Bracklyn 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 effect 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

In summary, the proposed development comprises the following main components:-

- 9 no. wind turbines with an overall tip height of 185m, and all associated ancillary infrastructure;
- Upgrades to the turbine component haul route;
- Construction of a 110kV electricity substation and installation of 6.3km of underground electricity line between the proposed substation and the existing Corduff-Mullingar 110kV overhead electricity line; and
- All associated and ancillary site development, excavation, construction, landscaping and reinstatement works, including provision of site drainage infrastructure.

The majority of the proposed development is located within the administrative area of County Westmeath; while approximately 2.5km of underground electricity line and the proposed end masts will be located within County Meath. Additionally, candidate quarries which may supply construction materials are also located within County Meath.

The proposed turbine component haul route is also located within the counties of Waterford, Kilkenny, Carlow, Kildare and Dublin.

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

8.1.3 Statement of Authority

This chapter was prepared by Niamh Nolan, an environmental consultant in the air quality section of AWN Consulting Ltd. She holds a BSocSci (Hons) in Social Policy and Geography from University College Dublin. She is an Associate Member of both the Institute of Air Quality Management and the Institution of Environmental Science. She has experience in mapping software primarily in QGIS and she specialises in the area of air quality, climate and sustainability.

8.2 Relevant Legislation & Guidance

8.2.1 Air Quality

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

- *Guidelines on the Information to be contained in Environmental Impact Statements* (EPA 2002);
- *Advice Notes on Current Practice (in the preparation of Environmental Impact Statements* (EPA 2003);
- *Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports* (hereafter referred to as the EPA Guidelines) (EPA 2017); and

- *Draft EPA Advice Notes for Preparing Environmental Impact Statements* (EPA 2015).

The statutory ambient air quality standards in Ireland are outlined in S.I. No. 180 of 2011 Air Quality Standards Regulations 2011 (hereafter referred to as the Air Quality Regulations), which incorporate the ambient air quality limits set out in Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe (hereafter referred to as the CAFE Directive), for a range of air pollutants. The statutory ambient air quality guidelines are discussed in greater detail in the sections below and **Annex 8.1**.

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

- *Guidance on the Assessment of Dust from Demolition and Construction V1.1* (IAQM 2016);
- *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes* (TII 2011);
- *Guidelines for Assessment of Ecological Impacts of National Roads Schemes* (TII 2009);
- UK Department of Environment Food and Rural Affairs (DEFRA) *Part IV of the Environment Act 1995: Local Air Quality Management, LAQM.TG (16)* (DEFRA 2018);
- UK Highways Agency (UKHA) *Design Manual for Roads and Bridges (DMRB) – LA 105 Air Quality* (UKHA 2019); and
- World Health Organization (WHO) *Air Quality Guidelines for Particulate Matter, Ozone, Nitrogen Dioxide and Sulfur Dioxide Global Update 2005 (WHO 2005)*.

8.2.1.1 Ambient Air Quality Standards

In order to reduce the risk to health from poor air quality, national and European statutory bodies have set limit values in ambient air for a range of air pollutants. The applicable legal standards in Ireland are outlined in the Air Quality Regulations, which incorporate the CAFE Directive. The Air Quality Regulations set limit values for the pollutants nitrogen dioxide (NO_2) and nitrogen oxides (NO_X), particulate matter (PM) with an aerodynamic diameter of less than 10 microns (PM_{10}), PM with an aerodynamic diameter of less than 2.5 microns ($PM_{2.5}$), lead (Pb), sulphur dioxide (SO_2), benzene and carbon monoxide (CO) (**Table 8.1**).

Pollutant	Regulation*	Limit Type	Value
NO_2	S.I. 180 of 2011	Hourly limit for protection of human health - not to be exceeded more than 18 times / year	200µg/m³ NO_2
		Annual limit for protection of human health	40µg/m³ NO_2
Nitrogen Oxides (NO + NO_2)		Critical limit for the protection of vegetation and natural ecosystems	30µg/m³ NO + NO_2
Lead	S.I. 180 of 2011	Annual limit for protection of human health	0.5µg/m³
SO_2	S.I. 180 of 2011	Hourly limit for protection of human health - not to be exceeded more than 24 times / year	350µg/m³
		Daily limit for protection of human health - not to be exceeded more than 3 times / year	125µg/m³
		Critical limit for the protection of vegetation and natural ecosystems (calendar year and winter)	20µg/m³
PM (as PM_{10})	S.I. 180 of 2011	24-hour limit for protection of human health - not to be exceeded more than 35 times / year	50µg/m³
		Annual limit for protection of human health	40µg/m³
PM (as $PM_{2.5}$)	S.I. 180 of 2011	Annual limit for protection of human health	25µg/m³
Benzene	S.I. 180 of 2011	Annual limit for protection of human health	5µg/m³
CO	S.I. 180 of 2011	8-hour limit (on a rolling basis) for protection of human health	10µg/m³

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

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

The World Health Organization (WHO) has published Air Quality Guidelines for the protection of human health (hereafter referred to as the WHO Guideline) (WHO 2006). The WHO Guideline values relating to NO_2, PM_{10} and $PM_{2.5}$ are shown in **Table 8.2.** The WHO Guideline values are more stringent than the European Union (EU) statutory limit values for PM_{10} and $PM_{2.5}$. In relation to NO_2, the compliance limit values are equivalent. However, the WHO one-hour guideline value is an absolute value while the EU standards allows this limit to be exceeded for 18 hours / annum without breaching the statutory limit value.

Pollutant	Regulation	Limit Type	Value
NO_2	WHO Guidelines	Hourly limit for protection of human health	200µg/m³ NO_2
		Annual limit for protection of human health	40µg/m³ NO_2
PM (as PM_{10})	WHO Guidelines	24-hour limit for protection of human health	50µg/m³ PM_{10}
		Annual limit for protection of human health	20µg/m³ PM_{10}
PM (as $PM_{2.5}$)	WHO Guidelines	24-hour limit for protection of human health	25µg/m³ $PM_{2.5}$
		Annual limit for protection of human health	10µg/m³ $PM_{2.5}$

Table 8.2 WHO Guidelines*

Table 8.2 WHO Guidelines*

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

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

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

8.2.1.2 Gothenburg Protocol

In 1999, Ireland signed the Gothenburg Protocol to the 1979 UN Convention on Long Range Transboundary Air Pollution. 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 42 kt for SO_2 (67% below 2001 levels), 65 kt for NO_X (52% reduction), 55 kt for VOCs (37% reduction) and 116 kt 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 $PM_{2.5}$.

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 2020 (EPA, 2020a) indicated that Ireland complied with the emissions ceilings for SO_2 but failed to comply with the ceiling for NH_3, NO_X and NMVOCs in recent years. 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 applied the 2010 NECD limits until 2020 and established new national emission reduction commitments which will be applicable from 2020 and 2030 for SO_2, NO_X, NMVOC, NH_3, $PM_{2.5}$ and CH_4. In relation to Ireland, 2020 emission targets are 25.5 kt for SO_2 (65% on 2005 levels), 66.9 kt for NO_X (49% reduction on 2005 levels), 56.9 kt for NMVOCs (25% reduction on 2005 levels), 112 kt for NH_3 (1% reduction on 2005 levels) and 15.6 kt for $PM_{2.5}$ (18% reduction on 2005 levels). In relation to 2030, Ireland's emission targets are 10.9 kt (85% below 2005 levels) for SO_2, 40.7 kt (69% reduction) for NO_x, 51.6 kt (32% reduction) for NMVOCs, 107.5 kt (5% reduction) for NH_3 and 11.2 kt (41% reduction) for $PM_{2.5}$.

8.2.2 Climate

The assessment has been undertaken with reference to the most appropriate guidance documents relating to climate which are set out in the following sections. In addition to specific climate guidance documents, the following guidelines were considered and consulted in the preparation of this chapter:-

- Environmental Protection Agency (EPA) (2002). *Guidelines on the Information to be contained in Environmental Impact Statements*;
- EPA (2003). *EPA Advice Notes on Current Practice (in the preparation of Environmental Impact* Statements);
- EPA (2017). *Guidelines on the Information to be contained in Environmental Impact Statements (Draft)*; and
- EPA (2015). *EPA Advice Notes for Preparing Environmental Impact Statements (Draft)*.

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

- *Climate Action and Low Carbon Development Act* (Act. No. 46 of 2015);
- Department of Communications, Climate Action & Environment (DCCAE) (2017) *National Mitigation Plan*;
- DCCAE (2017) *National Adaptation Plan*;
- DCCAE (2019) *Climate Action Plan 2019*;
- Department of Transport, Tourism and Sport (DTTAS) (2019) *Transport – Climate Change Sectoral Adaptation Plan*;
- *Climate Action and Low Carbon Development (Amendment) Bill 2021 (No. 46 of 2015)* (hereafter referred to as the 2021 Climate Bill).
- Westmeath County Council (2019) *Westmeath County Council Climate Adaptation Strategy 2019 - 2024*;
- European Commission (EC) (2014) 2030 *Climate and Energy Policy Framework*;
- Transport Infrastructure Ireland (TII) (2011) *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes; and*
- *UKHA (2019) Design Manual for Roads and Bridges: LA 114 - Climate*.

8.2.2.1 International and National Guidelines, Policy and Legislation

Ireland is party to both the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol. The Paris Agreement, which entered into force in 2016, is an important milestone in terms of international climate change agreements and includes an 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 GHG 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 in the Paris Agreement on elevating adaption onto the same level as action to cut and curb emissions.

In order to meet the commitments under the Paris Agreement, the EU enacted 'Regulation (EU) 2018/842 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No. 525/2013' (the Regulation) (European Parliament and Council of Europe 2018). The Regulation aims to deliver, collectively by the EU in the most cost-effective manner possible, reductions in GHG emissions from the Emission Trading Scheme (ETS) and non-ETS sectors amounting to 43% and 30%, respectively, by 2030 compared to 2005. The ETS is an EU-wide scheme which regulates the GHG emissions of larger industrial emitters including electricity generation, cement manufacturing and heavy industry. The non-ETS sector includes all domestic GHG emitters which do not fall under the ETS scheme and thus includes GHG emissions from transport, residential and commercial buildings and agriculture. Ireland's obligation under the Regulation is a 30% reduction in non-ETS greenhouse gas emissions by 2030 relative to its 2005 levels.

In 2015, the Climate Action and Low Carbon Development Act 2015 (No. 46 of 2015) was enacted by the Oireachtas (the Act) (Oireachtas 2015). The purpose of the Act was to enable Ireland 'to pursue, and achieve, the transition to a low carbon, climate resilient and environmentally sustainable economy by the end of the year 2050' (3.(1) of No. 46 of 2015). This is referred to in the Act as the 'national transition objective'. The Climate Act made provision for a national mitigation plan. However, the 2021 Climate Bill has subsequently removed any reference to a national mitigation plan and instead refers to both the Climate Action Plan, as published in 2019, and a series of National Long Term Climate Action Strategies.

In addition, the Act provided for the establishment of the Climate Change Advisory Council with the function to advise and make recommendations on the preparation of the national mitigation and adaptation plans and compliance with existing climate obligations.

The 'Climate Action Plan' (CAP), published in June 2019, outlines the current status across key sectors including Electricity, Transport, Built Environment, Industry and Agriculture and outlines the various broadscale measures required for each sector to achieve ambitious decarbonisation targets. The CAP also details the required governance arrangements for implementation including carbon-proofing of policies, establishment of carbon budgets, a strengthened Climate Change Advisory Council and greater accountability to the Oireachtas. The CAP details multiple actions related to actions to ensure that the 70% renewables target for 2030 can be achieved, these include the generation and distribution of wind energy.

Following on from Ireland declaring a climate and biodiversity emergency in May 2019, the European Parliament approved a resolution declaring a climate and environment emergency in Europe in November 2019. In December 2019, the Irish Government approved the publication of the General Scheme for the Climate Action (Amendment) Bill 2019 followed by the publication of the 2021 Climate Bill in March 2021. The 2021 Climate Bill was prepared for the purposes of giving statutory effect to the core objectives stated within the CAP.

The purpose of the 2021 Climate Bill, if enacted, is to provide for the approval of plans 'for the purpose of pursuing the transition to a climate resilient, biodiversity rich and climate neutral economy by no later than the end of the year 2050'. The 2021 Climate Bill also 'provide for carbon budgets and a sectoral emissions ceiling to apply to different sectors of the economy'. The 2021 Climate Bill defines the carbon budget as 'the total amount of greenhouse gas emissions that are permitted during the budget period'.

In June 2020 the Government published the 'Programme for Government – Our Shared Future' (Government of Ireland 2020). In relation to climate, there is a commitment to an average 7% per annum reduction in overall greenhouse gas emissions from 2021 to 2030 (51% reduction over the decade) with an ultimate aim to achieve net zero emissions by 2050. In order to achieve zero emissions by 2050 an increase in renewable energy availability to the grid will be required with a target of 70% by 2030.

8.2.2.2 Local Policy and Guidelines

The *Westmeath County Council Climate Adaptation Strategy 2019–2024* (Westmeath County Council 2019) highlights the risks that climate change poses but also the opportunities that may arise in terms of economic development through supporting the development of green businesses. The strategy notes that Westmeath's topography makes it vulnerable to certain types of climatic events. Larger flood plains around lakes and river basins are an issue during heavy rainfall, bogs are at risk during intense heatwaves, and in the event of heavy snowfalls/frosts, keeping roads such as the M6 and M4/N4 and rail lines open is of national importance. In addition climate events such as drought have the potential to impact bogs and peatlands and fluvial flooding may increase on low level lands along rivers and canals. The strategy is based around six thematic goals with aims of developing a planned and co-ordinated approach to Climate Adaptation. Goal 3 focuses on land use and development and states "the development of a Renewable Energy Strategy for the generation of renewable energy".

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 8.5.1.1**.

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.

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 100 m from the proposed wind farm boundary; however there are residential receptors in closer proximity to the grid connection route 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 Air Quality - Construction Traffic & Materials

This assessment focuses on identifying the existing baseline levels of PM_{10} and $PM_{2.5}$ in the region of the proposed development by an assessment of EPA monitoring data. Thereafter, the effect of the construction phase of the proposed development on air quality was determined by a qualitative assessment of the nature and scale of dust generating construction activities associated with the proposed development based on the guidance issued by the IAQM (2014).

LA 105 - Air Quality states that the following scoping criteria shall be used to determine whether the air quality impacts of a project can be scoped out or require an assessment based on the changes between the 'Do-Something' traffic scenario (with the proposed development) compared to the 'Do-Minimum' traffic scenario (without the proposed development):-

- Annual average daily traffic (AADT) changes by 1,000 or more;
- Heavy duty vehicle (HDV) AADT changes by 200 or more;
- A change in speed band; and
- A change in carriageway alignment by 5m or greater.

The above scoping criteria have been used in the current assessment to determine the road links required for inclusion in the modelling assessment. The construction stage traffic is, as described in detail at **Chapter 13**, below the above criteria therefore no further impact assessment is required and impacts are considered temporary and imperceptible and do not need to be considered further.

8.3.1.3 Climate – Embodied Energy Assessment

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

Information on the material quantities and construction traffic was obtained from Jennings O'Donovan & Partners Limited, the project developer and engineers for this assessment, and were used in combination with the emission factors outlined in the Inventory of Carbon & Energy (Version 3.0) (University of Bath, 2019) and UK Highways Agency carbon calculator (2019) in order to calculate the predicted embodied emissions for the materials used during the construction phase of the proposed development. The carbon calculator assessment uses known embodied carbon rates (expressed as CO_2eq) for materials and their associated transport to the site. The calculator also considers personnel travel, site energy and waste management and the associated embodied energy.

8.3.1.4 Climate – Forest Loss

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

8.3.1.5 Climate – Peat Removal

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

The GHG emissions associated with this peat excavation have been assessed using the IPCC methodology as outlined in *2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands* (IPCC, 2013). The *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories* states that there is no refinement required on this methodology (IPCC 2019).

In order to assess the impact of GHG emissions associated with the proposed development, the embodied energy from the construction materials, peat extraction and forest loss were combined and the total value compared to Ireland's 2019 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.

8.3.1.6 Climate – Turbine Manufacture Lifecycle Assessment

A lifecycle assessment was undertaken to determine the payback period for the proposed wind turbines. The wind turbine model proposed for installation at the Bracklyn Wind Farm is the Vestas V162-6.0. Information on the life cycle assessment undertaken for Vestas Wind Systems A/S, who are a major supplier of wind turbines, has been reviewed in order to develop a site specific lifecycle assessment for the project and is considered appropriate for a project of this type and scale (Elsam 2004, Vestas Wind Systems A/S 2013). Where site specific information was not available indicative information from the Vestas assessment was used. The life cycle assessment quantifies the associated power consumption associated with the production, operation, transport and end-of-life of the wind turbines.

The assessment also quantifies the associated GHG emissions associated with the production, operation, transport and end-of-life of the wind turbines. The energy balance associated with the wind power production during its lifetime (assumed to be 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 wind energy exported to the electricity grid.

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.

As per the construction phase scoping criteria detailed in **Section 8.3.1** and LA 105 - Air Quality (UKHA 2019), traffic effects have been scoped out of the operational phase as they are considered insignificant.

8.3.2.2 Climate

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

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

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 Casement Aerodrome Meteorological Station, Co. Dublin, which is located approximately 46 km south-east of the site. Data from the Casement Aerodrome Meteorological Station has been examined to identify the prevailing wind direction and average wind speeds over the period 2016-2020. Wind frequency is important as dust can only be dispersed by winds, and deposition of dust is a simple function of particle size, wind speed and distance. The closer the source of dust is to a receptor the higher the potential risk of impact of dust blow. The prevailing winds in the area are westerly to south-westerly in direction, thereby predominantly dispersing any potential dust emissions to the north-east of the site.

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 no dust is generated under "wet day" conditions where rainfall greater than 0.2 mm has fallen. Long-term information collected from Casement Aerodrome Meteorological Station identified that typically 183 days per annum are "wet" (Met Eireann 2021, 30-year averages). Thus, almost 50% of the time no significant dust generation will be likely due to meteorological conditions.

8.4.2 Review of EPA Monitoring Data

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

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

In terms of NO_2, PM_{10} and $PM_{2.5}$ air quality monitoring programmes have been undertaken in recent years by the EPA. The most recent annual report on air quality, "Air Quality Monitoring Report 2019" (EPA 2020b), 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 2021a). 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 area within which the proposed development is located is classed as Zone D.

NO_2 monitoring was carried out at two rural Zone D locations over the period 2015 - 2019, Emo and Kilkitt and the urban sites of Enniscorthy and Castlebar (EPA 2020b). Over the 2015–2019 period annual mean concentrations ranged from 2 – 5 µg/m^3 for the rural sites and 7 – 10 µg/m^3 for the urban sites (**Table 8.3**). Hence, long-term average concentrations measured at all locations were significantly lower than the annual average limit value of 40 µg/m^3. The hourly limit value of 200 µg/m^3 was not exceeded in any year, albeit 18 no. exceedances are permitted per year. The average results over the last five years at the rural Zone D locations suggest an upper average of no more than 3.4 µg/m^3 as a background concentration. Based on the above information, a conservative estimate of the background NO_2 concentration in the region of the proposed development is 4 µg/m^3.

Station	Averaging Period Notes 1, 2	Year				
		2015	2016	2017	2018	2019
Castlebar	Annual Mean NO_2 (µg/m^3)	8	9	7	8	8
	99.8th %ile 1-hr NO_2 (µg/m^3)	-	65.6	59.8	60.2	58.9

Kilkitt	Annual Mean NO_2 (μg/m³)	2	3	2	3	5
	99.8th %ile 1-hr NO_2 (μg/m³)	-	26.1	17.0	22.3	42.3
Emo	Annual Mean NO_2 (μg/m³)	3	4	3	3	4
	99.8th %ile 1-hr NO_2 (μg/m³)	-	35.5	27.5	41.6	27.8
Enniscorthy	Annual Mean NO_2 (μg/m³)	9	10	-	-	-
	99.8th %ile 1-hr NO_2 (μg/m³)	-	72.5	-	-	-

Note 1 *Annual average limit value - 40 μg/m³ (EU Council Directive 2008/50/EC & S.I. No. 180 of 2011).*

Note 2 *Hourly limit value - 200 μg/m³ measured as a 99.8th percentile (EU Council Directive 2008/50/EC & S.I. No. 180 of 2011).*

Table 8.3 Trends in Zone D Air Quality – Nitrogen Dioxide (NO2)

Long-term PM_{10} monitoring was carried out at the Zone D locations of Castlebar, Kilkitt, Enniscorthy and Claremorris over the period 2015–2019 (EPA, 2020b). Annual mean concentrations range from 10–18 μg/m³ for the urban sites and 7–9 μg/m³ for the rural site at Kilkitt (**Table 8.4**). Hence, long-term average PM_{10} concentrations measured at these locations were significantly lower than the annual average limit value of 40 μg/m³. The 90.4th percentile of 24-hour values was well below the limit value of 50 μg/m³ reaching at most 33.8 μg/m³ in Enniscorthy in 2015. Data for the rural site at Kilkitt suggests an upper average annual mean of no more than 8.2 μg/m³ as a background value. Based on the above data, a conservative estimate of the current background PM_{10} concentration in the region of the proposed development is 10 μg/m³.

Station	Averaging Period Notes 1, 2	Year				
		2015	2016	2017	2018	2019
Castlebar	Annual Mean PM_{10} (µg/m^3)	13	12	11	11	16
	90th%ile 24-hr PM_{10} (µg/m^3)	22.2	20.0	19.1	19.9	23.8
Kilkitt	Annual Mean PM_{10} (µg/m^3)	9	8	8	9	7
	90th%ile 24-hr PM_{10} (µg/m^3)	17.7	15.0	14.0	15.3	13.2
Claremorris	Annual Mean PM_{10} (µg/m^3)	10	10	11	12	11
	90th%ile 24-hr PM_{10} (µg/m^3)	16.5	17.4	17.3	19.9	19.7
Enniscorthy	Annual Mean PM_{10} (µg/m^3)	18	17	-	-	18
	90th%ile 24-hr PM_{10} (µg/m^3)	33.8	32.3	-	-	-

Note 1 *Annual average limit value - 40 µg/m^3 (EU Council Directive 2008/50/EC & S.I. No. 180 of 2011).*

Note 2 *Daily limit value - 50 µg/m^3 measured as a 90.4th percentile (EU Council Directive 2008/50/EC & S.I. No. 180 of 2011).*

Table 8.4 Trends in Zone D Air Quality – PM10

The results of $PM_{2.5}$ monitoring at Claremorris over the period 2015–2019 ranged from 4–6 µg/m^3 (EPA, 2020b), with an average $PM_{2.5}$/PM_{10} ratio between 0.4–0.6. 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. Based on this information, a ratio of 0.7 was used to generate a rural background $PM_{2.5}$ concentration of 7 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 in the vicinity of the proposed wind farm development.

8.4.2.1 Sensitivity of the Receiving Environment

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

In terms of receptor sensitivity to dust soiling, there are approximately 13 no. high sensitivity residential properties within 20m of the proposed development (e.g. main wind farm site, internal roads and grid connection).

Due to the linear nature of the grid connection works, not all properties will be impacted at once, therefore it is considered to be more than 10 no. but less than 100 no. receptors impacted at any time. The worst-case sensitivity of the area to dust soiling is considered to be high as per **Table 8.5**.

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

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

Table 8.5 Sensitivity of the Area to Dust Soiling Effects on People and Property

In addition to sensitivity to dust soiling, the IAQM guidelines also outline the assessment criteria for determining the sensitivity of the area to human health impacts. The criteria take into consideration the current annual mean PM_{10} concentration, receptor sensitivity and the number of receptors affected within various distance bands from the construction works. A conservative estimate of the current annual mean PM_{10} concentration in the vicinity of the proposed development is 10 µg/m^3. The worst-case sensitivity of the area to human health impacts is considered to be low as per **Table 8.6**.

Receptor Sensitivity	Annual Mean PM10 Concentration	Number Of Receptors	Distance from source (m)			
			<20	<50	<100	<200
High	< 24 µg/m^3	>100	Medium	Low	Low	Low
		10-100	**Low**	Low	Low	Low
		1-10	Low	Low	Low	Low
Medium	< 24 µg/m^3	>10	Low	Low	Low	Low
		1-10	Low	Low	Low	Low
Low	< 24 µg/m^3	>1	Low	Low	Low	Low

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

Table 8.6 Sensitivity of the Area to Human Health Impacts

The IAQM guidelines also outline the assessment criteria for determining the sensitivity of the area to ecological impacts from dust. The criteria takes into consideration whether the receiving environment is classified as a Special Area of Conservation (SAC), a Special Protected Area (SPA), a Natural Heritage Area (NHA) or a proposed Natural Heritage Area (pNHA) as dictated by the EU Habitats Directive or whether the site is a local nature reserve or home to a sensitive plant or animal species. The proposed development site is not located in the immediate vicinity of any such designated site which, due to intervening separation distances, are not assessed as likely to be affected.

8.4.3 Climate

8.4.3.1 Climate Pollutants

Climate is defined as the average weather over a period of time, whilst climate change is a significant change to the average weather. Climate change is a natural phenomenon but in recent years human activities, through the release of GHGs, have impacted on the climate (Intergovernmental Panel on Climate Change (IPCC) 2015). The release of anthropogenic GHGs is altering the Earth's atmosphere resulting in a 'Greenhouse Effect'. This effect is causing an increase in the atmosphere's heat trapping abilities resulting in increased average global temperatures over the past number of decades. The release of carbon dioxide (CO_2) as a result of burning fossil fuels, has been one of the leading factors in the creation of this 'Greenhouse Effect'. The most significant GHGs are CO_2, methane (CH_4) and nitrous oxide (N_2O).

For the purposes of this assessment, the definition outlined in Council Directive 2009/28/EC on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC (European Parliament and Council of Europe 2009) for GHGs has been used. In 'Annex V, C. Methodology Point 5' the relevant GHGs are defined as CO_2, CH_4 and N_2O. CO_2 accounted for 63.3% of total GHG emissions in Ireland in 2019 while CH_4 and N_2O combined accounted for 36.6%. The main source of CH_4 and N_2O are from the agriculture (93%) sector.

GHGs have different efficiencies in retaining solar energy in the atmosphere and different lifetimes in the atmosphere. In order to compare different GHGs, emissions are calculated on the basis of their Global Warming Potential (GWPs) over a 100-year period, giving a measure of their relative heating effect in the atmosphere. The Intergovernmental Panel on Climate Change (IPCC) 5th assessment report (AR5) (IPCC 2015) sets out the global warming potential for 100-year time period (GWP100) for CO_2 as the basic unit (GWP = 1) whereas methane gas (CH_4) has a global warming potential equivalent to 28 units of CO_2 and N_2O has a GWP100 of 265.

8.4.3.2 Baseline Climate

Given the circumstances of Ireland's declaration of a climate and biodiversity emergency in May 2019 and the November 2019 European Parliament approval of a resolution declaring a climate and environment emergency in Europe, in conjunction with Ireland's current failure to meet its EU binding targets under Regulation (EU) 2018/842, changes in GHG emissions either beneficially or adversely are of more significance than previously viewed prior to these declarations. Thus, the baseline climatic environment should be considered a highly sensitive environment for the assessment of impacts.

Data published in 2021 (EPA 2021b) predicts that Ireland is set to miss its target for compliance with the ESD as our non-ETS emissions are projected to be 7% below 2005 levels in 2020 under both projected scenarios compared to the target of 20% below 2005 levels by 2020. The Climate Action and Low Carbon Development (Amendment) Bill 2021, when enacted, will set a 'national climate objective' to achieve a climate neutral economy no later than 2050 and a total reduction of 51% emissions over the period to 2030. Ireland is estimated to have cumulatively exceeded its compliance obligations by 12.2 Mt CO_2 eq over the 2013-2020 period.

For 2019, total national emissions are estimated to be 59.90 million tonnes CO_2 equivalent (Mt CO_2eq). The sector with the highest emissions is agriculture at 35.3% of the total, followed by transport at 20.3%. Energy production contributed 15.8% of the total GHG emissions. Provisional 2020 data indicates a emissions of 57.21 million tonnes CO_2 equivalent (Mt CO_2eq), a decrease of 4% from 2019.

8.5 Description of Likely Effects

8.5.1 Construction Phase

8.5.1.1 Air Quality

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

During construction, the primary source of dust emissions with potential to impact sensitive receptors will be movement of vehicles on and off site. Materials with the highest potential for dust emissions will be concrete and aggregates for the construction of the hardstanding areas and access tracks. However, only ready-mix concrete will be used on site and all concrete will be delivered in enclosed trucks which will reduce the potential for dust emissions.

Earthworks taking place within the proposed development site will result in some dust emissions, particularly during earthwork activities. However, the majority of properties which border the site are a significant distance from the actual works areas. The potential magnitude of impact according to IAQM guidance (IAQM 2014) is large and when combined with the previously established sensitivity of the area (high sensitivity to dust soiling, low sensitivity in terms of human health and high in terms of ecological impacts) the potential risk can be found. The risk of significant nuisance dust impacts as a result of earthworks prior to mitigation is high with respect to nuisance dust and ecology. With respect to human health impacts the potential risk is considered to be low.

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 - Earthworks

Construction works taking place within the wind farm site will result in some dust emissions. However, the majority of properties which border the site are a significant distance from the actual works areas. Work areas that are in closer proximity to sensitive receptors along the grid connection will have more limited activities and short construction periods. The potential magnitude of impact according to IAQM guidance (IAQM 2014) is medium and when combined with the previously established sensitivity of the area (high sensitivity to dust soiling, low sensitivity in terms of human health and high in terms of ecological impacts) the potential risk can be found. The risk of significant nuisance dust impacts as a result of construction prior to mitigation is medium with respect to nuisance dust and ecology. With respect to human health impacts the potential risk is considered to be low.

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 8.8: Risk of Dust Impacts – Construction

The potential for trackout for vehicles leaving the site has also been assessed. According to the IAQM guidance (page 15, IAQM 2014), the number of one-way vehicle movements per day is classified as medium in terms of potential dust emission magnitude (10-50 HGVs per day). When combined with the previously established sensitivity of the area (high sensitivity to dust soiling, low sensitivity in terms of human health and high in terms of ecological impacts) the risk of significant nuisance dust impacts as a result of vehicle movement prior to mitigation is medium with the overall risk of human health impacts predicted to be low.

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 8.9: Risk of Dust Impacts - Trackout

To ensure any potential impacts are minimised, a Dust Management Plan will be formulated based on best practice measures associated with a medium risk of dust impacts. The Dust Management Plan will 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. When the dust mitigation measures detailed in the mitigation section of this chapter (**Section 8.6**) and **Annex 8.2** are implemented, fugitive emissions of dust from the site will be imperceptible and temporary and will pose no nuisance or human health impacts at nearby receptors.

8.5.1.2 Climate

Construction Materials, Peat & Forestry Removal

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

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

Detailed project information including volumes of materials was obtained for the purposes of this assessment. For the purposes of this assessment, it is assessed that concrete will be sourced from Lagan Cement (37.6km) or P. Plunkett Ltd. (24.7km) and aggregates will be sourced from Owens Quarry Products (17.8km) / Keegan Quarries (33.2km), however, other quarries in the area may also need to be utilised to source materials during the construction stage.

The proposed locations have been used to provide an estimate of the distance travelled to site for materials. The distances to site for these materials have been used in the calculations. Approximately 49,061m^3 of rock and fill material will be required for the hardstanding areas, access tracks, substation compound ground works and contractor compound ground works. An approximate total of 8,623m^3 of concrete will be required in the construction of the turbine bases.

Table 8.10 details the embodied carbon emissions associated with each category. The proposed development is expected to have a construction phase of 15-18 months approximately and an operational lifespan of 30-years. The predicted embodied emissions can be averaged over the full construction phase and the lifespan of the proposed development to give the predicted annual emissions to allow for direct comparison with national annual emissions and targets. Emissions have been compared against the total national GHG emissions in Ireland for 2019 (59,897,270 tonnes CO_2eq) and against Ireland's EU 2030 target of a 30% reduction in non-ETS sector emissions based on 2005 levels (32 Mtonnes CO_2eq) (set out in Regulation EU 2018/842 of the European Parliament and of the Council).

The GHG emissions associated with the loss of c. 28 hectares of forest has been calculated and amounts to an upper limit of 608 tonnes of CO_2. This mainly consists of commercial forestry which would be felled regardless of the proposed development. The forestry comprises primarily conifer plantation and small pockets of woodland. This is an indirect impact and classified as a temporary, negative, imperceptible impact. Any emissions due to forestry loss will be offset by replanting the equivalent area of forestry.

During the construction phase of the proposed development, peat will be excavated in order to build the required infrastructure. The total estimated peat volume to be excavated is 39,137m^3[1]. Excavation of peat can be a contributor to carbon sink losses associated with construction. The carbon release associated with the excavation and oxidization of peat soils can be relatively significant and should be included in any carbon calculation (IPCC 2006). The GHG emissions associated with this peat excavation have been assessed using the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Other Land Use, Chapter 7 Wetlands (IPCC 2006). The 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories states that there is no refinement required on this methodology (IPCC 2019). The on-site removal and subsequent abandonment of peat can be calculated based on the formula below and based on an assumption

[1] A bulking factor of 15% and contingency factor of 5% has been applied to the excavated peat volume to allow for expected increase in volume upon excavation and to allow for variation in ground conditions across the site

for the extracted peat of an average 1.7m peat depth (IPCC 2006). CO_2 emissions from peat removal & abandonment due to the construction phase are estimated to be 223tonnes CO_2eq.

The total construction phase embodied emissions totals 3,750 tonnes CO_2eq; which equates to 0.006% of Ireland national GHG emissions in 2019 or 0.011% of Ireland's 2030 GHG emission target. The predicted impact to climate during the construction phase is temporary and negative but, overall, not significant.

	Construction Phase Embodied Emissions (tonnes CO_2eq)
Manufacture of materials, transport and construction works	2,919
Emissions from forestry loss	608
Emissions from peat removal	223.2
Total Construction Phase Emissions	3,750
Total Annual Emissions as % of Irelands Total GHG emissions (2019 actual)	0.006%
Total Annual Emissions as % of Irelands 2030 GHG emission target	0.011%

Table 8.10 Predicted Construction Stage GHG Emissions

Wind Turbine Manufacture

The proposed development will involve the erection of 9 no. wind turbines and an export capacity of 54MW. For the purposes of this assessment, a capacity factor for wind generation of 34% was used based on future capacity factors for wind farms in this region provided in the Eirgrid report "*Enduring Connection Policy 1 Constraints Report for Area A Solar and Wind*" (Eirgrid, 2020). Based on an export capacity of in excess of 50 MW and a capacity factor of 34%, the expected electricity production is approximately 148,920 MWh per annum. Information on the life cycle assessment undertaken for Vestas Wind Systems A/S, who are a major supplier of wind turbines, has been reviewed (Elsam 2004, Vestas Wind Systems A/S 2013). 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 = 148,920 MWh / Year
- Expected GWh production during lifetime (30 years) = 4,468 GWh
- Expected Energy Consumed / Turbine Life Cycle = 3,636 MWh
- Total Energy Consumed / 9 Turbines Life Cycle = 32,724 MWh
- Energy balance assessment period = 30 years
- Energy balance = (32,724MWh/4,467,600 MWh)*360 months = 2.6 months

Thus, the site-specific energy balance gives a payback period for the current site of approximately 2.6 months.

8.5.2 Operational Phase

8.5.2.1 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. Due to the size, nature and remote location of the proposed development, increased road traffic emissions resulting from the proposed development are expected to have an imperceptible impact on air quality during the operational phase. The grid connection element of the proposed development will have a neutral impact on air quality during the operational phase as it will be buried underground and there will be no significant operational emissions associated with it.

However, the generation of electricity due to the installation of the wind farm will lead to a net saving in terms of NO_X emissions. The wind farm will have an export capacity of in excess of 50 MW and an assumed capacity factor of 34%, therefore the power generation from the development is expected to be approximately 149 GWh per annum. The capacity factor of 34% is based on an Eirgrid study for future windfarm developments in Region J (Page 33, Eirgrid, 2020).

The supply of c. 149 GWh of renewable electricity to the national grid will lead to a net saving in terms of NO_X emissions which may have been emitted from fossil fuels to produce electricity. Results, outlined in **Table 8.11**, indicate that the impact of the wind farm on Ireland's obligations under the Gothenburg Protocol and the Directive (EU) 2016/2284 targets are positive. The annual impact of the development is to decrease annual NOX emission levels by 0.4% of the ceiling levels (relative to the NO_X emissions associated with power generation in Ireland 2019 (EPA, 2021)). The total NO_X emissions savings over its 30-year life-span will amount to 894.9 tonnes of NO_X which is equivalent to 10.87% of the total NO_X emissions from power generation in 2019 or 0.91% of the total Irish NO_X emissions in 2019. This is considered a slight positive, long-term impact to air quality.

Scenario	NOX (tonnes/annum)
Emissions Saved Due To Wind Farm Note 1	29.8
National Emission Ceiling Note 2	66,913
Positive Impact of Wind farm (%) (as a percentage of National Emission Ceiling on an annual basis)	0.36%
Total NOX Saving (%) Over 30 Years Relative To NOX Emissions From Power Generation in 2019	10.87%

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

Note 2 *National Emission Ceiling (EU Directive 2016/2284) applicable from 2020*

Table 8.11 Predicted Impact of Bracklyn Wind Farm on Ireland's National Emissions Ceiling Obligations

8.5.2.2 Climate

During the operational phase, there will be no GHG emissions from the operation of the wind turbines. There are no emissions associated with the proposed grid connection during operation. However, due to the displacement of c. 149 GWh of electricity per annum which otherwise would have been produced from fossil fuels, there will be a net benefit in terms of GHG emissions.

GHG emissions, as a result of this development, will be imperceptible in terms of Ireland's obligations under the European Union's Effort Sharing Regulation (Regulation 2018/842). However, as stated above, the generation of c. 149 GWh of renewable electricity to the national grid will lead to a net saving in terms of GHG emissions. The Climate Action Plan (Government of Ireland, 2019) states a RES-E target of 70% by 2030 with wind power being the primary source to achieve this.

In order to calculate the net benefit in terms of GHG emissions, the GHG emissions from the average fossil fuel electricity mix in 2019 has been calculated (**Table 8.12**). The production of wind power for export to the national grid transforms the site from negative in terms of GHGs (associated with embodied energy from construction) to having a net positive annual impact on GHG emissions of the order of 0.08% of the annual Total GHG Emissions in Ireland in 2019. The total annual GHG emission savings will amount to approximately 47.908 tonnes of CO_2eq which over 30 years is equivalent to 12.0% of the total predicted annual GHG emissions from the energy sector in 2020 (EPA, 2019). This is a slight, positive, long-term impact to climate as a result of the proposed development.

	CO_2	N_2O	CH_4	% Of Irelands Total Emissions[1]
CCGT Producing 149 GWh (tonnes)	48,399	2.14 [4]	16.08[4]	
CCGT Producing 149 GWh (tonnes CO_2 Equivalent)	48,399	568.3	369.9	
Total Energy Consumed During Manufacture (inc peat and forestry removal) / Disposal of 9 Wind Turbines (averaged over 30 years)[3] (tonnes CO_2 Equivalent)	355			
Total / Annum (tonnes CO_2 Equivalent) Savings Due To Wind farm	47,908			0.08%
Total GHG Saving (%) Over 30 Years Relative To GHG Emissions From Power Generation in 2020[2]	12.0%			

(1) Based on an electricity generation of 0.325 tonnes CO_2/MWh (EPA, 2020b) and Irelands total 2019 GHG emissions

(2) Estimated GHG Emissions From Energy Sector (With Measures) of 13.3 Mtonnes in 2020.

(3) Based on ((148,920 x 0.325)/30)

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

Table 8.12 GHG Benefit from Proposed Development as A Result of Exporting 149 GWh per annum

8.5.3 Decommissioning Phase

8.5.3.1 Air Quality

The decommissioning phase will involve the removal of the proposed wind turbines and associated infrastructure from the site. Vehicles and generators associated with the removal of the turbines 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 pollutant concentrations in the vicinity of the site decommissioning is predicted to have an imperceptible, temporary, negative impact on local air quality.

8.5.3.2 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.

8.5.4 Cumulative Effects

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 8.6**, 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.

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.

8.6 Mitigation & Monitoring Measures

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.

8.6.1 Construction Phase

8.6.1.1 Air Quality

The greatest likelihood of effects 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
- During movement of materials both on and off-site, trucks will be stringently covered with tarpaulin at all times. Before entrance onto public roads, trucks will be adequately inspected to ensure no potential for dust emissions;
- Material handling systems and site stockpiling of materials will be designed and laid out to minimise exposure to wind. Water misting or sprays will be used as required if particularly dusty activities are necessary during dry or windy periods;
- 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.

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

8.6.1.2 Climate

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.

8.6.2 Operational Phase

8.6.2.1 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. Effects on local air quality as a result of emissions associated with site maintenance vehicles are predicted to be neutral and imperceptible in the long-term as the number of vehicles is predicted to be low and infrequent in nature.

8.6.2.2 Climate

The 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.

8.7 Residual Effects

8.7.1 Construction Stage

8.7.1.1 Air Quality

With effective implementation of the Dust Management Plan, outlined in **Section 8.6.1** and **Annex 8.2**, the proposed wind farm is expected to have an imperceptible impact on air quality during the construction and decommissioning phases.

8.7.1.2 Climate

No significant residual impacts from the proposed development are predicted for the construction phase as any impacts will be mitigated during the operational phase.

8.7.2 Operational Stage

8.7.2.1 Air Quality

No significant residual impacts from the proposed development are predicted for the operational phase.

8.7.2.2 Operational Stage - Climate

No significant adverse residual impacts from the proposed development are predicted for the operational phases. Residual impacts are considered to be positive and long term due to the production of 149 GWh of renewable electricity per annum to the national grid will lead to a net saving in terms of CO_2 emissions which may have been emitted from fossil fuels to produce electricity.

8.8 Summary

An assessment of the likely air quality and climate impact associated with the proposed development has been undertaken. The proposed development will comprise 9 no. wind turbines with an export capacity to the grid of 54MW. 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 c. 149 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 0.08% of the annual Total GHG Emissions in Ireland in 2019.

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