**Contents**

# 10 CLIMATE

A summary of the relevant legislation in relation to climate is provided in the following sections. As well as greenhouse gas emissions and carbon gains for the proposed project.

## 10.1 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 in the last few decades. Climate change is one of the most challenging global issues 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 biodiversity which 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 fight climate change.

### 10.1.1 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.

Under the Kyoto Protocol, industrialised countries are required to reduce the emissions of six greenhouse gases (CO2, which is the most important one, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride) on average by 5.2 % below the 1990 levels during the first "commitment period" from 2008 to 2012.

Under the Kyoto Protocol, the EU committed itself to reducing its greenhouse gases emissions by 8% during the first commitment period from 2008 to 2012. This target is shared between the Member States under a legally binding burden-sharing agreement, which sets individual emissions targets for each Member State, among which is Ireland.

#### 10.1.1.1 Doha Amendment to the Kyoto Protocol

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

- New commitments for Annex I Parties to the Kyoto Protocol who agreed to take on commitments in a second commitment period from 1 January 2013 to 31 December 2020;
- A revised list of greenhouse gases (GHG) to be reported on by Parties in the second commitment period; and
- Amendments to several articles of the Kyoto Protocol which specifically referenced issues pertaining to the first commitment period and which needed to be updated for the second commitment period.

During the first commitment period, 37 industrialised countries and the European Community committed to reduce GHG emissions to an average of 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. 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.

#### 10.1.1.2 COP21 Paris Agreement

The COP 21 or the Paris Climate Conference led to a new international climate agreement, applicable to all countries, aiming to keep global warming at 1.5°C - 2°C, in accordance with the recommendations of the Intergovernmental Panel on Climate Change (IPCC).

In response to the climate challenge, the agreement recognises that States have common but differentiated responsibilities, i.e. depending on respective capabilities and different national circumstances.

The purpose is to hold the increase in global average temperature to well below 2°C above pre-industrial levels and to ensure that efforts are pursued to limit the temperature increase to 1.5 °C. To achieve this, the Paris Agreement stipulates that all countries shall review their contributions to reducing greenhouse gas emissions every five years. Each new contribution set out on a national level should include a progression compared with the precedent. The Parties committed to reaching a global peak in greenhouse gas emissions as soon as possible, in order to achieve a balance between emissions and their removal in the second half of the century. The States are also required to increase their efforts to mitigate and reduce their greenhouse gas emissions.

#### 10.1.1.3 COP26 Climate Change Conference Glasgow

COP26 took place in Glasgow, Scotland between the 31st October and 12th November 2021. The summit was centred around the fact that “climate change is the greatest risk facing us all.” The UK, as hosts for the summit, have developed a ten point plan to deliver a green industrial revolution, seeking to lead the world in tackling and adapting to climate change.

The key items COP26 seeks to achieve are:

- Secure global net zero by mid-century and keep 1.5 degrees within reach;
- Adapt to protect communities and natural habitats;
- Mobilise finance

New deals and announcements were also made during the COP26:

- Forests: 137 countries took a landmark step forward by committing to halt and reverse forest loss and land degradation by 2030. The pledge is backed by $12bn in public and $7.2bn in private funding. In addition, CEOs from more than 30 financial institutions with over $8.7 trillion of global assets committed to eliminate investment in activities linked to deforestation.
- Methane: 103 countries, including 15 major emitters, signed up to the Global Methane Pledge, which aims to limit methane emissions by 30 per cent by 2030, compared to 2020 levels. Methane, one of the most potent greenhouse gases, is responsible for a third of current warming from human activities.
- Cars: Over 30 countries, six major vehicle manufacturers and other actors, like cities, set out their determination for all new car and van sales to be zero-emission vehicles by 2040 globally and 2035 in leading markets, accelerating the decarbonization of road transport, which currently accounts for about 10 per cent of global greenhouse gas emissions.
- Coal: Leaders from South Africa, the United Kingdom, the United States, France, Germany, and the European Union announced a ground-breaking partnership to support South Africa – the world’s most carbon-intensive electricity producer— with $8.5 billion over the next 3-5 years to make a just transition away from coal, to a low-carbon economy.

- Private finance: Private financial institutions and central banks announced moves to realign trillions of dollars towards achieving global net zero emissions. Among them is the Glasgow Financial Alliance for Net Zero, with over 450 firms across 45 countries that control $130 trillion in assets, requiring its member to set robust, science-based near-term targets.

#### 10.1.1.4 COP27 Climate Change Conference Sharm-el-Sheikh

Held in Egypt, COP27 was dubbed the Africa COP, providing an important opportunity to table issues critical to the continent; and the COP of implementation, where pledges would be translated into action on the ground.

The most important achievement of COP27 was that an agreement was finally reached to establish and operationalise a new loss and damage fund.

COP27 did not progress commitments or show evidence of significant action by countries to further draw down global emissions. By this measure, COP27 was a missed opportunity and potentially a step back.

However, it was encouraging to witness China and the US reopen their conversation on tackling climate change, and to see adaptation dialogues begin on enhancing resilience for 4 billion people living in the most climate-vulnerable communities by 2030.

#### 10.1.1.5 COP28 Climate Change Conference Dubai, United Arab Emirates

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. Concluded that the 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 main outcomes of the COP28 conference were:

- Establishment of a loss and damage fund for countries suffering from the effects of climate change;
- Fossil Fuel Phase-Out and increasement of renewable energy capacity, calling for a tripling of renewable energy capacity globally by 2030; and
- Mobilization of the private sector to invest in low-carbon and private-resilient projects.

#### 10.1.1.6 COP29 Climate Change Conference Baku, Azerbaijan

The 2024 UN Climate Change Conference (COP29) took place in November 2024 and was characterised by five key expectations:

- All developing counties expected the adoption of a new global climate finance goal.
- The EU, United States and small islands states sough a strong platform to push for higher ambition of emission reductions and advance the global energy-related targets agreed in COP28.
- The EU especially wanted to finish rules for the Paris agreement offset mechanisms.
- China, India, Saudi Arabia and other major emerging economies wanted to avoid being pushed towards higher mitigation ambition.
- The African states prioritised a strong outcome on adaptation.

The main outcomes of COP29 was named the Baku Climate Unity Pact, comprising the following:

- A new global climate financial goal: It calls on all actors to scale up finance by 2035.
- Mitigation work programme: Proposals and identification of technical options to reduce emissions in cities and encourage collaboration between governance levels. A digital platform, to be designed in 2025, will enable exchanging information on mitigation actions.
- Global goal on adaptation: The Baku Adaptation Roadmap keeps indicators to measure progress towards global resilience permanently in the agenda.

### 10.1.2 European Green Deal – European Climate Law (2021)

The European Green Deal, initially introduced by the European Commission in December 2019, sets out the 'blueprint' for a transformational change of the 27-country bloc from a high- to a low-carbon economy, without reducing prosperity and while improving people's quality of life, through cleaner air and water, better health and a thriving natural world. The Green Deal is intended to work through a framework of regulation and legislation setting clear overarching targets, e.g. a bloc-wide goal of net zero carbon emissions by 2050 and a 55% cut in emissions by 2030 (compared with 1990 levels). This is a substantial increase compared to the existing target, upwards from the previous target of at least 40% (2030 Climate & Energy Framework), and furthermore, these targets demonstrate the ambition necessary to keep the global temperature increase to well below 2°C and pursue efforts to keep it to 1.5°C as per the Paris Agreement.

### 10.1.3 Intergovernmental Panel on Climate Change (IPCC)

The Intergovernmental Panel on Climate Change (IPCC) is the United Nations body for assessing the science related to climate change.

In August 2021, the IPCC released their *Sixth Assessment Report Climate Change 2021: The Physical Science Basis* which categorically states the rise in global temperatures and increase in frequency and severity of natural disasters experienced across the world is related to human activity.

Continued greenhouse gas emissions will lead to increasing global warming, with the best estimate of reaching 1.5°C in the near term in considered scenarios and modelled pathways. Every increment of global warming will intensify multiple and concurrent hazards. Deep, rapid, and sustained reductions in greenhouse gas emissions would lead to a discernible slowdown in global warming within around two decades.

Some future changes are unavoidable and/or irreversible but can be limited by deep, rapid and sustained global greenhouse gas emissions reduction. The feasibility and effectiveness of options increase with integrated, multi-sectoral solutions that differentiate responses based on climate risk, cut across systems and address social inequities.

In 2023 the IPCC published the Sixth Assessment Report (AR6) which confirmed that unsustainable an unequal energy and land use as well as more than a century of using fossil fuels has caused global warming, with a global surface temperature reaching 1.1°C above 1850-1900 in 2011-2020. This has resulted in global impacts and related losses and damages to nature and people. The report also concluded that the earth's temperature will increase by 1.5°C by the first half of 2030 and will continue to increase to 2°C towards the end of the 21st century.

To slow down and eventually stop human-caused global warming, a net zero approach is needed. Rapid mitigation and accelerated implementation of adaptation measures could reduce projected losses and damages to human populations and ecosystems, while resulting in improvements for air quality and health.

#### 10.1.4 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.

Results from the CCPI showed that Ireland is 43rd in the 2024 CCPI, but it has climbed 14 places to 29th in the 2025 CCPI. Ireland receives a medium rating in Renewable Energy, Energy Use, and Climate Policy, but a low in GHG Emissions.

Ireland made significant progress in climate policy with the introduction of legally binding carbon budgets and sectoral emissions ceilings in 2022. However, government implementation remains low with necessary actions and measures delayed or overlooked in many areas.

The country's agricultural policies continue to support intensification of livestock farming, which increases GHG emissions, harms water and air quality, and is a primary contributor to biodiversity loss in Ireland. The CCPI highlight the need to reduce use of reactive nitrogen in fertiliser and to pay for ecosystem services.

Government plans for offshore wind are substantial, and new schemes have been introduced in transport, microgeneration, and energy efficiency. Use of coal in power generation, however, has increased. Energy retrofits and solar photovoltaics are not being delivered at the necessary scale and not reaching those most at risk of energy poverty. Fossil gas infrastructure and gas connections are also still being promoted.

Although hard work still remains to improve the overall CCPI, Ireland is making steady progress towards the set GHG 2030 emissions target compared to a well below 2°C benchmark.

### 10.2 National Legislation and Policy

#### 10.2.1 Climate Action and Low Carbon Development (Amendment) Act, 2021

The Climate Action and Low Carbon Development (Amendment) Act 2021 has been signed into law committing Ireland to 2030 and 2050 targets for reducing greenhouse gas (GHG) emissions and providing the governance framework. The country is on a legally binding path to net-zero emissions no later than 2050, and to a 51% reduction in emissions by the end of this decade.

The key issues collated in the act are:

- A national climate objective is to pursue and achieve no later than 2050, the transition to a climate resilient, biodiversity-rich, environmentally-sustainable and climate-neutral economy;
- The first two five-year carbon budgets proposed by the Climate Change Advisory Council should equate to a total reduction of 51% over the period to 2030, relative to a baseline of 2018;
- The role of the Climate Change Advisory Council has been strengthened;
- The Government must adopt carbon budgets that are consistent with the Paris agreement and other international obligations;
- The Government will determine, following consultation, how to apply the carbon budget across the relevant sectors, and what each sector will contribute in a given five-year period;
- Actions for each sector will be detailed in the Climate Action Plan which must be updated annually;

- 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; and
- Local Authorities must prepare individual Climate Action Plans which will include both mitigation and adaptation measures and will be updated every five years. Local Authority Development Plans must be aligned with their Climate Action Plan.

### 10.2.2 Climate Action Plan

The Climate Action Plan 2023 (CAP 23) is the first updated plan to be published since the introduction of the Climate Action and Low Carbon Development (Amendment) Act 2021. CAP 23 aims to keep Ireland's emissions within its mandatory carbon budget and achieve the legally binding target of reducing emissions by 51% (from a 2018 baseline) by 2030.

The plan aims to reduce emissions and take actions in the following main sectors:

- Reduce by 75% emissions coming from the electricity sector by 2030 through renewable energy infrastructure. Ensure that renewable energy generation projects and associated infrastructure are considered to be in the overriding public interest;
- Work on reducing the built environment emissions by 45% from the commercial buildings and 40% from the residential constructions by 2030. Achieved by using more efficient heating systems and opting for renewable energy sources;
- 25% reduction in emissions of the agricultural sector by 2030 by reducing chemical nitrogen and promoting biomethane produced on farms;
- Reduce by 35% emissions in the industrial sector by 2030 using low carbon substitutions and support emission reduction measures through SEAI;
- Promote sustainable transport initiatives to reduce by 50% emissions of this sector by 2030; and
- Increase Ireland's afforestation and carbon sinks.

The Climate Action Plan 2024 is the third annual update to Ireland's Climate Action Plan. The CAP 2024 sets the course to reduce emissions in half by 2030 and reach net-zero no later than 2050.

The Plan calls for further accelerated action to support Ireland achieving its 2030 targets, mitigate against the worst effects of climate change, build more resilient cities while improving the country's economic competitiveness.

In relation to reducing emissions from the transport sector, the CAP24 highlights the key targets that remain to be achieved which include the reduction by 20% in total vehicle kilometres travelled relative to business as usual, a 50% reduction in fossil fuel usage, a significant behavioural shift from private car usage to increase the total share of journeys undertaken by walking, cycling or public transport.

To achieve this, more policy measures will continue to be proposed to promote greater efficiency in the transport system, along with significant investment in sustainable travel alternatives, incentives and regulatory measures to promote the accelerated take-up of low carbon technologies.

### 10.2.3 Emissions Projections

As noted in Section 10.2.1 above, the Climate Action and Lowe Carbon Development (Amendment) Act 2021 commits Ireland to reduce its overall greenhouse gas emissions by 51% by 2030, compared to 2018 levels and achieving no later than 2050 the transition to a climate resilient, biodiversity rich, sustainable and climate neutral economy.

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 2023—2050' was published in May 2024. The report includes an assessment of Ireland's progress towards achieving its emission reduction targets out to 2030, 2040 and 2050 set under the EU ESD and Effort Sharing Regulation (ESR).

The EPA has produced two scenarios in preparing these greenhouse gas emissions projections: a "With Existing Measures" (WEM) scenario and a "With Additional Measures" (WAM) scenario. These scenarios forecast Irelands greenhouse gas emissions in different ways. The WEM scenario assumes that no additional policies and measures, beyond those already in place are implemented. The WAM scenario assumes that in addition to the existing measures, there is also full implementation of planned government policies and measures to reduce emissions such as those in the 2023 and 2024 Climate Action Plan.

The report shows that when only accounting for the impact of implemented and existing policies, Ireland's total emissions are expected to decrease by 9% in 2030, compared to 2005 levels. Factoring in additional measures, results in a projected decrease in GHG emissions of 25% in 2030 relative to 2005. The projections assume significant emissions reductions in key sectors such as electricity generation, residential buildings, transport, commercial and public services, and agriculture, with full and early implementation of existing policy commitments by 2030.

Under the EPA's projections, emissions in the first two carbon budgetary periods (2021-2025 and 2026-2030) are expected to exceed their limits by a margin of 17-27%, with the sectoral emissions ceilings for both budgetary periods projected to be exceeded in almost all sectors. It also indicates that if all the unmodelled measures in CAP23, and the yet unallocated emissions savings, were accounted for, the projected emissions reduction in 2030 would be 42%, 9 percentage points below our 2030 target.

Targets for 2030 under the ESR include binding annual limits per member state known as "Annual Emission Allocations" (AEAs). The AEAs required updating to reflect the 42% reduction target set in 2023. This is shown in the figure below.

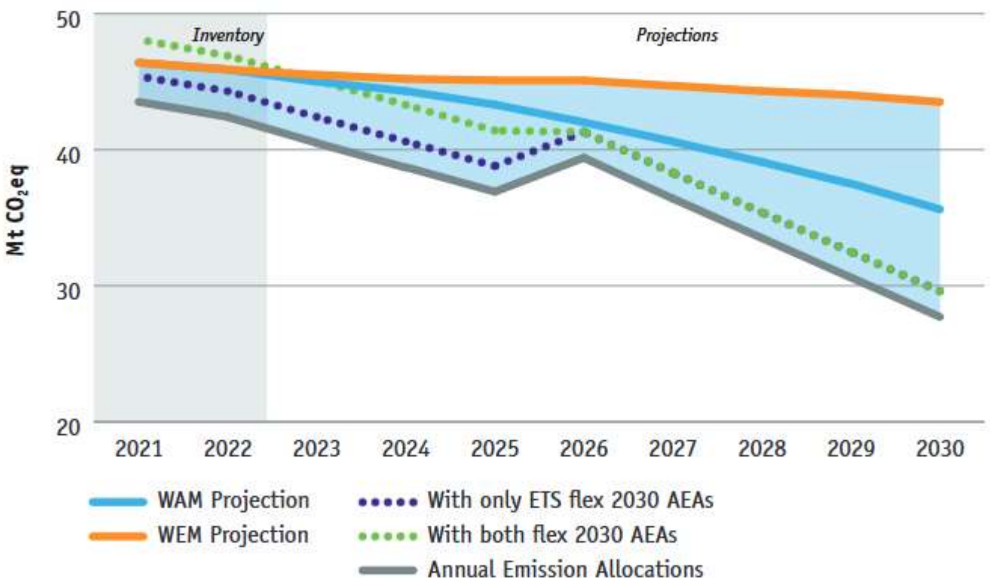


**Figure 10. 1 Projected emissions and Annual Emissions Allocations (AEAs) under the Effort Sharing Regulation for the period 2021-2030 (Source: EPA, 2024)**

Under the WEM scenario, the projections indicate that Ireland will cumulatively exceed its ESR 2021-2030 emissions allocation of 369.4 Mt CO2 eq by 80.3 Mt CO2 eq without the use of flexibilities. Under the WAM scenario, the projections indicate that Ireland will cumulatively exceed the ESR 2021-2030 emissions allocation by 50.1 Mt CO2 eq without the use of flexibilities.

The ESR provides two flexibilities (EU-ETS and LULUCF) to allow for a fair and cost-efficient achievement of the targets. The ETS flexibility available to Ireland for 2021 to 2030 is a maximum of 19.1 Mt CO2 eq (or 1.91 Mt CO2 eq annually).

The report concludes that urgent implementation of all climate plans and policies, plus, further new measures are needed for Ireland to meet the 51% emissions reduction target and put Ireland on track for climate neutrality by 2050.

### 10.2.4 Programme for Government

The Programme for Government was published in October 2020 and last updated April 2021. The programme focuses on different areas to face the impacts and challenges posed by climate change.

In terms of climate governance the programme establishes the commitment to update the Climate Action Plan annually; ensure that the appropriate departments have the capacity and expertise to manage the transition in energy efficiency and renewable energy; review the structure and operations of state agencies that will be responsible for delivery of targets; and work with the European Commission to advance a stronger National Energy and Climate Plan (NECP) for 2030.

In relation to energy, the programme proposes a National Energy Efficiency Action Plan to reduce energy use, including behavioural and awareness aspects of energy efficiency such as building and data management. It proposes to take all the necessary actions to deliver o at least 70% renewable electricity by 2030, as part of a rapid decarbonisation needed to meet the set targets, especially in the energy sector.

The Programme for Government was updated in 2025, and this updated document it includes a section related to climate change and the protection of the environment. It relates Ireland's climate commitments and goals with the UN Sustainable Development Goals (UN SDGs) and details the actions that the government will undertake to reduce the potential impacts of climate change. Some of these actions include:

- Making buildings more sustainable and energy efficient, reducing reliance on fossil fuels and lowering energy costs in households.
- Establishing a clear regulatory pathway, enable network upgrades, improve port facilities and ensure dependable schedule of renewable energy auctions to achieve 80% of Ireland's electricity generation from renewable source by 2030.
- Empower communities in renewable energy and making climate action accessible.
- Launch a roadmap to help industries reduce emissions through investment in efficient, low-carbon technologies.
- Develop and implement policies that promote and support modal change in transport and accelerate the decarbonisation of the sector.

Furthermore, the programme includes an investment plan for the future which includes the transport sector and proposes investing in diverse transport options among which active travel, to enhance the connectivity across urban and rural areas in a more sustainable manner.

## 10.3 Local Plans and Policy

### 10.3.1 Limerick Climate Action Plan 2024-2029

The Climate Action Plan sets out key actions to help County Limerick become more climate resilient while enhancing its biodiversity, becoming greener and more sustainable and achieving climate neutrality by 2050.

The targets of the plan include a 50% improvement in the Council's energy efficiency by 2029; a 51% reduction in the Council's greenhouse gas emissions by 2030; reducing the impacts of future climate change related events; and actively engage and inform the community about the climate actions taken.

The plan accounts for Limerick's emissions and the result show that transport is the third largest contributor to GHG emissions, with an estimated 11% of total emissions. Therefore, careful consideration is given to transition to more sustainable transport modes which require significant investment.

The Plan seeks to reduce the modal split of cars by 50% over its lifetime, pursuing the 50% reduction of the Council's overall GHG emissions. To achieve its objectives, the Plan proposes the following actions:

- Fleet strategy: includes reducing the energy and fuel use within the current fleet, shifting to more sustainable transport modes, public and active travel, and improve energy efficiency through adaptation of new technologies.
- Limerick Shannon Metropolitan Area Transport Strategy: reinforce its objectives to reduce transport emissions by 50% by 2030 through increased use of public transport, walking and cycling, and conversion of the transport fleet to zero emissions vehicles.
- Active Travel: expand and improve the cycling and pedestrian infrastructure as part of the shift to more sustainable transport modes.

The proposed Greenway is in line with the objectives and targets set in the Limerick Climate Action Plan and contributes to the benefits of reducing greenhouse gas emissions by promoting greener travel, cycling environmental benefits by reducing traffic congestion, active travel benefits and health benefits.

### 10.3.2 Limerick City and County Council: Climate Change Adaptation Strategy 2019-2024

The LCCC Climate Change Adaptation Strategy 2019-2024 is a high-level document designed to mainstream the issue of climate change in local authority plans, policies and operations. The overriding objective is to mainstream climate adaptation in all the functions and activities of the local authority.

Following on from the main objective there are a series of climate adaptation themes. Under each theme, there are a number of objectives, each with a number of linked actions. There are six themes in total listed below:

1. Extreme Weather Event Response
2. Land Use and Planning
3. Infrastructure, Built Environment and Service Provision
4. Environment
5. Economic Development Activities
6. Emerging Issues

There are three timeframes associated with the actions, short term within three years, medium term, three to five years and long term, five to ten years.

The report highlights some of the actions that are being undertaken by LCCC to mitigate against the effects of climate change. These include, among others, the changeout of public lighting to energy efficient lighting, development of urban and rural greenways to promote sustainable transport and contribute to a better quality of life, shift to electric vehicles, use renewable energy at LCCC's offices.

## 10.4 Climate and Weather in the Existing Environment

Ireland has a temperate, oceanic climate, resulting in mild winters and cool summers. The World Meteorological Organization (WMO) recommends that climate averages are computed over a 30-year period of consecutive records. The period of 30 years is considered long enough to smooth out year to year variations. Henceforth Met Éireann will reference 1991 to 2020 as the baseline period for day-to-day weather and climate comparisons.

The following table has the climate averages for the closest weather station located at Shannon Airport which is 20km north from the proposed Greenway.

The study area for this chapter is defined considering various levels, global, state and county, and how the project contributes to Limerick City and County Council and Ireland's greenhouse gases emissions accounting as well as supporting their commitment and objectives to reduce the impacts of climate change.

The Zone of Influence (ZoI) for the climate impacts associated with the greenway project encompasses both global and national dimensions. Greenhouse gas (GHG) emissions generated by the project contribute to the cumulative atmospheric concentration of GHGs, influencing climate patterns on a planetary scale. Climate change is inherently a global phenomenon, where the emissions from any single project become part of the collective global impact.

To assess the project's climate impacts in a more localised context, the ZoI also considers the state performance of Ireland concerning GHG emissions. Ireland's Climate Action Plan and sector-specific targets set the framework for reducing national emissions. The project's contribution to climate change is evaluated against key economic sectors.

The regional ZoI is also considered, focusing on the project's role in supporting local climate resilience and sustainable transport initiatives. The reduction of local emissions through increased active travel and decreased vehicle dependency contributes to regional targets within the context of local climate action plans.

Details of the project's contribution can be found in Section 10.5 of this chapter.

**Table 10.1 Data from Met Eireann Shannon Airport weather station averages 1991-2020**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TEMPERATURE (degrees Celsius) | | | | | | | | | | | | | |
| mean daily max | 8.9 | 9.4 | 10.9 | 13.4 | 16 | 18.3 | 19.5 | 19.1 | 17.5 | 14.2 | 11.1 | 9.2 | 14 |
| mean daily min | 3.3 | 3.3 | 4 | 5.8 | 8.1 | 10.8 | 12.6 | 12.4 | 10.7 | 8.1 | 5.5 | 3.7 | 7.4 |
| 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 |
| absolute max. | 14.7 | 15.5 | 19.6 | 23 | 27.8 | 32 | 30.2 | 29.2 | 25.6 | 21.9 | 17.2 | 15.4 | 32 |
| min. maximum | -2.4 | 0.7 | 0.2 | 5.5 | 7.5 | 12.2 | 13.4 | 14.3 | 10.7 | 7 | 0.8 | -6 | -6 |
| max. minimum | 11.5 | 12.2 | 11.7 | 13 | 14.4 | 17.8 | 18 | 18.6 | 17.5 | 16.2 | 13.3 | 12.6 | 18.6 |
| absolute min. | -11.2 | -5.1 | -5.8 | -2.9 | 0.1 | 3.1 | 6.2 | 4.4 | 1.7 | -2.3 | -6.6 | -11.4 | -11.4 |
| mean num. of days with air frost | 5.2 | 4.6 | 3.2 | 0.6 | 0 | 0 | 0 | 0 | 0 | 0.4 | 1.9 | 4.4 | 20.3 |
| mean num. of days with ground frost | 13 | 11.8 | 11.9 | 7.7 | 2.9 | 0.2 | 0 | 0 | 0.8 | 3.3 | 8 | 11.3 | 70.9 |
| mean 5cm soil | 5 | 5.1 | 6.6 | 9.4 | 12.9 | 16 | 17.2 | 16.5 | 14.2 | 10.7 | 7.7 | 5.6 | 10.6 |
| mean 10cm soil | 5.1 | 5.2 | 6.4 | 9 | 12.3 | 15.2 | 16.6 | 16.1 | 14 | 10.8 | 7.9 | 5.8 | 10.4 |
| mean 20cm soil | 5.8 | 5.9 | 7.1 | 9.5 | 12.5 | 15.3 | 16.7 | 16.5 | 14.7 | 11.7 | 8.7 | 6.6 | 10.9 |
| RELATIVE HUMIDITY (%) | | | | | | | | | | | | | |
| mean at 0900UTC | 87.8 | 87.9 | 85 | 79.3 | 76.2 | 76.6 | 80 | 82.3 | 85.1 | 87.4 | 89.9 | 88.9 | 83.9 |
| mean at 1500UTC | 81.2 | 75.4 | 69.8 | 64.1 | 63.5 | 64.6 | 69.3 | 69.1 | 70 | 75 | 81 | 83.5 | 72.2 |
| 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 |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| greatest daily duration | 8.1 | 10.2 | 11.5 | 13.6 | 15.6 | 15.8 | 15.7 | 14.4 | 12.2 | 10.1 | 8.3 | 7.1 | 15.8 |
| mean num. of days with no sun | 9.1 | 5.9 | 5.3 | 2.3 | 1.9 | 1.8 | 2.1 | 2.1 | 2.6 | 5.1 | 7.7 | 10.1 | 56 |
| 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 | 45.3 | 39.5 | 51 | 52.3 | 36.9 | 29.4 | 33.5 | 52.3 |
| mean num. of days with >= 0.2mm | 21.3 | 18.3 | 18 | 16.2 | 16.2 | 15.5 | 18.3 | 19 | 17.7 | 19.9 | 21.6 | 21 | 223 |
| mean num. of days with >= 1.0mm | 16.9 | 13.9 | 13.4 | 11.4 | 12.1 | 11.3 | 13.5 | 13.7 | 12.9 | 15.4 | 16.8 | 17.2 | 168.5 |
| mean num. of days with >= 5.0mm | 7.8 | 5.8 | 5.5 | 4.7 | 4.6 | 4.8 | 4.9 | 5.8 | 4.8 | 7 | 8 | 8.5 | 72.2 |
| 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 |
| max. mean 10-minute speed | 47 | 61 | 44 | 45 | 37 | 37 | 38 | 44 | 44 | 47 | 50 | 57 | 61 |
| mean num. of days with gales | 1.8 | 1.2 | 0.9 | 0.4 | 0.2 | 0.2 | 0 | 0.1 | 0.1 | 0.5 | 0.8 | 1.3 | 7.5 |
| 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 |
| snow lying at 0900UTC | 0.2 | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 | 0.5 |
| 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 |

### 10.4.1 Extreme Weather Events

Historic extreme weather events are recorded and updated in the Limerick City and County Council "Severe Weather" web page (https://www.limerick.ie/tags/severe-weather/articles), where weather alerts and statements are available and accessible for the public, working also as a warning system.

A few of the most recent extreme weather events registered by LCCC are listed in the following table.

**Table 10.2 Extreme weather events registered by LCCC.**

| Extreme weather event | Date | Actions/Measures |
|---|---|---|
| Storm Brian | October 2017 | Yellow wind and rainfall warning<br>Provision of sandbags<br>Deployment of crews after localised flooding in Limerick City |
| Low temperatures | November 2017 | Yellow snow-ice warning and low temperatures<br>Roads under winter road maintenance programme gritted |
| Low temperatures | January 2018 | Red alert for snow and ice<br>Closing of public offices and spaces |
| Storm Emma | February 2018 | Red weather warning<br>Gritting of strategic road network |
| Storm Lorenzo | October 2019 | Orange wind warning<br>Yellow rainfall warning<br>Temporary flood defences deployment |
| Storm Barra | December 2021 | Orange wind warning<br>Yellow rain warning<br>Parks and playgrounds closed<br>Flood defences erected in strategic areas |
| Storm Eunice | February 2022 | Orange weather warning |
| Extreme Heat | July 2022 | Yellow high temperature warning<br>Fire Danger notice<br>Summer ready information page |
| Storm Darragh | December 2024 | Orange wind warning<br>Boardwalk closure |
| Storm Eowyn | January 2025 | Red weather alert<br>Historic storm causing multi-hazard events |

The Office of Public Works (OPW) flood maps (https://www.floodinfo.ie/map/floodmaps/#) has records of past flood events in the Study Area of the proposed Greenway, associated with river floods of the Shannon.

**Table 10.3 Flood events in the Study Area**

| Flood event | Type of Event | Year |
|---|---|---|
| Flooding at Castletroy to Limerick | Recurring flood | 2020 |
| University of Limerick Area | Single flood event | 2009 |
| Castletroy, Limerick | Single flood event | 2009 |
| Plassey to Groody/Shannon Confluence | Single flood event | 2009 |

### 10.4.2 Climate Change Projections

Representative concentration pathways (RCP) portray possible future greenhouse gas and aerosol emissions scenarios. To address uncertainty in future concentrations of greenhouse gases and emissions of aerosols, data made available incorporates two RCPs: RCP 4.5 and RCP 8.5.

RCP 4.5 is described by the Intergovernmental Panel on Climate Change (IPCC) as a moderate scenario in which emissions peak around 2040 and then decline. RCP 8.5 is the highest baseline emissions scenario in which emissions continue to rise throughout the twenty-first century. Therefore, climate change projected under RCP 8.5 will typically be more severe than under RCP 4.5.

These scenarios can be viewed through Climate Ireland along with climate change variables. Climate Ireland works as a research service that connects and integrates scientific research, policy making and adaptation practice for the purposes of enhancing adaptation decision making in Ireland.

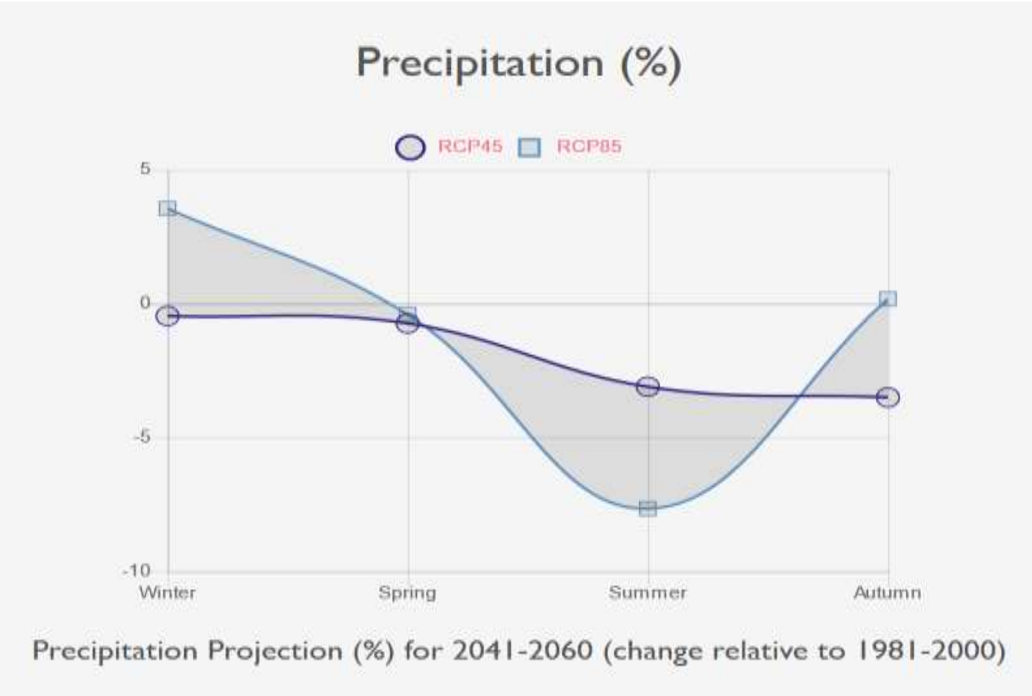


**Figure 10. 2 Precipitation change for RCP 4.5 and 8.5 scenarios (Source: Climate Ireland)**

The RCP 4.5 scenario show a decrease in precipitation for all seasons. While for RCP 8.5 scenario extreme weather events are more evident as there is an increase in precipitation during winter and autumn of 3.6% and 0.17% respectively while there is a severe drop during summer time of -7.67%. The percentage change in number of wet days (>30mm) for the Study Area is between 22.5 and 25%.

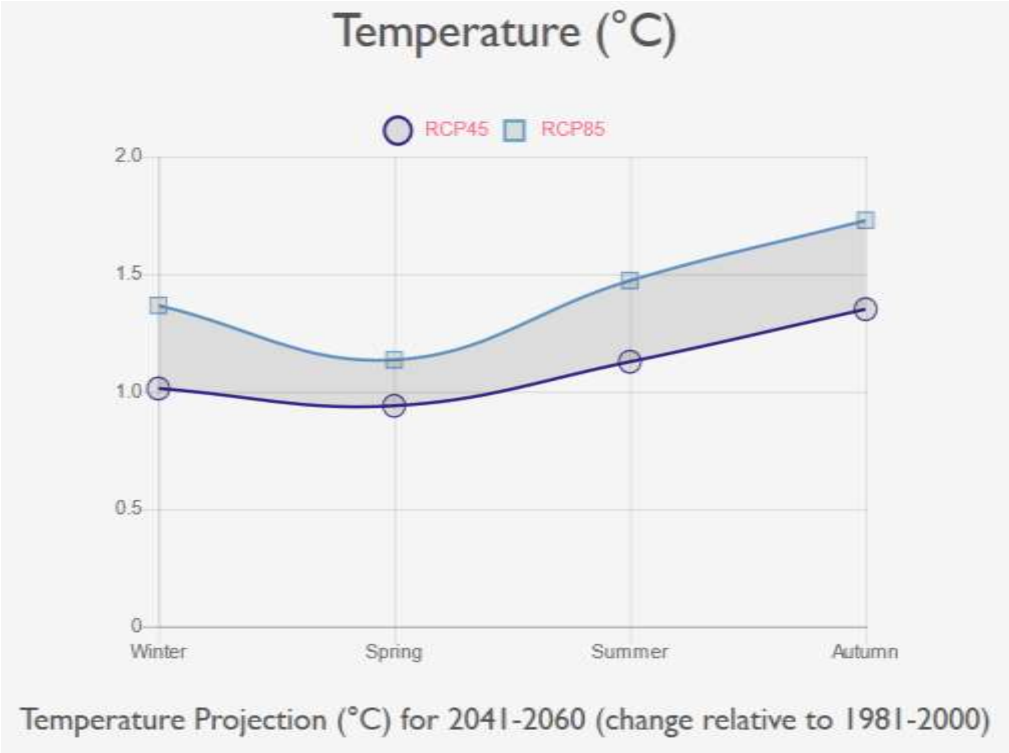


**Figure 10. 3 Temperature change for RCP 4.5 and 8.5 scenarios (Source: Climate Ireland)**

The projected change in average temperature for RCP 4.5 shows an increase of approximately 1°C up to 1.13°C in autumn. The RCP 8.5 scenario predicts an increase of up to 1.73°C for that season. Trends show increased temperatures for the upcoming years for all seasons compared to the 1981-2000 registered temperatures.

Increased temperatures can result in heatwaves which in the Study Area the number of heatwaves will increase between 4 and 6 days for the RCP 4.5 scenario and between 6 and 8 days for RCP 8.5.

### 10.4.3 Climate Risk Assessment for the Proposed Greenway

Climate risks result from four different factors.


**Figure 10.4 Definition of risk based on IPCC AR6**

The IPCC Sixth Assessment Report (AR6) provides standard definitions for each of these factors:

- Vulnerability: is the tendency of the receptors to be affected by climate related hazards. It is a product of:

  - Sensitivity: which is the degree to which the receptors are affected, either negatively or positively by climate change.
  - Adaptive capacity: which is the ability to adjust to potential damage, taking advantage of opportunities or to respond to consequences.
- Hazards: are associated with extreme weather-related events and may cause negative or positive impacts to receptors.
- Exposure: refers to the presence of receptors in places and settings that could be affected.
- Responses: can reduce or increase risks by affecting each of the other factors.

#### 10.4.3.1 Hazards

Severe windstorm events have impacted upon Limerick City and County most frequently over the period 1945-2025, with coastal flooding, river flooding, pluvial flooding and heatwaves affecting the County on a number of occasions. Coastal erosion, cold spells, droughts, heavy snowfall, and groundwater flooding have also impacted Limerick City and County, but less frequently.

Having assessed the range of climate hazards, the Climate Action Plan includes projected changes in the frequency and intensity of climate hazards to understand how existing climate impacts and risks may be exacerbated.

**Table 10.4 Climate hazards for Limerick City and County**

| Hazard type | Projected change | Future frequency |
|---|---|---|
| Heatwaves | Overall increase in temperature between 1.4 and 1.5°C.<br>Under the high emissions scenario heatwaves will become more frequent | ↑ Frequent |
| Droughts | Summer rainfall is expected to reduce, contributing to drought conditions | ↑ Common |
| Cold spell | Decrease in the number of frost days and ice days | ↓ Occasional |
| Heavy snowfall | Annual snowfall in the region is projected to decrease. | = Rare |
| Sever windstorms | There is uncertainty about the projections. By mid-century, there is indication that the average wind speed will remain similar. | = Very frequent |
| Coastal flood | Increase of up to 0.25m by 2050 which will increase frequency of coastal inundation | ↑ Frequent |
| Coastal erosion | A rising sea level is linked to an increase in erosion rates and extent. | ↑ Common |
| Pluvial and fluvial flood | Increase in frequency of heavy rainfall days, resulting in an increase of associated fluvial and pluvial flooding | ↑ Very frequent |
| Groundwater flood | Projected changes are currently not available as there is uncertainty in the change in groundwater flooding frequency | = Occasional |

Based on the climate hazards identified in Table 10.4, a detailed assessment of their potential impacts on the proposed Greenway project has been conducted. In this assessment, river and pluvial flooding have been combined, reflecting their interconnected nature and similar consequences on infrastructure and operations. This combination allows for a more holistic evaluation of flood-related risks.

The focus of this analysis is on hazards with a higher likelihood of occurrence and significant potential to impact the project's construction and operational phases.

#### 10.4.3.2 Vulnerability

Vulnerability is the tendency of the exposed system and its components to be adversely affected. To identify the climate change vulnerability of the project, the extent to which the project is sensitive to climate-related hazards was considered, along with related adaptive capacities. The sensitivity analysis was qualitative in nature and did not involve computation.

**Table 10.5 Sensitivity analysis**

| | Hazards | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Heatwaves | Drought | Cold spells | Heavy snowfall | Severe windstorms | Coastal flood | Coastal erosion | Pluvial and fluvial Flood | Groundwater flood |
| Sensitivity of the project | O | O | x | x | O | O | O | O | x |

O = Sensitive, x = Not Sensitive

The greenway, considering its location along the River Shannon is potentially vulnerable to climate change hazards, particularly due to its exposure and sensitivity to flooding, erosion, and extreme weather events. The greenway's proximity to the river makes it highly exposed to the risk of flooding, especially in the context of increased rainfall and more frequent storm events driven by climate change. Higher river flows, combined with rising sea levels, could lead to more frequent and severe flooding events, damaging the path and surrounding infrastructure. Additionally, the greenway may be sensitive to soil erosion and land degradation, as stronger and more frequent storms can erode riverbanks, affecting the stability of the greenway and its accessibility. These climate hazards may disrupt local biodiversity and recreational use of the greenway, undermining its value as a public space and transportation corridor. Adapting the greenway to these threats will require addressing these vulnerabilities through resilient design, flood defences, and ongoing monitoring to safeguard its long-term sustainability.

#### 10.4.3.3 Risk

The EU published the Commission Notice "Technical guidance on the climate proofing of infrastructure in the period 2021-2027" (2021/C 373/01). Part of the aim of this guidance is to identify the relevant climate hazards for the given specific project type at the planned location.

The risk of a project can be defined as the possibility to suffer negative effects in the future, and it is not constant but rather it is constantly evolving (IPCC, 2012). Since climate change impacts cannot be accurately predicted, generally the "climate risks" are a combination of the likelihood of an impact to occur and the magnitude of these.

***Risk = Likelihood x Magnitude***

The following qualitative and quantitative definitions for Likelihood and Magnitude are an adaptation from the EU Technical Guidance (2021/C 373/01) and the UKCIP (2003)[1].

Likelihood

- 1. Rare: highly unlikely to occur.
- 2. Unlikely.
- 3. Moderate: as likely to occur as not.
- 4. Likely.
- 5. Almost certain.

Magnitude

The magnitude of the consequences are relevant to each of the risk areas considered, as detailed in the table below.

**Table 10. 6 Magnitude of consequences across risk areas**

| Risk areas | Magnitude of consequence | | | | |
|---|---|---|---|---|---|
| | 0<br>Insignificant | 2<br>Minor | 3<br>Moderate | 4<br>Major | 5<br>Catastrophe |
| Asset damage/Engineering | Impact can be absorbed through normal activity | An adverse event that can be absorbed by continuous actions | A serious event that requires additional actions | A critical event that requires extraordinary actions | Disaster with the potential to lead to shut down or loss of the asset |
| Safety and Health | First aid case | Minor injury, medical treatment | Serious injury or lost work | Major or multiple injuries, permanent injury or disability | Single or multiple fatalities |
| Environment | No impact on baseline environment. Localised in the source area | Localised within the site boundaries. | Moderate harm with possible wider effects. Recovery in one year | Significant harm with local effect. Recovery longer than one year. Failure to comply with environmental regulations | Significant harm widespread effect. Recovery longer than one year. Limited prospect of full recovery |
| Social | No negative social impact | Localised, temporary social impact | Localised, long term social impact | Failure to protect vulnerable groups. National, long-term social impacts | Loss of communities. |
| Financial | No financial impact | Financial impact can be absorbed without difficulties | Financial impacts can be absorbed but with greater difficulties | Important financial loss | Great financial loss that results in the loss of the asset |

[1] UKCIP (2003). Climate adaptation : Risk, uncertainty and decision making. UKCIP Technical Report (R.Willows & R.Connell, Eds.). Oxford, UK.

| **Risk areas** | **Magnitude of consequence** | | | | |
|---|---|---|---|---|---|
| | **0 Insignificant** | **2 Minor** | **3 Moderate** | **4 Major** | **5 Catastrophe** |
| Reputation | Localised, temporary impact on public opinion | Localised, short-term impact on public opinion | Local, long-term impact on public opinion with adverse local media coverage | National, short-term impact on public opinion, negative national media coverage | National, long-term impact with potential to affect stability of authorities |
| Cultural Heritage | Insignificant impact | Short-term impact. Possible recovery and repair | Serious damage with wider impact to tourism industry | Significant damage with national and international impact | Permanent loss with resulting impact on society |

The above categories are then combined into a single matrix to obtain the risk.

**Table 10.7 Risk=Likelihood x Magnitude**

| Magnitude \ Likelihood | Score | Rare | Unlikely | Moderate | Likely | Almost certain |
|---|---|---|---|---|---|---|
| Score | | 1 | 2 | 3 | 4 | 5 |
| Insignificant | 0 | 0 | 0 | 0 | 0 | 0 |
| Minor | 2 | 2 | 4 | 6 | 8 | 10 |
| Moderate | 3 | 3 | 6 | 9 | 12 | 15 |
| Major | 4 | 4 | 8 | 12 | 16 | 20 |
| Catastrophe | 5 | 5 | 10 | 15 | 20 | 25 |

| Risk | Quantitative value |
|---|---|
| High | 15-25 |
| Moderate | 8-10 |
| Low | 2-6 |
| Insignificant | 0 |
| Unknown | - |

## 10.4.4 Identified Climate Risks

The following table evaluates the potential impacts of each identified climate hazard specifically for the Limerick City Greenway and related infrastructure.

**Table 10.8 Potential impact description**

| Hazard | Risk area | Potential Impact |
|---|---|---|
| River and pluvial flooding | Asset damage/engineering | Potential flooding of the greenway path, bridges, and complementary infrastructure, causing physical damage and access issues. |

| Hazard | Risk area | Potential Impact |
|---|---|---|
| | Safety and Health | Risk to users' safety, with flooded paths leading to slipping hazards. |
| | Environment | Damage to local ecosystems, especially sensitive areas of Annex I habitats along the riverbanks, including aquatic habitats and riparian vegetation. |
| | Social | Disruption to recreational activities and public transport routes for nearby communities |
| | Financial | Significant costs for repairs and restoration of the greenway following flood events. |
| | Reputation | Public dissatisfaction due to repeated disruptions and lack of flood resilience. |
| | Cultural Heritage | Potential damage to historical or cultural sites along the greenway route and the along the river. |
| Heatwaves | Asset damage/engineering | Overheating of outdoor equipment such as benches, signage, or lighting, potentially leading to wear or failure. |
| | Safety and Health | Increased risk of heat-related illnesses for greenway users, particularly during long periods of direct sun exposure. |
| | Environment | Increased stress on vegetation and wildlife along the greenway, especially for vulnerable species. |
| | Social | Discomfort for users, reduced foot traffic, and possible decreased use of the greenway during extreme heat periods. |
| | Financial | Potential costs for installing cooling infrastructure or shading along the greenway, and repair of heat-damaged elements. |
| | Reputation | Negative public perception due to insufficient cooling measures or lack of accessibility during heatwaves. |
| | Cultural Heritage | Potential damage to historical structures or artefacts along the greenway if they are exposed to extreme temperatures. |
| Droughts | Asset damage/engineering | Reduced water availability may reduce the aesthetic appeal of the site. |
| | Safety and Health | Higher temperatures may increase the risk of heat exhaustion for users, especially those engaging in physical activities along the greenway. |
| | Environment | Dry conditions may affect the health of riverine and riparian ecosystems, including flora and fauna that depend on regular water flow. |
| | Social | Reduced water features may make the greenway less attractive, decreasing recreational use and local engagement. |
| | Financial | Potential costs for maintaining water features or implementing water-saving measures to adapt to drought conditions. |
| | Reputation | Perception that the greenway is underperforming or unattractive during dry periods. |
| | Cultural Heritage | Minimal impact unless heritage areas are depended on local water features for cultural or aesthetic significance. |
| Severe windstorms | Asset damage/engineering | Damage to greenway structures like signage, seating, and trees, potentially obstructing paths or creating debris hazard. |
| | Safety and Health | Increased safety risks from falling debris or trees, leading to injury for users of the greenway. |
| | Environment | Destruction of vegetation and damage to wildlife habitats along the riverbank of the greenway, disrupting local ecosystems. |

| Hazard | Risk area | Potential Impact |
|---|---|---|
| | Social | Temporary closure or restricted access to the greenway for safety reasons, disrupting public access. |
| | Financial | High costs for debris removal, tree clearing, and repairing damaged infrastructure. |
| | Reputation | Negative public perception of the greenway's vulnerability to storms and insufficient resilience. |
| | Cultural Heritage | Windstorm damage could impact historical sites along the greenway and in nearby areas if they are not adequately protected. |
| Coastal erosion | Asset damage/engineering | If erosion affects areas near the river, it could weaken the greenway's path and embankments, causing damage to infrastructure. |
| | Safety and Health | Erosion could compromise the stability of greenway structures near the river, creating safety hazards for users. |
| | Environment | Loss of habitat along the riverbank due to erosion, impacting biodiversity and the overall ecological health of the area. |
| | Social | Reduced accessibility if erosion undermines the path or if sections of the greenway are closed for safety. |
| | Financial | High costs for implementing erosion control measures, such as reinforced riverbanks or re-routing paths. |
| | Reputation | Public concern regarding the long-term viability of the greenway and its environmental management. |
| | Cultural Heritage | Erosion may expose or damage cultural heritage sites along the riverbank. |
| Coastal flooding | Asset damage/engineering | Inundation of sections of the greenway, particularly near low-lying areas along the river, leading to structural damage. |
| | Safety and Health | Flooded areas increasing risks of slips and falls for users, as well as making access difficult for maintenance crews. |
| | Environment | Contamination of river ecosystems from floodwaters, potentially damaging sensitive habitats along the greenway. |
| | Social | Disruption to public access and recreational activities due to flooded areas, reducing community engagement. |
| | Financial | Repair costs following flooding events, along with potential lost income from reduced greenway usage. |
| | Reputation | Damage to the greenway's reputation due to persistent flooding risks and poor management of water hazards. |
| | Cultural Heritage | Coastal flooding may damage or destroy heritage sites near the greenway that are sensitive to water damage. |

**Table 10.9 Overall impact of the essential climate variables and hazards**

| Risk area | Climate variables | Likelihood | Magnitude | Risk |
|---|---|---|---|---|
| Asset damage/engineering | River and pluvial flooding | 4 | 3 | 12 |
| | Heatwaves | 4 | 2 | 8 |
| | Drought | 2 | 2 | 4 |
| | Severe windstorms | 3 | 3 | 9 |
| | Coastal flooding | 4 | 2 | 8 |

| Risk area | Climate variables | Likelihood | Magnitude | Risk |
|---|---|---|---|---|
| | Coastal erosion | 3 | 2 | 6 |
| Safety and Health | River and pluvial flooding | 3 | 3 | 9 |
| | Heatwaves | 3 | 2 | 6 |
| | Drought | 2 | 2 | 4 |
| | Severe windstorms | 3 | 2 | 6 |
| | Coastal flooding | 3 | 2 | 6 |
| | Coastal erosion | 2 | 2 | 4 |
| Environment | River and pluvial flooding | 3 | 3 | 9 |
| | Heatwaves | 3 | 2 | 6 |
| | Drought | 2 | 2 | 4 |
| | Severe windstorms | 2 | 2 | 4 |
| | Coastal flooding | 3 | 2 | 6 |
| | Coastal erosion | 2 | 2 | 4 |
| Social | River and pluvial flooding | 3 | 3 | 9 |
| | Heatwaves | 3 | 3 | 9 |
| | Drought | 2 | 2 | 4 |
| | Severe windstorms | 3 | 2 | 6 |
| | Coastal flooding | 3 | 2 | 6 |
| | Coastal erosion | 2 | 2 | 4 |
| Financial | River and pluvial flooding | 3 | 2 | 6 |
| | Heatwaves | 2 | 2 | 4 |
| | Drought | 0 | 2 | 0 |
| | Severe windstorms | 3 | 2 | 6 |
| | Coastal flooding | 3 | 2 | 6 |
| | Coastal erosion | 2 | 2 | 4 |
| Reputation | River and pluvial flooding | 4 | 2 | 8 |
| | Heatwaves | 3 | 2 | 6 |
| | Drought | 2 | 2 | 4 |
| | Severe windstorms | 3 | 2 | 6 |
| | Coastal flooding | 3 | 2 | 6 |
| | Coastal erosion | 2 | 2 | 4 |
| Cultural Heritage | River and pluvial flooding | 3 | 2 | 6 |
| | Heatwaves | 2 | 2 | 4 |
| | Drought | 2 | 1 | 2 |
| | Severe windstorms | 2 | 2 | 4 |
| | Coastal flooding | 3 | 2 | 6 |
| | Coastal erosion | 2 | 2 | 4 |

As identified in the LCCC Climate Action Plan, river and pluvial flooding, along with coastal flooding pose the highest risks to infrastructure and operational continuity of the greenway. Heatwaves, as they will increase in frequency, can pose a risk to health and safety for the greenway users. These hazards have the potential to damage assets, the surrounding environment and affect the public's perception of the greenway as a climate resilient infrastructure and alternative.

The analysis highlights the necessity of implementing robust adaptation measures tailored to each identified risk. Sustainable drainage systems, structural reinforcement, tree planting scheme, all are valuable measures to safeguard assets and environmental and social health against flooding and other climate hazards.

## 10.5 Carbon Accounting Calculations from the Proposed Greenway

### 10.5.1 Background

The value of the Limerick City Greenway (UL to NTP) cannot be understated. It is a place of congregation, celebration and connections that brings natural ecosystems into the city and links people to nature. Its gardens, trees, provide numerous aesthetic, health and economic benefits to the city. Its natural ecosystems also store a modest, but notable, amount of carbon while providing these community benefits. As the role of nature-based solutions emerge as a critical element of combating climate change, understanding this component of its natural assets will allow the Greenway to better align its operational and educational missions with global climate objectives.

### 10.5.2 Methodology

The assessment evaluates the carbon footprint of the Limerick City Greenway (UL to NTP). The methodology includes the carbon emissions associated with the embodied carbon of the materials that will be used for the construction of the greenway, as well as emissions during the construction phase that involves traffic, machinery used, vegetation clearance, etc. On the other hand, an effort will be made to calculate the carbon savings, through the planting scheme proposed as part of the Greenway design.

Data for the calculations was collected by the project's engineering team, carbon emission factors databases and calculators (Inventory of Carbon and Energy -ICE, DESNZ/DEFRA, Ireland's electricity mix, TII Carbon Calculator Tool, etc.) and guidance from the GHG Protocol. For above ground carbon, various available studies were used, included in the reference section of this report.

#### 10.5.2.1 Guiding principles

These principles will help ensure the credibility and consistency of efforts to quantify and report emissions. They are the principles by which the main carbon calculation guidelines abide to. These principles are listed below.

**Completeness**

All relevant information should be included in the quantification of a project's GHG emissions and in the aggregation of the total GHG footprint. This ensures that there are no material omissions from the data and information that would substantively influence the assessments and decisions of the users of the emissions data and information.

**Consistency**

The quantification of GHG emissions requires that methods and procedures are always applied to a project and its components in the same manner, that the same criteria and assumptions are used to evaluate significance and relevance.

**Transparency**

Clear and sufficient information should be available to allow for the credibility and reliability of reported GHG emissions to be assessed. Specific exclusions or inclusions should be clearly identified, and assumptions should be explained. Appropriate references should be provided for both data and assumptions. Information relating to the project boundary, the explanation of the baseline choice, should be sufficient to replicate results and comprehend the conclusions drawn.

**Conservativeness**

Conservative assumptions, values and procedures should be used. Conservative values and assumptions are those that are more likely to overestimate absolute emissions and "positive" relative emissions (net increases) and underestimate "negative" relative emissions (net reductions).

**Accuracy**

Carbon footprints involves many forms of uncertainty, including uncertainty about the identification of secondary effects, the identification of baseline scenarios, and baseline emission estimates. Therefore, GHG estimates are, in principle, approximate. Uncertainties with respect to GHG estimates or calculations should be reduced as far as is practical. Where accuracy is reduced, the data and assumptions used to quantify GHG emissions should be conservative.

**Relevance**

GHG sources, GHG sinks, GHG reservoirs, data and methodologies appropriate to the needs of the intended user should be selected.

#### 10.5.2.2 Greenhouse Gases included in the assessment

The GHGs included in the footprint include the seven gases listed in the Kyoto Protocol, namely: carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF6) and nitrogen trifluoride (NF3). The GHG emissions quantification process converts all GHG emissions into tonnes of carbon dioxide called CO2e (equivalent) using the Global Warming Potentials (GWP).

**Table 10.10 Global Warming Potentials in $CO_2$ equivalent**

| Greenhouse Gas | $CO_2$ equivalent (GWP) AR5 | $CO_2$ equivalent (GWP) AR6 |
|---|---|---|
| $CO_2$ | 1 | 1 |
| $CH_4$ | 28 | 29.8 fossil origin<br>27.2 non-fossil origin |
| $N_20$ | 265 | 273 |

#### 10.5.2.3 Classification of emissions

Greenhouse gas emissions can be divided into 3 scopes (GHG ,2011):

- Scope 1 emissions: These comprise of emissions that originate on-site. This is either fugitive gases from the site's processes or the combustion of fuels on-site.

- Scope 2 emissions: These emissions originate from the generation of electricity used on-site
- Scope 3 emissions: These are emissions that are out of the control of the facility. These include transport emissions, outsourced services, etc.

### 10.5.3 Project Boundaries

The extent of carbon footprint assessments depends on the boundaries (or scope) defined. Typical boundaries used in footprint calculations are the "cradle to grave" and "cradle to gate". Cradle to grave involves all carbon dioxide equivalent emissions throughout the life of the product. This includes the extraction of raw materials, manufacturing of the product, operation, maintenance, transport and finally the disposal of the product. The "cradle to gate" approach encompasses all the impacts from the extraction of raw materials to the departure of the finished product from the facility.

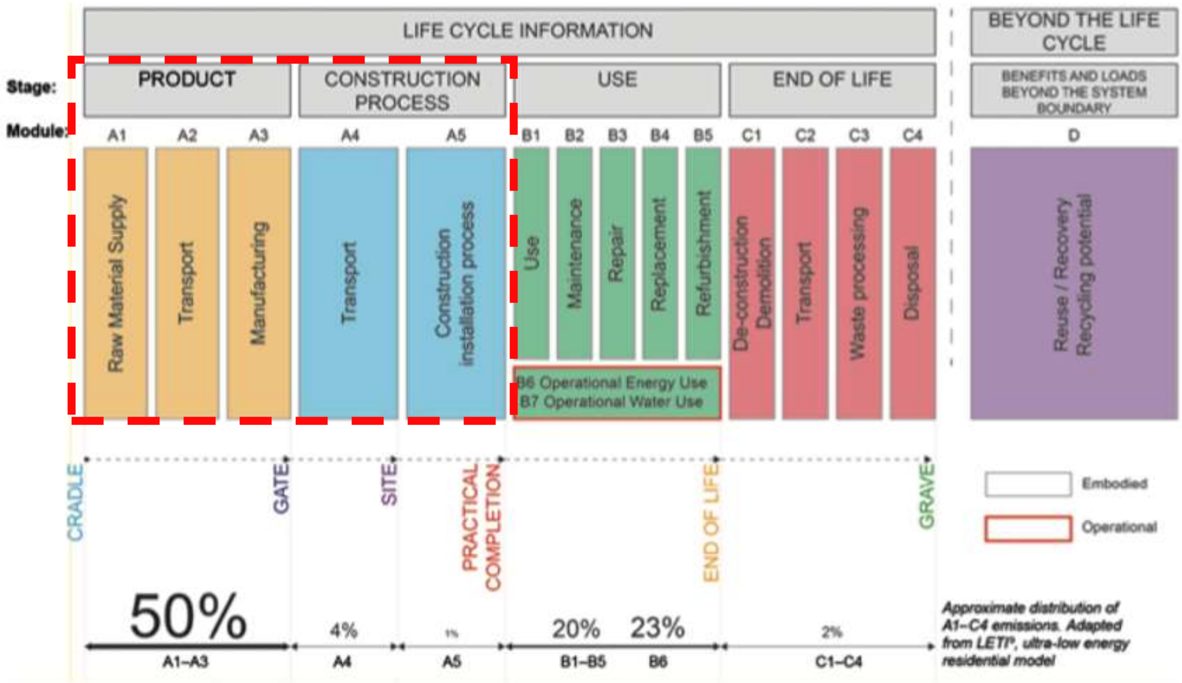


**Figure 10.5 Building life cycle stages considered in EN 15978:2011**

For the Limerick City Greenway (UL to NTP), the stages considered include the embodied carbon for the materials used during the construction and the construction process itself called the "Upfront carbon". The Use stage of the life cycle has been scoped out given the limited information at the time of writing the report and considering that the objective of the greenway is to have net zero carbon during its operation, through the promotion of sustainable transport modes.

Based on **Figure 10.5** above, the stages included in the assessment for the proposed works at the time of writing this report considering the information available, are:

- A1-A3 Cradle to Gate: product stage also known as 'cradle to gate' and modules A1–A3, are carbon emissions (kgCO2e) released during raw material extraction, processing, manufacture (including prefabrication of components or elements), and transportation of materials between these processes until the product leaves the factory gates to be taken to site.
- A4-A5: are associated with the embodied carbon released during the transport of materials/products to the site (A4), the energy usage due to activities on site (machinery use,

etc.), and the carbon emissions associated with the production, transportation, and end of life processing of materials wasted on-site (A5).

### 10.5.4 Carbon Footprint Calculation

A carbon footprint calculation was completed as part of the EIAR, using the Transport Infrastructure Ireland (TII) Carbon Assessment Tool for Road and Light Rail projects (2024) and the ICE Database (2019).

The tools were used to calculate the total embodied carbon for the construction phase of the proposed Greenway in terms of tonnes of carbon dioxide equivalency (tCO2 eq.)

#### 10.5.4.1 Embodied carbon of materials

For the purposes of this report embodied carbon represents the carbon emissions released during the lifecycle of building materials, including extraction, manufacturing and transport to the construction site.

Embodied carbon is calculated as global warming potential (GWP) and expressed in carbon dioxide equivalent units ($CO_2e$).

The main materials considered for the embodied carbon calculations of the proposed Greenway were:

- Gravel;
- Steel;
- Concrete;
- Asphalt products;
- Brick materials.

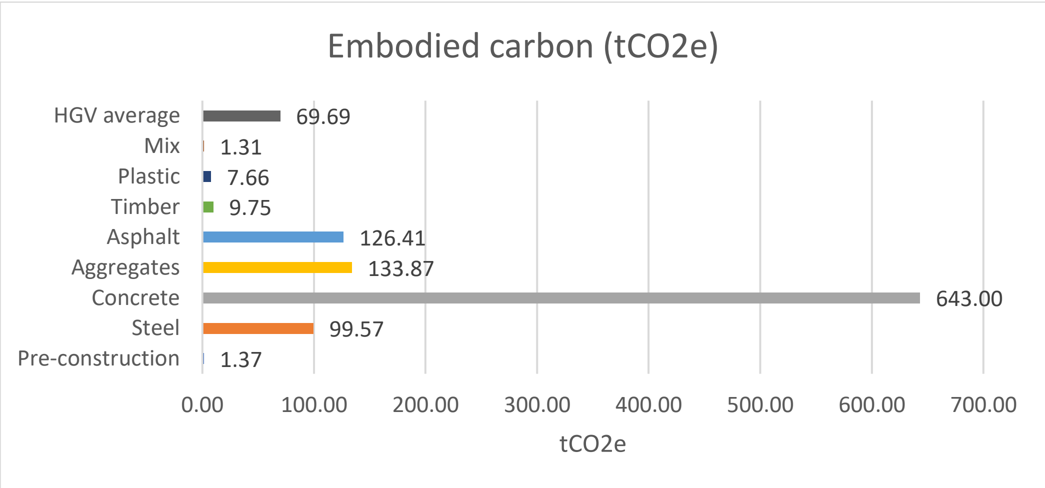


**Figure 10.6 Emissions in tCO2e for the embodied carbon of materials and transport**

The most carbon intensive material is concrete and so it shows in the carbon calculations. Concrete is responsible for more than 58% of the total embodied carbon from the materials considered for the construction of the greenway. Most concrete will come from prefabricated concrete kerbs and precast concrete circular pipework for the French drains. The two other most carbon intensive materials are asphalt (12%) and aggregates (12%). Asphalt will be used in the form of macadam for the proposed Greenway surface and crossings. Aggregates in the form of gravel will be used for the proposed Greenway surfacing. Steel is the next material with significant emissions adding to 10% of the total embodied carbon.

Land use change and clearance was also accounted as part of the embodied carbon calculations, as pre-constructions works. The most clearance will occur in agricultural land (2.8 ha) and resulting carbon emissions add to 1.37 $tCO_2e$.

#### 10.5.4.2 Construction activities

The carbon emissions calculated for the construction activities include the construction processes such as transport, use of machinery, commuting and waste generated as a result of these activities.

For the construction of the greenway, fuel use from machinery which include excavators, dump trucks, tractors, cranes, and a generator make up for 95% of all construction activities' emissions. Total carbon from fuel use results in 371.13 $tCO_2e$.

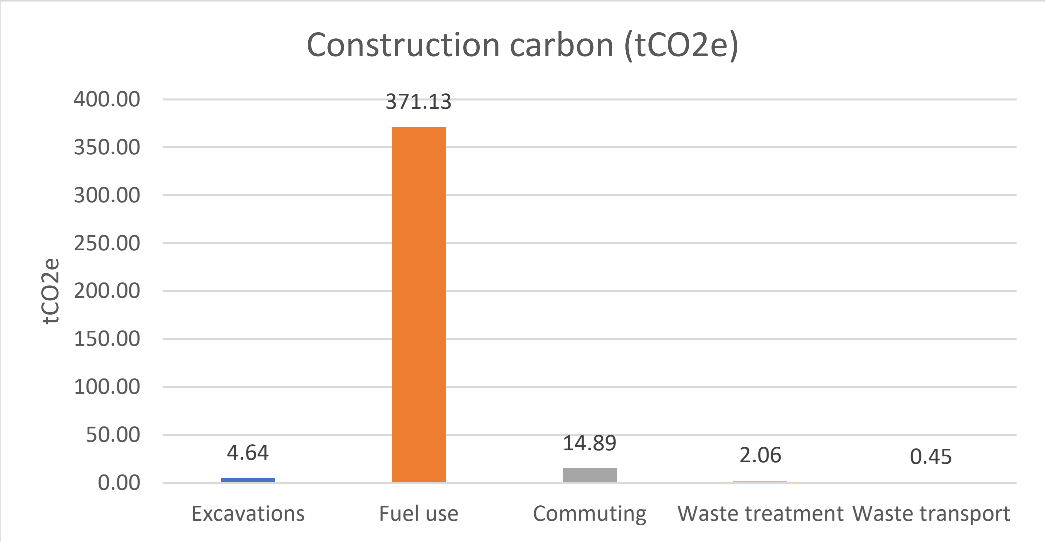


**Figure 10. 7 Construction related emissions**

Commuting makes up almost 4% of construction emissions, with an average commute distance of 16.8 km. Total carbon emissions related to commuting to the construction site was calculated to be 14.89 $tCO_2e$. Excavations make for just over 1% of the total emissions, followed by waste treatment (0.52%) and waste transport (0.11%).

#### 10.5.4.3 Operation

Emissions related to operation of the greenway are linked to energy usage of LED lighting assumed to come from 121 streetlights with 100W LED. This adds to 105,996 khw annual consumption which results in 472.74 $tCO_2e$ for a 20-year lifetime.

#### 10.5.4.4 Summary

The overall carbon footprint for the various screened stages of the Limerick City Greenway (UL to NTP) are presented in Table 10. 11.

**Table 10. 11 Overall carbon footprint for the various screened stages for the proposed green greenway**

| Carbon Footprint - Summary | | |
|---|---|---|
| | tCO2e | % total |
| Embodied carbon | 1092.63 | 55.79% |
| Construction | 393.17 | 20.07% |
| Operation | 472.74 | 24.14% |
| TOTAL | **1,958.54** | |

The embodied carbon of materials is the highest source of emissions, especially related to concrete as seen above. Embodied carbon for the construction of the greenway represents 55.79% of the total carbon emissions. This is followed by the operation over a 20-year life cycle related to energy use of the street lighting along the greenway (24.14%) and finally construction related mostly to fuel use (20.07%).

### 10.5.5 Emission Sectors

In 2023, Ireland's emissions are 1.2% below the historical 1990 baseline for the first time in over 30 years. The latest emission data showed a decreased of 6.8% compared to 2022 which were seen in most of the sectors except for transport which showed an increase of 0.3% (EPA latest emission data, updated July 2024).

#### 10.5.5.1 Manufacturing and Industry sector

In 2023 the manufacturing combustion sector was responsible for 7.5% of Ireland's greenhouse gas emissions or 4.13 Mt CO2e (million tonnes of carbon dioxide equivalent). Emissions from manufacturing combustion decreased by 4.6% or 0.20 Mt $CO_2e$ in 2023 compared to 2022 (EPA, 2023).

The non-metallic minerals related emissions latest data was of 1.09 Mt CO2e which is 26.3% for the manufacturing and industry sector.

The concrete related emissions for the proposed Greenway result in 643 $tCO_2e$ which would be 0.06% of the non-metallic emissions for the sector.

At a county level, according to the LCCC CAP 2024-2029, commercial and manufacturing emissions were 391,858 $tCO_2e$. Considering the concrete related emissions of the greenway project, they would account for 0.16% of the total emissions for this sector at a County scale.

Under the With Existing Measures scenario, emissions from manufacturing combustion are projected to decrease 12% from 4.3 to 3.8 Mt $CO_2e$ between 2022 and 2030. Under the With Additional Measures scenario, emissions from manufacturing combustion are projected to decrease by 32% between 2022 and 2030 to 2.9 Mt $CO_2e$. This scenario assumes further rollout of energy efficiency programmes, the use of biomethane for heat and an increase in carbon-neutral heating in low and high temperature heat in manufacturing.

#### 10.5.5.2 Transport sector

Between 1990 and 2023, the transport sector shows the greatest overall increase of GHG emissions at 129.2%, from 5,143.3 kt CO2e in 1990 to 11,790.8 kt CO2e in 2022, with road transport increasing by 133.6%. Fuel combustion emissions from Transport accounted for 9.3% and 21.4% of total national greenhouse gas emissions in 1990 and 2023, respectively.

This sector accounts for emissions from the combustion of fuel for all transport activity. In 2023, transport GHG increased by 0.3% from 2022. with road transport accounting for 94.7% of all transport emissions. Road transport resulted in 11.2 Mt CO2e in 2022.

Considering fuel combustion from machinery during plant use, transportation of construction materials and construction waste, and commuting for the proposed Greenway, total emissions for these activities were calculated to be 393.17 $tCO_2e$ which represents 0.004% of total road transport emissions.

Locally, at county level, emissions related to the transport sector for Limerick added to 493,548 t$CO_2$e. The greenway project emissions would account for 0.08% of the total emissions for the sector. And in the long-term it would reduce car related emissions and provide a more sustainable transport mode.

Transport emissions are expected to decrease over the period 2022-2030 by 5% with a total of 11.2 Mt $CO_2$e under the WEM scenario while the WAM scenario projects a decrease by 26% in that same period, assuming an increase in electric vehicles and biofuels.

#### 10.5.5.3 Energy

This sector accounts for emissions from fuels combusted in electricity generation, waste to energy incineration, oil and natural gas refining, briquetting manufacture as well as fugitive emissions from oil and gas production, transmission and exploration.

Sectoral emissions show a decrease of 21.6% in 2023 which is attributable to reductions in coal, fuel oil and natural gas use. In 2023 renewables accounted for 40.7%.

Energy industries emissions in 2023 accounted for 7.85 Mt $CO_2$e of which public electricity and heat production were the most emission intensive sectors.

The energy use calculated for the proposed Greenway is associated with the operation phase and related to public lighting along the route. This accounts for 472.74 t$CO_2$e which represents 0.006% of the total emissions for the energy sector.

Considering energy consumed at a residential level in Limerick County, which were recorded to be 434,519 t$CO_2$e (LCCC CAP 2024-2029), the energy related emissions for the greenway project would represent a 0.1% of the total emissions at a county level.

### 10.5.6 Carbon Saving Opportunities

Several strategies can be employed to reduce embodied carbon, including using low-carbon, carbon neutral or even carbon-storing materials. Most carbon-storing materials are plants (wood, hemp, straw, bamboo, algae) that have sequestered carbon during their growth before being transformed into a building material. Additionally, using recycled materials or reclaimed materials can reduce the emissions associated with manufacturing new materials.

By following the World Green Building Council on how the construction industry can reduce embodied carbon emissions, the proposed Greenway design applies the following steps aiming to reduce its overall carbon footprint:

- Measure carbon emissions across all the project's stages;
- Establish a baseline to set reduction targets and set a pathway in line with net zero emissions;
- Adopt best practices by disclosing material selection based on lowest embodied carbon, adoption of Environmental Product Declarations (EPD) from material manufacturers to be used in the selection process;
- Design with a low carbon approach for all the project stages; and
- Lead by example by working towards low carbon and net zero embodied carbon projects.

The best way to reduce embodied carbon is through prevention. Avoiding construction can eliminate the potential for embodied carbon. Through alternative strategies such as increased utilisation of existing assets by renovation or re-use, it can be possible to deliver the same function as a new build and thus eliminating the embodied carbon emissions associated with it. However, if renovation and re-use is not an option, other principles can help reduce embodied carbon during various stages of a building or infrastructure project.

The development of tools and data for calculating embodied carbon are becoming increasingly available and accessible. This includes life cycle assessment-based design tools and product labelling such as Environmental Product Declarations. Using such innovations, it is now possible to calculate embodied carbon upfront and use low embodied carbon materials to 'reduce and optimise' these emissions.

Reducing embodied carbon can be achieved through various approaches and initiatives.

**Reduce the embodied carbon of materials**

- Use the best available low carbon cement as per government policy;
- Consider alternatives to cement stabilisation of groundworks (lime and fly ash mix);
- Specify materials with Environmental Product Declarations (EPD) to encourage manufacturers to measure, report and reduce their carbon footprint.

**Use resources efficiently over their design life**

- Efficient design (measure then reduce the governing utilisation ratio of materials);
- Design to reduce waste and apply circular economy principles;
- Design for durability and adaptability.

Opportunities to reduce embodied carbon of materials come from initiatives that include material selection and manufacturing processes that use alternative raw materials and methods that can cut down the overall greenhouse gas emissions over a project's life cycle.

#### 10.5.6.1 Carbon saving for the Limerick City Greenway

The design of the proposed Limerick City Greenway (UL to NTP) was constructed based on European, national and local policies objectives that aim to reduce GHG emissions to mitigate the effects of climate change through the transition to more sustainable transport modes.

Major potential for modal shift exists amongst commuters with daily journeys of 5 km or less. Ireland's Transport for Net Zero's target is to increase sustainable transport journeys by 500,000 per day. To meet this target 261,218[2] people need to shift from other transport modes, especially cars, to cycling or walking. This adds to 3,696 km per commuter (16.8km per day for 220 working days/year), and a total of 965 million passenger/km (pkt) per year. The avoided greenhouse gas emissions considering this data is reflected in Table 10.12.

**Table 10.12 Avoided carbon due to a modal shift considering Ireland's target**

| Mode of transport | Embodied carbon of trip ($gCO_2e/km$) | Average occupancy | Carbon emissions of trip ($gCO_2e/pkt$) |
|---|---|---|---|
| Car | 170 | 1.5 | 113 |
| Bicycle | 21 | 1 | 21 |
| Avoided carbon ($gCO_2e/km$) | | | 92 |
| Avoided carbon ($tCO_2e/million\ pkt$) | | | 92 |

[2] CSO 2022 data on commuting to work by transport modes.

| | |
|---|---|
| **Avoided carbon ($tCO_{2}e$) if Ireland's targets are met** | 88,780 |

If Ireland's modal transport shift objectives are met, cycling could result in approximately 3% reduction of the total kilometres travelled by car[3], which also contributes to Ireland's overall 20% reduction in total vehicle kilometres travelled relative to business-as-usual (CAP, 2024).

Considering an average of 115 commuters per day (Manton et.al., 2014), over a 20 year lifetime or the proposed Greenway, the total passenger/km would reach 8.5 million (pkt). This could result in a total carbon saving of 782 tCO2e. This would be equivalent to reducing the emissions from over 300,000 litres of fuel consumed and over 100 cars driven in one year.

Both vehicle kilometres and fuel reductions are part of the Climate Action Plan 2024 KPI "*Reduction in Total Vehicle Kilometres and Fuel Usage, and Increase in Sustainable Transport Trips*".

The proposed planting scheme includes 305 trees planted along the greenway route and in areas where planting is possible, at a 5:1 ratio. According to the Tree Council a ten-year-old evergreen tree absorbs 14 kg of $CO_2$ per year. Ireland's forests remove over 6 million tonnes of $CO_2$ every year.

On average trees can absorb approximately 10 kg of $CO_2$ per year for the first 20 years (FLR Carbon Storage Calculator). By taking this average, the first 20 years could potentially sequester 61 $tCO_2$ over that time period[4]. Note that different species grow at different rates depending on their location and environmental factors and have different capacities to absorb carbon dioxide over their lifetime.

In terms of materials, as was seen in the calculations above, concrete is one of the most carbon intensive materials. However, the adoption of precast concrete can reduce carbon emissions. For 1m3 of concrete, the use of precast concrete can result in a c. 10% reduction of carbon emissions (Dong, et.al., 2015).

The Limerick City Greenway (UL to NTP) aids to achieve Ireland's objectives to carbon neutrality though careful consideration of carbon saving opportunities during its design and by promoting an important shift towards more sustainable transport modes and reduce the overall GHG emissions locally, regionally and nationally.

## 10.6 Likely Significant Effects and Associated Mitigation Measures

The classification of impacts in this EIAR will follow the definitions provided in the Glossary of Impacts contained stated in the '*Guidelines on the Information to be contained in Environmental Impact Statements*' (EPA, May 2022) as described in Chapter 1 – Section 1.6.2 of this EIAR.

### 10.6.1 'Do-Nothing'

If the proposed Greenway were not to proceed, no changes would be made to the current land use practice.

If the proposed Greenway were not to proceed, greenhouse gas emissions (carbon dioxide, carbon monoxide and nitrogen oxides) associated with construction vehicles and activities would not arise. However, the opportunity to further significantly reduce emissions of greenhouse gas to the atmosphere would be lost. The opportunity to contribute to Ireland's commitments under the Paris Agreement and the EU law would also be lost, as there would be no contribution to grow the sustainable transport network and reduce traffic associated emissions. This would be a **long-term slight negative impact.**

[3] CSO 2021 road traffic volumes
[4] 305 trees*10kg/tree/year = 3050 kg/year or 3.05t/year. 3.05t/year*20 years = 61 tonnes

### 10.6.2 Construction Phase

The construction of the greenway, site roads and all associated infrastructure is a potential source of carbon emissions to the atmosphere. The carbon footprint of a greenway can be divided into[5]:

- Embodied carbon of materials;
- Transport to site;
- Machinery: site preparation and construction; and
- Loss of carbon from carbon sink.

Construction materials comprise the most embodied carbon of the greenway, therefore the design process is fundamental to avoid these type of emissions. The second source of emissions is transport, followed by construction machinery but these impacts will not be significant as they will be restricted to the duration of the construction phase.

Construction traffic will give rise to some CO2 and N2O emissions during the construction phase of the proposed Greenway. As these emissions will only be associated with the construction phase of the development which will be ongoing for a period of seven months, the impact will be temporary in nature. As specified in Chapter 13 Material Assets, the estimated peak daily volume of construction traffic is 28/day. The increase in greenhouse gas emissions due to the proposed Greenway will result in a potential temporary imperceptible impact on climate.

As set out in Chapter 4 Description, the proposed works have been designed to minimise habitat disturbance and limit tree removal. Approximately 61 trees will undergo tree removal along the Greenway, making sure mature trees are avoided. Tree planting is proposed in existing greenfield sites to compensate for the loss due to tree felling along the route as a direct replacement of the trees and vegetation cleared along that section of the Greenway. Approximately area 305 trees will be planted along the travel path.

During construction, in the absence of mitigation, the risk of flooding of the works area and subsequent risk of sediment transport to surface waters from a flood event presents a potential short term significant negative impact due to flooding as a result of climate change. Mitigation measures are presented in Chapter 8.

OPW National Flood Hazard Mapping shows that almost the entire footprint of the proposed Greenway is within Flood Zone A and several historical flood events have been recorded in the area. However, on review of the Planning System and Flood Risk Management Guidelines for Planning Authorities, a Greenway, cycle path or active travel path falls under the category of development classified as "Amenity, open space, outdoor space and recreation" and is considered a flood compatible development. Considering the local topography, which slopes towards the River Shannon for the extent of the Proposed Works Area, and the designed surface slope of 2.5deg to the river, it is unlikely that surface water would pond on the Proposed Works Area and would discharge to the River Shannon. In addition, there will be shallow drains on the landward side of the greenway to capture surface water and transfer it into drainage culverts under the proposed path towards the river.

Flood risk from surface water to the Proposed Works Area is therefore considered to be low because the path surface will utilise a porous tarmacadam material, and positive drainage channels will be constructed to existing water bodies to manage surface water away from the proposed path. The

[5] Manton, et.al. (2014). Carbon costs and savings of Greenways: Creating a balance sheet for the sustainable design and construction of cycling routes.

proposed path has been designed so possible flood events would result in minimal damage to the local infrastructure. This resilience will be especially important in a climate altered future.

Therefore, it is considered that the construction phase of the Greenway will have **short-term slight negative impact.**

#### 10.6.2.1 Mitigation Measures

- Construction vehicles and plant will be maintained in good operational condition while onsite, minimising any emissions that arise;
- Reuse any excavated soil and demolition waste when possible in the surface layers of the greenway;
- Materials for the construction of the greenway will be obtained from local sources. This will significantly reduce the distance that delivery vehicles will have to travel, therefore reducing the amount of emissions associated with construction traffic; and
- Use of existing road infrastructure where possible, to avoid and reduce the construction of auxiliary roads which contribute to the overall carbon footprint of the proposed Greenway.

#### 10.6.2.2 Residual Impact

**Short-term imperceptible negative impact** on climate as a result of greenhouse gas emissions.

#### 10.6.2.3 Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects to climate change related to the construction of the proposed Greenway.

### 10.6.3 Operational Phase

The proposed Greenway will promote sustainable travel modes, such as walking and cycling. The proposed Greenway will displace GHG emissions associated with fossil fuel-based traffic. It will assist in reducing overall emissions that would otherwise arise from the usual commuting traffic to University of Limerick and its surrounding areas. This translates into a **long-term moderate positive effect.**

#### 10.6.3.1 Mitigation measures

To reinforce the importance of the greenway and the sustainable travel that it supports the following measures are proposed:

- Promote the greenway once constructed to ensure large usage and modal shift; and
- Encourage modal shift from high carbon releasing transport modes to cycling, walking and public transport.
- Access to these greenways by public transport and provision of bicycle hire on site can further improve their carbon efficiency by reducing trips by car.

#### 10.6.3.2 Residual Impact

**Long-term moderate positive impact** on climate as a result of reduce greenhouse gas emissions due to the transport modal shift to more sustainable options.

#### 10.6.3.3 Significance of Effects

Based on the assessment above, there will be long-term, moderate positive effects.

It is worth noting that given an assumed deign life cycle of 20 years for a greenway, 115 commuters travelling an average of 10km/day (Manton et.al., 2014) per year would be required to shift from the car to the bicycle in order to cancel out the carbon footprint of a 10km greenway.

As mentioned in Section 10.5.6 the potential carbon saving for the proposed Greenway over a 20-year lifetime period would be of 782 $tCO_2e$. The proposed Greenway also aligns with Ireland's Climate Action Plan 2024, by reducing the vehicle travelled kilometres and fuel consumption.

Considering that the proposed Limerick City Greenway (UL to NTP) is less than half this daily distance and that it is one of the main connections from Limerick city centre to the University campus, and National Technology Park, it is expected that the minimum commuter number of 115 will be exceeded.

## 10.7 Cumulative and In-Combination Effects

The proposed Greenway will likely overlap during the construction period. Impact on air quality and climate during the construction period are not expected to be significant in nature and therefore do not give rise to significant cumulative effects.

Potential in combination effects on air quality and climate between the proposed Greenway and other projects in the surrounding area were also considered as part of this assessment.

During the construction phase of the proposed Greenway, there will be emissions from construction plant and machinery and potential dust emissions associated with the construction activities of other projects, referenced in Chapter 13 of this report, adjacent to the proposed greenway. Of the most recent projects, three were granted permission in 2022 and one sought permission in Q4 of 2022. Once the mitigation proposals are implemented during the construction phase of these projects, there will be no cumulative negative effect on climate.

Emissions of greenhouse gases during the operation of the planned projects will be related to maintenance operations and activities, lighting and energy consumption. There will be no measurable negative cumulative effect of other projects on air quality and climate.

## REFERENCES

Burk Jan, et.al. (2024). Climate Change Performance Index. RESULTS Monitoring Climate Mitigation Efforts of 60 Countries plus the EU – covering 92% of the Global Greenhouse Gas Emissions. German Watch, New Climate Institute and Climate Action Network International.

Circular Ecology, 2019. Carbon Tool. Embodied Energy and Carbon Footprint Database.

Climate Action and Low Carbon Development Act 2015.

Climate Action and Low Carbon Development Plan (Amendment) Bill 2021.

Climate Action Plan (2023). Government of Ireland.

Climate Action Plan (2024). Government of Ireland.

Climatiq emission factors database.

Central Statistics Office – Census 2022. Commuting to work.

Department for Energy, Security & Net Zero and Department for Environment, Food & Rural Affairs Conversion Factors for Company Reporting 2024.

EC Directive 2013. 2030 Climate and Energy Framework.

EC 2015. Paris Agreement.

EPA (2024). Ireland's Greenhouse Gas Emissions Projections 2023-2050.

European Cyclist Federation. Environmental.

GHG Protocol. The GHG Protocol for Project Accounting. World Business Council for Sustainable Development and World Resources Institute. ISBN 1-56973-598-0.

Government of Ireland (2018). National Planning Framework.

Government of Ireland (2022) Sectoral Emissions Ceilings.

IPCC, 2022: Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press. Cambridge University Press, Cambridge, UK and New York, NY, USA, 3056 pp., doi:10.1017/9781009325844.

IPCC, 2023: Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland, 184 pp., doi: 10.59327/IPCC/AR6-9789291691647

Irish Green Building Council (2022). Building a zero carbon Ireland-A Roadmap to decarbonise Ireland's Built Environment across its Whole Life Cycle.

Kyoto Protocol to the United Nations Framework Convention on Climate Change, Dec. 10, 1997, 2303 U.N.T.S. 162.

Limerick Climate Action Plan 2024-2029.

Limerick City and County Council Physical Development Directorate (July 2019). Climate Change Adaptation Strategy 2019-2024.

Manton, et.al. (2014). Carbon costs and savings of Greenways: Creating a balance sheet for the sustainable design and construction of cycling routes. International Journal of Environment and Sustainable Development. 13.3.10.1054/IJESD.2014.056409.

Met Eireann (1991-2020). Meteorological Data from Shannon Airport Station.

Programme for Government: Our Shared Future (2020). Department of the Taoiseach. Last updated on 7 April 2021.

Regulation (EU) 2021/1119 - adopted by the European Union on 30 June 2021 - establishing the framework for achieving climate neutrality in the European Union (EU).

PAS2080: standard for managing carbon in buildings and infrastructure development.

SEAI emission factors.

Transport Infrastructure Ireland (TII) (2024). Transport Infrastructure Ireland Carbon Tool for Road and Light Rail Projects.