Chapter 11 Climate

Ballinlee Wind Farm

Ballinlee Green Energy Ltd.

September 2025

Contents

Tables

Appendix

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11. Climate

11.1 Introduction

This chapter considers the potential effects on climate arising from the proposed development, as well as considering the effects of climate change on the proposed development. A full description of the proposed development, development lands and all associated project elements is provided in Volume II, Chapter 02 Description of the Proposed Development of this EIAR. The nature and probability of effects on climate arising from the overall project has been assessed.

Mitigation measures have been provided to prevent significant effects and climate related residual effects associated with the proposed development are also summarised.

11.1.1 Competency of Assessor

This chapter of the EIAR has been prepared by Claire Boylan of Malachy Walsh and Partners (MWP). Claire Boylan holds a BSc (EnvMgt), an Adv Dip Planning and Environmental Law, a BBS and DipSc. Claire is an experienced Environmental Scientist at Malachy Walsh and Partners (MWP), having worked for 6 years in the environmental sector. Claire has worked on a variety of infrastructure projects, environmental licensing applications, conducted environmental assessments and supported the delivery of a number of environmental deliverables including Environmental Impact Assessment (EIA) Screening Reports, Appropriate Assessment (AA), Natura Impact Statements (NIS) and Environmental Impact Assessment Reports (EIAR). Prior to MWP, Claire had five years' experience reporting accredited air emissions monitoring for EPA Licensed sites. Claire has worked on Air and Climate Chapters for the following projects:

- Mixed Use Development, Cork City.
- Ballinla Wind Farm, Co. Offaly.
- Inis Cealtra Visitor Experience, Co. Clare.
- Large Scale Residential Development, Centre Park Road, Cork City.

This assessment has been reviewed by Ken Fitzgerald and Aileen O'Connor (MWP).

Aileen O'Connor (MWP), BSc(Hons), PGDip, has over 13 years' experience in the environmental field both in industry and consultancy work. Aileen is a Senior Environmental Consultant and holds a BSc(Hons) in Environmental Science and PGDip in Energy Management. Aileen is an experienced and competent environmental professional with a background in contaminated land assessment, licence compliance and waste management. Aileen has prepared and peer reviewed chapters of EIARs and has coordinated and delivered many environmental assessment reports and consent applications for transmission and power generation projects including the preparation of Resource Waste Management Plans and contributed to Material Assets Impact Assessments. More specifically, she has worked on a wide variety of projects during her career to date including wind farms, marine, quarries, industrial and commercial developments.

Ken Fitzgerald (MWP) has worked in the area of civil engineering, construction management, EIA and planning over the last 35 years. During the last 18 years he has focused on renewable energy and marine projects. He has managed the design, planning and preparation of EIA's for large-scale wind energy projects. He has acted as

planning lead on wind farm development projects that availed of both Local Authority and Strategic Infrastructure Development planning routes. He has expertise in planning appeals, public consultation, community engagement, Oral Hearings and in Judicial Review proceedings.

11.2 Methodology

11.2.1 Guidance and Legislation

The assessment has been prepared in accordance with:

- Guidelines on the Information to be contained in Environmental Impact Assessment Reports (EPA 2022);
- European Commission Guidance on the preparation of the EIAR 2017;
- 2018 Department of Housing Guidance.

In addition to international standards and guidelines relating to the assessment of Greenhouse Gas (GHG) emissions and associated climatic impact, the following methodology and guidance was utilised for the climate section of this EIAR:

- Calculating Carbon Savings from Wind Farms on Scottish Peat Lands (University of Aberdeen and the Macauley Institute 2008);
- Wind Farms and Carbon Savings (Scottish Natural Heritage, 2003);
- Transport Infrastructure Ireland (TII) Carbon Assessment Tool (Version 0.6.19) (TII, 2020);
- DECC (2024) National Adaptation Framework 2024;
- National Energy and Climate Plan 2021-2030;
- DCCAE (2025) Climate Action Plan 2025;
- Department of Transport, Tourism and Sport (DTTAS) (2019) Transport – Climate Change Sectoral Adaption Plan;
- The Climate Action and Low Carbon Development Acts 2015 to 2021;
- IEMA EIA Guide to: Climate Change Resilience and Adaptation (IEMA 2020);
- Limerick Climate Action Plan 2024-2029;
- Limerick Development Plan 2022-2028;
- European Commission (EC) (2014) 2030 Climate and Energy Policy Framework;
- UKHA (2019) Design Manual for Roads and Bridges: A 114 – Climate;
- European Green Deal (EC, 2022);
- Renewable Energy Directive (RED III);
- Kyoto Protocol (United Nations Framework Convention on Climate Change (United Nations Framework Convention on Climate Change (UNFCC), 1997);
- Paris Agreement (UNFCC, 2015);
- Summary of Global Climate Action at COP 28 (UNFCC, 2023);

- Summary of Global Climate Action at COP 29 (UNFCC, 2024); and
- IPCC Climate Change 2023 Synthesis Report.

11.2.1.1 Carbon Impact Assessment

In order to assess whether the carbon savings associated with the proposed renewable energy development 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 developed to support the process of determining the carbon effect of wind farm developments in Scotland in a comprehensive and consistent way. 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. This is accepted as best practice in Ireland and therefore this method has been adopted for this assessment to determine the potential carbon savings and losses from the proposed development, refer to Section 11.4.2.1.

It is important to note that there is no peat located within the majority of proposed development area. No peat is mapped on the GSI maps for the site. During a site walkover a small area of peaty type soil was noted in the north-eastern corner of the site. Site investigations found small patches of peat of less than 0.8m depth at T1, 0.25m at T2 and 0.3m at T4. The potential peat volumes to be excavated are c. 4351m^3. The excavated peat volumes will be included in the carbon calculation as part of the costs of the wind farm.

11.2.1.2 Climate – Embodied Energy Assessment

Climate change is a result of increased levels of carbon dioxide and other GHGs in the atmosphere causing the heat trapping potential of the atmosphere to increase. GHGs can be emitted from vehicles and embodied energy associated with materials used in the construction of a project. Embodied energy refers to the sum of the energy needed to produce a good or service. It incorporates the energy needed in the mining or processing of raw materials, the manufacturing of products and the delivery of these products to site. There is the potential for a number of embodied GHGs and GHG emissions during the construction phase of the proposed project. Construction vehicles, generators etc. may give rise to CO2 and N2O emissions as well as the large quantities of material such as stone, concrete and steel that will be required for a proposed project of this scale.

PE-ENV-01104 (TII, 2022b) recommends the calculation of the construction stage embodied carbon using the TII Online Carbon Tool (TII, 2022d). Embodied carbon refers to the sum of the carbon needed to produce a good or service. It incorporates the energy needed in the mining or processing of raw materials, the manufacturing of products and the delivery of these products to site. The TII Online Carbon Tool (TII, 2022d) uses emission factors from recognised sources including the Civil Engineering Standard Method of Measurement (CESSM) Carbon and Price Book database (CESSM, 2013), UK National Highways Carbon Tool v2.4 and UK Government 2021 Greenhouse Gas Reporting Conversion Factors. The tool aligns with PAS 2080 - Carbon Management in Infrastructure. The carbon emissions are calculated by multiplying the emission factor by the quantity of the material that will be used over the entire construction / maintenance phase. The GHG assessment commences with the high-level design, through the pre-construction (site clearance) stage, followed by the assessment of the embodied carbon associated with all materials used in the construction of the proposed project, the emissions during the construction phase activities and additionally emissions related to waste generated during the construction phase. As part of the proposed project, Construction Phase embodied GHG emissions are categorised under the following headings:

- Product Stages: The carbon emissions generated at this stage arise from extracting the raw materials from the ground, their transport to a point of manufacture and then the primary energy used (and the associated carbon impacts that arise) from transforming the raw materials into construction products. These stages have been included within the scope of this assessment.
- Construction: These carbon impacts arise from transporting the construction products to site, and their subsequent processing and assembly. This has been included within the scope of the assessment.
- In-Use Stages: This covers a wide range of sources from the embodied carbon emissions associated with the operation of the development, including the materials used during maintenance, replacement and refurbishment. Material refurbishment and replacement throughout the lifetime of the proposed project has been included within this assessment.
- End of Life Stages: The eventual deconstruction and disposal of the existing development at the end of its life takes account of the on-site activities of the demolition contractors. No 'credit' is taken for any future carbon benefit associated with the reuse or recycling of a material into new products.

Detailed information for the proposed project, including volumes of materials, is provided in Volume II, Chapter 02 Description of the Proposed Project of this EIAR.

Forests are an important part of the global carbon cycle and effective management at a regional scale can help to reduce GHG concentrations (UK Forestry Commission, 2012). Trees have the ability to sequester carbon with the peak CO2 uptake rate for forestry of the order of 5–20 tonnes of CO2/hectare/year with CO2 uptake rates declining before stand maturity. Additionally, after afforestation on mineral soils, there will be an increase of soil carbon soon after planting of the order of 0.2–1.7 tonnes of CO2/hectare/year (UK Forestry Commission 2012 and Intergovernmental Panel on Climate Change (IPCC) 2006). The TII Carbon Tool includes an assessment for forestry loss. Based on this analysis, the GHG emissions associated with the loss of 14.4 hectares of forestry as a result of the proposed project has been assessed.

11.2.1.3 Climate Change Vulnerability Assessment

LA 114 Climate (Design Manual for Roads and Bridges) (UKHA 2019) outlines that the study area for assessing a project's vulnerability to climate change should be based on the construction footprint/project boundary (including compounds and temporary land take). Impacts as a result of climate change involve increases in global temperatures and increases in the number of rainfall days per year. The EPA has compiled a list of potential adverse impacts as a result of climate change including the following which may be of relevance to the proposed development:

- More intense storms and rainfall events;
- Increased likelihood and magnitude of river and coastal flooding;
- Water shortages in summer in the east;
- Adverse impacts on water quality; and
- Changes in distribution of plant and animal species.

LA 114 Climate outlines an approach for undertaking a risk assessment where there is a potentially significant impact on the proposed development receptors due to climate change. The risk assessment assesses the likelihood and consequence of the impact occurring, leading to the evaluation of the impact significance. This assessment approach is provided as an appropriate method in the *EIA Guide to: Climate Change Resilience and Adaptation* (IEMA 2020). The operational phase assessment, after identifying the hazards and benefits to the climate change impacts, assesses the likelihood and consequences using the framework outlined in Table 11-1 and Table 11-2.

Table 11-1: Likelihood Categories

Likelihood Category	Description (Probability and Frequency of Occurrence)
Very High	The event occurs multiple times during the lifetime of the project (60 years) e.g. approximately annually, typically 60 events.
High	The event occurs several times during the lifetime of the project (60 years) e.g. approximately once every five years, typically 12 events.
Medium	The event occurs limited times during the lifetime of the project (60 years) e.g. approximately once every 15 years, typically four events.
Low	The event occurs during the lifetime of the project (60 years) e.g. once in 60 years.
Very Low	The event may occur once during the lifetime of the project (60 years)

Table 11-2: Measure of Consequence

Consequence of Impact	Description
Very Large Adverse	Operation – national level (or greater) disruption to strategic route(s) lasting more than one week.
Large Adverse	Operation – national level (or greater) disruption to strategic route(s) lasting more than one day but less than one week or regional level disruption to strategic route(s) lasting more than one week.
Moderately Adverse	Operation – regional level disruption to strategic route(s) lasting more than one day but less than one week.
Minor Adverse	Operation – regional level disruption to strategic route(s) lasting less than one day.
Negligible	Operation –disruption to an isolated section of a strategic route lasting less than one day.

The likelihood and consequence of each impact is then combined in the form of a matrix to identify the significance of each impact as outlined in **Table 11-3**. The significance conclusions for each impact are based on and incorporate confirmed design and mitigation measures. Where the assessment concludes that the impact is significant, LA 114 Climate states that '*the design and mitigation hierarchy should be reassessed to reduce the significance of impacts to an acceptable level (not significant)*'.

Table 11-3: Significant Matrix

		Measure of Likelihood				
		Very Low	Low	Medium	High	Very High
Measure of Consequence	Very Large Adverse	NS	S	S	S	S
	Large Adverse	NS	NS	S	S	S
	Moderate Adverse	NS	NS	S	S	S
	Minor Adverse	NS	NS	NS	NS	NS
	Negligible Adverse	NS	NS	NS	NS	NS

Note: NS = Not Significant; S = Significant

11.2.2 International Climate Agreements and Policies

Globally, governance relating to climate change has changed significantly since 1994 when the United Nations Framework Convention on Climate Change (UNFCCC) entered into force. Greenhouse gas emissions have been a primary focus of climate related international agreements for almost two decades. International greenhouse gas emission and climate targets play an important role in stimulating and enabling action for developed and developing nations. The following sections provide an overview of the international agreements that have played key roles in establishing climate governance.

11.2.2.1 Kyoto Protocol

The Kyoto Protocol was adopted on 11 December 1997, which operationalised the UNFCCC and was the first international agreement that committed countries to reduce their greenhouse gas emissions (GHGs). It set limitations and reduction targets for greenhouse gases for developed countries. The Kyoto Protocol came into effect in 2005, as a result of which, emission reduction targets agreed by developed countries, including Ireland, became binding for the first time. Under the Kyoto Protocol, the EU agreed to achieve a significant reduction in total greenhouse gas emissions in the period 2008 to 2012. These EU emission targets are legally binding in Ireland. Ireland's contribution to the EU commitment for the period 2008 – 2012 (the first commitment period) was to limit its greenhouse gas emissions to no more than 13% above 1990 levels. Ireland achieved its Kyoto Protocol targets under the EU burden-sharing agreement.

Doha Amendment to Kyoto Protocol

In Doha, Qatar, on 8th December 2012, the "Doha Amendment to the Kyoto Protocol" was adopted. The amendment includes:

- New commitments for Annex I Parties to the Kyoto Protocol who agreed to take on commitments in a second commitment period starting in 2013 and lasting until 2020 (The amendment entered into force on 31 December 2020).
- A revised list of greenhouse gases (GHG) to be reported on by Parties in the second commitment period; and
- Amendments to several articles of the Kyoto Protocol which specifically referenced issues pertaining to the first commitment period and which needed to be updated for the second commitment period.

During the first commitment period, 37 industrialised countries and the European Community committed to reduce GHG emissions to an average of 5% below 1990 levels. During the second commitment period, Parties committed to reduce GHG emissions by at least 18% below 1990 levels in the eight-year period from 2013 to 2020. The composition of Parties in the second commitment period is different from the first; however, Ireland and the EU signed up to both the first and second commitment periods. Under the protocol, countries must meet their targets primarily through national measures, although market-based mechanisms (such as international emissions trading) can also be utilised.

11.2.2.2 COP21 Paris Agreement

COP21 was the 21st session of the Conference of the Parties (COP) to the United Nations Convention. Every year since 1995, the COP has gathered the 196 Parties (195 countries and the European Union) that have ratified the Convention in a different country, to evaluate its implementation and negotiate new commitments. COP21 was organised by the United Nations in Paris and held from 30th November to 12th December 2015.

COP21 closed on 12th December 2015 with the adoption of the first international climate agreement (concluded by 195 countries and applicable to all). The twelve-page text, made up of a preamble and 29 articles, provides for a limitation of the global 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.

11.2.2.3 COP25 Climate Change Conference – Madrid

The 25th United Nations Climate Change conference COP25 was held in Madrid and ran from December 2nd to December 13th, 2019. While largely regarded as an unsuccessful conference, the European Union launched its most ambitious plan, 'The European Green New Deal' which aims to lower CO_2 emissions to zero by 2050. The

deal includes proposals to reduce emissions from the transport, agriculture and energy sectors and will affect the technology, chemicals, textiles, cement, and steel industries. Measures such as fines and pay-outs by member states who rely on coal power will be in place to encourage the switch to renewable clean energies such as wind. On the 4th of March 2020, the European Commission put forward the proposal for a European climate law. This aims to establish the framework for achieving EU climate neutrality. It aims to provide a direction by setting a pathway to climate neutrality and to this end, aims to set in legislation the EU's 2050 climate-neutrality objective.

11.2.2.4 COP27 Climate Change Conference – Sharm El-Sheikh

COP27 took place in Sharm El-Sheikh from the 6th of November 2022 to the 20th of November. The COP is a supreme decision-making body of the UNFCCC.

The three major topics of COP27 were:

- Closing the emissions gap to keep 1.5°C alive
- Loss and damage
- Climate finance

The summit took place a year after its precedent COP26 summit in Glasgow, Scotland. In Glasgow, the final agreement was delayed due to the stance of China and India, among others, who were not comfortable with the wording on the 'phase out' of coal in the draft text. This led to the watering down of this commitment to a 'phase down' of coal use. The hope was that COP27 would work to include further language on coal and fossil fuel reduction efforts and be matched by increased ambition and action to meet agreed pledges. Initial texts represented more serious language than used at COP26 in Glasgow, however, the published final text retains the language of Glasgow, phase down, which does not use any binding language to reduce use and is still only applicable to coal, not oil and gas. There has been the setting of a workplan for 2023 to help articulate the nature and components of a global collective goal on adaptation and resilience, however in order to achieve this, more work needs to be done by countries, cities and organisations as currently, the numbers on the Nationally Determined Contributions (NDCs) don't add up. Currently, no country has an NDC in place that is able to meet the Paris Agreement goals, making net zero by 2050 difficult to envision and 2030 commitments near impossible.

11.2.2.5 COP28 Climate Change Conference – Dubai

The COP28 took place in Dubai from the 30th of November to 13th December 2023. COP 28 was particularly momentous as it marked the conclusion of the first 'global stocktake' of the world's efforts to address climate change under the Paris Agreement. Having shown that progress was too slow across all areas of climate action – from reducing greenhouse gas emissions, to strengthening resilience to a changing climate, to getting the financial and technological support to vulnerable nations – countries responded with a decision on how to accelerate action across all areas by 2030. This includes a call on governments to speed up the transition away from fossil fuels to renewables such as wind and solar power in their next round of climate commitments.

The text also mentions the potential role of 'transitional fuels' in facilitating the energy transition while ensuring energy security. This is the first time that a UN climate change conference has formally recognised the necessity of moving away from fossil fuels to achieve the Paris Agreement targets, although the mention of fossil fuels faced opposition from oil-producing countries. The COP28 decision also highlights the importance of protecting and restoring nature and ecosystems and enhancing efforts to halt and reverse deforestation by 2030 and invites parties to preserve and restore oceans and coastal ecosystems. An agreement on the operationalisation of the Loss and Damage Fund was reached on the first day of the conference. The fund will initially be hosted by the World Bank. It has received over US$700 million in pledges, including US$100million each from Germany and the United Arab Emirates. The parties adopted a framework for the global goal on adaptation, with 2030 targets for

all parties to: conduct impact, vulnerability and risk assessments; adopt and implement adaptation plans and policy instruments; and set up monitoring, evaluation and learning systems for their national adaptation efforts.

The outcome of the global stocktake will inform the next round of nationally determined contributions, due in the first quarter of 2025. Negotiations on carbon markets under Article 6 of the Paris Agreement were not concluded during COP28 and will continue, as will the discussion about a post-2025 collective quantified goal for the provision of climate finance.

11.2.2.6 COP29 Climate Change Conference – Baku

The COP29 Climate Change Conference took place in Baku, Azerbaijan in November 2024. With a central focus on climate finance, the agreement will:

- Triple finance to developing countries, from the previous goal of USD 100 billion annually, to USD 300 billion annually by 2035.
- Secure efforts of all actors to work together to scale up finance to developing countries, from public and private sources to the amount of USD 1.3 trillion per year by 2035.

Known formally as the New Collective Quantified Goal on Climate Finance (NCQG), it was agreed after two weeks of intensive negotiations and several years of preparatory work, in a process that requires all nations to unanimously agree on every word of the agreement. The International Energy Agency expects global clean energy investment to exceed USD 2 trillion for the first time in 2024.

The new finance goal at COP29 builds on significant strides forward on global climate action at COP27, which agreed an historic Loss and Damage Fund, and COP28, which delivered a global agreement to transition away from all fossil fuels in energy systems swiftly and fairly, triple renewable energy and boost climate resilience. COP29 also reached agreement on carbon markets – which several previous COPs had not been able to achieve. These agreements will help countries deliver their climate plans more quickly and cheaply and make faster progress in halving global emissions this decade, as required by science.

Important agreements were also reached on transparent climate reporting and adaptation as summarized below.

Other achievements of COP29 include:

Article 6 of the Paris Agreement

After nearly a decade of work, countries have agreed on the final building blocks that set out how carbon markets will operate under the Paris Agreement, making country-to-country trading and a carbon crediting mechanism fully operational. On country-to-country trading (Article 6.2), the decision from COP29 provides clarity on how countries will authorize the trade of carbon credits and how registries tracking this will operate. And there is now reassurance that environmental integrity will be ensured up front through technical reviews in a transparent process.

On day one of COP29, countries agreed standards for a centralized carbon market under the UN (Article 6.4 mechanism). This is good news for developing countries, who will benefit from new flows of finance. And it is particularly good news for least developed countries, who will get the capacity-building support they need to get a foothold in the market.

This mechanism, known as the Paris Agreement Crediting Mechanism, is underpinned by mandatory checks for

projects against strong environmental and human rights protections, including safeguards that ensure a project can't go ahead without explicit, informed agreement from Indigenous Peoples. It also allows anyone affected by a project to appeal a decision or file a complaint.

Under the text agreed on Article 6.4, there is a clear mandate for the UN carbon market to align with science. It tasks the Body getting this market up and running to consider the best available science across all work going forward.

11.2.2.7 United Nations Sustainable Development Goals Report

Transforming our World: the 2030 Agenda for Sustainable Development which includes 17 Sustainable Development Goals (SDGs), and 169 targets was adopted by all UN Member States at a UN summit held in New York in 2015. The agenda is universally applicable with all countries having a shared responsibility to achieve the goals and targets which came into effect on January 1st, 2016. The goals and targets are to be actions over the 15-year period, are integrated and indivisible i.e., all must be implemented together by each Member State. In 2024, the report 'The Sustainable Development Goals Report 2024' was published. A progression of the 2023 report, which stated that the world is falling short of meeting most of the SDGs by 2030, especially in terms of climate action, the 2024 report states that intensifying, interconnected challenges continue to endanger the realization of the SDGs by the 2030 deadline. The Sustainable Development Goals Report 2024 reveals that progress has ground to a halt or been reversed across multiple fronts, despite reaffirmed pledges.

In October 2022, the Department of Communications, Climate Action & Environment, in partnerships with all Government Departments, key stakeholders, and based on input from two public consultation processes, published the Sustainable Development Goals National Implementation Plan 2022-2024[1]. The Plan identifies that, overall, the world is not on track to achieve the global Goals by 2030. The Plan sets out how Ireland will work to achieve the goals and targets of the Agenda for Sustainable Development both domestically and internationally. Ireland's first National Implementation Plan provided a framework for Ireland to work towards the implementation of the SDGs; the new Implementation Plan aims to build on the structures and mechanisms from the first Plan and to develop and integrate additional approaches in areas identified as requiring further action.

In September 2023, the UN Summit on the SDGs took place in New York and was co-facilitated by Ireland and Qatar. Representing the halfway mark to achieving the SDGs by 2030, it marked the beginning of a new phase of accelerated progress towards the SDGs with high-level political guidance on transformative and accelerated actions. The Global Sustainable Development Report 2023 was published in September 2023. The previous Global Sustainable Development Report (2019) found that for some targets the global community was on track, but for many others the world would need to quicken the pace. In 2023, the situation was much more worrisome owing to slow implementation and a confluence of crises. The 2023 Report goes on to highlight the current standing of each SDG and its relevant indicators. A 2023 UN Special Report 4 found that over 30% of the SDGs have seen either no improvement or reverse trends in progress. The push for transformation to achieve the SDGs will come through shifts in six key entry points:

1. Human Well Being and Capabilities
2. Sustainable and Just Economies
3. Food Systems and Healthy Nutrition
4. Energy Decarbonisation with Universal Access
5. Urban and Peri-Urban Development

[1] https://www.gov.ie/en/policy-information/ff4201-17-sustainable-development-goals/

6. Global Environmental Commons

The Proposed Development will contribute to Entry Point 4 due to the clean and renewable energy it will provide over its operational life. The phase out of fossil fuels in a manner that is globally and domestically just, while strengthening the transition to renewables by increasing energy efficiency and encouraging behavioural change will be key to achieving the SDGs relevant to the Proposed Development.

11.2.2.8 Climate Change Performance Index

Established in 2005, the Climate Change Performance Index (CCPI) is an independent monitoring tool which tracks countries climate protection performance. It assesses individual countries based on climate policies, energy usage per capita, renewable energy implementation and Greenhouse Gas Emissions (GHG) and ranks their performance in each category and overall. The CCPI uses a standardized framework to compare the climate performance of 63 countries and the EU, which together account for over 90% of global greenhouse gas emissions. The 2025 CCPI was published in November 2024, highlighted that progress in reducing global emissions remains slow. The CCPI identifies two critical factors – implementation gaps and ambition gaps.

Ireland ranked 29th, up 14 places from the previous period and is classed as a 'Moderate' performer in international performance. In the Renewable Energy Rating, Ireland is ranked at No. 21, the 'Medium' Category.

11.2.3 National Greenhouse Gas Emission and Climate Targets

11.2.3.1 Programme for Government

The Programme for Government 2025 '*Securing Ireland's Future*' was published in January 2025. In relation to climate change the programme commits to:

- Sustained action to tackle the climate crisis; to decarbonise the economy; and harness the digital and AI revolution to deliver effective and modern public services and to grow the economy.
- Build up the two long-term savings funds in preparation for fiscal challenges including demographic changes, climate resilience and dealing with future shocks.
- Commit to fully funding the Future Ireland Fund (FIF) and the Infrastructure, Climate, Nature Fund (ICNF) as set down in legislation.

11.2.3.2 Climate Action and Low Carbon Development (Amendment) Act 2021

The Climate Action and Low Carbon (Amendment) Act 2021 is a piece of legislation which commits the country to move to a climate resilient and climate neutral economy by 2050. This was passed into law in July 2021.

The Programme for Government has committed to a 7% average yearly reduction in overall greenhouse gas emissions over the next decade, and to achieve net zero emissions by 2050. This Act will manage the implementation of a suite of policies to assist in achieving this target.

The Act includes the following key elements, among others:

- Places on a statutory basis a 'national climate objective', which commits to pursue and achieve no later than 2050, the transition to a climate resilient, biodiversity-rich, environmentally sustainable and climate-neutral economy.
- Embeds the process of carbon budgeting into law. Governments are required to adopt a series of economy-wide five-year carbon budgets, including sectoral targets for each relevant sector, on a rolling 15-year basis, starting in 2021.

- Actions for each sector will be detailed in the Climate Action Plan, updated annually.
- A National Long Term Climate Action Strategy will be prepared every five years.
- Government Ministers will be responsible for achieving the legally binding targets for their own sectoral area with each Minister accounting for their performance towards sectoral targets and actions before an Oireachtas Committee each year.
- Strengthens the role of the Climate Change Advisory Council, tasking it with proposing carbon budgets to the Minister.
- Provides that the first two five-year carbon budgets proposed by the Climate Change Advisory Council should equate to a total reduction of 51% emissions over the period to 2030, in line with the Programme for Government commitment.

11.2.3.3 Climate Change Advisory Council 2023

The Climate Change Advisory Council (CCAC) was established on 18th January 2016 under the Climate Action and Low Carbon Development Act 2015. The CCAC aims to provide independent evidence-based advice and recommendations on policy to support Ireland's Just Transition to a biodiversity-rich, environmentally sustainable, climate-neutral, and resilient society.

The Annual Review 2025 is the ninth annual review carried out by CCAC and states that proactive adaptation is urgently needed if Ireland is to improve its preparedness for and response to rapidly emerging climate risks. This must be underpinned by robust climate data and services. The Council recommends that the Government:

- Establish a national climate damage register to monitor and record the economic, social and environmental impacts of extreme events in support of more robust preparedness and planning for future extreme events,
- Provide the necessary funding and support to sustain and improve the national climate observation system, including monitoring of all critical atmospheric, land and ocean variables.

11.2.3.4 Carbon Budgets

The first national carbon budget programme proposed by the Climate Change Advisory Council, approved by Government and adopted by both Houses of the Oireachtas in April 2022 comprises three successive 5-year carbon budgets. The total emissions allowed under each budget are shown in Table 11-4.

Table 11-4: Proposed Carbon Budgets of the Climate Change Advisory Council

	Carbon Budget 1 2021 – 2025	Carbon Budget 2 2026 – 2030	Provisional Carbon Budget 3 2031 – 2035
	All Gases		
Carbon Budget (Mt CO_2eq)	295	200	151
Annual Average Percentage Change in Emissions	-4.8%	-8.3%	-3.5%
The figures are consistent with emissions in 2018 of 68.3 Mt CO_2eq reducing to 33.5 Mt CO_2eq in 2030 thus allowing compliance with the 51% emissions reduction target by 2030			

In terms of the 2030 targets, the Effort Sharing Regulation (ESR) provides two flexibilities (use of EU Emissions Trading System (ETS) allowances and credit from action undertaken in the land use, land use change and forestry (LULUCF) sector) to allow for a fair and cost-efficient achievement of the targets. New Regulations in 2023 mean there are new rules around LULUCF flexibility that incorporates split budgets 2021-2025 to 2026-2030. Additional analyses are needed to estimate the impact of the new rules on flexibilities. In the interim, based on latest LULUCF inventory and projections data, the maximum amount of LULUCF flexibility now projected to be available is 13.4 Mt CO_2eq in the first 5-year period (or 2.68 Mt CO_2 eq per annum), with no flexibility available in the second 5-year period.

11.2.3.5 Sectoral Emissions Ceilings

The Sectoral Emissions Ceilings were launched in September 2022. The objective of the initiative is to inform on the total amount of permitted greenhouse gas emissions that each sector of the Irish economy can produce during a specific time period. The Sectoral Emissions Ceilings alongside the annual published Climate Action Plan provide a detailed plan for taking decisive action to achieve a 51% reduction in overall greenhouse gas emissions by 2030.

Section C of the Climate Action and Low Carbon Development (Amendment) Act 2021 provides the minister with a method of preparing the Sectoral Emissions Ceiling within the bounds of the carbon budget. The Sectoral Emission Ceilings for each 5-year carbon budget period was approved by the government on the 28th of July 2022 and are shown in **Table 11-5** below.

Table 11-5: Sectoral Emission Ceilings 2022

	Sectoral Emission Ceilings for each 5-year carbon budget period ($MtCO_2eq$)	
Sector	2021 – 2025 Carbon Budget 1	2026 – 2030 Carbon Budget 2
Electricity	40	20
Transport	54	37
Built Environment – Residential	29	23
Built Environment - Commercial	7	5
Industry	30	24
Agriculture	106	96
LULUCF[1]	Yet to be determined	Yet to be determined
Other (F-Gases, Waste & Petroleum refining)	9	8
Unallocated Savings	-	-26
Total[2]	Yet to be determined	Yet to be determined
Legally binding Carbon budgets and 2030 Emission Reduction Targets	295	200

1 Finalising the Sectoral Emissions Ceiling for the land-use, Land-use Change and Forestry (LULUCF) sector has been deferred for up to 18 months to allow for the completion of the Land-use Strategy. 2 Once LULUCF sector figures are finalised, total figures will be available.

An overview of the latest emissions data is available from the EPA (EPA Latest Emissions Data, May 2025) and is summarised as follows:

- In 2023, Ireland's GHG emissions are estimated to be 55.82 million tonnes carbon dioxide equivalent (Mt CO_2eq), which is 6.1% lower (or 3.79 Mt CO_2 eq) than emissions in 2022 (62.26 Mt CO_2 eq) and follows a 3.0% decrease in emissions reported for 2022. Emissions are 3.3% below the historical 1990 baseline for the first time in 33 years.
- In 2023 emissions in the stationary ETS1 emissions decreased (17%) and emissions under the ESR decreased (3.5%). When LULUCF is included, total national emissions decreased by 3.8%.
- Decreased emissions in 2023 compared to 2022 were observed in the largest sectors except for transport which showed an increase of 0.3%.
- Emissions per capita decreased from 11.31 tonnes CO_2eq/person in 2022 to 10.34 tonnes CO_2eq/person in 2023. Ireland's average tonnes of GHG/capita over the last ten years were 12.8 tonnes. With recent CSO preliminary 2022 census data showing a population of 5.28 million people and with population projected to increase to 5.67 million in 2030, 6.05 million in 2040 and 6.33 million by 2050, per capita emissions need to reduce significantly. At current per capita emission levels, each additional 500,000 people would contribute an additional 5 million tonnes of CO_2eq annually.

Table 11-6: Provisional greenhouse gas emissions for 2022 and 2023 Ireland (EPA May 2025)

Million tonnes CO2 eq	2022	2023	% change 2022-2023
Agriculture	21.782	20.717	-4.9%
Transport	11.759	11.798	0.3%
Energy Industries	10.003	7.860	-21.4%
Residential	5.753	5.347	-7.1%
Manufacturing Combustion	4.356	4.152	-4.7%
Industrial Processes	2.294	2.155	-6.1%
F-Gases	0.719	0.675	-6.0%
Commercial Services	0.734	0.715	-2.6%
Public Services	0.690	0.671	-2.7%
Waste	0.870	0.844	-3.0%
LULUFC*	3.655	3.895	6.5%
National Total excluding LULUFC	58.960	54.934	-6.8%
National Total including LULUFC	62.616	58.829	-6.0%

*Land Use, Land Use Change and Forestry (LULUCF)

Latest assessment of compliance

The final greenhouse gas emission inventory for 2023 is the third of ten years over which compliance with targets set in the European Union's Effort Sharing Regulation (EU 2018/842) will be assessed. This Regulation sets 2030 targets for emissions outside of the Emissions Trading Scheme (known as ESR emissions) and annual binding national limits for the period 2021-2030. Ireland's target is to reduce its greenhouse gas emissions by at least 42% by 2030 compared with 2005 levels, with a number of flexibilities available to assist in achieving this. The ESR includes the sectors outside the scope of the ETS (such as Agriculture, Transport, Residential, Public Services and Commercial Services and Waste).

Ireland's ESR emissions annual limit for 2023 is 40.52 Mt CO_2eq. Ireland's provisional 2023 greenhouse gas ESR emissions are 42.74 Mt CO_2eq, this is 2.22 Mt CO_2eq more than the annual limit for 2023. This value is the national total emissions less emissions generated by stationary combustion i.e. power plants, cement plants, and domestic aviation operations that are within the EU's emissions trading scheme.

Cumulatively from 2021-2023 and after using the ETS flexibility, Ireland is in compliance with the ESR by a net distance to target of 0.22 Mt CO_2eq, although in 2023 there is an exceedance of 0.29 Mt CO_2eq above its Annual Emissions Allocation with the ETS flexibility. Agriculture and Transport accounted for 75.9.0% of total ESR emissions in 2023. The revised LULUCF Regulation (2023) incorporates new rules around LULUCF flexibilities for the period 2021-2025 and 2026-2030. There is a high degree of uncertainty relating to the availability of the LULUCF flexibility and, if available, the quantity of flexibility in each budgetary period.

The latest projections (May 2025) indicate that currently implemented measures (With Existing Measures) will achieve a reduction of 10% on 2005 levels by 2030, significantly short of the 42% reduction target. If measures in the higher ambition (With Additional Measures) scenario are implemented, EPA projections show that Ireland can achieve a reduction of 22% by 2030, still short of the 42% reduction target.

In terms of the 2030 targets, the ESR provides two flexibilities (use of ETS allowances and credit from action undertaken in the land use, land use change and forestry (LULUCF) sector) to allow for a fair and cost-efficient achievement of the targets. New Regulations in 2023 mean there are new rules around LULUCF flexibility that incorporates split budgets 2021-2025 to 2026-2030. Additional analyses are needed to estimate the impact of the new rules on flexibilities. In the interim, based on latest LULUCF inventory and projections data, the maximum amount of LULUCF flexibility now projected to be available is 13.4 Mt CO_2eq in the first 5-year period (or 2.68 Mt CO_2 eq per annum), with no flexibility available in the second 5-year period.

11.2.3.6 Climate Action Plan 2025

The first Climate Action Plan (CAP) was published by the Irish Government in June 2019 (Government of Ireland, 2019). The Climate Action Plan 2019 outlined the current status across key sectors including Electricity, Transport, Built Environment, Industry and Agriculture and outlined the various broadside measures required for each sector to achieve ambitious decarbonisation targets. The 2019 CAP also detailed the required governance arrangements for implementation including, carbon-proofing of policies, establishment of carbon budgets, a strengthened Climate Change Advisory Council and greater accountability to the Oireachtas. The Government published the second Climate Action Plan in November 2021. The plan contains similar elements as the 2019 CAP and aims to set out how Ireland can reduce our greenhouse gas emissions by 51% by 2030 (compared to 2018 levels) which is in line with the EU ambitions, and a longer-term goal of achieving net-zero emissions no later than 2050. The 2021 CAP outlines that emissions from the Built Environment Sector must be reduced to 5 MtCO_2e by 2030 in order to meet our climate targets. This will require further measures in addition to those committed to in the 2019 CAP. This will include phasing out the use of fossil fuels for the space and water heating of buildings, improving the fabric and energy of our buildings, and promoting the use of lower carbon alternatives in construction.

Following on from Ireland declaring a climate and biodiversity emergency in May 2019 and the European Parliament approving a resolution declaring a climate and environment emergency in Europe in November 2019, the Government approved the publication of the General Scheme for the Climate Action (Amendment) Bill 2019 in December 2019 followed by the publication of the Climate Action and Low Carbon Development (Amendment) Act 2021 (No.32 of 2021) (hereafter referred to as the 2021 Climate Act) in July 2021 (Government of Ireland, 2021b). The 2021 Climate Act was prepared for the purposes of giving effect to the core objectives stated within the CAP.

The purpose of the 2021 Climate Act was to provide for the approval of plans *'for the purpose of pursuing the transition to a climate resilient, biodiversity rich and climate neutral economy by no later than the end of the year 2050'*. The 2021 Climate Act also aimed to *'provide for carbon budgets and a decarbonisation target range for certain sectors of the economy'*. The 2021 Climate Act defines the carbon budget as *'the total amount of greenhouse gas emissions permitted during the budget period'*. The 2021 Climate Act removes any reference to a national mitigation plan and instead refers to both the Climate Action Plan, as published in 2019, and a series of National Long Term Climate Action Strategies.

The most recent published Climate Action Plan is CAP 2025, the third Climate Action Plan to be prepared under the Climate Action and Low Carbon Development (Amendment) Act 2021. The Plan was first published on the 15th April 2025.

Key high impact sectors identified include:

Electricity

With a sectoral emissions ceiling of 40 $MtCO_2eq$. for 2021-2025, the electricity sector requires a 75% reduction in emissions based on 2018 levels by 2030. Through electrification, this sector will play a critical role in decarbonising other sectors, including transport, heating, and industry.

Central to achieving these goals is the strategic increase in the share of renewable electricity to 80% by 2030. This includes ambitious targets of deploying 9 GW of onshore wind, 8 GW of solar power, and at least 5 GW from offshore wind projects. These measures are vital not only for reducing electricity sector emissions but also for enabling the broader electrification of other sectors, thus multiplying the impact on overall emissions reductions.

Climate Action Plan 2025 details the significant actions required to enhance the electricity grid's capacity and flexibility. This will accommodate the significant upsurge in renewable energy while ensuring the system's reliability and efficiency. Additionally, managing electricity demand through innovative policies and technologies is crucial for aligning energy consumption with cleaner production.

11.2.3.7 Greenhouse gas emissions projections

In its approach to decarbonising, the EU has split greenhouse gas (GHG) emissions into two categories, the Emissions Trading System (ETS) and the non-ETS. Emissions from electricity generation and large industry in the ETS are subject to EU-wide targets which require that emissions from these sectors be reduced by 43% by 2030, relative to 2005 levels. Within the ETS, participants are required to purchase allowances for every tonne of emissions, with the amount of these allowances declining over time to ensure the required reduction of 43% in GHG emissions is achieved at EU-level.

Emissions from all other sectors, including agriculture, transport, buildings, and light industry are covered by the EU Effort Sharing Regulation (ESR). This established binding annual GHG emission targets for Member States for the period 2021–2030. Ireland is required to reduce its emissions from these sectors by 30% by 2030, relative to 2005 levels. Under the EU Green Deal, the targets for the ETS and non-ETS sectors will be revised upwards in

order to achieve the commitment, at EU level, to reach an economy-wide 2030 reduction in emissions of at least 55%, compared to 1990 levels.

The Environmental Protection Agency (EPA) publish Ireland's Greenhouse Gas Emission Projections and at the time of writing, the most recent report, 'Ireland's Greenhouse Gas Emissions Projections 2024—2055'[2] was published in May 2025. Key findings include:

- Ireland's Climate Act Ambition: Ireland is not on track to meet the 51 per cent emissions reduction target (by 2030 compared to 2018) based on these projections which include most of the 2024 Climate Action Plan measures.
- Budget period 1 (2021-2025), target of 295 Mt CO2eq is projected to be exceeded by between 8 to 12 Mt CO2eq. Budget period 2 (2026-2030), target of 200 Mt CO2eq is also expected to be exceeded by a significant margin of 77 to 114 Mt CO2eq (with carryover from Budget period 1).
- Sectoral Emission Ceilings for 2030 are projected to be exceeded by the Buildings, Electricity, Industry and Transport sectors; and met by the sector 'Other'.
- Ireland is not projected to meet its EU target, set under the Effort Sharing Regulation, of a 42 per cent emissions reduction by 2030 (compared to 2005) even with flexibilities applied. This assessment shows that greenhouse gas emissions will be reduced by 10 to 22 per cent by 2030 (compared to 2005) without the use of flexibilities and by 13 to 26 per cent with the use of flexibilities.
- Additional measures and accelerated implementation of existing measures is necessary to meet both National and EU targets. Projected gaps to National and EU 2030 targets reported this year are larger than last year due to more conservative delivery of measures and associated estimates of emission reductions by 2030.
- From 21.4 Mt CO2eq in 2018, total emissions from the Agriculture sector are projected to be between 18.0 and 21.6 Mt CO2eq in 2030 (a 16 per cent reduction in WAM and 1 per cent increase in WEM). Without full implementation of all planned policies and measures, there will be a net increase in emissions in this sector by 2030.
- Transport emissions are projected to decrease from 12.3 Mt CO2eq in 2018 to between 9.7 Mt CO2eq and 11.2 Mt CO2eq in 2030 (a 9 to 21 per cent reduction). Measures that are projected to contribute to greater emissions reductions include 640,000 electric vehicles by 2030 and avoid/shift measures such as a 50 per cent increase in daily active travel journeys.
- From 10.6 Mt CO2eq in 2018, emissions from the Energy Industries sector are projected to decrease to between 3.4 and 4.4 Mt CO2eq in 2030 (a 59 to 68 per cent reduction). Renewable energy generation at the end of the decade is projected to range from 60 to 68 per cent of electricity generation.
- Total emissions from the LULUCF sector are projected to increase over the period 2018 to 2030 by between 1.5 and 3.8 Mt CO2eq (an increase of 39 to 95 per cent). It is unlikely with current planned measures that the target set under the EU LULUCF Regulation, and included in Climate Action Plan 2024, will be met.

[2] https://www.epa.ie/publications/monitoring--assessment/climate-change/air-emissions/07875-EPA-GHG-Projections-Report-FINAL.pdf

11.2.4 Local Greenhouse Gas Emission and Climate Targets

11.2.4.1 Limerick Local Authority Climate Action Plan 2024-2029

The Limerick Local Authority Climate Action Plan 2024-2029 recognises that Climate change is increasingly understood to be the most critical, long-term global challenge of our time, with its impacts continuing to be felt both worldwide and at home. There is overwhelming evidence (such as that outlined in the Intergovernmental Panel on Climate Change (IPCC's) Working Group I Sixth Assessment Report) that our climate has changed since the pre-industrial era (roughly 1850-1900) and that the release of greenhouse gas (GHG) emissions through human activities are the principal cause of that change.

Recent extreme weather events have highlighted the vulnerability of individuals, businesses, communities, infrastructure and the environment to climate change, emphasising the need for urgent action across all sectors of society.

It is within this context that Limerick City and County Council has prepared this Climate Action Plan 2024- 2029. It aims to facilitate Limerick's transition to a low carbon and climate resilient County. This will be achieved by delivering and promoting best practice in climate action at local level. This aim is aligned to the Government's overall National Climate Objective, which seeks to pursue and achieve, by no later than the end of 2050, the transition to a climate resilient, biodiversity rich, environmentally sustainable and climate neutral economy.

The scope of the plan covers three key areas:

- Delivering climate action across local authority function and services;
- Influencing and leading climate action across its communities;
- Co-ordinating, facilitating and advocating for climate action.

Part of the Action Plan is to support an increase in renewable energy sources across the county. LCCC will prepare a Renewable Energy Strategy for the County that will include, wind, solar, integrated renewables as well as District Heating, Green Hydrogen, Anaerobic Digestion, including Bio Compressed Natural Gas.

11.3 Climate and Weather in the Existing Environment

There are a total of 25 synoptic stations located throughout Ireland. These stations are operated by Met Éireann. 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 to the proposed development is at Shannon Airport which is approximately 32km north west of the proposed development. The climate of the proposed development is best represented by data collected at this station. The average monthly precipitation, rainfall, and wind speeds for the 30 year period between 1991 and 2020 are summarised in Table 11-7.

Table 11-7: Shannon Airport 1991-2020 Averages

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
TEMPERATURE (°C)													
Mean temperature	6.1	6.3	7.5	9.6	12	14.5	16	15.8	14.1	11.2	8.3	6.4	10.7
SUNSHINE (hours)													
Mean daily duration	1.7	2.4	3.6	5.4	5.9	5.5	4.4	4.6	3.9	3	2.1	1.5	3.7
RAINFALL (mm)													
mean monthly total	103.8	86.7	75.8	62.3	63.1	69.6	75.8	87.6	77.4	95.5	106.6	115.4	1019.7
greatest daily total	38.2	33.8	34.8	40.2	25.0	45.3	39.5	51.0	52.3	36.9	29.4	33.5	52.3
WIND (knots)													
mean monthly speed	10	10.1	9.6	9.2	9	8.5	8.4	8.3	8.4	8.9	9.1	9.7	9.1
max. gust	75	86	63	66	52	51	52	61	58	66	69	83	86
WEATHER (mean no. of days with..)													
snow or sleet	1.5	1.8	1.2	0.3	0	0	0	0	0	0	0.1	1	5.9
hail	3.1	3.4	2.8	2	0.7	0	0	0.1	0.1	0.5	1	2.3	16
thunder	0.9	0.4	0.3	0.3	0.5	0.4	0.7	0.5	0.2	0.3	0.3	0.4	5.2
fog	3.4	2.2	2.4	1.8	1.3	1	0.9	1.6	2.8	3.1	4	3.8	28.3

11.3.1 Climate Change Vulnerability

Changes in Ireland's climate are expected to evolve over time in line with global trends including increasing temperatures, changes in precipitation patterns, and changes in the variability and intensity of storms. This has resulted in flooding events, sea level rise and sea surging events.

The main observed and projected changes in Ireland's climate parameters (National Adaption Framework, 2024) are summarised in Table 11-8 and Table 11-9.

Representative Concentration Pathways (RCPs), referenced in Table 11-9, refer to various scenarios that describe different 21st century pathways of GHG emissions and atmospheric concentrations, air pollutant emissions and land use.

TII's Guidance document PE-ENV-01104 (TII, 2022a) states that for future climate change a moderate to high Representative Concentration Pathways (RCP) should be adopted. RPC4.5 is considered moderate while RPC8.5 is considered high. Representative Concentration Pathways (RCPs) describe different 21st century pathways of GHG emissions depending on the level of climate mitigation action undertaken.

Table 11-8: Observed Climate Change Trends in Ireland

Parameter	Observed
Temperature	• Ireland's temperature has varied in line with global trends with annual average surface air temperature increasing 1.01°C over the last 120 years and 0.7°C when comparing the period 1991-2020 to 1961-1990. The frequency of warm years has increased from the late 1980s to present – with fifteen of the top 20 warmest years on record occurring since 1990.
Precipitation	• Increased annual precipitation of 7% has been recorded between the period 1991-2020 compared to 1961-1990. The decade 2011-2020 has been the wettest on record. Evidence suggests a trend towards increased winter rainfall and decreased summer rainfall.
Wind Speed and Storms	• Increasing wave heights over the last 70 years in the North Atlantic with winter season trends of increases up to 20 cm per decade, along with a northward displacement of storm tracks.
Sea Level and Sea Surface Temperature	• Satellite observations indicate the sea level around the coast of Ireland has increased by approximately 2-3mm per year since the 1990s. • Average sea temperature has risen with measurements at Malin Head showing an increase in average sea temperatures of 0.47°C over the last 10 years when compared to the period 1981-2010. Ocean acidity has also increased between 1991 and 2013.

Table 11-9: Projected Changes in Irelands Climate

Parameter	Projected Change
Temperature	• Ireland's climate is projected to warm incrementally across all future scenarios. Mid-century (2041-2070) annual mean temperatures are projected to increase by 1.08°C (0.59 to 1.72°C – 10th and 90th percentiles) for RCP4.5 and 1.52°C (1.14 to 1.93°C) for RCP8.5. End of century (2071-2100) annual mean temperatures show increases of 1.48°C (1.05 to 2.19°C) under RCP 4.5 and 2.71 °C (1.96 to 3.34°C) under RCP8.5. • The number of summer days (number of days when daily maximum temperature is >25oC) are projected to increase. By mid-century, RCP4.5 projects an increase of 2.97 (0.86 to 5.34) more summer days, while RCP8.5 shows an increase of 4.74 (2.46 to 6.70) more summer days. By end of century, larger increases of 4.08 (1.36 to 6.47) and 11.03 (6.48 to 16.83) are evident for RCP4.5 and 8.5 respectively. • In a national context, the average number of frost days (days when the minimum temperature is below 0°C) are projected to decrease by 16.18 (-22.09 to -8.84) days by mid-century for RCP4.5 and by 21.75 (-27.75 to -15.50) under RCP8.5. The end of century period sees a larger decrease in frost days, with a reduction of 21.10 (-27.20 to -14.99) and 31.42 (-36.95 to -24.71) under RCP4.5 and 8.5 respectively in comparison to the baseline. • The number of icing days (days when maximum temperature is lower than 0oC) is projected to decrease. -0.24 (-.36 to -0.10) days change from the baseline for RCP4.5 by mid-century, and -0.30 (-0.36 to -0.20) in RCP 8.5. For end of century, the change from the baseline goes to -0.30 (-0.36 to -0.19) -0.36 (-0.37 to -0.33) days for RCP4.5 and 8.5 respectively.
Precipitation	• Precipitation projections are more variable than temperature variables. Projected changes in summer precipitation by mid-century -1.79% (-12.54 to 8.68%) and 5.51% (-15.62% to 4.85%) for RCP4.5 and 8.5 respectively. End of century projections indicate changes of -1.97% (-12.86 to 6.82%) of precipitation for RCP4.5 and -7.28% (-2.76 to 6.57%) for RCP8.5 during the summer months. On an annual basis, end of century projections under RCP4.5 indicate changes in precipitation of 5.04% (0.3 to 9.87%) in reference to the baseline and 8.92% (1.21 to 15.96%) for RCP8.5. • Projections for heavy precipitation events are expected to increase annually with the number of days above 20mm increasing by 1.15 (0.06 to 2.44) days by mid-century for RCP4.5 and 1.69 (0.62 to 2.87) under RCP8.5.
Wind Speed and Storms	• Mean 10-m wind speeds are projected to decrease for all seasons by mid-century. The decreases are largest for summer months under the very high GHG emissions scenario (RCP8.5). The summer reductions in 10-m wind speed range from 0.3% to 3.4% for the intermediate GHG emissions scenario (RCP4.5) and from 2% to 5.4% for the very high GHG emissions scenario (RCP8.5).
Sea Level and Sea Surface Temperature	• Projections of sea level rise varies substantially around the coast of Ireland. Areas of the extreme southwest are likely to experience the largest increases in sea level at a rate of 3.3-4.8 mm per year and areas of the northeast coast are likely to experience sea level rise at a rate of 2.2-3.7 mm per year. Due to a limited understanding of some of the important effects driving sea level rise a best estimate of future upper bound for sea level rise cannot be provided with confidence. • The seas around Ireland are projected to continue to warm. Projected changes for the Irish Sea indicate a warming for all seasons with the highest in Autumn and lowest in Spring. Due to a limited number of climate model projections, projected changes remain uncertain.

The EPA's Critical Infrastructure Vulnerability to Climate Change report (EPA, 2021) assesses the future performance of Irelands critical infrastructure when climate is considered. With respect to energy infrastructure, in particular wind turbines, extreme winds are considered to represent medium risk and snow storms and flooding low risk. Based on the assessment conducted, the projected change in extreme winds is likely to be a major challenge for the energy infrastructure sector. A projected increase in the frequency of extreme wind events has the potential to have an impact on the above-ground distribution and transmission infrastructure.

11.4 Assessment of Impacts

11.4.1 Construction Phase

11.4.1.1 GHG Emissions

The construction of turbines, site tracks and other onsite infrastructure (as outlined in Volume II, Chapter 02 Description of the Proposed Development and Volume II, Chapter 04 Civil Engineering of this EIAR) will require the removal and reinstatement of soils, trees, hedgerows, construction materials, and the operation of vehicles and plant at the Proposed Development. Embodied carbon is carbon dioxide emitted during the manufacture, transport and construction of building materials, together with site activities. The most significant proportion of carbon emissions tend to occur during the construction phase as a result of embodied carbon in construction materials and emissions from construction activities. Detailed project information including volumes of materials can be found in Volume II, Chapter 02 Description of the Proposed Development of this EIAR. Also detailed in Volume II, Chapter 02 Description of the Proposed Development of this EIAR is the proximity of concrete/aggregate facilities capable of supplying the required construction materials. While these are the most likely sources of materials, other suppliers may also need to be utilised to source materials during the construction stage.

The selected quarries have been chosen to provide an estimate of the distance likely to be travelled to the proposed project site for materials. Estimates have been made of the required construction phase materials (turbine foundations, electricity substation and TDR works areas), these include approximately:

- 167,592m³ Granular material (some of which will be available form an onsite source)
- Steel reinforcement (2,882 tonnes)
- Precast Concrete Beams for Bridge Supports and joint bays along the grid connection route
- Concrete (35,586m³)

The predicted embodied emissions can be averaged over the full construction phase and the lifespan of the project to give the predicted annual emissions to allow for direct comparison with national annual emissions and targets. Emissions have been compared against both Ireland's Carbon Budget 2026-2030 of 200 Mt CO2eq and the industrial sector carbon budget for 2026 – 2030 (24 Mt CO2eq).

The GHG emissions associated with the loss of c. 14.4ha of forestry and 1,578m of hedgerow have been included within the calculations under the construction and installation process. During construction the loss of forestry will be minimised where possible.

The total construction phase embodied emissions totals 21,413.9 tonnes CO2eq; which equates to 0.0003% of Ireland's 2030 GHG emission target when annualised over the lifespan of the proposed project. The likely effect on climate will be considered cumulatively across the lifespan of the project.

Table 11-10: Source and Construction Phase Embodied Emissions

Source	Construction Phase Embodied Emissions (tonnes CO_2eq)
Materials (excl wind turbine manufacture)	18,665
Material Transport	361.8
Clearance	5.1
Land Use Change and Vegetation Loss (Forestry)	1,445.4
Excavation	334
Plant Use	61.8
Construction Worker Travel to site	204.9
End of Life/Deconstruction	334.9
Total	21,413.9
Annualised over lifespan	611.8
Total Annual Emissions as % of Irelands 2030 GHG emission target	0.01
Total Embodied Carbon Emissions as % of the 2030 Industry budget	0.09
Total Annualised Emissions as % of Irelands 2030 GHG emission target	0.0003
Total Annualised Embodied Carbon Emissions as % of the 2030 Industry budget	0.003

Note- This value does not include for energy generation from turbines during the operational phase or embodied energy during the construction phase

Wind Turbine Manufacture

The proposed project will involve the erection of 17 no. wind turbines with an output capacity of 76MW. For the purposes of this assessment, a capacity factor for wind generation of 35% was used, based on information provided in the SEAI Community Energy Resource Toolkit for Onshore Wind, August 2024. On this basis, the expected electricity production is expected to be c. 233 GWh per annum.

The lifecycle assessments output information provided by manufacturers vary but all of the potential turbines have a payback period or a value for carbon emissions per kWh produced. The lifecycle assessment payback period is estimated to be 0.8 years. The lifecycle assessments provided by the manufacturer provides a detailed review of all embodied carbon and processes within the manufacturing with far greater detail of specific components and activities compared to what could be completed using a carbon tool such as the TII tool. For this reason, the published data from the manufacture is utilised when assessing turbine manufacturing.

11.4.1.2 Climate Change on the Proposed Development

Potential for changes to long-term seasonal averages of wind speed, rainfall and temperature as a result of climate is not considered to be significant during the construction years (construction to be undertaken within 10 years). Thus, in line with the methodology outlined in **Table 11-1**, **Table 11-2** and **Table 11-3**, the likelihood of extreme weather and flooding in the years 2028 and 2029, during the construction phase, is assessed to be of medium likelihood (i.e occurring a limited amount of times rather than several) and with a minor adverse effect leading to a not significant impact.

Taking the above into account, consideration will still be given to the project's vulnerability to climate impacts during the construction phase and the contractor will manage the risk of climate change effects such as flooding, warm/cold weather events, storms and include management strategies in risk assessments and method statements, refer to **Section 11.4.4.1**.

In the absence of mitigation, the effects of climate change on the proposed development during the construction stage are therefore likely to be **adverse, not significant, temporary** and **direct**.

11.4.2 Operational Phase

11.4.2.1 Carbon Savings and Losses from the Wind Farm

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 emissions. However, there will be some carbon losses due to the manufacturing process of the wind turbines.

In order to demonstrate that the carbon savings will significantly outweigh any potential carbon losses, a methodology made available by the Scottish Government in an excel worksheet titled '*Calculating carbon savings from wind farms on Scottish peatlands'* was applied to this development (see Carbon Calculator (EIAR **Volume III**, **Appendix 11A**)).

As discussed earlier, this is an established methodology which has been approved by the Scottish government and Scottish Environmental Protection Agency (EPA). Submissions made by 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.

Clear felling of forestry and hedgerows is required to facilitate accommodation works, turbine access tracks, hard standings and the on-site substation. The carbon losses over the lifetime of the development are calculated from the area to be felled and the average carbon that would have been sequestered annually. The tool provides an option for calculation of tree removal carbon however does not include hedgerow removal. For the purposes of this assessment, a conservative approach will be taken and the area of hedgerow to be removed is input as a felled forestry area. The total felled area requiring planting is therefore taken as 14.56ha (incl hedgerows).

There was no peat mapped on the GSI maps for the site (as seen in **Volume II**, **Chapter 08** Land and Soils of this EIAR). During a site walkover a small area of peaty type soil was noted in the north-eastern corner of the site. Site investigations found small patches of peat of less than 0.8m depth at T1, 0.25m at T2 and 0.3m at T4. The potential peat volumes to be excavated are c. 4351m^3.

The turbine dimensions for the Ballinlee Wind Farm will have tip height of 160m with rotor of 136m diameter. There will be one turbine (T6) with a tip height of 150m with same rotor size. As part of indicating the likely beneficial environmental effects on the climate, it is considered that the proposed wind turbines will have an assumed rated electrical power output in excess of 76 megawatts (MW).

The capacity factor of a wind farm takes into account the intermittency of the wind and is based on average wind speeds. The wind capacity factor of 35%[3] is subject to weather conditions over a full year period.

Table 11-11: CO_2 Losses due to the Proposed Development

Source	CO2 Losses (tonnes CO_2 equivalent)
Losses due to turbine life (e.g. manufacture, construction & decommissioning)	63,529
Losses due to reduced carbon fixing potential	867
Losses from soil organic matter	14,846
Losses due to DOC & POC leaching	76
Losses due to felling forestry	6,727
Total	86,046

The calculations show 86,046 of CO_2 equivalent losses over the 35-year life span for the 4.5MW turbines.

The calculation spreadsheet uses counterfactual emission factors to calculate the payback period. There is no clear guidance on the appropriate emission factors to use in Ireland. A grid mix emission factor of 0.375 t CO_2 MWh-1 sourced from the SEAI document '*Energy Related CO_2 emissions in Ireland 2005 to 2018*' was used as the counterfactual emission factor. This resulted in a payback time of 1 year. Therefore, for the remaining 34 years of operation the proposed development will be directly responsible for significant carbon saving. The wind farm will save approximately 87,956 tonnes CO_2 per year with a total of 3,078,460 tonnes over the development lifetime.

Once operational, there will be no direct emissions to the atmosphere from the development, except for vehicles which will periodically visit the proposed development site for maintenance, however emissions associated with this low level of vehicles are considered insignificant. The carbon calculations demonstrate that significant CO_2 will be offset by the proposed development and will further assist Irelands CO_2 reduction commitments under the Paris Agreement and Ireland's Climate Action Plans 2025. The electricity generated will assist to displace electricity otherwise generated from coal, oil and gas fired power plants, thus reducing emissions from these power plants.

In the context of the proposed project, there will be a **long-term**, **moderate**, **positive** effect.

11.4.2.2 Climate Change on the Proposed Development

Climate adaptation seeks to ensure adequate resilience of major projects to the adverse impacts of climate change, such as increased flooding or droughts. Mitigation, on the other hand, seeks to reduce the emissions of GHGs by implementing low-carbon energy options. Adaptation during the operational phase of the proposed development aims to ensure potential climate change impacts will not significantly impact the operational phase.

A risk assessment has been conducted for potentially significant impacts on the proposed development associated with climate change. The risk assessment assesses the likelihood and consequence of potential impacts occurring and then provides an evaluation of the significance of the impact using the framework set out in **Section 11.2**.

<u>Flood Risk</u>

A flood risk assessment has been carried out and is included in **Volume III, Appendix 9B** of this EIAR.

[3] SEAI Community Resource Energy Toolkit, August 2024.

The flood risk assessment indicates that the proposed substation is located within Flood Zone C (low risk probability flooding). The majority of the turbines are located in Flood Zone C. Some of the 17 No. turbines are located within Flood Zone A/Flood Zone B therefore having a high to medium probability of flooding.

To ensure that there is no unacceptable flood risk, the following mitigation measures will be implemented:

a. The design flood level for the proposed substation is the 0.1% AEP MRFS flood level plus 500mm freeboard.

b. The design flood level for the proposed 17 no. turbines is the 1% AEP MRFS flood level plus 300mm freeboard.

The above measures are incorporated into the project design. Once these measures are implemented, risks to the development will not be significant and the proposed development will not have an adverse impact on flooding elsewhere.

Thus, in line with the methodology set out in **Section 11.2**, the likelihood of flood risk impacting on the proposed development during the operational phase is of low likelihood, with a minor adverse effect, leading to a predicted impact of not significant.

Taking the above into account, the effects of flood risk on the proposed development are likely to be **adverse, not significant, long term** and **direct**.

Increased Temperature and Extreme Weather

As outlined in **Table 11-9** at mid-century (2041-2070) annual mean temperatures are projected to increase by 1.08°C (0.59 to 1.72°C – 10th and 90th percentiles) for RCP4.5 and 1.52°C (1.14 to 1.93°C) for RCP8.5. End of century (2071-2100) annual mean temperatures show increases of 1.48°C (1.05 to 2.19°C) under RCP 4.5 and 2.71 °C (1.96 to 3.34°C) under RCP8.5.

Increased temperatures have the potential to cause the temperature of construction materials such as asphalt/bitumen, concrete and steel to increase however most construction materials have a wide service temperature range (i.e. Steel -40°C to 1093°C) and therefore it is not envisaged the integrity of the material would be affected. Furthermore, based on an increase of 0.59 to 1.72°C for RCP4.5 and 1.14 to 1.93°C for RCP8.5, it is considered that the impact of increased temperatures on the proposed development will not be significant.

Thus, in line with the methodology set out in **Section 11.2** the likelihood of increased temperatures impacting on the proposed development during the operational phase is of **medium likelihood**, with a **negligible adverse** effect, leading to a predicted impact of **not significant**.

In terms of extreme weather, the EPA report *'Research of regional climate model projections for Ireland'* is predicting a reduction in storms and wind intensity by mid-century and thus the risk of extreme weather impacting on the proposed development during operation is assessed as medium likelihood and with a minor adverse effect leading to a finding of a not significant impact.

Taking the above into account, the effects of climate change on the proposed development are likely to be **adverse, not significant, long term** and **direct**.

11.4.3 Decommissioning Phase

The lifecycle assessment of turbines includes for decommissioning within the lifecycle assessment and payback period. This period is likely to be a maximum of 8 months. Decommissioning will be agreed with the local authority and undertaken in accordance with the methods set out in **Volume II, Chapter 02** Description of the Proposed Development of this EIAR and given the significant potential for recycling of materials a decommissioning plan

will ensure that waste is diverted from landfill and recycled in line with the most recent guidelines at the time of decommissioning.

11.4.4 Mitigation Measures

11.4.4.1 Construction Phase

The Institute of Sustainability and Environmental Professionals (IEMA) Greenhouse Gas (GHG) Management Hierarchy (IEMA 2020b) will be followed for impact minimisation. The Hierarchy is as follows:

- First Eliminate

- Influence business decisions/use to prevent GHG emissions across the lifecycle

- Potential exists when organisations change, expand, rationalise or move business

- Transition to new business model, alternative operation or new product/service

- Then Reduce

- Real and relative (per unit) reductions in carbon and energy

- Efficiency in operations, processes, fleet and energy management

- Optimise approaches (e.g. technology) and digital as enablers

- If you can't eliminate or reduce, then Substitute

- Adopt renewables/low-carbon technologies (on site, transport etc)

- Reduce carbon (GHG) intensity of energy use and of energy purchased

- Purchase inputs and services with lower embodied/embedded emissions

- The final option is to Compensate

- Compensate 'unavoidable' residual emissions (removals, offsets etc)

- Investigate land management, value chain, asset sharing, carbon credits

- Support climate action and developing markets (beyond carbon neutral)

Embodied carbon of materials and construction activities will be the primary source of climate impacts during the construction phase. Measures to reduce the embodied carbon of the construction works will be implemented as follows:

- A construction programme will be created to allow for sufficient time to determine reuse and recycling opportunities;
- Alignment with requirements under the Local and National Climate Action Plan;
- The replacement, where feasible, of concrete containing Portland cement with a low carbon concrete as per the Climate Action Plan;
- The IEMA mitigation hierarchy will be followed (see above);
- A suitably competent contractor will be appointed who will undertake waste audits detailing resource recovery best practice and identify materials that can be reused/recycled;
- Materials will be reused on site within the new build areas where possible;

- Prevention of on-site or delivery vehicles from leaving engines idling, even over short periods;
- All plant and machinery will be well maintained and inspected regularly;
- Minimising waste of materials due to poor timing or over ordering on site will aid to minimise the embodied carbon footprint of the site; and
- Sourcing materials locally where possible to reduce transport related CO_2 emissions.

Measures (see **Section 11.4.2.2**) have been incorporated into the design of the proposed project to mitigate against the impacts of future climate change. These measures have been considered when assessing the vulnerability of the proposed project to climate change but will be reviewed on a regular basis (every 5 years) to ensure they continue to be appropriate to mitigate the effects of climate change.

The Construction Environmental Management Plan (CEMP) will collate and manage the proposed and agreed mitigation measures, monitoring and follow-up arrangements and management of environmental impacts. The environmental commitments of the project will be managed through the CEMP and will be secured in contract documentation and arrangements for construction and later development stages. The CEMP will mainly address the construction phase. However, where mitigation and monitoring are to continue into the operational and decommissioning, phases, these commitments will be communicated and transcribed into operational process documentation. The CEMP is included in **Volume III, Appendix 2A** of this EIAR.

During construction, the Appointed Contractor will be required to mitigate against the effects of climate change on the proposed development:

- The Contractor will be required to mitigate against the effects of climate change on the proposed development such as extreme rainfall / flooding through site risk assessments and method statements;
- The Contractor will also be required to mitigate against the effects of extreme wind / storms, temperature extremes through site risk assessments and method statements;
- All materials used during construction will be accompanied by certified datasheets which will set out the limiting operating temperatures. Temperatures can affect the performance of some materials, and this will require consideration during construction; and
- During construction, the Contractor will be required to mitigate against the effects of fog, lighting and hail through site risk assessments and method statements.

11.4.4.2 Operational Phase

There are no significant climate effects predicted during the operational phase of the proposed development and therefore no mitigation measures are required.

11.4.4.3 Decommissioning Phase

As stated previously the wind turbines are expected to have a lifespan of 35 years. Following the end of their useful life, the wind turbines may be replaced with a new set of machines, subject to planning permission being obtained, or the site will be decommissioned fully, with the exception of the electricity substation and site tracks and drainage.

Upon decommissioning of the proposed wind farm, the wind turbines will be disassembled and removed off-site for recycling. Turbine foundations will remain in place underground and along with hardstands will be allowed to revegetate naturally. Leaving the turbine foundations and hardstands in-situ is considered a more environmentally prudent option, as to remove that volume of reinforced concrete and stone from the ground

could result in potentially needless environment disturbances such as noise, dust and/or vibration and the associated expenditure of energy of removing them.

A detailed decommissioning plan will be agreed in advance of works taking place with Limerick City and County Council. The plan will include mitigation measures as per the IEMA GHG Management Hierarchy (IEMA 2020b).

11.4.5 Monitoring Measures

11.4.5.1 Construction Phase

There is no monitoring required during the construction stage of the proposed development.

11.4.5.2 Operational Phase

There is no monitoring required during the operational stage of the proposed development.

11.4.5.3 Decommissioning Phase

There is no monitoring required during the decommissioning stage of the proposed development.

11.5 Residual Impacts and Effects

There will be no significant climate residual effects from the construction phase or operational phase of the proposed development. Table 11-12 summarises the climate residual effects associated with the proposed development.

Table 11-12: Climate Residual Effects.

IMPACT (PRE-MITIGATION)	MITIGATION MEASURES	RESIDUAL EFFECT (POST-MITIGATION)					
		QUALITY OF EFFECT	SIGNIFICANCE	SPATIAL EXTENT	DURATION	OTHER RELEVANT CRITERIA	LIKELIHOOD
CONSTRUCTION							
GHG Emissions	See **Section 11.4.4.1**	Adverse	Imperceptible	Extensive	Temporary	Direct	Likely
Climate Change Effects on Proposed Development		Adverse	Imperceptible	Local	Temporary	Direct	Likely
OPERATIONAL							
Climate Change Effects on Proposed Development	See **Section 11.4.4.2**	Adverse	Not Significant	Local	Long-Term	Direct	Likely
Carbon Balance		Neutral	Imperceptible	Extensive	Long-Term	Direct	Likely

11.6 Cumulative Impacts and Effects

With respect to the requirement for a cumulative assessment from greenhouse gas emissions, PE-ENV-01104 (TII, 2022b) states that "as the identified receptor for GHG Assessment is the global climate and impacts on the receptor from a project are not geographically constrained, the normal approach for cumulative assessment in EIA is not considered applicable." However, by presenting the GHG impact of a project in the context of its alignment to Ireland's trajectory of net zero and any sectoral carbon budgets, this assessment will demonstrate the potential for the project to affect Ireland's ability to meet its national carbon reduction target. Therefore, the assessment approach is considered to be inherently cumulative.

The nature of the Proposed Development is such that, once operational, it will have a long-term, moderate, positive impact on climate. During the construction phase of the Proposed Development and other permitted or proposed projects and plans in the area that are yet to be constructed, there will be greenhouse gas emissions arising from production of construction materials (such as cement), and the operation of construction vehicles and plant. These will be restricted to the duration of the construction phase, and as such will give rise to emissions over a short-term duration. However, once emitted to the atmosphere, the greenhouse gas emissions that will arise from construction phase activities will have a permanent imperceptible adverse effect on Climate.

By presenting the GHG effect of a project in the context of its alignment to Ireland's trajectory of net zero and any sectorial carbon budgets, this assessment will demonstrate the potential for the project to effect Ireland's ability to meet its national carbon reduction target. Therefore, the assessment approach is considered to be inherently cumulative.

Having considered the above cumulative/in combination effets of the proposed development, the cumulative impacts on climate during the construction phase are likely to be **neutral, likely short term** and **direct** and during the operational phase are likely to be **positive**, **imperceptible, extensive, long term** and **direct.**

11.7 References

PE-ENV-01104 Climate Guidance for National Roads, Light Rail, and Rural Cycleways (Offline & Greenways) - Overarching Technical Document. TII, 2022a.

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2030 Climate and Energy Policy Framework. European Commission, 2014.

Design Manual for Roads and Bridges: A 114 – Climate. UKHA, 2019.

European Green Deal. European Commission, 2022.

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TII Online Carbon Tool. TII, 2022b.

Environmental Impact Assessment Guide to Climate Change Resilience & Adaptation, IEMA, 2020.

Institute of Environmental Management and Assessment Assessing Greenhouse Gas Emissions and Evaluating their significance (2nd Edition). IEMA, 2022.

Technical guidance on the climate proofing of Infrastructure in the Period 2021-2027. European Commission, 2021a.

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