions during the operational phase. It is likely that the operational development will be visited 1-2 times per week by a van or light goods vehicle (LGV); however, such trips will result in a negligible impact on air quality.

The generation of electricity from the proposed development will lead to a net savings in terms of NO_x emissions. The wind farm is expected to generate approximately 136 GWh per annum.

The supply of c. 136 GWh of renewable electricity to the national grid will lead to a net saving in terms of NOx emissions which may have been emitted from fossil fuels to produce electricity. Results, outlined in **Table 8.9**, indicate that the impact of the wind farm on Ireland's obligations under the Gothenburg Protocol and the EU 20-20-20 Targets are positive. The annual impact of the proposed development is to decrease annual NO_x emission levels by 0.6% of the ceiling levels (relative to the NO_x emissions associated with power generation in Ireland 2017 (SEAI 2018)). The total NO_X emission savings over its 30 year life-span will amount to over 1,547 tonnes of NO_X which is equivalent to 19.2% of the total NO_X emissions from power generation in 2017 or 1.4% of the total Irish NO_X emissions in 2017 (Note: 2018 data not available in latest SEAI report).

Scenario	NO_X (tonnes/annum)
Emissions Saved Due To Wind farm(1)	51.6
National Emission Ceiling(2)	66.186
Positive Impact of Wind farm (%) (as a percentage of National Emission Ceiling on an annual basis)	0.08%
Total NO_X Saving (%) Over 30 Years Relative To NO_X Emissions From Power Generation in 2017	19.2%

Table 8.9: Impact of Drumlins Wind Farm on the Ireland's National Emission Ceiling Obligations

(1) For NO_X emissions associated with power generation in Ireland (taken from SEAI Energy in Ireland 1990-2016[19].

(2) National Emission Ceiling (EU Directive 2016/2284)

8.5.3.2 Climate

Vehicular traffic is expected to be the only source of greenhouse gas emissions as a result of the operation of the proposed development. Vehicles, associated with the maintenance of the site, will give rise to CO_2 and N_2O emissions near the proposed development. There will be no greenhouse gas emissions from the operation of the wind turbines. However, due to the displacement of 136 GWh of electricity which otherwise would have been produced from fossil fuels, there will be a net benefit in terms of greenhouse gas emissions.

Greenhouse gases have different efficiencies in retaining solar energy in the atmosphere and different lifetimes in the atmosphere. In order to compare different greenhouse gases, emissions are calculated on the basis of their Global Warming Potential (GWP) over a 100-year period, giving a measure of their relative heating effect in the atmosphere. The GWP100 for CO_2 is the basic unit (GWP = 1) whereas CH_4 has a global warming potential equivalent to 21 units of CO_2 and N_2O has a GWP100 of 310 units.

Greenhouse gas emissions, as a result of the proposed development, will be imperceptible in terms of Ireland's obligations under the European Union's Effort Sharing Decision (Decision 406/2009/EC. However, as stated above, the generation of 136 GWh of renewable electricity to the national grid will lead to a net saving in terms of greenhouse gas emissions. By 2020, Ireland is committed to meeting a target for gross electricity consumption in Ireland from renewable energy sources of 40%. It is envisaged that this target will be met mainly through wind power generation (EPA 2018). The 2020 40% RES-E target will require 4,172 MW of installed renewable energy capacity; however, installed capacity currently stands at 3,700 MW.

In 2016, SEAI states that wind energy accounted for over 22.3% of all electricity generation with a total installed generating capacity of 2,827 MW in 2016 in the Republic of Ireland. The average capacity factor varies on an annual basis with a capacity of 32% in 2015 which increased from 28% in 2014 and 2013. The peak recorded wind power output was 3,080 MW, delivered on 12 December 2018. In general terms, CO_2 avoided through renewable energy use in all sectors totalled 3,932 kt CO_2 in 2016, with wind energy accounting for 2,188 kt CO_2 of the savings (SEAI 2018).

In order to calculate the net benefit in terms of greenhouse gas emissions, emissions from the average fossil fuel electricity mix in 2016 has been calculated (**Table 8.10**). The production of renewable electricity from wind energy developments for export to the national grid transforms the site from negative in terms of GHGs to having a net positive annual impact on GHG emissions of the order of 0.091% of the annual Total Greenhouse Gas Emissions in Ireland in 2017. In terms of the lifetime of the wind farm, the total GHG emission savings will amount to over 1,656,761 tonnes of CO_2eq which is equivalent to 13.86% of the total predicted annual GHG emissions from the energy sector in 2020 (EPA 2018).

	CO_2	N_2O	CH_4	% Of Irelands Total Emissions(1)
CCGT Producing 100 GWh(tonnes)	59,513	2.58	3.87	N_2O & CH_4 based on SEAI calculator
CCGT Producing 100 GWh (tonnes CO_2 Equivalent)	59,513	799.9	81.3	
GHG Emissions Due To Construction Materials including Grid Connection	-4,0660			
Total Energy Consumed During Manufacture / Disposal of 8 Wind Turbines (averaged over 30 years) (3)	-508			
Total / Annum (tonnes CO_2 Equivalent) Savings Due To Wind farm	55,225			0.091%
Total GHG Saving (%) Over 30 Years Relative To GHG Emissions From Power Generation in 2020[2]	13.8%			

Table 8.10: Greenhouse Gas Benefit from Drumlins Wind Farm As A Result of Exporting 136 GWh (tonnes).

(1) Based on an electricity generation of 0.437 tonnes CO_2/MWh [16] and Irelands total 2017 GHG emissions
(2) Estimated GHG Emissions from Energy Sector (With Measures) of 13.3 Mtonnes in 2020[20].
(3) Based on ((29,088 x 0.437)/30)

8.5.4 Decommissioning Phase

8.5.4.1 Air Quality

The decommissioning phase will involve the removal of the turbines and ancillary infrastructure from the site. Vehicles and generators associated with the removal of infrastructure have the potential to cause a temporary negative impact on local air quality in the short term. However, due to the short term nature of any associated works and low background concentrations in the vicinity of the site it is likely to have an imperceptible impact local air quality.

8.5.4.2 Climate

Similar to the air quality impact, vehicles related to the decommissioning phase will give rise to CO_2 and N_2O emissions. It is not predicted that the decommissioning phase will involve the use of a significant number of vehicles, with a significantly lesser number of vehicles required than during the construction phase. Therefore, emissions from vehicular traffic are likely to be negligible. Decommissioning will be undertaken in accordance with the methods set out at **Chapter 3** and, given the significant potential for recycling of materials, the climatic impact will likely be temporary and imperceptible.

8.6 Cumulative & Transboundary Impacts

During the construction phase, there is potential for cumulative impact to arise in relation to dust. This effect is only likely to arise should the construction phase of the proposed development run concurrently with the construction of another project. However, while significant cumulative effects are not assessed as likely to occur; following the implementation of the measures set out at **Section 8.7**, dust emissions from the proposed development will be wholly contained within the site of the proposed development and are unlikely, in combination with other construction activities, to adversely affect sensitive receptors.

Given the relative proximity of the proposed development to the international boundary with Northern Ireland, it is crucial that an assessment of likely transboundary effects is undertaken. The proposed wind farm is located c. 5km from Northern Ireland and, at this distance, it is assessed that there is no likelihood for any dust or exhaust emissions to adversely affect any sensitive receptors during the construction phase. The 38kV grid connection option to Clones (Option G1; see **Chapter 3**) is located c. 1.5km from Northern Ireland; however, given the limited scale and nature of this development, the likelihood for transboundary effects is assessed as negligible.

During the operational phase, it is assessed that there is no potential for likely significant adverse cumulative effects. The proposed development will, in combination with other wind energy developments, result in a beneficial effect on both air quality and climate.

8.7 Mitigation and Monitoring

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

Specific mitigation measures, additional to best practice methods, are not proposed in relation to climate as the proposed development will result in a net benefit in the abatement of GHGs.

8.7.1 Construction Phase

8.7.1.1 Air Quality

The greatest likelihood for impacts on air quality during the construction phase is from construction dust emissions and the potential for nuisance dust. In order to minimise dust emissions during construction, a series of mitigation measures have been prepared in the form of an outline Dust Minimisation Plan (see **Annex 8.2**).

A detailed Dust Minimisation Plan will be formulated prior to the construction phase of the project Measures to be included within the Dust Minimisation Plan include:-

- Access tracks and public roads in the vicinity of the site shall be regularly cleaned to remove mud, aggregates and debris and maintained as appropriate. All road sweepers shall be water assisted;
- Any road that has the potential to give rise to fugitive dust shall be regularly watered, as appropriate, during dry and/or windy conditions;
- Vehicles delivering material with dust potential shall be enclosed or covered with tarpaulin at all times to restrict the escape of dust;
- Public roads in the vicinity of the site shall be regularly inspected for cleanliness and cleaned as necessary;
- In the event of dust nuisance occurring outside the site boundary, movement of materials will be immediately terminated and satisfactory procedures implemented to rectify the problem before the resumption of operations;
- If issues persist and the above measures are not satisfactorily control dust emissions, a wheel washing system with rumble grids to dislodge accumulated dust and mud prior to leaving the site should be installed; and
- The dust minimisation plan shall be reviewed at regular intervals during the construction phase to ensure the effectiveness of the procedures in place and to maintain the goal of minimisation of dust through the use of best practice and procedures.

8.7.1.2 8.Climate

Construction related plant, machinery and vehicles, generators etc., may give rise to some CO_2 and N_2O emissions. However, due to the short-term and temporary nature of these works, the impact on climate will not be significant. Best practice construction methods including just in time delivery methods to prevent material waste, reuse of on-site materials where possible and the minimisation of fuel use, including generators, will reduce construction related climate emissions.

8.7.2 Operational Phase

8.7.2.1 Air Quality

The proposed development will not result in any significant adverse air quality effects during the operational phase and no mitigation measures are proposed.

8.7.2.2 Climate

The proposed development will have a positive and beneficial impact on through the reduction of greenhouse gas emissions associated with energy generation and will make a significant contribution to Ireland's GHG abatement commitments. Thus, no mitigation measures are necessary in terms of the operational phase of the proposed development.

8.8 Residual Impact

With effective implementation of the mitigation measures outlined above, the proposed development is assessed as likely to have an insignificant adverse impact on air quality and climate during the construction phase. No likely significant residual adverse impacts from the proposed development are predicted for the operational or decommissioning phases.

8.8.1 Construction Phase

With effective implementation of the Dust Minimisation Plan and other mitigation measures outline above, the proposed development is likely to have a short-term negligible impact on air quality and climate.

8.8.2 Operational Phase

The likely impact on air quality during the operational phase will be imperceptible as there will be essentially no change in traffic volumes as a result of the scheme. As discussed above, the operational wind farm would be visited, on average, 1-2 times per week.

The likely impact of climate will be beneficial and will displace 136 GWh of fossil fuel derived electricity per annum leading to a reduction in CO_2eq emissions.

A table of the likely residual impacts is shown in **Table 8.11** below.

Receptor	Impact	Significance of unmitigated impact	Mitigation	Residual impact
Air Quality	Reduction in air quality from construction phase generated dust	Temporary slight adverse	Effective implementation of the Dust Minimisation Plan	Temporary Negligible Impact
Climate	4,660 tonnes CO_2eq of greenhouse gases from construction machinery and delivery vehicles (including cumulative of wind farm and grid connection)	Slight adverse	N/A	Slight adverse
Climate	Manufacture and energy use of wind turbines	Slight adverse	Payback period of 2.5 months	Imperceptible
Air Quality	Savings of 1,547 tonnes of NO_x due to the operation of the wind farm over 30 years	Positive	No mitigation measures necessary as the impact is positive	Long-Term Slight Positive Impact
Climate	1,656,761 tonnes of GHG emission savings due to the operation of the wind farm over 30 years	Moderate positive	No mitigation measures necessary as the impact is positive	Long-Term Positive Impact

Table 8.11: Summary of Likely Residual Impacts

8.9 Summary

An assessment into the likely air quality and climate impact associated with the proposed development has been undertaken. The proposed development will include 8 turbines with an export capacity to the grid of approximately 44 MW. The wind farm design life is 30 years after which the turbines will be decommissioned. The assessment of baseline air quality in the region has shown that current levels of key pollutants are significantly lower than their limit values.

Following the implementation of appropriate mitigation measures to minimise any likely adverse effects on air quality and climate, construction phase effects are assessed as ranging from Slight-adverse to Imperceptible. During the operational phase, the development will result in a long term positive effect on both air quality and climate. The generation of 136 GWh of electricity from the proposed development will lead to a net saving in terms of greenhouse gas emissions. The production of this renewable electricity results in the proposed development having a net positive annual impact on GHG emissions of the order of 0.091% of the Total Greenhouse Gas Emissions in Ireland in 2017.

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