10. AIR AND CLIMATE

10.1 Air Quality

10.1.1 Introduction

This chapter identifies, describes and assesses the potential significant direct and indirect effects on air quality and climate arising from the construction, operation and decommissioning of the proposed Glenard Wind Farm.

The site of the proposed development is located on the Inishowen peninsula in Co. Donegal, approximately 5.9km east of Buncrana and 6.3km west of Quigley's Point. The townlands within which the proposed development is located can be found in Chapter 1 Table 1-1 of this EIAR.

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

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

10.1.1.1 Relevant Guidance

The air quality and climate section of this EIAR has been completed in accordance with in accordance with the EIA Directive 2011/92/EU as amended by Directive 2014/52/EU and having regard, where relevant, to guidance contained in the Section 1.7.1 of this EIAR.

10.1.1.2 Statement of Authority

This chapter of the EIAR was completed by Eoin McCarthy and Michael Watson. Eoin is a Senior Environmental Scientist with McCarthy O'Sullivan Ltd. with over 9 years of experience in private consultancy. Eoin holds B.Sc. (Hons) in Environmental Science from NUI, Galway. Michael Watson is Project Director and head of the Environment Team in MKO. Michael has over 19 years' experience in the environmental sector. Following the completion of his Master's Degree in Environmental Resource Management, Geography, from National University of Ireland, Maynooth he worked for the Geological Survey of Ireland. Between them, they have completed Air and Climate EIAR chapters for over twenty wind energy projects.

10.2 Air Quality

10.2.1 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).
- The 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 and was transposed into Irish law by the Arsenic, Cadmium, Mercury, Nickel and Polycyclic Aromatic Hydrocarbons in Ambient Air Regulations, 2009 (S.I. No. 58 of 2009).

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) (as amended by Directive EU 2015/1480) 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 10-1 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 (μg/m^3) and parts per billion (ppb). The notation PM10 is used to describe particulate matter or particles of ten micrometres or less in aerodynamic diameter. PM2.5 represents particles measuring less than 2.5 micrometres in aerodynamic diameter.

The CAFE Directive was transposed in to Irish legislation by the Air Quality Standards Regulations 2011 (S.I. No. 180 of 2011) as amended by the Air Quality Standards (Amendments) and Arsenic, Cadmium, Mercury, Nickel and Polycyclic Aromatic Hydrocarbons in Ambient Air Regulations, 2016 (S.I. 659 2016). 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 10-1 Limit values of Directive 2008/50.EC, 1999/30/EC and 2000/69/EC (Source: https://www.epa.ie/air/quality/standards/)

Pollutant	Limit Value Objective	Averaging Period	Limit Value (ug/m^3)	Limit Value (ppb)	Basis of Application of Limit Value	Attainment Date
Sulphur dioxide (SO2)	Protection of Human Health	1 hour	350	132	Not to be exceeded more than 24 times in a calendar year	1st Jan 2005

Pollutant	Limit Value Objective	Averaging Period	Limit Value (ug/m^3)	Limit Value (ppb)	Basis of Application of Limit Value	Attainment Date
Sulphur dioxide (SO2)	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 (SO2)	Protection of vegetation	Calendar year	20	7.5	Annual mean	19th Jul 2001
Sulphur dioxide (SO2)	Protection of vegetation	1st Oct to 31st Mar	20	7.5	Winter mean	19th Jul 2001
Nitrogen dioxide (NO2)	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 (NO2)	Protection of human health	Calendar year	40	21	Annual mean	1st Jan 2010
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

Pollutant	Limit Value Objective	Averaging Period	Limit Value (ug/m^3)	Limit Value (ppb)	Basis of Application of Limit Value	Attainment Date
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 (NO2)	Protection of ecosystems	Calendar year	30	16	Annual mean	19th Jul 2001
Particulate matter 10 (PM10)	Protection of human health	24 hours	50	-	Not to be exceeded more than 35 times in a calendar year	1st Jan 2005
Particulate matter 2.5 (PM2.5)	Protection of human health	Calendar year	40	-	Annual mean	1st Jan 2005
Particulate matter 2.5 (PM2.5) Stage 1	Protection of human health	Calendar year	25	-	Annual mean	1st Jan 2015
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	Protection of human health	Calendar year	20	-	Annual mean	1st Jan 2020

Pollutant	Limit Value Objective	Averaging Period	Limit Value (ug/m^3)	Limit Value (ppb)	Basis of Application of Limit Value	Attainment Date
(PM2.5) Stage 2						
Lead	Protection of human health	calendar year	0.5		Annual mean	1st Jan 2005
Carbon Monoxide	Protection of human health	8 hours	10,000	8620	Not to be exceeded	1st Jan 2005
Benzene	Protection of human health	calendar year	5	1.5	Annual mean	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 10-2 presents the limit and target values for ozone.

Table 10-2 Target values for Ozone Defined in Directive 2008/50/EC

Objective	Parameter	Target Value for 2010	Target Value from 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	-

*The sum of the differences between hourly ozone concentration and 40 ppb for each hour when the concentration exceeds 40 ppb during a relevant growing season, e.g. for forest and crops.

10.2.1.1 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). A more recent European Environmental Agency (EEA) Report, '*Air Quality in Europe – 2020 Report'* highlights the negative effects of air pollution on human health. The report assessed that poor air quality accounted for premature deaths of approximately 417,000 people in Europe in 2018, 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 2018 were around 55,000 and 20,600 premature deaths, respectively.

Of these numbers, 1,180 deaths due to poor air quality were estimated in Ireland in 2018 with 1,300 Irish deaths attributed to fine particulate matter ($PM_{2.5}$), 50 Irish deaths attributed to nitrogen oxides (NO_2) and 60 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.

Whilst there is the potential of such emissions to be temporarily generated from the site construction work, mitigation measures discussed below in Sections 10.2.4 will be implemented to reduce the impact from these potential emissions.

10.2.2 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. The site of the Proposed Development lies within Zone D, which represents rural areas located away from large population centres.

10.2.3 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 most recent report on air quality in Ireland, 'Air Quality in Ireland 2020' was published by the EPA in 2021. The EPA reports provide SO_2, PM_{10}, NO_2 and O_3 concentrations for areas in Zone D.

10.2.3.1 Sulphur Dioxide (SO_2)

Sulphur dioxide data for Cork Harbour, Kilkitt, Askeaton and Letterkenny in 2020 is presented in Table 10-3**Error! Reference source not found.**.

Table 10-3 Average Sulphur Dioxide Data for Zone D Sites in 2020

Parameter	Measurement (ug/m^3)
Annual Mean	4.15
Hourly values > 350	0.5
Hourly max	135.18
Daily values > 125	0
Daily max	25.55

During the monitoring period there were no exceedances of the daily limit values for the protection of human health. As can observed from Table 10-3 the average maximum hourly value recorded during the assessment period was 135.18 µg/m^3. In addition, there were no exceedances of the annual mean limit for the protection of ecosystems. It would be expected that SO_2 values at the Proposed Development site would be similar or lower than those recorded for the Zone D sites above.

10.2.3.2 Particulate Matter (PM_{10})

Sources of particulate matter include vehicle exhaust emissions, soil and road surfaces, construction works and industrial emissions. The EPA report[1] provide annual mean PM_{10} concentration for twelve Zone D towns, Tipperary Town, Carrick-on-shannon, Enniscorthy, Birr, Askeaton, Macroom, Castlebar, Cobh, Claremorris, Kilkitt, Cavan and Roscommon Town. Particulate matter (PM_{10}) data for 2020 is presented in Table 10-4.

Table 10-4 Average Particulate Matter (PM_{10}) Data for Zone D Sites in 2020

Parameter	Measurement (ug/m^3)
Annual Mean	11.17
% Data Capture	75
Values > 50 ug/m^3	Max 5
Daily Max	46.5

Notes: [1-] PM_{10} daily limit for the protection of human health: No more than 35 days >50 $\mu g/m^3$

The daily limit of 50 $\mu g/m^3$ for the protection of human health was not exceeded more than 35 times during the monitoring period. It would be expected that PM_{10} values at the Proposed Development site would be similar or lower than those recorded for the Zone D sites above.

10.2.3.3 Nitrogen Dioxide (NO_2)

Nitrogen dioxide data for Emo Court, Birr, Castlebar, Carrick-on-shannon and Kilkitt in 2020 is presented in Table 10-5.

Table 10-5 Average Nitrogen Dioxide Data for Zone D Sites in 2020

Parameter	Measurement ($\mu g/m^3$)
Annual Mean	7.6
NO_2 Values >200	0
Values > 140 (UAT)	0
Values >100 (LAT)	0
Hourly Max.	54

The annual NO_2 value was below the annual mean limit value for the protection of human health of 40 $\mu g/m^3$. Furthermore the lower and upper assessment thresholds of 100 and 140 $\mu g/m^3$ was not exceeded during the monitoring period. The average hourly max. NO_2 value of 54 $\mu g/m^3$ measured during the monitoring period was below the hourly max threshold of 200 $\mu g/m^3$. It would be expected that NO_2 values at the Proposed Development site would be similar lower than those recorded for the Zone D sites above.

[1] *EPA (2021). Air Quality in Ireland 2020.*

10.2.3.4 Carbon Monoxide (CO)

The EPA report[1] provide rolling 8-hour carbon monoxide concentrations for Birr a zone D site. Carbon Monoxide data for 2020 is presented in Table 10-6.

Table 10-6 Carbon Monoxide Data for Birr - Zone D Site in 2020

Parameter	Measurement
Annual Mean	0.4 mg/m^3
Median	0.4 mg/m^3
% Data Capture	4.2%
Values > 10	0
Max	1.2 mg/m^3

The average concentration of carbon monoxide was 0.4 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.

10.2.3.5 Ozone (O_3)

The EPA report[1] provide rolling 8-hour ozone concentrations for seven Zone D sites, Emo Court, Kilkitt, Carnsore Point, Mace Head, Castlebar, Valentia and Malin Head. Ozone (O_3) data for 2020 is presented in Table 10-7. As can be observed from Table 10-7 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 10-7 Average Ozone Data for Zone D Sites in 2019

Parameter	Measurement
Annual Mean	62 µg/m^3
Median	63 µg/m^3
% Data Capture	98%
No. of days > 1800	0 days

10.2.3.6 Dust

There are no statutory limits for dust deposition in Ireland. The German TA-Luft standard for dust deposition sets a maximum permissible emission level for dust deposition of 350 mg/m^2/day. Recommendations from the Department of the Environment, Health & Local Government[2]apply the Bergerhoff limit of 350 mg/m^2/day to the site boundary of quarries. This limit value can also be implemented with regard to dust impacts from construction activities associated with the Proposed Development.

[2] *DOEHLG (2004) Quarries and Ancillary Activities, Guidelines for Planning Authorities*

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 location, the nature of the dust, i.e. soil, sand, peat, 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 effects on local air quality and the relevant associated mitigation measures are presented in Sections 10.2.4.3 below.

10.2.4 Likely and Significant Impacts and Associated Mitigation Measures

10.2.4.1 'Do-Nothing' Effect

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

10.2.4.2 Construction Phase

10.2.4.2.1 *Exhaust Emissions*

Turbines and Other Infrastructure

The construction of turbines, site roads and other onsite infrastructure (including the substation and 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.

Borrow Pit

The extraction of material from the proposed borrow pit will also require the use of construction machinery and plant, thereby giving rise to exhaust emissions. This is also a Short-term Slight Negative Impact, which will be reduced through use of the best practice mitigation measures as presented below.

Grid Connection

The construction of the underground cabling route 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.

Transport to and from Site

The transport of turbine components, construction materials, waste and construction staff to and from the site, 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, unless otherwise 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 is kept to a minimum.
- The majority of aggregate materials for the construction of the proposed development will be obtained from the borrow pit 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.
- The Materials Recovery Facility (MRF) will be local to the proposed development site to reduce the amount of emissions associated with vehicle movements. The nearest licensed waste facility to the site is Inishowen Recycling Ltd. which is located approximately 6km to the northwest of the Proposed Development.

Residual Impact

Short-term Slight Negative impact.

Significance of Effects

Based on the evaluation above there will be no significant direct or indirect effects on air quality due to the construction of the proposed development from exhaust emissions.

10.2.4.3 Dust Emissions

Dust emissions arise when particulate matter becomes airborne making it available to be carried downwind from the source. Dust emissions can lead to elevated PM_{10} and $PM_{2.5}$ concentrations and may also cause dust soiling. Turbines and Other Infrastructure

The construction of turbine foundations and hardstands, substation, anemometry mast, site roads, and all other onsite infrastructure and borrow pit extraction (as outlined in Chapter 4 of this EIAR) excluding the grid connection route works and works along the turbine delivery route/haul route which is considered separately below, will give rise to dust emissions during the construction phase.

However, the nearest sensitive receptor to the site boundary is located 260m northwest of the proposed new site entrance. Therefore, the potential for impacts on off-site receptors during the construction of the proposed development is limited. It is considered that this will be a short-term, slight, negative impact. Dust suppression mitigation measures to reduce this impact are presented below.

Haul Route

In order to accommodate the delivery of turbine components and other abnormal loads, road widening works will be required along the L1731 in the townland of Illies and along the local access road in the townland of Glenard. Excavation works within the verges along intermittent areas of these roads will give rise to localised dust emissions. It is considered that these works will have short term, temporary and slight negative impact on sensitive receptors. Mitigation measures to reduce this impact are discussed below.

Grid Connection Cable

The excavation of the grid connection cabling route trench will give rise to localised dust emissions. However, due to the nature of construction along the proposed grid connection as described in Chapter 4 of this EIAR which works as a "rolling" construction site, these works will not be concentrated in any one section of the route for a significant period of time. Therefore, it is considered that there will a short term slight negative impact on sensitive receptors located along the route. Mitigation measures to reduce this impact are presented below.

Transport to Site

The transport of turbine components, construction materials and construction staff to the wind farm site will give rise to some localised dust emissions during periods of dry weather. This will have a short-term slight negative impact on sensitive receptors. Mitigation measures to reduce the significance of this effect are presented below.

10.2.4.3.2 *Mitigation*

- A wheel wash facility will be installed on site and will be used by vehicles before leaving site.
- In periods of extended dry weather, dust suppression may be necessary along haul roads, site roads, substation and construction compounds and all infrastructure locations and around the borrow pit area to ensure dust does not cause a nuisance. When necessary, de-silted 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, turbine bases, 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.
- The transport of construction materials which may have the potential to generate dust will be undertaken with tarpaulin cover or similar, where necessary.
- The transport of dry excavated material from the on-site borrow pit. which may have potential to generate dust will be minimised. If necessary, excavated material will be dampened prior to transport from the borrow pits.
- A Construction and Environmental Management Plan (CEMP) will be in place throughout the construction phase (see Appendix 4-3). The CEMP includes these dust suppression measures.

Residual Impact

Short-term Imperceptiple Negative Impact.

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects on air quality due to dust emissions during the construction phase of the proposed development.

10.2.4.4 Operational Phase

10.2.4.4.1 *Exhaust Emissions*

Exhaust emissions associated with the operational phase of the Proposed Development will arise from occasional machinery and Light Goods Vehicles (LGV) that are intermittently required onsite for maintenance. This will give rise to a Long-term Imperceptible Negative Impact.

Mitigation

Any vehicles or plant brought onsite during the operational phase will be maintained in good operational order, thereby minimising any emissions that arise.

Residual Impact

Long-term Imperceptible Negative Impact

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects on air quality from exhaust emissions during the operation of the Proposed Development.

10.2.4.4.2 *Air Quality*

By providing an alternative to electricity derived from coal, oil or gas-fired power stations, the proposed development 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 10.3.4.

Residual Impact

Long-term Significant Positive Impact

Significance of Effects

Based on the assessment above there will be a significant positive effect on air quality due to the operation of the Proposed Development.

10.2.4.4.3 *Human Health*

Exposure to chemicals such as SO_2 and NO_x are known to be 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: Population and Human Health.

Residual Impact

Long-term Slight Positive Impact

Significance of Effects

Based on the assessment above there will be a significant positive effect on human health due to the operation of the Proposed Development.

10.2.4.5 Decommissioning Phase

Any impact and consequential effects that occur during the decommissioning phase are similar to that which occur during the construction phase, be it of less impact based on the lesser extent of the works which are described in Chapter 4. For example, the grid connection route will be left in situ in the public roadway; thus, no works will be required for this during the decommissioning phase. Likewise, the substation will remain on site resulting in no additional truck movements or requirement for demolitions and removal works for this piece of infrastructure. The mitigation measures prescribed for the construction phase of the proposed development will be implemented during the decommissioning phase thereby minimising any potential impacts.

10.3 Climate

All relevant legislation and policy in relation to climate is outlined in detail in Chapter 2 of this EIAR. A summary of the same is provided in the following sections.

10.3.1 Climate Change and Greenhouse Gases

Although variation in climate 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. The latest EPA Greenhouse Gas Emissions 1990-2020 (provisional figures) were released in October 2020. These latest statistics show that Irelands greenhouse gas emissions from the combustion of fossil fuels in the energy industry sector amounted to 17.9% of overall emissions in 2020, a 0.5% increase on 2019 figures. .[3] Changing climate patterns are thought to increase the frequency of extreme weather conditions such as storms, floods and droughts. In 2018, residential emissions increased by 8% in Ireland due to a colder winter.[4] 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.

10.3.1.1 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.

Under the Kyoto Protocol, the EU agreed to achieve a significant reduction in total greenhouse gas emissions in the period 2008 to 2012. These EU emission targets are legally binding on Ireland. Ireland's contribution to the EU commitment for the period 2008-2012 was to limit its greenhouse gas emissions to no more than 13% above 1990 levels.

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[3] *https://www.epa.ie/publications/monitoring–assessment/climate-change/air-emissions/Irelands-Provisional-Greenhouse-Gas-Emissions-report-1990-2020_final.pdf*
[4] *ibid*

10.3.1.1.1 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 5% below 1990 levels. During the second commitment period, Parties committed to reduce GHG emissions by at least 18% below 1990 levels in the eight-year period from 2013 to 2020. The composition of Parties in the second commitment period is different from the first; however, Ireland and the EU signed up to both the first and second commitment periods.

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.

10.3.1.1.2 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.

10.3.1.1.3 COP25 Climate Change Conference

The 25th United Nations Climate Change conference COP25 was held in Madrid and ran from December 2nd to December 13th, 2019. 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.

10.3.1.2 COP26 Climate Change Conference Glasgow

COP26 took place in Glasgow, Scotland between the 31st October and 12th November 2021. The summit was centred around the fact that "*climate change is the greatest risk facing us all.*" The UK, as hosts for the summit, have developed a ten point plan to deliver a green industrial revolution, seeking to lead the world in tackling and adapting to climate change.

The key items COP26 seeks to achieve are:

- Secure global net zero by mid-century and keep 1.5 degrees within reach
- Adapt to protect communities and natural habitats
- Mobilise finance
- Work together to deliver

All world leaders at the summit confirmed the need to urgently address the gaps in ambition and work together to achieve climate action.

The summit highlighted that the Paris Agreement is working, with leaders outlining national targets and efforts to further reduce emissions. There was a clear commitment to working together to achieve climate aims, with significant announcements including:

- "Over 40 leaders joined the Breakthrough Agenda, a 10-year plan to work together to create green jobs and growth globally, making clean technologies and solutions the most affordable, accessible and attractive option before 2030 – beginning with power, road transport, steel, hydrogen and agriculture.
- Over 120 countries covering more than 90% of the world's forests endorsed the Glasgow Leaders' Declaration on Forests & Land Use committing to work collectively to halt and reverse forest loss and land degradation by 2030, backed by the biggest ever commitment of public funds for forest conservation and a global roadmap to make 75% of forest commodity supply chains sustainable.
- A Just Energy Transition Partnership was announced to support South Africa's decarbonisation efforts; a powerful example of collaboration between an emerging economy and international partners.
- The launch of the Global Methane Pledge saw over 100 countries committing collectively to reduce global methane emissions by 30% by 2030."

10.3.1.2.1 *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. Coming into effect on January 1st, 2016, the goals and targets are to be actions over the 15-year period, 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. 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 10-8.

Table 10-8 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 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	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 the 2.7 per cent annual rate needed to reach target 3 of Sustainable Development Goal 7.	*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* *National Energy Efficiency Action Plan for Ireland # 4 2017-2020* *Better Energy Programme* *One World, One Future* *The Global Island*

	their respective programmes of support		
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 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	*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*

		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.	

10.3.1.3 European Green Deal – European Climate Law (2021)

The European Green Deal, initially introduced by the European Commission in December 2019, sets out the 'blueprint' for a transformational change of the 27-country bloc from a high- to a low-carbon economy, without reducing prosperity and while improving people's quality of life, through cleaner air and water, better health and a thriving natural world. The Green Deal is intended to work through a framework of regulation and legislation setting clear overarching targets, e.g. **a bloc-wide goal of net zero carbon emissions by 2050 and a 55% cut in emissions by 2030 (compared with 1990 levels).** This is a substantial increase compared to the existing target, upwards from the previous target of at least 40% (2030 Climate & Energy Framework), and furthermore, these targets demonstrate the ambition necessary to keep the global temperature increase to well below 2°C and pursue efforts to keep it to 1.5°C as per the Paris Agreement. With regard to the energy sector, the Green Deal focuses on 3 no. key principles for the clean energy transition, which will help reduce greenhouse gas emissions and enhance the quality of life for citizens:

- Ensuring a secure and affordable EU energy supply;
- Developing a fully integrated, interconnected and digitalised EU energy market; and
- Prioritising energy efficiency, improving the energy performance of our buildings and developing a power sector based largely on renewable sources (e.g. the subject development)

The European Climate Law 2021 writes into law the objectives set out above in the European Green Deal for Europe's economy and society to become climate-neutral by 2050. Climate neutrality by 2050 means achieving net zero greenhouse gas emissions for EU countries as a whole, mainly by cutting emissions, investing in green technologies and protecting the natural environment. The Climate Law includes:

- A legal objective for the Union to reach climate neutrality by 2050;

- An ambitious 2030 climate target of at least 55% reduction of net emissions of greenhouse gases as compared to 1990, with clarity on the contribution of emission reductions and removals;
- A process for setting a 2040 climate target, taking into account an indicative greenhouse gas budget for 2030-2050 to be published by the Commission;
- A commitment to negative emissions after 2050;
- The establishment of European Scientific Advisory Board on Climate Change, that will provide independent scientific advice;
- Stronger provisions on adaptation to climate change; and
- Strong coherence across Union policies with the climate neutrality objective

The law aims to ensure that all EU policies contribute to this goal and that all sectors of the economy and society play their part. All 27 no. EU Member States have committed to turning the EU into the first climate neutral continent by 2050. One third of the 1.8 trillion-euro investments from the NextGenerationEU Recovery Plan, and the EU's seven-year budget, will finance the European Green Deal. On 14th July 2021, the European Commission adopted a set of proposals to make the EU's climate, energy, transport and taxation policies fit for reducing net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels. Achieving these emission reductions in the next decade which is crucial to Europe becoming the world's first climate-neutral continent by 2050 would clearly be assisted by the proposed development.

10.3.1.4 Intergovernmental Panel on Climate Change

The Intergovernmental Panel on Climate Change released their *Sixth Assessment Report Climate Change 2021: The Physical Science Basis*[5] in August 2021 which categorically states the rise in global temperatures and increase in frequency and severity of natural disasters experienced across the world is related to human activity. It indicates that climate change has and will negatively impact all aspects of human life and unless immediate action is taken. It states that the aim to curtail global temperature rise to 1.5 degrees is now not possible however, maintaining just a 2-degree rise may be possible, only with immediate and large-scale action is taken to reduce greenhouse gas emissions. The report is hopeful that if global emissions can be cut in half by 2030 and that if net zero emissions can be achieved by 2050 the rise in temperatures can be halted and possibly reversed. This report is a stark warning that de-carbonisation must be increased additional efforts made to reduce carbon emissions across all sectors.

Greenhouse gas (GHG) emissions resulting from the provision of energy services have contributed significantly to the historic increase in atmospheric GHG concentrations with most of the observed increase in global average temperature since the mid-20th century is very likely due to the observed increase in anthropogenic GHG emissions with the consumption of fossil fuels accounts for the majority of global anthropogenic GHG emissions[6]. There are multiple options for lowering GHG emissions from the energy system while still satisfying the global demand for energy services. Wind energy has significant potential to reduce GHG emissions. Moreover, attempts to measure the relative impacts of various electricity supply technologies suggest that wind energy generally has a comparatively small environmental footprint.[7]

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[5] *Working Group 1 (Aug 2021) Climate Change 2021 The Physical Science Basis, 1IPCC AR6 .Available at: https://www.ipcc.ch/report/ar6/wg1/*
[6] *Edenhofer et al 2011, Renewable Energy Sources and Climate Change Mitigation: Summary for Policy makers and Technical Summary. Technical Support Unit Working Group III Potsdam Institute for Climate Impact Research (PIK) Published for the IPCC. Available at: https://www.ipcc.ch/site/assets/uploads/2018/03/SRREN_FD_SPM_final-1.pdf*
[7] *ibid*

10.3.1.5 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 2021 CCPI[8] was published in December 2020. While the CCPI 2021 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 performer in the CCPI 2019 but climbed 7 places to 41st place in 2020 and has since climbed 2 places to 39th in 2021. Previously categorised as a "very low" performer in international performance in 2019, it moved to a "low" category performer in 2020 and retains this status for 2021. Fortunately, Ireland ranks "very high" in 7th place for Renewable Energy. Ireland ranks 50th for GHG emissions, two places lower than China with a "very low" category performer. 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 in their 2020[9] country by country summary:

"While the country is rated low for its international climate policy performance, national experts' evaluation leads to a very low rating for national performance. Experts acknowledge the new Climate Action Plan's governance proposals, including putting the 2050 target into law and introducing legally-binding five-year carbon budgets, as positive if enacted without delay. They highlight however, that the government must go much further in implementing policies across all sectors that drive sustained emissions reductions over the next decade."

10.3.2 National Legislation and Policy

10.3.2.1 Climate Action Plan

The Climate Action Plan (CAP 2019) was published on the 1st of August 2019 by the Department of Communications, Climate Action and Environment and featured 183 action plans which set out how Ireland would meet its EU targets to reduce its carbon emissions by 30% between 2021 and 2030 and laid the foundations for achieving net zero carbon emissions by 2050.

The Climate Action Plan 2021 (CAP 2021) was published on the 4th November 2021 by the Department of the Environment, Climate and Communications. The CAP sets out an ambitious course of action over the coming years to ensure that Ireland achieves its legally binding target (*the Climate Action and Low Carbon Development (Amendment) Act 2021*) of net-zero greenhouse gas emissions no later than 2050, and a reduction of 51% by 2030, and in doing so, prevent / mitigate the potentially devastating consequences of climate change on Ireland's environment, society, economic and natural resources.

The overall aim of the CAP 2021 is to deliver a 'step-change' in Ireland's emissions performance over the coming decade in line with European Green Deal such that EU targets for 2030, and beyond, are met and the country will in a position to successfully achieve its mid-century decarbonisation objectives.

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[8] *Climate Change Performance Index 2021 Results: Climate Mitigation Efforts of 57 Countries plus the EU. Covering 90% of the Global Greenhouse Gas Emissions. Available at: https://ccpi.org/download/the-climate-change-performance-index-2021/*

[9] *Buck, J. et al Dec 2019 Climate Change Performance Index Results 2020. Available at: https://ccpi.org/wp-content/uploads/ccpi-2020-results-the_climate_change_performance_index-1.pdf*

10.3.2.2 Climate Action and Low Carbon Development (Amendment) Act, 2021

The Climate Action and Low Carbon Development (Amendment) Act 2021, which was signed into law on the 23rd July 2021, legally binds Ireland to achieve Net-Zero emissions no later than 2050, and to a 51% reduction in emissions by 2030. The Act provides the framework for Ireland to meet its international and EU climate commitments and to become a leader in addressing climate change. As indicated by the premise of the legislation, the reduction of emissions is a key proponent of the Climate Action and Low Carbon Development (Amendment) Bill 2021 and incorporates the following key provisions:

- Embeds the process of setting binding and ambitious emissions-reductions targets in law;
- Provides for a national climate objective, which commits to pursue and achieve no later than 2050, the transition to a climate resilient, biodiversity-rich, environmentally-sustainable and climate-neutral economy;
- Provides that the first two five-year carbon budgets proposed by the Climate Change Advisory Council should equate to a total reduction of 51% over the period to 2030, relative to a baseline of 2018;
- The role of the Climate Change Advisory Council has been strengthened;
- The government must adopt carbon budgets that are consistent with the Paris agreement and other international obligations;
- Actions for each sector will be detailed in the Climate Action Plan which must be updated annually; and
- Local Authorities must prepare individual Climate Action Plans which will include both mitigation and adaptation measures and will be updated every five years.

If planning consent is favourably granted by the Board for Proposed Development, the project represents a significant opportunity be a nationally important wind energy generator, contributing to the 51% reduction in emissions being sought, which is as outlined above a legally binding requirement. The proposed development is therefore considered compliant with the relevant planning policies and objectives set out at both the European (e.g. European Green Deal) and National tiers of governance in this regard.

10.3.2.3 Emissions Projections

In June 2021 the Environment Protection Agency released 'Ireland's Greenhouse Gas Emissions Projections 2020-2040'[10] which highlighted that emissions have trended upwards since 2011 with an overall peak in emissions reported in 2018. These three key sectors, agriculture, transport and energy industries, have consistently represented the largest share of emissions. Despite the economic impact of COVID-19, the CAP 2021 highlights that GHG emissions in Ireland only decreased by 3.6% in 2020.The minor scale of these reductions demonstrate the scale of the decarbonisation challenge for Ireland over the coming decade. Ireland exceeded its cumulative 2020 greenhouse gas emissions target by 12 million tonnes, which is characterised by the EPA as being a 'wide margin'. Growing electricity demand over the next ten years (c. 19% - 50%) will further compound this challenge. In order to meet emission targets while ensuring the security of electricity supply, and a cost-effective delivery of new electricity generation on the system, CAP 2021 has set out a target a renewable energy target of up to 80% with onshore wind targeted for up to 8GW.

The proposed development will have an export capacity in the range of 60MW to 93MW and therefore will help contribute towards this target. As well as this, it will provide much needed grid infrastructure, and the capacity to offset 3,652,600 tonnes of CO_2 in its operational lifetime thereby reducing the Greenhouse Gas effect and improving air quality as we transition to cleaner energy industries. Please see Section 10.3.4 for details on Carbon offset calculations.

[10] *Environment Protection Agency (June 2021) Ireland's Greenhouse Gas Emissions Projections 2020-2040.*

10.3.3 Climate and Weather in the Existing Environment

Ireland has a temperate, oceanic climate, resulting in mild winters and cool summers. The Met Eireann weather station at Malin Head, Co. Donegal, is the nearest weather and climate monitoring station to the proposed development site that has long-term meteorological data recorded for the 30-year period from 1981-2010 (the most recent long-term data available). The monitoring station is located approximately 25 kilometres northeast of the site. Meteorological data recorded at Malin Head over the 30-year period from 1981 - 2010 is shown in Table 10-9 overleaf. The wettest months are January and November, and May is usually the driest. August is the warmest month with a mean daily temperature of 14.7° Celsius.

Table 10-9 Data from Met Éireann Weather Station at Malin Head, 1981 to 2010: Monthly and Annual Mean and Extreme Values

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
TEMPERATURE (degrees Celsius)													
Mean daily max	8.1	8.1	9.3	10.8	13.1	15.1	16.8	17	15.6	13	10.4	8.6	12.2
Mean daily min	3.6	3.5	4.4	5.8	7.8	10.3	12.1	12.3	10.9	8.5	6.1	4.2	7.5
Mean temperature	5.9	5.8	6.9	8.3	10.5	12.7	14.5	14.7	13.3	10.8	8.2	6.4	9.8
Absolute max.	14.4	14.5	15.9	20.7	22.4	24.6	25.9	25.9	23.4	20.6	17.6	15.1	25.9
Absolute Min.	-5.6	-6.2	-4.4	-1.5	0.7	2.6	6.5	6.4	4	0.4	-1.2	-4.8	-6.2
Mean No. of Days with Air Frost	2.4	2.1	1	0.2	0	0	0	0	0	0	0.3	2	8
Mean No. of Days with Ground Frost	8	7.1	5.2	2.9	0.6	0	0	0	0	0.4	2.6	6.9	33.6
RELATIVE HUMIDITY (%)													
Mean at 0900UTC	83.2	82.1	81.6	79.6	79.1	81.5	84.1	83.4	82.5	83	82.8	82.8	82.1
Mean at 1500UTC	80.8	77	77.1	75.7	75.7	78.7	80.6	79.8	77.5	77.6	79.7	81.3	78.5
SUNSHINE (Hours)													
Mean daily duration	1.2	2.3	3	5.1	6.5	5.5	4.6	4.4	3.7	2.6	1.5	1.1	3.5
Greatest daily duration	7.6	8.7	11.6	13.6	15.5	16	15.6	14.6	12.2	9.4	7.3	6.7	16
Mean no. of days with no sun	10.6	5.8	5.5	3.3	2.3	2.4	2.7	3.1	3.5	6	8.3	11.6	65.1
RAINFALL (mm)													

Mean monthly total	117.4	84.8	85.9	63.1	56.9	69.1	76.8	93.2	91.8	118.4	104.5	114.2	1076
Greatest daily total	32.6	34.3	31.4	26.3	35	26.7	38.7	49.9	48.6	60	31.6	39.6	60
Mean num. of days with >= 0.2mm	22	18	20	16	16	16	18	19	19	21	21	20	226
Mean num. of days with >= 1.0mm	18	13	15	12	11	11	14	14	14	17	17	16	172
Mean num. of days with >= 5.0mm	8	6	6	4	3	4	5	6	6	8	7	7	70
WIND (knots)													
Mean monthly speed	19	18.6	17.3	14.6	13.3	12.8	12.3	12.8	14.6	16.8	17.6	17.5	15.6
Max. gust	91	86	90	71	68	62	74	62	85	78	92	96	96
Max. mean 10-minute speed	65	57	67	52	49	42	55	44	61	57	61	67	67
Mean num. of days with gales	11.8	10.3	8.7	3.6	2.1	1	0.7	1.1	3	6.5	8	8.5	65.3
WEATHER (Mean No. of Days With:)													
Snow or sleet	5.1	5.2	3.4	1.6	0.1	0	0	0	0	0	1.1	3.8	20.4
Snow lying at 0900UTC	0.4	0.4	0.4	0	0	0	0	0	0	0	0	1	2.3
Hail	9.2	7.4	7.6	4.4	1.7	0.3	0.1	0.2	0.6	3.1	5.8	7.3	47.7
Thunder	0.7	0.6	0.3	0.2	0.4	0.7	0.8	0.6	0.3	0.5	0.5	0.6	6.1
Fog	0.4	0.4	0.8	1.3	1.7	1.6	1.6	1.2	0.6	0.1	0.4	0.3	10.5

10.3.4 Calculating Carbon Losses and Savings from the Proposed Development

10.3.4.1 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). Bogs and peatlands are known to store large amounts of carbon. Due to the waterlogged nature of these 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. The site of the proposed development is situated on peatland with the majority of the site covered by commercial forestry plantation. For this reason, the carbon balance between the use of renewable energy and the loss of carbon stored in the peat is assessed in this section of the EIAR.

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. Peatland habitats are significant stores of organic carbon. The vegetation on a peat bog slowly absorbs CO_2 from the atmosphere when it is alive and converts it to organic 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 ground.

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 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, locally, 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.

10.3.4.2 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.

Although the loss of carbon fixing potential from plants on peat land is not substantial, it is nonetheless calculated for areas from which peat is removed and the areas affected by drainage. This calculation can take account of the annual gains due to the carbon fixing potential of the peat land and the time required for any habitat restoration. The carbon sequestered in the peat itself represents a much more substantial potential source of carbon loss. During wind farm construction, carbon is lost as a result of peat excavation and peat drainage. The amount of carbon lost is estimated using default values from the Intergovernmental Panel on Climate Change (IPCC, 1997) as well as by more site-specific equations derived from the scientific literature. Carbon gains due to habitat improvement and site restoration are calculated in a similar fashion.

Peatlands are essentially unbalanced systems. When flooded, peat soils emit less carbon dioxide but more methane than when drained. In waterlogged soils, carbon dioxide emissions are usually exceeded by plant fixation, so the net exchange of carbon with the atmosphere is negative and soil carbon stocks increase. When soils are aerated, carbon emissions usually exceed plant fixation, so the net exchange of carbon with the atmosphere is positive. In order to calculate the carbon emissions resulting from the removal or drainage of the peat, the Macauley Institute method accounts for emissions occurring if the peat had been left in-situ and subtracts these from the emissions occurring after removal and drainage.

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.

The drainage of peat soils leads to continual loss of soil carbon until a new steady state is reached, when inputs are approximately equal to losses. For peats, this steady state approximates 0% carbon, so 100% carbon loss from drained peats is assumed if the site is not restored after decommissioning of the wind farm. The amount of carbon lost is calculated on the basis of the annual emissions of methane and carbon dioxide, the area of drained peat, and the time until the site is restored. In the case of the proposed wind farm site, the model has been prepared on the basis that restoration will not occur upon decommissioning of the wind farm (i.e. site roads and hardstands will be left in situ). Refer to Appendix 4-6 of the EIAR for details in relation to decommissioning.

The effects of drainage may also reduce dissolved and particulate organic carbon retention within the peat. Losses of carbon dioxide due to leaching of dissolved and particulate organic carbon are calculated as a proportion of the gaseous losses of carbon from the peat. The Macauley Institute method assumes that published good practice is employed in relation to avoiding the risk of peat landslides. This is certainly the case in respect of the proposed development, which has been the subject of a peat stability risk assessment, as described in the *Geotechnical and Peat Stability Assessment Report* in Appendix 8-1 of this EIAR. Therefore, this potentially large carbon loss pathway is omitted from the calculations.

Clear-felling of existing forestry surrounding turbine locations is necessary to allow for the construction of the proposed development footprint and the erection of the wind turbines, and to protect local bat populations. 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 a forestry plantation was due to be felled with no plan to replant, the effect of the land use change is not attributable to the wind farm development and is omitted from the calculation. If, however, the forestry is felled for the development as is the case for this project, 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.

10.3.4.3 Calculating Carbon Losses and Savings

10.3.4.3.1 *Carbon Losses*

The Scottish Government on-line carbon calculator as outlined in the sections above, was used to assess the impacts of the proposed wind farm in terms of potential carbon losses and savings taking into account peat removal, drainage, habitat improvement, forestry felling..

A copy of the outputs is provided as Appendix 10-1 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 available for the Irish electricity generation plant, and so the CO_2 emissions savings from the proposed wind farm development were calculated separately from the worksheet.

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

Table 10-10 CO_2 losses from the Proposed Development

Origin of Losses	CO_2 Losses (tonnes CO_2 equivalent)
Losses due to turbine life (e.g. due to production, transportation, erection, operation and dismantling of the wind farm)	81,777
Losses due to backup (i.e. electricity obtained from fossil fuel source to stabilise electricity supply to the national grid)	64,156
Losses due to reduced carbon fixing potential	1,760
Losses from soil organic matter and due to leaching of dissolved and particulate organic carbon (CO2 loss from removed and drained peat)	76,682
Losses due to felling forestry	37,191
Total	261,567

The worksheet model calculates that the proposed development is expected give rise to 261,567 tonnes of CO_2 equivalent losses over its 35-year life. Of this total figure, the proposed wind turbines directly account for 81,777 tonnes, or 31%. Losses due to backup account for 64,156 tonnes, or 24.5%. Losses from soil organic matter, reduced carbon fixing potential and the felling of forestry accounting for the remaining 54.5% or 115,633 tonnes. The figure of 115,633 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 rather than the acid bog assumed by the model that gives rise to the 115,633 tonnes and therefore the actual CO_2 losses are expected to be lower than this value.

The model was used to calculate the CO_2 losses from the wind farm on the basis that the hydrology and habitats of the site are not to be restored upon decommissioning. However, at the end of the 35 year lifespan of the proposed development, the turbines may be replaced with newer models and therefore the carbon losses associated with not restoring the site habitats or hydrology would be further offset by the carbon-neutral renewable energy that the new turbines would generate.

10.3.4.3.2 Carbon Savings

According to the model described above, the proposed wind farm development will give rise to total losses of 261,567 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.

For the purposes of this calculation, the rated capacity of the proposed wind farm is assumed to be 93MW (i..e the maximum proposed output capacity).

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

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

A conservative figure for the carbon load of electricity generated by natural gas in Ireland was source from Sustainable Energy Authority Ireland's (SEAI) February 2020 report, '*Energy-Related CO_2 Emissions in Ireland 2005-2018.'* The emission factor for electricity generated by natural gas in Ireland in 2018 was 366 g CO_2/kWh.

The calculation for carbon savings is therefore as follows:

$$CO2 \text{ (in tonnes)} = \frac{(93 \times 0.35 \times 8{,}760 \times 366)}{1000}$$

$$= 104{,}360 \text{ tonnes per annum}$$

Based on this calculation, approximately 104,360 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 35-year lifetime of the wind farm, therefore, 3,652,600 tonnes of carbon dioxide will be displaced from traditional carbon-based electricity generation.

As noted previously areas cleared of forestry for the proposed development at Glenard will be replaced by replanting at alternatives sites. A total of 80.5 hectares of new forestry will be replanted at alternative sites to compensate the loss of forestry at the development site. Given that losses due to felling forestry account for 37,191tonnes of CO_2, it has been assumed for the purposes of this calculation that the same quantity of CO_2 can be saved by replanting forestry at alternative sites.

In total, it is estimated that 3,652,600 tonnes of carbon dioxide will be displaced over the proposed 35-year lifetime of the wind farm.

Based on the Scottish Government carbon calculator as presented above 261,567 tonnes of CO_2 will be lost to the atmosphere due to changes in the peat environment and due to the construction and operation of the proposed development. This represents 7.1% of the total amount of carbon dioxide emissions that will be offset by the proposed wind farm project. The 261,567 tonnes of CO_2 that will be lost to the atmosphere due to changes in the peat environment and due to the construction and operation of the proposed development will be offset by the proposed development in approximately **30 months** of operation.

The above calculation is based on the proposed maximum output capacity of the proposed development, which is 93MW. Should the export capacity of the proposed development be 60MW (i.e. the proposed minimum output capacity) it is estimated that approximately 67,329 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 35-year lifetime of the wind farm, therefore, 2,356,515 tonnes of carbon dioxide will be displaced from traditional carbon-based electricity generation. In this scenario, the CO_2 that will be lost to the atmosphere due to changes in the peat environment and due to the construction and operation of the proposed development will be offset by the proposed development in approximately **47 months** of operation.

10.3.5 Likely Significant Effects and Associated Mitigation Measures

10.3.5.1 '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, moderate, negative impact.

10.3.5.2 Construction Phase

10.3.5.2.1 *Greenhouse Gas Emissions*

Turbines and Other Infrastructure

Microclimate

The construction of turbine foundations and hardstands, site roads, site entrances, anemometry mast 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. Small pockets of clear felling will be required across the site totalling approximately 70ha rather than one large single area. Therefore, there will be no direct or indirect impact on site temperature and microclimate due to this action. Furthermore, clear felling forms part of the cycle of commercial forestry and without the proposed development clear felling would occur as normal in due course. The potential impact from the construction and felling activities will be slight, 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.

Macroclimate

As demonstrated in section 10.3.4 above, it is estimated that 3,652,600 tonnes of carbon dioxide will be displaced over the proposed 35-year lifetime of the wind farm. Thus, the proposed wind farm offers

Ireland an indigenous form of sustainable electricity and would provide for security of supply against our dependence on imports in addition to the positive impact on the macroclimate.

Grid Connection

The construction of the proposed substation and excavation of associated cable trenches will require the use of construction machinery 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.

Transport to Site

The transport of turbine components, construction materials, waste and construction staff to and from the site will also give rise to greenhouse gas emissions associated with the transport vehicles. This constitutes a short-term, 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.
- 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 is kept to a minimum.
- The majority of aggregate materials for the construction of the proposed development will be obtained from the borrow pit 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.
- The Materials Recovery Facility (MRF) will be local to the proposed development site to reduce the amount of emissions associated with vehicle movements. The nearest licensed waste facility to the site is Inishowen Recycling Ltd. which is located approximately 6km to the northwest of the Proposed Development.

Residual Impact

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 on climate during the construction phase.

10.3.5.3 Operational Phase

10.3.5.3.1 *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. The proposed development will displace carbon dioxide from fossil fuel-based electricity generation, over the proposed 35-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 moderate positive effect.

Residual Impact

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 long-term positive effects on climate during the operational phase.

10.3.5.4 Decommissioning Phase

Any impacts and consequential effects that occur during the decommissioning phase are similar to that which occur during the construction phase, albeit of less impact. For example the grid connection route will be left in the public roadway and the substation will remain in situ. The mitigation measures prescribed for the construction phase of the proposed development will be implemented during the decommissioning phase thereby minimising any potential impacts.

10.4 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 2.3 and Section 2.6 of this EIAR.

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 (Aught and Carrowglen Wind Farms), there will be minor emissions from construction plant and machinery and potential dust emissions associated with all construction activities. Should these developments be constructed simultaneously, there will be a short-term slight negative cumulative impact on air quality and climate due to vehicular and dust emissions.

Emissions of carbon dioxide (CO_2), oxides of nitrogen (NO_x), sulphur dioxide (SO_2) or dust emissions during the operational phases of the proposed development and other developments, listed in Section 2.3 of Chapter 2, will be minimal, relating to the use of operation and maintenance vehicles onsite, and therefore there will be a long-term, imperceptible, negative cumulative impact 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.

10.5 Transboundary Effects

Given that the proposed development is located approximately 7km northwest of the land border between the Republic of Ireland and Northern Ireland at its nearest point, the potential for transboundary effects has been considered throughout this EIAR.

During the construction phase, turbine components will be transported from the Port of Derry to the site of the proposed development and will therefore be travelling on the Northern Ireland road network for distance of approximately 12km. The delivery of turbine components is expected to take place over a number of weeks during the construction period. There is the potential for temporary, imperceptible negative transboundary impacts on air quality and climate due to the greenhouse gas emissions from turbine component delivery vehicles. The turbine component delivery vehicles will be maintained in good working order thereby keeping emissions to a minimum. The construction of the proposed development will not have significant effects on air quality and climate in Northern Ireland.

During the operational phase of the proposed development, 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. The proposed development will displace carbon dioxide from fossil fuel-based electricity generation, over the proposed 35-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 moderate positive transboundary impact on air quality and climate in Northern Ireland. The operation of the proposed development will have a positive effect on air quality and climate in Northern Ireland.