11. AIR AND CLIMATE

11.1 Introduction

11.1.1 Background

The site of the proposed Lyrenacarriga Wind Farm development (the 'Proposed Development') is located approximately 5 kilometres southeast of Tallow, Co. Waterford and approximately 9 kilometres northwest of Youghal Co. Cork. The townlands in which the proposed development is located are listed in Table 1-1 in Chapter 1 of this EIAR. A full description of the proposed development is set out in Chapter 4 of the EIAR.

The primary land-uses within and in the vicinity of the site comprises forestry, agriculture and low-density residential development. Due to the non-industrial nature of the Proposed Development and the general character of the surrounding environment, air quality sampling was deemed to be unnecessary for this EIAR. It is expected that air quality in the existing environment is good, since there are no major sources of air pollution (e.g. heavy industry) in the vicinity of the site.

The production of energy from wind turbines has no direct emissions as is expected from coal or oil-based power stations. Harnessing more energy by means of wind farms will reduce dependency on oil, gas and coal power stations, thereby resulting in a reduction of harmful emissions that can be damaging to human health and the environment. Some minor indirect emissions associated with the construction of wind farms include vehicular and dust emissions.

11.1.1.1 Relevant Guidance

The air quality and climate section of this EIAR is carried out in accordance with the EIA Directive 2011/92/EU as amended by Directive 2014/52/EU and having regard, where relevant, to the guidance set out in Section 1.5 in Chapter 1 of this EIAR.

11.1.2 Statement of Authority

This section of the EIAR has been prepared by Eoin O'Sullivan and reviewed by Michael Watson, both of MKO. Eoin is an experienced geo-environmental scientist and has over ten years' experience in the design, implementation and interpretation of all phases of geo-environmental and geotechnical site investigations. Eoin has also extensive experience in the preparation of air and climate assessments and reports for EIAs, particularly relating to wind energy. Eoin is also proficient in undertaking detailed quantitative risk assessments for the protection of controlled waters and human health. Eoin holds an MSc in Environmental Engineering and is a Chartered Member of the Chartered Institute of Water and Environmental Management (CWEM) and Chartered Environmentalist (CEnv) with the Society of Environment.

Michael Watson has over seventeen years' experience in the environmental sector and had worked for the Geological Survey of Ireland and then a prominent private environmental & hydrogeological consultancy prior to joining MKO in 2014. Michael completed an MA in Environmental Management at NUI, Maynooth in 1999. Michael is a professional geologist (PGeo) and full member of IEMA (MIEMA) as well as a Chartered Environmentalist (CEnv).

11.2 Air Quality

11.2.1 Air Quality Standards

In 1996, the Air Quality Framework Directive (96/62/EC) was published. This Directive was transposed into Irish law by the Environmental Protection Agency Act 1992 (Ambient Air Quality Assessment and Management) Regulations 1999. The Directive was followed by four Daughter Directives, which set out limit values for specific pollutants:

- The first Daughter Directive (1999/30/EC) addresses sulphur dioxide, oxides of nitrogen, particulate matter and lead.
- The second Daughter Directive (2000/69/EC) addresses carbon monoxide and benzene. The first two Daughter Directives were transposed into Irish law by the Air Quality Standards Regulations 2002 (SI No. 271 of 2002).
- A third Daughter Directive, Council Directive (2002/3/EC) relating to ozone was published in 2002 and was transposed into Irish law by the Ozone in Ambient Air Regulations 2004 (SI No. 53 of 2004).
- The fourth Daughter Directive, published in 2007, relates to polyaromatic hydrocarbons (PAHs), arsenic, nickel, cadmium and mercury in ambient air.

The Air Quality Framework Directive and the first three Daughter Directives have been replaced by the Clean Air for Europe (CAFE) Directive (Directive 2008/50/EC on ambient air quality), which encompasses the following elements:

- The merging of most of the existing legislation into a single Directive (except for the Fourth Daughter Directive) with no change to existing air quality objectives.
- New air quality objectives for PM2.5 (fine particles) including the limit value and exposure concentration reduction target.
- The possibility to discount natural sources of pollution when assessing compliance against limit values.
- The possibility for time extensions of three years (for particulate matter PM10) or up to five years (nitrogen dioxide, benzene) for complying with limit values, based on conditions and the assessment by the European Commission.

Table 11-1 below sets out the limit values of the CAFE Directive, as derived from the Air Quality Framework Daughter Directives. Limit values are presented in micrograms per cubic metre ($\mu g/m^3$) and parts per billion (ppb). The notation PM_{10} is used to describe particulate matter or particles of ten micrometres or less in aerodynamic diameter. $PM_{2.5}$ represents particles measuring less than 2.5 micrometres in aerodynamic diameter.

The CAFE Directive was transposed into Irish legislation by the Air Quality Standards Regulations 2011 (S.I. No. 180 of 2011). These Regulations supersede the Air Quality Standards Regulations 2002 (S.I. No. 271 of 2002), the Ozone in Ambient Air Regulations 2004 (S.I. No. 53 of 2004) and the Ambient Air Quality Assessment and Management Regulations 1999 (S.I. No. 33 of 1999).

Table 11-1 Limit values of Directive 2008/50/EC, 1999/30/EC and 2000/69/EC (Source: EPA)

Pollutant	Limit Value Objective	Averaging Period	Limit Value (µg/m3)	Limit Value (ppb)	Basis of Application of Limit Value	Attainment Date
Sulphur dioxide (SO_2)	Protection of Human Health	1 hour	350	132	Not to be exceeded more than 24 times in a calendar year	1st Jan 2005
Sulphur dioxide (SO_2)	Protection of human health	24 hours	125	47	Not to be exceeded more than 3 times in a calendar year	1st Jan 2005
Sulphur dioxide (SO_2)	Upper assessment threshold for the protection of Human Health	24 hours	75	28	Not to be exceeded more than 3 times in a calendar year	1st Jan 2005
Sulphur dioxide (SO_2)	Lower assessment threshold for the protection of human health	24 hours	50	19	Not to be exceeded more than 3 times in a calendar year	1st Jan 2005
Sulphur dioxide (SO_2)	Protection of vegetation	Calendar year	20	7.5	Annual mean	19th Jul 2001
Sulphur dioxide (SO_2)	Protection of vegetation	1st Oct to 31st Mar	20	7.5	Winter mean	19th Jul 2001
Nitrogen dioxide (NO_2)	Protection of human health	1 hour	200	105	Not to be exceeded more than 18 times in a calendar year	1st Jan 2010
Nitrogen dioxide (NO_2)	Protection of human health	Calendar year	40	21	Annual mean	1st Jan 2010

Pollutant	Limit Value Objective	Averaging Period	Limit Value (µg/m3)	Limit Value (ppb)	Basis of Application of Limit Value	Attainment Date
Nitrogen dioxide (NO_2)	Upper assessment threshold for the protection of human health	1 hour	140	73	Not to be exceeded more than 18 times in a calendar year	1st Jan 2010
Nitrogen dioxide (NO_2)	Lower assessment threshold for the protection of human health	1 hour	100	52	Not to be exceeded more than 18 times in a calendar year	1st Jan 2010
Nitrogen monoxide (NO) and nitrogen dioxide (NO_2)	Protection of ecosystems	Calendar year	30	16	Annual mean	19th Jul 2001
Particulate matter 10 (PM_{10})	Protection of human health	24 hours	50	-	Not to be exceeded more than 35 times in a calendar year	1st Jan 2005
Particulate matter 10 (PM_{10})	Upper assessment threshold for the protection of human health	24 hours	30	-	Not to be exceeded more than 7 times in a calendar year	Based on the indicative limit values for 1 January 2010
Particulate matter 10 (PM_{10})	Lower assessment threshold for the protection of human health	24 hours	20	-	Not to be exceeded more than 7 times in a calendar year	Based on the indicative limit values for 1 January 2010
Particulate matter 2.5 ($PM_{2.5}$)	Protection of human health	Calendar year	40	-	Annual mean	1st Jan 2005

Pollutant	Limit Value Objective	Averaging Period	Limit Value (µg/m3)	Limit Value (ppb)	Basis of Application of Limit Value	Attainment Date
Particulate matter 2.5 ($PM_{2.5}$) Stage 1	Protection of human health	Calendar year	25	-	Annual mean	1st Jan 2015
Particulate matter 2.5 ($PM_{2.5}$) Stage 2	Protection of human health	Calendar year	20	-	Annual mean	1st Jan 2020
Lead (Pb)	Protection of human health	Calendar year	0.5	-	Annual mean	1st Jan 2005
Carbon Monoxide (CO)	Protection of human health	8 hours	10,000	8,620	-	1st Jan 2005
Benzene (C_6H_6)	Protection of human health	Calendar Year	5	1.5	-	1st Jan 2010

The Ozone Daughter Directive 2002/3/EC is different from the other Daughter Directives in that it sets target values and long-term objectives for ozone rather than limit values. Table 11-2 presents the limit and target values for ozone.

Table 11-2 Target values for Ozone Defined in Directive 2008/50/EC

Objective	Parameter	Target Value for 2010	Target Value for 2020
Protection of human health	Maximum daily 8-hour mean	120 mg/m^3 not to be exceeded more than 25 days per calendar year averaged over 3 years	120 mg/m^3
Protection of vegetation	AOT40 calculated from 1 hour values from May to July	18,000 $mg/m^3.h$ averaged over 5 years	6,000 $mg/m^3.h$
Information Threshold	1-hour average	180 mg/m^3	-
Alert Threshold	1-hour average	240 mg/m^3	-

AOT_{40} is a measure of the overall exposure of plants to ozone. It is the sum of the excess hourly concentrations greater than 80 g/m^3 and is expressed as g/m^3 hours.

11.2.1.1 Air Quality and Health

The World Health Organisation (WHO) in 2016 estimated that ambient air pollution caused 4.2 million deaths worldwide in 2016 (WHO, 2018). The Environmental Protection Agency (EPA) report '*Air Quality in Ireland 2018*' noted that in Ireland, the premature deaths attributable to poor air quality are estimated at 1,180 people per annum. A more recent European Environmental Agency (EEA) Report, '*Air Quality in Europe – 2019 Report*' highlights the negative effects of air pollution on human health. The report assessed that poor air quality accounted for premature deaths of approximately 412,000 people in Europe in 2016, with regards to deaths relating to $PM_{2.5}$. The estimated impacts on the population in Europe of exposure to NO_2 and O_3 concentrations in 2016 were around 71,000 and 15,100 premature deaths per year, respectively. Of these numbers, 1,180 deaths due to poor air quality were estimated in Ireland in 2016 with 1,100 Irish deaths attributed to fine particulate matter ($PM_{2.5}$), 50 Irish deaths attributed to nitrogen oxides (NO_2) and 30 Irish deaths attributed to Ozone (O_3). These emissions, along with others including sulphur oxides (SO_x) are produced during fossil fuel-based electricity generation in various amounts, depending on the fuel and technology used, emissions from industry and power plants, vehicles emissions and transport fuels.

A more recent report by the Environmental Protection Agency (EPA) '*Air Quality in Ireland 2019*'[1] noted that in Ireland, the premature deaths attributed to particulate matter has increased from the 2016 levels to an estimated 1,300 people per annum, using Irish air quality data from 2017.

11.2.2 Air Quality Zones

The EPA has designated four Air Quality Zones for Ireland:

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

These zones were defined to meet the criteria for air quality monitoring, assessment and management described in the Framework Directive and Daughter Directives for list 1 substances. The site of the proposed development lies within Zone D, which represents rural areas located away from large population centres.

11.2.3 Existing Air Quality

The air quality in the vicinity of the proposed development site is typical of that of rural areas in the South of Ireland, i.e. Zone D. Prevailing south-westerly winds carry clean, unpolluted air from the Atlantic Ocean onto the Irish mainland. The EPA publishes Air Monitoring Station Reports for monitoring locations in all four Air Quality Zones. The ambient air quality monitoring carried out closest to the Proposed Development site is at Cork Harbour (within EPA Zone B), located approximately 30 kilometres southwest of the Proposed Development site. The monitoring site was situated near the public car park on the quay in Monkstown, Cork.

More recent data is also available for Ozone and Carbon Monoxide (CO) at the Cork South Link Road and Bishopstown Cork Institute of Technology (CIT) monitoring stations. Lower measurement values for all air quality parameters would be expected for the proposed development site as it lies in a rural location, within Zone D.

[1] *Environmental Protection Agency: Air Quality in Ireland 2019. Available at: https://www.epa.ie/pubs/reports/air/quality/Air%20Quality%20In%20Ireland%202019.pdf*

11.2.3.1 Sulphur Dioxide (SO2)

Sulphur dioxide data for the 2007-2008 monitoring period in Cork Harbour is presented in Table 11-3.

Table 11-3 Sulphur Dioxide Data for Cork Harbour 2007 - 2008

Parameter	Measurement
No. of hours	4,688
No. of measured values	4,620
Percentage Coverage	98.97%
Maximum hourly value	32.7 µg/m3
98 percentile for hourly values	9.3 µg/m3
Mean hourly value	3.4 µg/m3
Maximum 24-hour mean	11.6 µg/m3
98 percentile for 24-hour mean	6.9 µg/m3

During the period of operation there were no exceedances of the 350 µg/m^3 hourly limit for the protection of human health. There were no exceedances of the 50 µg.m^{-3} lower assessment threshold. The directive stipulates that the lower assessment threshold should not be exceeded more than three times in the calendar year. It would be expected that SO_2 values at the proposed development site (Zone D) would be significantly lower than those recorded at the Cork Harbour monitoring site (Zone B).

11.2.3.2 Particulate Matter (PM10)

Sources of particulate matter include vehicle exhaust emissions, soil and road surfaces, construction works and industrial emissions. Particulate matter (PM_{10}) data for the 2007-2008 monitoring period in Cork Harbour is presented in Table 11-4. Due to technical difficulties with the TEOM FDMS (Tapered Element Oscillating Microbalance and Filter Dynamics Measurement System) sampler, a full data set of the measurement period was not completed.

Table 11-4 Particulate Matter (PM_{10}) Data for Cork Harbour 2007-2008

Parameter	Measurement
No. of days	207
No. of measured values	81
Percentage Coverage	39%
Maximum daily value	48.8 µg/m3
98 percentile for daily values	39.3 µg/m3
Mean daily value	16.7 µg/m3

The twenty-four-hour limit value for the protection of human health (50 µg/m^3) was not exceeded during the measurement period. The directive stipulates that the limit value should not be exceeded more than 35 times in a calendar year. The upper assessment threshold was exceeded on 7 days, the lower assessment threshold was exceeded on 24 days. The mean of the daily values during the measurement period (16.7 µg/m^3) is below the annual limit value for the protection of human health (40 µg/m^3). It would be expected that PM_{10} values at the proposed development site (Zone D) would be significantly lower than those recorded at the Cork Harbour monitoring site (Zone B).

11.2.3.3 Nitrogen Dioxide (NO_2)

Nitrogen dioxide and oxides of nitrogen (NOx) data for the 2007-2008 monitoring period in Cork Harbour is presented in Table 11-5.

Table 11-5 Nitrogen Dioxide and Oxides of Nitrogen Data Cork Harbour 2007-2008

Parameter	Measurement
No. of hours	4,642
No. of measured values	4,579
Percentage Coverage	98.6%
Maximum hourly value (NO2)	62.8 µg/m3
98 percentile for hourly values (NO2)	43.9 µg/m3
Mean hourly value (NO2)	10.4 µg/m3
Mean hourly value (NOx)	15.4 µg/m3 NO2

All hourly mean NO_2 values were below the lower assessment threshold (100 µg/m^3). The Directive stipulates that the lower assessment threshold should not be exceeded more than 18 times in a calendar year.

The mean hourly NO_2 value (15.4 µg/m^3) during the period of measurement was below the annual lower assessment threshold for the protection of human health (26 µg/m^3). The mean hourly value of NO_x (15.4 µg/m^3 NO_2) during the measurement period is below the annual limit value for the protection of vegetation (30 µg/m^3 NO_x). However, the report states that the applicability of this limit to urban air pollution monitoring is questionable.

It would be expected that NO_2 and NO_x values at the proposed development site (Zone D) would be significantly lower than those recorded at the Cork Harbour monitoring site (Zone B).

11.2.3.4 Carbon Monoxide (CO)

Data for Carbon Monoxide (CO) monitoring carried out in Cork South Link Road for 2017 is shown in Table 11-6. The average concentration of carbon monoxide was 0.3 mg/m^3. The carbon monoxide limit value for the protection of human health is 10,000 µg/m^3 (or 10mg/m^3). On no occasions were values in excess of the 10 mg limit value set out in Directives 2000/69/EC or 2008/69/EC.

Table 11-6 Carbon Monoxide Data for Cork South Link Road in 2017

Parameter	Measurement
No. of hours	8,760
No. of measured values	7,154
Percentage Coverage	81.7%
Maximum hourly value	2.8 mg/m3
98 percentile for hourly values	4.3 mg/m3
Mean hourly value	0.3 mg/m3
Maximum 8-hour mean	1.5 mg/m3
98 percentile for 8-hour mean	0.74 mg/m3

11.2.3.5 Ozone (O_3)

Ozone data for Bishopstown CIT for 2017 is presented in Table 11-7. As can be observed from Table 11-7 there were no exceedances of the maximum daily eight-hour mean limit of 120 µg/m^3. The legislation stipulates that this limit should not be exceeded on more than 25 days.

Table 11-7 Summary statistics for Bishopstown CIT in 2017

Parameter	Measurement
Annual Mean	50 µg/m^3
Median	53 µg/m^3
% Data Capture	99%
No. of days > 120	0 days
Maximum 8-hour value	93 µg/m^3

11.2.3.6 Dust

There are no statutory limits for dust deposition in Ireland. However, EPA guidance suggests that a deposition of 10 mg/m^2/hour can generally be considered as posing a soiling nuisance. This equates to 240 mg/m^2/day. The EPA recommends a maximum daily deposition level of 350 mg/m^2/day when measured according to the TA Luft Standard 2002.[2],[3]

Construction dust has the potential to be generated from on-site activities such as excavation and backfilling. The extent of dust generation at any site depends on the type of activity undertaken, the

[2] *Environmental Protection Agency Office of Environmental Enforcement (OEE) Air Emissions Monitoring Guidance Note (AG2), Revision 4 (May 2018). EPA: Wexford, Ireland Available at: http://www.epa.ie/pubs/advice/air/emissions/Emission_Monitoring_Guidance_AG2_May2018.pdf*
[3] *Technical Instructions on Air Quality Control TA Luft (2002) English Translation. Available at: http://www.cement.or.kr/mater_down/UMEG_TA-Luft2002_Englisch.pdf*

location, the nature of the dust, i.e. soil, sand, etc., and the weather. In addition, dust dispersion is influenced by external factors such as wind speed and direction and/or, periods of dry weather. Construction traffic movements also have the potential to generate dust as they travel along the haul route.

The potential dust-related impacts on local air quality and the relevant associated mitigation measures are presented in Sections 11.2.4 below.

11.2.4 Likely Significant Effects and Associated Mitigation Measures

11.2.4.1 'Do-Nothing' Effect

If the proposed development were not to proceed, there would be no exhaust emissions from construction plant and vehicles, nor would there be dust emissions due to the movement of these vehicles or from tree felling. However, the opportunity to reduce emissions of carbon dioxide, oxides of nitrogen (NO_x), and sulphur dioxide (SO_2) to the atmosphere would be lost due to the continued dependence on electricity derived from coal, oil and gas-fired power stations, rather than renewable energy sources such as the proposed wind farm. This will result in an indirect negative effect on air quality nationally, regionally and locally.

11.2.4.2 Construction Phase

11.2.4.2.1 *Exhaust Emissions*

1. Turbines and Other Infrastructure

The construction of turbines, site roads and other onsite infrastructure will require the operation of construction vehicles and plant on site. Exhaust emissions associated with vehicles and plant will arise as a result of construction activities. This potential effect will not be significant and will be restricted to the duration of the construction phase and localised to works locations. Therefore, this is considered a short-term slight negative impact. Mitigation measures to reduce this impact are presented below.

2. Grid Connection

The construction of the proposed substation and associated grid connection will require the use of construction machinery, thereby giving rise to exhaust emissions. This is a short-term slight negative impact, which will be reduced through use of the best practice mitigation measures as presented below. The proposed substation will be connected via overhead line to the existing 110 kV overhead line, which traverses the site. The proposed turbines will be connected back to the onsite substation via underground collector cabling.

3. Transport to Site

The transport of turbines and construction materials to the site, which will occur on specified routes only (see Section 4.4 in Chapter 4 of this EIAR), will also give rise to exhaust emissions associated with the transport vehicles. This constitutes a slight negative impact in terms of air quality. Mitigation measures in relation to exhaust emissions are presented below.

Mitigation

- All construction vehicles and plant will be maintained in good operational order while onsite, thereby minimising any emissions that arise.

- Turbines and construction materials will be transported to the site on specified routes only, as agreed with the Planning Authority. Timing of turbine components delivery (abnormal sized loads) will also be agreed with the Planning Authority.
- When stationary, delivery and on-site vehicles will be required to turn off engines.
- Users of the site will be required to ensure that all plant and vehicles are suitably maintained to ensure that emissions of engine generated pollutants are kept to a minimum.
- The majority of aggregate materials for the construction of the Proposed Development will be obtained from borrow pits on the site of the Proposed Development. This will significantly reduce the number of delivery vehicles accessing the site, thereby reducing the amount of emissions associated with vehicle movements.

Residual Impact

Short-term Imperceptible Negative impact.

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects.

11.2.4.2.2 *Dust Emissions*

1. Turbines and Other Infrastructure

The construction of turbines, site roads and other onsite infrastructure will give rise to dust emissions during the construction phase. This potential effect will not be significant and will be restricted to the duration of the construction phase. Furthermore, the forested nature of the site provides natural screening of the surrounding areas from any potential dust generated on site. Therefore, this is a short-term slight negative impact. Dust suppression mitigation measures to reduce this impact are presented below.

An area of 45.6 hectares (ha) of coniferous forestry will be required to be permanently felled as part of the wind farm development, plus an additional 5.4 ha of temporary felling. Felling can give rise to dust emissions. This felling will be carried out in accordance with Forest Service guidelines and in compliance with any Felling Licence granted by the Forest Service, in addition to the mitigation measures listed below. The potential impacts associated with replanting are assessed in the Replanting Assessment included as Appendix 4-3 of this EIAR.

2. Grid Connection

The construction of the proposed substation and associated grid connection will give rise to localised dust emission during their construction. This is a short-term slight negative impact. Mitigation measures to reduce this impact are presented below.

3. Transport to Site

The transport of turbines and construction materials to the wind farm site will also give rise to some localised dust emissions during periods of dry weather. This is a short-term slight negative impact. Mitigation measures to reduce the significance of this impact are presented below.

4. Borrow Pits

Development of the proposed borrow pits and the extraction of material from this location will give rise to localised dust emissions. This is a short-term moderate negative impact. Mitigation measures to reduce this impact are presented below.

Mitigation

- In periods of extended dry weather, dust suppression may be necessary along haul roads, site roads, around borrow pit areas and other infrastructure to ensure dust does not cause a nuisance. If necessary, water will be taken from stilling ponds in the site's drainage system and will be pumped into a bowser or water spreader to dampen down haul roads, borrow pit and site compounds to prevent the generation of dust where required. Water bowser movements will be carefully monitored to avoid, insofar as reasonably possible, increased runoff.
- All plant and materials vehicles shall be stored in dedicated areas (on site).
- Areas of excavation will be kept to a minimum, and stockpiling will be minimised by coordinating excavation, spreading and compaction.
- Turbines and construction materials will be transported to the site on specified haul routes only.
- The agreed haul route roads adjacent to the site will be regularly inspected for cleanliness and cleaned as necessary. Any clay, soil or silty material deposited by site traffic will be removed from the roads to maintain the stoned running surface. This removal of spoil material can have a substantial reduction effect of dust production in dry spells. Removed spoil material will be transported to the borrow pit or other suitable storage location for containment and storage.
- The transport of construction materials to the site that have significant potential to cause dust, will be undertaken in tarpaulin or similar covered vehicles where necessary.
- The transport of spoil that has the significant potential to generate dust, to the on-site borrow pits will be minimised. If necessary, excavated spoil will be dampened prior to transport to the borrow pits.
- A Construction and Environmental Management Plan (CEMP) will be in place throughout the construction phase (see Appendix 4-4). The CEMP includes dust suppression measures.

Residual Impact

Following implementation of mitigation measures as outlined above, residual impacts of dust generation from the construction phase will have a Short-term Imperceptible Negative Impact.

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects.

11.2.4.3 Operational Phase

11.2.4.3.1 *Exhaust Emissions*

Exhaust emissions associated with the operational phase of the proposed development will arise from machinery and vehicles that are intermittently required onsite for maintenance. This will give rise to a long-term imperceptible negative effect.

Mitigation

Any vehicles or plant brought onsite during the operational phase will be maintained in good operational order that comply with the Road Traffic Acts 1961 as amended, thereby minimising any emissions that arise.

Residual Impacts

Long-term Imperceptible Negative Impact

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects.

11.2.4.3.2 *Air Quality*

The proposed development, by providing an alternative to electricity derived from coal, oil or gas-fired power stations, will result in emission savings of carbon dioxide (CO_2), oxides of nitrogen (NO_x), and sulphur dioxide SO_2. The production of renewable energy from the proposed development will have a long-term significant positive impact on air quality. Further details on the carbon dioxide savings associated with the proposed development are presented in Section 11.3.4 below.

Residual Impact

Long-term Significant Positive Impact

Significance of Effects

Based on the assessment above there will be a significant positive direct or indirect effect.

11.2.4.3.3 *Human Health*

Long-term exposure to chemicals such as SO_2 and NOx are harmful to human health. The production of clean, renewable energy from the proposed development will offset the emission of these harmful chemicals by fossil fuel powered sources of electricity and, therefore, will have a long-term slight positive impact on human health. Further information on the impact of the proposed development on Human Health is contained in Chapter 5 of this EIAR: Population and Human Health.

Residual Impact

Long-term Slight Positive Impact

Significance of Effects

Based on the assessment above there will be no significant effects.

11.2.4.4 Decommissioning Phase

Any impact and consequential effect that occurs during the decommissioning phase are similar to that which occur during the construction phase, be it of less impact. The grid connection and substation will be left in situ; thus, no removal or demolition works will be required for these elements during the decommissioning phase. The mitigation measures prescribed for the construction phase of the

proposed development will be implemented during the decommissioning phase thereby minimising any potential impacts.

11.3 Climate

Climate legislation and policy is outlined in detail in Chapter 2 of this EIAR, however, a summary of the key information is provided in Section 11.3.1 below.

11.3.1 Climate Change and Greenhouse Gases

Although climate change is thought to be a natural process, the rate at which the climate is changing has been accelerated rapidly by human activities. Climate change is one of the most challenging global issues facing us today and is primarily the result of increased levels of greenhouse gases in the atmosphere. These greenhouse gases come primarily from the combustion of fossil fuels in energy use. Changing climate patterns are thought to increase the frequency of extreme weather conditions such as storms, floods and droughts. In addition, warmer weather trends can place pressure on animals and plants that cannot adapt to a rapidly changing environment. Moving away from our reliance on coal, oil and other fossil fuel-driven power plants is essential to reduce emissions of greenhouse gases and combat climate change.

11.3.1.1 Greenhouse Gas Emission Targets

Ireland is a Party to the Kyoto Protocol, which is an international agreement that sets limitations and reduction targets for greenhouse gases for developed countries. It is a protocol to the United Nations Framework for the Convention on Climate Change. The Kyoto Protocol came into effect in 2005, as a result of which, emission reduction targets agreed by developed countries, including Ireland, are now binding.

11.3.1.1.1 *Doha Amendment to the Kyoto Protocol*

In Doha, Qatar, on 8th December 2012, the *"Doha Amendment to the Kyoto Protocol"* was adopted. The amendment includes:

- New commitments for Annex I Parties to the Kyoto Protocol who agreed to take on commitments in a second commitment period from 1 January 2013 to 31 December 2020;
- A revised list of greenhouse gases (GHG) to be reported on by Parties in the second commitment period; and
- Amendments to several articles of the Kyoto Protocol which specifically referenced issues pertaining to the first commitment period and which needed to be updated for the second commitment period.

During the first commitment period, 37 industrialised countries and the European Community committed to reduce GHG emissions to an average of five percent against 1990 levels. During the second commitment period, Parties committed to reduce GHG emissions by at least 18 percent below 1990 levels in the eight-year period from 2013 to 2020; however, the composition of Parties in the second commitment period is different from the first.

Under the protocol, countries must meet their targets primarily through national measures, although market-based mechanisms (such as international emissions trading can also be utilised).

11.3.1.1.2 COP21 Paris Agreement

COP21 was the 21st session of the Conference of the Parties (COP) to the United Nations Convention. Every year since 1995, the COP has gathered the 196 Parties (195 countries and the European Union) that have ratified the Convention in a different country, to evaluate its implementation and negotiate new commitments. COP21 was organised by the United Nations in Paris and held from 30th November to 12th December 2015.

COP21 closed on 12th December 2015 with the adoption of the first international climate agreement (concluded by 195 countries and applicable to all). The twelve-page text, made up of a preamble and 29 articles, provides for a limitation of the temperature rise to below 2°C above pre-industrial levels and even to tend towards 1.5°C. It is flexible and takes into account the needs and capacities of each country. It is balanced as regards adaptation and mitigation, and durable, with a periodical ratcheting-up of ambitions.

11.3.1.1.3 COP25 Madrid Climate Change Conference

COP25, the 25th session of the COP, was held between the 2nd and 13th of December 2019 in Madrid. The conference was characterised by repeated warnings from civil society (NGOs and corporates) on emerging evidence and scientific consensus on climate change risk. Specifically, it is noted that there are only '10 years left' before the opportunity of limiting global warming to 1.5°C is no longer feasible. As such, the only scenario that makes it possible is a '7.6% reduction of global GHG emissions every year between 2020 and 2030, and to reach net zero emissions by 2050'. However, there was no consensus achieved between States to finalise the operating rules of the Paris Agreement and ensure that it became operational by 2020.

While largely regarded as an unsuccessful conference, the European Union launched its most ambitious plan, 'The European Green New Deal' which aims to lower CO_2 emissions to zero by 2050. The deal includes proposals to reduce emissions from the transport, agriculture and energy sectors and will affect the technology chemicals, textiles, cement and steel industries. Measures such as fines and pay-outs by member states who rely on coal power will be in place to encourage the switch to renewable clean energies such as wind.

On the 4th of March 2020, the European Commission put forward the proposal for a European climate law. This aims to establish the framework for achieving EU climate neutrality. It aims to provide a direction by setting a pathway to climate neutrality and to this end, aims to set in legislation the EU's 2050 climate-neutrality objective. If accepted, this climate law will likely be implemented in 2021. Decisions regarding the global carbon market were postponed until the next Climate Conference (COP26) which was due to be held in Glasgow in November 2020. However, this conference has since been postponed to November 2021, due to the COVID-19 pandemic.

11.3.1.1.4 Europe 2020 Strategy

The *'Europe 2020 Strategy'* is the EU's agenda for growth and jobs. The Europe 2020 Strategy targets on climate change and energy include:

- Reducing GHG emissions by at least 20% compared with 1990 levels;
- Increasing the share of renewable energy in final energy consumption to 20%; and
- Moving towards a 20% increase in energy efficiency.

The *'Europe 2020 indicators – climate change and energy'* report provides a summary of recent statistics on climate change and energy in the EU, with reference to the progress of Member States in meeting the required targets. The EU is expected to exceed its Europe 2020 target of reducing GHG emissions by 20% by 2020. However, while the EU as a whole is projected to exceed its 2020 target of reducing greenhouse gas emissions by 20%, Ireland is currently one of the countries projected to miss its

national targets. The Europe 2020 report emphasises the importance of continued action on climate change:

> *"Despite the EU's shrinking share in global CO_2 emissions, recent findings on the potentially catastrophic impacts of climate change confirm the ongoing importance of its climate and energy goals. EU emission cuts alone cannot halt climate change, but if it can show that a low-carbon economy is feasible, and can even increase innovation and employment, it will serve as a role model to other regions. Continuous investment in advanced low-carbon technologies can also help the EU uphold technological leadership and secure export markets. A successful transformation of the energy sector... is pivotal in this respect."*

While official figures for 2020 have not been released to date, the 2019 SEAI National Energy Projections Report, published in 2019 acknowledges that Ireland will fall short of its 2020 targets, it states *"...it is expected that Ireland will fall short of its mandatory European target for an overall 16% renewable energy share by 2020, with overall achievement approximately 13%".* The report goes on to confirm *"Compared with other European Countries Ireland was 22nd out of the EU28 for overall renewable energy share and 26th out of the EU-28 for progress towards overall 2020 renewable energy target."*

11.3.1.1.5 United Nations Sustainable Development Summit 2015

Transforming our World: the 2030 Agenda for Sustainable Development which includes 17 Sustainable Development Goals (SDGs) and 169 targets was adopted by all UN Member States at a UN summit held in New York in 2015. The Agenda is universally applicable with all countries having a shared responsibility to achieve the goals and targets. Targets and ctions over the 15-year period which began in January 2016, are integrated and indivisible i.e. all must be implemented together by each Member State.

The Sustainable Development Goals National Implementation Plan 2018-2020 was published by the Department of Communications, Climate Action & Environment in partnerships with OSI, Esri Ireland and the Central Statistics Office in 2018. The Plan sets out how Ireland will work to achieve the goals and targets of the Agenda for Sustainable Development both domestically and internationally. Relevant SDGs and how they are implemented into Irish National plans and policies can be found in Table 11-8.

Table 11-8 United Nations Sustainable Development Goals adopted in 2015. https://sustainabledevelopment.un.org/sdgs

SDG	Targets	International Progress to Date (2019)	National Relevant Policy
SDG 7 Affordable and Clean Energy: *Ensure access to affordable, reliable, sustainable and modern energy for all*	› By 2030, ensure universal access to affordable, reliable and modern energy services › By 2030, increase substantially the share of renewable energy in the global energy mix › By 2030, double the global rate of improvement in energy efficiency › By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy	The renewable energy share of total final energy consumption gradually increased from 16.6 per cent in 2010 to 17.5 per cent in 2016, though much faster change is required to meet climate goals. Global primary energy intensity (ratio of energy used per unit of GDP) improved from 5.9 in 2010 to 5.1 in 2016, a rate of improvement of 2.3 per cent, which is still short of	*Ireland's Transition to a Low Carbon Energy Future 2015-2030* *Strategy to Combat Energy Poverty in Ireland* *Ireland's Transition to a Low Carbon Energy Future 2015-2030* *National Mitigation Plan*

SDG	Targets	International Progress to Date (2019)	National Relevant Policy
	efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology › By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States, and land-locked developing countries, in accordance with their respective programmes of support	the 2.7 per cent annual rate needed to reach target 3 of Sustainable Development Goal 7.	*National Energy Efficiency Action Plan for Ireland # 4 2017-2020* *Better Energy Programme* *One World, One Future* *The Global Island*
SDG 13 Climate Action: *Take urgent action to combat climate change and its impacts** **Acknowledging that the United Nations Framework Convention on Climate Change is the primary international, intergovernmental forum for negotiating the global response to climate change.*	Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries Integrate climate change measures into national policies, strategies and planning Implement the commitment undertaken by developed-country parties to the United Nations Framework Convention on Climate Change to a goal of mobilizing jointly $100 billion annually by 2020 from all sources to address the needs of developing countries in the context of meaningful mitigation actions and transparency on implementation and fully operationalize the Green Climate Fund through its capitalization as soon as possible	In 2017, greenhouse gas concentrations reached new highs, with globally averaged mole fractions of CO2 at 405.5 parts per million (ppm), up from 400.1 ppm in 2015, and at 146 per cent of pre-industrial levels. Moving towards 2030 emission objectives compatible with the 2°C and 1.5°C pathways requires a peak to be achieved as soon as possible, followed by rapid reductions. During the period 1998–2017, direct economic losses from disasters were estimated at almost $3 trillion. Climate-related and geophysical disasters claimed an estimated 1.3 million lives. As of April 2019, 185 parties had ratified the Paris Agreement. Parties to the Paris Agreement are expected to prepare, communicate and maintain successive	*National Adaptation Framework* *Building on Recovery: Infrastructure and Capital Investment 2016-2021* *National Mitigation Plan* *National Biodiversity Action Plan 2017-2021* *National Policy Position on Climate Action and Low Carbon Development*

SDG	Targets	International Progress to Date (2019)	National Relevant Policy
		nationally determined contributions, and 183 parties had communicated their first nationally determined contributions to the secretariat of the United Nations Framework Convention on Climate Change, while 1 party had communicated its second. Under the Agreement, all parties are required to submit new nationally determined contributions, containing revised and much more ambitious targets, by 2020. Global climate finance flows increased by 17 per cent in the period 2015–2016 compared with the period 2013–2014. As at 20 May 2019, 75 countries are seeking support from the Green Climate Fund for national adaptation plans and other adaptation planning processes, with a combined value of $191 million.	

11.3.1.1.6 *Climate Action Network Europe Off Target Report 2018*

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

In March 2019, the Minister for Communications, Climate Action, and the Environment, Richard Bruton, announced a renewable electricity target of 70% by 2030 for Ireland. Furthermore, the release of the Climate Action Plan in June 2019 has noted a 30% reduction in greenhouse gases by 2030. Considering only renewable energy from electricity as part of this plan and to meet the required level of emissions reduction by 2030, Ireland will:

- Reduce CO_2 eq. emissions from the sector by 50–55% relative to 2030 NDP projections.
- Deliver an early and complete phase-out of coal- and peat-fired electricity generation.

- Increase electricity generated from renewable sources to 70%, indicatively comprised of:
  - at least 3.5 GW of offshore renewable energy;
  - up to 1.5 GW of grid-scale solar energy; and
  - up to 8.2 GW total of increased onshore wind capacity.
- Meet 15% of electricity demand by renewable sources contracted under Corporate PPAs.

Achieving 70% renewable electricity by 2030 will involve phasing out coal and peat-fired electricity generation plants, increasing our renewable electricity, reinforcing our grid (including greater interconnection to allow electricity to flow between Ireland and other countries), and putting systems in place to manage intermittent sources of power, especially from wind.

As noted previously, Ireland is not on track for meeting its 2020 renewable energy targets. It is now more critical than ever that we continue to progress renewable energy development in Ireland so as we are successful in meeting our 2030 target.

The Climate Action Plan noted specific sectors which are required to step-up in order to help Ireland achieve its EU targets. The renewable energy sector was cited alongside the country's commitment to increase onshore wind capacity by up to 8.2 GW. The proposed development will help contribute towards this target.

The proposed wind farm development is compatible with the relevant provisions as set out in the Climate Action Plan 2019, relating to the harnessing of renewable energy. In summary, the proposed development will contribute the following:

- Production of 183,960 MWh (megawatt hours) of electricity which would be sufficient to supply 43,800 Irish households with electricity per year. This calculation is presented in Section 4.3.16 of Chapter 4 of this EIAR and is based on a minimum wind farm output capacity of 60 Megawatts (MW), i.e. 17 No. 3.5-MW turbines. Assuming 17 No. 5-MW turbines are installed on the site, i.e. wind farm output of 85 MW, this would produce 260,610 MWh of electricity, sufficient to supply 62,050 Irish households with electricity each year.
- Helping to meet the target that 70% of our electricity needs will come from renewable sources by 2030.
- Helping to reduce carbon emissions and improving Ireland's security of energy supply.
- Provision of grid connection infrastructure to support the renewable energy output from the proposed development.

Further detail on the EU 2030 targets are set in Chapter 2, Sections 2.1 and 2.2 of this EIAR.

11.3.1.1.7 *Climate Change Performance Index*

Established in 2005, the Climate Change Performance Index (CCPI) is an independent monitoring tool which tracks countries climate protection performance. It assesses individual countries based on climate policies, energy usage per capita, renewable energy implementation and Greenhouse Gas Emissions (GHG) and ranks their performance in each category and overall. The 2020 CCPI was published in December 2019 and presented at the COP25. While the CCPI 2020 indicated signs of potential reductions in global emissions, no country achieved its Paris Climate targets and therefore the first three places of the ranking system remain unoccupied.

Ireland, ranked the worst EU performer in the CCPI 2019, climbed 7 places from 48th out of 60 globally ranked countries to 41st place and has moved from a "very low" to "low" in international performance. However, it remains at "very low" at a national performance level. The CCPI report states that while some improvements have been made, GHG per capita emissions are at a high level and *"significant challenges lie ahead in closing Ireland's emission gap, meeting the current (2030) target and aligning Ireland's emission trajectory with a net zero goal for 2050. Therefore, the country still ranks among the*

bottom ten performers in this indicator." Recognising Ireland's Climate Action Plan 2019, the CCPI states:

> "*the government must go much further in implementing policies across all sectors that drive sustained emissions reductions over the next decade. Near-term ambition needs to be ratcheted up quickly by specifying deep cuts in fossil fuel and reactive nitrogen usage to put Ireland on a net zero emissions pathway aligned with the Paris temperature goals."*

11.3.1.1.8 Climate Action Plan

The Climate Action Plan 2019 (CAP) was published on the 1st of August 2019 by the Department of Communications, Climate Action and Environment. The CAP sets out an ambitious course of action over the coming years to address the impacts which climate may have on Ireland's environment, society, economic and natural resources. This Plan clearly recognises that Ireland must significantly step up its commitments to tackle climate disruption.

Chapter 1 of the CAP sets out the nature of the challenge which Ireland faces over the coming years. The CAP notes that the evidence for warming of our climate system is beyond dispute with observations showing that global average temperatures have increased by more than 1°C since pre-industrial times. These changes will cause extensive direct and indirect harm to Ireland and its people, as well as to other countries more exposed and less able than we are to withstand the associated impacts environmental impacts such as extremes in weather, flooding, displacement of population by the creation of climate refugees, poorer water quality and poorer air quality. In order to help reduce CO2 emissions and reach our 2030 and 2050 emissions targets, CAP has set out a list of renewable energy goals which includes implementing up to 8.2 GW total of increased onshore wind capacity on the island.

The Proposed Development can assist in reaching this target not only by fulfilling the implementation of renewable energy and much needed grid infrastructure, it has the capacity to offset **2,429,706 tonnes** of CO_2 thereby reducing the Greenhouse Gas effect and improving air quality as we transition to cleaner energy industries. Please see Section 11.3.4 for details on Carbon offset calculations.

11.3.1.1.9 Emissions Projections

Ireland's target is to achieve a 20% reduction of non-Emissions Trading Scheme (non-ETS) sector emissions, i.e. agriculture, transport, residential, commercial, non-energy intensive industry and waste, on 2005 levels, with annual binding limits set for each year over the period 2013 – 2020. The Environmental Protection Agency (EPA) publishes Ireland's Greenhouse Gas Emission Projections with the most recent report, 'Ireland's Greenhouse Gas Emissions Projections 2019 –2040 published in July 2020. The report includes an assessment of Ireland's progress towards achieving its emission reduction targets out to 2030 will result in a reduction in Ireland's total greenhouse gas emissions by up to 23% only with the full and early implementation of the 2019 Climate Action Plan.

Implementation of the "With Additional Measures" scenario" (including the impact of the 2019 Climate Action Plan) is projected to save 79 Mt CO2 eq over the period 2021-2030 compared to the "With Existing Measures" scenario which would see Ireland exceeding its carbon budget by approximately 51 Mt CO2 eq over the 2021-2030 period. The 'With Existing Measures' scenario assumes that no additional policies and measures, beyond those already in place by the end of 2017 (latest national greenhouse gas emission inventory) are implemented. The 'With Additional Measures' scenario assumes the implementation of the "With Existing Measures" scenario and further implementation of the governments renewable and energy efficiency policies including those set out in the National Renewable Energy Action Plan (NREA), the National Energy Efficiency Action Plan (NEEAP), the National Development Plan 2018-2027 and the 2019 Climate Action Plan. These projections are based on a forecast of strong economic growth. The impact of Covid-19 is not included in these figures. This impact of the pandemic in terms of greenhouse gas emissions will be incorporated in the next round of projections.

The EPA Emission Projections notes the following key trends:

- *Ireland is set to miss its target for compliance with the EU's Effort Sharing Decision (Decision No 406/2009/EC). Ireland is projected to meet non-ETS EU targets over the period 2021 to 2030. This assumes full implementation of the 2019 Climate Action Plan and the use of flexibilities in relation to land use, land use change and forestry. However, Ireland's non-ETS emissions are projected to be only 2-4% below 2005 levels in 2020, compared to the EU target of 20%;*
- *Full and early implementation of the 2019 Climate Action Plan is needed if the savings projected are to materialise. The scale and pace of the changes needed are significant, requiring much greater reliance on renewables, cross-cutting measures such as an €80 per tonne of CO2 carbon tax by 2030 and further ambitious measures in sectors such as transport, agriculture and power generation;*
- *A 70% contribution of renewable energy in electricity generation by 2030 will be achieved by approximately tripling the 2018 renewable generation capacity, while phasing out coal and peat use. Increased renewables, and greater interconnection, are projected to result in energy industries emissions decreasing by over 34% by 2030 compared to the most recent figures in 2018.*

11.3.2 Programme for Government 2020

The Programme for Government 2020 was published in June 2020. In relation to climate change the programme recognises that the next ten years are a critical period in addressing the climate crisis. It is an ambition of the programme to more than halve carbon emissions over the course of the decade (2020-2030). The programme notes that the government are committed to reducing greenhouse gas emissions by an average 7% per annum over the next decade in a push to achieve a net zero emissions by the year 2050. The programme also recognises the severity of the climate challenge as it clarifies that:

> *"Climate change is the single greatest threat facing humanity"*

With regards to energy the programme notes that the government will implement a new National Energy Efficiency Action Plan to reduce energy use, including behavioural and awareness aspects of energy efficiency such as building and data management. Further, the government are also committed to the rapid decarbonisation of the energy sector, along with this it is noted that the necessary steps will be taken to deliver at least 70% of renewable electricity by the year 2030. Some of the measures to achieve this will include the following:

- Hold the first Renewable Electricity Support Scheme (RESS) auction by the end of 2020, with auctions held each year thereafter, including the first RESS auction for offshore wind in 2021.
- Produce a whole-of-government plan setting out how at least 70% renewable electricity generation by 2030 will be delivered and how the necessary skills base, supply chains, legislation, and infrastructure to enable it will be delivered. This new plan will make recommendations for how the deployment of renewable electricity can be sped.
- Finalise and publish the Wind Energy Guidelines, having regard to the public consultation that has taken place.
- Continue Eirgrid's programme 'Delivering a Secure, Sustainable Electricity System' (DS3).
- Strengthen the policy framework to incentivise electricity storage and interconnection.

Support the clustering of regional and sectoral centres of excellence in the development of low-carbon technologies.

11.3.2.1.1 *Climate Action and Low Carbon Development (Amendment) Bill 2020*

The Draft Climate Action and Low Carbon (Amendment) Bill 2020, published in October 2020, is a piece of legislation which commits the country to move to a climate resilient and climate neutral economy by 2050. The Programme for Government commits to a 7% average yearly reduction in overall greenhouse gas emissions over the next decade, and to achieving net zero emissions by 2050. This Bill will manage the implementation of a suite of policies to assist in achieving this target. The Bill includes the following key elements, among others:

- Establishes a 2050 emissions target
- Introduces system of successive 5-year, economy-wide carbon budgets starting in 2021
- Strengthens the role of the Climate Change Advisory Council in proposing carbon budgets
- Introduces a requirement to annually revise the Climate Action Plan and prepare a National Long Term Climate Action Strategy at least every decade.

11.3.3 Climate and Weather in the Existing Environment

Both County Cork and County Waterford have a temperate oceanic climate, resulting in mild winters and cool summers. The Met Éireann weather station at Cork Airport is the nearest weather and climate monitoring station to the proposed development site, located approximately 40 kilometres to the southwest of the site. Meteorological data recorded at Cork Airport over the 30-year period from 1981-2010 is shown in Table 11-9 overleaf. The wettest months are October and December, and April is usually the driest. July is the warmest month with an average temperature of 15.3° Celsius. The mean annual temperature recorded at Cork Airport was 9.9° Celsius.

Table 11-9 Data from Met Éireann Weather Station at Cork Airport, 1981 to 2010 – Monthly an Annual Mean and Extreme Values

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
TEMPERATURE (degrees Celsius)													
Mean daily max	8.2	8.3	9.9	11.8	14.4	17.0	18.7	18.5	16.5	13.2	10.3	8.5	12.9
Mean daily min	3.0	3.1	4.0	4.9	7.4	10.0	11.8	11.8	10.2	7.7	5.2	3.7	6.9
Mean temperature	5.6	5.7	6.9	8.4	10.9	13.5	15.3	15.2	13.3	10.5	7.8	6.1	9.9
Absolute max.	16.1	14.0	15.7	21.2	23.6	27.5	28.7	28.0	24.7	21.4	16.2	13.8	28.7
Absolute min.	-8.0	-4.7	-4.3	-2.3	-0.9	3.7	6.7	5.3	2.3	-0.9	-3.3	-7.2	-8.0
Mean num. of days with air frost	4.6	4.1	1.8	1.2	0.0	0.0	0.0	0.0	0.0	0.2	1.2	3.6	16.7
Mean num. of days with ground frost	12.8	11.8	9.7	7.8	2.1	0.1	0.0	0.0	0.5	2.4	7.3	11.0	65.3
RELATIVE HUMIDITY (%)													
Mean at 0900UTC	89.8	89.4	87.8	83.1	80.6	81.3	83.2	85.4	88.4	90.1	90.7	90.5	86.7
Mean at 1500UTC	83.7	78.9	75.5	71.3	70.9	71.5	72.9	72.8	75.4	80.4	83.4	85.4	76.8
SUNSHINE (Hours)													
Mean daily duration	1.8	2.4	3.3	5.3	6.2	5.8	5.4	5.2	4.3	3.0	2.3	1.7	3.9
Greatest daily duration	8.5	10.0	11.5	13.6	15.5	16.0	15.3	14.4	11.9	10.3	8.7	7.6	16.0
Mean no. of days with no sun	10.1	7.9	6.3	3.1	2.1	2.5	2.0	2.6	3.6	6.4	8.6	11.9	67.1
RAINFALL (mm)													

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Mean monthly total	131.4	97.8	97.6	76.5	82.3	80.9	78.8	96.8	94.6	138.2	120.0	133.1	1227.9
Greatest daily total	45.7	49.9	55.2	34.2	34.9	59.7	73.2	60.9	58.9	52.1	47.9	41.9	73.2
Mean num. of days with >= 0.2mm	20	17	19	16	15	14	15	15	16	19	19	19	204
Mean num. of days with >= 1.0mm	16	13	14	11	12	10	10	11	11	15	14	15	152
Mean num. of days with >= 5.0mm	9	6	5	5	5	5	5	5	5	8	7	8	73
WIND (knots)													
Mean monthly speed	12.1	12.0	11.6	10.3	10.1	9.4	9.0	9.0	9.4	10.7	10.9	11.6	10.5
Max. gust	78	83	70	62	59	49	57	54	58	75	66	80	65.9
Max. mean 10-minute speed	52	54	43	40	40	33	40	38	39	48	46	56	44.1
Mean num. of days with gales	2.3	1.8	1.3	0.3	0.3	0.0	0.1	0.2	0.3	1.0	1.2	1.9	10.8
WEATHER (Mean No. of Days With:)													
Snow or sleet	3.1	3.1	2.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.3	2.2	11.3
Snow lying at 0900UTC	0.7	0.5	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	2.0
Hail	1.0	1.1	1.4	1.9	0.7	0.2	0.1	0.0	0.1	0.3	0.2	0.4	7.4
Thunder	0.2	0.1	0.1	0.1	0.6	0.5	0.8	0.3	0.0	0.4	0.1	0.1	3.3
Fog	7.8	6.8	8.5	7.5	7.6	7.6	8.4	8.8	9.1	8.7	7.6	8.4	96.8

11.3.4 Calculating Carbon Losses and Savings from Wind Farms

11.3.4.1 Background

In addition to the combustion of fossil fuels, greenhouse gases are also released through natural processes such as the decomposition of organic material (which is composed of carbon). Certain types of wind farm sites, such as bogs and peatlands are known to store large amounts of carbon. Due to the waterlogged nature of such habitats, stored carbon is not broken down and released into the atmosphere. The construction of wind farms on bog and peat habitats may affect the natural hydrological regime, thus exposing and drying out the peat and allowing the decomposition of carbon. It is necessary therefore to demonstrate that any wind farm constructed on such sites saves more carbon than is released. There is no peat present within the development footprint at the site of the proposed Lyrenacarriga Wind Farm.

The carbon balance of proposed wind farm developments in peatland habitats has attracted significant attention in recent years. When development such as wind farms are proposed for peatland areas, there will be direct impacts and loss of peat in the area of the development footprint. There may also be indirect impacts where it is necessary to install drainage in certain areas to facilitate construction. The works can either directly or indirectly allow the peat to dry out, 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.

The site of the proposed development is underlain by Sandstone Till and rock outcrops, with none of the proposed development footprint being located on a peatland. For this reason, the carbon balance between the use of a renewable energy and the loss of carbon stored in the peat is not assessed in this section of the EIAR. Carbon dioxide is released in the manufacture and transportation of turbines to the site, and therefore a carbon loss/saving calculation for the proposed development has been undertaken.

11.3.4.2 Methodology for Calculating Losses

A methodology was published in June 2008 by scientists at the University of Aberdeen and the Macauley Institute with support from the Rural and Environment Research and Analysis Directorate of the Scottish Government, Science Policy and Co-ordination Division. The document, '*Calculating Carbon Savings from Wind Farms on Scottish Peat Lands*', was developed to calculate the impact of wind farm developments on the soil carbon stocks held in peat. This methodology was refined and updated in 2011 based on feedback from users of the initial methodology and further research in the area. The web-based version of the carbon calculator, which supersedes the Excel-based versions of the tool, was released in 2016. The tool provides a transparent and easy to follow method for estimating the impacts of wind farms on the carbon dynamics of peatlands. Previously guidance produced by Scottish Natural Heritage in 2003 had been widely employed to determine carbon payback in the absence of any more detailed methods.

Given the absence of peat underlying the site, the proposed wind farm development will not give rise to any impact on peat habitat. The Macauley Institute methodology states that the total volume of peat impacted by the construction of the wind farm is strongly correlated to the extent of the peatland affected by drainage at the site. Therefore, in calculating the carbon loss/saving of the proposed development, all potential carbon losses associated with constructing a wind farm on peatland environments were discounted, but the carbon losses as a result of the manufacture, transportation and erection of the proposed turbines was included in the calculation, including as a result of the removal of vegetation.

Felling of existing forestry surrounding turbine locations may often be necessary to avoid reductions in the wind energy yield of wind farm proposals. Forestry may be felled earlier than originally planned due to the wind farm development, so limiting the nature and longevity of the resulting timber produced. If the forestry is felled for the development, the effects are judged to be attributable to the wind farm development. Carbon losses as a result of felling are calculated from the area to be felled, the average carbon sequestered annually, and the lifetime of the wind farm. Alterations in soil carbon levels following felling are calculated using the equations for drainage and site restoration already described.

11.3.4.3 Calculating Carbon Losses and Savings

11.3.4.3.1 *Carbon Losses*

The Scottish Government on-line carbon calculator was used to assess the impacts of the proposed wind farm in terms of potential carbon losses and savings taking into account drainage, habitat improvement and site restoration.

A copy of the outputs is provided as Appendix 11-1 of this EIAR. Where available and relevant, site-specific information was inserted into the worksheet. Otherwise, default values were used. The worksheet was pre-loaded with information specific to the CO_2 emissions from the United Kingdom's electricity generation plant, which is used to calculate emissions savings from proposed wind farm projects in the UK. Similar data to that used in the worksheet to calculate the CO_2 emissions from the UK electricity generation plant, was not allowable for input for the Irish electricity generation plant, and so the CO_2 emissions savings from the proposed wind farm development have been calculated separately from the worksheet as set out in Section 11.3.4.3.2 below.

The main CO_2 losses due to the proposed wind farm development are summarised in Table 11-10.

Table 11-10 CO_2 losses from the Proposed Development

Origin of Losses	CO_2 Losses (tonnes CO_2 equivalent)	
	Expected	Maximum
Losses due to turbine life (e.g. due to production, transportation, erection, operation and dismantling of the wind farm)	48,909	72,893
Losses due to backup	35,182	50,261
Losses due to reduced carbon fixing potential	6,028	9,939
Losses due to felling forestry for wind farm	20,196	21,164
Total	**110,315**	**154,257**

The worksheet model calculates that the proposed development will give rise to 110,315 tonnes of CO_2 equivalent losses over its 30-year life. Of this total figure, the proposed wind turbines directly account for 48,909 tonnes, or 44%. Losses due to backup account for 35,182 tonnes, or 32%. Losses from reduced carbon fixing potential and the felling of forestry accounting for the remaining 24% or 26,224 tonnes. The figure of 26,224 tonnes of CO_2 arising from ground activities associated with the proposed

development is calculated based on the entire development footprint being "Acid Bog", as this is one of only two choices the model allows (the other being Fen). The habitat that will be impacted by the development footprint comprises predominantly commercial forestry and grassland which is underlain by Sandstone Till rather than the acid bog assumed by the model that gives rise to the 26,224 tonnes and therefore the actual CO_2 losses are expected to be lower than this value.

The figures discussed above are based on the assumption that the hydrology of the site and habitats within the site are restored on decommissioning of the proposed wind farm after its expected 30-year operational life. As a worst-case scenario, the model was also used to calculate the CO_2 losses from the wind farm if the hydrology and habitats of the site were not to be restored, as may be the case if the turbines were replaced with newer models, rather than decommissioned entirely. This worst-case scenario would increase the expected carbon losses by an additional 43,942 tonnes, or by 40% to 154,257 tonnes. Any failure to restore the site habitats or hydrology for the reasons outlined above would be further offset by the carbon-neutral renewable energy that the new turbines would generate.

11.3.4.3.2 Carbon Savings

According to the model described above, the proposed wind farm development will give rise to total losses of 110,315 tonnes of carbon dioxide.

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

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

where: A = The rated capacity of the wind energy development in MW

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

C = The number of hours in a year

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

A rated output of between 3.5 MW and 5.0 MW has been chosen to calculate the power output of the proposed 17-turbine wind farm, which would result in an estimated installed capacity of between 60 MW and 85 MW. For the purposes of this calculation, the conservative minimum rated capacity of the proposed wind farm of 60 MW is used.

A load factor of 0.35 (or 35%) has been used for the proposed development[4].

The number of hours in a year is 8,760.

The most recent data for the carbon load of electricity generated in Ireland is for 2017 and was published in Sustainable Energy Authority Ireland's (SEAI) December 2018 report, '*Energy in Ireland, 2018 Report.'* The emission factor for electricity in Ireland in 2017 was 436.6 g CO_2/kWh.

The calculation for carbon savings is therefore as follows:

[4] *SEAI (2019) Renewable Energy In Ireland 2019 Report. Sustainable Energy Authority of Ireland.*

$$CO_2 \text{ (in tonnes)} = \frac{(60 \times 0.35 \times 8{,}760 \times 436.6)}{1000}$$

$$= 80{,}316.94 \text{ tonnes per annum}$$

Based on this calculation, approximately 80,317 tonnes of carbon dioxide will be displaced per annum from the largely carbon-based traditional energy mix by the proposed wind farm. Over the proposed thirty-year lifetime of the wind farm, therefore, 2,409,510 tonnes of carbon dioxide will be displaced from traditional carbon-based electricity generation.

As noted previously areas cleared of forestry for the Proposed Development will be replaced by replanting onsite and offsite alternatives sites. A total of 51 hectares of new forestry will be replanted onsite and offsite alternatives sites to compensate the loss of forestry at the Proposed Development site. Given that losses due to felling forestry account for 20,196 tonnes of CO_2, it has been assumed for the purposes of this calculation that the same quantity of CO_2 can be saved over the windfarm lifetime by replanting forestry at alternative sites.

In total, it is estimated that **2,429,706** tonnes of carbon dioxide will be displaced over the proposed thirty-year lifetime of the Proposed Development. There would be a higher CO_2 displacement should a higher capacity turbine be used on the site.

Based on the Scottish Government carbon calculator as presented above 110,315 tonnes of CO_2 will be lost to the atmosphere due to the construction and operation of the proposed development. This represents 4.5% of the total amount of carbon dioxide emissions that will be offset by the proposed wind farm project. The 110,315 tonnes of CO_2 that will be lost to the atmosphere due to the construction and operation of the proposed development will be offset by the proposed development in approximately **16 months** of operation.

11.3.5 Likely Significant Effects and Associated Mitigation Measures

11.3.5.1 'Do-Nothing' Effect

If the proposed development were not to proceed, greenhouse gas emissions, e.g. carbon dioxide (CO2), carbon monoxide and nitrogen oxides associated with construction vehicles and plant would not arise. However, the opportunity to further significantly reduce emissions of greenhouse gas emissions, including carbon dioxide (CO_2), oxides of nitrogen (NO_x), and sulphur dioxide (SO_2), to the atmosphere would be lost. The opportunity to contribute to Ireland's commitments under the Kyoto Protocol and EU law would also be lost. This would be a long-term slight negative impact.

11.3.5.2 Construction Phase

11.3.5.2.1 *Greenhouse Gas Emissions*

1. Turbines and Other Infrastructure

The construction of turbine bases and hardstands, site roads and all associated infrastructure will require the operation of construction vehicles and plant on site. Greenhouse gas emissions, e.g. carbon dioxide (CO_2), carbon monoxide and nitrogen oxides associated with vehicles and plant will arise as a result of the construction activities. This potential impact will be slight only, given the insignificant quantity of greenhouse gases that will be emitted, and will be restricted to the duration of the construction phase. Therefore, this is a short-term slight negative impact. Mitigation measures to reduce this impact are presented below.

2. Grid Connection

The construction of the proposed substation and associated grid connection will require the use of construction machinery, thereby giving rise to greenhouse emissions. This is a short-term slight negative impact, which will be reduced through use of the best practice mitigation measures as presented below.

3. Transport to Site

The transport of turbines and construction materials to the site, which will occur on specified routes only (see Section 4.4 in Chapter 4 of this EIAR), will also give rise to greenhouse gas emissions associated with the transport vehicles. This constitutes a slight negative impact in terms of air quality. Mitigation measures in relation to greenhouse gas emissions are presented below.

Mitigation

- All construction vehicles and plant will be maintained in good operational order while onsite, thereby minimising any emissions that arise.
- Turbines and construction materials will be transported to the site on specified routes only unless otherwise agreed with the Planning Authority.
- The majority of aggregate materials for the construction of the proposed wind farm will be obtained from the three proposed borrow pits on the site of the Proposed Development. This will significantly reduce the number of delivery vehicles accessing the site, thereby reducing the amount of emissions associated with vehicle movements.

Residual Impacts

Short-term Imperceptible Negative Impact on Climate as a result of greenhouse gas emissions.

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects.

11.3.5.3 Operational Phase

11.3.5.3.1 *Greenhouse Gas Emissions*

The Proposed Development will generate energy from a renewable source. This energy generated will offset energy and the associated emission of greenhouse gases from electricity-generating stations dependent on fossil fuels, thereby having a positive effect on climate. As detailed in Table 11-10 above, the Proposed Development will displace carbon dioxide from fossil fuel-based electricity generation over the proposed 30-year lifespan of the proposed wind farm. The proposed project will assist in reducing carbon dioxide (CO_2) emissions that would otherwise arise if the same energy that the proposed wind farm will generate were otherwise to be generated by conventional fossil fuel plants. This is a long-term significant positive effect on climate.

Some potential long-term slight negative impacts that may occur during the operational phase of the Proposed Development are the release of small amounts of carbon dioxide to the atmosphere due to the potential alteration to the drainage of the site and the removal of carbon fixing vegetation. These impacts will be slight and will be nullified by the quantity of carbon dioxide that will be displaced by the Proposed Development and by the design and layout of the development which has ensured the utilisation of as much of the existing roads on site as possible to gain access to the proposed turbine locations and minimise the construction of additional roads through carbon fixing vegetation.

Residual Impacts

Long-term Moderate Positive Impact on Climate as a result of reduced greenhouse gas emissions.

Significance of Effects

Based on the assessment above there will be a direct long-term moderate, positive effect.

11.3.5.4 Decommissioning Phase

Any impact and consequential effect that occurs during the decommissioning phase are similar to that which occur during the construction phase, be it of less impact. The mitigation measures prescribed for the construction phase of the proposed development will be implemented during the decommissioning phase thereby minimising any potential impacts

11.4 Cumulative Assessment

Potential cumulative effects on air quality and climate between the Proposed Development and other developments in the vicinity were also considered as part of this assessment. The developments considered as part of the cumulative effect assessment are described in Section 2.7 of this EIAR.

The nature of the proposed development is such that, once operational, it will have a long-term, moderate, positive impact on the air quality and climate.

During the construction phase of the Proposed Development and other developments within 20 kilometres of the wind farm site that are yet to be constructed, there will be minor emissions from construction plant and machinery and potential dust emissions associated with the construction activities. However, once the mitigation proposals, as outlined in Sections 11.2.4 and 11.3.5 are implemented during the construction phase of the Proposed Development, there will be no cumulative negative effect on air and climate.

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

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