ENVIRONMENTAL IMPACT ASSESSMENT REPORT (EIAR) FOR THE PROPOSED DERNACART WIND FARM, COUNTY LAOIS

VOLUME 2 – MAIN EIAR

CHAPTER 16 - AIR QUALITY AND CLIMATE

DECEMBER 2019

Statkraft

FEHILY TIMONEY
30 YEARS

TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF TABLES

Page

16 AIR QUALITY AND CLIMATE

16.1 Introduction

This chapter assesses the effect on air quality and climate for the region surrounding the proposed Dernacart Wind Farm development. The assessment considers the construction, operational and decommissioning phases of the proposed development which have the potential to impact on air quality and climate. Mitigation measures and the residual impacts after the proposed mitigation measures have been implemented are also described.

The Chapter includes calculations of the emissions, including greenhouse gas emissions, arising from the proposed development. It also provides a balance of carbon losses and savings associated with the project in the context of Irish energy and planning policy and consistent with the objectives of the Climate Action Plan 2019 which sets objectives for policy action including decarbonisation targets for the country. In terms of renewable energy, electricity generated from renewable sources is to increase to 70% by 2030, with up to 8.2GW of increased onshore wind capacity.

Further details on EU and Irish climate change and adaptation policies, and well as relevant legislation and standards are provided in Chapter 1 – Introduction. Chapter 2 – Need and Alternatives, and Chapter 3 – Policy of this EIAR.

16.1.1 Air Quality

In order to protect human health, vegetation and ecosystems, EU Directives set out air quality standards for member states including for a wide variety of pollutants. These Directives set out requirements for monitoring, assessment and management of ambient air quality. The European Commission set down the principles to this approach in 1996 with its Air Quality Framework Directive (96/62/EC). Four "daughter" directives lay down limits for specific pollutants:

- 1st Daughter Directive (99/30/EC): Sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead;
- 2nd Daughter Directive (2000/69/EC): Carbon monoxide and benzene;
- 3rd Daughter Directive (2002/3/EC): Ozone; and
- 4th Daughter Directive (2004/107/EC): Polyaromatic hydrocarbons, arsenic, nickel, cadmium and mercury in ambient air.

The Ambient Air Quality and Cleaner Air for Europe (CAFE) Directive (2008/50/EC) was published in May 2008, replacing the Framework Directive and the 1st, 2nd and 3rd Daughter Directives. The 4th Daughter Directive will be included in CAFE at a later stage. The associate limit and target values are outlined below.

The CAFE Directive was transposed into Irish law by the Air Quality Standards Regulations 2011 (S.I. No. 180 of 2011). It replaces 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 S.I. No. 33 of 1999. The fourth Daughter Directive was transposed into Irish legislation by the Arsenic, Cadmium, Mercury, Nickel and Polycyclic Aromatic Hydrocarbons in Ambient Air Regulations 2009 (S.I. No. 58 of 2009). Table 16.1 details the limit values for pollutants as per the CAFE Directive.

Table 16-1: Limit Values of CAFE Directive 2008/50/EC

Pollutant	Limit Value Objective	Averaging Period	Limit Value ug/m3	Limit Value ppb	Basis of Application of the Limit Value
SO_2	Protection of human health	1 hour	350	132	Not to be exceeded more than 24 times in a calendar year

Pollutant	Limit Value Objective	Averaging Period	Limit Value ug/m3	Limit Value ppb	Basis of Application of the Limit Value
SO_2	Protection of human health	24 hours	125	47	Not to be exceeded more than 3 times in a calendar year
SO_2	Protection of vegetation	calendar year	20	7.5	Annual mean
SO_2	Protection of vegetation	1 Oct to 31 Mar	20	7.5	Winter mean
NO_2	Protection of human health	1 hour	200	105	Not to be exceeded more than 18 times in a calendar year
NO_2	Protection of human health	calendar year	40	21	Annual mean
NO + NO_2	Protection of ecosystems	calendar year	30	16	Annual mean
PM_{10}	Protection of human health	24 hours	50		Not to be exceeded more than 35 times in a calendar year
PM_{10}	Protection of human health	calendar year	40		Annual mean
$PM_{2.5}$ - stage 1	Protection of human health	calendar year	25		Annual mean
$PM_{2.5}$ - stage 2	Protection of human health	calendar year	20		Annual mean
Lead	Protection of human health	calendar year	0.5		Annual mean
Carbon Monoxide	Protection of human health	8 hours	10,000	8620	Not to be exceeded
Benzene	Protection of human health	calendar year	5	1.5	Annual mean

There are no statutory limits for dust deposition, however, TA Luft (German Government 'Technical Instructions on Air Quality') states a guideline value of 350 mg/m^2/day.

There are no statutory limit values in relation to ozone, however, the Ozone Daughter Directive sets target values. These are detailed in Table 16.2 along with information threshold and alert threshold values.

Table 16-2: Target Values for Ozone

Objective	Calculation	Target Value for 2020
Protection of Human Health	Maximum daily 8-hour mean	120 µg/m^3
Protection of vegetation	AOT40, calculated from 1-hour values from May to July	6000 µg/m^3-h
Information threshold	1-hour average	180 µg/m^3
Alert Threshold	1-hour average	240 µg/m^3

The World Health Organisation (WHO) in 2016 estimated that ambient air pollution had caused 4.2 million deaths worldwide in 2016 (WHO, 2018). According to the EPA (Air Quality in Ireland 2017 – Indicators of Air Quality (EPA 2018), in Ireland the number of deaths directly linked to air pollution is estimated at 1,150 premature deaths in Ireland in 2015 due to poor air quality (predominantly due to $PM_{2.5}$), with a figure of 422,000 premature deaths across the wider EU (EEA, 2018 cited in 'Air Quality in Ireland 2017 – Indicators of Air Quality, EPA 2018). Generally, air quality in Ireland is acceptable.

However, in the short term, when compared with WHO guideline values and EEA reference level values; ozone, particulate matter and PHAs are of concern in the short term and NO_2 levels are expected to increase as road traffic increase.

The use of fossil fuel-based electricity generation leads to NOx and SOx emissions. Wind generation does not produce any NOx or SOx emissions. Therefore, by replacing electricity generated from the burning of fossil fuels, operation of the proposed wind farm will have a beneficial effect on air quality and human health.

16.1.2 Climate

Carbon dioxide (CO_2) is a greenhouse gas which, if released in excessive amounts, can lead to increases in global temperatures known as 'global warming' or the 'greenhouse effect' which can influence climate change. Due to the use of fossil fuels in transportation and construction, the proposed development will result in greenhouse gas emissions during its construction and decommissioning phases. However, during the course its operation there will only be very minor direct emissions, and overall the project will have a long-term positive impact by providing a sustainable and renewable energy source, which will replace electricity generated from the burning of fossil fuels. Should the wind farm not be developed, fossil fuel power stations will be the primary alternative to provide the required quantities of electricity. This will further contribute to greenhouse gas and other emissions, and hinder Ireland in its commitment to meet its target to increase electricity production from renewable sources and to reduce greenhouse gas emissions.

At the Paris climate conference (COP21) in December 2015, 195 countries adopted the first-ever universal, legally binding global climate deal. The agreement sets out a global action plan to put the world on track to avoid dangerous climate change by limiting global warming to well below 2°C above pre-industrial levels and to limit the increase to 1.5°C. Under the agreement, Governments also agreed on the need for global emissions to peak as soon as possible, recognising that this will take longer for developing countries and to undertake rapid reductions thereafter in accordance with the best available science.

The International Panel on Climate Change (IPCC) has put forward its clear assessment that the window for action on climate change is rapidly closing and that renewable energy sources such as wind will have to grow from 30% of global electricity at present to 80% by 2050 if we are to limit global warming. In this regard the Government enacted the *Climate Action and Low Carbon Development Bill 2015 which* provides for the approval of plans by the Government in relation to climate change for the purpose of pursuing the transition to a low carbon, climate resilient and environmentally sustainable economy.

Under the EU Commission's Climate and Energy Package, Ireland is required to deliver a 20% reduction in non-ETS (Emissions Trading Scheme) greenhouse gas emissions by 2020 (relative to 2005 levels). In addition, Ireland also has binding annual emission limits for the period 2013-2020 to ensure a gradual move towards the 2020 target. In the EPA 2018 publication *Ireland's Greenhouse Gas Emissions Projections 2017 – 2035*, it is reported that Ireland has exceeded its annual binding limit for first time in 2016. Over the period 2013 – 2020 Ireland is projected to cumulatively exceed its compliance obligations by approximately 17Mt CO_2 equivalent under the *With Existing Measures* scenario and 16.3 Mt CO_2 equivalent under the *With Additional Measures* scenario.

An amendment to the Kyoto Protocol – the Doha Amendment, was adopted on 8th December 2012 in Doha, Qatar. A second commitment period was agreed (2013-2020); a revised list of greenhouse gases to be reported on by Parties in the second commitment was agreed and added nitrogen trifluoride to the list of greenhouse gases; and amendments were made 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 industrialized countries and the European Community committed to reduce greenhouse gas emissions to an average of five percent below 1990 levels.

During the second commitment period, Parties committed to reduce greenhouse gas 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.

In December 2018, the revised Energy Efficiency Directive, the revised Renewable Energy Directive and the new Governance Regulation were formally adopted. The new regulatory framework includes a binding renewable energy target for the EU for 2030 of 32% with an upwards revision clause by 2023. This agreement will help the EU meet the Paris Agreement goals.

The main achievements of this agreement in terms of renewable energy production are:

- Sets a new, binding renewable energy target for the EU for 2030 of 32%, including a review clause by 2023 for an upward revision of the EU level target;
- Improves the design and stability of support schemes for renewables;
- Delivers real streamlining and reduction of administrative procedures;
- Establishes a clear and stable regulatory framework on self-consumption;
- Increases the level of ambition for the transport and heating/cooling sectors; and
- Improves the sustainability of the use of bioenergy.

The Irish government has recently published the Climate Action Plan 2019 which sets out a plan of action to address climate change and sets decarbonisation targets. In terms of renewable energy, an increase in electricity generated from renewable sources is to increase to 70% by 2030, with up to 8.2GW of increased onshore wind capacity.

16.2 Methodology

This chapter assesses the impact of the air emissions associated with the proposed development. As the operation of wind turbines do not give rise to emissions, the assessment focuses on the construction and decommissioning phases of the proposed Dernacart Wind Farm and associated grid connection.

16.2.1 Air Quality

Due to the nature and characteristics of the proposed development, the short-term nature of the construction period and the general character of the surrounding area, baseline air quality data acquisition was not considered to be necessary. A review of existing air quality monitoring data from the Environmental Protection Agency (EPA) was reviewed to characterise the receiving environment.

The impact assessment methodology applied involved the review and assessment of the proposed wind farm and associated infrastructure to identify the sources and magnitudes of air emissions during construction and decommissioning.

To assess the impacts of construction dust emissions, the NRA's *Assessment Criteria for the impact of dust emissions from construction activities with standard mitigation in place* was used. This table is provided in Appendix 8 of the *National Roads Authority (NRA) Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes* (NRA, 2011) and reproduced below in Table 16.3. The NRA was merged with the Railway Procurement Agency and was effectively dissolved on 1 August 2015. The merger of the two agencies is called Transport Infrastructure Ireland (TII).

Table 16.4 details the definitions of impact magnitude for changes in ambient pollutant concentrations and Table 16.5 details the descriptors for changes in annual mean nitrogen dioxide, PM_{10} and $PM_{2.5}$ at receptors.

Table 16-3: Assessment Criteria for the Impact of Dust Emissions from Construction Activities, with Standard Mitigation in Place

Source		Potential Distance for Significant Effects (Distance from source)		
Scale	Description	Soiling	PM_{10}	Vegetation Effects
Major	Large construction sites, with high use of haul routes	100m	25m	25m
Moderate	Moderate sized construction sites, with moderate use of haul routes	50m	15m	15m
Minor	Minor construction sites, with limited use of haul routes	25m	10m	10m

(source: NRA/TII, 2011)

Table 16-4: Definition of Impact Magnitude

Magnitude of Change	Annual Mean NO_2/PM_{10}	No. Days with PM_{10} conc. >50µg/m³	Annual Mean PM_{10}
Large	Increase/Decrease ≥4µg/m³	Increase/Decrease > 4 days	Increase/Decrease ≥2.5 µg/m³
Medium	Increase/Decrease 2-< 4µg/m³	Increase/Decrease 3 or 4 days	Increase/Decrease 1.25 - <2.5 µg/m³
Small	Increase/Decrease 0.4 - <2 µg/m³	Increase/Decrease 1 or 2 days	Increase/Decrease 0.25 - <1.25 µg/m³
Imperceptible	Increase/Decrease <0.4 µg/m³	Increase/Decrease <1 day	Increase/Decrease <0.25 µg/m³

(source: NRA/TII, 2011)

Table 16-5: Air Quality Impact Descriptors for Changes to Annual Mean Nitrogen Dioxide and PM_{10} and $PM_{2.5}$ Concentrations at a Receptor

Absolute Concentration In relation to Objective/Limit Value	Change in Concentration		
	Small	Medium	Large
Increase with Scheme			
Above Objective/Limit Value with Scheme (≥40µg/m³ of NO_2 or MP_{10}) (≥25µg/m³ of $PM_{2.5}$)	Slight adverse	Moderate adverse	Substantial adverse
Just below objective/limit value with scheme (36- <40 µg/m³ of NO_2 or PM_{10}) (22.5 - <25 µg/m³ of $PM_{2.5}$)	Slight adverse	Moderate adverse	Moderate adverse
Below objective/limit value with scheme (30- <36 µg/m³ of NO_2 or PM_{10}) (18.75 - < 22.5 µg/m³ of $PM_{2.5}$)	Negligible	Slight adverse	Slight adverse
Well below objective/limit value (<30 µg/m³ of NO_2 or PM_{10}) (<18.75 µg/m³ of $PM_{2.5}$)	Negligible	Negligible	Slight adverse

Absolute Concentration In relation to Objective/Limit Value	Change in Concentration		
	Small	Medium	Large
Decrease with Scheme			
Above objective/limit value without scheme (≥40 µg/m^3 of NO_2 or PM_{10}) (≥25 µg/m^3 of $PM_{2.5}$)	Slight beneficial	Moderate beneficial	Substantial beneficial
Just below objective / limit value without scheme (36 - <40 µg/m^3 of NO_2 or PM_{10}) (22.5 - <25 µg/m^3 of $PM_{2.5}$)	Slight beneficial	Moderate beneficial	Moderate beneficial
Below objective/limit value without scheme (30 - <36 µg/m^3 of NO_2 or PM_{10}) (18.75 - <22.5 µg/m^3 of $PM_{2.5}$)	Negligible	Slight beneficial	Slight beneficial
Well below objective/limit value without scheme (<30 µg/m^3 of NO_2 or PM_{10}) (<18.75 µg/m^3 of $PM_{2.5}$)	Negligible	Negligible	Slight beneficial

(source: NRA/TII, 2011)

16.2.2 Climate

A desk-top study was undertaken of available climatic information to characterise the climate in the local region.

The assessment considered the net impact in terms of CO_2 emissions that the development and operation of the proposed wind farm will have, including the CO_2 savings associated with the development's potential to replace electricity generated by burning fossil fuel.

The impact assessment considered the positive impacts the proposed wind farm will have on contributing to national targets for the reduction of greenhouse gas emissions.

Greenhouse gas emissions are associated with the manufacture, transport, construction, operation and decommissioning of wind turbines.

The Intergovernmental Panel on Climate Change (IPCC) in 'Renewable *Energy Sources and Climate Change Mitigation*' (2014) state that 50 estimates from 20 studies indicate that emissions "*are small compared to the energy generated and emissions avoided over the lifetime of wind farm plants* [farms]*: the GHG* [greenhouse gas] *emissions intensity of wind energy is estimated to range from 8 to 20g CO2/kWh in most instances*". The IPCC (2010) report that payback time (this is the carbon payback time which estimates the length of the time required for the wind turbines to be in operation before offsetting the carbon consumed during construction), based on lifecycle assessment procedures, per turbine vary between 0.25 years and 0.65 years for onshore developments.

The amount of CO_2 emissions that could potentially be avoided on an annual basis due to the proposed wind farm is estimated based on the expected output of the wind farm. The net displacement value may increase or decrease somewhat, as the generation mix in Ireland develops, under different fuel prices scenarios and as demand changes over time, and as more storage, interconnection and demand side management (smart meters) come online. Section 16.4.4 provide details of the calculations of carbon savings associated with the proposed wind farm.

16.2.3 Carbon Emissions

Ireland's greenhouse gas emissions are tracked and projected by the EPA for submission to the EU UNFCCC annually. Carbon dioxide emissions are reported alongside methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6), and nitrogen trifluoride (NF_3).

For 2017, total national greenhouse gas emissions were 60.74 million tonnes carbon dioxide equivalent (Mt CO_2eq). This is 0.9% lower (0.53Mt CO_2eq) than emissions in 2016, but 9.6% higher than emissions in 1990.

Emissions reductions have been recorded in seven of the last 10 years, however, two of the last three years have seen large increases in emissions. In the last three years national total emissions increased by 6.4% or 3.65 Mt CO_2eq.

Emissions in the Energy Industries sector showed a decrease of 6.9% between 2016 and 2017 which is attributable to decreases in the consumption of coal, peat and oil by 21.2%, 6.2% and 47.8% respectively while there were increases in natural gas, biomass and non-renewable wastes of 3.6%, 22.3% and 126.1% respectively for electricity generated from wind and hydro renewables. In 2017, electricity generated from wind and hydro increased by 21.1% and 1.6% respectively, reflected in a 9.1% decrease in the emissions intensity of power generation in 2017 (437g CO_2/kWh) compared with 2016 (480 g CO_2/kWh). Renewables accounted for 29.6% of electricity generated in 2017, up from 25.5% in 2016. Ireland exported 2.3% of electricity generated in 2017 and total final consumption of electricity increased by 1.1% (EPA, 2019).

SEAI estimate that 30.1% of energy generation was from renewable sources in 2017; the use of renewables in electricity generation in 2017 reduced CO_2 emissions by 3.3 Mt and avoided €278 million in fossil fuel imports. Over 500 MW of wind generation was installed during 2017 and wind generation accounted for 25.2% of the electricity generated (SEAI, 2018).

The EPA's latest projections report, 'Ireland's Greenhouse Gas Emissions Projections 2018-2040' (June 2019) projected Ireland's greenhouse gas emissions under two scenarios: The *With Existing Measures* scenario and the *With Additional Measures* scenario. The With Existing Measures (WEM) scenario incorporates the anticipated impact of policies and measures that were in place (and legislatively provided for) by the end of 2017. The With Additional Measures (WAM) scenario is primarily based on SEAI's Advanced energy projection (which includes existing and planned policies and measures) and anticipated progress in the implementation of Government renewable and energy efficiency policies and measures including those set out in the National Renewable Energy Action Plan (NREAP), the National Energy Efficiency Action Plan (NEEAP) and Ireland's National Development Plan 2018 - 2027. Figure 16.1 illustrates the WEM and WAM projected emissions in relation to Energy Industries.

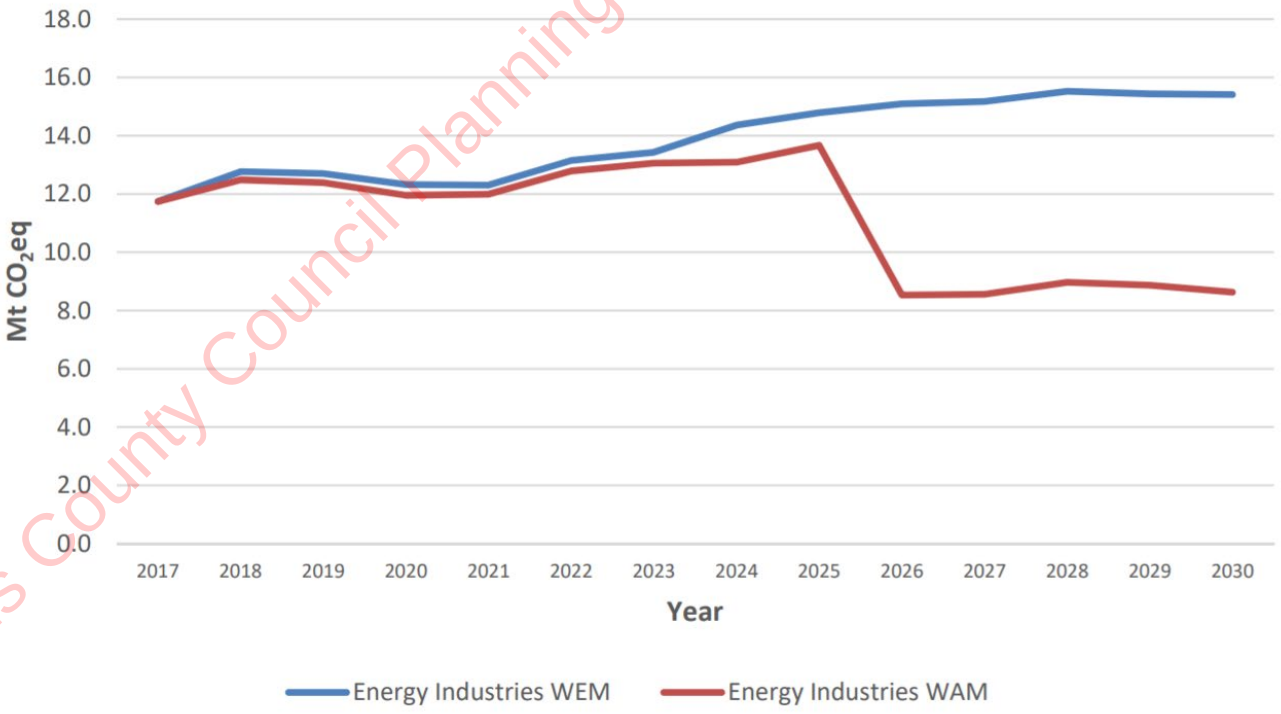

Figure 16-1: Greenhouse Gas Emissions Projections from the Energy Industries Sector under the WEM and WAM scenarios out to 2030

Ireland's 2020 target is to achieve a 20% reduction of non-Emission 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.

A new Effort Sharing Regulation setting out 2030 targets for EU Member States has recently been adopted by the European Council. Irelands 2030 target is a 30% reduction of emissions compared to 2005 levels by 2030 with binding annual limits over the 2021-2030 period to meet that target. Over the longer-term Ireland's National Policy Position on Climate change has set a target of an aggregate reduction in carbon dioxide (CO_2) emissions of at least 80% (compared to 1990 levels) by 2050 across the electricity generation, built environment and transport sectors.

According to 'Ireland's Greenhouse Gas Emissions Projections 2018-2040' (EPA, 2019), 2018 greenhouse gas emissions projections show total emissions increasing from current levels by 1% and 6% by 2020 and 2030 respectively, under the WEM (With Existing Measures) scenario. Under the WAM (With Additional Measures) scenario emissions are estimated to decrease by 0.4% by 2020 and decrease by 110% by 2030.

Ireland's non-ETS emissions are projected to be 5% and 6% below 2005 levels in 2020 under the WEM and WAM scenarios, respectively. The target for Ireland is a 20% reduction below 2005 levels by 2020. Ireland has exceeded its annual binding limits in 2016 and 2017. Over the period 2013 – 2020, Ireland is projected to cumulatively exceed its compliance obligations by approximately 10 Mt CO_2 equivalent under the With Existing Measures scenario and 9 Mt CO_2 equivalent under the With Additional Measures scenario (EPA, 2019).

On 14th May 2018, the European Council adopted a regulation on greenhouse gas emission reductions. The regulation sets out binding emission reduction targets for Member States in sectors falling outside the scope of the EU emissions trading system for the period 2021- 2030. The Regulation (Effort Sharing Regulation) maintains existing flexibilities under the current Effort Sharing Decision (e.g. banking, borrowing and buying and selling between Member States) and provides two new flexibilities (use of ETS allowances and credit from action undertaken in the Land Use, Land Use Change and Forestry (LULUCF) sector) to allow for a fair and cost-efficient achievement of the targets. The results show that in a low fuel price scenario, Ireland will exceed the carbon budget over the period 2021 – 2030 by 86-101 Mt CO_2 equivalent or by 40-56 Mt CO_2 with full use of the ETS and LULUCG flexibilities.

16.3 Existing Environment

16.3.1 Air Quality

European air quality legislation requires that each member state be defined in terms of Zones and Agglomerations for air quality, with Ireland divided into four zones. Dublin Conurbation is one zone – Zone A and Cork Conurbation is defined as Zone B. Zone C consists of 24 cities and towns (such as Galway, Limerick and Waterford cities and towns such as Naas, Newbridge, Celbridge, Leixlip) with a population of greater than 15,000 while Zone D covers the remainder of the country. The proposed wind farm is located in Zone D.

The air quality in each zone is monitored by the EPA and classified with respect to upper and lower assessment thresholds based on measurements over the previous five years. The number of monitoring locations required is dependent on population size and whether ambient air quality concentrations exceed the upper assessment threshold, are between the upper and lower assessment thresholds, or are below the lower assessment threshold. The Air Quality in Ireland 2017 – Indicators of Air Quality (EPA, 2018) noted that Ireland's overall air quality was good and compares favorably with other member states and all the parameters were below the EU limit and target values. However, when compared to the tighter WHO Air Quality Guideline values, Ireland exceeded the WHO Guideline values in 2017 for PM_{10}, $PM_{2.5}$, O_3 and PAH. The Air Quality Index for Health map on the EPA website, shows that the current air quality within the proposed development site is classed as 1 – Good.

16.3.2 Climate

The dominant influence on Ireland's climate is the Gulf Stream. Consequently, Ireland does not suffer from the extremes of temperature experienced by many other countries at similar latitude.

The climatic conditions for the wider geographical area have been derived from historical meteorological measurements complied by Met Éireann at Oak Park synoptic station which is approximately 44km south east of the proposed wind farm site. These meteorological conditions are presented in Table 16.6 for the period 2016 – Aug 2019 (source www.met.ie/climate).

Table 16-6: Monthly Weather Data from Oak Park Synoptic Station

Total rainfall in millimetres for OAK PARK												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
2019	30.9	36.8	122.9	72.5	14.1	55	42.6	80.7				
2018	108.1	38.7	98.1	73	24.3	5.2	42.5	39.8	53.7	58.3	160.5	119.3
2017	36.3	57.8	66.6	15.8	81.8	91	52.7	62.3	92.5	62.9	52.8	84.2
2016	110.9	95.7	40.6	64.3	61.6	61.7	29.6	46	97.4	32.3	26.3	80.2
mean	80.4	57.3	63.4	55.9	59.8	60.8	58.7	71.9	69.6	92.9	85.9	83.6
Mean temperature in degrees Celsius for OAK PARK												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
2019	5.9	7.5	7.4	8.9	11	13	16.7	16.2				
2018	5.4	3.6	4.8	9	12.5	16.4	17.8	16	12.8	10	8.1	8.4
2017	6	6.5	8.3	9	12.4	15	15.7	15	13	11.5	6.7	5.6
2016	5.9	4.9	6.1	7.5	12.3	15.1	16	16	14.6	10.6	5.2	6.3
mean	5.1	5.6	6.9	8.4	11	13.7	15.6	15.3	13.2	10.1	7.2	5.5
Mean 10cm soil temperature for OAK PARK at 0900 UTC												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
2019	5.3	5.5	6.3	8.8	12.8	14.8	17.7	16.2				
2018	4	2.5	4.1	8.8	13.4	18.6	19.4	16.3	12.7	9.4	6.8	6.9
2017	4.9	5.1	7	9.7	13.8	16.4	16.7	15.3	12.8	10.9	6.4	4.5
2016	4.8	3.8	4.9	7.7	13.3	16.3	17.1	16.3	14.3	10	4.8	5.2
mean	3.7	3.7	5.4	8.1	12	15.5	16.9	15.9	13	9.3	6	4.2
Global Solar Radiation in Joules/cm2 for OAK PARK												

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2019	7642	14822	29254	35333	52217	52607	53970	37759				
2018	8391	15960	23667	38598	56893	65358	57086	40751	32665	19493	7581	4932
2017	7224	11187	27159	34762	55979	52967	52622	39969	30597	14765	10430	6224
2016	7115	12740	26712	39673	54004	48106	46967	40151	28957	20024	10980	5581
mean	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Potential Evapotranspiration (mm) for OAK PARK												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
2019	12.6	20.6	37.5	52	76.6	82.3	94.1	65.9				
2018	13.5	17	29.8	52.3	84.7	110.7	107.9	74.5	50.7	27.4	13.4	11.6
2017	11.5	17.9	35.4	50	80.7	86.5	87.7	68.2	45.8	25.9	10.3	9.4
2016	10.9	16.6	33.9	52	79.4	78.4	79.7	70.5	47.3	26.7	9.9	8.3
mean	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Evaporation (mm) for OAK PARK												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
2019	16.5	28.8	55.5	74.6	107.4	115.4	127	90.2				
2018	17.5	24.3	43.7	77.3	119.3	148.6	142.2	100.2	70	37.6	17.9	14.8
2017	15.3	25.4	51.7	71	114	121.5	120.1	93.3	64.2	35.5	13.9	11.9
2016	14.8	24	49.5	76	111.6	108.4	110.1	96.6	65.4	36.6	13.9	10.8
mean	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
DEGREE DAYS BELOW 15.5 DEGREE CELSIUS FOR OAK PARK												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
2019	299	225	252	206	148	97	30	N/A	N/A	N/A	N/A	N/A
2018	312	334	333	199	117	47	26	46	101	175	222	221
2017	293	253	223	194	116	54	44	52	92	129	N/A	307
2016	297	309	291	241	115	50	40	34	61	153	310	284

16.4 Impact Assessment

16.4.1 Do-Nothing Impact

If the proposed Dernacart Wind Farm development does not proceed, local air quality and the microclimate will remain unchanged. The potential for carbon savings associated with the proposed development will not be achieved, and Ireland's ability to meet current and future binding targets for decarbonisation reduced, with the associated impact this will have on the national economy and on Ireland's international reputation.

16.4.2 Air Quality

16.4.2.1Construction Phase Impacts

The principal source of potential air emissions during the construction of the proposed wind farm will be dust arising from earthworks, tree felling activities, trench excavation along cable routes, construction of the new access tracks, temporary storage of excavated materials, movement of construction vehicles, loading and unloading of aggregates/materials and movement of materials around the site.

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. The amount of dust generated and emitted from a working site and the potential impact on the surrounding areas varies according to:

- The type and quantity of material and working methods
- Distance between site activities and sensitive receptors
- Climate/local meteorology and topography

Table 16.7 details the NRA assessment criteria used for assessing the impact of dust from construction activities sites of varying scale.

Table 16-7: NRA Assessment Criteria for the Impact of Dust Emissions from Construction Activities with Standard Mitigation in Place

Source		Potential Distance for Significant Effects (Distance from source)		
Scale	**Description**	**Soiling**	**PM_{10}**	**Vegetation Effects**
Major	Large construction sites, with high use of haul roads	100 m	25 m	25 m
Moderate	Moderate construction sites, with moderate use of haul roads	50 m	15 m	15 m
Minor	Minor construction sites, with limited use of haul roads	25 m	10 m	10 m

Source: NRA / TII, 2011

Applying the NRA criteria in Table 16.7, the overall construction of the proposed Dernacart Wind Farm would be considered a moderate construction site. This would result in soiling effects which have the potential to occur up to 50m from the source, with PM_{10} deposition and vegetation effects occurring up to 15m from the source.

Construction vehicles and plant emissions have the potential to increase concentrations of NO_2, Benzene and PM_{10} in the receiving environment.

It is not predicted that an air quality impact will occur due to traffic at the proposed development as the impacts will fall below the screening criteria set out in the UK DMRB guidance (UK Highways Agency 2007), on which the NRA/TII guidance is based. This UK DMRB guidance states that road links meeting one or more of the following criteria can be defined as being 'affected' by a proposed development and should be included in the local air quality assessment:

- Road alignment change of 5 metres or more;
- Daily traffic flow changes by 1,000 AADT or more;
- HGVs flows change by 200 vehicles per day or more;
- Daily average speed changes by 10 km/h or more; or
- Peak hour speed changes by 20 km/h or more.

As detailed in Chapter 10 Traffic and Transportation, the average combined increase in HGVs and LGVs is 71 trips over the 12 month construction period.

Plant and machinery such as generators, excavators etc. will be required at various stages of the construction works. These will be relatively small units which will be operated on an intermittent basis. Although there will be an emission from these units, given their scale and the length of operation time, the impacts of emissions from these units will be negligible.

16.4.2.2 Operational Phase Impacts

Once the proposed wind farm development is constructed there will be no significant direct emissions to atmosphere. A diesel generator will be located at the substation; however, this will only be operated as a back-up/emergency power supply. The operational phase of the wind farm will result in positive impacts on air quality due to the displacement of fossil fuels as an energy source.

16.4.2.3 Decommissioning Phase Impacts

In terms of decommissioning, there will be truck movements associated with removing the turbines from the wind farm resulting in vehicular emissions and also dust. However, the number of truck movements would be significantly less than the construction phase and would potentially result in a slight temporary impact.

16.4.3 Climate

As set out above, greenhouse gas emissions will arise from construction vehicles, plant and equipment during the construction and decommissioning phases of the proposed development. The potential impacts arising from these emissions on climate are assessed hereunder with respect to micro global climates.

Microclimate - The significance of impacts associated with the conversion of vegetated surfaces to un-vegetated surfaces is assessed through the consideration of the area of the land experiencing such a change. The proposed wind farm site is currently predominately a greenfield site except for existing roads and track. The total area of proposed permanent hardstanding is approximately 16% of the wind farm planning development area, and consequently there will be no direct or indirect impact on air temperature and/or microclimate due to the development. The presence of wind turbines is not expected to have an impact on the microclimate.

Macroclimate - Carbon dioxide (CO_2) is a greenhouse gas which if released in excessive amounts can lead to increases in global temperatures known as 'global warming' or 'greenhouse effect' which can cause climate change. The carbon emissions associated with the development are low and will only represent a very small proportion Ireland's greenhouse gas emissions during the construction and decommissioning phases. However, the carbon savings associated with the switch from fossil fuel generated electricity to renewables will contribute to Ireland's ability to meet national emission targets and to the EU's ambition of becoming carbon neutral by 2050. The proposed Dernacart Wind Farm development offers Ireland an indigenous form of sustainable electricity and would also contribute to security of supply against Ireland's dependence on imports.

16.4.4 Carbon Balance

The online Scottish Windfarm Carbon Assessment Tool: (https://informatics.sepa.org.uk/CarbonCalculator/index.jsp). was used to estimate carbon emissions and savings associated with the proposed wind farm development.

Appendix 16.1 details the inputs to the model. Data that was inputted into the model for assessment purposes included the wind turbine number (8 no.), an assumed rating for the turbines (5MW), the assumed capacity factor (35%), area of forestry to be felled (18ha), details of the foundations and hardstanding. In terms of the capacity factor, EirGrid in their *'All Island Generation Capacity Statement'* (2018-2027) estimate a capacity factor of approximately 30% for onshore wind. A 35% capacity factor has been applied for the proposed development. This is greater than the EirGrid estimation due to the turbine type proposed for the site i.e. tall turbines (tip height of up to 185m) with greater rotor diameters. This turbine type allows for the use of fewer, taller turbines with an increased efficiency and in return greater economic benefit to the consumer. In terms of emissions factor which is used in the calculation of carbon emissions savings, an assumption was made to use the fossil fuel mix emission factor; the carbon assessment tool uses the fixed value of 0.45 tonnes CO_2/MWh. The assumption to use this emission factor was made based on the reality that additional wind generation will displace fossil fuel generation and a mix of fossil fuels are used (Scot. Gov., 2018).

The construction of the wind farm and associated grid connection will result in CO_2 emissions or losses, something which is standard for wind farm developments. These losses are due to the manufacture, construction and decommissioning of the turbines and also include losses during the construction, operational and decommissioning phases of the wind farm due to reduced CO_2 fixing and storage potential and CO_2 losses from soil organic matter; including tree felling, soil and peat excavation and changes to drainage. For the proposed Dernacart Wind Farm development, the initial CO_2 losses are set out in in Table 16.8 – these were calculated using the Scottish Government Windfarm Carbon Assessment Tool. Assuming an operational life of 30 years, Dernacart Wind Farm's payback time for CO_2 losses (from manufacture, construction, operation and decommissioning phases) is estimated to be approximately 13 months. Should further restoration measures be put in place, such as forestry replanting or drain blocking allowing peatland recovery within the site, the total CO_2 emissions and carbon payback time would be further reduced.

It is estimated that Dernacart Wind Farm will result in the net displacement of approximately 55,188 tonnes of CO_2 per annum or 1,655,640 tonnes of CO_2 over a 30 year lifespan. From an operational perspective, the proposed development will displace CO_2 emissions from fossil fuel generated electricity and will assist Ireland in meeting its renewable energy targets and obligations.

Table 16-8: Carbon Balance Results

Origin of Losses	**Total CO_2 Losses due to windfarm (tonnes CO_2 equivalent)**
Turbine manufacture, construction and decommissioning	35,028
Losses due to Backup	9,461
Losses from soil organic matter	6,688
Felling of Forestry	7,128
Other	459
Total Expected Losses	58,764
Emissions Savings	**Expected CO_2 emission savings (tonnes CO_2 per Annum)**
Fossil fuel mix electricity generation	55,188
Energy output from windfarm	**MWh/Annum**

Output from windfarm	122,640
Carbon payback time	**Months**
Fossil fuel mix of electricity generation	13

16.4.5 Cumulative Impacts

In terms of cumulative impacts, negative cumulative impacts in relation to air quality would only occur if a large development was located in the vicinity of the site and was being constructed at the same time. There are a large number of developments in the planning system within 20km of the site including housing developments, agricultural developments, solar energy farms, wind farms, grid system services facility, infilling of lands, cheese manufacturing facility, blending and packaging facility, upgrade of a waste water treatment plant and energy storage facilities.

Cumulative impacts may arise if the construction period of these projects occurs simultaneously with the construction of the proposed Dernacart Wind Farm. This could result in increased emissions from traffic, including vehicle emissions and dust. Assuming that the Planning Authority will require all the potential developments in the area to be carried out in accordance with Irish legislation and standards and provided the mitigation measures as detailed in Section 16.5 are implemented, there will be no significant cumulative impact on air quality.

In terms of climate, the proposed Dernacart Wind Farm will act cumulatively with other local renewable energy projects in reducing CO_2 emissions by displacing fossil fuel in the production of electricity. This will increase the local contribution to Ireland's ability to meet national emission targets and to the EU's ambition of becoming carbon neutral by 2050.

The proposed Dernacart Wind Farm development in combination with other local renewable energy projects would contribute further to security of supply against Ireland's dependence on imports.

16.5 Mitigation Measures

16.5.1 Air Quality

16.5.1.1 Construction Phase

A Construction Environmental Management Plan (CEMP) has been prepared and is included in Appendix 4.2. This includes for the following mitigation measures during the construction phase of the proposed wind farm relevant to air quality:

- The internal access roads will be constructed prior to the commencement of other major construction activities. These roads will be finished with graded aggregate;
- A water bowser will be available to spray work areas (wind farm and grid connection route) and haul roads, especially during periods of excavations works coinciding with dry periods of weather, in order to suppress dust migration from the site;
- All loads which could cause a dust nuisance will be covered to minimise the potential for fugitive emissions during transport;
- Gravel will be used at the site exit point to remove any dirt from tyres and tracks before travelling along public roads;
- Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable.
- The access and egress of construction vehicles will be controlled to designated locations, along defined routes, with all vehicles required to comply with onsite speed limits;
- Construction vehicles and machinery will be serviced and in good working order;
- Wheel washing facilities will be provided at the entrance/exit point of the proposed development site;
- The developer in association with the main construction contractor will develop and implement a dust control plan as part of the CEMP (the outline CEMP contained in Appendix 4.2 will be updated by the Contractor). This plan will address aspects such as excavations, haul roads, temporary stockpiling and restoration works. The plan will be in place prior to any construction activities and will be established and maintained through the construction period.
- Sensitive receptors within 100m of the proposed development and along haulage routes entering the site; and dwellings directly adjacent to the cable route construction that experience dust soiling, where appropriate, and with the agreement of the landowner, will have the facades of their dwelling cleaned if required should soiling have taken place;
- Ensure all vehicles switch off engines when stationary – no idling vehicles; and
- Exhaust emissions from vehicles operating within the site, including trucks, excavators, diesel generators or other plant equipment, will be controlled by the contractor by ensuring that emissions from vehicles are minimised through regular servicing of machinery.

16.5.1.2 Operational Phase

As the operation of the wind farm will not give rise to air emissions, mitigation measures are considered unnecessary.

16.5.1.3 Decommissioning Phase

Mitigation measures for the removal of turbine structures would be similar to those for the construction phase with respect to dust control and minimisation. Should it be necessary to remove access tracks and foundations from the wind farm site as part of decommissioning, dust mitigation measures similar to those undertaken for the construction phase will be put in place to reduce any dust nuisance. In terms of the underground grid cable, this is likely to be left in situ and so no impacts are envisaged.

16.5.2 Climate

It is considered that the proposed development will have an overall positive impact in terms of reducing carbon emissions. It will assist Ireland in meeting its national mandatory target to supply 16% of its overall energy needs from renewable sources by 2020, which is driven by climate change policy and the requirements for a reduction in greenhouse gas emissions along with energy security and competitiveness.

As no impacts on climate are predicted during construction, no mitigation measures are proposed.

16.6 Residual Impacts

16.6.1 Air Quality

Following the implementation of the above mitigation measures, the proposed development may result in slight to moderate residual impacts on air quality arising from fugitive dust emissions during certain construction activities. These will be localised in nature and as they will be associated with particular elements of the construction phase, they will be temporary in nature and will not result in any permanent residual impacts. Slight Impacts related to vehicle emissions will cease following construction and no significant impacts are anticipated.

16.6.2 Climate

There will be residual positive impacts from the proposed development in terms of reducing CO_2 emissions by displacing fossil fuel in the production of electricity with renewable energy. It is estimated that an output of up to 40MW for the proposed Dernacart Wind Farm will result in the net displacement of 55,188 tonnes (from Calculator Tool) of CO_2 emissions per annum.

16.7 References

Design Manual for Roads and Bridges (DMRB) (2007). Volume 11 Environmental Assessment Section 3 Environmental Assessment Techniques.

EEA, 2018. Air Quality in Europe – 2018 Report.

EirGrid, 2018. All-Island Generation Capacity Statement 2018 – 2027.

EPA, 2019. Ireland's Final Greenhouse Gas Emissions – 1990 – 2017.

EPA, 2018. Air Quality in Ireland 2017 – Indicators of Air Quality, EPA.

Intergovernmental Panel on Climate Change (IPCC) (2014). Renewable Energy Sources and Climate Change Mitigation.

National Roads Authority (NRA), 2011. Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes.

SEAI, 2018. Energy in Ireland – 2018 Report.

SEAI, 2014. Quantifying Ireland's Fuel and CO_2 Emissions Savings from Renewable Electricity in 2012.

Scottish Government Windfarm Carbon Assessment Tool – https://informatics.sepa.org.uk/CarbonCalculator

Scot Gov, 2018. Calculating potential losses and savings from wind farms on Scottish peatlands; technical note – Version 2.10.0. Scottish Government: https://www.gov.scot/binaries/content/documents/govscot/publications/advice-and-guidance/2018/12/carbon-calculator-technical-guidance/documents/calculating-potential-carbon-losses-and-savings-from-wind-farms-on-scottish-peatlands-technical-guidance/calculating-potential-carbon-losses-and-savings-from-wind-farms-on-scottish-peatlands-technical-guidance/govscot%3Adocument/Calculating%2Bpotential%2Bcarbon%2Blosses%2Band%2Bsavings%2Bfrom%2Bwind%2Bfarms%2Bon%2BScottish%2Bpeatlands%2B-%2Btechnical%2Bguidance.pdf

Statutory Instrument (S.I. No. 180 of 2011) – Air Quality Standards Regulations, 2011.

WHO, 2018. WHO Factsheet: Ambient (outdoor) air quality and health.

www.eirgridgroup.com

www.epa.ie

www.met.ie

www.seai.ie