8 AIR QUALITY AND CLIMATE CHANGE

8.1 INTRODUCTION

This chapter describes the likely significant impacts from the construction, operation and decommissioning of the proposed Drumnahough wind energy project on air quality and climate.

8.1.1 Scope of Assessment

The aim of this assessment is to consider whether the wind energy project including wind turbines, grid connection, battery storage, site infrastructure and replacement forestry lands would be likely to result in significant air quality and climate impacts. The cumulative effect of the proposed development in combination with neighbouring existing and permitted developments is then assessed to determine any likely significant air quality and climate impacts.

The potential impacts and likely effects of the decommissioning phase will be of similar magnitude, if not slightly less than the construction phase. Therefore, the outcome of the construction phase assessment should be taken as representative of the decommissioning phase impacts.

There will be approximately 37.2 ha of trees felled to facilitate wind farm infrastructure (See **Chapter 2** for full details). Any machinery used in the harvesting of the trees will have a negligible impact on local air quality, significantly less than any plant and machinery used during the proposed development construction phase. These replanting activities have been scoped out from further assessment.

The felled trees will be re-planted elsewhere. This will ensure no net loss of carbon sequestering trees. However, the potential impact of the early felling of the trees on carbon sequestration has been assessed.

8.1.2 Methodology

At a local level, the existing air quality at the Drumnahough site was characterised. The scale and duration of the construction works was examined and its potential to significantly impact on local air quality assessed. Mitigation measures are described to minimise the potential effects.

The local climate was characterised based on 30 year averages measured at a representative weather observatory. The compatibility of the project with the 2019 national Climate Action Plan (CAP) was examined.

8.1.3 Assessment Criteria

8.1.3.1 Air Quality

In the European Union (EU), directives set down Air Quality Standards to protect health, vegetation, and ecosystems. The Ambient Air Quality and Cleaner Air for Europe (CAFÉ) Directive (2008/50/EC) was published in May 2008 and was transposed into Irish legislation by the Air Quality Standards Regulations 2011 (S.I. No. 180 of 2011).

There will be some pollutants named in the CAFÉ directive arising during construction from plant and machinery exhaust emissions. These include carbon dioxide (CO_2), sulphur dioxide (SO_2), nitrogen oxides (NO_x), carbon monoxide (CO), and particulate matter (PM_{10}). However, these emissions will be minor and temporary, will be quickly dispersed and will not exceed the limit values (refer to **EIAR Volume 3 Appendix F-1** for a table of the limit values) as set out in the CAFÉ Directive 2008/50/EC.

There is greater potential for temporary nuisance to occur as a result of fugitive dust from the excavation and transport of soil and materials during construction. The National Roads Authority (NRA) has published guidance for assessing dust impacts at a local level from road construction ('*Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes*'). Similar construction methodologies will be used during the proposed wind farm development therefore it is considered appropriate to adopt the criteria described in **Table 8-1**, which are taken from the aforementioned NRA guidance document.

Table 8-1 provides a list of distances at which dust could be expected to result in a nuisance from construction sites for impacts such as soiling, particulate matter $(PM)_{10}$ deposition and vegetation effects. These distances present the potential for dust impact with standard mitigation in place. The proposed Drumnahough wind farm is considered a moderate construction site.

Table 8-1 Assessment Criteria for the impact of dust from construction with standard mitigation in place

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

8.1.3.2 Climate Change

The potential impact of the proposed development on climate is assessed primarily by demonstrating that the wind farm aligns completely with the provisions set out in the national Climate Action Plan 2019, specifically those relating to renewable energy.

In order to demonstrate that the carbon savings will significantly out-weigh any potential carbon losses a methodology made available by the Scottish Government (2019) in tabular spreadsheet format titled *Calculating carbon savings from wind farms on Scottish peatlands* was applied to this development.

This 'carbon calculator' is the Scottish Government's tool provided to support the process of determining the carbon impact of wind farm developments in Scotland. The purpose of the tool is to assess, in a comprehensive and consistent way, the carbon impact of wind farm developments. This is done by comparing the carbon costs of wind farm developments with the carbon savings attributable to the wind farm.

As there is no comparable Irish version it is considered appropriate to adopt the Scottish methodology which has been tried and tested and subject to audit by the Scottish Environmental Protection Agency.

8.1.4 Statement on Limitations and Difficulties Encountered

It is not possible to quantify exactly what impact the proposed development will have on Climate Change and Air Quality beyond the site boundary. It has been, however, possible to determine the significance of the impact. It is universally accepted that replacing fossil fuel generated electricity with wind generated and other forms of renewable electricity has a positive rather than negative effect nationally and globally on air quality and climate. The information provided in this chapter is considered sufficient to enable an informed decision to be made on the significance of the potential impacts of the project on air quality and climate.

8.2 EXISTING ENVIRONMENT

The proposed development is located in central County Donegal and is approximately 11 km south west of Letterkenny and 12 km north west of Ballybofey (**Figure 8-1**). These urban centres are the largest nearby potential sources of pollution. There are no major sources of pollution in the vicinity of the proposed development site.

Traffic on the local road network emits Carbon Dioxide (CO_2) and Nitrox Oxides (NOx) from vehicle exhausts. Agricultural practices on nearby farmland generate methane (CH_4) emissions and Coillte operations emit CO_2 and NOx also from the exhausts of machinery used for tree felling.

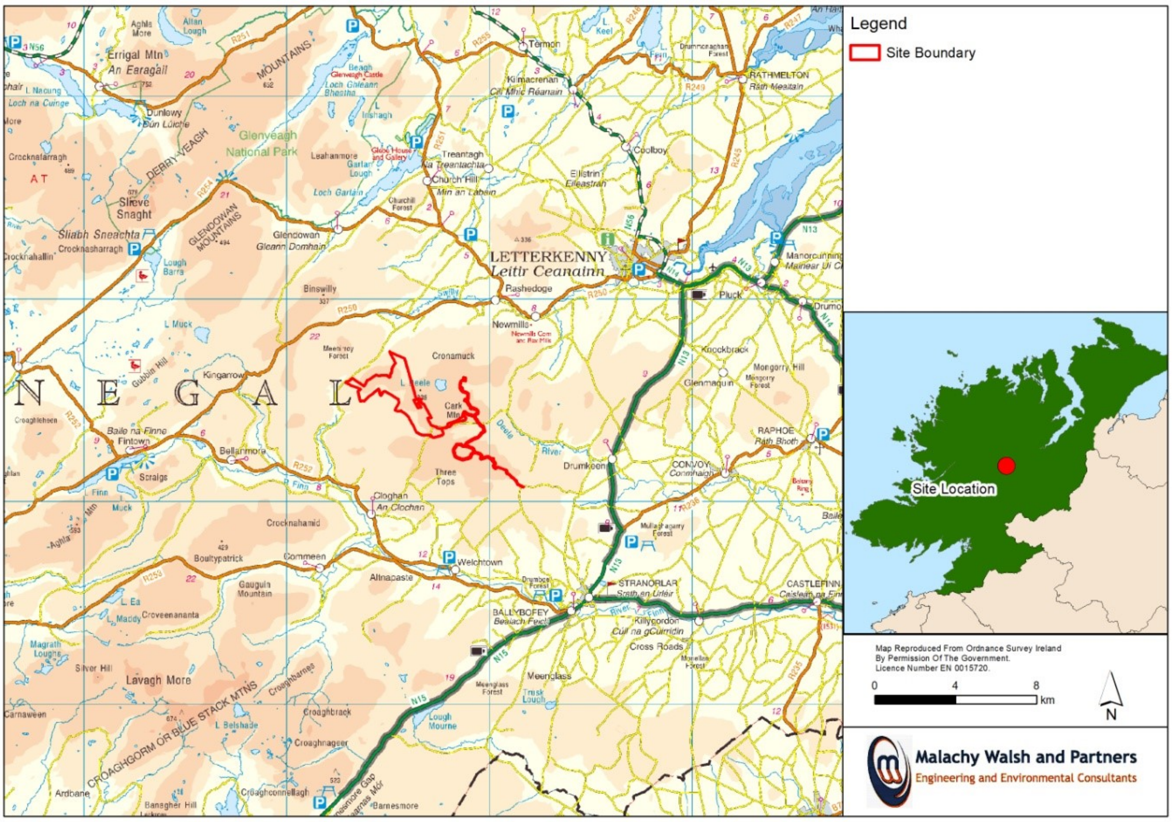

Figure 8-1 Proposed site location

Representative Environmental Protection Agency (EPA) ambient air quality data has been used to characterise the existing air quality in the area. The sensitive receptors include houses and ecologically sensitive areas. The nearest dwellings are shown on **Figure 8-2**. The nearest dwelling to a works area is 773 m. There are no designated or ecological sites that are overly sensitive to low levels of dust or minor exhaust emissions within or near the site boundary. Where potential impacts could occur, these are addressed in the biodiversity chapters.

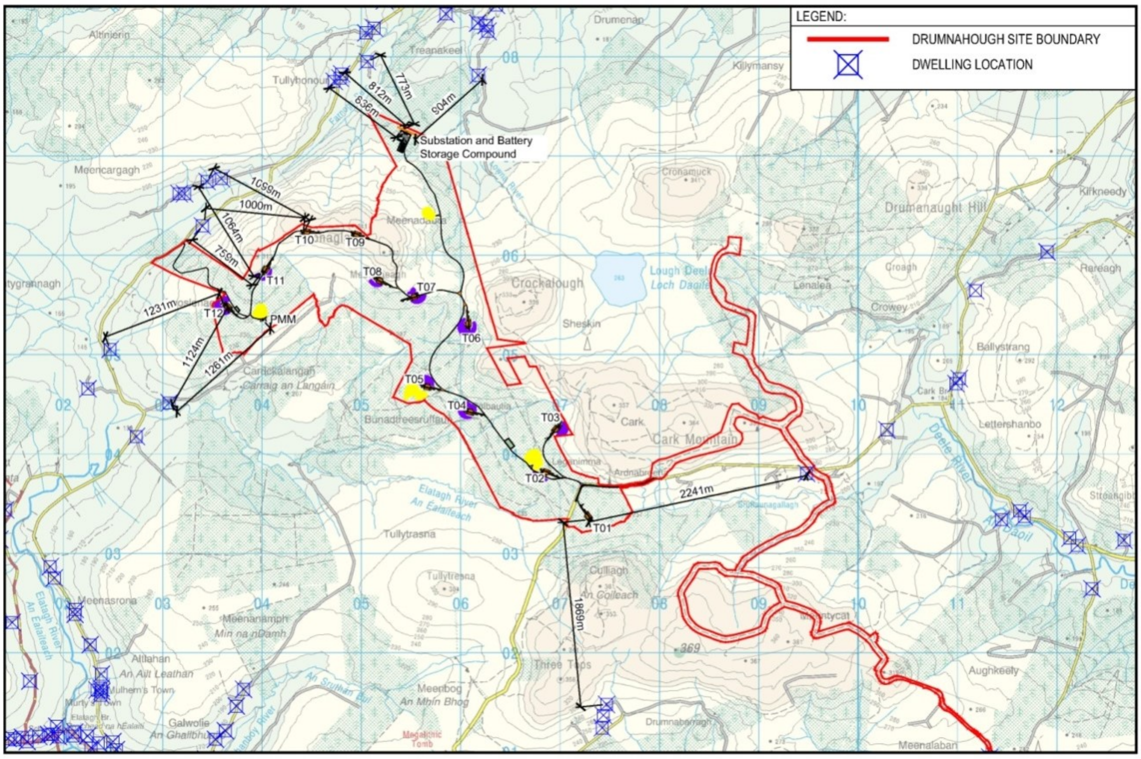

Figure 8-2 Nearest Dwellings to proposed works areas

8.2.1 Local Air Quality

Representative Environmental Protection Agency (EPA) ambient air quality data has been used to characterise the existing air quality in the area.

The EPAs Air Quality Index for Health (AQIH) is a number from one to ten that describes the current air quality in a region, A ranking of 10 means the air quality is 'Very Poor' and a ranking of 1 – 3 inclusive means that the air quality is 'Good'. The AQIH is calculated on an hourly basis using representative sampling from each region. There are six regions as follows: Dublin, Cork, Large Towns (>15,000 population), Small Towns (5,000 – 15,000 population), Rural East and Rural West.

The AQIH is based on measurements of five air pollutants all of which can harm health. The five pollutants are:

- Ozone gas
- Nitrogen dioxide gas
- Sulphur dioxide gas
- $PM_{2.5}$ particles and
- PM_{10} particles

There is no accompanying health message for at risk groups and the general population in areas classed as ‘Good’. Outdoor activities can be enjoyed as usual.

In areas of ‘Fair to Poor’ air quality i.e. AQIH ranking 4 to 10 certain types of outdoor activity should be restricted or avoided for at risk individuals and the general population depending on the AQIH ranking.

The AQIH is calculated every hour. The index was accessed via the EPA’s website (https://gis.epa.ie/EPAMaps/) on the 25th June 2020. The air quality for the region where the Drumnahough Wind Farm is proposed (Rural West AQIH Region 6) is currently ranked as ‘2 - Good’. Refer to **Figure 8-3**.

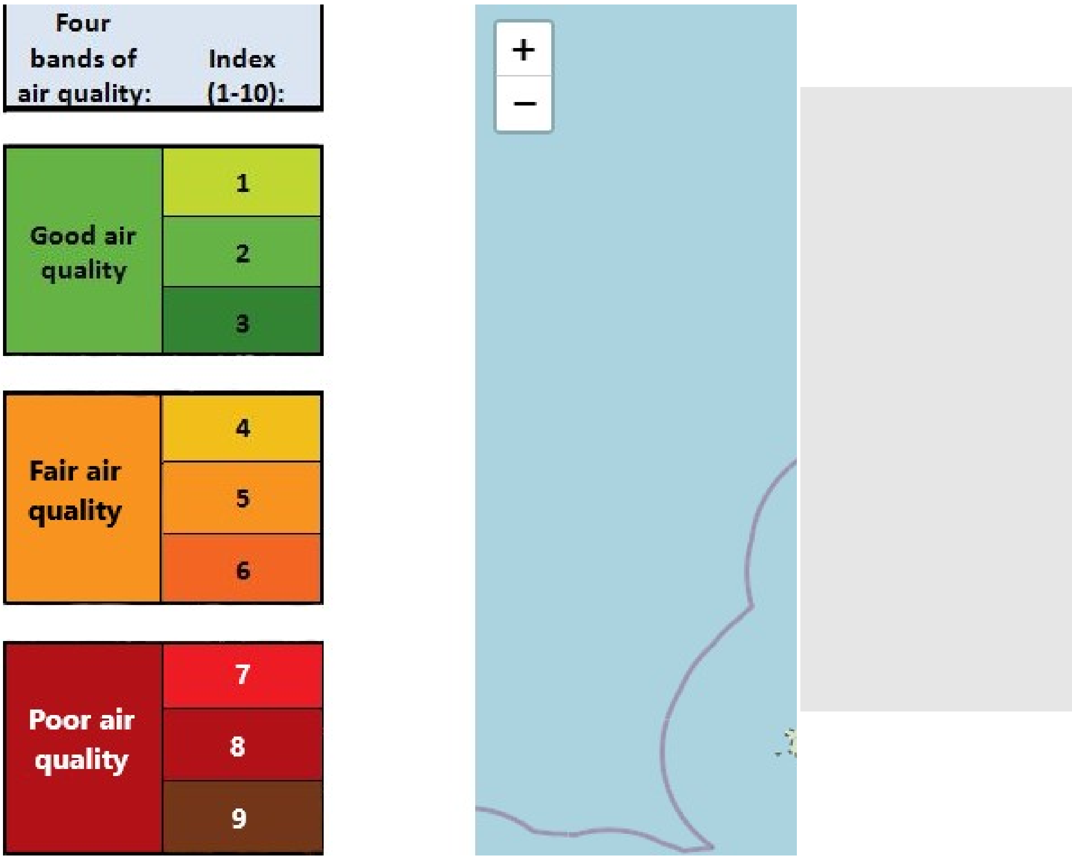

Figure 8-3 Existing Air Quality Index for Health (AQIH)

The nearest air quality station to the site is in Letterkenny. This station monitors PM_{10}, $PM_{2.5}$ and SO_2 and is located in an Urban Area.

Letterkenny station updates every two to five minutes with the calculated Air Quality Index for Health (AQIH). As of May 26th, 2020, the air quality index characterised by this station was classified as 1 ‘Good’.

8.2.2 Global Climate

Every year, the World Meteorological Organisation (WMO) issues a Statement on the State of the Global Climate. It is based on data provided by National Meteorological and Hydrological Services and other national and international organisations. Some of the key messages in the WMO *Statement of the State of the Climate 2019* are as follows:

- Global mean temperature for January to October 2019 was 1.1±0.1°C above pre-industrial levels. 2019 is likely to be the 2nd warmest year on record. The past five years are the five warmest years on record, and the past decade, 2010-2019, is the warmest decade on record. Since the 1980s, each successive decade has been warmer than any preceding decade since 1850.
- Global atmospheric mole concentrations of greenhouse gases reached record levels in 2018 with carbon dioxide (CO_2) reaching 407.8±0.1 parts per million, 147% of pre-industrial levels. Measurements from individual sites indicate that concentrations of CO_2 continued to increase in 2019. Methane and nitrous oxide, both important greenhouse gases, also reached record levels.
- In May of 2019, the Mauna Loa Observatory in Hawaii, which has tracked atmospheric CO_2 levels since the late 1950s detected 415.26 parts per million (ppm) CO_2 in the atmosphere. The last time Earth's atmosphere contained this much CO_2 was more than three million years ago. (Since then, on May 3rd 2020 an average daily CO_2 level of 418.12ppm was measured, setting a new record)
- The ocean absorbs over 90% of the heat trapped in the Earth's system as a result of rising concentrations of greenhouse gases. Ocean heat content, which is a measure of this heat accumulation, reached record levels again in 2019.
- In 2019, the global mean sea level reached its highest value since the beginning of the high-precision altimetry record (January 1993).
- Extreme heat conditions are taking an increasing toll on human health and health systems. Greater impacts are recorded in locations where extreme heat occurs in contexts of ageing populations, urbanisation, urban heat island effects, and health inequities. In 2018, a record 220 million vulnerable persons over age of 65 were exposed to heatwaves, compared with the average for the baseline of 1986-2005, breaking the previous record set in 2015 by 11 million.

8.2.3 Local Climate

There are a total of 25 synoptic stations located throughout Ireland. These stations are operated by Met Eireann. The parameters measured and recorded at these stations include rainfall, temperature, wind speed and direction, relative humidity, solar radiation, clouds, atmospheric pressure, sunshine hours, evaporation, and visibility.

The nearest synoptic station, approximately 60 km, to the proposed Drumnahough development site is Malin Head. The climate of the proposed wind farm is best represented by data collected at this station. The average monthly precipitation, rainfall, and wind speeds for the 30 year period between 1981 and 2010 are summarised in **Table 8-2** below.

Table 8-2 Malin Head 1981 – 2010 Averages

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
TEMPERATURE (degrees Celsius)													
mean daily max	8.1	8.1	9.3	11	13	15	17	17	16	13	10.4	8.6	12.2
SUNSHINE (hours)													
mean daily duration	1.2	2.3	3	5.1	6.5	5.5	4.6	4.4	3.7	2.6	1.5	1.1	3.5
RAINFALL (mm)													
mean monthly total	117	85	86	63	57	69	77	93	92	118	105	114	1076
greatest daily total	32.6	34	31	26	35	27	39	50	49	60	31.6	39.6	60
WIND (knots)													
mean monthly speed	19	19	17	15	13	13	12	13	15	16.8	17.6	17.5	15.6
max. gust	91	86	90	71	68	62	74	62	85	78	92	96	96
WEATHER (mean no. of days with..)													
snow or sleet	5.1	5.2	3.4	1.6	0.1	0	0	0	0	0	1.1	3.8	20.4
hail	9.2	7.4	7.6	4.4	1.7	0.3	0.1	0.2	0.6	3.1	5.8	7.3	47.7
thunder	0.7	0.6	0.3	0.2	0.4	0.7	0.8	0.6	0.3	0.5	0.5	0.6	6.1
fog	0.4	0.4	0.8	1.3	1.7	1.6	1.6	1.2	0.6	0.1	0.4	0.3	10.5

8.3 LIKELY SIGNIFICANT EFFECTS

8.3.1 Do Nothing Scenario

If the proposed development were not to proceed, an opportunity to offset Green House Gas (GHG) emissions from fossil fuel based energy sources would be lost. The potential for Ireland to reach its renewable energy targets set out in the Climate Action Plan and to contribute to climate change mitigation would be reduced. As its stands Ireland is unlikely to meet 2020 targets for renewable electricity.

Emissions of nitrogen dioxide (NO_x) and sulphur dioxide (SO_2) from coal, oil and gas fired power plants that would otherwise have been displaced will continue, resulting in a continued deterioration in air quality.

Poor air quality in our urban centres is a growing concern. As stated on the EPA's website: *The WHO estimates show that more than 400,000 premature deaths are attributable to poor air quality in Europe annually. In Ireland, the number of premature deaths attributable to poor air quality is estimated at 1,180 people and is mainly due to cardiovascular disease. The World Health Organisation (WHO) has described air pollution as the 'single biggest environmental health risk'*.

This can be categorised as a likely indirect long term significant negative effect.

8.3.2 Construction Phase

During the construction phase there will be emissions from vehicle exhausts. The movement of machinery, construction vehicles and the use of generators during the construction phase will generate exhaust fumes containing predominantly carbon dioxide (CO_2), sulphur dioxide (SO_2), nitrogen oxides (NO_x), carbon monoxide (CO), and particulate matter (PM_{10}).

There will be dust generated from moving and transporting soil and materials in and around the construction site and on public roads. Weather conditions will play an important role in the quantity of dust generated. The potential for fugitive dust emissions is greatest during periods of prolonged dry weather.

8.3.2.1 Dust Emissions

Using the NRA criteria listed in **Table 8-1**, the construction of the Drumnahough wind farm can be characterised as a moderate-sized construction site. Therefore, dust is unlikely to cause an impact at sensitive receptors beyond 50 m of the source, with standard mitigation measures in place. There is a minimum separation of 1 km between the nearest dwelling and turbine location and 773 m to the nearest works area. There is no dwelling within 500 m of any site development areas, therefore dust is unlikely to be a significant impact at the nearest dwellings. Standard mitigation measures for dust prevention and control are presented in **Section 8.4**.There are no designated sites within the potential zone of impact for significant effects from dust. Please refer to the biodiversity chapters for potential significant impacts to flora and fauna.

Blasting may be required to extract rock from the borrow pits**.** The nearest dwelling is 1.8 km from a borrow pit location. At such separation distances fugitive dust from blasting activities will not be significant.

8.3.2.2 Vehicle Emissions

Exhaust emissions from construction and delivery vehicles during construction are unlikely to have an adverse impact on local air quality and will not impact significantly on local, regional or national air quality standards given the scale of plant and machinery involved, the high levels of dispersion, and the limited extent and duration of the works.

Overall, there will be no significant effects on air quality and climate at sensitive receptors for the short-term duration of the construction phase.

8.3.3 Operational Phase

8.3.3.1 Air Quality

Once operational, there will be no direct emissions to the atmosphere from the proposed development. The CO_2 offset by the proposed development will further assist Irelands CO_2 reduction commitments under the Paris Agreement and the Climate Action Plan 2019. The electricity generated will displace electricity that would otherwise have been generated by burning fossil fuels.

In the context of this project contributing to the commitments in the CAP, there will be a long-term significant positive effect.

8.3.3.2 Compatibility with Climate Policy and Targets

In recognition of the need to limit global temperatures, the Paris Agreement came into existence in 2015. It follows on from the Kyoto Protocol with the intention of accelerating progress towards decarbonisation, climate resilient and sustainable societies. The primary aim of the Paris Agreement is to limit global temperature rise to well below 2 degrees Celsius.

Under the agreement Ireland has committed to renewable energy targets for 2020 including a target of 40% electricity to come from renewable sources. The Government's 2019 CAP highlights the fact that in 2017, 30.1% of electricity was produced from renewable sources and that rising demand for electricity will make meeting the 2020 target of 40% unlikely.

The Drumnahough Wind Farm is aligned with current energy and climate policy, aims and objectives, which primarily seek to increase the production of electricity from renewable sources.

8.3.3.3 2019 Climate Action Plan

To help meet the required level of emissions reduction by 2030, the CAP sets a target of up to 8.2 Giga Watts (GW) total of increased onshore wind capacity. By its very nature, the proposed wind farm will contribute to achieving this target and move Ireland one step closer towards decarbonisation and ultimately a net zero GHG emissions society.

The proposed development is fully compatible with the provisions relating to renewable energy set out in the CAP, summarised as follows:

- The project will contribute directly to the CAP commitment that 70% of national electricity will come from renewable sources by 2030, up from 30%.
- The project will contribute directly towards meeting Ireland's renewable energy production targets by 2030 and 2040.
- The project will contribute directly to the specific objectives for onshore wind capacity in Ireland by 2025 and 2030.
- The project will contribute directly to the objectives of the CAP through the provision of grid connection infrastructure to support the renewable energy output and the provision of a battery energy storage system.
- The technology to be used is recognised as a least cost technology by the CAP.

The project will lead to a reduction in greenhouse gas emissions by using a least cost technology recognised in the CAP. The development will provide approximately 184,000 MWh per year of renewable electricity to the national grid. The battery energy storage will support the renewable energy output.

8.3.3.4 Carbon Savings and Losses from the Proposed Development

Once operational, the electricity generated by the wind farm will displace electricity that would otherwise have been produced by burning fossil fuels. This will also displace the associated greenhouse gas emission. However, there will be some carbon losses due to the manufacturing process of the wind turbines and the drainage and excavation of organic soil/ peat during the construction phase.

Bogs and peatlands thrive under waterlogged conditions. Under such anaerobic conditions, organic material does not readily decompose, therefore, the carbon content of the material remains in-situ. This is often referred to as a carbon sink.

The drainage and excavation of undisturbed peat will lead to the drying out and therefore decomposition of organic material and release of CO_2 into the atmosphere.

While there is peat across the site, it is not by definition a fen or acid bog. The site is highly modified and has been drained to facilitate commercial forestry. The hydrological regime across the site has already been significantly altered.

In order to demonstrate that the carbon savings will significantly out-weigh any potential carbon losses, a methodology made available by the Scottish Government in tabular spreadsheet format titled *Calculating carbon savings from Wind Farms on Scottish peatlands* was applied to this development.

As mentioned earlier, this is an established methodology which has been approved by the Scottish government and Scottish Environmental Protection Agency (EPA). Submissions made by the developers using this tool are regularly audited by the Scottish EPA. In the absence of an Irish equivalent, it is considered appropriate to use this tool for the proposed development.

There will be some clear felling of forestry around turbine locations as a mitigation measure for the protection of bats. These trees may be felled earlier than originally planned as a result of the proposed development. The carbon losses over the lifetime of the proposed development are calculated from the area to be felled and the average carbon that would have been sequestered annually. Any felled forestry will be replanted resulting in no net loss.

The theoretical worst-case carbon losses due to the proposed Drumnahough Wind Farm are presented in **Table 8-3**. The results are a theoretical worst-case as the site has been classified as an undisturbed acid or fen bog for the purpose of the tool, which is not the case in reality. As stated it has been drained to some extent during the planting of commercial forestry. The actual carbon losses will be lower than those presented for this reason.

Table 8-3 CO_2 Losses due to Drumnahough Wind Farm

Source	CO_2 Losses (tonnes CO_2 equivalent)
Losses due to turbine manufacture, construction & decommissioning	50,450
Losses due to reduced plant fixation	2,929
Losses from soil organic matter	112,358,
Losses due to leaching	14,168
Losses due to felling forestry	14,733
Total	**194,638**

The calculations show 194,638 tonnes of CO_2 equivalent losses over the proposed development's 30 year life span. 50,450 tonnes CO_2 equivalent or 26 % of the losses come from the turbine life. The remainder accounts for 144,188 tonnes or 74 % of the CO_2 equivalent losses. The early felling of the forestry accounts of 14,733 tonnes CO_2 equivalent losses or 8 % of the total.

The CO_2 emissions savings were calculated separately using the following formula and using Irish counterfactual data.

CO_2 (tonnes) = A X B X C X D / 1000

Where:

- **A** = The rated capacity of the wind energy development
- **B** = The capacity factor is the amount of energy produced (MW output) relative to the theoretical maximum that could have been produced if the wind generation operated at full capacity. Therefore, it represents the average output of the wind generation.
- **C =** The number of hours in a year
- **D** = CO_2 displacement in tonnes per Megawatt hour (MWh)

The rated capacity (A) is assumed to be 60 MW (12 (turbines) x 5 (MW)). The capacity factor used is 35% (Baringa Partners LLP, 2018). This is based on the on the average figure for Ireland, as referenced by the Irish Wind Energy Association (IWEA). The most recent emission factor for electricity in Ireland reported in the SEAI's *Energy in Ireland 2018* report was 436.6g CO_2/kWh.

CO_2 (tonnes) = (60 x 0.35 x 8,760 x 436.6) / 1000

= 80,316 tonnes per year

The calculations show that the theoretical worst case 194,638 tonnes of CO_2 that will be lost due to the Drumnahough Wind Farm construction and operation will be recovered in just over 2 years; the actual recovery will be quicker for reasons explained earlier. Over the 30 year lifespan of the Drumnahough Wind Farm, this accounts for 8 % of the total amount of CO_2 emissions that will be offset by the Drumnahough Wind Farm. Over the life span of the Drumnahough Wind Farm 2,409,480 tonnes of CO_2 will be offset.

This is a long term moderate positive effect. It is consistent with the objectives of the CAP reflecting a move away from fossil fuel generated electricity in favour of renewable electricity generation and national decarbonisation.

8.3.3.5 Battery Energy Storage System (BESS)

There have been few studies to characterise emissions associated with battery usage in storage applications. In order to do a life cycle analysis (LCA) of the carbon emissions associated with the BESS the following needs to be considered.

1) Emissions associated with the manufacture of the batteries
2) Emissions associated with recycling or disposing the batteries.

8.3.3.5.1 Emissions associated with building the batteries

A 2019 paper from IVL Swedish Environmental Research Institute reviewed the available carbon emissions data for lithium-ion batteries. The study looked at three steps in the manufacture of the battery including i) mining and refining, ii) battery material production and iii) cell production & battery pack assembly. A cradle to gate mid-range number of 89 kg C02-eq/kWh was estimated, accounting for a mix of renewable and fossil fuel electricity used in the manufacturing process.

8.3.3.5.2 Emissions associated with recycling or disposing of the batteries

End of life recycling was not considered in the aforementioned study, primarily because of the large amount of uncertainties in the calculations. The EU has adopted Product Environmental Footprint Category Rules (PEFCR). A PEFCR battery study reported that 12% of the GHG emissions of a lithium-ion batteries lifetime occur at the end of life stage. This would add another 11 kg to the 89 kg for a total of 100 kg $C0_2$-eq/kWh.

8.3.3.5.3 Estimating the footprint

This figure of 100 kg C02-eq/kWh provides the basis on which to estimate a carbon footprint for the manufacture and disposal of the batteries used in the BESS. The Drumnahough BESS has 20 MWh of energy storage which equates 20,000 kWh. 100 kg $C0_2$-eq/kWh adds another 2,000 tonnes of carbon dioxide to the carbon footprint of Drumnahough Wind Farm. This increases the payback period by less than a month.

8.3.4 Decommissioning Phase

The scale of works involved during the decommissioning phase will primarily involve the dismantling and removal of the Drumnahough Wind Farm infrastructure off-site and the dust generating activities will be greatly reduced when compared to the construction phase. Similarly, emissions from plant and machinery exhausts will be lower than anticipated for the construction phase. Where possible materials will be recovered and recycled minimising the energy required for disposal. The likely impact will be a slight temporary adverse effect.

8.3.5 Cumulative Effects

There will be no CO_2 or any other GHG emissions once the proposed development is operational, with the exception of occasional operational and maintenance vehicle exhausts. This effect will be imperceptible. Therefore, there will be no measurable adverse cumulative effect with other existing wind farm developments in the area.

Should the proposed development and other renewable electricity generation projects become operational; the combined beneficial cumulative effects will be greater than those described in this chapter. The tonnes of CO_2 emissions avoided and the improvement to air quality, especially in our towns and cities will be greatly enhanced.

The potential cumulative impact with other renewable energy projects will be a long term significant positive effect on air quality and climate and human health.

8.3.6 Risk of Major Accidents and Natural Diasters

Given the temporary nature of the construction stage and the scale of the proposed project, as well as the environmental protection measures that will be implemented from the outset, the risk of disasters (typically considered to be natural catastrophes e.g. very severe weather event) or accidents (e.g. fuel spill, traffic accident and peat slides) is considered low.

MWP completed assessments of the risk presented using the industry best practice guidance of the Scottish Executive and Scottish Government guidelines for Peat Landslide Hazard and Risk Assessments. The outcome of the risk assessment was that landslide presented a Negligible Level of risk to the Wind Farm Infrastructure. A further risk assessment for the risk of landslide to surrounding environment found a Negligible Level of risk.

A review of the national flood hazard mapping website http://www.floodmaps.ie/View/Default.aspx) indicates there is no history of flooding in the site. Notwithstanding this, in the case of the occurrence of a severe weather event such as flooding during construction, construction work will cease.

Flood risk is considered in EIAR Chapter 10 to determine whether the site is at risk from extreme fluvial flooding events. This assessment concluded that the site is not at risk from extreme flooding. The assessment also considered the increase risk of downstream flooding as a result of the proposed development. The assessment considers that forest felling, new site access tracks, turbine hard-standing areas and other new, hard surfaces have the potential to contribute to a low level of increase in surface water run-off. The assessment however determined that the risk of an increase in downstream flooding is low due to the small percentage increase in run-off contributing to the catchments as a result of the wind farm development. The proposed development is at a distance of approximately 7.5km from the nearest recorded location by the Office of Public Works (OPW) where flooding has occurred in the Swilly sub catchment.

There is potential for the Proposed Development to be impacted by severe weather including increased wind and storms. However, wind turbines are designed to withstand extreme weather conditions with brake mechanisms installed within the turbines so that they only operate under specific wind speeds and will shut-down during high wind speed events. Therefore, there is very low risk to the Proposed Development from high wind speeds.

Best construction practice including that for Health and Safety will be employed to minimise the risk of any accidents occurring. All work on site will be carried out in compliance with the Health and Safety Act 2005, the Health and Safety (Construction) Regulations 2013 and all relevant Legislation and Work Practice to ensure that the construction areas, site environs and public roads remain safe for all users.

8.4 MITIGATION MEASURES

It is recommended that best practice is adhered to during the construction phase in order to minimise fugitive dust emissions in particular.

Outlined below are a series of mitigation measures and good working practices to ensure that any potential impacts during the construction phase are minimised and to ensure there will be no adverse impact on the receiving environment. The mitigation measures have been sourced from national and international best practice guidance documents for the implementation of dust management plans including:

- ‘*Control of Dust from Construction and Demolition Activities*’, UK British Research Establishment (BRE), 2003.

- '*Environmental Good Practice on Site'*, Construction Industry Research and Information Association (CIRA), 2015.
- '*Environmental Management Plans'*, Institute of Environmental Management and Assessment (IEMA), 2013.
- '*Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan'* National Roads Authority of Ireland (NRA), 2005.

8.4.1 Construction Phase

8.4.1.1 Dust Generation

The potential effects arising from dust and exhaust emissions will be minimised through the provision of mitigation measures that will be incorporated in the site specific Construction and Environmental Management Plan (See EIAR Volume 3 Appendix B-2). Examples of such measures include:

- The use of water as a dust suppressant, e.g. a water bowser to spray access tracks and crane hardstanding areas during any extended dry periods when fugitive dust emissions could potentially arise.
- Public roads will be inspected regularly for cleanliness and cleaned as necessary.
- All loads entering and leaving the site will be covered during dry periods if dust becomes a nuisance on site.
- Control of vehicle speeds passing over access roads and crane hardstanding areas within the site.
- Wheel wash facilities will be implemented at the site entrance from the public road to facilitate removal of any material collected by vehicles entering or leaving the site and preventing its deposition on public roads.
- Site stockpiling of materials will be designed and laid out to minimise exposure to wind. The potential for nuisance and pollution from excavated materials will be strictly controlled as per the site specific spoil and peat management plans detailed in the project CEMP.
- Daily site inspections will take place to examine dust measures and their effectiveness.

8.4.1.2 Construction Traffic Emissions

Construction traffic emissions can be reduced using the following measures:

- Ensure regular maintenance of plant and equipment. Carry out periodic technical inspection of vehicles to ensure they perform most efficiently.
- Implementation of the Traffic Management Plan (See EIAR Volume 3 Appendix H-2). to minimise congestion; and
- All site vehicles and machinery to be switched off when not in use - no idling.
- The majority of aggregate materials for the construction of the Drumnahough Wind Farm will be obtained from on-site borrow pits. This will reduce the number of delivery vehicles to site, thereby reducing the amount of emissions associated with vehicle movements.

8.4.2 Operational Phase

It is not expected that any negative impacts to the climate will occur during the operational phase, therefore no mitigation measures are required.

8.4.3 Decommissioning Phase

Impacts resulting from the decommissioning phase are expected to be similar in nature, but smaller in scale in comparison to the construction phase. Therefore, similar mitigation measures such as those related to dust and construction vehicles are recommended.

8.5 RESIDUAL IMPACTS

8.5.1 Construction Phase

During the construction phase there will be a short term slight adverse effect on local air quality.

8.5.2 Operational Phase

Once operational, there will be no negative residual air quality impacts. The operation of the Drumnahough Wind Farm will displace CO_2 emissions and air pollutants that would otherwise have been produced by fossil fuel generated electricity. This project in combination with other renewable energy projects deemed necessary in the national Climate Action Plan will result in a long term significant beneficial effect on air quality and climate.

8.6 CONCLUSION

There is the potential for dust nuisance to occur during the construction phase. However, considering the separation distance to nearby dwellings, in addition to strict adherence to best practice outlined in Section 8.4, the impact on local air quality will not be significant. There will be some CO_2 losses associated with the turbine life (manufacture, construction and decommissioning), and the disruption of the natural on-site natural sink resources. However this will be quickly repaid once the wind farm is operational. The calculated CO_2 payback period is 2 years

The operational life of Drumnahough Wind Farm will support the National Policy and Government Plans in line with our International and EU obligations to move to a low carbon economy by 2050. The operational life of Drumnahough Wind Farm will contribute positively towards national greenhouse gas emission reduction targets and will not result in any negative residual impacts to air quality. It is predicted that the operational life of the wind farm will offset approximately 2,409,480 tonnes of CO_2 emissions.

REFERENCES

Baringa Partners LLP (2018) *A 70% Renewable Electricity Vision for Ireland in 2030*. Baringa Partners LLP.

Construction Industry Research and Information Association (CIRA) (2015) *Environmental Good Practice on Site*. CIRA.

Department of Climate, Communications, and the Environment (DCCAE) (2019). *Climate Action Plan*. DCCAE.

Eirgrid (2018) *Generation Capacity Statement*. Eirgrid.

Institute of Environmental Management and Assessment (IEMA) (2008) *Environmental Management Plans*. IEMA.

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

Scottish Government (2019) *Calculating carbon savings from Wind Farms on Scottish peatlands.* Scottish Government.

Sustainable Energy Authority of Ireland (SEAI) (2018), *Energy in Ireland*. SEAI.

UK British Research Establishment (BRE) (2003) *Control of Dust from Construction and Demolition Activiti*es. BRE.

Lithium-Ion Vehicle Battery Production: Status 2019 on Energy Use, CO2 Emissions, Use of Metals, Products Environmental Footprint, and Recycling by Erik Emilsson and Lisbeth Dahllöf. Published November 2019.

PEFCR – Product Environmental Footprint Category Rules for High Specific Energy Rechargeable Batteries for Mobile Applications. Published February 2018.

CO2 Earth, 2020, Viewed 26/05/2020, <www.co2.earth/daily-co2>

European Parliament 2020, Viewed, 28/05/2020 <www.europarl.europa.eu/news/en/press-room/20191121IPR67110/the-european-parliament-declares-climate-emergency>

Environmental Protection Agency, 2020, Viewed 27/05/2020 <www.epa.ie/irelandsenvironment/air/>

Forbes 2020, Viewed 6/06/2020, Estimating the Carbon Footprint of Utility-Scale Batter Storage< https://www.forbes.com/sites/rrapier/2020/02/16/estimating-the-carbon-footprint-of-utility-scale-battery-storage/#1bd230cb7adb

Office of Public Works (OPW), 2020, Viewed 28/05/2020, <http://www.floodmaps.ie/View/Default.aspx>

World Meteorological Organisation (WMO), 2020, Viewed 28/05/2020 <https://library.wmo.int/doc_num.php?explnum_id=10108, 2020>