14.0 AIR QUALITY & CLIMATE

14.1 INTRODUCTION

This chapter assesses the effect on air quality and climate for the region surrounding the proposed Castlebanny Wind Farm. All meteorological data contained in this report has been received from Met Éireann. This information is adjusted where necessary to take into account the proposed site's location and elevation.

The proposed wind farm is located in south-east Kilkenny between the settlements of Mullinavat, Inistioge and Ballyhale as described in Chapter 2 (Description). The site of the proposed wind farm comprises approximately 1,200 ha. of Coillte-owned forestry and a further approximately 234 ha. of land under third-party ownership which is split between forestry, agricultural grassland and arable crops.

Planning Permission is being sought from ABP for the installation of 21 no. wind turbines, which are anticipated to have a nominal capacity of between a minimum of 5MW and a maximum of 6MW per turbine, which is equivalent to between 105-126 MW in total. For the purposes of this assessment, a worst-case scenario of 105 MW is being assumed, as this would have the lowest energy output and longest carbon payback period possible for the proposed wind farm. In reality, the energy output is likely to be greater than this, thereby reducing any carbon payback periods, and also increasing any positive impacts on climate in the operational phase. The turbines will have a blade tip height of up to a maximum of 185 metres (m). The proposed project includes an onsite 110kV substation, a loop-in 110kV underground grid connection, all accommodation works associated with the turbine delivery route, and all other ancillary works. A full description of the proposed development is provided in Chapter 2- Description of the Proposed Development.

As described in Chapter 2 (Description of the Proposed Development), the proposed wind farm is expected to produce between 303,534 and 364,241 MWh of electricity annually, which would be sufficient to supply the equivalent of between 66,072 and 79,286 Irish households with electricity per year. This is based on the Sustainable Energy Authority of Ireland *"'Energy in Ireland 2019 Report" from December 2019,* which details domestic consumption values for electricity customers in 2018.

14.1.1 Statement of Authority

This chapter was prepared by Niamh O'Connell, and John Staunton of TOBIN Consulting Engineers. Niamh O'Connell has 2 years' experience as a project scientist at TOBIN Consulting Engineers. She completed a BSc in Chemistry of Pharmaceutical Compounds in University College Cork and is currently completing an MSc in Environmental Sustainability in University College Dublin on a part time basis, including an EIA Procedures module.

This chapter has been reviewed by Dr John Staunton, Senior Project Manager and Environmental Scientist in TOBIN. John has more than eleven years' postgraduate experience in both research and environmental consultancy. John holds a BSc and PhD in Environmental Science and has considerable experience in project managing wind energy developments and carrying out associated impact assessments including in preparing assessments in relation to air quality and climate.

14.2 BACKGROUND

14.2.1 Climate

When considering the need for this wind farm development, and wind energy as an energy source in general, it is important to place its development in an international, national and local policy context from the perspectives of environment, energy and planning. In addition to the provisions set out in the Climate Action Plan, Chapter 4 (Planning and Development Policy Context) of this EIAR outlines the legislative mechanisms and requirements from a global to local level (including the National Energy and Climate Plan (NECP) 2021-2030), which have been formulated to support the generation of energy from renewable sources and reduce the dependency on fossil fuels.

The discussion in Chapter 4 (Planning and Development Policy Context) of the EIAR demonstrates that the proposed wind farm development is consistent with the current energy and planning policy context and drivers, which seek to increase the share of electricity generation from renewable sources and establish wind energy developments in suitable locations, thereby minimising any environmental impacts.

In September 2020, the European Commission updated its Climate and Energy Framework 2030[1] which seeks to drive continued progress towards a low-carbon economy and build a competitive and secure energy system that ensures affordable energy for all consumers and increase the security of the EU's energy supply. It proposes to achieve a 40% reduction in greenhouse gas (GHG) by 2030 relative to 1990, and a binding EU-wide target for renewable energy of at least 32% by 2030. The combination of these measures, as well as an increase in energy efficiency is set to achieve a reduction of 55% in net greenhouse gas emissions.

The Sustainable Energy Authority of Ireland (SEAI)[2] indicates that 33.3% of electricity demand in Ireland was produced from renewable energy sources in 2018. Electricity has been an area of considerable decarbonising success and a target area for future progress in Ireland, but the country is still falling short of its 2020 target of 40%[3]. Under the Renewable Energy Directive 2009/28/EC, Ireland is legally bound to deliver 16% of its final energy requirements from renewable sources by 2020, a target the country is also on track to miss.

14.2.1.1 Climate Action Plan 2019

The Climate Action Plan 2019 sets out in detail the changes that are required in order "to adopt a more ambitious commitment to net zero greenhouse gas emissions by 2050, as part of finalising Ireland's long-term climate strategy by the end of 2019 as per the advice of the Intergovernmental Panel on Climate Change and the recommendation of the Joint Oireachtas Committee on Climate Action". The Climate Action Plan also references in Section 3 "Project Ireland 2040" which included several significant measures aimed at achieving Ireland's targets including "a target of 55% renewable power".

[1] https://ec.europa.eu/clima/policies/strategies/2030_en

[2] https://www.seai.ie/data-and-insights/seai-statistics/key-publications/renewable-energy-in-ireland/

[3] https://www.seai.ie/data-and-insights/seai-statistics/key-publications/renewable-energy-in-ireland

The Climate Action Plan, in the Executive Summary, references the detailed sectoral roadmap which is designed to deliver a cumulative reduction in emissions, over the period 2021 to 2030, of 58.4 $MtCO_2$ eq. outside the Emissions Trading System (ETS), 17 $MtCO_2$ eq. within the ETS and 26.8. $MtCO_2$ eq. from land use. Specifically, in relation to electricity generation there is a commitment to increase the reliance on renewables from 30% to 70% adding 12 GW of renewable energy capacity.

By its nature, the proposed Castlebanny Wind Farm project is fully compatible with all of the relevant provisions set out in the Climate Action Plan 2019, relating to the harnessing of renewable energy. It is also recognised in the Executive Summary of the Climate Action Plan that *Achieving 70% renewables will require us to build out significant infrastructures.* Castlebanny Wind Farm is one such infrastructural development which will contribute to achieving the committed 70% renewables target by 2030.

The Climate Action Plan also states in Section 7.1 that *"Ensuring we build renewable rather than fossil fuel, generation capacity to help meet this demand is essential. It makes economic sense, but also facilitates decarbonising our heating and transport through electrification".* The development of the proposed Castlebanny Wind Farm will be directly compatible with this goal.

This is further supported by a review of the country's ability to decouple economic growth from emissions growth. The Climate Action Plan acknowledges in Section 7.1 that *"While ongoing action on energy efficiency can help offset some energy demand growth, ensuring the deployment of increasing renewable generation capacity will be fundamental to our success".* Furthermore the Climate Action Plan states *"Ensuring increased levels of renewable generation will require very substantial new infrastructure, including wind and solar farms, grid reinforcement, storage developments, and interconnection".* The development of the proposed wind farm is directly aligned to the required deployment of renewable energy capacity and an increase in renewable energy generation levels.

The proposed works for the development of Castlebanny Wind Farm include the wind turbine infrastructure itself. However, supporting this infrastructure, the proposed development will also include an onsite substation and grid connection which will ensure that the proposed development will be entirely compatible with and key to the provisions set out in the Climate Action Plan 2019 i.e. the wind farm will include not only the infrastructure for producing renewable energy but will also include measures for grid connection.

With respect to choosing a pathway that creates the "Least Burden" and offers the "Most Opportunity" for Ireland, the Climate Action Plan describes in Section 4.2 a "Marginal Abatement Cost Curve (MACC)" which has been developed to provide a solid analytical foundation for the most cost-effective pathway to reduce emissions in line with Ireland's decarbonisation targets. Using Ireland's 2018 GHG Emission Projections 2017-2035[4] associated projections of economic activity and assessments of over 300 business cases for technology, the Climate Action Plan seeks to identify the technologies, and associated levels of adoption, required to meet the country's 2030 target in the most economical way. The Climate Action Plan states that, in the power generation sector, increasing onshore wind to 8.2GW (i.e. an approximate doubling of existing capacity) while also building offshore wind capacity are the most economical options from the MACC for electricity production. The potential metrics outlined in Table 7-5 of the Climate Action Plan are included as Table 14-1 herein.

[4] www.epa.ie

Table 14-1: Potential Metric for Onshore Wind Capacity (GW) for the years 2025 and 2030, as presented in Table 7-5 of the Climate Action Plan 2019.[5]

Key Metrics	2017	2025 Based on MACC	2030 Based on NDP	2030 Based on MACC
Share of Renewable Electricity, %	~30%[20]	52%	55%	70%
Onshore Wind Capacity, GW	~3.3	6.5	N/A	8.2
Offshore Wind Capacity, GW	NA	1.0	N/A	3.5
Solar PV Capacity, GW	NA	0.2	N/A	0.4
CCGT Capacity, GW	~3.6	5.1	N/A	4.7

The indicative construction schedule for the proposed Castlebanny Wind Farm (as detailed in Chapter 2 (Description of the Proposed Development) of this EIAR) should also be considered with respect to the compatibility of the proposed development with the Climate Action Plan 2019. Construction is proposed to commence (subject to planning permission) in 2024 As such, the wind farm will be contributing renewable energy to the national grid within the timelines required for compliance with the Climate Action Plan objectives for 2030.

In summary, the proposed Castlebanny Wind Farm is unequivocally compatible with and key to all of the relevant provisions set out in the Climate Action Plan 2019, relating to the harnessing of renewable energy. The proposed development will directly contribute to the following:

- A reduction in greenhouse gas emissions by utilisation of a least cost technology as identified in the Plan;
- Input of renewable energy to the national grid;
- The commitment that 70% of our electricity needs will come from renewable sources by 2030
- Meeting Ireland's Renewable Energy production targets by 2030 and 2040;
- Meeting the specific objectives for onshore wind capacity in Ireland by 2030 (based on the indicative construction and commissioning schedule for the proposed development); and
- Provision of grid connection infrastructure to support the renewable energy output from the proposed development.

[5] https://www.seai.ie/resources/publications/Renewable-Energy-in-Ireland-2019.pdf

14.2.1.2 Climate Action and Low Carbon Development (Amendment) Bill 2020.

The Climate Action and Low Carbon Development (Amendment) Bill 2020, published in October 2020, sets out a plan for decarbonisation with the objective to achieve a carbon neutral economy by the year 2050. This sets a target for a reduction of 7% per year in terms of greenhouse gas emissions. Under the Bill, the first fifteen-year phase is divided into three five-year periods, during which carbon budgets will be prepared and implemented for each sector. The Bill will require annual updating of the Climate Action Plans in order to meet these targets. Similarly, the National Long Term Climate Action Strategy, will require review at minimum every 10 years. Under the Bill, the onus shall be put on local authorities to prepare and continually revise their individual Climate Action Plans to include mitigation and adaptation measures at least once every 5 years. The carbon budgets will be monitored, with carbon savings from previous budgets incorporated into successive budgets, and a deficit in carbon savings will be brought forward to the next budget (up to a maximum of 1% of the current budget). The Bill also makes amendments to the National Oil Reserve Act, 2007, in which it makes provisions to "support projects which seek to increase climate resilience in the State". The proposed Castlebanny Wind Farm will provide a significant contribution towards supporting the renewable energy targets, not only for County Kilkenny, but also on a national scale.

14.2.1.3 International Climate Commitments

Ireland ratified the United Nations Framework Convention on Climate Change (UNFCCC) in April 1994 and the Kyoto Protocol in 1997 (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 Kyoto Protocol, Ireland agreed to limit the net anthropogenic growth of the six Greenhouse Gases (GHGs) under the Kyoto Protocol to 13% above the 1990 level over the period 2008 to 2012 (ERM, 1998). The limit was set at 314.18Mt CO_2eq for the 5 year period, giving a yearly limit of 62.84Mt CO_2eq. Ireland succeeded in meeting the 5 year limit, largely as a result of including forest sinks.[6] However, for the next time period, Ireland is not on track to meet its limits. The UNFCCC is continuing detailed negotiations in relation to GHGs reductions and in relation to technical issues such as Emission Trading and burden sharing.

In 2015, the Conference of the Parties (COP21) to the agreement was convened in Paris. This conference was 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 gigatons 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.

Since COP21, three additional conferences have been held addressing climate change matters, with the most recent (COP 25) held in Spain in December 2019. The 2018 COP 24 reached an agreement on the implementation of what had been previously agreed in Paris. This includes how governments will measure, report on and verify their emission-cutting efforts, which are intended to strengthen delivery of what had been agreed in 2015. The 2019 COP aimed to

[6] http://www.epa.ie/pubs/reports/air/airemissions/Ire_GHG_Emissions_1990_2012_handout.pdf

finalise the rules of the Paris Agreement, but details around "Article 6" of the agreement, reporting requirements for transparency and common timeframes for climate pledges were deferred until 2020.

Chapter 4 of this EIAR (Policy Planning and Development Context) discusses the above climate agreements and commitments in further detail.

14.2.2 Air Quality

The EC has formally adopted the Air Quality Framework Directive (96/62/EC). The First Daughter Directive, 99/30/EC (adopted April 1999), set specific limits for: nitrogen dioxide (NO_2), sulphur dioxide (SO_2), particulate matter (PM_{10}) and lead (Pb). In December 2001, the EC adopted the Second Daughter Directive, 2000/69/EC, relating to limit values for benzene and carbon monoxide (CO) in ambient air. The Third Daughter Directive, 2002/3/EC, established target values and long term objectives for the concentration of ozone in air. These directives have been transposed into Irish legislation by the Air Quality Standards Regulations, 2011 (S.I. No. 180 of 2011).

The Fourth Daughter Directive 2004/107/EC relates to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air. This completes the list of pollutants initially described in the Framework Directive (96/62/EC). The Fourth Daughter Directive was transposed into Irish legislation by The Arsenic, Cadmium, Mercury, Nickel and Polycyclic Aromatic Hydrocarbons in Ambient Air Regulations 2009 (S.I. No. 58 of 2009).

The original Air Quality Directives (except the Fourth Daughter Directive 2004/107/EC) have been replaced by one overriding European Directive, known as the Clean Air for Europe Directive (CAFE Directive) (2008/50/EC) adopted in May 2008 (transposed into Irish Law under S.I. No. 180 of 2011). The EU intends to incorporate the Fourth Daughter Directive into the CAFE Directive in the future. Within the CAFE Directive the specified limits for the protection of human health remain unchanged from those specified in S.I. No. 180 of 2011.

14.3 METHODOLOGY

The significance of effects of the proposed development has been assessed in accordance with the EPA guidance document *Draft Guidelines on the information to be contained in Environmental Impact Assessment Reports* (EIAR), Draft, August 2017[7]. Table 1-1 of this EIAR, is taken from the EPA document. It outlines guidance for describing the quality and significance of effects. The effects associated with the proposed development are described with respect to the EPA guidance in the relevant sections of this chapter.

14.3.1 Climate

14.3.1.1 Background

As atmospheric levels of CO_2 are widely recognised as being one of the primary causes of climate change, the impact assessment below is based on the potential impacts that the proposed project would have in relation to changes in emissions of CO_2. The Climate Action Plan (See section 14.2.1.1 above) sets out the strategy for Ireland to reduce its production of CO_2 nationally. Carbon dioxide (CO_2) emissions occur naturally in addition to being released with the burning of fossil fuels. All organic material is composed of carbon, which is released as CO_2 when the material decomposes. Organic material acts as a store of carbon. When the vegetation dies, in the acidic waterlogged conditions of bogs and peatlands, the organic material does not decompose fully and the organic carbon is retained in the accumulating mass of the peatland. The carbon balance of proposed wind farm developments in peatland habitats has attracted significant attention in recent years. When developments such as wind farms are proposed for peatland areas, there will be direct effects and loss of peat in the area of the development footprint. There may also be indirect effects where it is necessary to install drainage in certain areas to facilitate construction. The works can either directly or indirectly allow the peat to dry out, which permits the full decomposition of the stored organic material with the associated release of the stored carbon as CO_2. It is essential, therefore, that any wind farm development in a peatland area saves more CO_2 than is released.

It is important to note at this point that although there are small pockets of shallow (<0.5m) peat around the wider wind farm site, the proposed development has been designed to avoid these areas. Also, most of the wind farm site is used for commercial forestry or agriculture and is already drained. Given the above, for the purposes of this assessment, the proposed development will not directly or indirectly disturb any peat.

Of the 21 no. proposed turbines, 19 no. are located within or close to forestry, which will require some felling works to be carried out in order to facilitate the proposed infrastructure. It is proposed that a large proportion (approximately 90%) will be replanted offsite (see Appendix 2-5 'Forestry Replanting Assessment Report' of this EIAR), while the remainder is replanted onsite at the end of the construction phase (i.e. at the location of the borrow pits and at the location of 1 no. construction compound, after reinstatement). However, there will be some extra carbon losses into the atmosphere, associated with the harvesting and transport of the felled trees. Further information on the forestry felling can be found in Appendix 2-4 'Forestry Report' of this EIAR.

[7] https://www.epa.ie/pubs/advice/ea/EPA%20EIAR%20Guidelines.pdf

When assessing the potential for natural disasters on the proposed project in this EIAR, cognisance was taken of climate change (i.e. the predicted future climate[8] for Ireland as described by Met Éireann) in relation to factors such as precipitation and temperature. Met Éireann has considered any uncertainty in the trajectories of greenhouse gases and based their predictions on the most likely outcomes.

14.3.1.2 Calculating Carbon Losses and Savings

The carbon emitted or saved as a result of the proposed development is hugely significant in order to assess its impact on climate. The carbon calculation takes into account the carbon released from a number of sources during the construction, operational and decommissioning stages. These include the effects of drainage works, forestry felling, losses associated with harvesting and transport of felled trees, changes in land use and wind turbine manufacture and construction. Also included in the assessment tool is the assessment of peat disturbance, but as the proposed development was designed to avoid any such areas of peat, the other sources mentioned above play the primary roles in the current project. Similarly, assessments are carried out to estimate the savings of carbon over the lifetime of the wind farm, compared to the current fossil fuel methods of electricity generation which power the grid. The assessments in the carbon savings category relate to the capacity of the wind farm over the number of years for which it is operational, forestry felling, improvement works at the site (i.e. peatland improvement, habitat creation, etc.) and the restoration of the site (i.e. removal of infrastructure and restoration of previous conditions) when the wind farm will be decommissioned. As there is no peat being excavated, there will be no restoration of peat.

The Scottish Government have produced an online carbon calculator which aims to estimate the levels of carbon losses and savings from proposed wind farm developments. The calculations are heavily influenced by the losses of carbon that occur in peatland areas – through removal, drainage and site restoration works. Given the avoidance of existing pockets of peat present at the site by the proposed development, the peat-related elements of the calculator findings were not used. A number of assumptions were made in relation to the site characteristics, where the model uses correction factors based on the Scottish landscape or requires the selection from a specific list. An example of this would be soil type which onsite was found to be tills derived from mainly non-calcareous parent materials, whereas "Peaty Gley" was the most applicable choice provided in the model.

The completed worksheet, including the assumptions used in the model, is provided in Appendix 14-1 of this EIAR. The model calculates the total carbon emissions associated with the proposed wind farm development including manufacturing of the turbine technology, transport, construction of the development and tree felling. Although the model can account for carbon losses due to peatland disturbance, the proposed development footprint is not located on peat and so this was not included in the completed model worksheet. The model accounts for improvement works and the years taken for the site to return to its original characteristics but does not factor in the potential re-use of turbine components. All metal components can be recycled, while there is limited potential for the recycling/reuse of the fibreglass blades.

The model also calculates the carbon savings associated with the proposed wind farm development against three comparators:

i. Coal fired Electricity Generation

[8] https://www.met.ie/epa-climate-projections-2020

ii. Grid mix of Electricity Generation
iii. Fossil fuel mix of Electricity Generation.

The above comparators are based on UK energy generation figures, which take into account a higher proportion of renewables and nuclear energy, than is provided in Ireland. The most representative case for Ireland, therefore, would be to use a simple formula that is based on the latest available data for electricity generation in Ireland. This is:

$$CO_2 \text{ (in tonnes)} = \frac{A \times B \times C \times D}{1000}$$

For this formula:

- A = the rated capacity of the proposed wind farm (MW)
- B = the capacity/load factor. This accounts for the periods where the proposed wind farm would not be generating power.
- C = number of hours in 1 year
- D = Latest data for the carbon cost per kWh from the national grid.

The formula values that apply to the proposed development are as follows:

- A = 105MW – The anticipated power output of the proposed wind farm is between 105 – 126MW. For the purposes of assessing the worst-case scenario, the lowest value has been used here. In reality it is likely that the power output will be higher, and therefore the potential positive impacts on climate for the operational phase may be greater.
- B = 32.2% (0.322)
- C = 8,760
- D = 375.2 g CO2/kWh, based on the 2018 figures, published in 'Energy in Ireland, Key Statistics 2019' by the Sustainable Energy Authority of Ireland (SEAI)

The expected CO_2 losses due to the proposed wind farm development and the total savings anticipated as a result of the wind farm are summarised in Section 14. 5 below.

14.3.2 Air Quality

14.3.2.1 Air Quality Standards and Guidelines

The Environmental Protection Agency (EPA) is the competent authority responsible for the implementation of all Irish and EU ambient air quality legislation. The main air pollutants monitored by the EPA are ozone, carbon monoxide, nitrogen dioxide and oxides, sulphur dioxide, particulate matter (PM_{10} and $PM_{2.5}$), benzene, lead, Poly Aromatic Hydrocarbons (PAH), Arsenic, Nickel, Cadmium and Mercury[9]. Apart from ozone, all of these pollutants result from the burning of fossil fuels, either from transport, domestic heating, electricity generating stations or industry. High ozone levels are formed from the reaction of two key pollutants, nitrogen oxides (NO_x) and volatile organic compounds (VOCs), in the presence of sunlight.

The EPA uses the limits as described in the CAFÉ Directive to assess and regulate air quality standards. These limit values are presented in Table 14-2.

[9] http://www.epa.ie/air/quality/monitor/

In particular, dust particles may pose a risk to human respiratory and cardiovascular health should their size fall below 10 microns, PM_{10}. No specific statutory guidelines exist in Ireland in relation to dust particles exceeding the 10-micron limit, nor have any project specific standards been issued regarding the production of nuisance dust during development. However, for reference the German TA Luft standards[10] provide a numerical benchmark for comparison purposes. This document sets out an upper limit average of no more than 350mg.m^{-2}.day^{-1} for non-hazardous dust over a one-year timescale at any receptors outside of the site boundaries.

This limit of 350mg.m^{-2}.day^{-1}, based on the Bergerhoff method[11] is confirmed by the Department of the Environment, Health and Local Government recommendations for use at quarries. Where no definitive protocol exists, this can be applied as the best approach with respect to construction related dust.

Table 14-2: Air Quality Standards Regulations 2011 (based on EU Council Directive 2008/50/EC)

Pollutant	*Regulation* Note 1	*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/m^3 NO_2
		Annual limit for protection of human health	None	40 µg/m^3 NO_2
		Critical level for protection of vegetation	None	30 µg/m^3 NO + NO_2
Lead	2008/50/EC	Annual limit for protection of human health	100% Note 2	0.5 µg/m^3
Sulphur dioxide	2008/50/EC	Hourly limit for protection of human health - not to be	150 µg/m^3	350 µg/m^3

[10] https://www.bmu.de/fileadmin/Daten_BMU/Download_PDF/Luft/taluft_engl.pdf

[11] http://www.epa.ie/pubs/advice/general/epa_management_extractive_industry.pdf

Pollutant	*Regulation*[Note 1]	*Limit Type*	*Margin of Tolerance*	*Value*
		exceeded more than 24 times/year		
		Daily limit for protection of human health - not to be exceeded more than 3 times/year	-	125 µg/m^3
		Critical level for protection of vegetation	-	20 µg/m^3
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/m^3 PM_{10}
		Annual limit for protection of human health	20%	40 µg/m^3 PM_{10}
$PM_{2.5}$ (Stage 1)	2008/50/EC	Annual limit for protection of human health	20% from June 2008. Decreasing linearly to 0% by 2015	25 µg/m^3 $PM_{2.5}$
$PM_{2.5}$ (Stage 2)	-	Annual limit for protection of human health	-	20 µg/m^3 $PM_{2.5}$
Benzene	2008/50/EC	Annual limit for protection of human health	100% until 2006 reducing	5 µg/m^3

Pollutant	*Regulation*[Note 1]	*Limit Type*	*Margin of Tolerance*	*Value*
			linearly to 0% by 2010*	
Carbon Monoxide	2008/50/EC	8-hour limit (on a rolling basis) for protection of human health	60%	10 mg/m^3 (8.6 ppm)
Ozone (O_3)	2004/107/EC	8 hours	-	120 µg/m^3
Cadmium (Cd)	2004/107/EC	Concentration in the PM_{10} fraction averaged over a calendar year	-	5 ng/m^{3**}
Nickel (N)	2004/107/EC	Concentration in the PM_{10} fraction averaged over a calendar year	-	20 ng/m^{3**}
Arsenic (As)	2004/107/EC	Concentration in the PM_{10} fraction averaged over a calendar year	-	6 ng/m^{3**}

* 5 µg/m^3 from the date of entry into force of these Regulations, reducing on 1 January 2006 and every 12 months thereafter by 1 µg/m^3 to reach 0 µg/m^3 by 1 January 2010

** Target value effective from 31 December 2012

Note 1 EU 2008/50/EC – Clean Air For Europe (CAFÉ) Directive replaces the previous Air Framework Directive (1996/30/EC) and Daughter Directives 1999/30/EC and 2000/69/EC

Note 2 EU 2008/50/EC states - 'Stage 2 — indicative limit value to be reviewed by the Commission in 2013 in the light of further information on health and environmental effects, technical feasibility and experience of the target value in Member States'

Due to the non-industrial emission nature of the proposed development, the short-term nature of the construction period and the general character of the surrounding area, air quality sampling was deemed to be unnecessary for this EIAR. The nearest licenced industrial site, Green Biofuels Ireland Ltd. (operated under IPPC Licence No. P0829 issued by the EPA and therefore all emissions from this site are strictly controlled and monitored), is just over 10km from the site entrance. It is anticipated that the air quality is good at the site of the proposed development.

The most representative available air quality data for the proposed development site was assessed to see if the proposed development could have the potential to deteriorate the values to unacceptable levels in the area. The nature of the proposed works was reviewed alongside this to determine to what extent the likely air quality-related emissions would occur. The air quality data was sourced from the EPA monitoring data as described in Section 14.4.

14.4 EXISTING ENVIRONMENT

14.4.1 Climate

14.4.1.1 Greenhouse Gasses

The sources of Ireland's carbon emissions is quite different to how it was in 1990 as seen in Figure 14-1. While emissions from energy industry have been reducing in recent years, they still accounted for approximately 16% of total carbon emissions in 2019.

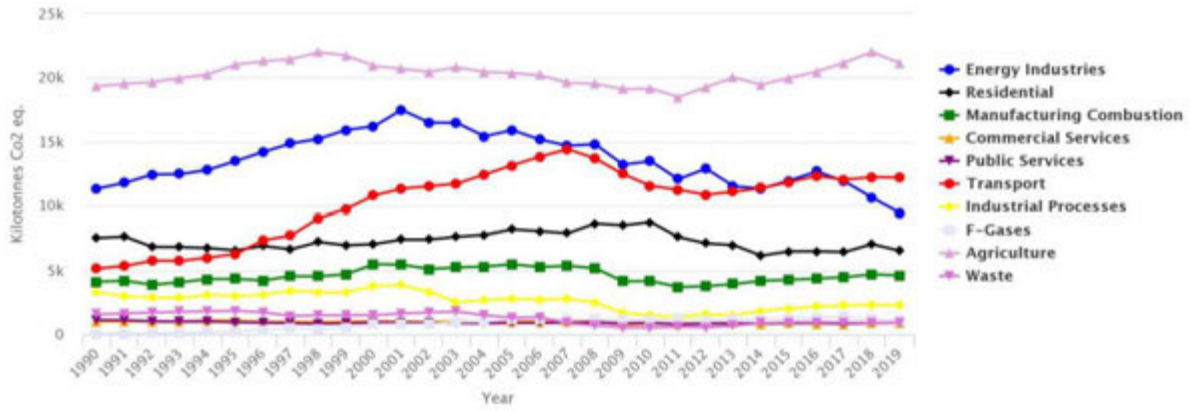

Figure 14-1: Sources of carbon emissions in Ireland since 1990 (Source EPA, https://www.epa.ie/ghg/indicatorsprogresstotargets/)

The Climate Action Plan (2019) states that "*Our latest projections indicate that a strong surge in demand for electricity, at a rate faster than the introduction of renewables, will mean Ireland's ETS sector emissions will continue to increase up to 2025, after which point policies contributing to fuel switching in power generation will contribute towards stronger emissions reduction to the end of the decade".* This highlights the necessity to increase the generation capacity for renewable energies nationally in the coming decade. Further information on the Climate Action Plan is provided in Section 14.2.1.1 above.

14.4.1.2 Climatic Conditions

A desk-top assessment of available climatic information was undertaken to characterise the existing climate. Although there is no site specific climate data available for the site of the proposed wind farm, long term meteorological data is available online for a number of locations around Ireland which are broadly representative of this location. The meteorological data contained in this EIAR chapter has been received from Met Éireann.

According to Met Éireann[12], in general terms, Ireland's climate can be described as follows:

"The dominant influence on Ireland's climate is the Atlantic Ocean. Consequently, Ireland does not suffer from the extremes of temperature experienced by many other countries at similar latitude. The warm North Atlantic Drift has a marked influence on sea temperatures. This maritime influence is strongest near the Atlantic coasts and decreases with distance inland. The hills and mountains, many of which are near the coasts, provide shelter from strong winds and

[12] https://www.met.ie/climate

from the direct oceanic influence. Winters tend to be cool and windy, while summers, when the depression track is further north and depressions less deep, are mostly mild and less windy.".

Rainfall Stations

There are approximately 500 rainfall stations across the country[13], strategically located. These stations measure the daily rainfall in millimetres (mm). A number of these stations also measure additional parameters such as soil moisture, temperature, humidity, etc.

Synoptic Stations

There are currently 25 synoptic stations[14] located throughout Ireland that observe and record surface meteorological data. Parameters observed include rainfall, temperature, wind speed and direction, relative humidity, solar radiation, clouds, atmospheric pressure, sunshine hours, evaporation and visibility. They report a mixture of snapshot hourly observations of the weather known as synoptic observations and daily summaries of the weather known as climate observations[15].

The climate of the proposed wind farm location is best described by measurements collected by the National Meteorological Service from meteorological stations in Kilkenny and Johnstown Castle, County Wexford.

The Kilkenny Met Éireann Weather Station is the closest station and is one of the 500 rainfall stations, located approximately 20km north of the proposed wind farm site. The average monthly precipitation for Kilkenny is summarised in Table 14-3 below.

Table 14-3: 30-year Average Monthly Precipitation at Kilkenny (1978-2007)

Period	Total Rainfall (mm)
January	78.3
February	66.1
March	67.9
April	56.4
May	60.4
June	61.0
July	54.6

[13] https://www.met.ie/climate/the-national-observing-network/

[14] https://www.met.ie/latest-reports

[15] http://www.met.ie/

Period	Total Rainfall (mm)
August	77.8
September	69.0
October	95.3
November	80.2
December	90.4
Total Annual	857.4

The elevation of the rainfall gauge at Kilkenny is approximately 52 mOD and is, therefore, located in the region of 68 to 213m lower in elevation relative to the proposed wind farm site, where elevation ranges from 145 mOD to 265 mOD approximately. Although there may be a slight difference in precipitation locally as a result of this elevation difference, this is not anticipated to be significant. The annual average precipitation at the proposed wind farm site is taken to be the measured annual average precipitation at the Kilkenny rain gauge, 857.4mm/annum[16, 17]. The number of days per year in which a mean rainfall of 0.2mm is exceeded as 193. While the elevation of the proposed wind farm site is greater than Kilkenny City (approximately 80 – 200m difference), this is unlikely to cause a significant difference.

Based on the average precipitation in Table 14-3, approximately 56% of the total annual rainfall is recorded during the winter period (October – March). This amount of precipitation (including snow) will normally be associated with more prolonged Atlantic frontal weather depressions passing over the region compared to the summer.

Wind

The proposed site is approximately equidistant from the Casement Aerodrome and the Cork Airport Aerodrome, at 110km and 113km respectively. The Casement Aerodrome Met Station wind rose diagram shows that the prevailing winds are from the south west, while the Cork Airport wind rose diagram highlights a West to south westerly prevailing wind (Refer to Appendix 14-2 'Casement Aerodrome Wind Rose Diagram'[18] and Cork Airport Aerodrome Wind Rose Diagram). Based on the averages between 1978 and 2007[19], the mean annual wind speed at Kilkenny is 6.9 knots (3.5 m/s) while the maximum average monthly gust reached 58 knots (29.8 m/s) over the period. The mean number of days with gales during these years was 1.9 days. This wind data provides some context for regional wind direction and speed but are not likely to be reflective of those at the proposed development site, due to differences in location and elevation.

[16] Mean for the period 1978-2007, station closed in 2007

[17] https://www.met.ie/climate-ireland/1981-2010/kilkenny.html

[18] https://www.met.ie/climate-ireland/SummaryClimAvgs.pdf

[19] https://www.met.ie/climate-ireland/1981-2010/kilkenny.html

The SEAI Wind Atlas shows wind speed at the site of the proposed wind farm is generally between approximately 8-9m/s at a height of 100m[20]. This speed is likely to be more representative of the site conditions as it accounts for elevation.

14.4.2 Air Quality

The EU Clean Air for Europe Directive requires Member States to categorise geographic areas in terms of Zones and Agglomerations for the purpose of managing Air Quality. The vicinity of the proposed Castlebanny Wind Farm falls into the area classified as Zone D – Rural Ireland.

The main areas defined in each zone are:

- Zone A: Dublin
- Zone B: Cork
- Zone C: Other cities and large towns comprising Limerick, Galway, Waterford, Drogheda, Dundalk, Bray, Navan, Ennis, Tralee, Kilkenny, Carlow, Naas, Sligo, Newbridge, Mullingar, Wexford, Letterkenny, Athlone, Celbridge, Clonmel, Balbriggan, Greystones, Leixlip and Portlaoise.
- Zone D: Rural Ireland, i.e. the remainder of the State excluding Zones A, B and C.

A detailed description of the Air Quality Zones is given on the EPA website[21].

The proposed Castlebanny Wind Farm site is situated within the EPA's 'Rural East' Air Quality Index for Health Region. The most recent reporting by the EPA indicates that the current air quality in this region is classified as Good (according to EPA records accessed on 18/11/20). Table 14-4 gives a summary description of the Air Quality Index for Health (AQIH) regions and the Air Quality Management Zones.

[20] https://gis.seai.ie/wind/

[21] http://www.epa.ie/air/quality/zones.

Table 14-4: Air Quality Index for Health Regions and corresponding Air Quality Zone

AQIH Region	Definition	Comparison with Air Quality Management Zone
Dublin City	Dublin agglomeration from Shankill in south Dublin to Lucan in west Dublin to Swords in north Dublin.	Zone A Dublin conurbation
Cork City	Cork agglomeration incorporating Cork City Council jurisdiction with additional built-up areas.	Zone B Cork conurbation
Large Towns Population > 15,000	Galway, Limerick, Waterford, Clonmel, Kilkenny, Sligo, Drogheda, Wexford, Athlone, Ennis, Bray, Naas, Carlow, Tralee, Dundalk, Navan, Letterkenny, Celbridge, Newbridge, Mullingar, Balbriggan, Greystones, Leixlip and Portlaoise.	Corresponds to Zone C Large Towns
Small Towns	Towns and cities with a population between 5,000 and 15,000.	Corresponds to Zone D Rural Ireland
Rural West	Towns with population less than 5,000, villages and rural areas in Counties Clare, Cork, Donegal, Galway, Kerry, Leitrim, Limerick, Mayo, Roscommon and Sligo.	
Rural East	Towns with population less than 5,000, villages and rural areas in Counties Carlow, Cavan, Dublin, Kildare, Kilkenny, Laois, Longford, Louth, Meath, Monaghan, Offaly, Tipperary, Waterford, Westmeath,	

The Air Quality for Health Index is described in detail on the EPA website[22].

The EPA undertakes air monitoring at various sites nationwide as representations for a variety of settings. The most proximal air quality monitoring stations to the proposed wind farm are listed in Table 14-5. Although no data is available relating to air quality in the immediate vicinity of the study area, it is expected that the air quality at the proposed Castlebanny Wind Farm site can be represented by these sites as the data presented is the most recent data available and provides a reference of the air quality in a rural setting in relative proximity to the site.

[22] http://www.epa.ie/air/quality/index

The most recent monitoring carried out by the EPA is summarised in their annual report "Air Quality Monitoring Report 2019"[23]. Taking account of the urban/rural designations as listed above, nitrogen dioxide testing was carried out in four designated air quality sites, two rural (Zone D) and two urban, in order to fulfil the requirements of the Air Quality Standards Regulations, 2011 (S.I. No. 180 of 2011). Within a 5-year period, spanning from 2014 to 2018, assessment was carried out at the rural sites of Emo, County Laois and Kilkitt, County Monaghan, and at the urban sites of Castlebar, County Mayo and Enniscorthy, County Wexford. The results[24] as presented below highlight a mean annual range of 2 - 4µg/m^3 in the rural test sites and 7 -13µg/m^3 in the urban test sites for the years 2014-2018. With the annual average maximum concentration at 40µg/m^3, both the urban and the rural sites were in compliance. The data from the rural stations below are likely to be representative of the typical background concentrations at the proposed development.

Table 14-5: NO2 trends for air quality monitoring stations in zone D.

Station	Proximity to site (km)	Averaging Period Notes 1, 2	Year				
			2014	2015	2016	2017	2018
Castlebar	Approx. 210	Annual Mean NO_2 (µg/m^3)	8	8	9	7	8
		99.8th %ile 1-hr NO_2 (µg/m^3)	71.2	-	65.6	59.8	60.2
Kilkitt	Approx. 182	Annual Mean NO_2 (µg/m^3)	3	2	3	2	3
		99.8th %ile 1-hr NO_2 (µg/m^3)	26.9	-	26.1	17.0	22.3
Emo	Approx. 74	Annual Mean NO_2 (µg/m^3)	3	3	4	3	3
		99.8th %ile 1-hr NO_2 (µg/m^3)	25.5	-	35.5	27.5	41.6
Enniscorthy	Approx. 40	Annual Mean NO_2 (µg/m^3)	13	9	10	-	-
		99.8th %ile 1-hr NO_2 (µg/m^3)	-	-	72.5	-	-

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

Note 2 Hourly limit value - 200 µg/m^3 measured as a 99.8th percentile (EU Council Directive 2008/50/EC & S.I. No. 180 of 2011).

Similar testing was carried out for Particulate Matter of 10 microns diameter or less, with the sites chosen for monitoring shown below. Castlebar and Enniscorthy are chosen to represent urban environments and Kilkitt and Claremorris, County Mayo represent rural environments over the time period between 2014 and 2018. Over this period the results show the annual mean concentrations falling well below the annual average maximum value of 40 µg/m^3 (at 10 – 22 µg/m^3 and 8 – 12 µg/m^3 for urban and rural sites respectively) and the mean hourly concentrations falling well below the maximum of 50µg/m^3. The data from the rural stations are

[23] http://www.epa.ie/pubs/reports/air/quality/epaairqualityreport2019.html

[24] http://erc.epa.ie/safer/index.jsp

likely to be broadly representative of the typical background concentrations at the proposed development.

Table 14-6: PM_{10} trends for air quality monitoring stations in zone D.

Station	Averaging Period Notes 1, 2	Year				
		2014	2015	2016	2017	2018
Castlebar	Annual Mean PM_{10} (µg/m^3)	12	13	12	11	11
	90th %ile 24-hr PM_{10} (µg/m^3)	20.9	22.2	20.0	19.1	19.9
Killkitt	Annual Mean PM_{10} (µg/m^3)	9	9	8	8	9
	90th %ile 24-hr PM_{10} (µg/m^3)	15.4	17.7	15.0	14.0	15.3
Claremorris	Annual Mean PM_{10} (µg/m^3)	10	10	10	11	12
	90th %ile 24-hr PM_{10} (µg/m^3)	15.2	16.5	17.4	17.3	19.9
Enniscorthy	Annual Mean PM_{10} (µg/m^3)	22	18	17	-	-
	90th %ile 24-hr PM_{10} (µg/m^3)	37.3	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 14-7: Air Monitoring Stations in Proximity to the Proposed Castlebanny Wind Farm Site

Monitoring Station	Proximity to Castlebanny Wind Farm	Air Quality Zone	Pollutants Measured	Monitoring Period
Thomastown, County Kilkenny	Approx. 29 km	Zone D	PM_{10}, $PM_{2.5}$	Continuous
Mountrath, County Laois	Approx. 78 km	Zone D	SO_2, NO_2, CO, PM_{10}, C_6H_6, Pb, metals	22/09/2004 – 14/06/2005
Emo, County Laois	Approx. 79 km	Zone D	Continuous NO_2 Continuous O_3	Continuous

Current data is available for a Zone D (Rural Ireland) monitoring location at Emo in County Laois on a continuous basis; however, the measurements are limited to the monitoring of Ozone and Nitrogen Dioxide only. Similarly, current data is available for a Zone D (Rural Ireland) monitoring location at Thomastown in County Kilkenny on a continuous basis; however, the measurements are limited to the monitoring of PM_{10} and $PM_{2.5}$ only.

The monitoring location that is currently used to collate data on background air quality for Zone D (Rural Ireland) across the broader suite of air quality parameters is the Kilkitt air quality monitoring site in County Monaghan (> 185 km from the proposed site) in conjunction with the

Emo monitoring site in County Laois and the Thomastown monitoring site in County Kilkenny. Reference to each monitoring location is made below.

Air Quality Monitoring at Kilkitt, County Monaghan (Zone D – Rural Ireland)

The information on the EPA website relating to air quality monitoring notes, *"The Kilkitt site is located in the drinking water treatment works at Kilkitt in County Monaghan. This is a rural setting with little traffic or other influences on air quality. Monitoring is done using continuous monitors for nitrogen oxides, sulphur dioxide and ozone. PM_{10} heavy metals and Benzo (a) Pyrene are also measured at this site."*[25]

This location is the most reflective of the rural nature of the proposed development site.

Data from the continuous monitoring at Kilkitt, County Monaghan shows that nitrogen dioxide concentration is consistently below the 200µg/m^3 EPA limit[26] value, with concentrations generally in the range below 10 µg/m^3.

Ozone concentration is consistently below the 180µg/m^3 EPA limit[26]and is generally in the range of 50-65 µg/m^3[27] with periodic spikes in concentrations between 65-85µg/m^3.

Sulphur dioxide concentrations are consistently below the 125µg/m^3 EPA limit[26] value, with concentrations generally <2µg/m^3[27].

PM_{10} is monitored on a continuous basis. The conditions for a perceived exceedance in PM_{10}, require the daily limit of 50 µg/m^3 to be broken 35 times within a year or have an annual average of 40 µg/m^3. The EPA Air Quality data demonstrates that the 50 µg/m^3 limit for PM_{10} has not been breached in 2020 (up to 31st of October)[28]. For the period of March 2020 to May 2020, a graph on the EPA website shows a high point at approximately 30 µg/m^3 (accessed on 11th November 2020)[25].

Air Quality Monitoring at Emo, County Laois (Zone D – Rural Ireland)

The information on the EPA website relating to air quality monitoring notes, *"The Emo site is located in the grounds of Emo Court, a stately home in County Laois. The site is heavily forested and was chosen to assess the levels of ozone in a forested area. Monitoring is done using a continuous monitor for ozone. Monitoring for oxides of nitrogen began in January 2013."*[29]

Data from the continuous monitoring presented from Emo Court shows that nitrogen dioxide concentration is consistently below the 200µg/m^3 limit value and Ozone concentration is consistently below the 180µg/m^3 limit (based on seven-day data available online[30]).

[25] http://www.epa.ie/air/quality/data/kt/

[26] http://www.epa.ie/air/quality/standards/

[27] http://www.epa.ie/air/quality/data/kt/gas/

[28] https://www.epa.ie/air/quality/reports/pm10/

[29] http://www.epa.ie/air/quality/data/emo/

[30] http://www.epa.ie/air/quality/data/emo/gas/

Air Quality Monitoring at Thomastown, County Kilkenny (Zone D – Rural Ireland)

Particulate matter is continuously monitored at Thomastown, Co. Kilkenny[31] since a monitor was installed in June 2019. The data available for the site shows consistent compliance with limits for PM_{10} and PM_{25}, with the highest readings in the available data at 24.75 µg/m^3 and 22.07 µg/m^3 respectively. Both readings were large outliers, much larger than the mean readings and therefore the annual mean limits of 40 µg/m^3 and 20 µg/m^3 for PM_{10} and PM_{25} have not been exceeded in the area.

14.5 POTENTIAL IMPACTS

14.5.1 Do nothing Effect

It is most likely that the site of the proposed development would continue in its current land uses, which are primarily of forestry and agriculture.

In relation to the air quality and climate at the site, it is unlikely that there would be any significant local positive or negative impacts in the 'Do Nothing' scenario. However, there would be a negative impact on the wider air quality targets in Ireland, should fossil fuel generators continue to be used for energy supply. Similarly, the 'Do Nothing' scenario does not provide any benefits in terms of meeting nationwide targets for renewable energy and carbon emission targets. It is likely that fines will be imposed on Ireland due to non-compliance with these targets. The Do-Nothing scenario supports the continued use of fossil fuels to meet the increased national energy demand, leading to increased carbon emissions. This would have a potential significant permanent negative effect.

14.5.2 Climate

14.5.2.1 Construction Phase

During the construction phase of the proposed development, the potential negative effects on climate will include those associated with exhaust emissions from construction traffic. These works include those on the site of the wind farm itself, as well as along the grid connection cable route, and along the TDR. There will also be vehicular emissions associated with the transport of materials and infrastructure components to the site. These effects will be of short-term duration, being limited to the time of the construction works. There is a **slight short-term negative effect** on climate anticipated from this.

The felling of forestry will be required over approximately 83 ha of the site area However, these areas of forestry are a commercial crop that would be felled at some point as part of the ongoing forestry cycle, regardless of the construction of the proposed wind farm. A detailed assessment of the existing biomass associated with the proposed felling was carried out (See Appendix 2-4 for details). Approximately 75 ha of this area will be replanted off site (Appendix 2-5) while the remaining approximately 7.9 ha will be replanted onsite at the end of the construction phase. The result is that there is no net loss of afforested area, and therefore the loss of carbon associated with tree felling is negated. The felling is anticipated to have a **short-term imperceptible neutral effect** on climate.

[31] https://airquality.ie/station/TNO4157

The potential impact on climate, in terms of CO_2 loss, during the component lifecycle (which covers manufacture, transport to site, erection (incl. construction of concrete foundations) and decommissioning phases) is assessed as part of the carbon modelling for the operational phase of the development, and is detailed in Table 14-8 below.

14.5.2.2 Operational Phase

Carbon Losses

The expected and maximum, worst-case scenario CO_2 losses due to the proposed wind farm development are summarised in Table 14-8, which is based on the results obtained from the Scottish Carbon Calculator described in Section 14.3 above. The input and results data for the carbon calculator are provided in Appendix 14-1. The model assumes that projects are constructed on peatlands (the only options in the model are acid bog and fen) but as the proposed wind farm infrastructure footprint will avoid peat, the losses from soil organic matter will be taken as being nil. The absence of losses due to Dissolved & Particulate Organic Carbon leaching is reflective of the lack of land/habitat improvements included in the model.

Table 14-8: CO_2 losses from the proposed development

Origin of Losses	Expected CO_2 Losses (tonnes CO_2 equivalent)	Minimum CO_2 Losses (tonnes CO_2 equivalent)	Maximum CO_2 Losses (tonnes CO_2 equivalent)
Losses due to turbine lifecycle (e.g. manufacture, construction, decommissioning)	88,500	88,500	108,122
Losses due to backup (to the grid)	72,434	72,434	86,921
Losses due to decreased carbon fixing potential	1,587	841	2,354
Losses from soil organic matter	0	0	0
Losses due to Dissolved & Particulate Organic Carbon leaching	0	0	0
Losses due to felling forestry[1]	38,291	35,934	39,412
Total	200,812	197,709	236,809

[1.] The data as calculated from SNH may overestimate the carbon lost as a result of tree felling. An estimate based on site specific survey data in the Forestry Report (Appendix 2-4 of this EIAR), yielded a much smaller carbon displacement of 15,128.65tCO^2e. The difference between

the two methodologies may reflect the fact that a significant proportion of the onsite forestry crop is quite young (the SNH model may assume a more mature crop), as well as the fact that the calculations in Appendix 2-4 of this EIAR do not account for the carbon loss associated with roots. In order to ensure the assessment deals with the worst-case scenario, the SNH figure will be used.

The tree felling losses mentioned in the table above do not account for the replanting of forestry which is proposed, thereby negating these carbon losses completely over time. However, it must be taken into account that the trees which will be felled as part of the wind farm construction will be replanted within 2 years. Furthermore, felling of the forestry will be carried out at some point regardless of the development, as they are part of a commercial forest rotation. It also should be noted that a significant portion of the carbon present in the forestry, which has been felled and is used for timber, is embedded for the lifetime of the product and therefore is not lost into the environment. Further information on the forestry felling is provided in Appendix 2-4 of this EIAR, while information on the offsite replanting sites is provided in Appendix 2-5 of this EIAR.

Based on the calculations as presented above, the worst case scenario is that 236,809 tonnes of CO_2 are expected to be lost to the atmosphere due to the construction, operation and decommissioning of the proposed development.

Carbon Savings

The SNH model is preset with data for a UK-based fossil fuel mix which incorporates a different level of renewables than Ireland as well as nuclear power. A more suitable approximation of the Irish case involves calculating carbon savings based on the most recent data provided by the SEAI and is discussed in Section 14.3.1 above. The formula was used to calculate carbon dioxide emissions saving based on the generation of electricity from the proposed wind farm rather than from carbon-based fuels such as peat, coal, gas and oil.

The worst case (i.e. assuming an output of just 105MW) calculation for carbon savings is therefore as follows:

$$CO_2 \text{ (in tonnes)} = \frac{(105 \times 0.322 \times 8{,}760 \times 375.2)}{1000} = 111{,}125 \text{ tonnes per annum}$$

Based on a lifetime of 35 years, the wind farm is anticipated to save 3,889,378 tonnes of carbon equivalent. The worst case estimate of whole life carbon losses to the environment associated with the proposed development as calculated from the SNH calculator above is 236,809 tonnes, representing 6.1% of the volume of carbon offset during the lifetime of the windfarm. This would take approximately 26 months (2.13 years) to be paid back assuming the worst case scenario with maximum carbon losses. As mentioned above, this payback period is a worst-case scenario.

While in operation, the wind farm will have **indirect, positive effects** on the climate. Wind energy is a renewable, clean and a sustainable means of electricity generation. The proposed Castlebanny Wind Farm will have a positive effect on the atmospheric environment and climate by avoiding emissions of pollutants and greenhouse gases that would otherwise be emitted from a conventional, fossil fuel fired generation plant. This will have a **long-term moderate positive effect** on climate. It will provide a significant contribution to the renewable energy production targets for County Kilkenny and on a national scale for Ireland.

During the operational phase, there will be a requirement for regular maintenance works to be carried out to ensure the smooth operation of the turbines over their lifetime. This will require the presence of vehicles onsite which will give rise to greenhouse gas emissions. There will also be a presence of vehicles associated with the proposed amenity facility onsite. This vehicular activity has the potential for a **long term imperceptible negative effect** on climate.

The proposed amenity facility will also have a presence of vehicles at the proposed public car park. However, as the vehicles will be confined to the public car park, the potential impact from this car park will be negligible. In addition, the amenity will encourage walking and cycling activities within the site. Therefore, no specific mitigation measures are proposed.

14.5.2.3 Decommissioning Phase

The largest likely climatic effect during the decommissioning phase is a result of the presence of vehicular traffic at the site (similar to the construction phase albeit at a much smaller scale as the access tracks and turbine foundations will be left in place), which will emit carbon into the atmosphere. The effect will be a **short term, imperceptible negative effect** on climate . There is likely to be a negative effect on the climate post the decommissioning phase due to the loss of energy from a renewable source.

14.5.3 Air Quality

14.5.3.1 Construction Phase

Dust or pollutants generated from the proposed development construction phase will typically arise from:

- Movement of construction vehicles;
- Transportation of turbines and construction materials to and within the site;
- Blasting, breaking and crushing of Rock;
- Movement and placement of stockpiles (excavated soils/fill materials); and
- Wind generated dust from stockpiles, any required excavations and exposed unconsolidated soils.

There will be some exhaust emissions from construction activities onsite during the construction phase giving rise to a **localised short-term imperceptible negative effect** on air quality on site. There will also be a predicted increase in traffic volumes on nearby roads (R704) resulting from the construction phase, as discussed in Chapter 16 (Traffic & Transport), which is anticipated to have a **potential short-term imperceptible negative effect** on air quality along these routes due to dust and emissions.

Using the NRA Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes, the impact of the proposed development in terms of dust is likely to be minimal. With reference to Box A8.1 in Appendix 8 of the document, the development would be fall into the "major" development category. For major developments, the distance for significant effects to occur is cited as 25m for PM_{10}, while the distance for dust soiling effects is 100m. There are no residential sensitive receptors within 100m of the proposed main wind farm development footprint and as such dust generated onsite will not have a significant effect on the surrounding areas. Some short sections of the grid connection route and works associated with the turbine delivery route will involve transient temporary works in closer proximity to sensitive receptors which may have the potential to cause a temporary moderate negative impact.

In addition, data provided in the Kilkenny 30-year Average shows the number of days per year in which a mean rainfall of 0.2mm is exceeded as 193 (See section 14.4.1 above). This further limits the impact of dust on the air quality as dust is carried from a particulate solid dispersed in the air into suspension in the water. With rainfall anticipated for just over half the year, it is unlikely that significant nuisance will be caused by dust on these days, and that dust generated on dry days will be minimised in line with the measures outlined in the mitigation section below and also detailed in the CEMP.

Considering the above, the proposed development will have a potential **short-term moderate impact** with regard to dust within the site of the proposed wind farm, while this would be a potential **short-term slight negative impact** in the area around the wind farm site.

The grid connection and TDR works will not have the same level of impact because the excavation works are relatively shallow and mostly located off road. While there are sensitive receptors located alongside some of these areas, any dust related effects on air quality will be transient and localised as the works move along the routes, and between TDR pinch points. Therefore, there will be a potential brief **slight negative effect** on the areas around the grid connection and TDR works prior to mitigation measures being applied.

14.5.3.2 Operation Phase

As discussed in Section 14.4.2, the existing environment at the site of the proposed project currently has a high standard in relation to Air Quality. On a national level, the wind farm while in operation will have an **indirect, slight positive effect** on air quality due to the corresponding reduction in fossil fuel power generation which can produce a number of harmful pollutants. Wind energy is a renewable, clean and sustainable means of electricity generation.

The positive impact on air quality associated with the reduced reliance on fossil fuel based electricity generation mentioned above will have a slight positive effect on human health, as it is known that chemicals such as NO_x and SO^2 which are produced by burning fossil fuels can have harmful effects on human health.

The proposed amenity facility will also have a presence of vehicles during the operational phase to carry out onsite maintenance works and accessing the proposed public amenity car park. This vehicular activity will have the potential to create nuisance dust and exhaust emissions locally. The effect on the onsite air quality will be a **long term negligible negative** as a result.

14.5.3.3 Decommissioning Phase

The decommissioning works are likely to produce a limited amount of dust and pollutants as a result of site works and exhaust emissions from construction vehicles, but there will be less traffic than the construction phase of the development primarily due to the fact that the access tracks and turbine foundations will remain in-situ. The impact on air quality during the decommissioning phase will have a potential **short-term slight negative effect** in terms of air quality (dust and emissions).

14.6 MITIGATION MEASURES

14.6.1 Climate

14.6.1.1 Construction Phase

During the construction phase of the proposed development, all contractors will ensure that machinery used on site is properly maintained and is switched off when not in use to avoid unnecessary exhaust emissions from construction traffic.

14.6.1.2 Operational Phase

During the operational phase of the proposed development, the works onsite will be limited to maintenance associated with the wind farm components and use of the amenity facilities. Although the intensity of activity will be only a small fraction of the construction phase, all employees and contractors that are on site will ensure that machinery used is properly maintained and is switched off when not in use to avoid unnecessary exhaust emissions from maintenance traffic.

As the proposed development will produce a significant amount of renewable energy, the operational phase will not require further climate-related mitigation measures.

14.6.1.3 Decommissioning Phase

Similar to the construction phase, all contractors will ensure that machinery used on site is properly maintained and is switched off when not in use to avoid unnecessary exhaust emissions from construction traffic.

14.6.2 Air Quality

14.6.2.1 Construction Phase

Potential effects arising from dust and exhaust emissions will be minimised through the provision of mitigation measures that are detailed below and also incorporated into the Construction Environmental Management Plan (CEMP). These are as follows:

- Minimisation of extent of working areas;
- Stockpiling of excavated materials will be limited to the volumes required to practically meet the construction schedule;
- Drop heights of excavated materials into haulage vehicles will be minimised to a practicable level;
- Daily inspections by site personnel to identify potential sources of dust generation along with implementation measures to remove causes where found;
- Provision of dust suppression measures (e.g. sweeps/covers/water bowsers) will be used on stockpiles and the road surface during periods of extended dry weather.
- Traffic coming to site will only use the specified haul routes.;
- Onsite borrow pits will be used to minimise quantities of stone material being brought to site;
- Best practice (including industry recognised dust suppression techniques/equipment) will be used to minimise the potential for dust production during the extraction of rock from the borrow pits and excavations elsewhere;
- Vehicles and plant will be routinely serviced to minimise the exhaust emissions during construction;

- Vehicles will not be left running unnecessarily and low emission fuels will be used where possible; and
- The use of a wheelwash near the site entrance (will prevent the transfer of dust from the construction works on to public roads.

14.6.2.2 Operational Phase

During the operation phase of the proposed development routine maintenance works will be required, during which all contractors/staff will ensure that machinery used on site is properly maintained and is switched off when not in use to avoid unnecessary exhaust emissions from maintenance traffic. Traffic associated with the public amenity facility will be confined to the proposed public car park.

14.6.2.3 Decommissioning Phase

All relevant mitigation measures as described in Section 14.6.2.1 will be implemented during decommissioning works, the majority of which are related to machinery and vehicles at the site. Vehicles and plant will be routinely serviced to minimise the exhaust emissions during construction and will not be left running unnecessarily. Similarly, emphasis will be put on dust reduction measures and inspections as described in Section 14.6.2.1.

14.7 RESIDUAL IMPACTS

14.7.1 Climate

14.7.1.1 Construction Phase

The proposed construction works will have a **short-term imperceptible negative effect** on climate due to greenhouse gas emissions.

14.7.1.2 Operational Phase

Electricity generated by the operational wind farm will result in an avoidance of greenhouse gas emissions that would otherwise occur through generation from fossil fuel sources. The carbon costs to construct the proposed project would take approximately 26 months in the worst case to pay back (See Section 14.5.2), with the proposed project preventing the emission of a total of 3,889,378 tonnes of carbon over its 35-year lifespan in that case. The avoided emissions, therefore, result in a **moderate, long-term, positive effect** on climate. The proposed project would also significantly contribute towards the achievement of renewable energy production targets for County Kilkenny and Ireland.

The greenhouse gas emissions associated with the expected maintenance vehicles and use of the public amenity car park will have a potential **negligible long term negative effect** on climate.

14.7.1.3 Decommissioning Phase

The decommissioning phase of the proposed development will likely be similar to the construction phase, albeit at a smaller scale. There is anticipated to be a **short-term imperceptible negative effect** on climate due to greenhouse gas emissions.

14.7.2 Air Quality

14.7.2.1 Construction Phase

There is anticipated to be a very localised potential **slight, short-term, negative effect** on air quality through dust generation and exhaust emissions during the construction stage, following the application of mitigation measures outlined above and in the CEMP.

14.7.2.2 Operational Phase

In the context of an operational lifetime of 35 years, emissions of a number of pollutants associated with burning fossil fuels including nitrous oxides (NO_x), sulphurous oxides (SO_x), particulate matter (PM) and secondary pollutants, such as ozone, will be avoided at energy production facilities elsewhere in the country through the generation of renewable energy. The avoided emissions, therefore, result in a potential **slight long-term, positive effect** on air quality at those locations.

It is anticipated that the site activity (i.e. vehicles for maintenance and amenity use) might have a very localised **long term imperceptible negative effect** on air quality through dust generation and exhaust emissions during the operational stage.

14.7.2.3 Decommissioning Phase

The decommissioning phase of the proposed development will likely be similar to the construction phase, albeit at a smaller scale. There is anticipated to be a **short-term imperceptible negative effect** on air quality due to dust and exhaust emissions.

14.8 CUMULATIVE IMPACT ASSESSMENT

A list of all other existing and approved plans/projects and projects pending a decision from the planning authority is provided in Section 4.3 of this EIAR (including other wind farm and infrastructure developments in the vicinity) and these were all considered as part of this cumulative assessment. In particular, the following projects were relevant for air quality and climate:

- Pl. Ref. 16/14 - Planning permission for the permission of a period of 15 years and the retention of existing quarry with an extraction area of approximately 1.20 ha. at Castlegannon, Ballyhale. Planning permission was granted 24/10/2016.
- Pl. Ref. 16/445 -– Highfield Solar Limited Highfield application for a 10 year permission for the construction of a Solar PV Energy development at Derrynahinch, Knocktopher, within a total site area of up to 10.6 ha, to include one, single-storey electrical substation building, electrical transformer/inverter station modules, solar PV panels ground mounted on steel support structures" . Granted by Council 17/01/2017.
- Pl Ref: 16/778 - ART Generation Ltd application for a solar farm at Tullaroan, Callan, consisting of PV arrays for the generation of electricity of up to 5MW for export to the national grid on land covering an area of approximately 10.6 hectares (approximately 9.8 hectares for the solar arrays and 0.8 for the existing site entrance and access road) with associated infrastructure. Granted by Council 25/04/2017.
- Pl Ref: 16/592 - Solar Sense SPV3 Limited applied for permission for a solar photovoltaic installation comprising up to 26,100m^2 of solar panels on ground mounted frames, 4 no. inverters housed in 2 units, 1 no.20kV substation, security fencing, new entrance onto public road, access tracks, CCTV; underground cable and ducts including underground

cable and ducts along the public road to the entrance of the existing Ballyhale substation within the townland of Kiltorcan, Co. Kilkenny. Kilkenny County Council refused permission but the decision was overturned by ABP and they granted permission 13/02/2018.

- PI Ref: 19/538 – Solar Sense SPV 3 Ltd applied for permission for the provision of 4 no battery storage container required by the previously granted solar farm in Ballyhale and Kiltorcan, (Reg Ref: 16/592). Permission was granted 25/10/2019.

Should any other works or construction projects occur (e.g. construction of residential/agricultural/commercial developments, agricultural and forestry activity, works associated with maintenance of the existing nearby wind farms, Solar PV energy developments and nearby quarry activity) in the wider area at the same time as the construction of the proposed development, there will also be emissions (including dust and exhaust emissions from plant and machinery) associated with those other projects. Once the mitigation measures described in Section 14.6 above are implemented, there will be no measurable negative cumulative impacts on air quality. There would also be no significant negative impact on climate.

The proposed offsite replanting of forestry will involve a small level of emission generation for the planting works, with the forestry itself sequestering carbon as it grows. However, this will occur at locations which are remote from the proposed wind farm site (>50km), so it is therefore not anticipated that there will be any significant cumulative impacts in relation to either air quality or climate from the offsite forestry replanting lands.

During the operational phase of the proposed development, there will be a long term, moderate positive effect on climate and a long-term, slight positive effect on air quality. Other operating wind farms and permitted Solar PV energy developments in the local area will replicate the same positive effects and generate an even greater cumulative long term, moderate positive effect on air quality and climate.

14.9 CONCLUSION

The climate emergency requires immediate action to be taken to mitigate against the warming of the earth by in excess of 1.5˚C. The Irish government have set out their commitment to carbon neutrality by the year 2050, in line with similar EU efforts. As part of this plan, a significant increase in the production of renewable energy is required before the year 2030. The proposed Castlebanny Wind Farm project will provide a significant contribution to achieving this target. Ireland has committed to having 70% of our electricity needs coming from renewable energy sources by the year 2030, with onshore wind planned to be a major source for this. The estimated power output of between 105-126 MW of Renewable Energy to the electrical grid, is directly compatible with the provisions set out in the Climate Action Plan 2019.

There will be expected carbon costs of a maximum of 236,809 tonnes which reflects the worst case scenario and was used for the calculation in this chapter) associated with the construction of the proposed project as detailed above, but these costs are anticipated to be offset within 26 months as a worst-case scenario once the wind farm becomes operational. When the forestry replanting (and the associated balance of carbon) is accounted for, over the 35 year life of the wind farm it is anticipated that 3,652,569 tonnes of carbon will be offset in the production of electricity. The project will have a positive long-term impact on climate and air quality, with a reduction in greenhouse gas emissions by utilisation of the least cost renewable energy technology.

The proposed Castlebanny Wind Farm is located in a rural area, which would be considered to have generally good background air quality. The construction phase of the proposed project will result in a potential for localised dust and greenhouse gas emissions, but the mitigation measures proposed above will ensure that any such effects are minimised as much as possible and will not be significant.

Overall, there are no significant negative effects on air quality or climate associated with the proposed development. There will be a moderate positive long-term impact on climate, and the proposed wind farm will make a significant contribution towards achieving the carbon reduction targets set out for Ireland.

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