10. AIR AND CLIMATE

10.1 Air Quality

This chapter identifies, describes and assesses the potential significant direct and indirect effects on air quality and climate arising from the operation and decommissioning of the Cleanrath wind farm development. Direct and indirect effects on air quality and climate relating to the construction phase are also summarised in this chapter of the EIAR. The detailed assessment of the construction phase effects is included in Chapter 10 the Remedial EIAR (rEIAR) which accompanies this application.

The Cleanrath wind farm development is a constructed wind farm site at Cleanrath, Cork situated approximately 2.5km northeast of Inchigeelagh and 12km southwest of Macroom in Co. Cork. The townlands in which the Cleanrath wind farm development is located are outlined in Table 1-1 of this EIAR.

The land uses and types within the Cleanrath wind farm development site currently, other than the constructed wind farm development, are agriculture, turf cutting and commercial forestry.

The surrounding land uses, and types, comprise a mixture of forestry, agricultural land, turf cutting and wind energy. The closest wind farm to the site is the Derragh Wind Farm, which is currently operational and is located approximately 3km west of the Cleanrath wind farm development site.

Due to the non-industrial nature of the Cleanrath wind farm development and the general character of the surrounding environment, air quality sampling was deemed to be unnecessary for this EIAR.

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 wind farms 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 Cleanrath wind farm development include vehicular and dust emissions. Emissions from the construction, short-term operation, sleep mode operation, future normal operation and decommissioning (including early decommissioning) of the Cleanrath wind farm development are addressed in Section 10.1.5.

10.1.1.1 Relevant Guidance

The air quality and climate section of this EIAR is carried out in accordance with the 'EIA Directive' as amended by Directive 2014/52/EU and having regard, where relevant, to guidance listed in Section 1.7.2 of Chapter 1: Introduction.

10.1.2 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), 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 $PM_{2.5}$ (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 PM_{10}) 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 ($\mu g/m^3$) 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 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 (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

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 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
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 2.5 ($PM_{2.5}$)	Protection of human health	Calendar year	40	-	Annual mean	1st Jan 2005
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

Pollutant	Limit Value Objective	Averaging Period	Limit Value (µg/m3)	Limit Value (ppb)	Basis of Application of Limit Value	Attainment Date
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 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 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	-

* AOT40 is a measure of the overall exposure of plants to ozone. It is 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.

10.1.2.1 Air Quality and Health

The EPA report '*Air Quality in Ireland 2018*[1] noted that in Ireland, the premature deaths attributable to poor air quality are estimated at 1,180 people. 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. From this, 1,100 Irish deaths were attributable to fine particulate matter ($PM_{2.5}$), 50 Irish deaths were attributable to nitrogen oxides (NO_2) and 30 Irish deaths were attributable to Ozone (O_3) (Source: *Air Quality in Europe – 2019 Report',* EEA, 2019). These emissions, along with others including sulphur oxides (SO_2) are produced during fossil fuel-based electricity generation in various amounts, depending on the fuel and technology used.

[1] *EPA (2019). Air Quality in Ireland 2018 - Key Indicators of Ambient Air Quality,* https://www.epa.ie/pubs/reports/air/quality/epaairqualityreport2018.html

10.1.3 Air Quality Zones

The Environmental Protection Agency (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 Cleanrath wind farm development lies within Zone D, which represents rural areas located away from large population centres.

10.1.4 Existing Environment

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 Cleanrath wind farm development site is at Cork Harbour in Monkstown Co. Cork, located approximately 67 kilometres east of the Cleanrath wind farm development. EPA air quality data is available for Cork in the report '*Ambient Air Monitoring at Cork Harbour, Co. Cork 31st August 2007 – 15th March 2008*', as detailed below. More recent monitoring data for some parameters has been carried out at the South Link Road in Cork City and also at Cork Institute of Technology (CIT), Bishopstown, Co. Cork These monitoring locations lies within Zone B. Lower measurement values for all air quality parameters would be expected for the Cleanrath wind farm development site as it lies in a rural location, within Zone D.

The forestry replanting lands in Co. Cork are also located within Zone D and are fully described in the Assessment of Replanting Lands report included as Appendix 4-2 of this EIAR. The report also assesses the potential effects of replanting on air quality and climate within the vicinity of the replanting land.

10.1.4.1 Sulphur Dioxide (SO_2)

Sulphur Dioxide data for CIT, Bishopstown, Co. Cork, located approximately 54 kilometres east of the site, for 2016 is presented in Table 10-3 . Neither the hourly limit value nor lower assessment threshold set out in the CAFE Directive were exceeded during the monitoring period.

Table 10-3 Sulphur Dioxide Data for CIT in 2016

Parameter	Measurement
No. of hours	7,808
No. of measured values	7,658
Percentage Coverage	98.1%
Maximum hourly value	33.6 µg/m^3
99.7 percentile for hourly values	11.4 µg/m^3
Mean hourly value	3.1 µg/m^3
Maximum 24-hour mean	9.7 µg/m^3
98 percentile for 24-hour mean	8.8 µg/m^3

10.1.4.2 Particulate Matter (PM_{10})

Particulate matter (PM_{10}) data for the 2007/2008 monitoring period in Cork Harbour is presented in Table 10-3. The 24-hour limit value for the protection of human health (50 µg/m3) was not exceeded during the measurement period. The upper assessment threshold was exceeded on 7 days and the lower assessment threshold was exceeded on 24 days. The CAFE Directive stipulates that these assessment thresholds should not be exceeded more than 35 times in a calendar year. The mean of the daily values during the measurement period is below the annual limit value for the protection of human health (40 $\mu g/m^3$).

Table 10-4 Particulate Matter (PM_{10}) Data Cork Harbour August 2007 to March 2008

Parameter	Measurement
No. of days	207
No. of measured values	81
Percentage Coverage	39%
Maximum daily value	48.8 $\mu g/m^3$
Mean daily value	16.7 $\mu g/m^3$

10.1.4.3 Nitrogen Dioxide (NO_2)

Nitrogen dioxide and oxides of nitrogen data for the 2007/2008 monitoring period at Cork Harbour is presented in Table 10-5. No hourly mean NO_2 value was above the lower assessment threshold. The CAFE Directive stipulates that this threshold should not be exceeded more than 18 times in a calendar year. The mean hourly NO_2 value during the measurement period was below the annual lower assessment threshold for the protection of human health, which is 26 $\mu g/m^3$.

Table 10-5 Nitrogen Dioxide and Oxides of Nitrogen Data Cork Harbour 2007/2008

Parameter	Measurement
No. of hours	4642
No. of measured values	4579
Percentage Coverage	98.6%
Maximum hourly value (NO_2)	62.8 $\mu g/m^3$
99.8 percentile for hourly values (NO_2)	43.9 $\mu g/m^3$
Mean hourly value (NO_2)	10.4 $\mu g/m^3$
Mean hourly value (NOx)	15.4 $\mu g/m^3$ NO_2

10.1.4.4 Carbon Monoxide (CO)

Carbon Monoxide data for the 2015 monitoring period at the South Link Road in Cork, located approximately 58km east of the site is presented in Table 10-6. The mean hourly concentration of carbon monoxide recorded was 0.3 mg/m^3. The carbon monoxide limit value for the protection of human health is 10 mg/m^3. The lower Assessment Threshold is 5 mg/m^3. On no occasions were values in excess of the 10 mg limit value set out in the CAFE Directive/ Air Quality Standards Regulations 2011 (as amended) recorded.

Table 10-6 Carbon Monoxide Data for 2015 at South Link Road

Hourly Values	Result
No. of hours	8,760
No. of measured values	8526
Percentage Coverage	97.3%
Maximum hourly value	1.9 mg/m^3
98 percentile for hourly values	0.8 mg/m^3
Mean hourly value	0.3 mg/m^3
Maximum 8-hour mean	1.8 mg/m^3
98 percentile for 8-hour mean	0.79 mg/m^3

10.1.4.5 Ozone (O_3)

Ozone data for CIT, Bishopstown, Co. Cork located approximately located approximately 54 kilometres east of the site, for 2016 is presented in Table 10-7. The legislation stipulates that this limit should not be exceeded on more than 25 days. On no occasions were values in excess of the limit value.

Table 10-7 Summary statistics for O_3 concentrations for 2016: CIT

Hourly Values	Result
No. of hours	7,827
No. of measured values	7,720
Percentage Coverage	98.6%
Maximum hourly value	129.3 mg/m^3
98 percentile for hourly values	90.2 mg/m^3
Mean hourly value	50.31 mg/m^3
Maximum 8-hour mean	98.4 mg/m^3

10.1.4.6 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.

Construction dust had the potential to be generated from on-site activities such as excavation and backfilling. The extent of dust generation at any site depended 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 mitigation measures which were implemented are presented in Sections 10.1.5.2.2 and 10.1.5.3.2 below.

10.1.5 Likely Significant Effects and Associated Mitigation Measures (Air Quality)

10.1.5.1 'Do-Nothing' Effect

An alternative land-use option to developing the Cleanrath wind farm development would have been to leave the site as it was prior to construction, with no changes made to the land-use practices of low-intensity agriculture, turf cutting and commercial forestry. This option would have no positive impact with regards to the production of renewable energy or the offsetting of greenhouse gas emissions. On the basis of the positive environmental effects arising from the Cleanrath wind farm development, the do–nothing scenario was not the chosen option. Instead, an application for planning permission was made and granted ultimately by An Bord Pleanála.

The Cleanrath wind farm development has been constructed, has been operational and is now operating in Sleep Mode with the site essentially in a shut-down mode with no export of electricity pending the outcome of the Substitute Consent process. In the event that Substitute Consent is obtained, the intention is to recommence and continue the full operation of the Cleanrath wind farm development until the end of 25 years from the formal commissioning of the turbines in July 2020 and implement the decommissioning plan for the Cleanrath wind farm development at the end of the operational period.

In the event that Substitute Consent is not granted and full operation of the development is not recommenced, it will remain in Sleep Mode which is, in effect, the “do nothing” option insofar as it represents the current situation as at the date of the application for Substitute Consent. There is the possibility that the decommissioning plan may need to be implemented early, should Substitute Consent not be granted. These scenarios are assessed in this chapter.

10.1.5.2 Construction Phase

This section provides a summary of the effects of the construction phase of the Cleanrath wind farm development on air quality. A detailed assessment of the construction phase effects, including any associated mitigation measures, is included in Chapter 10 of the rEIAR which accompanies this application.

10.1.5.2.1 *Exhaust Emissions*

Exhaust emissions, associated with the construction of the wind farm infrastructure, extraction of rock from the borrow pit, grid connection works and the transport of construction materials and turbine components to the site occurred throughout the construction phase of the Cleanrath wind farm development. Following implementation of the appropriate mitigation measures, the residual impact of exhaust emissions from the construction phase was a Short-term Imperceptible Negative Impact. There were no significant direct or indirect effects on air quality due to exhaust emissions during the construction phase of the Cleanrath wind farm development.

10.1.5.2.2 Dust Emissions

Dust emissions, associated with the construction of the wind farm infrastructure, extraction of rock from the borrow pit, grid connection works and the transport of construction materials and turbine components to the site would have occurred throughout the construction phase of the Cleanrath wind farm development. Following implementation of the appropriate mitigation measures, the residual impact of dust generation from the construction phase was a Short-term Slight Negative Impact. There were no significant direct or indirect effects on air quality due to dust emissions during the construction phase of the Cleanrath wind farm development.

10.1.5.3 Operational Phase

The effects set out below relate to the operational phase of the Cleanrath wind farm development should Substitute Consent be granted. This includes the previous period of short-term operation and the current period of Sleep Mode and also assesses the future operation.

10.1.5.3.1 Exhaust Emissions

Exhaust emissions associated with the operational phase of the Cleanrath wind farm development has arisen and will arise from machinery and vehicles that are intermittently required onsite for maintenance, including the machinery involved in the minor peatland habitat restoration works and turbine component delivery vehicles required in the unlikely event of a turbine component needing to be replaced. The number of vehicles is low and the type is standard road going vehicles and so 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 that comply with the Road Traffic Acts 1961 as amended, thereby minimising any emissions that arise.

Residual Impact

Long-term Imperceptible Negative Impact

Significance of Effects

Based on the assessment above there have been and will be no significant direct or indirect effects on air quality due to exhaust emissions in the operation of the Cleanrath wind farm development.

10.1.5.3.2 Air Quality

Although exhaust emissions will arise during the operational phase, the Cleanrath wind farm 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 Cleanrath wind farm development will have a long-term slight positive impact on air quality. Further details on the carbon dioxide savings associated with the Cleanrath wind farm development are presented in Section 10.2.3 below.

Residual Impact

Long-term Slight Positive Impact

Significance of Effects

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

10.1.5.3.3 *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 Cleanrath wind farm 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 Cleanrath wind farm 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 no slight positive direct and indirect effect.

10.1.5.4 Decommissioning Phase

The wind turbines which form part of the Cleanrath wind farm development are expected to have a lifespan of approximately 25 years and remain on site for that period of time pending the outcome of the Substitute Consent process. However, should the development not be consented, there is the possibility that an early decommissioning phase will be implemented and so this potential has been assessed.

The works required during either an early decommissioning phase or decommissioning after the end of the useful lifetime of the wind farm do not differ and are described in Chapter 4: Description of the Cleanrath wind farm development. The potential effects do however differ. The early decommissioning of the project would result in a renewable energy facility not being provided at this location and would prevent the potentially positive effects on air quality from being realised.

In order to make up the potential short fall in renewable energy generation, the early decommissioning of the Cleanrath wind farm development would ultimately lead to the potential for an alternative wind farm site being identified and developed with further potential for air quality impacts by both the early decommissioning the Cleanrath wind farm development and the construction of a wind farm at an alternative site.

Any impact and consequential effect that occurs during the decommissioning phase post operation will be similar to that which occurs during part of the construction phase when turbines were being erected. The impacts and associated effects will be materially less than during the construction phase as significant ground works are not required to decommission a wind farm. However, the early decommissioning of the project would result in a renewable energy facility not being provided at this location and the Cleanrath wind farm development being decommissioned and therefore eliminate potential benefits for air quality from being realised.

Further details on decommissioning of the Cleanrath wind farm development are included in Section 4.10 of this EIAR. It is considered that the potential effects on air quality from the decommissioning of the Cleanrath wind farm development post operation will be short term and imperceptible.

10.2 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.

10.2.1 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. 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.

10.2.1.1 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. 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.

10.2.1.1.1 *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. Ireland is part of the second commitment period under the Kyoto Protocol, where they agreed to fulfil their commitments under Article 3 of the Protocol for the second commitment period in 2017.

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.

10.2.1.1.2 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.

10.2.1.1.3 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. The Commission will present draft laws for the new deal to the EU in January of 2020 and if accepted 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, but has been postponed to 2021

10.2.1.1.4 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) publish Ireland's Greenhouse Gas Emission Projection and at the time of writing, the most recent report, '*Ireland's Greenhouse Gas Emissions Projections 2018–2040*' was published in June 2019. The report includes an assessment of Ireland's progress towards achieving its emission reduction targets out to 2020 and 2030 set under the EU Effort Sharing Decision (Decision No 406/2009/EU) and Effort Sharing Regulation (Regulation (EU) 2018/842).

The 2019 emission projections report include the impact of new climate mitigation policies and measures which were outlined in the National Development Plan 2018. These projections see a greater impact from policies and measures and a greater reduction in emissions over the longer term, particularly in the "With Additional Measures" scenario. The 2019 emissions projections do not take into account policies and measures set out in the Climate Action Plan 2019. Such measures will be taken into consideration in an updated future projections report in 2020.

Greenhouse gas emissions are projected to 2040 using two scenarios; '*With Existing Measures*' and '*With Additional Measures*'. 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) and the National Development Plan 2018-2027.

The EPA Emission Projections Update notes the following key trends:

- Total emissions are projected to increase from current levels by 1% and 6% by 2020 and 2030, respectively, under the "*With Existing Measures*" scenario.
- Under the "*With Additional Measures*" scenario, emissions are estimated to decrease by 0.4% and 10% by 2020 and 2030, respectively.
- Ireland's non-Emissions Trading Scheme (ETS) emissions are projected to be 5% and 6% below 2005 levels in 2020 under the '*With Existing Measures*' and '*With Additional Measures*' scenarios, respectively. The target for Ireland is a 20% reduction.
- Ireland has exceeded its annual binding limits in 2016 and 2017 under both scenarios, '*With Existing Measures*' and '*With Additional Measures*'.
- Over the period 2013 – 2020, Ireland is projected to cumulatively exceed its compliance obligations by 10 Mt CO_2 (metric tonnes of Carbon Dioxide) equivalent under the '*With Existing Measures*' scenario and 9 Mt CO_2 equivalent under the '*With Additional Measures*' scenario.

The report concludes:

- *"Projections indicate that Ireland will exceed the carbon budget over the period 2021-2030 by 52-67Mt CO_2 equivalent with the gap potentially narrowing to 7-22 Mt CO_2 equivalent if both the ETS and LULUCF flexibilities described in the Regulation are fully utilised."*
- *"To determine compliance under the Effort Sharing Decision, any overachievement of the binding emission limit in a particular year (between 2013 and 2020) can be banked and used towards compliance in a future year. However, even using this mechanism Ireland will still be in non-compliance according to the latest projections."*
- *"A significant reduction in emissions over the longer term is projected as a result of the expansion of renewables (e.g. wind), assumed to reach 41-54% by 2030, with a move away from coal and peat... [...] ... However, Ireland still faces significant challenged in meeting EU 2030 targets in the non-ETS sector and national 2050 reduction targets in the electricity generation, built environment and transport sectors. Progress in achieving targets is dependent on the level of implementation of current and future plans."*

10.2.1.1.5 Progress to Date

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

- Reducing greenhouse gas (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.

Further details on the Europe 2020 Strategy are included in Chapter 2: Background to the Cleanrath wind farm development of this EIAR. Regarding progress on targets, the '*Europe 2020 indicators – climate change and energy*' report provides a summary of recent statistics on climate change and energy in the EU.

In 2015, EU greenhouse gas emissions, including emissions from international aviation and indirect carbon dioxide (CO_2) emissions, were down by 22.1% when compared with 1990 levels. However, regarding the progress of individual Member States, and Ireland in particular, the Europe 2020 indicators include the following statements:

- 24 countries are on track to meet their GHG targets, except Austria, Belgium, Ireland and Luxembourg.
- Luxembourg emitted the most GHG per capita in the EU in 2014 followed by Estonia, Ireland and the Netherlands.
- In 2015, Malta was the farthest from reaching their national target, followed by Ireland, Belgium and Luxembourg.

While the EU as a whole is projected to exceed it's 2020 target of reducing GHG 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:

10.2.1.1.6 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. The most recent progress update for these goals is from 2019. While the UN are currently updating the progress against these goals for 2020, they have yet to be provided. 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	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*

SDG	Targets	International Progress to Date (2019)	National Relevant Policy
	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		*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 mobilising 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 CO_2 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	*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 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.	

10.2.1.1.7 *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.

In April 2020 the Sustainable Energy Authority of Ireland (SEAI) released a progress report for Ireland's 2020 climate and energy targets, titled: "*Renewable Energy in Ireland – 2020 Update*". The report shows that Ireland is not on track to meet any of its 2020 renewable energy targets and ranks second last of the 28 European countries (including the UK) in terms of progress towards 2020 targets. Renewable sources made up just 11% of Ireland's energy consumption in 2018, which is significantly short the 16% goal for 2020. The report notes that Ireland's dependence on fossil fuels for heating requirements (over 93%) was the primary cause for failing to achieve its overall renewable energy target.

As stated above, Ireland are not on track for meeting their 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 Cleanrath wind farm development will help contribute towards this target.

The Cleanrath 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 Cleanrath wind farm development will contribute the following:

- Production of 91,980 MWh of electricity which would be sufficient to supply 21,900 Irish households with electricity per 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 Cleanrath wind farm development.

Further detail on the EU 2030 targets are noted in Chapter 2, Section 2.2 of this EIAR.

10.2.1.1.8 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 performer in the CCPI 2019, climbed 7 places to 41st place and has moved from a "very low" performer to a "low" performer 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".*

10.2.2 Climate and Weather in the Existing Environment

Ireland has a temperate, oceanic climate, resulting in mild winters and cool summers. The Met Éireann weather station at Cork Airport, Co. Cork, is the nearest weather and climate monitoring station to the Cleanrath wind farm development site that has meteorological data recorded for the 30-year period from 1981-2010. The monitoring station is located approximately 56 kilometres east of the site. 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 10-9 Data from Met Éireann Weather Station at Cork Airport 1981–2010: 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	8.2	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**
min. maximum	-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**
max. minimum	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**
absolute min.	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**
mean num. of days with air frost	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 num. of days with ground frost	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 5cm soil	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**
mean 10cm soil	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**
mean 20cm soil	-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**
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 num. 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)													
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**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
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**

10.2.3 Calculating Carbon Losses and Savings from the Cleanrath wind farm development

10.2.3.1 Background

Carbon dioxide (CO_2) emissions occur naturally in addition to being released with the burning of fossil fuels. All organic material is composed of carbon, which is released as CO_2 when the material decomposes. Organic material acts as a store of carbon. Peatland habitats are significant stores of organic carbon. The vegetation on a peat bog slowly absorbs CO_2 from the atmosphere when it is active 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 accumulating mass of the peatland. The site of the Cleanrath wind farm development is partially situated on peat habitats very shallow peat soils, ranging between 0.3m to 3.4m. 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.

The carbon balance of proposed wind farm developments in peatland habitats has attracted significant attention in recent years. When developments such as wind farms are proposed for peatland areas, there will be direct effects and loss of peat in the area of the development footprint. There may also be indirect effects where it is necessary to install drainage in certain areas to facilitate construction. The works can either directly or indirectly allow the peat to dry out, which permits the full decomposition of the stored organic material with the associated release of the stored carbon as CO_2. It is essential therefore that any wind farm development in a peatland area saves more CO_2 than is released.

10.2.3.2 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 energy 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. This 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 takes 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 Cleanrath wind farm development was designed to minimise any impact on any blanket bog habitat or areas of wet heath habitats. The development footprint was carefully planned to avoid areas of undisturbed peatland where possible, and the majority of works were proposed for areas of cutover bog, conifer plantation and recently felled woodland, along with the use of existing tracks where possible. The restoration of 4.13ha of peatland habitat, as discussed in Section 4.9.1 and in Chapter 6 of this EIAR will be undertaken during the future operation of the site. The restoration will comprise the management of an area of forestry that was felled during construction along with an additional hectare of immature forestry will be felled to establish suitable peatland habitat. The works will involve felling, chipping and removal of brash and restoring the peatland habitat to its original condition prior to planting which will include the blocking of drains with no further drainage to be installed around the area. 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. However, the Peatland Restoration Plan, included as Appendix 6-8 of this EIAR, demonstrates a high probability that the hydrological regime will be restored across the site, disturbance of the remaining peat will be minimised, and peat-forming vegetation will develop in areas from which peat was removed or drained. In the case of the Cleanrath wind farm development site, the model has been prepared on the basis of two scenarios, one where restoration of the wind farm areas will occur on decommissioning, and another where restoration will not occur.

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 Cleanrath wind farm development, which has been the subject of a peat stability risk assessment, as described in the Peat Stability Risk Assessment in Appendix 8-1. of this EIAR. Furthermore, the Cleanrath wind farm development was constructed without peat slide incident. Therefore, this potentially large carbon loss pathway is omitted from the calculations.

Clear-felling of existing forestry surrounding turbine locations was necessary in the construction of the Cleanrath wind farm development to achieve the required setback between the trees and the turbines for the protection of bats. Forestry was felled earlier than originally planned due to the Cleanrath 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 and the effect of the land use change is not attributable to the wind farm development then this is omitted from the calculation. If, however, the forestry is felled for the Cleanrath wind farm development, the effects are judged to be attributable. 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.

10.2.3.3 Calculating Carbon Losses and Savings

10.2.3.3.1 Carbon Losses 25-year Operation

The Macauley Institute method for calculating carbon losses from wind farm projects was used to assess the impacts of the Cleanrath wind farm development in terms of potential carbon losses and savings taking into account peat removal, drainage, habitat improvement and site restoration.

The worksheet made available as part of the '*Calculating carbon savings from wind farms on Scottish peat lands'* report, was downloaded and used to input the necessary data. A copy of this worksheet 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 Cleanrath wind farm development were calculated separately from the worksheet.

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

Table 10-10 CO_2 Losses from the Cleanrath wind farm development

Origin of Losses	CO_2 Losses (tonnes CO_2 equivalent)	
	Expected	Maximum
Losses due to turbine life (e.g. manufacture, construction, decommissioning)	20,431	20,431
Losses due to backup	0	0
Losses due to reduced carbon fixing potential	1,070	1,863
Losses from soil organic matter	1,983	2,519
Losses due to DOC & POC leaching	0	0
Losses due to felling forestry	4,066	4,292
Total	27,551	29,104

The worksheet model calculates that the Cleanrath wind farm development will give rise to 27,551 tonnes of CO_2 equivalent losses **over its 25-year life**. Of this total figure, the wind turbines directly account for 20,431 tonnes, or 74%. Losses from soil organic matter and reduced carbon fixing potential and the felling of forestry accounting for the remaining 26% or 7,119 tonnes. It should be noted that forestry on the Cleanrath wind farm development site forms part of a commercial crop, which would have been felled in coming years regardless of whether the Cleanrath wind farm development proceeded or not.

The figure of 7,119 tonnes of CO_2 arising from ground activities associated with the Cleanrath wind farm 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 impacted by the development footprint comprises predominantly commercial forestry, rather than the acid bog assumed by the model that gives rise to the 7,119 tonnes CO_2 figure, 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 Cleanrath wind farm development after its expected 25-year useful life. As a worst-case scenario, the model was also used to calculate the CO_2 losses from the Cleanrath wind farm development 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 and taking account of the future turf cutting activities. This worst-case scenario would increase the expected carbon losses by an additional 22,990 tonnes, or 45% to 37,721 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.

10.2.3.3.2 Carbon Losses from Early Decommissioning

The worksheet model has also been used to estimate the carbon losses associated with early decommissioning should it occur. The data inputs into this model assumes no additional felling or further disturbance of peatland habitat and that the foundations will be covered with imported soil material and that all site access roads will be retained. The model also takes into account the carbon losses associated with the manufacture of turbines and the provision of drainage during wind farm construction. A copy of this worksheet is provided as Appendix 10-2 of this EIAR. The potential carbon loss is similar to the continued operation of the development as the majority of the losses have been incurred at this stage.

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

Table 10-11 CO_2 Losses from the Cleanrath wind farm development

Origin of Losses	CO_2 Losses (tonnes CO_2 equivalent)	
	Expected	Maximum
Losses due to turbine life (e.g. manufacture, construction, decommissioning)	20,431	20,431
Losses due to backup	0	0
Losses due to reduced carbon fixing potential	1,070	1,863
Losses from soil organic matter	1,983	2,519
Losses due to DOC & POC leaching	0	0
Losses due to felling forestry[2]	2,033	2,033
Total	**25,518**	**26,846**

[2] *As a precautionary measure, it is assumed that half of the permanently felled areas will become available again around the existing infrastructure for replanting.*

The worksheet model calculates that the early decommissioning of the Cleanrath wind farm development will give rise to 25,518 tonnes of CO_2 equivalent losses. Of this total figure, the wind turbines directly account for 20,431 tonnes, or 80%.

10.2.3.3.3 Carbon Savings – 25-year Operation

According to the model described above, the Cleanrath wind farm development gave rise to total losses of 27,551 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 Cleanrath wind farm development is 26.4MW (based on 4 No. 3.6MW and 5 No. 2.4MW turbines).

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

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*'. 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:

$$CO_2 \text{ (in tonnes)} = \frac{(26.4 \times 0.35 \times 8{,}760 \times 436.6)}{1000}$$

$$= 35{,}339 \text{ tonnes per annum}$$

Based on this calculation, 35,339 tonnes of carbon dioxide will be displaced per annum from the largely carbon-based traditional energy mix by the Cleanrath wind farm development. Over the proposed 25-year lifetime of the development, therefore, 883,475 tonnes of carbon dioxide will be displaced from traditional carbon-based electricity generation.

As noted previously areas cleared of forestry for the Cleanrath wind farm development have been replaced by replanting at alternatives sites. A total of 8.33 hectares of new forestry has been replanted at alternative sites to compensate the loss of forestry at the development site. Given that losses due to felling forestry account for 4,066 tonnes 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 and any further replanting required by additional felling at the Cleanrath wind farm development.

In total, it is estimated that 887,541 tonnes of carbon dioxide will be displaced over the proposed 25 year lifetime of the Cleanrath wind farm development.

Based on the Macauley Institute model as presented above, 27,551 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 Cleanrath wind farm development. This represents 3.1% of the total amount of carbon dioxide emissions that will be offset by the Cleanrath wind farm development. The 27,551 tonnes of CO_2 that were lost to the atmosphere due to changes in the peat environment and due to the construction and operation of the Cleanrath wind farm development will be offset by the Cleanrath wind farm development after approximately 9.4 months of operation.

10.2.3.3.1 *Carbon Savings – Early Decommissioning*

Should early decommissioning occur, the opportunity to generate renewable energy and offset carbon emissions to the atmosphere would essentially be lost. While small amounts of renewable energy were generated during the initial operational period, the turbines are now operating in Sleep Mode and if they do not return to normal operation c. 35,339 tonnes per annum in carbon savings will be lost for each of the proposed 25 year operational period.

10.2.4 Likely Significant Effects and Associated Mitigation Measures

10.2.4.1 'Do-Nothing' Effect

An alternative land-use option to developing the Cleanrath wind farm development would have been to leave the site as it was prior to construction, with no changes made to the land-use practices of low-intensity agriculture, turf cutting and commercial forestry. This option would have no positive impact with regards to the production of renewable energy or the offsetting of greenhouse gas emissions. On the basis of the positive environmental effects arising from the Cleanrath wind farm development , the do–nothing scenario was not the chosen option. Instead, an application for planning permission was made and granted ultimately by An Bord Pleanála.

The Cleanrath wind farm development has been constructed, has been operational and is now operating in Sleep Mode with the site essentially in a shut-down mode with no export of electricity pending the outcome of the Substitute Consent process. In the event that Substitute Consent is obtained, the intention is to recommence and continue the full operation of the Cleanrath wind farm development until the end of 25 years from the formal commissioning of the turbines in July 2020 and implement the decommissioning plan for the Cleanrath wind farm development at the end of the operational period.

In the event that Substitute Consent is not granted and full operation of the development is not recommenced, it will remain in Sleep Mode which is, in effect, the "do nothing" option insofar as it represents the current situation as at the date of the application for Substitute Consent. There is the possibility that the decommissioning plan may need to be implemented early, should Substitute Consent not be granted. This would result in further carbon losses and the opportunity to offset these losses as well as carbon losses from the construction phase through carbon savings generated by an operational site will have been lost.

This would be a long-term slight negative impact.

10.2.4.2 Construction Phase

This section provides a summary of the effects of the construction phase of the Cleanrath wind farm development on air climate. The detailed assessment of the construction phase effects, including any associated mitigation measures, is included in Chapter 10 of the rEIAR which accompanies this application.

10.2.4.2.1 Greenhouse Gas Emissions

Greenhouse gas emissions, e.g. carbon dioxide (CO_2), carbon monoxide and nitrogen oxides associated with vehicles and plant will have arisen as a result of the construction of the wind farm infrastructure, extraction of rock from the borrow pit, grid connection works and the transport of construction materials and turbine components to the site occurred throughout the construction phase of the Cleanrath wind farm development. Following implementation of the appropriate mitigation measures, the residual impact of greenhouse gas emissions from the construction phase was a Short-term Imperceptible Negative Impact on climate. There were no significant direct or indirect effects on air quality due to greenhouse gas emissions during the construction phase of the Cleanrath wind farm development.

10.2.4.3 Operational Phase

10.2.4.3.1 Greenhouse Gas Emissions

The Cleanrath wind farm development will generate energy from a renewable source in any future operational phase. 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 Cleanrath wind farm development will displace carbon dioxide from fossil fuel-based electricity generation, over the proposed 25-year lifespan as set out in Section 10.2.3.3.3.

The Cleanrath wind farm development will assist in reducing carbon dioxide (CO_2) emissions that would otherwise arise if the same energy that the Cleanrath wind farm development will generate were otherwise to be generated by conventional fossil fuel plants. This is a long-term slight positive effect.

Some potential long-term imperceptible negative impacts that may occur during the operational phase of the Cleanrath wind farm development are the release of small amounts of carbon dioxide to the atmosphere from vehicles that were intermittently required onsite for maintenance as well as plant and machinery used for some reinstatement works that were also completed on site during this phase along with 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 Cleanrath wind farm development some of which has already occurred during the short-term operation phase 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 turbine locations and minimise the construction of additional roads through peat-based habitats.

Residual Impact

Long-term Slight 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.

10.2.4.4 Decommissioning Phase (Early)

The wind turbines which form part of the Cleanrath wind farm development are expected to have a lifespan of approximately 25 years and remain on site for that period of time pending the outcome of the Substitute Consent process. However, should the development not be consented, there is the possibility that an early decommissioning phase will be implemented and so this potential has been assessed.

The decommissioning phase itself will have no significant effect on climate however the indirect effects are described here.

The works required during either an early decommissioning phase or decommissioning after the end of the useful lifetime of the wind farm do not differ and are described in Chapter 4: Description of the Cleanrath wind farm development. The potential effects do however differ. The early decommissioning of the project would result in a renewable energy facility not being provided at this location and the Cleanrath wind farm development being decommissioned and therefore eliminate the climate change benefits which will accrue through its continued operation.

In order to make up the potential short fall in renewable energy generation, the early decommissioning of the Cleanrath wind farm development would ultimately lead to the potential for an alternative site being identified and developed with further potential for carbon losses by both the early decommissioning the Cleanrath wind farm development and the construction of a wind farm at an alternative site.

Should a new site not be available, early decommissioning would lead to the reduction in renewable energy being supplied to the national grid which is contrary to climate policy. Should Early Decommissioning occur, this would be a potentially long term slight negative effect on climate. The Cleanrath wind farm development and building of its infrastructure has been shown to have had no significant environmental effects nor an adverse impacts on Natura 2000 sites and has the potential for positive effects on climate.

A Decommissioning Plan has been prepared (Appendix 4-9) for an early decommissioning of the Cleanrath wind farm development the detail of which will be agreed with the local authority prior to any decommissioning

Any impact and consequential effect that occurs during the decommissioning phase will be similar to that which occurs during part of the construction phase when turbines were being erected. The impacts and associated effects will be materially less than during the construction phase as significant ground works are not required to decommission a wind farm

10.2.4.5 Decommissioning Phase (Post Operational Phase)

Prior to the end of the operational period the Decommissioning Plan (Appendix 4-9) will be updated in line with decommissioning methodologies that may exist at the time and will agreed with the competent authority at that time. That decommissioning plan will be as set out in Chapter 4 and Decommissioning, will include the disassembly of the turbines for removal offsite for reuse or recycling. Turbine foundations will remain in place underground and will be covered with earth and reseeded as appropriate. The site access roadways are highly likely to be required by the ongoing farming and forestry operations, and therefore they will be left in situ for future use. The 33kV electrical cabling connecting the Cleanrath wind farm development to the substation in the townland of Rathgaskig will be removed from the underground cable ducting at the end of the useful life of the Cleanrath wind farm development. The 38kV grid connection cabling that continues from the Derragh Substation to the Coomataggart Substation may remain in place as it will be an ESB networks asset and will serve the exiting 38kV substation .

Any impact and consequential effect that occurs during the decommissioning phase will be similar to that which occurs during part of the construction phase when turbines were being erected. The impacts and associated effects will be materially less than during the construction phase as significant ground works are not required to decommission a wind farm,

The decommissioning phase will have no significant impact on climate.

10.3 Cumulative Assessment

Potential cumulative effects on air quality and climate between the Cleanrath wind farm development and other projects in the vicinity were also considered as part of this assessment. The projects considered as part of the cumulative effect assessment are described in Section 2.5 of this EIAR.

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

Other Wind Farms

During the construction phase of the Cleanrath wind farm development and other projects described in Section 2.5 of this EIAR, there were 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 10.1.5.2 and 10.2.4.2 are implemented during the construction phase of the Cleanrath wind farm development, there was no cumulative negative effect on air and climate.

There will be no net carbon dioxide (CO_2) emissions from operation of the Cleanrath wind farm development. Emissions of carbon dioxide (CO_2), oxides of nitrogen (NO_x), sulphur dioxide (SO_2) or dust emissions during the short-term operational, sleep mode operational and future normal operational phases of the Cleanrath wind farm development will be minimal, relating to the use of operation and maintenance vehicles onsite as outlined in Section 10.2.4.3 above, and therefore there will be no measurable negative cumulative effect with other projects on air quality and climate including non-wind energy related projects also described in Section 2.5.

The nature of the Cleanrath wind farm 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. Likewise the potential for cumulative