Bonneagar Iompair Éireann
Transport Infrastructure Ireland

NTA
Údarás Náisiúnta Iompair
National Transport Authority

Luas Finglas

Environmental Impact Assessment Report 2024

Chapter 14: Climate

BARRY TRANSPORTATION
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Project Ireland 2040
Building Ireland's Future

Table of Contents

Appendices

List of Figures

List of Tables

GLOSSARY OF FREQUENTLY USED TERMS

Acronym	Term
CAP	Climate Action Plan
CCR	Climate change risk
CH_4	Methane
CO_2	Carbon Dioxide
DCC	Dublin City Council
DECC	Department of the Environment, Climate & Communications
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
ETS	Emission Trading Scheme
EV	Electric Vehicle
FCC	Fingal County Council
GHG	Greenhouse gas
HEV	Hybrid Electric Vehicle
LRT	Light Rail Transit
LRV	Light Rail Vehicle
NAF	National Adaptation Framework
N_2O	Nitrous Oxide
OTD	Overarching Technical Document
PHEV	Plug-in Hybrid Electric Vehicle
SSFRA	Site Specific Flood Risk Assessment
(M)tCO_{2eq}	(Million) Tonnes of Carbon Dioxide Equivalent
TII	Transport Infrastructure Ireland
UNFCCC	United Nations Framework Convention on Climate Change
ZEVI	Zero Emission Vehicles Ireland

SECTION 14: CLIMATE

14.1 Introduction

This Chapter of the Environmental Impact Assessment Report (EIAR) assesses the impact on climate of Luas Finglas (hereafter referred to as the proposed Scheme) during the Construction Phase and Operational Phase. In accordance with the requirements of Directive 2014/52/EU of the European Parliament and of the Council of 16th April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (i.e. the EIA Directive), it describes and assesses the likely direct and indirect significant climate effects of the proposed Scheme. This Chapter also provides a characterisation of the receiving environment within the proposed Scheme and within a wider study area in the vicinity of the proposed Scheme. The EIA Directive 2014/52/EU describes the importance of considering the impact of projects on climate change and on greenhouse gas (GHG) emissions within EIAs: "*Climate change will continue to cause damage to the environment and compromise economic development. In this regard, it is appropriate to assess the impact of projects on climate (for example greenhouse gas emissions) and their vulnerability to climate change.*"

The provision of a more sustainable mode of transport in the area as a result of the proposed Scheme will facilitate a reduction in congestion, reduced greenhouse gas (GHG) emissions and associated air quality improvements along the proposed Scheme, resulting in enhanced community wellbeing. The delivery of the proposed Scheme will also aid in contributing to the national target of 500,000 additional trips by walking, cycling and public transport per day by 2030 as outlined as a target in the Climate Action Plans 2021, 2023 and 2024.

The objectives of the proposed Scheme are described in Chapter 1 (Introduction) and the proposed Scheme is described in Chapter 5 (Description of the proposed Scheme). The assessment is based on a reasonable worst-case scenario with respect to potential impacts arising from the proposed Scheme. The description of the proposed Scheme is based on the design prepared to inform the planning stage and to allow for a robust assessment as part of the Environmental Impact Assessment (EIA) Process.

This chapter should be read in conjunction with the following chapters, and their appendices, which present related impacts arising from the proposed Scheme and proposed mitigation measures to ameliorate the predicted impacts:

- Chapter 5 (Description of the proposed Scheme);
- Chapter 6 (Construction Activities);
- Chapter 7 (Human Health);
- Chapter 8 (Population);
- Chapter 10 (Water);
- Chapter 11 (Land and Soils);
- Chapter 13 (Air Quality);
- Chapter 18 (Material Assets: Traffic and Transportation);
- Chapter 19 (Material Assets: Resource and Waste Management);
- Chapter 21 (Landscape & Visual Amenity); and
- Chapter 22 (Risk of Major Accidents and Disasters).

Thirty-eight million passenger journeys were made on Luas in 2022 with an average 120,000+ passenger journeys made each day. Modern LRTs are one of the most environmentally friendly and energy-efficient forms of public transport, with zero emissions at the point of use. The existing Luas network and its continued expansion has the potential to reduce commuter's carbon footprint and prevent chronic road congestion, helping to meet the carbon emissions goals set out in the Climate Action Plans (TII Climate Action Roadmap, 2023).

The proposed Scheme will impact positively on the climate by improving transport emissions by providing a frequent reliable, high capacity, electrified rail service and connected with an increase in cycle-LRT trips

contributes to the modal shift away from private cars, thereby improving transport emissions, and working towards achieving Ireland's carbon emissions reduction targets.

A Greenhouse Gas Emissions (GHG) assessment has been undertaken to identify the impact of GHGs arising due to the proposed Scheme during its lifetime and addresses how the proposed Scheme will affect the ability of the Government to meet its carbon reduction targets. The potential impacts associated with the Construction Phase of the proposed Scheme have been assessed, including all temporary construction activities such as demolitions, excavations, trackout, construction methods, construction materials, etc. The potential impacts associated with the Operational Phase of the proposed Scheme have taken into account the predicted changes in traffic flows on road links in proximity to the proposed Scheme and due to the proposed Park & Ride facility at St Margaret's Road, as well as the operation of the proposed Scheme.

A Climate Change Risk (CCR) Assessment has been undertaken to identify the vulnerability of the proposed Scheme to climate change and adaptation measures to increase the resilience of the proposed Scheme. An assessment of the proposed Scheme in relation to its vulnerability to climate change during the Construction and Operational Phase has been undertaken.

The climate impact assessment has been carried out in accordance with Transport Infrastructure Ireland (TII) guidance documents and assessment tools relating to greenhouse gas (GHG) emissions including the use of the TII Carbon Assessment Tool for Road and Light Rail Projects and climate change risk (CCR) assessment.

The Climate Action Plan 2024 (CAP24) is the most recent approved climate action plan for the purposes of Section 15 of the Climate Action and Low Carbon Development Act 2015 (as amended). In determining the proposed Scheme for planning approval, An Bord Pleanála will be performing its functions under Section 15 of the Climate Action and Low Carbon Development Act 2015 in a manner consistent with the most recent approved climate action plan, i.e. CAP24.

14.1.1 Outline Scheme Description

The proposed Scheme comprises a high-capacity, high-frequency light rail running from Broombridge to Charlestown, connecting Finglas and the surrounding areas with Dublin's wider public transport network by providing a reliable, and efficient public transport service to the city centre via Broombridge.

As shown in Volume 4 — Map Figure 1-1, starting from Broombridge, the proposed Scheme travels northwards, crossing the Royal Canal and the Maynooth railway line adjacent to Broome Bridge. It then runs adjacent to the east of Broombridge Road and the Dublin Industrial Estate. It then crosses the Tolka Valley Park before reaching the proposed St Helena's Stop and then proceeds northwards towards the proposed Luas Finglas Village Stop. From here, the route passes through a new corridor created within the Finglas Garda Station car park, making its eastern turn onto Mellowes Road. The route then proceeds through Mellowes Park, crossing Finglas Road, towards the proposed St Margaret's Road Stop. Thereafter, the proposed line continues along St Margaret's Road before reaching the terminus Stop proposed at Charlestown.

The proposed Scheme has been designed to integrate with the existing and future transport network, providing connections with bus services at all new Stops, mainline rail services at Broombridge, and a Park & Ride facility to intercept traffic on the N/M2. In addition, the proposed Scheme through the inclusion of integrated cycle lanes and cycling infrastructure sets out to facilitate multimodal "cycle- light rail transit (LRT) trips" as a key aspect of the Luas Finglas scheme.

The proposed Scheme will comprise a number of principal elements as outlined in Table 14-1 and Table 14-2. A full description of the proposed Scheme is provided in the following chapters of this EIAR:

- Chapter 1 (Introduction);
- Chapter 5 (Description of the proposed Scheme); and
- Chapter 6 (Construction Activities).

Table 14-1: Overview of the Key Features of the proposed Scheme

Scheme Key Features	Outline Description
Permanent Scheme Elements	
Light Rail track	3.9km extension to the Luas Green Line track from Broombridge to Finglas (2.8km of grass track, 700m of embedded track and 360m of structure track)
Depot Stabling facility	A new stabling facility (with stabling for eight additional LRVs) will be located just south of the existing Broombridge terminus, as an extension of the Hamilton depot area.
Luas Stops	Four Stops located at: St Helena's, Finglas Village, St Margaret's Road and Charlestown to maximise access from the catchment area including the recently re-zoned Jamestown Industrial Estate.
Main structures	Two new Light Rail Transit (LRT) bridges will be constructed as part of the proposed Scheme: a bridge over the River Tolka within the Tolka Valley Park and a bridge over the Royal Canal and the Iarnród Éireann (IÉ) railway line at Broombridge. A number of existing non-residential buildings shall be demolished to facilitate the proposed Scheme. In addition, the existing overbridge at Mellowes Park will be demolished.
At grade signalised junctions	10 at grade signalised junctions will be created at: Lagan Road, Ballyboggan Road, Tolka Valley Road, St. Helena's Road, Wellmount Road, Cappagh Road, Mellowes Road, North Road (N2), McKee Avenue, Jamestown Business Park entrance. Note: The junction at Charlestown will be reconfigured but does not have a LRT crossing.
Uncontrolled crossings	13 at grade uncontrolled crossings (11 pedestrian / cycle crossings and two local accesses located at: Tolka Valley Park, St Helena's, Farnham pitches, Patrickswell Place, Cardiff Castle Road, Mellowes Park, St Margaret's Road, and ESB Networks.
Cycle facilities	Cycle lanes are a core part of the proposed Scheme in order to facilitate multimodal "cycle-LRT trips". Approximately 3km of segregated cycle lanes and 100m of non-segregated cycle lanes along the route. Covered cycle storage facilities will be provided at Broombridge Terminus, Finglas Village Stop and St Margaret's Road Stop and within the Park & Ride facility. "Sheffield" type cycle stands will be provided at all stop locations.
Power substations	Two new traction power substations for the proposed Scheme will be located near Finglas Village Stop behind the existing Fire Station, and near the N2 junction before St Margaret's Road Stop where the current spiral access ramp to the pedestrian overbridge is located. A third substation is required for the Park & Ride facility.
Park & Ride facility	A new Park & Ride facility, with e-charging substation, located just off the M50 at St Margaret's Road Stop will be provided with provision for 350 parking spaces and secure cycle storage to facilitate multimodal "cycle-LRT trips". The building will feature photovoltaic (PV) panel roofing and is the location for an additional radio antenna. This strategic Park and Ride facility will intercept traffic on the N/M2, before congestion begins to form.
Temporary Scheme Elements	
Construction compounds	There will be three principal construction compounds, two located west of Broombridge Road and one located at the northern extents of Mellowes Park. In addition, there are other secondary site compound locations for small works/storage. Details can be found in Chapter 6 (Construction Activities) of this EIAR.

Table 14-2: Summary of New Bridges of the proposed Scheme

Identity	Location	Description
Royal Canal and Rail Bridge	Approximately 10m east of the existing Broome Bridge and then continuing north, parallel with Broombridge Road on its east side	The proposed bridge is an eight-span structure consisting of two main parts: a variable depth weathering steel composite box girder followed by a constant depth solid concrete slab. The bridge has the following span arrangement: 35 + 47.5 + 30 + 17 + 3x22 + 17m. Steel superstructure extends over the first three spans. The bridge deck is continuous over the full length of 212.5m and has solid approach ramps at both ends.
Tolka Valley Park Bridge	Approximately 30m west of the existing Finglaswood Bridge	A three-span structure with buried end spans, thus appearing as a single span bridge. End spans as well as part of the main span consist of post-tensioned concrete variable depth girder, the central section of the main span is a suspended weathering steel composite box girder. The overall length of the bridge is 65m with spans 10m, 45m, 10m.

14.2 Methodology

The climate impact assessment has been undertaken with reference to the current guidance documents relating to this Chapter of the EIAR, as outlined in Section 14.2.2 Relevant Guidelines, Policy and Legislation, and the approach to the climate impact assessment has been as follows;

- A review of available published climate impact related publications and data on Greenhouse Gas (GHG) emissions relevant to the wider area in proximity to the proposed Scheme has been undertaken as outlined in Section 14.3;
- A review of applicable standards and guidelines has been carried out in order to define the significance criteria for the climate impact of the Construction and Operational Phases of the proposed Scheme undertaken as outlined in Section 14.2.2;
- A prediction and assessment of the likely Construction Phase climate impacts has been undertaken in relation to the proposed Scheme as outlined in Section 14.4;
- A prediction and assessment of the likely Operational Phase climate impacts as a result of the proposed Scheme has been undertaken as outlined in Section 14.4;
- Any mitigation measures deemed necessary to avoid or reduce potential adverse impacts on climate from the proposed Scheme are identified, explained and quantified as outlined in Sections 14.4 and 14.5. The mitigation measures adopted in the Construction and Operational Phases of the proposed Scheme have been incorporated into the TII Carbon Tool calculations. In addition to these mitigation measures, there are a series of additional construction mitigation measures that TII is prepared to commit to, as detailed in Section 14.5; and
- Section 14.6 summarises the potential significant residual impacts, which may result from the Construction and Operational Phases of the proposed Scheme. Residual impacts are the final or intended impacts which occur after the proposed mitigation measures have been implemented. They refer to the degree of change that will occur after the proposed mitigation measures have taken effect.

14.2.1 Study Area

The proposed Scheme is approximately 4km in length and is the northern extension of the Luas Green Line from its current terminus in Broombridge to a new terminus in Charlestown, which will overpass the Royal Canal and the Maynooth railway line, will cross the Tolka Valley Park and proceed northward towards Luas Finglas Village Stop. The route will proceed through Mellowes Park, crossing Finglas Road, towards proposed St. Margaret's Road Stop. Thereafter, the proposed Scheme will continue along St. Margaret's Road before reaching the terminus stop proposed at Charlestown. The proposed Scheme will include four proposed stops, an extension to the Luas Broombridge Hamilton Depot, a 350-space Park & Ride facility near St Margaret's Road, the Royal Canal and Rail Overbridge at Broombridge and the Tolka Valley Park Bridge both of which are located at the southern end of the proposed Scheme, and ancillary infrastructure.

The proposed Scheme study area in terms of the Greenhouse Gas (GHG) emissions assessment, relates to Ireland's overall Climate budget. To determine the proposed Scheme carbon emissions, construction and operational design attributes that will have a bearing on GHG emissions have been assessed quantitatively and compared to Ireland's overall Climate budget.

The proposed Scheme study area in terms of the Climate Change Risk (CCR) assessment relates to the potential climate impacts and in-combination impacts as defined by other environmental disciplines on the proposed Scheme itself. In terms of CCR, the study area relates to future potential climate change impacts such as flooding. A Site-Specific Flood Risk Assessment (SSFRA) has been prepared as a supporting document to the EIAR. The FRA is provided in Volume 5 - Appendix A10.2.

14.2.2 Relevant Guidelines, Policy and Legislation

The assessment has been undertaken with reference to the relevant guidance documents relating to climate which are referred to in the following sections. The assessment has made reference to national and international standards and guidelines relating to the assessment of GHG emissions and associated climate impacts from infrastructure schemes. These are summarised below:

- Climate Action and Low Carbon Development Act 2015 (hereafter referred to as the 2015 Climate Act), (Number 46 of 2015);
- Climate Action and Low Carbon Development (Amendment) Act 2021 (hereafter referred to as the 2021 Climate Act) (No. 32 of 2021);
- National Adaptation Framework (hereafter referred to as the NAF) Planning for a Climate Resilient Ireland 2024, (Department of the Environment, Climate & Communications (DECC, 2024);
- Climate Action Plan 2021 (hereafter referred to as CAP21);
- Climate Action Plan 2023 (hereafter referred to as CAP23);
- Climate Action Plan Progress Report Q4, 2023;
- Climate Action Plan 2024 (hereafter referred to as CAP24, the latest Climate Action Plan approved by Government on 21st May 2024);
- 2030 Climate and Energy Policy Framework (European Commission, 2014);
- Dublin City Council (DCC) Climate Neutral Dublin 2030, Local Authority Climate Action Plan 2024-2029; (hereafter referred to as the DCC Climate Action Plan) (DCC, Climate Action Regional Office (CARO) and Dublin's Energy Agency Codema);
- Fingal County Council (FCC) Climate Action Plan 2024 – 2029 (hereafter referred to as the FCC Climate Action Plan) (FCC, Climate Action Regional Office (CARO) and Dublin's Energy Agency Codema);
- Ireland's Long-term Strategy on Greenhouse Gas Emissions Reduction, (Department of the Environment, Climate & Communications (DECC 2024);
- Ireland's Climate Change Assessment (ICCA), Volumes 1-4 (Environment Protect Agency (EPA January 2024);
- National Transport Authority (2022) Greater Dublin Area Transport Strategy 2022- 2042;
- National Sustainable Mobility Policy (SMP) (Department of Transport, 2022);
- National Sustainable Mobility Policy Year One progress Report (Department of Transport, 2023);
- The Circular Economy and Miscellaneous Provisions Act 2022 (Number 6 of 2022);
- TII Climate Action Roadmap September 2023; and
- TII Climate Adaptation Strategy, December 2022.

The Climate assessment has followed the methodology outlined in the following Transport Infrastructure Ireland (TII) guidance documents and assessment tools:

- OTD PE-ENV-01104 - Climate Guidance for National Roads, Light Rail, and Rural Cycleways (Offline and Greenways) – Overarching Technical Document (OTD PE-ENV-01104, December 2022);
- PE-ENV-01105 - Climate Assessment of Proposed National Road Projects – Standard (PE-ENV-01105, December 2022);
- PE-ENV-01106 - Air Quality Assessment of Specified Infrastructure Projects – Overarching Technical Document (PE-ENV-01106, December 2022);

- PE-ENV-01107 - Air Quality Assessment of Proposed National Roads - Standard (TII PE-ENV-01107, Dec 2022);
- GE-ENV-01106 - TII Carbon Tool for Road and Light Rail Projects: User Guidance Document (GE-ENV-01106, February 2024);
- GE-ENV-01107 - TII Road Emissions Model (REM): Model Development Report (GE-ENV-01107, December 2022); and
- GE-GEN-01101 - Guide to the implementation of Sustainability for TII Projects (GE-GEN-01101, July 2023).

In addition to specific climate guidance documents, the following guidelines were consulted in the preparation of this Chapter:

- Guidelines on the Information to be contained in Environmental Impact Assessment Reports (EPA, 2022) (hereafter referred to as the EPA Guidelines); and
- Institute of Environmental Management & Assessment Guide - Assessing Greenhouse Gas Emissions and Evaluating their Significance (IEMA, 2nd Edition, February 2022) (hereafter referred to as the IEMA 2022 GHG Guidelines).

14.2.2.1 National and International Guidelines, Policy and Legislation

Ireland is party to both the United Nations Framework Convention on Climate Change (UNFCCC, 1992) and the Kyoto Protocol (UNFCCC 1997). Ireland is party to the Paris Agreement, which is an international treaty under the UNFCCC. The Paris Agreement was adopted in December 2015 and entered into force in November 2016. Its goal is to limit global warming to well below 2 degrees Celsius above pre-industrial levels, with efforts to limit it to 1.5 degrees Celsius, by reducing greenhouse gas emissions and enhancing global climate resilience.

In order to meet the commitments under the Paris Agreement, the European Union (EU) enacted Regulation (EU) 2018/842 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No. 525/2013 of the European Parliament and of the Council of 21st May 2013, on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and EU level relevant to climate change, and repealing Decision 280/2004/EC (hereafter referred to as the GHG Regulation). The GHG Regulation aims to deliver, collectively by the EU in the most cost-effective manner possible, reductions in GHG emissions from the Emission Trading Scheme (ETS) and non-ETS sectors of 43% and 30%, respectively, by 2030 compared to 2005. The ETS is an EU-wide scheme which regulates the GHG emissions of larger industrial emitters including electricity generation, cement manufacturing and heavy industry. The non-ETS sector includes all domestic GHG emitters which do not fall under the ETS scheme and thus includes GHG emissions from transport, residential and commercial buildings and agriculture.

As a signatory to the Paris Agreement, Ireland made commitments to reduce its greenhouse gas emissions and take action to mitigate and adapt to climate change. Ireland's obligation under the GHG Regulation is a 30% reduction in non-ETS GHG emissions by 2030 relative to its 2005 levels. To fulfil its commitments under the Paris Agreement, Ireland has developed and implemented various climate policies and measures. These include the 2015 Climate Act and the 2021 Climate Act, the National Mitigation Plan 2017, the National Adaptation Framework, and other initiatives aimed at reducing emissions, promoting renewable energy, enhancing energy efficiency, and building resilience to climate impacts.

The Climate Acts (2015 & 2021)

In 2015, the Climate Action and Low Carbon Development Act 2015 (the "2015 Climate Act") was enacted by the Oireachtas. The Act was amended in 2021 by the Climate Action and Low Carbon Development (Amendment) Act 2021 (the "2021 Climate Act").

The purpose of the 2015 Climate Act, as set out in section 3(1), was to enable Ireland '*to reduce the extent of further global warming, to pursue, and achieve, the transition to a low carbon, climate resilient and*

environmentally sustainable economy by the end of the year 2050'. It established a framework for setting national climate objectives, developing mitigation and adaptation strategies, and monitoring progress towards meeting climate targets. One of the central components of the 2015 Climate Act was the setting of long-term emission reduction targets for Ireland. The 2015 Act requires the government to set legally binding targets for reducing greenhouse gas emissions by certain percentages by specified years. The 2015 Act mandates the development and implementation of a National Mitigation Plan in July 2017, which outlines how Ireland will achieve its emissions reduction targets. The plan includes measures and policies to reduce emissions across key sectors of the economy, such as energy, transport, agriculture, and industry.

Section 15 of the 2015 Act sets out the duty of a body, with respect to climate, stating that the relevant body (An Bord Pleanála) must, as far as practicable, perform its functions in a manner consistent with:

- the most recent approved climate action plan;
- the most recent approved national long term climate action strategy;
- the most recent approved national adaptation framework and approved sectoral adaptation plans;
- the furtherance of the national climate objective; and
- the objective of mitigating greenhouse gas emissions and adapting to the effects of climate change in the State.

This Chapter of the EIAR presents all of the data and information that An Bord Pleanála requires to perform its obligations as described above in terms of Climate impact. It can be satisfied that it will be complying with those obligations in granting approval for Luas Finglas, because the following explains clearly how the proposed Scheme is consistent with the Climate Action Plans particularly CAP23 and CAP24. The proposed Scheme is:

- consistent with the most recent climate action plan/strategies and in furtherance of the national climate objective (i.e. of achieving net zero by 2050 (sub-sections a, b, and d));
- consistent with the most recent national adaptation framework and plans, ensuring that the impact of future climate change has been considered and adaptation has been applied to reduce vulnerability to such impacts (sub-section c); and
- consistent with the objective of mitigating GHG emissions and adapting to the effects of climate change (sub-section e).

The purpose of the 2021 Climate Act is to provide for the approval of plans 'for the purpose of pursuing the transition to a climate resilient, biodiversity rich and climate neutral economy by no later than the end of the year 2050'. The 2021 Climate Act also provides for carbon budgets and a sectoral emissions ceiling to apply to different sectors of the economy. The 2021 Climate Act removes any reference to a national mitigation plan and instead refers to both the Climate Action Plan and a series of National Long Term Climate Action Strategies. In addition, the Environment Minister is required to request that each local authority prepare a 'local authority climate action plan' lasting five years and specifying the mitigation measures and the adaptation measures to be adopted by the local authority. The 2021 Climate Act has set a target of a 51% reduction in the total amount of greenhouse gases over the course of the first two carbon periods ending 31st December 2030 relative to 2018 annual emissions. The 2021 Climate Act defines the carbon budget as 'the total amount of greenhouse gas emissions that are permitted during the budget period'. The 2021 Climate Act outlines a series of specific actions including:

- To outline a strategy known as the 'National Long Term Climate Strategy' not less than once in every five-year period with the first to be published for the period 2021 to 2035 and with each subsequent Strategy covering the next three five-year carbon budgets and also include a longer-term perspective of at least 30 years;
- To adopt a system of carbon budgets which will be determined as part of a grouping of three five-year periods calculated on an economy-wide basis, starting with the periods 2021 to 2025, 2026 to 2030, and 2031 to 2035;
- To introduce a requirement for Government to adopt "sectoral emission ceilings" for each relevant sector within the limits of each carbon budget;

- To request all local authorities to prepare climate action plans for the purpose of contributing to the national climate objective. These plans should contain mitigation and adaptation measures that the local authority intends to adopt. Each local authority is also required to consider any significant effects the implementation of the local authority climate action plan may have on the adjoining local authority;
- Increasing the power of the Advisory Council to recommend the appropriate climate budget and policies;
- Requiring the Minister to set out a roadmap of actions to include sector specific actions that are required to comply with the carbon budget and sectoral emissions ceiling for the period to which the plan relates; and
- Reporting progress with the CAP on an annual basis with progress including policies, mitigation measures and adaptation measures that have been adopted.

The Minister with responsibility for each sector will give an account of matters during the period to which the annual report relates including:

- Sector specific progress under the most recent climate action plan and any significant failure to implement such policies and measures, or to achieve sector specific targets;
- Whether there has been a reduction or increase in GHG emissions based on the annual EPA GHG report;
- Compliance with the sectoral emissions ceiling and any measures envisaged to address any failures to comply with the target; and
- The implementation of adaptation policy measures and any adaptation policy measures envisaged, where a sectoral adaptation plan has been prepared.

Climate Action Plans

The 2015 Climate Act required the government to develop and implement Climate Action Plans, which detail specific actions and policies to be undertaken to achieve emissions reduction targets and adaptation objectives. The act established the Climate Change Advisory Council, an independent body tasked with providing expert advice and recommendations on climate policy to the government. The Climate Change Advisory Council monitors progress towards climate targets, assesses the effectiveness of policies and measures, and publishes reports on Ireland's climate performance. Climate Action Plans set out the detailed measures to cut emissions and meet our forthcoming targets in each sector.

The Climate Action Plan (CAP) is the Irish Government's roadmap to delivering on its climate targets. It was first published in 2019 and was later updated in 2021. The Climate Action Plan 2021 (CAP21), published in November 2021, was the first of Ireland's Climate Action Plans which provided a detailed plan for taking decisive action to achieve a 51% reduction in overall greenhouse gas emissions by 2030 and setting Ireland on a path to reach net-zero emissions by no later than 2050, as committed to in the Programme for Government and the Climate Act 2021. In relation to the transport sector the detailed measures to cut emissions and meet targets included the following:

- Enable 500,000 daily sustainable travel journeys by 2030 through major public transport projects such as BusConnects and Connecting Ireland; the expansion of rail services and cycling and walking infrastructure;
- Increase the use of biofuels in transport;
- Expand electrification of bus and rail fleets with 1,500 electric buses by 2030;
- Increase the number of EVs to circa 1 million by 2030; and
- Update the public transport and public fleets to low emission alternatives.

CAP21 outlined the current status across key sectors including electricity, transport, built environment, industry and agriculture and outlines the various broadscale measures required for each sector to achieve ambitious decarbonisation targets. CAP21 also detailed the required governance arrangements for implementation including carbon-proofing of policies, establishment of carbon budgets, a strengthened Advisory Council and greater accountability to the Oireachtas. CAP21 acknowledged that policies need to be better aligned to achieve more ambitious targets for modal shift, which will involve the building of supporting infrastructure such as Luas Finglas.

CAP21 identified the electrification of transport as the most cost-effective abatement opportunity. CAP21 set a transport sector reduction target in GHG emissions of 42% to 50% relative to 2030 pre-National Development Plan 2018 – 2027. In June 2020, the Government published the Programme for Government – Our Shared Future (Government of Ireland, 2020). In relation to climate, there is a commitment to an average 7% per annum reduction in overall GHG emissions from 2021 to 2030 (51% reduction over the decade) with an ultimate aim to achieve net zero emissions by 2050. Policy changes include the acceleration of the electrification of the transport system, including electric bikes, electric vehicles and electric public transport, alongside a ban on new registrations of petrol and diesel cars from 2030. In addition, there will be a policy to ensure an unprecedented modal shift in all areas by a re-orientation of investment to walking, cycling and public transport.

The Climate Action Plan 2023 (CAP23) and the Climate Action Plan 2024 (CAP24) are the second and third annual update to CAP21. These plans identify the electrification of transport as the most cost-effective transport emissions abatement opportunity. CAP23 and CAP24 outline a range of targets specifically in relation to the transport sector as summarised below.

CAP24 is the most recent approved climate action plan for the purposes of Section 15 of the Climate Action and Low Carbon Development Act 2015 (as amended) and the relevant body (An Bord Pleanála) will be performing its functions in a manner consistent with the most recent approved climate action plan (CAP24).

CAP21, CAP23 and CAP24 have clear alignment of purpose, which is to ensure Ireland achieves its net carbon zero target for 2050 as set out as the national climate objective in Section 3 of the Climate Action and Low Carbon Development Act 2015 (No. 46 of 2015). Achieving this target is vital to stabilise climate change and avoid the worst effects of it in future. The proposed Scheme is part of this wider climate action plan to achieve Net Zero by 2050 for Ireland and will support the delivery of government strategies, as outlined in all four of the published National Climate Action Plans (2019, 2021, 2023 and 2024) by enabling sustainable mobility, a Just Transition and an integrated sustainable transport.

A key element in CAP23 and CAP24 that is relevant to the proposed Scheme is the adoption of the 'Avoid-Shift-Improve' framework for Transport by:

- developing services, communities, and infrastructure in such a manner as to avoid the need to travel as much as we do today;
- improving the relative attractiveness of sustainable travel modes such as Public Transport, Cycling and Walking, to shift away from car use; this will facilitate increased use of lower-carbon modes and reduce the percentage of total journeys that are made by private car (modal share) from over 70% (today) to just over 50% in 2030; and
- complement these measures by increasing the proportion of EVs in our car fleet to 30% by 2030, which will improve the efficiency of the national car fleet; electrification of the freight and public transport sector will also be key.

CAP23 Summary

The Transport Section of CAP23 is framed around the Avoid-Shift-Improve approach: reducing or avoiding the need for travel, shifting to public transport, walking and cycling and improving the energy efficiency of vehicles.

CAP23 Targets: This Climate Action Plan reframes the previous pathway outlined in CAP21 under the Avoid-Shift-Improve Framework. The following 2030 targets are higher targets than outlined in CAP21:

- 'Avoid' targets include a 20% reduction in total vehicle kilometres travelled and a 50% reduction in fuel usage;
- 'Shift' targets include a 50% increase in daily active travel journeys and a 130% increase in daily public transport journeys;
- 'Improve' targets set percentage shares for low fossil public and private vehicles, including that 100% of new car registrations should be EVs; and
- Interim targets are also given for 2025. 77 key actions are identified for the transport sector.

By 2030, CAP23 aims to achieve the following in terms of transport emissions:

- 20% reduction in total vehicle, car and commuting kilometres travelled;
- 50% reduction in fuel usage;
- 50% increase in daily active travel journeys;
- 130% increase in daily public transport journeys;
- 25% reduction in daily car journeys;
- A shift in the mode of daily transport – 53% car, 19% public transport and 28% active travel;
- 30% shift of all "escort-to-education" journeys to sustainable modes;
- 30% electric vehicle (EV) share of the private car fleet;
- 100% of new registrations to be EV;
- 20% EV share of total light goods vehicle fleet;
- 30% zero emissions share of new heavy duty vehicle registrations;
- 1,500 EV buses in the public bus fleet;
- Expansion of electrified rail services; and
- A renewable fuel blend in diesel increase to 20%.

CAP23 Public Transport Proposals: CAP23 actions focus on continuing programmes of work: advancing BusConnects in five cities, MetroLink, DART+, Cork Area Commuter Rail Programme, PSO electric bus fleet procurement including depot charging upgrades, and investment in passenger freight rail. Several actions are identified for the development of public transport coverage, including prioritisation of NTA Connecting Ireland and new town services. Several actions are identified for smart, shared and integrated mobility including rollout of 'eMobility Hubs' in five cities, the development of decarbonisation pathway for interurban rail services and establishment of a new Unit in the Department of Transport to engage with shared mobility stakeholders. An action for the public sector is supporting development of a Public Procurement Framework for charging infrastructure for public sector fleets.

CAP23 Wider Strategy Proposals: In line with the Avoid-Shift-Improve approach, other CAP23 actions are identified to pursue enhanced spatial and land use planning; demand management strategy; road space re-allocation; and active travel infrastructure.

CAP24 Summary

The aims of CAP24 are largely consistent with CAP23, and it recognises that significant investment in new public transport infrastructure is required to deliver on Ireland's carbon emissions reduction targets, and to provide people with sustainable alternatives to car usage (15.2.4.2 of the CAP 24). CAP24 remains consistent on transport policy and retains an emphasis on the 'Avoid-Shift-Improve' framework. This framework emphasises the crucial role of spatial and land-use planning in designing transport systems that can support our net-zero ambition and seek to "avoid" unnecessary emissions by reducing journey times and travel demand in the first instance. The expected outcome is that CAP24 will build on CAP23 in enabling Ireland to meet the first and second carbon budget.

CAP24 Targets: No change has been made to the key performance indicators provided in CAP23, to set out the level of change required to meet a 50% compliant pathway. Key targets include a 20% reduction in total vehicle kilometres travelled relative to business-as-usual, a 50% reduction in fuel usage, and significant increases to sustainable transport trips and modal share. Fleet electrification and biofuels will continue to provide the greatest share of emissions abatement in the medium term.

CAP24 Public Transport Proposals: Several distinct actions are identified for the development of public transport coverage without direct reference to Luas and/or the proposed Scheme. However, reference is made to transport planning in cities for sustainable transport investment and service enhancements across active travel, bus, light rail and heavy rail for each city.

CAP24 Electrification Proposals: Following the publication of the National EV Charging Infrastructure Strategy in January 2023, the draft National En-Route EV Charging Plan, the primary focus in 2024 will be

on the expansion in the provision of public charging infrastructure alongside the development of Regional and Local Authority EV Charging Network plans.

CAP24 Wider Strategy Proposals: CAP24 actions are to publish and implement actions from the National Demand Management Strategy along with the Greater Dublin Area (GDA) Demand Management Scheme and to continue to accelerate the delivery of NTA Connecting Ireland and new town services, via demand responsive transport pilot initiatives, conventional and non-conventional modes of public transport services.

Section 15.3 of CAP24 outlines the Targets and 2025 and 2030 KPIs to communicate the level of change required in the Transport sector. The Key Metrics to Deliver Abatement in Transport are outlined in Table 14-3. The expansion of electrified rail services is a key deliverable to achieve the 2025 and 2030 KPIs. The proposed Scheme is entirely consistent with this key deliverable.

Table 14-3: Key Metrics to Deliver Abatement in Transport (CAP24)

Theme	2025 KPI	2025 abatement (vs 2018) Mt CO_{2eq}	2030 KPI	2030 abatement (vs 2018) Mt CO_{2eq}	2031 – 2035 measures
Avoid (Encompassing a range of behavioural change and sustainable transport measures) 1					
Reduction in total vehicle kilometres Reduction in fuel usage	n/a	Abatement captured under shift measures below	20% reduction in total vehicle kilometres relative to 2030 BAU scenario	Abatement captured under shift measures below	Continued application of avoid-shift-improve approach
Shift (Encompassing a range of behavioural change and sustainable transport measures)					
Increase in sustainable transport trips Shift in daily journeys model share	Additional 125,000 sustainable journeys Rollout of sustainable demand management measures informed by national demand strategy Delivery of Pathfinder programs	0.72	50% increase in daily active travel journeys 130% increase in daily public transport journeys 25% reduction in daily car journeys Shift in daily mode share. 2018: 72% (car), 8% (PT), 20% (AT)	2.09	Continued application of avoid-shift-improve approach
Improve					
Fleet electrification	175,000 passenger EVs 20,000 commercial vans 700 low emission HGV 300 EV buses in PSO bus fleet Expansion of electrified rail services	1.96	Private car fleet Battery EV share of total passenger car fleet 30% EV share of new registrations 100% 845,000 private EVs 2 Commercial fleet 20% EV share of total LGV fleet 95,000 commercial EVs 30% Zero Emissions share of new heavy duty vehicle registrations 3,500 HGV's PT services	4.74	

Theme	2025 KPI	2025 abatement (vs 2018) Mt CO_{2eq}	2030 KPI	2030 abatement (vs 2018) Mt CO_{2eq}	2031 – 2035 measures
			1,500 EV bosses in PSO boss fleet Expansion of electrified rail services		
Biofuels blend rate 3	E10:E12	0.53	E10:B20	1.08	
Total estimated abatement potential		3.21		7.91	
Sub targets – Changing Transport Behaviours by Journey Purpose					
Escort to education journeys	Achieve 30% reduction in the share of current escort-to-education career journeys to sustainable modes with accelerated implementation of safe routes to schools programs and enhancement of school transport scheme				
Commuting journeys	Achieve a 20% reduction in commuting private car kilometres, enabled through initiatives such as the Smarter Travel Mark pathfinder programme, and establishing network of remote working hubs				
Note 1 - 120 Avoid + Shift measures combine to achieve 0.72 Mt CO_{2eq} (million tonnes of carbon dioxide equivalent) abatement for 2025 period and 2.09 Mt CO_{2eq} abatement for 2030 period. Note 2 - Private car EV targets are kept under ongoing review and may be subject to recalculation on a regular basis. Note 3 - A renewable transport fuel obligation has been in place since 2010 and, since then, increasing volumes of renewable transport fuels (e.g., biofuels) have been introduced to Ireland's transport fuel supply. The obligation ensures that a certain percentage of the motor fuel placed on the market by fuel suppliers is renewable transport fuel (for example: bioethanol and biodiesel).					

In terms of the Construction Phase carbon emissions, CAP24 aims to decrease embodied carbon in construction materials by at least 30% embodied carbon for materials produced and used in Ireland by 2030. This will be achieved through product substitution for construction materials and reduction of clinker content in cement. CAP24 also outlines that public sector procurement contracts for delivery and haulage should specify zero-emissions vehicles where possible.

Box 1: The proposed Scheme is in compliance with the aims of the latest Climate Action Plan because of the following components:

- Luas Finglas will provide a key public transport connection between Dublin's north-western suburbs and the city centre and will be key to the overall reduction in reliance on the private car in areas served by the proposed Scheme;
- Luas Finglas is projected to result in an approximate reduction of 10,000 car trips daily;
- The interconnectivity between the light rail element and the active mobility options provided as part of the proposed Scheme includes the 4.4km of segregated cycle tracks and 0.3km non-segregated cycle tracks along the route, covered cycle storage facilities provided at Broombridge Stop, Finglas Stop and St Margaret's Stop and within the Park & Ride structure along with cycle stands provided at all stop locations;
- The proposed Scheme includes the provision of EV Charging Stations at the Park & Ride facility;
- The proposed Scheme will be integrated with other public transport modes to ensure maximum public benefit and promotes sustainable transport and improved connectivity; and
- During construction, low embodied carbon construction methods and materials will be used, and zero-emissions delivery and haulage vehicles will be used, where possible.

Therefore, the proposed Scheme will directly help achieve the following aims in the latest Climate Action Plan:

- 20% reduction in total vehicle, car and commuting kilometres travelled;
- 50% reduction in fuel usage;
- 50% increase in daily active travel journeys;
- 130% increase in daily public transport journeys;
- 25% reduction in daily car journeys;
- A shift in the mode of daily transport – 53% car, 19% public transport and 28% active travel;
- 30% shift of all "escort-to-education" journeys to sustainable modes;
- 30% electric vehicle (EV) share of the private car fleet;
- 100% of new registrations to be EV;
- 20% EV share of total light goods vehicle fleet;
- Expansion of electrified rail services;
- Low carbon construction methods and low carbon cement material will be specified as far as practicable;
- Low embodied carbon materials to be used during the Construction Phase; and
- Zero-emissions delivery and haulage vehicles will be used during the construction stage, where possible.

Long-term Strategy on Greenhouse Gas Emissions Reductions 2024

The latest Government's Long-term Strategy on Greenhouse Gas Emissions Reductions (published in August 2024) sets out indicative pathways, beyond 2030, towards achieving carbon neutrality for Ireland by 2050. It builds on the decarbonisation pathways set by the carbon budgets, sectoral emissions ceilings and Climate Action Plan 2024, to ensure coherent and effective climate policy. It is underpinned by analysis of transition options across each key sector of the economy and provides a crucial link between Ireland's 2030 climate targets and the long-term goal set by Ireland's National Climate Objective and by European Climate Law. As stated, CAP24 provides a pathway to a 50% emissions reduction for the sector by 2030 (relative to 2018). The primary measures to deliver decarbonisation include measures to reduce and curtail aspects of road transport demand, a strong shift to sustainable travel modes and the electrification of vehicle fleets.

The proposed Scheme has been purposefully designed to interact with other sustainable transport modes, opening a wider network for Luas users to transfer to additional final destinations and enabling a smooth transition across a complex network. The proposed Scheme provides connectivity and integration with other public transport services (Metrolink, DART, Bus, Active Travel Network) leading to more people availing of public and active transport. This aligns with the Long-term Strategy.

Box 2: The proposed Scheme will help to achieve the 'Long-term Strategy on Greenhouse Gas Emissions Reductions' for the following reasons;

- *'Curtail aspects of road transport demand'* - Luas Finglas will provide a key public transport connection between Dublin's north-western suburbs and the city centre and will be key to the overall reduction in reliance on the private car in areas served by the proposed Scheme. Luas Finglas is projected to result in an approximate reduction of 10,000 car trips daily;
- *'A strong shift to sustainable travel modes'* - The interconnectivity between the light rail element and the active mobility options provided as part of the proposed Scheme includes the 4.4km of segregated cycle tracks and 0.3km non-segregated cycle tracks along the route, covered cycle storage facilities provided at Broombridge Terminus, Finglas Stop and St. Margaret's Stop and within the Park & Ride structure along with cycle stands provided at all stop locations. The proposed Scheme will be integrated with other public transport modes to ensure maximum public benefit and promotes sustainable transport and improved connectivity; and
- *'The electrification of vehicle fleets'* - The proposed Scheme is an electrified rail service and includes the provision of EV Charging Stations at the Park & Ride facility.

The EU Fit for 55 Package

In July 2021, the European Commission adopted 'Fit for 55' as part of the European Green Deal, which outlines across-sectoral package detailing binding actions. The Green Deal commits to achieving climate-neutrality in the European Union (EU) by 2050 and sets the EU GHG emissions reduction target to at least 55% by 2030, compared to 1990 levels, in order to limit global warming to 1.5 degrees Celsius, in line with the Paris Agreement. It commits to reducing transport emissions and contains a key set of measures for achieving the goals of the European Green Deal. Cities will be at the forefront of delivering on the EU's increased ambition to achieve climate net neutrality by 2050. Providing people with more and better public transport is the fast, affordable and fair way to enable the transition to zero-emission land transport.

The proposed Scheme is compliant in delivering infrastructure that supports low-carbon transport systems and emission reductions and promote further use of low-carbon products in construction projects.

Box 3: The proposed Scheme will help to achieve the 'Fit for 55' targets for the following reasons;

- The proposed Scheme is an electrified rail service and includes the provision of EV Charging Stations at the Park & Ride facility;
- Luas Finglas is projected to result in an approximate reduction of 10,000 car trips daily;
- The proposed Scheme will be integrated with other public transport modes to ensure maximum public benefit and promotes sustainable transport and improved connectivity; and
- During the Construction Phase, low carbon construction methods and low embodied carbon materials will be specified as far as practicable; and zero-emissions delivery and haulage vehicles will be used during the construction stage, where possible.

National Adaptation Framework - Planning for a Climate Resilient Ireland 2024

A National Adaptation Framework has been developed to address the impacts of climate change and enhance resilience. This framework identifies climate-related risks and vulnerabilities, sets adaptation priorities, and integrates climate considerations into decision-making processes across sectors.

The recent National Adaptation Framework, Planning for a Climate Resilient Ireland was published in January 2024 (NAF2024). NAF2024 outlines that at a national level, observed climate change in Ireland is in line with global trends. In response to current and potential future impacts of climate change there has been a surge in the implementation of climate-related policy at a global, European and national level to both mitigate and adapt to climate change. NAF2024 provides an update on Ireland's progress on adaptation since the publication of the 2018 NAF and provides a new Framework to strengthen the national adaptation response in line with developments made in climate policy and science. Substantial efforts have been put in place to establish the foundations for adaptation planning across Government and adaptation measures have started to be implemented within sectors and at local level. In line with progress made across policy, research and adaptation planning and implementation, the NAF2024 provides stakeholders with a new framework to build on the achievements made to date and strengthen national climate adaptation and resilience. NAF2024 establishes a set of key principles to be used when planning for and implementing adaptation. It outlines the importance of mainstreaming climate change adaptation as well as identifying the key government actors with overarching responsibility for managing the NAF.

TII, in association with Transdev, has developed a Luas Severe Weather Management Plan, *PSF-ENW-003, Strategy for Adapting to Climate Change on Irelands Light rail and National Road Network, December 2017.* This plan sets out TII's and Transdev's (the company responsible for operating Luas) pre-determined actions to providing a response system to a severe weather event occurring on the Luas system. The plan provides a framework for managing responses to any weather event that has the potential to seriously disrupt Luas services. The objectives of the Luas Severe Weather Management Plan are as follows:

- Provide a safe, reliable and consistent level of public transport – establish that the appropriate response plans (Transdev or maintenance contractors) have been activated and tested to provide a safe, reliable and consistent level of public transport;

- Communications link and status – establish and maintain communication links to the Lead Agency (be it the Local Authority or the relevant Government Department). Provide the travelling public with up to date and accurate information; and
- Support (strategic and/or tactical) – establish whether Transdev and its maintenance contractors require additional support and provide such support where possible and appropriate

Box 4: The proposed Scheme will comply with the National Adaptation Framework (NAF2024) for the following reasons;

- The proposed Scheme is an electrified rail service, including an approximately 4km extension to the Luas Green Line track from Broombridge to Finglas (2.8km of grass track, 700m of embedded track and 360m of structure track) with associated infrastructure;
- In terms of Climate Adaptation, the proposed Scheme has been designed by considering the vulnerability to climate change and adaptation measures to accommodate climate change impacts were identified, as appropriate as part of its detailed design;
- The proposed Scheme design considered the following Climate variables; Flooding (coastal), Flooding (fluvial), Flooding (pluvial), Flooding (groundwater), Extreme heat, Extreme cold, Wildfire, Drought, Extreme wind, Lightning, Hail, Landslides, Slope failure and Fog; and
- The proposed Scheme aligns with NAF24 as it takes climate change effects, including the need for greater resilience, into account. The potential vulnerability of the proposed Scheme to the above referenced Climate variables has been considered as part of the proposed Scheme design.

The Climate Change Advisory Council Annual Review 2024 - Transport

The latest Climate Council's Annual Review of the transport sector (published in June 2024) highlights that carbon emissions increased last year and that even with the full implementation of proposed policies and measures the transport sector will exceed its emissions ceiling. The increase in emissions was driven by a rise in demand for petrol and diesel of 7.7% and 1% respectively, underlining the need for urgent measures to drive the uptake of more efficient vehicles in the sector. This is especially the case given the decline in battery electric vehicles (BEV) sales this year.

Positive developments in 2023 included a 24% increase in public transport use, a significant increase in new rural bus service provision through Connecting Ireland and Local Link, and a 20% average fare reduction on public bus services.

To support the transformational change needed, the Council proposed a series of recommendations, including the following measures which are relevant to the proposed Scheme:

- A full review of taxation in the Transport sector (including vehicle registration tax, motor tax, excise duty, carbon tax, fuel pricing and distance-based charges) aligned with climate objectives and minimises negative impacts on society;
- Reallocation of road space to provide better access for more sustainable modes of transport;
- Public transport services need to improve, and more public engagement is needed to understand the barriers people face in making sustainable transport choices; and
- The Government must complete the planning reform necessary to speed up the delivery of major public and active transport infrastructure projects and minimise the costs and delays associated with the planning process.

Box 5: The proposed Scheme will assist the Climate Change Advisory Council Annual Review 2024 – Transport recommendations for the following reasons:

- Luas Finglas will provide better access for more sustainable modes of transport by providing a key public transport connection between Dublin's north-western suburbs and the city centre and will be key to the overall reduction in reliance on the private car in areas served by the proposed Scheme;
- Luas Finglas is projected to result in an approximate reduction of 10,000 car trips daily;
- The proposed Scheme will be integrated with other public transport modes to ensure maximum public benefit and promotes sustainable transport and improved connectivity. The proposed

Scheme has been designed to interact with other sustainable transport modes, for Luas users to transfer to additional final destinations and enable a smooth transition across the network; and
- The proposed Scheme is an electrified rail service and includes the provision of EV Charging Stations at the Park & Ride facility. Research has shown that the expansion of the charging network and availability of fast chargers is a critical driver of increased EV uptake.

The Circular Economy and Miscellaneous Provisions Act 2022

To comply with The Circular Economy and Miscellaneous Provisions Act 2022, TII is committed to delivering on a Circular Economy (CE) Plan along with applying the principles of CE to Luas Finglas. The Luas Team undertook a number of circular economy workshops to explore and prioritise opportunities for integrating circular economy principles in the proposed Scheme approach. TII put 5 key circular economy opportunities into practice for the purpose of the proposed Scheme design:

- Earthworks optimisation: adopting a hierarchy for soil reuse on the proposed Scheme. The reuse of excavated materials brings opportunities for reduced resource consumption, reduced emissions and reduced costs to the proposed Scheme;
- Design for disassembly of track: adopting a design for disassembly approach to track design improving maintenance and track replacement over the life cycle of the proposed Scheme. It will prevent concrete breaking out, reduce carbon emissions and costs;
- Material data integration: BIM and material data integration can enhance circularity across a project's lifecycle. The proposed Scheme design has integrated key material data into the data environment. This enables identification of reuse or recycling possibilities, material properties and sources to enable recovery of assets, components and materials after their first life; Sharing of lighting and other assets; Public lighting, CCTV, and signage has been designed to avoid duplication of components such as lighting poles;
- Active travel: In terms of active travel, the proposed Scheme brings additional social value through integration of active travel facilities into the Luas network. The design of these facilities has been developed in collaboration with stakeholders, to understand how the users of the network can benefit from the proposed Scheme. This brings more social value to the proposed Scheme by providing green spaces for the local community; and
- Adopting nature-based solutions and a regenerative design approach: the proposed Scheme has been designed to target the best possible biodiversity outcomes in drainage, planting and design of public space.

14.2.2.2 Regional Guidelines, Policy and Legislation

A Dublin Climate Action Regional Office (CARO) was established as one of four regional climate change offices, in response to Action 8 of the 2018 National Adaptation Framework (DECC, 2018). One of its roles is to assist the local authorities within the region in preparing their climate change action plan. The four local authorities within the Dublin Region (Dublin City Council (DCC), Fingal County Council (FCC), South Dublin County Council (SDCC) and Dún Laoghaire Rathdown Council (DLRCC) each have an individual climate change action plan.

The individual plans were prepared having regard to A Strategy Towards Climate Change Action Plans for the Dublin Local Authorities (Codema, 2017), which includes aims such as aiding the local authorities in tackling climate change and setting a path to tackling the challenges related to the consequences of climate change. As the proposed Scheme will pass predominantly through the DCC jurisdiction, and partly through FCC jurisdiction (at Charlestown), a discussion on the DCC Climate Neutral Dublin 2030, FCC Draft Climate Change Action Plan 2024-2029 and the Local Authority Climate Action Plan 2024-2029, are outlined below.

Dublin City Council Climate Neutral Dublin 2030, Local Authority Climate Action Plan 2024-2029

Dublin County Council's Climate Neutral Dublin 2030, Local Authority Climate Action Plan 2024-2029 was published in March 2024. The DCC second climate action plan, Climate Neutral Dublin 2030, prepared in accordance with Climate Action and Low Carbon Development (Amendment) Act 2021, has three targets that are interdependent:

- A 51% reduction in greenhouse gas emissions in line with our National Climate Objective by 2030, while striving for neutrality before 2050 as per Dublin City's participation in the EU Mission for 100 Climate Neutral and Smart Cities (Net Zero Cities);
- A Climate Resilient City prepared for the known and unknown impacts of climate change; and
- A Just Transition meaning that the actions taken do not cause harm.

Achieving these targets requires collaboration to ensure that the actions connecting the foundations of the plan are interdisciplinary and account for the diverse systems that support life in the city. The four foundations of the plan are:

- A Resilient City;
- A Resource-Full City;
- A Creative City; and
- A Social City.

The connecting actions listed in Appendix 1 of the DCC Climate Action Plan support the foundations. While the actions are categorised, they are not independent of each other. All actions are interconnected and require a collaborative and interdisciplinary approach.

Some of the transport-related measures promoted within the DCC Climate Action Plan involve the conversion of fleet vehicles to low emission vehicles, delivery of Active Travel Projects, sustainable energy communities, quiet zones and low carbon mobility hubs (EV charging infrastructure). In relation to public transport the target is to, by 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, and improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons.

Box 6: The proposed Scheme is in compliance with the aims of DCC's Climate Neutral Dublin 2030 Local Authority Climate Action Plan because of the following components:

- Luas Finglas will provide a key public transport connection between Dublin's north-western suburbs and the city centre and will be key to the overall reduction in reliance on the private car in areas served by the proposed Scheme;
- Luas Finglas is projected to result in an approximate reduction of 10,000 car trips daily;
- The interconnectivity between the light rail element and the active mobility options provided as part of the proposed Scheme includes the 4.4km of segregated cycle tracks and 0.3km non-segregated cycle tracks along the route, covered cycle storage facilities provided at Broombridge Stop, Finglas Stop and St Margaret's Stop and within the Park & Ride structure along with cycle stands provided at all stop locations;
- The proposed Scheme includes the provision of EV Charging Stations at the Park & Ride facility; and
- The proposed Scheme will be integrated with other public transport modes to ensure maximum public benefit and promotes sustainable transport and improved connectivity.

Therefore, the proposed Scheme will directly help achieve the following aims in the DCC Climate Neutral Dublin 2030 Local Authority Climate Action Plan:

- Promote active travel and public transport (including bike bunker roll-out);
- Promote shift to active modes of commuting to reduce transport emissions;
- Regular maintenance of regional and local roads and active travel routes to mitigate risks;
- Identify areas in need of infrastructure that supports re use, repair, repurpose, and free cycling;
- Delivery of public electric vehicle charging infrastructure in collaboration with key partners including ZEVI and ESB Networks;
- Develop strategy to convert fleet to low emission vehicles based on sustainable energy/fuel sources; and ensure end of life plans are in place for vehicles; and
- Community engagement events, e.g. bike week annually, pedestrian days in areas with high footfall, European mobility week and cycle training programmes.

FCC Climate Change Action Plan 2024-2029

Fingal County Council's Climate Action Plan 2024-2029 (CAP) was published in March 2024. The Plan will have effect for a period of five years, from the date of approval. This Plan has been prepared by FCC in partnership with the other Dublin local authorities, Codema and CARO, to create a low carbon and climate resilient County, by delivering and promoting best practice on climate action, at the local level. It aims to show how FCC can contribute towards the Irish goal of net zero no later than 2050 and the transition to a climate resilient, biodiversity rich, environmentally sustainable and climate neutral economy.

A Climate Action Steering Group at Executive Management Level will oversee the implantation of the Plan. The Plan is centred around actions that collectively address four key targets, which are framed by the Climate (Amendment) Act 2021 and the national Climate Action Plan, which are as follows:

- 50% improvement in the Councils energy efficiency by 2030;
- 51% reduction in the Councils greenhouse gas emissions by 2030;
- To make Dublin a climate resilient region by reducing the impacts of future climate change-related events; and
- To actively engage and inform our communities on climate action.

In Fingal, the transportation sector is the largest contributor to GHG emissions, with an estimated 45% of total emissions. FCC supports the Avoid-Shift-Improve approach adopted in CAP23 and CAP24, through its own Development Plan policies and objectives. The Fingal Development Plan 2023-2029 has a focus on Connectivity & Movement in support of Climate Action and strengthening the integration of land-use and transport planning; with a priority focus on compact growth served by high quality public transport and increased provision of walking and cycling infrastructure. The actions in this plan further support this approach. In relation to Public Transport, FCC will continue to work with the relevant transportation bodies (including the NTA, Transport Infrastructure Ireland (TII), Dublin Bus, Luas, Irish Rail, Bus Éireann, and Road Safety Authority) to facilitate and provide support in delivering major improvements to the public transport network, and measures to achieve modal shift.

Box 7: The proposed Scheme is in compliance with the aims of FCC's Climate Action Plan 2024-2029 because of the following components:

- Luas Finglas will provide a key public transport connection between Dublin's north-western suburbs and the city centre and will be key to the overall reduction in reliance on the private car in areas served by the proposed Scheme;
- Luas Finglas is projected to result in an approximate reduction of 10,000 car trips daily;
- The interconnectivity between the light rail element and the active mobility options provided as part of the proposed Scheme includes the 4.4km of segregated cycle tracks and 0.3km non-segregated cycle tracks along the route, covered cycle storage facilities provided at Broombridge Stop, Finglas Stop and St Margaret's Stop and within the Park & Ride structure along with cycle stands provided at all stop locations;
- The proposed Scheme includes the provision of EV Charging Stations at the Park & Ride facility; and
- The proposed Scheme will be integrated with other public transport modes to ensure maximum public benefit and promotes sustainable transport and improved connectivity.

Therefore, the proposed Scheme will directly help achieve the following Actions in the FCC Climate Action Plan 2024-2029:

- FCC's support of public transport projects are specifically detailed as an action (T20). T20 states that FCC will "*Support the development and expansion of existing public transport services including MetroLink, BusConnects and DART expansion to Balbriggan*". This statement is inclusive of the proposed Scheme;
- FCC's support of Park & Ride facility projects are specifically detailed as an action (T21). T21 states that FCC will "*facilitate the provision of Park and Ride facilities in appropriate locations at transport nodes and along strategic transport corridors in accordance with the NTA Strategy and encourage*

the inclusion of EV charge points and bike parking". Regarding the Park and Ride facility, the Action Plan states that they should be strategically located, in accordance with NTA strategy and design for inclusion of EV charging and cycle park facilities; and
- Other FCC key action areas for transport related emissions include Electric Vehicle Charge Point (EVCP) provision and Active Travel actions including Protected Cycleways/Walkways, Connectivity, Mobility and Modal shift measures.

Greater Dubin Area Transport Strategy 2022-2042

The Transport Strategy for the Greater Dublin Area (GDA) 2022- 2042 replaces the previous Transport Strategy for the Greater Dublin Area 2016-2035. The Transport Strategy has been prepared and published by the National Transport Authority in accordance with Section 12 of the Dublin Transport Authority Act, 2008. It sets out how transport will be developed across the region, covering Dublin, Meath, Wicklow and Kildare, over the period of the strategy.

In developing a regional transport strategy there is a wide range of challenges that must be taken into account. While the prime challenge for transport planning is to promote sustainable alternatives to the private car where feasible, it should be emphasised that the Transport Strategy seeks to meet this challenge by providing for all modes in a balanced manner. The transport sector is committed to meeting the targets of reducing emissions by 51% by 2030 and setting a path towards a zero net-emissions scenario by 2050 in full, as set out in the Climate Action and Low Carbon Development (Amendment) Act 2021. For transport, there are three main actions required, namely:

- Reducing the demand for travel;
- Increasing use of public transport, walking and cycling and reducing car use; and
- Conversion of the transport fleet to zero emissions vehicles.

Chapter 16 of the Transport Strategy sets out a pathway for the achievement of a 50% reduction in CO_2 emissions for travel in the GDA by 2030, through a combination of measures to be implemented by a range of actors, including government, local authorities and the private sector. The measures throughout the Strategy are categorised under the Avoid-Shift-Improve headings.

The Transport Strategy, in combination with other Government policies and programmes is forecast to lead to a reduction in carbon emissions from transport in the GDA from 3.2 $MtCO_{2eq}$ in 2018 to c.1.0 $MtCO_{2eq}$ in 2042.

Several measures under the actions for Light Rail are outlined in the strategy. Since the inclusion of a light rail network in the Dublin Transport Initiative Strategy in 1994, the reintroduction of LRT services into Dublin has been a major element of successive plans and investment programmes for the regional transport system. The strategy proposes that demand will be served in part by higher capacity Luas systems including Luas Finglas (as well as other public transport projects):

- *Measure LRT3 – Luas Finglas*: It is intended to extend the Luas Green Line northwards to Finglas, inclusive of a potential park and ride facility at or close to its terminal stop.

Box 8: The proposed Scheme is in compliance with the aims in the Greater Dublin Area Transport Strategy 2022-2042 because of the following components:

- Luas Finglas will provide a key public transport connection between Dublin's north-western suburbs and the city centre and will be key to the overall reduction in reliance on the private car in areas served by the proposed Scheme;
- Luas Finglas is projected to result in an approximate reduction of 10,000 car trips daily;
- The interconnectivity between the light rail element and the active mobility options provided as part of the proposed Scheme includes 4.4km of segregated cycle tracks and 0.3km non-segregated cycle tracks along the route, covered cycle storage facilities provided at Broombridge Stop, Finglas Stop

and St Margaret's Stop and within the Park & Ride structure along with cycle stands provided at all stop locations;
- The proposed Scheme includes the provision of EV Charging Stations at the Park & Ride facility; and
- The proposed Scheme will be integrated with other public transport modes to ensure maximum public benefit and promotes sustainable transport and improved connectivity.

Therefore, the proposed Scheme will directly help achieve the following aims in the Greater Dubin Area Transport Strategy 2022-2042:

- Measure LRT3 – Luas Finglas: It is intended to extend the Luas Green Line northwards to Finglas, inclusive of a potential park and ride facility at or close to its terminal Stop; and
- The proposed Scheme aligns with the strategy, on account of the fact it facilitates sustainable mobility and associated positive effects, including those relating to:
  - Reductions in greenhouse gas emissions and associated achievement of legally binding targets; and
  - Reductions in consumption of non-renewable energy sources and achievement of legally binding renewable energy targets.

14.2.3 Data Collection and Collation

14.2.3.1 Data Sources

In accordance with the relevant TII Publications listed below in section 14.2.4.1, the Climate assessment is based on a desk-based assessment methodology. Localised monitoring of climate change parameters over a short-term period is not feasible or accurate. Weather stations are used to record atmospheric and weather conditions such as temperature, rainfall, humidity and wind over long periods of time, to enable understanding of climate change, i.e. the long-term atmospheric trends for a specific location. This data can be used to understand how the climate is changing, by comparing the climate for one time period against the climate for another time period. Therefore, all research data and relevant publications have been based on a review from the following sources;

- Transport Infrastructure Ireland (TII);
- Department of Environment, Climate & Communications (DECC);
- Environmental Protection Agency (EPA);
- Sustainable Energy Authority Ireland (SEAI);
- Fingal County Council (FCC);
- Dublin City Council (DCC);
- Climate Ireland https://www.climateireland.ie;
- Met Éireann https://www.met.ie/; and
- Flood Maps https://www.floodinfo.ie/map/floodmaps

14.2.4 Methodology for the Assessment of Impacts

14.2.4.1 Transport Infrastructure Ireland Guidelines

To align with the requirements of the Environmental Impact Assessment (EIA) Directive 2014/52/EU (The European Parliament and the Council of the European Union, 2014 amending Directive 2011/92/EU) the climate assessment includes the following assessments:

- Greenhouse Gas Emissions (GHG) Assessment - Impact of the project on the climate. This assessment quantifies GHG emissions from a project during its lifetime and contextualises the magnitude of the impact of these emissions against relevant carbon budgets, targets and policy; and
- Climate Change Risk (CCR) Assessment - Impact of a changing climate on the project. This assessment identifies the impact of a changing climate on a project and receiving environment. The assessment considers a project's vulnerability to climate change and identifies adaptation measures to accommodate climate change impacts.

This Climate assessment has been completed in accordance with the following TII Publications:

- Climate Guidance for National Roads, Light Rail and Rural Cycleways (Offline & Greenways) – Overarching Technical Document. This Overarching Technical Document (OTD PE-ENV-01104, December 2022) provides guidance on the methodology, scope and processes underlying climate assessment (CA) for National Roads, Light Rail, and Rural Cycleways (Offline & Greenways) projects;
- Climate Assessment of Proposed National Roads – Standard. This Standard Document (SD PE-ENV-01105, December 2022) sets out the required approach for Climate Practitioners to identify significant climate effects; in terms of both Greenhouse Gas (GHG) emissions and climate resilience, associated with all stages of proposed national road developments: the design, construction, and operation of national roads in accordance with TII's project planning and national planning requirements;
- Air Quality Assessment of Specified Infrastructure Projects - Overarching Technical Document (OTD PE-ENV-01106, Dec 2022); and
- Air Quality Assessment of Proposed National Roads - Standard (SD PE-ENV-01107, Dec 2022).

Note: The Air Quality OTD PE-ENV-01106 and SD PE-ENV-01107 are relevant because the Road Emissions Model (REM) output is required to provide road user carbon emission calculations as a result of the of the modal shift (the change from one form of transportation to another) to inform the climate impact assessment.

TII have developed the TII Road Emissions Model (REM) and the TII Carbon Tool, for use in the assessment of air quality and climate effects for national road schemes and light rail projects. These Technical Guidance documents are:

- TII Carbon Tool for Road and Light Rail Projects: User Guidance Document (GE-ENV-01106, February 2024); and
- TII Road Emissions Model (REM): Model Development Report, GE-ENV-01107, December 2022.

14.2.4.2 Assessing Life-cycle Carbon Emissions

An assessment of the impact on climate change (including greenhouse gas (GHG) emissions) from the Construction and Operational Phases of the proposed Scheme has been undertaken using the Transport Infrastructure Ireland (TII) calculation tool for assessing lifecycle carbon emissions for national road and light rail infrastructure projects in Ireland. The purpose of the tool is to assist Transport Infrastructure Ireland (TII) to comply with the requirements of the revised Environmental Impact Assessment (EIA) Directive 2014/52/EU, which requires European Union (EU) Member States to assess the impact of projects on climate change (including greenhouse gas (GHG) emissions) as part of the EIA process.

Using the guidance outlined in TII OTD PE-ENV-01104 and the TII Carbon Tool, the lifecycle carbon emissions for the proposed Scheme have been calculated. The TII Carbon Tool for lifecycle carbon emissions assesses various stages of the proposed Scheme as follows:

- "**Pre-Construction"** stage considers activities that will take place at the pre-construction stage of a project, specifically clearance and demolition works;
- **"Embodied Carbon"** stage considers the product stage, including materials that will be used during the construction process, their lifetime (to determine replacement cycles) and details of material transportation;
- **"Construction Activities"** stage considers construction activities that will take place during infrastructure development, including excavation activities, energy use of construction activities, water use and landscaping & vegetation;
- The **"Operational Use Carbon"** stage considers emissions associated with the operation of the infrastructure scheme such as energy, water and waste;
- The **"Operational Carbon Emissions"** of a project, considers emissions associated with the use of the project by the users;
- The **"Maintenance Carbon"** stage of a project, considers emissions associated with the fuel used for the maintenance of the infrastructure scheme during its use; and
- "**End of Life Carbon**" stage considers the decommissioning of the scheme, including deconstruction and demolition activities and waste disposal.

14.2.4.3 Greenhouse Gas Assessment (GHG) Assessment Methodology

OTD PE-ENV-01104, Table 5.1 outlines the GHG Assessment step by step methodology. The following aspects of the proposed Scheme have been assessed in terms of the GHG Assessment:

- Potential direct and indirect greenhouse gas (GHG) emissions associated with the construction and maintenance of the proposed Scheme – this includes site clearance, embodied carbon, material transport, construction activities and waste management;
- Potential changes in GHG emissions associated with modal shift changes in road traffic volumes within the study area due to the Operational Phase of the proposed Scheme;
- A summary of the approach for each of the above aspects is provided in the following sections; and
- Construction and maintenance phase climate emissions.

The OTD PE-ENV-01104 sets out the approach for Climate Assessment for all TII projects and recommends the use of the online TII Carbon Assessment Tool to calculate emissions arising from construction and maintenance for national road and light rail infrastructure projects in Ireland. The online TII Carbon Assessment Tool allows TII to update emission factors and add new materials into the database for use in Climate Assessment for all TII projects. The tool is based on the requirements of Publicly Available Specification PAS 2080:2023 *Carbon management in buildings and infrastructure*.

The carbon emissions are calculated by multiplying the emission factor by the quantity of the material that will be used over the entire construction / maintenance phase. The goal of the tool is to assist project development as a decision-making tool that drives lower carbon infrastructure and to facilitate the integration of environmental issues into transport infrastructure planning, construction and operation.

The GHG assessment is not solely based on whether a project emits GHG emissions alone, but how it makes a relative contribution towards achieving a science based 1.5°C aligned transition towards net zero. The crux of assessing significance is “not whether a project emits GHG emissions, nor even the magnitude of GHG emissions alone, but whether it contributes to reducing GHG emissions relative to a comparable baseline consistent with a trajectory towards net zero by 2050” (IEMA 2022 GHG Guidelines). The Climate Assessment has assessed the following:

- The extent to which the trajectory of GHG emissions from the project aligns with Ireland’s GHG trajectory to net zero by 2050; and
- The level of mitigation of GHG emissions.

These significance criteria align with the overall aim of the local and national Climate Action Plans to achieve Net Zero Carbon by 2050 as set out as the National climate objective in Section 3 of the 2015 Climate Action and Low Carbon Development Act (No. 46 of 2015).

The Greenhouse Gas Assessment Instructions in OTD PE-ENV-01104, outline that it is a requirement to investigate GHG reduction opportunities, clearly define the scope and boundary of the assessment and collect necessary data to complete the assessment using the TII Carbon Assessment Tool, in association with the Project manager, Design Team and environmental disciplines at the start of the phase and throughout the design development. This has been undertaken.

Construction Phase Emissions

The TII Carbon Tool has been used to estimate the total GHG emissions associated with the construction of the proposed Scheme. The Luas Team undertook a detailed review of the proposed Construction Phase to identify clearance and demolition works, construction methods, construction materials and Construction Phase durations to allow for the collation of detailed design data to inform the Carbon Tool input data.

Operational Phase Emissions from Modal Shift Changes in Road Traffic Volumes

Emissions from road transport along the existing roads in the study area that will experience a modal shift, i.e. a potential net reduction or increase in road traffic and CO_2 emissions along specific road links, with the proposed Scheme in operation have been calculated using the TII Road Emissions Model (REM).

In order to calculate the impact of modal shift (the change from one form of transportation to another) due to the proposed Scheme, the TII Road Emissions Model (REM) has been used to calculate greenhouse and non-greenhouse gas emissions, as used for the Air Quality Assessment. This has been undertaken using annual average daily traffic (AADT) flow data and speeds for light and heavy vehicles on the surrounding road network, without and with the proposed Scheme in operation. This has been used to assess the climate impact of the proposed Scheme due to the modal shift on the surrounding road network within the study area.

The TII REM tool calculates road transport emissions by integrating traffic volumes and vehicular speeds for light and heavy goods vehicles together with Irish fleet composition information. The TII REM tool provides a spatial and temporal estimate of carbon dioxide equivalent emissions and the pollutant concentrations resulting from vehicular use on the National Roads Network. The REM integrates:

- Traffic information from the TII National Transport Model which provides validated estimates of the volumes of light and heavy vehicles, and the speed at which they travel, on the National Roads Network;
- A Fleet Mix database developed by researchers in the Energy Policy and Modelling Group at University College Cork for cars based on economic projections, and for other light and heavy vehicles by AECOM. The Fleet Mix database is underpinned by the Central Statistics Office's goods vehicles registration data (both heavy and light goods vehicles);
- Emission Rate Database derived from the European Environment Agency's (EEA) COPERT Emissions Tool – the EU industry standard vehicle emissions calculator – published in the EMEP/EEA air pollutant emission inventory guidebook. These data were adjusted further using data published in the UK by DEFRA; and
- An Ambient Air Quality Model module, which calculates pollutants (CO_2, NOx, NO_2, PM_{10} and $PM_{2.5}$) released from each individual road link, using predictions of atmospheric pollutants concentration and dispersion, scaled up to an annual average concentration.

Under EU and national policy on electric vehicles and fuel and engine technology, the proportions of the different vehicle classifications (EURO classification) will change in the future because it is expected the fleet will move towards increased adoption of newer and relatively lower emission vehicles in the future, including greater uptake of hybrid (HEV), battery-electric (BEV) and alternative fuelled vehicles. The extent of this change is unknown. Therefore, the TII REM tool can generate results for three separate Fleet Databased scenarios within the REM model as follows:

- Business as Usual (BaU) scenario; i.e. excluding strategic policy interventions for reduction of CO_2, etc, and based on existing trends in vehicle purchasing and turnover of vehicles out of the vehicle fleet;
- Climate Action Plan (CAP) based on achieving increases in EVs including 151,000 passenger car EV and PHEVs by 2025 and 840,000 passenger car EV and PHEVs by 2030; and
- An intermediate case using linear extrapolation to a central value between BaU and CAP for each vehicle sub-classification.

The BaU represents a scenario whereby there is no progression in reducing the average tailpipe greenhouse gas emissions per vehicle while the CAP scenario assumes a full implementation of current CAP policy and targets. Worst-case results for the BaU scenario in Year of Opening 2035 and Design Year 2050 are presented within this assessment of the existing roads in the study area that will experience a reduction or increase in road traffic volumes by >1,000 AADT with the proposed Scheme in operation, in accordance with TII Guidance.

The screening approach uses the following criteria to determine the affected road network (ARN). The criteria are based on the changes between the Do-Something (DS) traffic compared to the Do-Minimum (DM) traffic as follows:

- Road alignment will change by 5m or more; or
- Annual average daily traffic (AADT) flows will change by 1,000 or more; or

- Heavy duty vehicle (HDV) (vehicles greater than 3.5 tonnes, including buses and coaches) flows will change by 200 AADT or more; or
- Daily average speed change by 10 kmph or more; or
- Peak hour speed will change by 20 kmph or more.

The traffic data for the existing roads in the study area that will experience a reduction or increase in road traffic volumes by >1,000 AADT with the proposed Scheme in operation, have been input to the model to generate road vehicle emissions for 2023 Base Year, 2035 Opening Year and 2050 Design Year.

14.2.4.4 Climate Change Risk Assessment Methodology

OTD PE-ENV-01104, Table 5.2 outlines the CCR Assessment step by step methodology. The assessment methodology is a two-stage process. Stage 1 Climate Screening includes Sensitivity Analysis, Exposure Analysis and Vulnerability Assessment of specific climate hazards. If the results of Stage 1 indicate a climate hazard is a potential vulnerability, then Stage 2 Detailed Climate Risk Assessment is carried out. The detailed climate risk assessment analyses climate hazards and their impacts to quantify the significance of the risks to the project in the current and future climate conditions. The process assesses the likelihood and consequences of the impacts or risks associated with the hazards identified in the vulnerability assessment (or climate screening) and assesses the significance of the risk to the project. This process also enables the identification, appraisal, selection and implementation of adaptation measures, which aim to improve the resilience of the project to climate change.

The Stage 1 Climate Screening is undertaken using the following methodology:

- In undertaking the sensitivity analysis, the asset categories and climate hazards to be considered in the climate screening include:
  - Asset categories – Pavements, drainage, structures, utilities, landscaping, signs, light posts, associated auxiliary buildings, and fences; and
  - Climate hazards – Flooding (coastal), flooding (pluvial), flooding (fluvial), extreme heat; extreme cold, wildfire, drought, extreme wind, lightning and hail, landslides and fog.
- Determine the sensitivity (low, medium, or high) of each asset category to each of the climate hazards by assigning a sensitivity score of 1 to 3;
- Using the historic climate data, assess the level of exposure for each climate hazard within the proposed Scheme study area; and
- Take the product of sensitivity and exposure, for each climate hazard and each asset category identified – $\boldsymbol{Vulnerability} = \boldsymbol{Sensitivity} \times \boldsymbol{Exposure}$. Any climate hazards with vulnerabilities marked as high have been included in the Stage 2 detailed climate change risk assessment.

The Stage 2 Climate Change Risk Assessment is undertaken using the following methodology:

- The asset categories considered in the climate screening have formed the key project receptors in this assessment as well as any critical connecting infrastructure and significant parts of the surrounding environment;
- Define the climate baseline (historic extreme climate events) using historic climate conditions and gathering climate change projection data to understand future climate conditions;
- The probability levels of future climate projections are determined for the CCR Assessment using relevant resources such as https://www.climateireland.ie/; and
- The climate data gathered is used to identify climate-related risks to the project to generate a comprehensive list of risks based on the climate change hazards that have been deemed relevant to the proposed Scheme and location.

The vulnerability and risk of both the Construction and Operational Phases of the proposed Scheme to climate change have been assessed in terms of the CCR Assessment.

14.2.5 Assessment Criteria

14.2.5.1 Carbon Budgets

Ireland's national emission reduction objectives, as set in the Climate Action and Low Carbon Development (Amendment) Act 2021, are to achieve a 51% emissions reduction by 2030 compared to 2018 and achieve a climate neutral economy by no later than the end of 2050.

The Climate Action and Low Carbon Development (Amendment) Act 2021 provides for the establishment of carbon budgets in support achieving Ireland's climate ambition. The carbon budget programme, comprising three 5-year budgets came into effect on 6th April 2022 for the following periods:

- Budget 1 from 2021-2025 has been set at 295 Mt CO_{2eq} representing an average of 4.8% reduction per annum for the first budget period;
- Budget 2 from 2026-2030 has been set at 200 Mt CO_{2eq} representing an average of 8.3% reduction per annum for the second budget period; and
- Budget 3 from 2031-2035 has been set at 151 Mt CO_{2eq} representing an average of 3.5% reduction per annum for the third provisional budget.

To deliver these targets, in July 2022 the Department of the Taoiseach issued Sectoral Emissions Ceilings which set maximum limits on greenhouse gas emissions for each sector of the Irish economy to the end of the decade. For transport, the proposed sectoral emissions ceiling delivers ~20% and 50% emissions reductions in 2025 and 2030.

CAP24 sets out the sectoral emissions ceilings agreed by Government, which set the required level of abatement to be achieved in the transport sector by 2030 at 50%. In quantitative terms, this legally binding target thus obligates the transport sector to achieve a reduction from its 2018 emissions baseline of 12.2 Mt CO_{2eq} to 6.1 Mt CO_{2eq} by 2030, and to do so in a manner that is consistent with a sectoral emissions ceiling of 54 Mt CO_{2eq} for the first carbon budget period (2021-2025), and a further reduced sectoral emissions ceiling of 37 Mt CO_{2eq} over the second carbon budget period (2026-2030). These emissions ceilings are summarised in Table 14-4 for the transport sector.

Table 14-4: Transport Sectoral Emissions Ceilings

GHG emissions Mt CO_{2eq}			% change vs. 2018		Sectoral emissions ceilings, Mt CO_{2eq}	
2018	2025	2030	To 2025	To 2030	2021-2025	2026-2030
12.2	10	6.1	~20%	~50%	54	37

In order to achieve the sectoral emissions ceilings outlined in Table 14-4 for the transport sector, CAP24 outlines that the focus is on pursuing measures to address travel demand by pursuing policy measures that promote greater efficiency in our transport system, allied with significant investment in sustainable alternatives and incentives and regulatory measures to promote the accelerated take-up of low carbon technologies.

CAP 24 outlines the latest GHG emissions for the transport sector in Table 14-5 and the recent trends in GHG emissions for the transport sector in Table 14-6.

Table 14-5: Transport Sector – Latest GHG Emissions

Transport Sector GHG emissions Mt CO_{2eq}	Percentage share of Total GHG emissions	Emissions tCO_{2eq} per capita
11.63	17.1%	2.28

Table 14-6: Trends in GHG Emissions

Timeframe	Percentage share	Absolute Change Mt CO_{2eq}
2018-2022	-4.5%	-0.55

CAP24 outlines that the structure for the sector's decarbonisation pathway set out in CAP23 was naturally skewed to deliver the greatest share of emissions abatement in the second half of this decade. The cumulative emissions over the first two years of the carbon budget programme (22.6 $MtCO_{2eq}$) suggests that, at present, the transport sector is currently aligned to the required compliance pathway to 2025, with 41.9% of the 1st carbon budget consumed over those first two years. However, it is important to note that the sector's emissions were artificially depressed in 2021 as a continued legacy of COVID-19 public health restrictions, and transport emissions over both 2021 and 2022 have seen increases in emissions of approximately 6% per annum with the ending of pandemic restrictions and the return to pre-COVID levels of economic activity. Though the overall emissions trend since 2018 is downward and 2022 emissions were 4.5% lower than 2018 levels, the scale of abatement required (5.2% p.a.) over the period 2023-2025 highlights the urgent need to reverse this recent rebound in emissions to avoid jeopardizing the sector's capacity to achieve its abatement pathway in future years.

The Department of Transport is responsible for overseeing a 50% reduction in transport sector emissions to 2030. Meeting the target emissions will require full implementation of the core measures outlined in CAP24.

Due to the fact that the proposed Scheme is not due to be constructed until 2031, it cannot contribute to the emissions reductions target of 6 Mt CO_{2eq} by 2030. However, it can be stated that the proposed Scheme directly relates to measures outlined in the Climate Action Plan that will contribute to the emissions reductions beyond 2030, as follows;

- T3 – Electrify mass transportation, i.e. 'expanded electrified rail services';
- T4 – Sustainable transport journeys and demand management measures, i.e. 'a reduction in car passenger kilometres versus Do Nothing'; and
- T5 – Further modal shift (Tier 2), i.e. 'encouraging a behavioural change to reduce kilometres travelled to a greater extent'.

In terms of the aims of the EPA's Greenhouse Gas Emissions Projections 2022-2040 to reduce transport emissions by 50% by 2030, the proposed Scheme will allow for a reduction in total vehicle kilometres, to be achieved by behavioural and sustainable policies and measures outlined in the Climate Action Plan 2024, with a significant increase in daily active travel journeys and in daily public transport journeys. The Operational Phases road traffic use GHG emissions savings with the proposed Scheme in operation have been quantified.

14.2.6 Significance Assessment

14.2.6.1 Significance Criteria for GHG Assessment

OTD PE-ENV-01104 outlines that based on the extent to which the trajectory of GHG emissions from the project aligns with Ireland's GHG trajectory to net zero by 2050 and the level of mitigation taking place that "*the Climate Practitioner should use the matrix shown in Table 6.7 to assess the significance of GHG emissions arising as a result of the project*". Therefore, the Significance Matrix shown in Table 14-7 [Table 6.7 from OTD PE-ENV-01104] has been used to assess the significance of GHG emissions arising as a result of the proposed Scheme.

Table 14-7: TII Significance Matrix for the GHG Assessment

Effects	Magnitude of Impact	Definition
Significant Adverse	Major Adverse	The project's GHG impacts are not mitigated; The project has not complied with do-minimum standards set through regulation, nor provide reductions required by local or national policies; and No meaningful absolute contribution to Ireland's trajectory towards net zero.
	Moderate Adverse	The project's GHG impacts are partially mitigated; The project has partially complied with do-minimum standards set through regulation, and have not fully complied with local or national policies; and Falls short of full contribution to Ireland's trajectory towards net zero.
Not Significant	Minor Adverse	The project's GHG impacts are mitigated through 'good practice' measures; The project has complied with existing and emerging policy requirements; and Fully in line to achieve Ireland's trajectory towards net zero.
	Negligible	The project's GHG impacts are mitigated beyond design standards; The project has gone well beyond existing and emerging policy requirements; and Well 'ahead of the curve' for Ireland's trajectory towards net zero.
Beneficial	Beneficial	The project's net GHG impacts are below zero and it causes a reduction in atmosphere GHG concentration; The project has gone well beyond existing and emerging policy requirements; and Well 'ahead of the curve' for Ireland's trajectory towards net zero, provides a positive climate impact.

14.2.6.2 Significance Criteria for CCR Assessment

As stated, the CCR Assessment is undertaken in two stages, Stage 1 Climate Screening including Sensitivity Analysis, Exposure Analysis and Vulnerability Assessment of specific climate hazards, followed by Stage 2 Detailed Climate Risk Assessment.

To undertake the Sensitivity Analysis, a score is applied for each asset category (pavements, drainage, structures, earthworks, etc.) against each climate hazard (flooding, extreme temperature, etc.).Table 14-8 (OTD PE-ENV-01104, Table 7.1) provides the definitions and scoring used when assessing sensitivity.

Table 14-8: Sensitivity Definition and Scoring

Level	Definition	Scoring
High sensitivity	The climate hazard will or is likely to have a major impact on the asset category.	3
Medium sensitivity	It is possible or likely the climate hazard will have a moderate impact on the asset category.	2
Low sensitivity	It is possible the climate hazard will have a low or negligible impact on the asset category.	1

The aim of the Exposure Analysis is to identify which climate hazards are relevant to the planned project location e.g. flooding would represent a significant hazard for a project located next to a river in a floodplain. Therefore, whilst Sensitivity Analysis focuses on the type of project, Exposure Analysis focuses on location. The hazards assessed are the same as those used for the sensitivity analysis. To undertake the Exposure Analysis, an exposure score is applied for each climate hazard at the project location. The allocation of exposure level is informed by the high-level climate data. Table 14-9 (OTD PE-ENV-01104, Table 7.3) shows the Exposure Analysis definitions and scoring.

Table 14-9: Exposure Analysis Definition and Scoring

Level	Definition	Scoring
High exposure	It is almost certain or likely this climate hazard will occur at the project location i.e. might arise once to several times per year.	3
Medium exposure	It is possible this climate hazard will occur at the project location i.e. might arise a number of times in a decade.	2
Low exposure	It is unlikely or rare this climate hazard will occur at the project location i.e. might arise a number of times in a generation or in a lifetime.	1

The Vulnerability Assessment combines the outcomes of the Sensitivity Analysis and Exposure Analysis with the aim to identify the key vulnerabilities and the potentially significant climate hazards associated with the proposed Scheme. To complete the Vulnerability Assessment, the product of Sensitivity Analysis and Exposure Analysis for each climate hazard and each asset category is identified and mapped as per Table 14-10 (OTD PE-ENV-01104, Table 7.5).

Table 14-10: Vulnerability Matrix [$\boldsymbol{Vulnerability = Sensitivity \times Exposure}$]

Sensitivity	Exposure		
	Low (1)	Medium (2)	High (3)
Low (1)	1	2	3
Medium (2)	2	4	6
High (3)	3	6	6

Any high vulnerabilities (score >5) are then subjected to the Stage 2 Detailed Climate Risk Assessment using a combination of likelihood analysis and impact analysis. The likelihood analysis looks at how likely the identified climate hazards are to occur within a given timescale. Table 14-11 (OTD PE-ENV-01104, Appendix D, Table D.2) presents the likelihood analysis key used for this assessment.

Table 14-11: Likelihood Analysis Key

Term	Qualitative	Quantitative
Rare	Highly unlikely to occur	5%
Unlikely	Unlikely to occur	20%
Moderate	As likely to occur as not	50%
Likely	Likely to occur	80%
Almost Certain	Very likely to occur	95%

The impact analysis investigates the consequences of the climate hazards and also refers to the severity and magnitude. Table 14-12 (OTD PE-ENV-01104, Appendix D, Table D.3) provides guidance to ranking the risk areas and this table was taken from the European Commission (2021) technical guidance on the climate-proofing of infrastructure in the period 2021-2027.

Table 14-12: Consequence Analysis Key

Risk Areas	Insignificant	Minor	Moderate	Major	Catastrophic
Asset damage, engineering, operational	Impact can be absorbed through normal activity	Adverse event that can be absorbed by taking business	A serious event that requires additional emergency business	A critical event that requires extraordinary /emergency	Disaster with the potential to lead to shut down or collapse or loss

Risk Areas	Insignificant	Minor	Moderate	Major	Catastrophic
		continuity actions	continuity actions	business continuity action	of the asset / network
Health and safety	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. No recovery required	Localised within site boundaries. Recovery measurable within one month of impact	Moderate harm with possible wider effect Recovery in one year	Significant harm with local effect Recovery longer than one year. Failure to comply with environmental regulations / consent	Significant harm with widespread effect. Recovery longer than one year. Limited prospect of full recovery
Social	No negative social impact	Localised, temporary social impacts	Localised, long-term social impacts	Failure to protect poor or vulnerable groups. National, long- term social impacts	Loss of social license to operate. Community protests
Financial	x % internal rate of return (IRR) <2% of turnover	x % IRR 2-10% of turnover	x % IRR 10-25% of turnover	x % IRR 25-50% of turnover	x % IRR > 50% of turnover
Reputational	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 the stability of the government
Cultural Heritage and cultural premises	Insignificant impact	Short-term impact. Possible recovery or repair	Serious damage with a wider impact to tourism industry	Significant damage with national and international impact	Permanent loss with resulting impact on society

Table 14-13 (OTD PE-ENV-01104, Table 7.11) presents summary outcome of the assessment of likelihood and consequence of each climate hazard in the form of a climate risk matrix.

Table 14-13: Climate Risk Matrix

Likelihood	Exposure				
	Insignificant	Minor	Moderate	Major	Catastrophic
Rare	Low	Low	Medium	High	Extreme
Unlikely	Low	Medium	Medium	High	Extreme
Moderate	Low	High	High	Extreme	Extreme
Likely	Medium	High	High	Extreme	Extreme
Almost Certain	High	High	Extreme	Extreme	Extreme

In order to assess the Climate Change Risks on the proposed Scheme the following has been completed:

- Determined the initial likelihood, consequence and risk rating for each risk identified for each climate scenario considered; and
- Assessed the number of 'Significant' climate risks facing the project (prior to the implementation of adaptation measures).

The risk framework and the risk ratings allocated are used to determine significance. The risk rating levels e.g., 'Low', 'Medium', 'High', 'Extreme' have been denoted as either 'Significant' or 'Not Significant', and each risk allocated a significance rating depending on its highest initial risk rating.

In the Stage 2 Detailed Climate Risk Assessment, 'Low' and 'Medium' have been defined as 'Not Significant' whilst, 'High' and 'Extreme' have been defined as 'Significant'.

If the Stage 2 Detailed Climate Risk Assessment concludes that there are significant climate risks to the proposed Scheme, these must be managed and reduced to an acceptable level through the identification and implementation of adaptation measures. Adaptation measures are actions that can be implemented to improve resilience to climate change, if deemed to be required.

14.3 Baseline Environment

14.3.1 Macroclimate

Macroclimates refer to the overall climate experienced across a large geographic area, such as an entire country or a provincial area. Microclimates are distinct, localised climates representative of a smaller scale area that represent a prevailing climate of that area which may be affected by topography, vegetation and/or the presence of artificial structures. A microclimate could be representative of upland areas, coastal regions, forests and urban areas.

The Climate Ireland website (www.climateireland.ie) provides up-to-date information on Ireland's changing climate for a wide range of variables and across atmospheric, terrestrial and oceanic domains. This website collates the latest research on historic and projected climate trends in Ireland and is used as the reference for the macroclimate within the State. The EPA Research Report No. 386 'The Status of Ireland's Climate, 2020' has been referenced and this report highlights the following regarding the current status of Ireland's climate:

- The annual average surface air temperature in Ireland has increased by approximately 0.9°C over the last 120 years, with a rise in temperatures being observed in all seasons. Fifteen of the top 20 warmest years on record have occurred since 1990 and the length of warm spells has increased slightly over the last 60 years; and
- Annual precipitation was 6% higher in the period 1989 to 2018, compared to the 30-year period 1961 to 1990. The decade 2006 to 2015 was the wettest on record; and

In association with the increased temperatures, the following has also been reported in relation to the status of Ireland's ocean:

- Sea level continues to rise; Satellite observations indicate that the sea level around Ireland has risen by approximately 2-3 mm/year since the early 1990s. Analysis of sea level data from Dublin bay suggests a rise of approximately 1.7 mm/year since 1938 which is consistent with global average rates; and
- Sea surface temperatures indicate that the ocean is getting warmer; The average sea surface temperature at Malin Head over the 10 years between 2009 and 2018 was 0.47°C above the 1981-2010 mean. The global trend from 1990 to 2020 has been a rise in ocean temperature of 0.15°C / decade.

The following has also been reported in relation to the status of Ireland's terrestrial areas:

- River flows: there is an increase in flows across most of the country. There is an upward trend in river flow in the period 1972-2017. However, there is evidence in recent years of an increase in potential drought conditions especially in the east;

- Vegetation fires: most fires occur between March and June each year. The average area burned annually is 4,000 - 6,000 ha;
- Upland heaths and blanket bogs have the strongest association with fires. Land cover: the area of forests and artificial surfaces has increased. Land cover observations since 1990 show increases in the area covered by both artificial surfaces and forests and a decrease in wetland areas which include peatlands; and
- There has been a growth in forest extent of 30% from 1990 to 2018 above ground biomass: the total volume of trees and hence carbon sequestered in forest has increased above ground biomass. Privately owned forest that has been grant aided by the Irish government has undergone the largest increase in tree volume. The volume of trees has increased by 38% between 2006 and 2017.

The above is linked to the following scientific findings:

- Background carbon dioxide (CO_2) concentrations reached 414 ppm in 2020 which is approximately a 50% increase compared to pre-industrial levels;
- Methane (CH_4) concentrations are at 1940 ppb - which is approximately a 170% increase compared to pre-industrial levels; and
- Nitrous oxide (N_2O) concentrations are now above 330 ppb - which is approximately a 20% increase compared to pre-industrial levels.

Climate projections for the future indicate that observed climate trends will continue and intensify over the coming decades including the following:

- Changes in wind speeds and storm tracks;
- Increased likelihood of river and coastal flooding;
- Changes in distribution of plant and animal species and in the phenology (the timing of lifecycle events)
- of native species;
- Water stress for crops, pressure on water supply and adverse impacts on water quality; and
- Negative impacts on human health and wellbeing.

14.3.2 Microclimate

14.3.2.1 Historical Weather Data – Dublin Airport

The Met Éireann weather station at Dublin Airport, County Dublin, is the nearest weather and climate monitoring station to the proposed Scheme that has meteorological data recorded for the latest 30-year period from 1991 to 2020, as reported in Table 14-14. The meteorological station at Dublin Airport is located approximately 4km north-east of the proposed Scheme.

Table 14-14: Summary of Met Éireann meteorological data at Dublin Airport, recorded for the 30-year period from 1991 to 2020

Measurement	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Temperature (°C)													
Mean daily max	8	8.5	10.1	12.3	14.8	17.7	19.5	19.1	16.9	13.6	10.3	8.3	13.3
Mean daily min	2.3	2.2	3	4	6.6	9	11.3	11.2	9.5	7.1	4.3	2.6	6.1
Mean temperature	5.2	5.3	6.6	8.2	10.7	13.3	15.4	15.1	13.2	10.4	7.3	5.5	9.7
Absolute max.	16.4	16.2	18.6	21.7	23.2	26.4	27.1	27.2	25	20.9	17.5	15.4	27.2
Min. maximum	-3.2	-0.6	-0.6	4.2	6.3	10.3	11.8	13.8	9.6	5.2	-1.9	-4.8	-4.8
Max. minimum	11.8	11.9	11.9	12.5	14.6	15.8	17.6	18.1	19.1	15.9	12.8	12.9	19.1
Absolute min.	-9.5	-7.9	-7.9	-5.6	-3	0.7	3.9	2.4	0.4	-4.7	-8.4	-12.2	-12.2
Mean num. of days with air frost	7.1	7.2	5.5	3.9	0.5	0	0	0	0	0.8	3.3	6.7	35
Mean num. of days with ground frost	15.2	14.3	13.3	10.4	4.2	0.4	0	0.2	0.7	4.9	9.5	13.9	87
Mean 5cm soil	4	4	5.4	8.5	12.4	15.5	16.7	15.7	13.2	9.6	6.4	4.5	9.7
Mean 10cm soil	4.2	4.3	5.4	7.9	11.4	14.6	15.9	15.2	12.9	9.7	6.7	4.8	9.4
Mean 20cm soil	4.8	4.9	6	8.4	11.6	14.7	16.1	15.6	13.5	10.5	7.5	5.5	9.9
Relative Humidity (%)													
Mean at 0900UTC	87.9	87.9	84.7	79.8	77	76.2	78.6	81.1	84.1	86.5	89.4	88.8	83.5
Mean at 1500UTC	81.6	76.9	71.6	68.7	67.8	67.7	69	69.8	71.9	75.8	81.6	83.9	73.9
Sunshine (hours)													
Mean daily duration	1.9	2.9	3.7	5.4	6.4	6	5	5	4.4	3.4	2.4	1.7	4
Rainfall (mm)													
Mean monthly total	61.8	52.4	51.4	55	57	64	61	73.4	63.3	78.4	82.7	72.1	772.5
Greatest daily total	27.1	28.1	35.8	37	42.1	73.9	39.2	68.3	42.1	71.3	62.8	42.4	73.9
Mean num. of days with >= 0.2mm	17.7	16.1	16.5	15.8	15.3	14.8	16.9	17.1	15.5	17	18.3	18.6	199.6
Mean num. of days with >= 1.0mm	12.5	11	10.7	11.1	10.5	9.8	11.6	11.8	10.7	11.6	12.5	13.3	137.1

Measurement	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
mean num. of days with >= 5.0mm	3.8	3.2	3.5	3.5	3.6	3.9	3.8	4.4	4.1	5	5.2	4.8	48.8
Wind Speed (knots)													
mean monthly speed	12.3	12	11.4	10.3	9.9	9.2	9.1	9.2	9.6	10.5	11.2	11.7	10.5
max. gust	80	67	66	54	57	53	49	44	56	69	66	76	80
max. mean 10-minute speed	53	48	45	37	39	38	36	32	39	51	42	55	55
mean num. of days with gales	2.3	1.4	1	0.2	0.1	0.1	0.1	0	0.2	0.5	0.8	1.2	7.8
Weather (Mean Number of Days with.)													
snow or sleet	3.2	3.2	2.4	0.7	0.1	0	0	0	0	0	0.6	2.3	12.5
snow lying at 0900UTC	0.7	0.4	0.3	0	0	0	0	0	0	0	0.1	0.7	2.2
hail	1.1	1.5	1.8	2	1	0.1	0.2	0.1	0.1	0.2	0.4	0.7	9.2
thunder	0.2	0.2	0.3	0.2	0.7	0.6	0.9	1	0.2	0.3	0.3	0.2	5
fog	2.4	2.4	3.4	2.6	2.4	2.2	2.3	2.8	3.4	2.6	2.3	3.4	32.3

The World Meteorological Organisation (WMO) defines climate as the average weather over an extended period of 30 years. This 30-year time period is used as it is considered long enough to account for year-to-year variations. The 30-year average meteorological data from the meteorological station at Dublin Airport for each of the past four 30-year average periods (1961-2020) is presented in Table 14-15. The data shows limited variation for temperature and sunshine but there is a trend of increasing rainfall (circa 5.4% increase), humidity (c. 1.8% increase) and average wind speed (c. 6% increase) in the period 1991-2020 relative to 1961-1990.

Table 14-15: Summary of Met Éireann 30-Year Average Meteorological Data from Dublin Airport, recorded for the period from 1961 to 2020

Parameter	1961-1990	1971-2000	1981-2010	1991-2020
Mean Temperature (°C)	9.6	9.8	9.8	9.7
Mean Relative Humidity (%)	82.0	82.4	83.0	83.5
Mean Sunshine (hours)	3.9	3.9	3.9	4.0
Mean Rainfall (mm)	732.7	734.7	758.0	772.5
Mean Wind Speed (knots)	9.9	10.0	10.3	10.5

The 30-year average rainfall for Dublin Airport for the period from 1991 to 2020 was 772.5mm, up from 758.0 mm for the period from 1981 to 2010. The highest monthly total averages for the period were typically recorded from August to December. The greatest daily average total of rainfall was observed in the month of October with the number of days with ≥ 5.0 mm rainfall recorded at 48.8 days per annum, up from 42 days for the period from 1981 to 2010. July was the warmest month with a mean temperature of 15.4° C, this is slightly lower than the previous 30-year average (1981 to 2010) of 15.6° Celsius. January was the coldest month with a mean temperature of 5.2° C in the 1981 to 2010 averaging period and 5.3° C in the 1991 to 2020 averaging period.

Figure 14-1 indicating the Dublin Airport wind direction and wind speed data, which outlines that there is a prevailing south-west to westerly wind direction in the area of the proposed Scheme. The wind-rose for the Dublin Airport Meteorological Station (2015-2019) and the Met Éireann 30-year Average Meteorological Data from Dublin Airport, recorded for the period from 1991 to 2020 indicates that wind speeds are generally west to south-west in direction, typically moderate with relatively infrequent gales with an average of 7.8 days with gales per annum and an average maximum wind gust of 80 knots during the period.

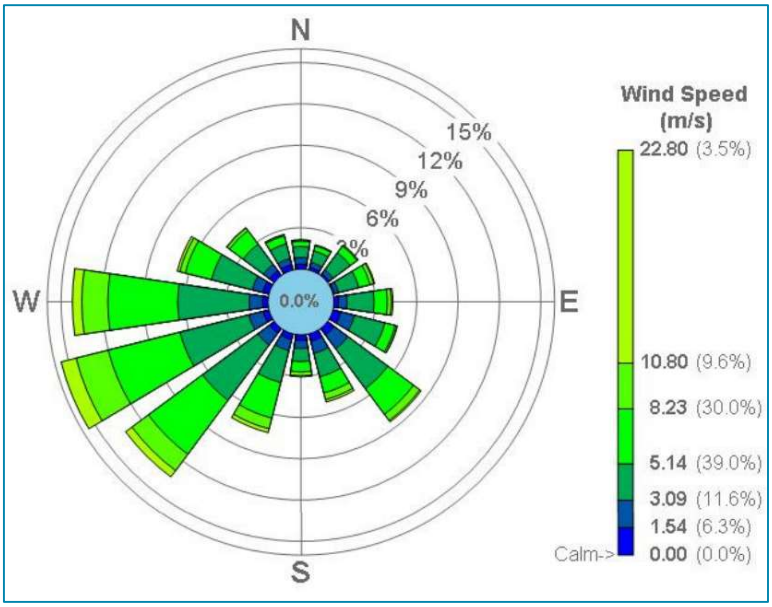

Figure 14-1:Dublin Airport Windrose (2015 to 2019 inclusive)

The recent weather patterns and extreme weather events recorded by Met Éireann have been reviewed. Met Éireann's 2023 Climate Statement, published in January 2024, states 2023's average shaded air temperature in Ireland is provisionally 11.2°C, which is 1.65°C above the 1961-1990 long-term average. 2022 was previously reported as the warmest year on record, but 2023 was reported as 0.38°C warmer (see Figure 14-2). 2023 also had above average rainfall, the warmest June on record and the wettest March and July on record. Record high sea surface temperatures (SST) across the Atlantic were recorded since April 2023, which included a severe marine heatwave to the west of Ireland during the June 2023. This marine heatwave contributed to the record rainfall in July.

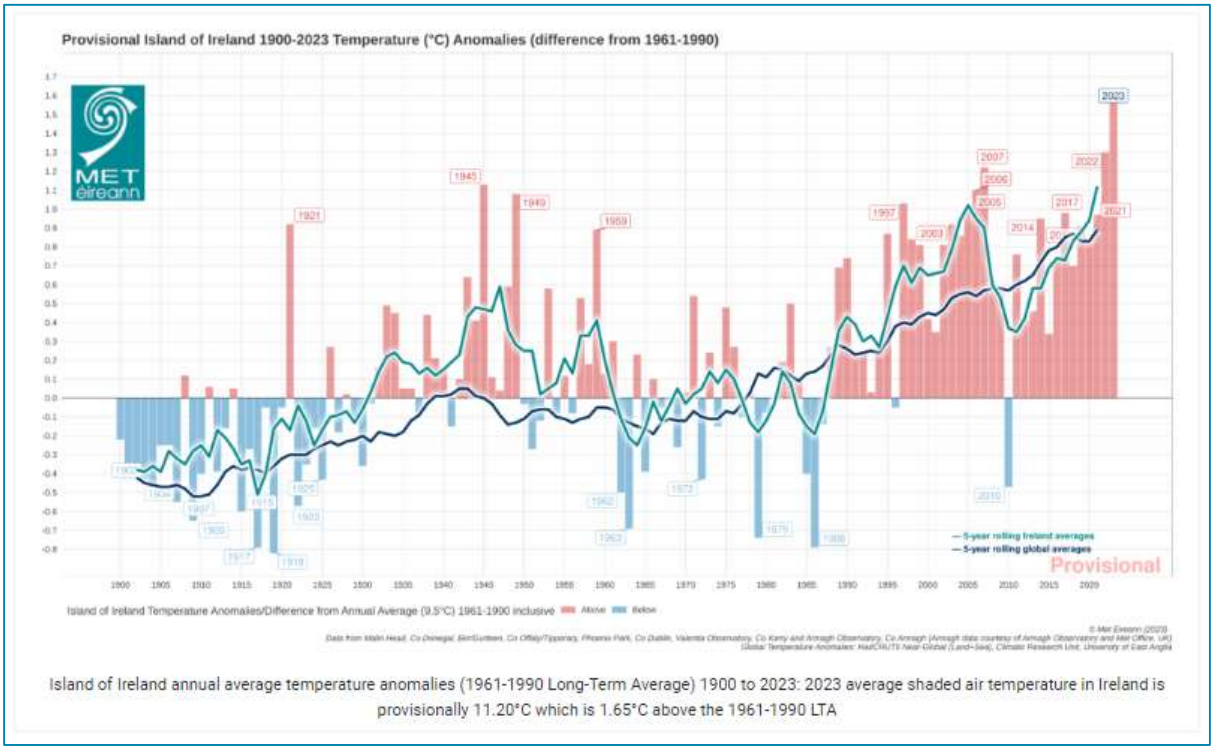

Figure 14-2: 1900-2023 Temperature (°C) Temperature Anomalies (differences from 1961-1990)

A noticeable feature of the recent weather has been an increase in the frequency and severity of storms with notable recent events including violent storms such as Storm Eunice (2022), Storm Barra (2021), Storm Ellen (2020) and Storm Ophelia (2017). Refer to Table 14-16 below.

Table 14-16: Summary of significant past weather and climate events (Met Éireann - https://www.met.ie/climate/major-weather-events)

Year	Date	Event
2022	July 2022	Highest Temperature Recorded in Ireland since 1887
2022	Fri 18 Feb 2022	Violent Storm Eunice
2021	Tue 7 Dec 2021	Violent Storm Barra
2020	Wed 19 Aug 2020	Violent Storm Ellen
2018	Summer	Heatwaves and Drought
2018	28 Feb – 4 Mar	Snow Storm Emma
2017	16 October	Violent Storm Ophelia
2014	12 February	Hurricane-Force Storm Darwin
2013/14	Winter	Winter Storms
2011	24 October	Heavy Rainfall in the greater Dublin Area

Year	Date	Event
2010	Nov/Dec	Severe Cold Spell
2009/10	Winter	Coldest winter for almost 50 years
2009	November	Severe flooding in many parts of the country.
2008	Summer	Heavy rain and flooding
2006	Summer	Warmest summer since record breaking year of 1995
2003	19 September	Flooding/Landslide at Pollatomish
2002	14 November	Severe flooding in eastern areas
2002	1 February	Coastal flooding along the eastern and southern coasts
2000	5 November	Severe flooding in east and southeast
1998	26 December	Hurricane force winds over north and northwest
1998	December	Flooding along Blackwater
1997	24 December	Windstorm
1997	3-6 August	Extensive flooding in southeast and south
1995	Summer	Warmest Summer on record
1995	17 March	A tornado in the Summerhill area of Co Meath
1993	11 June	Flooding in Dublin/Kildare area
1991	5 January	Windstorm
1990	February	Storms and heavy rain
1989	27-28 Oct	Heavy Rainfall in the West and Northwest
1988	9 February	Storm Force winds over Ireland
1987	21 October	Flooding in northern areas
1987	January	Heavy Snowfall
1986	August	Storm – Hurricane Charley
1985	25-26 July	Widespread thunderstorms
1982	January	Heavy snowfall in eastern areas
1980	1-2 Nov	Prolonged and heavy Rainfall in the West and SW
1974/5/6	June-August	Dry Period Oct 1974 to Aug 1976
1976	2 January	Storm
1974	11-12 January	Severe storm caused widespread damage
1973	27-30 Nov	Floods in south and southwest
1963	11 June	Severe thunderstorm in Dublin
1963	January	Severe Cold Spell
1961	16 September	Storm – Hurricane Debbie

14.3.2.2 Existing National Greenhouse Gas (GHG) Inventory

'Ireland's National Inventory Report 2023', published by the EPA, states that in 2021, total emissions of greenhouse gases including indirect emissions from solvent use (without LULUCF[1]) in Ireland were 62,109.9 kt CO_2 equivalent, which is 11.6% higher than emissions in 1990 as presented in Figure 14-3. National Total GHG Emissions (excluding LULUCF) 1990 - 2021. The total for 2021 is 13.5% lower than the peak of 71,814.5 kt CO_2 equivalent in 2001 when emissions reached a maximum following a period of unprecedented economic growth.

The total greenhouse gas emissions in Ireland in 2022, was estimated to be 60.76 million tonnes carbon dioxide equivalent (Mt CO_{2eq}), which is 1.9% lower (or 1.19 Mt CO_{2eq}) than emissions in 2021 (61.95 Mt CO_{2eq}) and emissions are 4.6% below pre-COVID 2019 figures. Decreased emissions in 2022 compared to 2021 were observed in the largest sectors except for transport, waste and commercial services. These three sectors showed increases in emissions (+6.0%, +4.9% and +0.2% respectively), as shown in Table 14-17. This data is based on provisional 1990-2022 Inventory data updated in July 2023 by the EPA.

In relation to the greenhouse gases; carbon dioxide (CO_2) accounted for 60.4% of the total, with methane (CH_4) and nitrous oxide (N_2O) contributing 29.0% and 9.4% as CO_2 equivalent, respectively and F-gases contributing 1.2% of the total as CO_2 equivalent.

Table 14-17: Ireland's Greenhouse gas emissions changes 2021-2022 (Mt CO_{2eq})

Sector	2021 (Mt CO_{2eq})	2022 (Mt CO_{2eq})	% Change
Agriculture	23.626	23.337	-1.2%
Transport	10.978	11.634	+6.0%
Energy Industries	10.262	10.076	-1.8%
Residential	6.992	6.105	-12.7%
Manufacturing Combustion	4.614	4.288	-7.1%
Industrial Processes	2.475	2.289	-7.5%
F-Gases	0.745	0.741	-0.5%
Commercial Services	0.765	0.767	+0.2%
Public Services	0.672	0.659	-1.9%
Waste	0.826	0.867	+4.9%
LULUCF	7.338	7.305	-0.4%
Total excluding LULUCF	61.955	60.763	-1.9%
Total including LULUCF	69.293	68.068	-1.8%
Note: LULUCF = Land Use, Land-use Change and Forestry covers the following categories; Forest land, Cropland, Grassland, Wetlands, Settlements, Other land and Harvested Wood products.			

As shown in Figure 14-3, in 2022, the energy industries, transport and agriculture sectors accounted for 74.1% of total GHG emissions. Agriculture is the single largest contributor to the overall emissions, at 38.4%. Transport, energy industries and the residential sector are the next largest contributors, at 19.1%, 16.6% and 10.0%, respectively. Ireland's GHG emissions from Transport has increased from 9.2% in 1990.

[1] **LULUCF -** Land Use, Land-use Change and Forestry covers the following categories; Forest land, Cropland, Grassland, Wetlands, Settlements, Other land and Harvested Wood products. This sector is a net source of carbon.

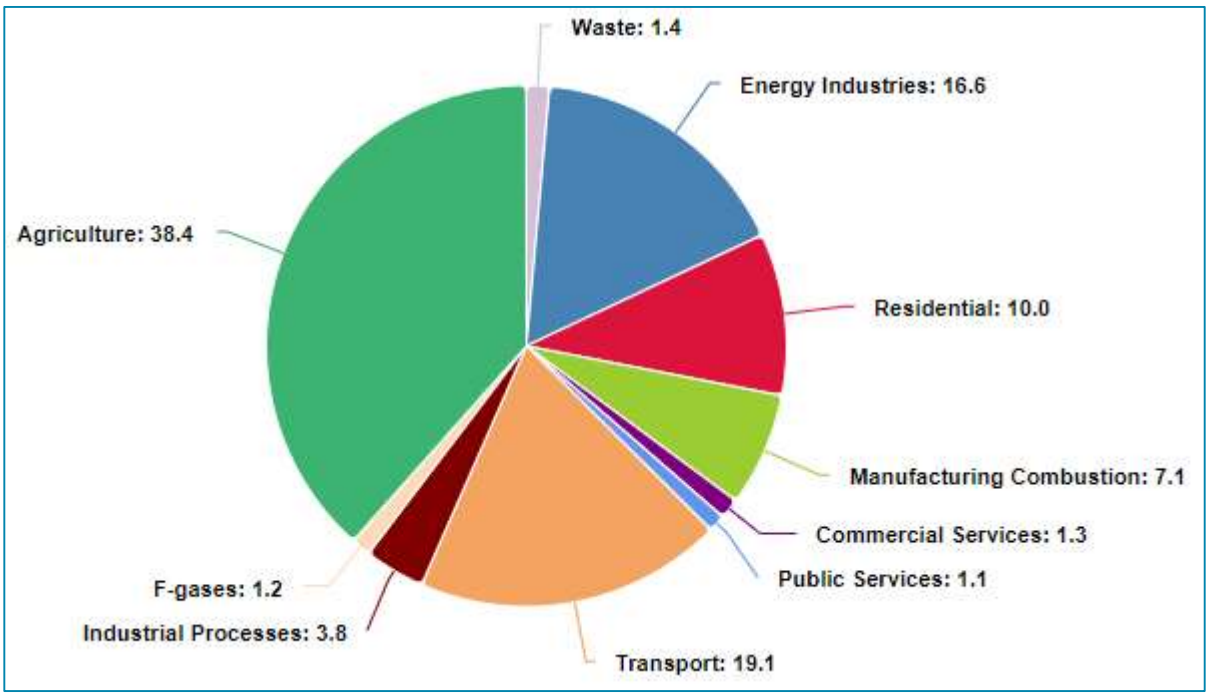

Figure 14-3: Greenhouse Gas Emission per sector in 2022

14.3.2.3 National Greenhouse Gas Emissions Projections 2022-2040 - Transport

EPA Ireland's Greenhouse Gas Emissions Projections 2022-2040 (June 2023) state that the main source of emissions from the transport sector is road transport. The transport sector is projected to contribute to 21% of Ireland's total emissions by 2030 in the With Existing Measures scenario. Figure 14-4 shows the trend in emissions from Transport in the With Existing Measures (WEM) and With Additional Measures (WAM) scenarios. The WEM and WAM scenario projections from 2022 to 2030 are described below.

With Existing Measures (WEM) scenario:

- Under the With Existing Measures scenario, transport emissions are projected to decrease by 1% over the period 2021-2030 from 10.9 to 10.8 Mt CO_{2eq};
- The Biofuel Obligation Scheme places an obligation on fuel suppliers to blend an increasing percentage of biofuel with their fuel. For road transport in the WEM scenario a 10% blend for petrol and a 12% blend for diesel at the pumps by 2030 is assumed. A statutory target of approximately 12% biofuel applies from 1st January 2020;
- In terms of the uptake of Electric Vehicles, the With Existing Measures scenario assumes approximately 554,000 electric vehicles on the road by 2030. This includes approximately 404,000 passenger battery electric vehicles and 89,000 passenger plug-in hybrid electric vehicles; and
- The WEM scenario includes an additional 500,000 public transport and active travel journeys by 2035 and the impact of transport infrastructure projects such as the DART Expansion and BusConnects programmes.

With Additional Measures (WAM) scenario:

- Under the With Additional Measures scenario, transport emissions are projected to decrease by 35% over the period 2021 to 2030 from 10.9 to 7.2 Mt CO_{2eq} (Figure 14-4);
- For the With Additional Measures scenario, it is assumed that incremental increases will occur in the Biofuel Obligations Scheme with 10% blend for petrol and a 20% blend for diesel at the pumps by 2030;
- This scenario assumes 943,500 electric vehicles on the road by 2030, as a result of the implementation of the Climate Action Plan 2023. This includes 845,000 private electric vehicles, and 95,000 commercial electric vehicles;

- This scenario also includes a 20% reduction in total vehicle kilometres to be achieved by behavioural and sustainable policies and measures outlined in the Climate Action Plan 2023, such as a 50% increase in daily active travel journeys and a 130% increase in daily public transport journeys;
- The impact of transport infrastructure projects such as the DART Expansion and BusConnects programme is also included in the WAM scenario; and
- The extent of the impact of ambitious additional policies and measures in the Climate Action Plan 2023 over the period can be seen in Figure 14-4, as well as the significant impact of COVID restrictions on transport emissions in 2020 and the rebound in 2021.

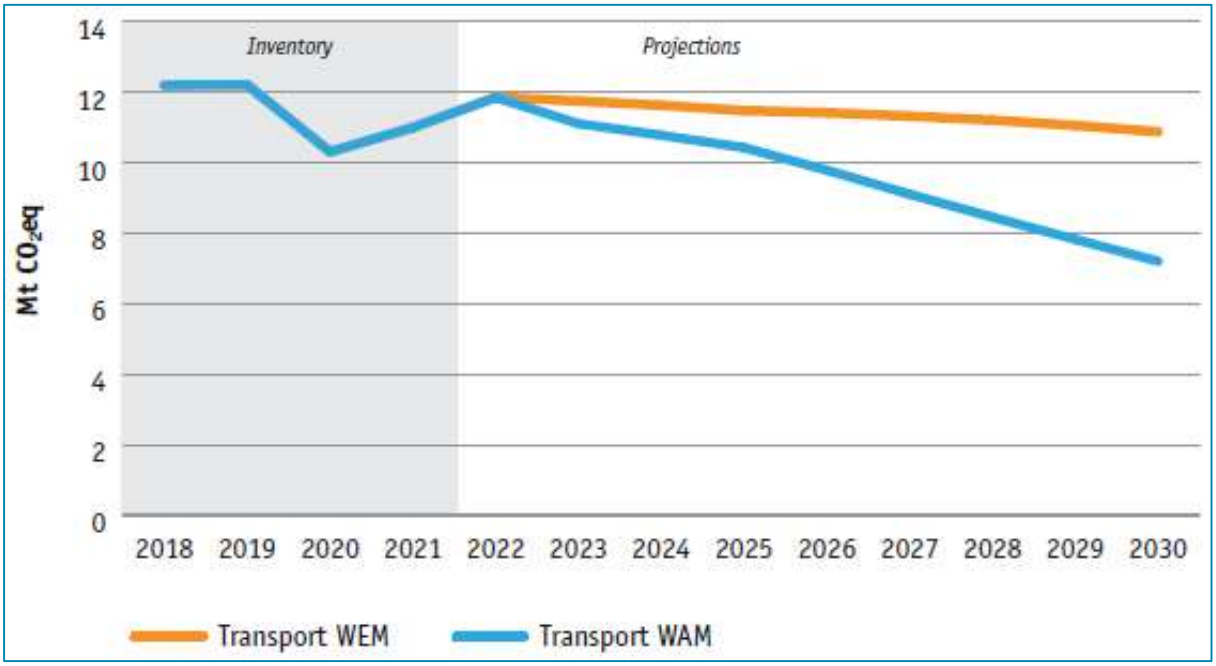

Figure 14-4: Greenhouse Gas Emissions Projections from the Transport Sector under the 'With Existing Measures' and 'With Additional Measures' scenarios out to 2030

Table 14-18 outlines a summary of the EPA 2020-2040 GHG emissions projections (kt CO_{2eq}) for 2025, 2030, 2035 and 2040 for the With Existing Measures (WEM) and With Additional Measures (WAM) scenarios.

Table 14-18: EPA 2020-2040 GHG Emissions Projections (kt CO_{2eq})

Source	With Existing Measures (kt CO_{2eq})				With Additional Measures (kt CO_{2eq})			
	2025	2030	2035	2040	2025	2030	2035	2040
Transport	11469.0	10869.9	9290.5	7671.6	10417.5	7197.4	5997.9	4397.6
Domestic aviation	17.2	17.8	17.8	17.8	17.2	17.8	17.8	17.8
Road transport	10781.5	10164.1	8571.2	6945.0	9718.7	6532.2	5333.3	3749.6
Railways	147.9	154.8	161.2	167.1	160.7	174.6	187.3	199.2
Domestic navigation	373.8	373.8	373.8	373.8	373.8	373.8	373.8	373.8
Other transport	148.6	159.4	166.5	167.9	147.0	99.0	85.7	57.2
National Total	57996.0	52867.3	51140.3	47880.3	54505.4	42499.8	39741.0	34731.1
National Total incl. LULUCF	66687.7	62533.1	62164.7	58062.3	62760.2	49723.6	47903.3	41582.2

Therefore, the proposed Scheme directly assists the aims of the EPA's Greenhouse Gas Emissions Projections 2022-2040 to reduce transport emissions by 50% by 2030. The proposed Scheme will assist in achieving this target by allowing for a reduction in total vehicle kilometres, by supplying expanded electrified rail services and assisting behavioural change measures (i.e. modal shift) outlined in CAP24. The proposed Scheme will result in a significant increase in daily active travel journeys and a significant increase in daily public transport journeys.

It is Government policy to expand electrified rail services as part of the public transport system. The proposed Scheme is an electrified rail service and includes the provision of EV Charging Stations at the Park & Ride facility. Research has shown that the expansion of the charging network and availability of fast chargers is a critical driver of increased EV uptake.

The proposed Scheme allows for sustainable transport journeys and a reduction in car passenger kilometres. Luas Finglas is projected to result in an approximate reduction of 10,000 car trips daily. Luas Finglas will provide better access for more sustainable modes of transport by providing a key public transport connection between Dublin's north-western suburbs and the city centre and will be key to the overall reduction in reliance on the private car in areas served by the proposed Scheme. The proposed Scheme will be integrated with other public transport modes to ensure maximum public benefit and promotes sustainable transport and improved connectivity.

The proposed Scheme aligns with the EPA's Greenhouse Gas Emissions Projections 2022-2040 to reduce transport emissions, on account of the fact it facilitates sustainable mobility and associated positive effects, including those relating to:

- Reductions in greenhouse gas emissions and associated achievement of legally binding targets; and
- Reductions in consumption of non-renewable energy sources and achievement of legally binding renewable energy targets.

All of the above is quantified in Section 14.4.

14.4 Predicted Impact Assessment

14.4.1 Greenhouse Gas (GHG) Assessment

The impacts of the Construction and Operational Phases of the proposed Scheme have been assessed in terms of potential Greenhouse Gas (GHG) emissions.

The details of the construction activities that will be carried out during the Construction Phase are described in Chapter 6 (Construction Activities). The predominant aspects of the Construction Phase will be the construction of the proposed Luas LRT system, including preparatory works, utilities diversion, earthworks, drainage, road/NMU upgrades, track works, OCS installation, signalling and ancillary works. This will involve activities which are likely to impact climate directly and indirectly.

The Description of the Proposed Scheme is described in Chapter 5 (Description of the proposed Scheme). The principal activities associated with the Operational Phase of the Luas Finglas will be the use of the new Luas line as well the Park & Ride element. In terms of the operational climate impact, the associated maintenance activity required over the course of the proposed Scheme's lifetime and the potential changes in GHG emissions associated with changes in road traffic volumes within the study area due to the Operational Phase of the proposed Scheme have been assessed.

As outlined in the Preliminary Business Case, one of the overarching objectives for Luas Finglas includes:

- Contribution to the Climate Action Plan targets for the decarbonisation of transport.

The overarching objectives were devised to be SMART: specific, measurable, attributable, realistic and time bound. In terms of decarbonisation, the objectives are set out as follows:

- Measurable:
  - Reduction in carbon emissions from transport related to travel in the Finglas corridor.
  - Carbon emissions related to Luas Finglas.
- Attributable:
  - Pre-Operation:
    - Transport modelling during construction.
    - Emission reductions defined by the Project Sustainability Plan.
  - During Operation:
    - Energy efficiency for Luas vehicles and facilities.
    - Procurement.
    - Mode share by sustainable transport.
- Realistic:
  - The need to increase public transport use to reduce carbon emissions is set out in the Climate Action Plan 2023.
  - Potential to set CO2 level targets in contract documents.
- Time Bound:
  - Contract performance timelines for Luas operation.
  - Transport modelling has been undertaken for two future years: Opening Year (2035) and Design Year (2050).

The proposed Scheme includes a proposal to install photovoltaic (PV) panels on the Park & Ride facility roof, further supporting renewable energy usage. The power supply for the proposed Scheme will be

delivered from electrical sub-stations via an Overhead Catenary System (OCS). Power will be supplied to the sub-stations from the national grid.

The TII Carbon tool has been designed to include a lifecycle modular approach for carbon reporting, with the quantification of GHG emissions aligned to PAS 2080 requirements. An assessment of key materials has been undertaken to focus carbon calculations. Using the TII Carbon Tool for lifecycle carbon emissions, the outputs for the construction and Operational Phase of the proposed Scheme have been assessed. The TII Carbon Tool has been completed based on inputs from the following stages of the Construction and Operational Phase of the proposed Scheme;

- Pre-Construction;
  - Clearance and Demolition Activities;
  - Land Use Change and Vegetation Loss; and
  - Water Use During Clearance and Demolition Activities.
- Embodied Carbon;
  - Raw Materials Embodied Carbon;
  - Transport;
  - Construction; and
  - Excavation Activities.
- Construction Activities;
  - Water Use During Construction Activities; and
  - Construction Worker Travel to Site.
- Construction waste;
- Operational Use;
  - Operational Energy Use;
  - Operational Water Use;
  - Operational Waste; and
  - Landscaping and Vegetation.
- User Emissions;
  - Road Use; and
  - Train Operation.
- Maintenance; and
- End-of-Life.
  - Deconstruction Activities; and
  - Decommissioning Waste.

14.4.1.1 Construction Phase Greenhouse Gas (GHG) Assessment

Consideration is given in this section to aspects of the proposed Scheme and the GHG emissions that may arise during the Construction Phase, notably:

- Embodied emissions in the imported materials required for the proposed Scheme relative to other materials. Embodied emissions are the carbon footprint of a material i.e. the total emissions released throughout the supply chain of the material. This includes the energy required for extraction, processing, operation and disposal of a material. For example, with some construction materials such as steel, the use of recycled materials has lower embodied GHG emissions than the use of virgin material;

- Direct emissions from plant machinery and equipment used during the Construction Phase; and
- Transport emissions from vehicles importing and exporting material to and from the construction site(s).

The TII Carbon Tool has been completed by the Luas Team for the proposed Scheme.

A summary of the inputs and outputs of the TII Carbon Tool for each stage of the carbon calculation for the Construction Phase is detailed below. The TII Carbon Tool Memorandum including the details of the TII Carbon Tool Inputs and Outputs is included in Volume 5 - Appendix A14.1. The TII Carbon Tool Memorandum sets out the model information parameters for the project lifetime, including the construction and operational phase of the proposed Scheme.

Pre-Construction Light Rail:

- Clearance & Demolition Activities Emissions = 10.86 tCO_{2eq}
  - General Site Clearance = 24.72 Ha.
- Land Use & Vegetation Loss Activities Emissions (Carbon sink removed) = 38.93 tCO_{2eq}
  - Natural Grassland = 0.31 Ha (Modified Grassland); and
  - Natural Grassland = 0.99 Ha (Other Neutral Grassland).
  - Transitional Woodland Scrub = 0.02 Ha (Wet Woodland).
  - Transitional Woodland Scrub = 0.2 Ha (Wood pasture and parkland).
  - Transitional Woodland Scrub = 0.02 Ha (Introduced Scrub).
- Water Use Emissions = 0.01 tCO_{2eq}
  - Water Use = 84,537 litres.

Carbon saving identified and implemented:

- Maintaining existing tree corridors to minimise tree clearance. Carbon storage associated with retention of existing trees = 483.42 tCO_{2eq};
- Landscape design strategy implemented. To address carbon and climate adaptation; and
- Habitat retention creation and enhancement. Carbon storage associated with habitats.

Embodied Carbon:

- Raw Materials Embodied Activities Emissions = 53,673.7 tCO_{2eq}
  - Series 1700 Structural Concrete = 50,021.7 m^3;
  - Series 1800 Structural Steelwork = 2,800.7 tonne;
  - Railtrack, Track Foundation (Bottom Ballas, limestone or granite) = 3,493 m^3;
  - Railtrack, Track Foundation (Waterproof & Membranes) = 19,402 m^3;
  - Railtrack, Track (Flat bottom rails) = 693 tonne; and
  - Railtrack, Track Foundation (Sleepers-concrete) = 2.8 Nr.
- Transport of Raw Materials Emissions = 2.22 tCO_{2eq}
  - HGV Movements

Carbon saving identified and implemented:

- Incorporation of concrete with 25% or 50% ground granulated blast furnace slag (GGBS) to reduce the carbon footprint. Lower carbon footprint than other cements produced in Ireland and the use of 25% or 50% GGBS concrete reduced carbon emissions by 7647.47 tCO_{2eq};
- The design is based on the use of a grass track with 50% lower concrete requirements associated with proposed Vignole grass-track, reducing carbon by 729.42 tCO_{2eq};

- Implementation of nature-based SuDS solutions to provide attenuation, saved 9,484m of 1.2m diameter concrete culverting.

Construction Light Rail:

- Excavation Activities Emissions = 32.89 tCO_{2eq}
  - General Excavation Cuttings & Foundations = 49,498 m^3.
- Construction Activities Emissions = 127.52 tCO_{2eq}
  - Construction, Electricity Use = 187,586 kWh; and
  - Construction, Plant Use = 26,640 litres.
- Construction Water Use Emissions = 0.01 tCO_{2eq}
  - Construction, Water Use = 42,895 litres.
- Construction Worker Travel Emissions = 257.64 tCO_{2eq}
- Construction Waste Emissions = 288.49 tCO_{2eq}
  - Aggregate & Soil exported Off-site = 30,000 tonnes;
  - Hazardous Waste = 2,700 tonnes; and
  - Concrete brick, tiles & ceramics = 4,236 tonnes.
- Carbon saving identified and implemented;
  - Soil reuse checklist to be implemented. To explore the potential for soil reuse within the scheme;
  - Proposal to reuse approximately 4,000m^3 of site won material to reinstate an existing void at the stabling site. Reusing excavated soil can be an effective way to reduce the environmental impact of construction activities while also saving money and improving soil quality. By reusing excavated soil, it can also help to reduce waste and conserve raw material usage. Sending 4,000m^3 of soil to landfill = 4.96 tCO_{2eq} associated with waste processing and 0.02 tCO_{2eq} associated with transportation;
  - Proposal to reuse all topsoil material excavated (approximately 9,000m^3). Reusing excavated soil can be an effective way to reduce the environmental impact of construction activities while also saving money and improving soil quality. By reusing excavated soil, it can also help to reduce waste and conserve raw material usage;
  - Larger construction site areas to reduce the number of Construction Phase to reduce waste. To facilitate optimised Construction Phase and cycles, reducing waste transport by 5% = 0.005 tCO_{2eq}; and
  - Provision of satellite compounds to reduce travel distances. Reduce fuel consumption during the Construction Phase by 5% = 3.55 tCO_{2eq}.

Quantified Construction Phase Climate Mitigation Measures

The proposed Scheme includes a number of specific measures that include a quantifiable reduction in carbon, as outlined in Table 14-19 below.

Table 14-19: Quantified Carbon Reducing Measures associated with the proposed Scheme (tCO_{2eq}) – Construction Phase

Mitigation Measure	Rationale	Reduction (tCO_{2eq})
Maintaining existing tree corridors, where possible to minimise tree clearance.	Carbon storage associated with existing trees.	483.42
Incorporation of concrete with 25% or 50% ground granulated blast furnace slag (GGBS) to reduce the carbon footprint.	Use of GGBS results in a reduction of 1025.95 tCO_{2eq} across bridges and trackform. It also results in a reduction of 6621.52 tCO_{2eq} for the Park and Ride (assuming 60% of concrete associated with the Park and Ride is GGBS).	7647.47
Proposed Vignole grass-track indicates >50% reduction in structural concrete.	The design is based on the use of a grass track to reduce concrete requirements.	729.42
Proposal to reuse approximately 4,000m3 of site won material to reinstate an existing void at the stabling site.	Sending 4,000m^3 of soil to landfill would involve 4.96 tCO_{2eq} associated with waste processing and 0.02 tCO_{2eq} associated with transportation.	4.98
Larger construction site areas to facilitate optimised Construction Phase and reduce the transportation of waste.	Considered to represent a 5% reduction in the transport of waste.	0.005
Provision of satellite compounds to reduce travel distances to reduce the overall fuel consumption associated with the Construction Phase.	Considered to represent a 5% reduction in fuel consumption during construction.	3.553
Implementation of nature-based SuDS solutions.	Nature-based SuDS solutions saved 9,484m of 1.2m diameter concrete culverting.	4861.88

Construction Phase GHG Emissions:

The TII Carbon Tool results indicate that the primary source of GHG emissions from the Construction Phase of the proposed Scheme is from emissions associated with the embodied carbon from the materials used in the construction of the proposed Scheme. Refer to Table 14-20 below. The total estimated carbon generated during the Construction Phase is 54,430.2 tCO_{2eq}. Embodied carbon in the materials required for construction is the largest component of construction activity carbon emissions (53,673.7 tCO_{2eq}). Construction activities mainly consist of diesel use for mobile and fixed plant for the Construction Phase and accounts for 418.1 tCO_{2eq}.

Table 14-20: Estimated carbon emission associated with the Construction Phase of the proposed Scheme (tCO_{2eq})

Phase	Pre-Construction	Embodied Carbon	Construction Activities	Construction Waste	TOTAL
Construction Phase	49.8	53,673.7	418.1	288.6	54,430.2

14.4.1.2 Magnitude of GHG Emissions from the Construction Phase

The total estimated carbon generated during the Construction Phase is 54,430.2 tCO_{2eq}, with various mitigations incorporated into the proposed Construction Phase activities as outlined above. Ireland's carbon budgets have been used to contextualise the magnitude of GHG emissions from the Construction Phase of the proposed Scheme, as shown in Table 14-21. To put the total Construction Phase emissions of 54,430.2 tCO_{2eq} in context versus the 3rd Carbon Budget (2031 to 2035) of 151 Mt CO_{2eq}, the GHG emissions (tCO_{2eq}) contribution due to the Construction Phase of the proposed Scheme will be 0.036% of the carbon budget emissions.

Table 14-21: The proposed Scheme Construction Phase GHG Emissions in the Context of Ireland's 3rd Carbon Budget (2031 to 2035) of 151 Mt CO_{2eq}.

Carbon Budget Period	Lifecycle Stage	Carbon Budget (tCO_{2eq})	Proposed Development GHG emissions (tCO_{2eq})	Percentage of 3rd carbon budget emissions
3rd Carbon Budget (2031 to 2035)	Construction	151,000,000	54,430.2	0.036%

14.4.1.3 Operational Phase Greenhouse Gas (GHG) Assessment

The Operational Phase of the proposed Scheme includes maintenance of the proposed Scheme infrastructure as outlined in Chapter 5 (Description of the proposed Scheme). During the Operational Phase there is a requirement for ongoing sources of operational and embodied emissions associated over the life of the scheme (60 years).

The TII Carbon Tool 'Light Rail Option' has been used to quantify the Operational and Maintenance Phase Emissions of the proposed Scheme.

Operational Phase Power Requirements

- The power supply for the proposed Scheme will be delivered from electrical sub-stations via an Overhead Catenary System (OCS). Power will be supplied to the sub-stations from the national grid.
- Electricity usage for the operation of the proposed Scheme will equate to approx. 1,035 tCO_{2eq} (3,440,000 kWh) per annum or 62,100 tCO_{2eq} over the 60-year lifetime of the proposed Scheme;
- Electricity usage for the maintenance and operation of the two substations, stops, and Park and ide facility will equate to approx. 8,177.1 tCO_{2eq} per annum or 490,620 tCO_{2eq} over the 60-year lifetime of the proposed Scheme.

Quantified Operational Phase Climate Mitigation Measures.

The design includes a number of intrinsic considerations that will assist in the reduction of carbon (e.g. optimised gradients to reduce operational energy demand and reducing stop / go movements by combining road junctions in close proximity and increasing fully segregated sections to allow LRVs longer coasting at low energy consumption). Alongside these design considerations, the proposed Scheme includes a number of specific measures that include a quantifiable reduction in carbon, as outlined in Table 14-22 below.

Table 14-22: Quantified Carbon Reducing Measures associated with the proposed Scheme (tCO_{2eq}) – Operational Phase

Mitigation Measure	Rationale	Reduction (tCO_{2e})
Habitat retention creation and enhancement. Carbon storage associated with habitats and gains in vegetated land.	1.27Ha of Transitional Woodland Scrub has a Carbon Sink of 34.5 tCO_{2eq} 1.62Ha of Mixed Forest has a Carbon sink of 160.38 tCO_{2eq}	194.9

Mitigation Measure	Rationale	Reduction (tCO_{2e})
Inclusion of a solar array on the roof of the Park & Ride.	Solar array is acknowledged as an energy source within Carbon Tool (319,500kWh generating 0 tCO_{2eq}), if this was electricity from the grid it would equate to 96.16 tCO_{2eq}.	96.16

- For the Luas Finglas drainage system (See EIAR Appendix A10.5), it is intended to use SuDS systems for surface water collection and attenuation where possible. A SuDS system offers environmental benefits, as it requires less maintenance over traditional closed surface water collection and attenuation systems (for example, piped collection systems and buried attenuation structures). A reduced maintenance regime over the lifetime of the proposed Scheme will be one of the drainage design objectives. The proposed design maximises the use of green track, for landscaping, infiltration, visual amenity and reducing of urban heat intensity. Extensive planting proposals aim to create connected green spaces along the route. The carbon emission savings from this design approach is estimated at approx. 194 tCO2eq per annum or 11,640 tCO2eq over the 60-year lifetime of the proposed Scheme; and
- A Solar PV panel array is to be installed on Park & Ride facility roof. The proposed Scheme includes a multi-storey car park and the roof is proposed to be a green or blue roof with PV panels. Approximately 350 car parking spaces will be provided. The facility is designed to facilitate 100% EV parking, with approximately 20% of EV spaces provided from opening year. The electricity generated by the operation of the Solar PV panel array on the park and ride facility will equate to a saving of approx. 96 tCO_{2eq} per annum or 5,760 tCO_{2eq} over the lifetime of the proposed Scheme.

Operational Phase Road Traffic Emission Reductions

The potential changes in greenhouse gas emissions due to the Operational Phase traffic impacts of the proposed Scheme have been assessed using the TII REM tool. The Operational Phase road traffic use GHG emissions savings with the proposed Scheme in operation are outlined in Table 14-23. The comparison between the Do-Minimum and Do-Something GHG emissions in the opening year 2035 and the design year 2050 indicates that there is an overall decrease in annual road traffic CO_{2eq} emissions due to the proposed Scheme. This indicates that there will be an approximate 4% decrease in carbon emissions per annum within the study area with the proposed Scheme in operation. The carbon emission reduction from road traffic use GHG emissions savings is estimated at approx. 180 tCO_{2eq} per annum or 10,800 tCO_{2eq} over the 60-year lifetime of the proposed Scheme.

Table 14-23: Operational Phase Study Area Road Use GHG Emissions (tCO_{2eq} / year) – Opening Year 2035 & Design Year 2050 (Note; from TII REM Tool, Business as Usual (BaU) scenario)

Scenario	Study Area Road Use Emissions (tCO2eq/annum)	
	2035	2050
Do Minimum	4,554.89 tCO2eq	4,711.53 tCO2eq
Do Something	4,371.38 tCO2eq	4,531.3 tCO2eq
Change tCO2eq	-183.51 tCO2eq	-180.23 tCO2eq
% Change	-4.0%	-3.8%

The road traffic GHG emission reductions have been put in context versus the carbon budget for the transport sector in 2030 and are 6,000 kt CO_{2eq}. Approximately 4,400 kt CO_{2eq} is projected to be emitted by the transport sector in 2040 and by 2050, it is expected that the car fleet will be fully electric. Therefore, the overall carbon reduction due to the proposed Scheme across a 60-year lifespan, assuming the Business as Usual (BaU) scenario developed by the TII REM Tool, equates to a reduction of 0.18% versus the overall 2030 transport sector carbon budget.

The EPA Ireland's Greenhouse Gas Emissions Projections 2022-2040 (2023) indicates GHG Emissions Projections for Transport in 2030 and 2040 'with existing measures' of 10,869.95 kt CO_{2eq} and 7,671.56 kt CO_{2eq} respectively, and in 2030 and 2040 'with additional measures' of 7,197.36 kt CO_{2eq} and 4,397.65 kt CO_{2eq} respectively.

The impact on climate due to the overall reduction in road traffic GHG emissions during the Operational Phase of the proposed Scheme is long-term and beneficial. The beneficial impact of reduced CO_{2eq} emissions due to the proposed Scheme is on account of the expected modal shift from road traffic to public transport.

Operational Phase GHG Emissions.

Table 14-24 outlines a summary of the estimated annual carbon emissions associated with the Operational Phase of the proposed Scheme (tCO_{2eq}), due to operational energy use, water use, waste, landscaping and vegetation, LRVs use, maintenance and associated road traffic use changes.

Table 14-24: Estimated Annual Carbon Emissions, Inclusive of Quantified Carbon Reducing Measures Associated with the proposed Scheme (tCO_{2eq})

Phase	Operational Energy Use	LRVs Operation	Water	Operational Waste	Maintenance Plant Fuel Use	Landscaping & Vegetation	PV Solar Array on Park & Ride	Road Vehicle Use	TOTAL
Operational Phase	8,177.0	1,035.2	0.06	1.79	59.73	-194.8	-96	-180.2	8,802.8

14.4.1.4 Magnitude of GHG Emissions from the Operational Phase

The total estimated annual carbon generated during the Operational Phase is 8,802.8 tCO_{2eq} / annum, with various mitigations incorporated into the proposed Operational Phase activities as outlined above.

Ireland's carbon budgets have been used to contextualise the magnitude of GHG emissions from the Construction Phase of the proposed Scheme, as shown in Table 14-21. To put the annual Operational Phase emissions of 8,802.8 tCO_{2eq} in context versus the 3rd Carbon Budget (2031 to 2035) of 151 Mt CO_{2eq}, the GHG emissions contribution due to the Operational Phase of the proposed Scheme will be 0.029% of the carbon budget emissions. Refer to Table 14-25 below.

Table 14-25: The proposed Scheme Operational Phase GHG emissions in the Context of Ireland's 3rd Carbon Budget (2031 to 2035)

Carbon Budget Period	Lifecycle Stage	Carbon Budget (tCO_{2eq})	Proposed Development GHG emissions (tCO_{2eq})	Percentage of 3rd carbon budget emissions
3rd Carbon Budget (2031 to 2035)	Operational	151,000,000	44,014 tCO_{2eq} (8,802.8 tCO_{2eq} / annum)	0.029%

14.4.1.5 Assessment of the Significance of GHG emissions from the Proposed Scheme

The assessment of the significance of GHG emissions from the proposed Scheme during the Construction and Operational Phase is based on the 'Significance Matrix' shown in Table 14-7 [Table 6.7 from OTD PE-ENV-01104].

The assessment of the significance of GHG emissions from the proposed Scheme is based on the GHG trajectory against Ireland's net zero trajectory, and the level of mitigation taking place to evaluate the level of significance.

The commitment to reduce embodied emissions and the level of mitigation taking place during the Construction Phase of the proposed Scheme is fully aligned with the targets and trajectory of CAP24. Therefore, by employing the TII significance criteria, the residual impact on climate of the Construction Phase emissions, with this mitigation commitment, is assessed as a 'not significant' effect with a 'minor adverse' significance over the Construction Phase. Refer to Table 14-26 below.

Table 14-26: Significance of GHG Emissions during the Construction Phase.

Construction Phase Effects	Construction Phase Significance Level	TII Guidelines Description
Not significant	Minor adverse	The project's GHG impacts are mitigated through 'good practice' measures. The project has complied with existing and emerging policy requirements; and Fully in line to achieve Ireland's trajectory towards net zero.

Maintenance and operational emissions equate to circa 8,802.8 tCO_{2eq} per annum. The predicted impact on climate due to the overall reduction in road traffic GHG emissions during Operational Phase of the proposed Scheme is long-term and beneficial due to the expected modal shift. Therefore, by employing the TII significance criteria, the long-term residual impact on climate of the Operational Phase emissions, with the mitigation commitments, is assessed as a 'not significant' effect with a 'negligible' significance over the over the Operational Phase. Refer to Table 14-27 below.

Table 14-27: Significance of GHG Emissions during the Operational Phase.

Operational Phase Effects	Operational Phase Significance Level	TII Guidelines Description
Not significant	Negligible	The project's GHG impacts are mitigated beyond design standards. The project has gone well beyond existing and emerging policy requirements; and Well 'ahead of the curve' for Ireland's trajectory towards net zero.

14.4.2 Climate Change Risk (CCR) Assessment

The approach to assessing the climate risk on the proposed Scheme is that the potential risks associated with the construction and Operational Phase are comparable in certain respects. For example, the sensitivity of the proposed Scheme to climate change during the construction and Operational Phase relates primarily to occurrences of heavy rainfall resulting in fluvial and/or pluvial flooding. Reference to https://www.floodinfo.ie/map/floodmaps indicates that the area along the proposed Scheme is potentially prone to flooding from the River Tolka in the Tolka Valley Park. The proposed Scheme will cross the River Tolka approximately 50m north of Ballyboggan Road in the Tolka Valley Park. The proposed Scheme design ensures that the potential for fluvial flooding and/or pluvial flooding due to occurrences of heavy rainfall have been minimised to a very low potential of occurrence A Site-Specific Flood Risk Assessment (SSFRA) has been included as a supporting document to the EIAR. The FRA is provided in Volume 5 - Appendix A10.2.

Periods of extreme heat that could lead to potential damage to rail track, pavements or utilities along the proposed Scheme are extremely rare in Ireland with a very low potential of occurrence. There is a low sensitivity to periods of extreme heat during the Construction and Operational Phase.

Temperature fluctuation around freezing (0°C) is also very infrequent as shown in the Met Eireann 30-year meteorological data. There is a low sensitivity to periods of extreme cold during the Construction and Operational Phases.

Assets such as utilities, landscaping and fences are considered to have a high sensitivity to wildfires. Such fires can cause significant asset damage, cease construction or operation and impact on the health of workers and the community. Drainage assets have a medium direct sensitivity to wildfires.

All assets have a low sensitivity to drought with the exception of landscaping works which has a moderate sensitivity to drought.

There is a low to moderate sensitivity to landslides, lightning & hail and fog for all assets as these may have the potential for short term interruptions to construction or operation but are not significant.

The Sensitivity Analysis, the Exposure Analysis and the Vulnerability Matrix for the Climate Change Risk Assessment of the proposed Scheme are presented in Table 14-28 to Table 14-30.

Table 14-28: Sensitivity Analysis for the proposed Scheme

Climate Hazards	Flooding (coastal)	Flooding (pluvial)	Flooding (fluvial)	Extreme Heat	Extreme Cold	Wildfire	Drought	Extreme wind	Lightning & hail	Landslides	Fog
Pavements	2	2	2	2	2	2	1	1	1	1	1
Drainage	2	2	2	2	2	2	1	1	1	1	1
Structures	2	2	2	2	2	2	1	2	1	1	1
Utilities	2	2	2	2	2	3	1	2	2	1	1
Landscaping	2	2	2	2	2	3	2	2	2	1	1
Signs	2	2	2	1	1	2	1	2	2	1	1
Light Posts	2	2	2	1	1	2	1	2	2	1	1
Associated Auxiliary Buildings	2	2	2	1	1	2	1	2	2	1	1
Fences	2	2	2	1	1	3	1	2	2	1	1

Note:
High Sensitivity = Score 3 – 'The climate hazard will or is likely to have a major impact on the asset category'.
Medium Sensitivity = Score 2 – 'It is possible or likely the climate hazard will have a moderate impact on the asset category'.
Low Sensitivity = Score 1 – 'It is possible the climate hazard will have a low or negligible impact on the asset category'.

Table 14-29: Exposure Analysis for the proposed Scheme

Climate Hazards	Flooding (coastal)	Flooding (pluvial)	Flooding (fluvial)	Extreme Heat	Extreme Cold	Wildfire	Drought	Extreme wind	Lightning & hail	Landslides	Fog
Pavements	1	2	1	2	2	1	1	2	2	1	2
Drainage	1	2	1	2	2	1	1	2	2	1	2
Structures	1	2	1	2	2	1	1	2	2	1	2
Utilities	1	2	1	2	2	1	1	2	2	1	2
Landscaping	1	2	1	2	2	1	1	2	2	1	2
Signs	1	2	1	2	2	1	1	2	2	1	2
Light Posts	1	2	1	2	2	1	1	2	2	1	2
Associated Auxiliary Buildings	1	2	1	2	2	1	1	2	2	1	2
Fences	1	2	1	2	2	1	1	2	2	1	2

Note:
High Exposure = Score 3 – 'It is almost certain or likely this climate hazard will occur at the proposed Scheme location i.e. might arise once to several times per year'.
Medium Exposure = Score 2 – 'It is possible this climate hazard will occur at the proposed Scheme location i.e. might arise a number of times in a decade'.
Low Exposure = Score 1 – 'It is unlikely or rare this climate hazard will occur at the proposed Scheme location i.e. might arise a number of times in a generation or in a lifetime'.

To undertake the vulnerability assessment, the product of sensitivity and exposure for each climate hazard and each asset category is identified. Table 14-30 provides the vulnerability matrix for the proposed Scheme (Vulnerability = Sensitivity x Exposure).

Table 14-30: Vulnerability Matrix for the proposed Scheme (Vulnerability = Sensitivity x Exposure)

Climate Hazards	Flooding (coastal)		Flooding (pluvial)		Flooding (fluvial)		Extreme Heat		Extreme Cold		Wildfire		Drought		Extreme wind		Lightning & hail		Landslides		Fog	
	Sensitivity	Exposure	Sensitivity	Exposure	Sensitivity	Exposure	Sensitivity	Exposure	Sensitivity	Exposure	Sensitivity	Exposure	Sensitivity	Exposure	Sensitivity	Exposure	Sensitivity	Exposure	Sensitivity	Exposure	Sensitivity	Exposure
Pavements	2	1	2	2	2	2	2	2	2	2	2	1	1	1	1	2	1	2	1	1	1	2
Vulnerability	2		4		4		4		4		2		1		2		2		1		2	
Drainage	2	1	2	2	2	2	2	2	2	2	2	1	1	1	1	2	1	2	1	1	1	2
Vulnerability	2		4		4		4		4		2		1		2		2		1		2	
Structures	2	1	2	2	2	2	2	2	2	2	2	1	1	1	2	2	1	2	1	1	1	2
Vulnerability	2		4		4		4		4		2		1		4		2		1		2	
Utilities	2	1	2	2	2	2	2	2	2	2	3	1	1	1	2	2	2	2	1	1	1	2
Vulnerability	2		4		4		4		4		3		1		4		4		1		2	
Landscaping	2	1	2	2	2	2	2	2	2	2	3	1	2	1	2	2	2	2	1	1	1	2
Vulnerability	2		4		4		4		4		3		2		4		4		1		2	
Signs	2	1	2	2	2	2	1	2	1	2	2	1	1	1	2	2	2	2	1	1	1	2
Vulnerability	2		4		4		2		4		2		1		4		4		1		2	
Light Posts	2	1	2	2	2	2	2	2	2	2	2	1	1	1	1	2	1	2	1	1	1	2
Vulnerability	2		4		4		4		4		2		1		2		2		1		2	
Associated Auxiliary Buildings	2	1	2	2	2	2	1	2	1	2	2	1	1	1	2	2	2	2	1	1	1	2
Vulnerability	2		4		4		2		4		2		1		4		4		1		2	
Fences	2	1	2	2	2	2	1	2	1	2	3	1	1	1	2	2	2	2	1	1	1	2
Vulnerability	2		4		4		2		4		3		1		4		4		1		2	

Based on the vulnerability assessment undertaken as part of the CCR Assessment for the proposed Scheme, there are only low and medium vulnerabilities to climate change risk across all hazards. Table 14-31 (OTD PE-ENV-01104, Table 7.6) provides a summary of the proposed Scheme Vulnerability to Climate Change.

Table 14-31: Summary of the proposed Scheme Vulnerability to Climate Change.

		Exposure		
		Low (1)	**Medium (2)**	**High (3)**
Sensitivity	**Low (1)**	Landslides	-	-
	Medium (2)	Flooding (coastal), Drought, Fog	Flooding (pluvial), Flooding (fluvial), Extreme Heat, Extreme Cold, Extreme wind, Lightning & Hail	-
	High (3)	Wildfire	-	-

14.4.2.1 Climate Change Risk Register

OTD PE-ENV-01104 presents a sample risk framework to assess climate risks based on the framework detailed in the EU Technical Guidance on climate proofing (2021). This sample framework has been adopted for this proposed Scheme to evaluate the risk associated with the highest risk hazards on the construction and Operational Phase of the proposed Scheme.

Construction Phase Climate Change Risk Register:

The Construction Phase risk register is presented in Table 14-32. The Construction Phase risk register shows that with the good construction practices, detailed design and mitigation controls in place with regard to the construction of the proposed Scheme and accompanying infrastructure, the risk to the construction works from flooding has been mitigated to reduce the likelihood of such an event having a significant adverse impact during the Construction Phase. As such, the risk of flooding (both pluvial and fluvial) has been suitably mitigated through good design and working practice, as outlined in Chapter 6 (Construction Activities), to reduce the risk of climate change to 'not significant'.

Similarly, the working practices around standard emergency response and weather informed work planning reduce any potential significant risk for extreme winds to reduce the risk of climate change impacts on the Construction Phase to not significant.

The potential vulnerability of the Construction Phase to climate change has been suitably mitigated and the potential impact during the Construction Phase is assessed to be 'Not Significant' for the short-term Construction Phase.

Table 14-32: Climate Risk Register (Construction Phase)

Climate Variable	Risk Statement	Receptors	Impact Type	Planned Controls	Initial Risk Rating			Significance
					Likelihood	Consequences	Risk Rating	
Construction Phase								
Flooding (coastal)	During periods of high rainfall in areas of high flood risk (i.e., Parts of Finglas village & Tolka Valley Park areas) there is a potential risk to worker safety, construction activities and the environment.	All assets under construction within the flood risk areas.	Asset damage, human health risk, proposed Scheme delays (potential financial implications)	Warning system Re: rainfall and flood water levels. No site compounds within potential flood areas. The proposed works sequences and methods of construction include proposals to manage the risk of flooding of the works. (As outlined in EIAR Appendix A6.1 CEMP).	Unlikely	Moderate	Medium	Not Significant
Flooding (pluvial)					Unlikely	Moderate	Medium	Not Significant
Flooding (fluvial)					Unlikely	Moderate	Medium	Not Significant
Extreme Heat	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Extreme Cold	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Wildfire	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Drought	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Extreme wind	Cranes or other elevated operations which have a high sensitivity to extreme winds.	Cranes, or elevated working operations.	Asset damage, human health risk, proposed Scheme delays	Working at heights operations will be programmed in favourable weather conditions and in accordance with H&S guidance.	Unlikely	Moderate	Medium	Not Significant
Lightning & hail	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Climate Variable	Risk Statement	Receptors	Impact Type	Planned Controls	Initial Risk Rating			Significance
					Likelihood	Consequences	Risk Rating	
Landslides	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Fog	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Note: N/A = The proposed Scheme has little or no Vulnerability to Climate Change due to this variable.								

Operational Phase Climate Change Risk Register:

The Operational Phase risk register is presented in Table 14-33. The Operational Phase risk shows that with the committed design measures in place as identified in Chapter 5 (Description of proposed Scheme), the risk of adverse climate change impact on the proposed Scheme is low. As such, the risk of flooding (both pluvial and fluvial) has been suitably mitigated through good design to reduce the risk of climate change to not significant. In short, the vulnerability of the Operational Phase to climate change has been suitably mitigated and the potential impact is assessed to be 'Not Significant' in the long-term.

No significant risk due to Extreme Heat, Extreme Cold, Wildfire, Drought, Lightning & hail, Landslides and Fog during the Construction and Operational Phase of the proposed Scheme has been identified.

Table 14-33: Climate Risk Register (Operational Phase)

Climate Variable	Risk Statement	Receptors	Impact Type	Planned Controls	Initial Risk Rating			Significance
					Likelihood	Consequences	Risk Rating	
Operational Phase								
Flooding (coastal)	During periods of high rainfall in areas of high flood risk (i.e., Parts of Finglas village & Tolka Valley Park areas) there is a potential risk of damage to proposed Scheme infrastructure.	All proposed Scheme infrastructure within the flood risk areas.	Asset damage & human health risk.	Low sensitivity to flood risk given the absence of any significant risks and drainage systems for the proposed Scheme is designed to meet best practice standards (EIAR Appendix A10.5).	Unlikely	Moderate	Low	Not Significant
Flooding (pluvial)					Unlikely	Moderate	Low	Not Significant
Flooding (fluvial)					Unlikely	Moderate	Low	Not Significant
Extreme Heat	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Extreme Cold	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Wildfire	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Drought	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Extreme wind	Damage to proposed Scheme utilities and infrastructure with a high sensitivity to extreme winds.	Lighting masts and/or elevated signs.	Asset damage & human health risk.	The lighting masts and elevated signs designed to comply with appropriate guidance.	Rare	Minor	Low	Not Significant
Lightning & hail	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Landslides	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Fog	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Note: N/A = The proposed Scheme has little or no Vulnerability to Climate Change due to this variable.								

14.5 Monitoring and Mitigation Measures

14.5.1 Construction Phase

The need to mitigate Construction Phase carbon emissions due to the use of traditional construction methods and materials is clearly outlined in national policy such as in CAP23 which states, as Action EN/23/12: *'Specify low carbon construction methods and low carbon cement material as far as practicable for directly procured or supported construction projects from 2023. CAP24 states that a key target is to decrease embodied carbon in construction materials, with a Key Performance Indicator (KPI) of a decrease by 10% embodied carbon for materials produced and used in Ireland by 2025, through product substitution for construction materials and reduction of clinker content in cement, with this figure aiming to be 30% by 2030.'*

There has been ongoing interaction between the climate impact assessment team and the design team to assess the potential pathways for mitigation during construction of the proposed Scheme.

Embodied carbon in the materials to be used in the Construction Phase dominate the predicted carbon emissions due to the proposed Scheme. The mitigation measures adopted in the Construction Phase of the proposed Scheme which have been incorporated into the TII Carbon Tool calculations, are outlined in Table 14-34.

Table 14-34: Mitigation Measures Adopted in the Construction Phase of the proposed Scheme which have been Incorporated into the TII Carbon Tool Calculations

Construction Phase	Mitigation Measure	Rationale	Reduction (tCO_{2eq})
Pre-Construction Light Rail	Maintaining existing tree corridors, where possible to minimise tree clearance.	Carbon storage associated with existing trees.	483.42
Embodied Carbon	Incorporation of concrete with 25% or 50% ground granulated blast furnace slag (GGBS) to reduce the carbon footprint.	Use of GGBS results in a reduction of 1136.16 tCO_{2eq} across bridges and trackform. It also results in a reduction of 6621.52 tCO_{2eq} for the Park and Ride (assuming 60% of concrete associated with the Park and Ride is GGBS).	7757.68
	Proposed Vignole grass-track indicates >50% reduction in structural concrete.	The design is based on the use of a grass track to reduce concrete requirements.	729.42
Construction Light Rail	Proposal to reuse approximately 4,000m^3 of site won material to reinstate an existing void at the stabling site.	Sending 4,000m^3 of soil to landfill would involve 4.96 tCO_{2eq} associated with waste processing and 0.02 tCO_{2eq} associated with transportation.	4.98
	Larger construction site areas to facilitate optimised Construction Phase and reduce the transportation of waste.	Considered to represent a 5% reduction in the transport of waste.	0.005
	Provision of satellite compounds to reduce travel distances to reduce the overall fuel consumption associated with the Construction Phase.	Considered to represent a 5% reduction in fuel consumption during construction.	3.553
	Implementation of nature-based SuDS solutions.	Nature-based SuDS solutions saved 9,484m of 1.2m diameter concrete culverting.	4861.88

In addition to the above mitigation regarding material choices, there are a series of additional construction mitigation measures that TII is prepared to commit to:

- Subject to planning approval, the appointed Contractor will implement a whole-life Carbon Management Plan aligned to PAS 2080:2023 Carbon management in buildings and infrastructure which has been used to inform the detailed design, build and operation of the proposed Scheme. The TII Carbon Assessment Tool for the calculation of emissions arising from the Construction Phase (e.g., embodied carbon in construction materials, energy, and fuel use) and maintenance emissions is aligned with PAS 2080;
- Subject to planning approval, undertake updated Climate Change Risk Assessments for all aspects of the proposed Scheme final design and implement measures to mitigate identified impacts during detailed final design and prior to the commencement of construction and operation;
- Facilitating sustainable material use, such as Green Cement and recyclable material;
- Integrate and maintain measures to manage construction and operational surface water and stormwater runoff as presented in the proposed Scheme Drainage Design drawings [EIAR Appendix A10.5];
- Divert waste materials from landfill / incineration to re-use onsite or offsite or recycling material;
- The use of non-concrete assets has been optimised in the design to minimise the need for concrete. The design is based on the use of a grass track with 50% lower concrete requirements associated with proposed Vignole grass-track, reducing carbon emissions by 729.42 tCO2eq;
- Aggregates required for pavement materials shall be secondary aggregates. Virgin aggregates shall only be employed where it is demonstrated that secondary aggregates are unsuitable for structural reasons and/or they are unavailable;
- The Contractor shall secure construction materials from local/regional sources or sources within the State to minimise material transport emissions and reduce life cycle carbon emissions associated with the construction materials;
- Achieve a reduction in mains water use during construction through the use of rainwater harvesting, water re-use and efficiency systems and devices at all work sites, stations, and buildings;
- Reuse rainwater and pumped water from excavations collected on site. This will account for at least 25% of the water required during the Construction Phase;
- For electricity generation at the construction compounds, hydrogen generators or electrified plant shall be utilised over traditional diesel generators. This shall also apply to lower powered mobile plant;
- A regular maintenance schedule for all construction plant machinery shall be undertaken to maintain optimum machinery efficiency;
- Construction machinery engines will be turned off when machinery is not in use;
- Minimise and prevent idling of construction vehicles and plant and equipment both on-site and in construction compounds;
- Efficiently schedule deliveries undertaken to minimise emissions;
- Ensure conformity of construction vehicles with the latest EU emissions standards and their emissions should meet upcoming standards prior to the legal requirement date for the new standard;
- A Waste Management Plan for Construction and Demolition Waste will be implemented as part of the CEMP [EIAR Appendix A6.1 CEMP];
- Issue a notification under Article 27 of the European Communities (Waste Directive) Regulations 2011 (S.I. No. 126 of 2011), as amended (Waste Directive Regulations (2011)) (referred to as Article 27) to the Environmental Protection Agency on behalf of TII to classify much of the Construction Phase generated inert waste material as a by-product and not a waste. This will allow the material to be re-used in the construction of the proposed Scheme. Article 27 is discussed further in Chapter 19 (Material Assets: Resource and Waste Management);
- Reuse materials as much as possible within the extent of the sites. In addition, materials will be sourced locally where possible to reduce the embodied carbon emissions associated with transport;
- All operations will achieve high recycling rates with an aim to achieve zero waste directly to landfill. This will also include audits prior to any demolition/excavation to review for material that can be reused on site, e.g. the proposal to reuse approximately 4,000m3 of site won material to reinstate an existing void at the stabling site will save 4.96 tCO2eq associated with waste processing and 0.02 tCO2eq associated with transportation; and
- Sustainable timber post fencing will be specified over steel in boundary treatments.

14.5.1.1 Monitoring

No specific Construction Phase monitoring regarding climate impact is proposed.

14.5.2 Operational Phase

The mitigation measures adopted in the Operational Phase of the proposed Scheme which have been incorporated into the TII Carbon Tool calculations are outlined in Table 14-35.

Table 14-35: Mitigation Measures Adopted in the Operational Phase of the proposed Scheme which have been Incorporated into the TII Carbon Tool Calculations

Operational Phase	Mitigation Measure	Rationale	Reduction (tCO_{2eq})
Operations	Habitat retention creation and enhancement. Carbon storage associated with habitats and gains in vegetated land.	1.27ha of Transitional Woodland Scrub has a Carbon Sink of 34.5 tCO_{2eq} 1.62ha of Mixed Forest has a Carbon sink of 160.38 tCO_{2eq}	194.9
	Inclusion of a solar array on the roof of the Park & Ride.	Solar array is acknowledged as an energy source within Carbon Tool (319,500kWh generating 0 tCO_{2eq}), if this was electricity from the grid it would equate to 96.16 tCO_{2eq}.	96.16

In a wider context, the Luas approach to energy consumption focuses on efficiency and the use of renewable energy sources. Luas has already transitioned to using 100% wind-generated electricity for its operations, significantly reducing reliance on fossil fuels.

14.5.2.1 Monitoring

No specific Operational Phase monitoring regarding climate impact is proposed.

14.6 Residual Impacts

As outlined in the IEMA 2022 GHG Guidelines, to determine significance of impact, the key test for a project is "*whether it contributes to reducing GHG emissions relative to a comparable baseline consistent with a trajectory towards net zero by 2050*". The approach used to assess significance is based on the following principles:

- Is the project "business as usual" in terms of climate reduction? This would result in a major or moderate negative impact;
- Is the project compatible with net zero by 2050 and complies with 'good practice' reduction measures? This would result in a minor adverse impact that is not significant;
- Does the project achieve emissions that go substantially beyond the reduction trajectory and has minimal residual emissions? This would result in a negligible effect that is not significant; and
- Does the project cause GHG emissions to be avoided or removed from the atmosphere? This would result in a beneficial effect that is significant.

In relation to the significance of impact of a project, the IEMA 2022 GHG Guidelines states the following;

'Minor adverse impact (not significant): A project that is compatible with the budgeted, science based 1.5°C trajectory (in terms of rate of emissions reduction) and which complies with up-to-date policy and 'good practice' reduction measures to achieve that has a minor adverse effect that is not significant. The project may have residual impacts but is doing enough to align with and contribute to the relevant transition scenario. A 'minor adverse' or 'negligible' non-significant effect conclusion does not necessarily refer to the magnitude of GHG emissions being carbon neutral (i.e. zero on balance) but refers to the likelihood of avoiding severe climate change and achieving net zero by 2050. A 'minor adverse' effect or better is a high

bar and indicates exemplary performance where a project meets or exceeds measures to achieve net zero earlier than 2050.

Negligible Impact (not significant): A project that achieves emissions mitigation that goes substantially beyond the reduction trajectory, or substantially beyond existing and emerging policy compatible with that trajectory, and has minimal residual emissions, is assessed as having a negligible effect that is not significant.'

The significance criteria for impacts outlined in the IEMA 2022 GHG Guidelines state that the impact significance must be taken for the project as a whole over its lifecycle rather than individual phases.

14.6.1 Construction Phase

The total estimated carbon generated during the Construction Phase is 54,604.1 tCO_{2eq}, with various mitigations incorporated into the proposed Construction Phase activities as outlined above. Ireland's carbon budgets have been used to contextualise the magnitude of GHG emissions from the Construction Phase of the proposed Scheme, as shown in Table 14-21. To put the total Construction Phase emissions of 54,604.1 tCO_{2eq} in context versus the 3rd Carbon Budget (2031 to 2035) of 151 Mt CO_{2eq}, the GHG emissions (tCO_{2eq}) contribution due to the Construction Phase of the proposed Scheme will be 0.0362% of the carbon budget emissions. This assumes construction of the proposed Scheme in 2031.

The commitment to reduce embodied emissions and the level of mitigation taking place during the Construction Phase of the proposed Scheme is fully aligned with the targets and trajectory of CAP24. Therefore, by employing the TII significance criteria, the residual impact on climate of the Construction Phase emissions, with this mitigation commitment, is assessed as a 'not significant' effect with a 'minor adverse' significance over the Construction Phase.

14.6.2 Operational Phase

The total estimated annual carbon generated during the Operational Phase is 8,802.8 tCO_{2eq} / annum, with various mitigations incorporated into the proposed Operational Phase as outlined above. Ireland's carbon budgets have been used to contextualise the magnitude of GHG emissions from the Operational Phase of the proposed Scheme, as shown in Table 14-23. To put the annual Operational Phase emissions of 8,802.8 tCO_{2eq} in context versus the 3rd Carbon Budget (2031 to 2035) of 151 Mt CO_{2eq}, the GHG emissions contribution due to the Operational Phase of the proposed Scheme will be 0.029% of the carbon budget emissions. This assumes the proposed Scheme becomes operational in 2031 to 2035.

Since the proposed Scheme's '*GHG impacts are mitigated beyond design standards'*, the proposed Scheme '*has gone well beyond existing and emerging policy requirements*'; and the proposed Scheme is '*well 'ahead of the curve' for Ireland's trajectory towards net zero*', the residual impact on climate of the Operational Phase emissions, with the mitigation commitments, is assessed as a 'not significant' effect with a 'negligible' significance over the Operational Phase.

14.6.3 Conclusion

The proposed Scheme will support the delivery of government strategies outlined in CAP24 and the 2015 and 2021 Climate Acts by enabling sustainable mobility and delivering a sustainable transport system. The proposed Scheme will provide connectivity and integration with other public transport services leading to more people availing of public transport, helping to further reduce GHG emissions.

As stated above, a project with a 'negligible' significance achieves emissions mitigation that goes substantially beyond the reduction trajectory and has minimal residual emissions. As previously quantified, the proposed Scheme provides sustainable public transport that significantly reduces the use of the private car and is projected to result in an approximate reduction of 10,000 car trips daily. Therefore, the proposed Scheme reduces Operational Phase vehicle emissions to significantly offset Construction Phase and Operational emissions.

As stated above also, in relation to significance, the IEMA 2022 GHG Guidelines states that A *'minor adverse'* or *'negligible'* non-significant effect conclusion does not necessarily refer to the magnitude of GHG emissions being carbon neutral (i.e. zero on balance) but refers to the likelihood of avoiding severe climate change and achieving net zero by 2050. A 'minor adverse' effect is a high bar and indicates exemplary performance where a project meets or exceeds measures to achieve net zero earlier than 2050.

Based on the analysis outlined above, it is concluded that the proposed Scheme achieves the objectives in supporting the delivery of an efficient, low carbon and climate resilient public transport service, which supports the achievement of Ireland's emission reduction targets.

As outlined in Chapter 18 (Material Assets: Traffic and Transport), in the opening year 2035, Luas Finglas will deliver an increase of 1.3 million low carbon public transport trips per annum. This represents an 11% increase in public transport trips due to the delivery of Luas Finglas. In 2050, this increases to an additional 1.8 million public transport trips which represents a 13% increase due to the delivery of Luas Finglas. The reductions in general traffic flows in the study area have been assessed and have a positive impact to the environment. The proposed Scheme will reduce CO_{2eq} emissions due to the removal of cars from the road network and the Operational Phase road traffic GHG emission savings with the proposed Scheme in operation have been quantified.

Due to the fact that the proposed Scheme is not due to be constructed until 2031, it cannot contribute to the emissions reductions target of 6Mt CO_{2eq} by 2030. However, it can be stated that the proposed Scheme, directly relates to measures outlined in the Climate Action Plan that will contribute to the emissions reductions beyond 2030, as follows;

- T3 – Electrify mass transportation, i.e. 'expanded electrified rail services';
- T4 – Sustainable transport journeys and demand management measures, i.e. 'a reduction in car passenger kilometres versus Do Nothing'; and
- T5 – Further modal shift (Tier 2), i.e. 'encouraging a behavioural change to reduce kilometres travelled to a greater extent'.

In terms of the aims of the EPA's Greenhouse Gas Emissions Projections 2022-2040 to reduce transport emissions by 50% by 2030, the proposed Scheme will allow for a reduction in total vehicle kilometres, to be achieved by behavioural and sustainable policies and measures outlined in the Climate Action Plan 2024, with a significant increase in daily active travel journeys and in daily public transport journeys.

The proposed Scheme, also directly relates to the national target of 500,000 additional trips by walking, cycling and public transport per day by 2030 as outlined as a target in the Climate Action Plan 2024. The interconnectivity between the light rail elements of proposed Scheme and the cycling facilities (segregated cycle lanes, bike parking facilities etc.) being provided as part of the proposed Scheme, facilitate the multimodal shift to active travel "cycle LRT trips" as a core part of the proposed Scheme, which aligns with CAP24. Luas encourages the integrated use of bicycles and LRT – 'cycle-LRT trips' as a core part of the proposed Scheme. Integrated bicycle and LRT journeys are a convenient, fast and sustainable way to travel, with added benefits for one's health and well-being, as well as carbon emission reductions.

It is concluded that the proposed Scheme will make a significant long-term contribution to reduction in carbon emissions. Therefore, in line with the IEMA 2022 GHG Guidelines significance criteria, the overall residual effect of the proposed Scheme is assessed as 'beneficial' effect with a 'beneficial' significance in the long term, when the significance criteria for impacts is taken for the project as a whole over its 60-year lifecycle rather than for individual phases.

14.7 Cumulative Impacts

The cumulative assessment of relevant plans and projects has been undertaken separately in Chapter 24 (Cumulative Impacts) of this EIAR.

14.8 Difficulties Encountered

No significant difficulties were encountered during preparation of the Climate Impact Assessment Chapter. The TII Carbon Tool has been completed by the Engineering Design Team for the proposed Scheme. The quantification of materials, sourcing of materials and how these inform the embodied construction carbon calculations in the TII Carbon Tool is based on the proposed Scheme EIAR design stage. The volumes of materials, sourcing of products, technical specification for materials, etc. may all potentially change to some degree during the detailed design phase by the appointed contractor. Throughout the assessment, efforts have been made to provide a conservative scenario of the embodied carbon of construction materials in the TII Carbon Tool.

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