9 AIR AND CLIMATE

9.1 Air Quality

9.1.1 Introduction

The Proposed Project is located in northwest Co. Kildare, approximately 6.5km (kilometres) north of the village of Allenwood, 6km east of Carbury and 3km south of Johnstownbridge. The townlands within which the Proposed Project will be located are listed on Table 1.1 in Chapter 1 of this EIAR.

The Proposed Project comprises a large scale solar PV farm with an export capacity of approximately 70 Megawatts (MW). It will consist of a solar photovoltaic array and associated infrastructure, battery storage compound, inverters, access roads and parking, site compounds and security fencing, amenity trails and landscaping, peat and subsoil storage areas (repositories), site drainage and all associated works. The Proposed Project will also include the construction of a 110 kV substation within the site with a battery storage compound adjacent to this. It is then envisaged to connect from this substation to the Derryiron-Maynooth 110 kV overhead line that traverses the southern section of the Timahoe North site.

The primary land-uses within and in the vicinity of the site comprise woodlands, peat harvesting, agriculture and one-off housing. No significant air emissions are expected to arise during the operational period and only some temporary emissions are expected during the construction period; as such considering the Proposed Project and the general character of the surrounding environment, air quality sampling was deemed to be unnecessary for this EIAR. Although the operational Drehid Waste Management Facility is located 1.6km southwest of the Proposed Project it is expected that air quality in the existing environment is good. That facility operates under an Industrial Emissions (IE) licence issued by the Environmental Protection Agency (EPA) where all emissions are controlled and monitored.

The Drehid Waste Management Facility at present has an application (Ref; PL09.300506) submitted to An Bord Pleanála as 'Strategic Infrastructure Development' for an extension to the current site. Should permission be granted for that extension, it too will be required to operate under IE licence from the EPA which will set limits on air quality as required.

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

9.1.2 Statement of Authority

This section of the EIAR has been prepared by Órla Murphy and reviewed by Michael Watson, Environmental Scientists with MKO. Órla is an Environmental Scientist with over 2 years' experience in private practice in both Scotland and Ireland; where she has completed numerous assessments for EIAs and has experience composing a variety of EIAR chapters; particularly relating to renewable energy. She holds a BSc (Hons) in Geography and a MSc. in Environmental Protection and Management.

Michael Watson is a Project Director with MKO; with over 17 years of experience in the environmental sector. His project experience includes the management and productions of Environmental Impact Statements (EISs)/EIARs, particularly within the renewable energy sector. Further information on competencies can be found in Chapter 1 and in Appendix 1-1.

9.1.3 Air Quality Standards

In 1996, the Council Directive 96/62/ EC of 27 September 1996 on ambient air quality assessment and management, termed as the 'Air Quality Framework Directive' was published. This Directive was transposed into Irish law by the Environmental Protection Agency Act 1992 (Ambient Air Quality Assessment and Management) Regulations 1999 (S.I. No 33 of 1999). The Directive was followed by four Daughter Directives, which set out limit values for specific pollutants:

- The first Daughter Directive (1999/30/EC)[1] addresses sulphur dioxide, oxides of nitrogen, particulate matter and lead.
- The second Daughter Directive (2000/69/EC)[2] addresses carbon monoxide and benzene. The first two Daughter Directives were transposed into Irish law by the Air Quality Standards Regulations 2002 (S.I. No. 271 of 2002).
- The third Daughter Directive, Council Directive (2002/3/EC)[3] relating to ozone was published in 2002 and was transposed into Irish law by the Ozone in Ambient Air Regulations 2004 (S.I. No. 53 of 2004). This is termed as the 'Ozone Daughter Directive 2002/3/EC'.
- The fourth Daughter Directive, Council Directive (2004/107/EC)[4] relating to polyaromatic hydrocarbons (PAHs), arsenic, nickel, cadmium and mercury in ambient air, 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 were repealed by Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe, termed as the 'CAFE Directive' 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.

[1] Directive 1999/30/EC of 22 April 1999 Relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air

[2] Directive 2000/69/EC of the European Parliament and of the Council of 16 November 2000 relating to limit values for benzene and carbon monoxide in ambient air

[3] Directive 2002/3/EC of the European Parliament and of the Council of 12 February 2002 relating to ozone in ambient air

[4] Directive 2004/107/EC of the European Parliament and of the Council of 15 December 2004 relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air

Table 9.1 below sets out the limit values of the CAFE Directive, as derived from the Air Quality Framework Daughter Directives. Limit values are presented in micrograms per cubic metre (µg/m^3) and parts per billion (ppb). The notation 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 in to Irish legislation by the Air Quality Standards Regulations 2011 (S.I. No. 180 of 2011) as amended by the Air Quality Standards (Amendments) and Arsenic, Cadmium, Mercury, Nickel and Polycyclic Aromatic Hydrocarbons in Ambient Air Regulations, 2016 (S.I. No. 659 of 2016). These Regulations revoke 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 9.1 Limit values of Directive 2008/50/EC, 1999/30/EC and 2000/69/EC (Source: EPA)

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

Pollutant	Limit Value Objective	Averaging Period	Limit Value (µg/m3)	Limit Value (ppb)	Basis of Application of Limit Value	Attainment Date
Nitrogen 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
Carbon Monoxide (CO)	Protection of human health	8 hours	10,000	8,620	Not to be exceeded	1st Jan 2005
Benzene (C_6H_6)	Protection of human health	Calendar Year	5	1.5	Annual mean	1st Jan 2010

The Ozone Daughter Directive 2002/3/EC is different from the other Daughter Directives in that it sets target values and long-term objectives for ozone rather than limit values. Table 9.2 presents the parameter and target values for ozone.

Table 9.2 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 ug/m3 not to be exceeded more than 25 days per calendar year averaged over 3 years	120 ug/m^3

Protection of vegetation	AOT40 calculated from 1-hour values from May to July	18,000 ug/m3.h averaged over 5 years	6,000 ug/m3.h
Information Threshold	1-hour average	180 ug/m^3	-
Alert Threshold	1-hour average	240 ug/m^3	-

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

9.1.3.1 Air Quality and Health

A recent European Environmental Agency Report, *'Air Quality in Europe – 2018 Report'* highlights the negative effects of air pollution on human health. The report assessed that poor air quality accounted for premature deaths of approximately 422,000 people in Europe in 2015, 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 2015 were around 79,000 and 17,700 premature deaths per year respectively, From this, 1,100 Irish deaths were attributable to fine particulate matter ($PM_{2.5}$), 30 Irish deaths were attributable to nitrogen oxides (NO_2) and 20 Irish deaths were attributable to Ozone (O_3) (*Source: Air Quality in Europe – 2018 Report', EEA, 2018*). These emissions, along with others including sulphur oxides (SO_x) are produced during fossil fuel based electricity generation in various amounts, depending on the fuel and technology used.

9.1.4 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 Proposed Project lies within Zone D, which represents rural areas located away from large population centres.

9.1.5 Existing Air Quality

The EPA publishes Air Monitoring Station Reports for monitoring locations in all four Air Quality Zones. The ambient air quality monitoring carried out closest to the Proposed Project site is at Newbridge, Co. Kildare, located approximately 19.0 kilometres south of the Proposed Project site. EPA air quality data is available for Newbridge in the report *'Ambient Air Monitoring at Newbridge, Co. Kildare 1st October 2009 – 24th May 2010'*, as detailed below.

The air quality in the vicinity of the Proposed Project site is typical of that of rural areas in the south of Ireland, i.e. Zone D. As the ambient air quality monitoring mentioned above is carried out in Zone C; lower measurement values for all air quality parameters would be expected for the Proposed Project site as it lies in a rural location, within Zone D.

9.1.5.1 Sulphur Dioxide (SO_2)

Sulphur dioxide data for the 2009/2010 monitoring period in Newbridge is presented in Table 9.3. Neither the hourly limit value nor lower assessment threshold set out in the CAFE Directive were exceeded during the monitoring period.

Table 9.3 Sulphur Dioxide Data Newbridge October 2009 to May 2010

Parameter	Measurement
No. of hours	5,635
No. of measured values	5,193
Percentage Coverage	92.2%
Maximum hourly value	31.9 µg/m^3
98 percentile for hourly values	8.8 µg/m^3
Mean hourly value	2.9 µg/m^3
Maximum 24-hour mean	7.7 µg/m^3
98 percentile for 24-hour mean	7.0 µg/m^3

9.1.5.2 Particulate Matter (PM_{10})

Particulate matter (PM_{10}) data for the 2009/2010 monitoring period in Newbridge is presented in Table 9.4. The 24-hour limit value for the protection of human health (50 µg/m^3) was exceeded 2 times during the measurement period. The upper assessment threshold was exceeded on 10 days and the lower assessment threshold was exceeded on 37 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 µg/m^3).

Table 9.4 Particulate Matter (PM10) Data Newbridge October 2009 to May 2010

Parameter	Measurement
No. of days	236
No. of measured values	197
Percentage Coverage	83.5%
Maximum daily value	74.3 µg/m^3
Mean daily value	17.3 µg/m^3

9.1.5.3 Nitrogen Dioxide (NO_2)

Nitrogen dioxide and oxides of nitrogen data for the 2009/2010 monitoring period in Newbridge is presented in Table 9.5. There was one exceedance of the lower threshold value concerning the protection of human health. The CAFE Directive stipulates that no more than 18 exceedances each of the lower assessment threshold, upper assessment threshold and limit value are allowed per 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 µg/m^3.

Table 9.5 Nitrogen Dioxide and Oxides of Nitrogen Data Newbridge October 2009 to May 2010

Parameter	Measurement
No. of hours	5,200
No. of measured values	5177
Percentage Coverage	99.6%
Maximum hourly value (NO2)	104.3 µg/m^3
99.7 percentile for hourly values (NO2)	78.3 µg/m^3

Parameter	Measurement
Mean hourly value (NO2)	15.4 µg/m^3
Mean hourly value (NOx)	24.8 µg/m^3 NO2

9.1.5.4 Carbon Monoxide (CO)

Carbon monoxide data for the 2009/2010 monitoring period in Newbridge is presented in Table 9.6. The mean hourly concentration of carbon monoxide recorded was 0.4 mg/m^3. The carbon monoxide limit value for the protection of human health is 10 mg/m^3. On no occasion 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 9.6 Carbon Monoxide Data Newbridge October 2009 to May 2010

Hourly Values	Result
No. of hours	5,484
No. of measured values	5,315
Percentage Coverage	96.9%
Maximum hourly value	2.2 mg/m^3
98 percentile for hourly values	1.2 mg/m^3
Mean hourly value	0.4 mg/m^3
Maximum 8-hour mean	1.87 mg/m^3
98 percentile for 8-hour mean	1.09 mg/m^3

9.1.5.5 Dust

There are no statutory limits for dust deposition in Ireland. However, EPA guidance suggest "a soiling of 10mg/m^2/hour is generally considered to pose a soiling nuisance" (TA Luft, 2002). 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 has the potential to be generated from on-site activities due to the excavation of the substation foundation, peat and material management and development of new access, temporary construction compounds and parking facilities. The extent of dust generation at any site depends on the type of activity undertaken, the location, the nature of the dust, i.e. soil, sand, peat, etc., and the weather. In addition, dust dispersion is influenced by external factors such as wind speed and direction and/or, periods of dry weather. Construction traffic movements also have the potential to generate dust as they travel along the haul route.

The potential dust-related effects on local air quality and the relevant associated mitigation measures are presented in Sections 9.1.5.2.1 below.

9.1.6 Likely Significant Effects and Associated Mitigation Measures (Air)

9.1.6.1 'Do-Nothing' Effect

If the Proposed Project were not to proceed, the opportunity to reduce emissions of carbon dioxide, oxides of nitrogen, and sulphur dioxide to the atmosphere would be lost due to the continued dependence on electricity derived from coal, oil and gas-fired power stations, rather than renewable energy sources such as the proposed solar project. This would result in an indirect negative impact on air quality.

9.1.6.2 Construction Phase - Solar Farm, Substation & Grid Connection

9.1.6.2.1 Dust Emissions

Solar Farm

The construction of the solar array, access roads, peat repositories, amenity facilities and other onsite infrastructure (as outlined in Chapter 4 of this EIAR) could potentially give rise to dust emissions during the construction phase. The potential for impacts on off-site receptors is limited due to the isolated nature of the site and the vegetative screening that exists surrounding the site. The potential effect will not be significant and will be restricted to the duration of the construction phase. Therefore, this is considered a short-term slight negative impact. Dust suppression mitigation measures to reduce this impact are presented below.

Substation and Grid Connection

The construction of the proposed Substation and Grid Connection will give rise to localised dust emissions during their construction. The potential for impacts on off-site receptors is limited due to the distance of the works from receptors and the vegetative screening that exists around the Substation and Grid Connection works areas. This is therefore considered a potentially short-term slight negative impact.

Mitigation measures to reduce the potential for impacts associated with all of the Proposed Project works are presented below.

Mitigation

- In periods of extended dry weather, dust suppression may be necessary along haul roads and at works areas to ensure dust does not cause a nuisance. If necessary, water will be used from settlement ponds in the site's drainage system, and will be pumped into a bowser or water spreader to dampen down haul roads and site compounds to prevent the generation of dust where required. Water bowser movements will be carefully monitored to avoid, insofar as reasonably possible, increased runoff.
- All plant and materials vehicles shall be stored in dedicated areas (on site).
- Areas of excavation will be kept to a minimum, and stockpiling will be minimised by coordinating excavation, spreading and compaction.
- Solar panels and construction materials will be transported to the site on specified haul routes only.
- The agreed haul route roads adjacent to the site will be regularly inspected for cleanliness, and cleaned as necessary.
- The transport of construction materials to the site that have significant potential to cause dust, will be undertaken in tarpaulin or similar covered vehicles where necessary.
- A Construction and Environmental Management Plan (CEMP) will be in place throughout the construction phase (see Appendix 4-5). The CEMP includes dust suppression measures.

Residual Impact – Proposed Project

Short-term Imperceptible Negative Impact

Significance of Effects – Proposed Project

Based on the assessment above there will be no significant effects associated with the construction phase of the Proposed Project.

9.1.6.2.2 Exhaust Emissions

Solar Farm

The construction of the solar array, access roads and other onsite infrastructure (as outlined in Chapter 4 of this EIAR) will require the operation of construction vehicles and plant on site. Exhaust emissions associated with vehicles and plant will arise as a result of construction activities. This potential effect will not be significant and will be restricted to the duration of the construction phase and localised to works locations. Therefore, this is considered a transient short-term slight negative impact. Mitigation measures to reduce this impact are presented below.

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

Substation and Grid Connection

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

Mitigation – Proposed Project

- All construction vehicles and plant will be maintained in good operational order while onsite, thereby minimising any emissions that arise.
- All machinery will be switched off when not in use.
- Aggregate materials for the construction of site access tracks and all associated infrastructure will all be locally sourced, where possible, which will further reduce potential emissions.

Residual Impact – Proposed Project

Short-term Imperceptible Negative impact.

Significance of Effects – Proposed Project

Based on the assessment above there will be no significant effects associated with the construction phase of the Proposed Project.

9.1.6.3 Operational Phase - Solar Farm, Substation and Grid Connection

9.1.6.3.1 Exhaust Emissions

Exhaust emissions associated with the operational phase of the Proposed Project site will arise from machinery and vehicles that are intermittently required onsite for maintenance. This will give rise to a potentially long-term imperceptible impact as the numbers of vehicles accessing the Proposed Project site for either the Solar Farm or the Substation and Grid Connection during the operational phase will be minimal.

Mitigation

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

Residual Impact

Long-term Imperceptible Negative Impact

Significance of Effects – Proposed Project
Based on the assessment above there will be no significant effects associated with the operational phase of the Proposed Project.

9.1.6.3.2 Air Quality

The Proposed Project, by providing an alternative to electricity derived from coal, oil or gas-fired power stations, will result in emission savings of carbon dioxide (CO_2), oxides of nitrogen (NO_x), and sulphur dioxide (SO_2). The production of renewable energy from the Proposed Project will have a long-term significant positive impact on air quality. Further details on the carbon dioxide savings associated with the Proposed Project are presented in Section 9.2.3 below.

Residual Impact
Long-term Significant Positive Impact

Significance of Effects – Proposed Project
Based on the assessment above there will be a significant positive effect. Exposure to chemicals such as SO_2 and NOx are thought to be harmful to human health. The production of renewable energy from the Proposed Project will have a long-term slight positive impact on human health.

Residual Impact
Long-term Slight Positive Impact

Significance of Effects – Proposed Project
Based on the assessment above there will be no significant effects associated with the operational phase of the Proposed Project.

9.1.6.4 Decommissioning Phase - Solar Farm, Substation and Grid Connection

The solar farm infrastructure proposed as part of the Proposed Project are expected to have a lifespan of approximately 35 years. Following the end of their useful life, the solar infrastructure may be replaced, subject to planning permission being obtained, or the Proposed Project may be decommissioned fully. Individual panels may need to be replaced during the lifetime of the Proposed Project and this will occur on an as needed basis. The onsite substation will remain in place as it will be under the ownership of the ESB/EirGrid and part of the national transmission system.

The works required during the decommissioning phase are described in Section 4.11 in Chapter 4 of this EIAR. Any impact and consequential effect that occurs during the decommissioning phase will be similar to that which occurs during the construction phase, however to a lesser extent.

9.1.7 Human Health Effects

9.1.7.1 Construction Phase

The assessment completed in Section 9.1.5 shows that the potential negative residual impacts and effects associated with emission to air are not significant and will be localised to the Proposed Project works areas. In the absence of any significant air quality effects at any offsite locations including dwellings there will be no effects on human health associated with emissions to air.

9.1.7.2 Operational Phase

A recent European Environmental Agency Report, 'Air Quality in Europe – 2018 Report', as detailed above in Section 9.1.3.1, highlights the negative effects of air pollution on human health. The report assessed that poor air quality accounted for premature deaths of approximately 422,000 people in Europe in 2015. Emissions relating to $PM_{2.5}$, NO_2, O_3 and SOx) are produced during fossil fuel based electricity generation in various amounts, but there are no such emissions associated with the operation of the Proposed Project. Therefore, the operation of the Proposed Project will generally result in lower environmental levels of such parameters, and consequential positive beneficial effects on human health.

9.1.7.3 Decommissioning Phase

The works required during the decommissioning phase are described in Section 4.11 in Chapter 4 of this EIAR. Any impact and consequential effect that occurs during the decommissioning phase will be similar to that which occurs during the construction phase noted above in Section 9.1.7.1, however to a lesser extent.

9.2 Climate

9.2.1 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.

9.2.1.1 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 - 2012. These EU emission targets are legally binding on Ireland. Ireland's contribution to the EU commitment for the period 2008 – 2012 was to limit its greenhouse gas emissions to no more than 13% above 1990 levels.

9.2.1.1.1 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:

i. 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;
ii. A revised list of greenhouse gases (GHG) to be reported on by Parties in the second commitment period; and

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

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

9.2.1.1.2 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 including the EU member states 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.

9.2.1.1.3 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. In May 2018, the EPA published an update on Ireland's Greenhouse Gas Emission Projections to 2035, *'Ireland's Greenhouse Gas Emissions Projections 2017 – 2035'* (Environmental Protection Agency, 2018).

The 2018 report states that the *"latest EPA greenhouse gas emissions projections indicate an overall increase in greenhouse gas emissions from most sectors. The projected growth in emissions is largely underpinned by projected strong economic growth and relatively low fuel prices leading to increasing energy demand over the period"*.

Greenhouse gas emissions are projected to 2035 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 2014 are implemented. The 'With Additional Measures' scenario takes into account an expected shortfall in achieving full energy efficiency targets and renewable targets for electricity, transport and heat as set out in the National Energy Efficiency Action Plan and National Renewable Energy Action Plan.

The Environmental Protection Agency - Greenhouse Gas Emission Projections notes the following key trends:

- Ireland's non-Emissions Trading Scheme (ETS) emissions are projected to be 0% and 1% below 2005 levels in 2020 under the 'With Measures' and 'With Additional Measures' scenarios, respectively. The target for Ireland is a 20% reduction.
- Over the period 2013 – 2020, Ireland is projected to cumulatively exceed its compliance obligations by 17 Mt CO_2 (metric tonnes of Carbon Dioxide) equivalent under the 'With Measures' scenario and 16.3 Mt CO_2 equivalent under the 'With Additional Measures' scenario.

The EPA report states that "Ireland is not projected to meet 2020 emissions reduction targets and is not on the right trajectory to meet longer term EU and national emission reduction commitments". The report also states:

- *Fossil fuels such as coal and peat continue to be key contributors to emissions from the power generation sector and the extent of their use will be a key determinant in influencing future emissions trends from this sector. Total emissions are projected to increase from current levels by 1% and 4% by 2020 and 2030 respectively under the With Existing Measures scenario. Under the With Additional Measures scenario emissions are estimated to increase by 2% by 2020 and decrease by 1% by 2030. Ireland is not on the right long term trajectory in meeting national 2050 targets in the electricity generation, built environment and transport sectors ('Greenhouse Gas Emission Projections 2017 - 2035*, EPA, 2018)

9.2.1.1.4 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 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 Section 2.2.3.3 of this EIAR in Chapter 2: Background to the Proposed Project. Regarding progress on targets, the *'Europe 2020 indicators – climate change and energy'* report[5] 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 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 201 followed by Estonia, Ireland and the Netherlands.

[5] http://ec.europa.eu/eurostat/statistics-explained/index.php/Europe_2020_indicators_-_climate_change_and_energy

While the EU as a whole is projected to exceed its 2020 target of reducing GHG emissions by 20%, Ireland is currently one of the countries projected to miss its national targets.

9.2.2 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 Mullingar, Co. Westmeath, is the nearest weather and climate monitoring station to the Proposed Project site that has meteorological data recorded for the 30-year period from 1979-2008[6]. The monitoring station is located approximately 36 kilometres northwest of the site. Meteorological data recorded at Mullingar over the 30-year period from 1979 - 2008 is shown in Table 9.7 overleaf. The wettest months are October, December and January, and July is usually the driest. July is the warmest month with a mean daily temperature of 15.2° Celsius.

[6] The station at Mullingar closed in 2007/2008, so data is available between the periods of 1979-2008, rather than the typical 1981-2010.

Table 9.7 Data from Met Éireann Weather Station at Mullingar, 1979 to 2008

	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	7.4	7.9	9.8	12.1	14.9	17.3	19.2	18.9	16.7	13.2	9.9	7.9	12.9
mean daily min	1.5	1.5	2.8	4.1	6.3	9.2	11.1	10.8	8.9	6.2	3.5	2.2	5.7
mean temperature	4.5	4.7	6.3	8.1	10.6	13.2	15.2	14.8	12.8	9.7	6.7	5.0	9.3
absolute max.	13.8	15.4	19.1	21.6	25.0	28.3	29.7	29.1	25.0	20.1	17.3	14.6	29.7
min. maximum	-3.2	-0.6	1.4	4.1	0.0	10.1	10.9	11.4	10.6	6.3	2.7	-1.7	-3.2
max. minimum	11.6	11.5	11.5	12.5	12.7	15.3	17.4	18.0	16.8	15.4	12.5	12.4	18.0
absolute min.	-14.9	-6.6	-8.0	-4.4	-2.6	0.2	3.8	2.1	0.0	-4.4	-6.9	-12.4	-14.9
RELATIVE HUMIDITY (%)													
mean at 0900UTC	90.8	89.8	87.6	81.9	78.3	79.7	82.1	84.8	87.6	89.9	91.7	91.8	86.3
mean at 1500UTC	83.4	77.8	72.8	68.1	67.1	69.1	69.9	70.6	72.1	77.0	82.2	85.9	74.7
SUNSHINE (Hours)													
mean daily duration	1.8	2.5	3.2	4.9	5.8	5.0	4.6	4.6	3.9	3.2	2.2	1.6	3.6
greatest daily duration	8.2	9.9	10.9	13.6	15.4	15.9	15.3	14.4	12.2	10.1	8.6	7.3	15.9
mean num. of days with no sun	10.3	7.2	5.3	2.9	1.9	2.2	1.8	1.9	3.3	5.7	8.4	11.0	62.0
RAINFALL (mm)													
mean monthly total	91.7	72.0	78.3	62.1	68.7	70.5	61.8	80.8	73.8	102.1	82.4	97.1	941.3
greatest daily total	30.3	24.7	29.5	27.6	26.1	52.9	26.6	58.2	42.1	48.8	43.7	38.8	58.2
mean num. of days with >= 0.2mm	19	17	20	15	16	16	16	17	17	19	18	19	209
mean num. of days with >= 1.0mm	15	13	15	11	12	11	11	13	12	14	13	14	154
mean num. of days with >= 5.0mm	6	5	5	4	5	4	3	5	4	6	6	7	60
WIND (knots)													
mean monthly speed	9.0	9.1	9.1	7.7	7.3	6.7	6.4	6.3	6.7	7.5	7.8	8.3	7.6
max. gust	67	71	59	56	58	48	48	50	51	59	62	73	58.5
max. mean 10-minute speed	38	36	36	30	34	26	27	28	32	36	32	39	32.8
mean num. of days with gales	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.2	0.8
WEATHER (Mean No. of Days With:)													
snow or sleet	5.0	4.4	3.5	1.6	0.2	0.0	0.0	0.0	0.0	0.0	0.4	2.7	17.8
snow lying at 0900UTC	2.7	0.9	0.8	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.0	5.7
hail	0.6	0.9	2.0	2.0	1.1	0.2	0.1	0.1	0.1	0.5	0.2	0.3	8.1
thunder	0.1	0.2	0.2	0.3	0.9	0.9	1.2	0.8	0.1	0.1	0.1	0.1	4.9
fog	3.4	3.0	2.4	2.0	1.8	1.3	1.9	2.9	4.0	4.1	4.1	4.3	35.1

9.2.3 Calculating Carbon Losses and Savings from the Proposed Project

9.2.3.1 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.

When developments such as solar PV 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 solar PV farm development in a peatland area saves more CO_2 than is released.

The site of the Proposed Project is situated on peat habitat. The carbon balance between the use of a renewable energy and the loss of carbon stored in the peat is assessed in this section of the EIAR.

9.2.3.2 Calculating Carbon Losses and Savings

Bord Na Móna developed a methodology, based on their extensive experience, for calculating carbon losses and savings from the Proposed Project. This was used to assess the effects of the Proposed Project in terms of potential carbon losses and savings taking into account peat removal, drainage and site restoration. The methodology reflects the specific nature of the cutaway peat lands upon which the Proposed Project is proposed to be located.

The completed worksheet including the assumptions used in the model is provided as Appendix 9-1 to this EIAR. The peat losses are based on the volume of peat disturbed and redistributed, and also changes to some in-situ peat. The peat displaced from construction areas is either side casted or stored within the designated peat repositories. No peat will be transported offsite. There will be some vegetation control under the solar PV panels themselves on in-situ peatland to prevent inter-panel shading and this results in a diminishing in carbon sequestration from the plants. The remaining in-situ peat is assumed to be undisturbed and as such is assigned a zero net emission value in this analysis.

The model calculates the total carbon emissions associated with the Proposed Project including manufacturing of the PV module technology and associated balance of plant, transport, construction of the development and carbon losses due to peatland disturbance.
The model also calculates the carbon savings associated with the Proposed Project against three comparators:

i. The average fossil emissions on the Irish Grid – based on the SEM Reference mid-merit plant
ii. The EU Fossil Fuel Comparator (a measure of the fossil intensity across the European market)

iii. A displaced 'Load Following' combined cycle gas turbine plant.

The expected and maximum, worst-case scenario CO_2 losses due to the Proposed Project are summarised in Table 9.8 and the total savings against the three comparators listed above are summarised in Table 9.9. The full carbon calculation for the Proposed Project can be referred to in Appendix 9-1.

The development of the Proposed Project will require an upgrade of the existing drainage system. The primary elements of the upgrade will be the development of a restriction or choke point on water discharges from the Proposed Project site to restrict the rate of discharge to a controlled level, the installation of a large collector drain and associated internal drains within the footprint of the Proposed Project and the creation of check dams outside of the infrastructure footprint in the vicinity of the Proposed Project and across the site. The overall impact on water levels within the site is considered to be neutral and therefore is not considered in the calculation. A degree of tree felling will be required to facilitate the development. The area required will be offset through the active planting of another part of the Proposed Project site. This impact is also considered to be neutral and therefore is not considered in the calculation.

9.2.3.2.1 Carbon Losses

As with the proposed methodology, taking account of the total carbon emissions associated with the Proposed Project, the main CO_2 losses due to the Proposed Project are summarised in Table 9.8.

Table 9.8 CO_2 losses from the Proposed Project

Origin of Losses	CO_2 Losses (tonnes CO_2 equivalent)
Losses due to solar PV module lifecycle (e.g. manufacture, construction, decommissioning)	255,350
Losses due to Additional Cycling Emissions	44,745
Losses from peat land disturbance emissions	6,475
Total	306,571

The peat losses are based on the volume of peat disturbed and redistributed, and takes a 'worst case' approach as described above.

9.2.3.2.2 Carbon Savings

Table 9.9 CO_2 savings from the Proposed Project

Origin of Savings	CO2 Savings (tonnes CO2 equivalent)	Payback (years)
SEM Mid-Merit Plant	2,076,046	5.17
EU Fossil Fuel Comparator (FFC)	1,837,071	5.84
'Load Following' Combined Cycle Gas Turbine Plant	1,100,625	9.75

Based on the Bord Na Móna model calculations as presented above, 306,571 tonnes of CO_2 will be lost to the atmosphere due to changes in the peat environment, changes in the cycling of mid-merit gas-fired generation units and due to the construction and operation of the Proposed Project. This represents a fraction of the total amount of carbon dioxide emissions that will be offset by the Proposed Project as set out in Table

9.9. According to Table 9.9, SEM Mid-Merit Plant and 'Load Following' savings allowed for 2,076,046 and 1,100,625 tonnes of CO_2 savings respectively.

Based on the EU Fossil Fuel Comparator (FFC) savings, the volume of CO_2 that will be lost to the atmosphere will be offset by the Proposed Project during its first 5.8 years of operation.

9.2.4 Likely Significant Effects and Associated Mitigation Measures (Climate)

9.2.4.1 'Do-Nothing' Effect

If the Proposed Project were not to proceed, the opportunity to significantly reduce emissions of greenhouse gas emissions, including carbon dioxide, oxides of nitrogen and sulphur dioxide, to the atmosphere would be lost. The opportunity to contribute to Ireland's commitments under the Kyoto Protocol and EU law would also be lost. This would be a permanent slight negative impact.

9.2.4.2 Construction Phase

There are no significant direct construction impacts from the Proposed Project in regard to climate.

9.2.4.2.1 Greenhouse Gas Emissions

Solar Farm

The construction of the solar panels, access roads and other onsite infrastructure (as outlined in Chapter 4 of this EIAR) will require the operation of construction vehicles and plant on site. Greenhouse gas emissions, e.g. carbon dioxide (CO_2), associated with vehicles and plant will arise as a result of the construction activities. This potential impact will be imperceptible only, given the insignificant quantity of greenhouse gases that will be emitted, and will be restricted to the duration of the construction phase. Therefore, this is a short-term imperceptible negative impact. Mitigation measures to reduce this impact are presented below.

Substation and Grid Connection

The construction of the proposed Substation and Grid Connection will require the use of construction machinery, thereby giving rise to greenhouse emissions. This potential impact will be imperceptible only, given the insignificant quantity of greenhouse gases that will be emitted, and will be restricted to the duration of the construction phase. Therefore, this is a short-term imperceptible negative impact. This potential impact will be reduced through use of the best practice mitigation measures as presented below.

Mitigation

- All construction vehicles and plant will be maintained in good operational order while onsite, thereby minimising any emissions that arise.
- All machinery will be switched off when not in use.
- Aggregate materials for the construction of site access tracks and all associated infrastructure will all be locally sourced where possible, which will further reduce potential emissions.

Residual Impact

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

Significance of Effects – Proposed Project
Based on the assessment above there will be no significant effects associated with the construction phase of the Proposed Project.

9.2.4.3 Operational Phase - Solar Farm, Substation and Grid Connection

There are no significant direct operational impacts from the Proposed Project site in regard to climate.

9.2.4.3.1 Greenhouse Gas Emissions

The Proposed Project will generate energy from a renewable source. This energy generated will offset energy and the associated emission of greenhouse gases from electricity-generating stations dependent on fossil fuels, thereby having a positive effect on climate. As detailed in the above model in Section 9.2.3.2, the Proposed Project will displace carbon dioxide from fossil fuel-based electricity generation, over the 35-year lifespan of the Proposed Project. The Proposed Project will assist in reducing carbon dioxide (CO_2) emissions that would otherwise arise if the same energy that the Proposed Project site will generate, were otherwise to be generated by conventional fossil fuel plants. This is a long-term significant positive effect.

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 no significant effects.

9.2.4.4 Decommissioning Phase - Solar Farm, Substation and Grid Connection

The solar farm infrastructure proposed as part of the Proposed Project are expected to have a lifespan of approximately 35 years. Following the end of their useful life, the solar infrastructure may be replaced, subject to planning permission being obtained, or the Proposed Project may be decommissioned fully. Individual panels may need to be replaced during the lifetime of the Proposed Project and this will occur on an as needed basis. The onsite substation will remain in place as it will be under the ownership of the ESB/EirGrid and part of the national transmission system.

The works required during the decommissioning phase are described in Section 4.11 in Chapter 4 of this EIAR. Any impact and consequential effect that occurs during the decommissioning phase will be similar to that which occurs during the construction phase, however to a lesser extent.

9.3 Cumulative Assessment

Potential cumulative effects on air quality and climate between the Proposed Project site and other developments in the vicinity were also considered as part of this assessment. The developments considered as part of the cumulative effect assessment are described in Section 2.6 of this EIAR.

The nature of the Proposed Project site is such that, once operational, it will have a long-term, slight, positive impact on air quality and climate.

During the construction phase of the Proposed Project, in combination effects with all other developments in the vicinity of the Proposed Project; there will be minor emissions from construction plant and machinery and potential dust emissions associated with the construction activities. However, once the mitigation proposals, as

outlined in Section 9.1.6 are implemented during the construction phase of the Proposed Project, there will be no cumulative negative effect on air and climate.

The nearest source of air emissions to the site would be from the operational Drehid Waste Management Facility, located 1.6km from the infrastructure of the Proposed Project. The only potential emissions that could cumulatively cause negative effects from both operations are dust emissions (during the construction phase of the proposed Solar Farm and Substation and Grid Connection works). The former waste licence and existing IE licence for the Drehid facility includes strict dust mitigation measures and an extensive dust deposition monitoring regime. The results of dust deposition monitoring over the past number of years shows that that facility is generally in compliance with its licence limits and dust emissions are not a significant issue. The facility does at present have an application submitted to An Bord Pleanála as 'Strategic Infrastructure Development' for an extension to the current site. Should permission be granted for that extension, it too will be required to operate under IE licence from the EPA which will set mitigation measures and limits on air quality emissions including dust deposition.

The assessment documented in Section 9.1.6.2.1 above shows that the potential dust emissions from the Proposed Project, particularly during the construction stage can be managed and will have no significant effects. The Drehid facility does and will continue to operate with strict dust deposition limits and so the potential for significant cumulative effects are limited and are considered to be imperceptible.

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