

Chapter 2

Climate Change





Climate Change

1. Introduction

Climate change is recognised as the defining challenge for this century. In 2019, Dáil Éireann declared a climate and biodiversity emergency (Houses of the Oireachtas, 2019). Addressing the causes and consequences of climate change represents a multi-generational challenge, with the scale of the responses needed being uniquely determined by the effectiveness of actions taken now and in the coming years.

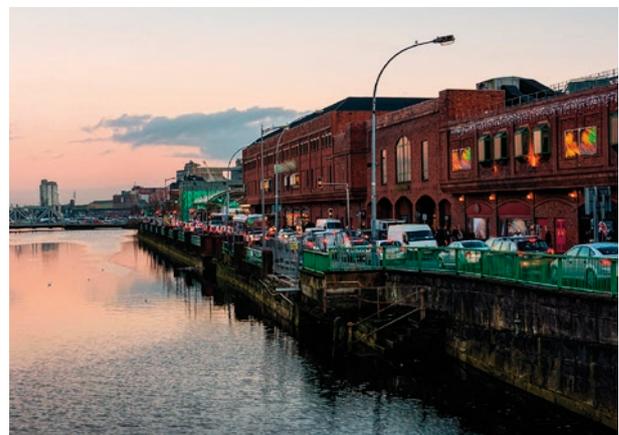
The 2015 Paris Agreement provides the framework for global actions to prevent dangerous and irreversible climate change. That agreement was adopted following confirmation by the Intergovernmental Panel on Climate Change (IPCC) in its Fifth Assessment Report that warming of the climate system is unequivocal and that the human causes of this are clear (IPCC, 2014). This is evident globally and in Ireland. Both natural and human systems are experiencing diverse changes and impacts as a result of climate change. Adaptation planning to manage current and future unavoidable climate impacts and risks is required. The more rapidly we reduce greenhouse gas (GHG) emissions, the lesser the impact of any future changes, and the more manageable and less costly they will be.

At a national level, Ireland's Climate Action Plan is an important step towards reaching national and EU climate goals for 2050 (DCCA, 2019a). Creating the requisite climate-neutral economy and resilient society to achieve climate neutrality by 2050 entails rapid and far-reaching transformative change across the energy, transport, land use, agriculture and food, buildings and industry sectors. Change could bring opportunities and significant co-benefits, ranging from job creation and innovation to improved air quality and human health, reduced traffic congestion and warmer, more efficient homes.

In Ireland, there has been a marked escalation in social awareness and public engagement around climate change. A recent survey conducted on behalf of the Environmental Protection Agency (EPA) shows that 58 per cent of adults cite climate change as one of the top three environmental concerns requiring action (EPA, 2020a). The transition to a climate-neutral economy and climate neutrality by 2050 requires an integrated response, ensuring fairness and a just transition for all. It must be planned and managed to underpin both systemic change to enable low-carbon technologies and practices to flourish, and behavioural change to enable individuals, communities, businesses and organisations to play their part.

In this chapter we provide an overview of the key indicators and projections of climate change and the scientific understanding of the drivers of these. The policy responses at the global, European Union (EU) and national levels are described.

Ireland's GHG emissions and trends are presented along with an overview of the emerging structures that are designed to inform and enable effective national responses to climate change. These are explored further in Chapters 3, 11, 12 and 13. The transition to a climate-neutral and climate-resilient Ireland should give rise to significant opportunities and benefits. The pathways for achieving this transition will be enhanced via an effective, integrated responses that puts climate action and the management of climate risk at the centre of decision-making. Approaches to doing this, including citizen engagement, are also outlined.





2. The Causes of Climate Change

Enhanced levels of atmospheric GHGs, particularly carbon dioxide, have changed the Earth's energy balance, resulting in less thermal energy/heat being lost to space. This is causing global warming, which is observed as increased global average temperatures, changes in precipitation patterns, mean sea level rise and changes in the character of weather extremes.

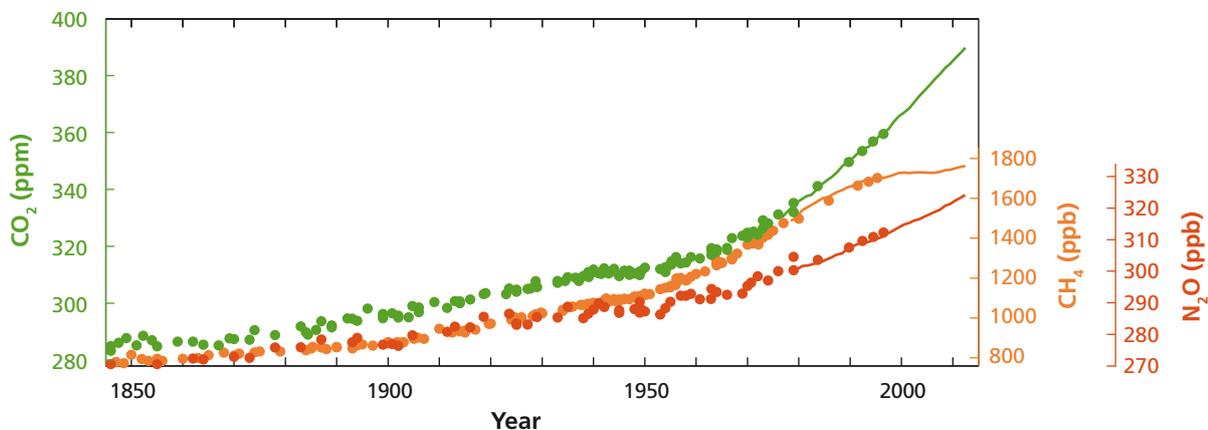
The Earth's energy balance (i.e. the balance between the amount of energy it receives from the Sun and that lost to space) has remained relatively stable for millennia. This balance is regulated by relatively small amounts of gases in the atmosphere, known as GHGs, as well as microscopic particles, dusts and clouds. The most rapid and dramatic changes to the energy balance have occurred when major volcanic eruptions have launched large amounts of material into the upper atmosphere, where it can reside for years. This material reflects sunlight back to space and causes regional and global cooling (e.g. 1816 was known as the 'year without a summer', when the average global temperature decreased by 0.4-0.7°C, with major food shortages experienced across the Northern Hemisphere). The other principal source of such particulates is human activities, specifically combustion for heating, transport and industry.

Greenhouse gases, however, are different: as gases they are invisible and they reside in the atmosphere for years to centuries. The atmospheric concentrations of the main GHGs (i.e. carbon dioxide, methane and nitrous oxide) remained relatively stable for at least 800,000 years until the start of the industrial revolution in the 18th century. Since then they have increased at an unprecedented rate, reaching levels that have not existed on Earth for, in all likelihood, millions of years.

Carbon dioxide concentrations have increased by 40 per cent since pre-industrial times (Figure 2.1). The global average atmospheric carbon dioxide in 2019 was 409.8 parts per million (ppm for short), with a range of uncertainty of plus or minus 0.1 ppm. Carbon dioxide levels today are higher than at any point in at least the past 800,000 years.¹ This is primarily due to fossil fuel emissions but also land use changes, which release carbon from biomass and soils. This increased energy in the Earth's climate system is driving changes that are observed across the world's continents, islands and oceans (IPCC, 2014, 2018, 2019a).

Carbon dioxide is the largest and most important contributor to climate change. Methane, nitrous oxide, other gases and ozone are also important GHGs. Carbon dioxide is particularly important owing to its role in the global carbon cycle, which is central to life on Earth. This cycle is being significantly disrupted by the combustion of fossil fuels. As a consequence, carbon dioxide is accumulating in the atmosphere, where it is the key driver of global climate change.

Figure 2.1 Atmospheric concentrations of the GHGs carbon dioxide (CO₂, green), methane (CH₄, orange) and nitrous oxide (N₂O, red), determined from ice core data (dots) and from direct atmospheric measurements (lines) (Source: IPCC, 2014, Figure SPM.1 (panel (c)))



¹ <https://www.climate.gov/news-features/understanding-climate/climate-change-atmospheric-carbon-dioxide#:~:text=The%20global%20average%20atmospheric%20carbon,least%20the%20past%20800%2C000%20years> (accessed 8 October 2020)



Global Changes, Local Impacts

The 2018 IPCC report *Global Warming of 1.5°C* reported that the global temperature had increased by 1.0°C relative to pre-industrial levels and that, at the current rate of warming, the world would reach a 1.5°C warming between 2030 and 2050 (IPCC, 2018). If continued, a 2°C increase could occur early in the second half of this century. The main features of such an increase are:

- increase in average temperature (surface air temperature and sea surface temperature)
- changes in precipitation patterns
- changes in the rate of occurrence and scales of extreme weather events, such as heat waves, rainfall events, storms, sea surges and flash floods
- slow-onset changes such as sea level rise, the loss of glaciers and ecosystem changes.

Evidence of these changes is apparent around the world, as outlined in the IPCC Fifth Assessment Report (IPCC, 2014). Key features are explored in detail in the 2019 *Special Report on the Ocean and Cryosphere in a Changing Climate* (IPCC, 2019a). Across Europe, there has been an increase of almost 2°C since the latter half of the 19th century.²



3. International, European Union and National Policy Context

The goals established in the 2015 Paris Agreement provide the basis for global actions on climate change; the EU Green Deal and its 2050 climate neutrality objective is a response to this. Ireland's National Policy Position for 2050 was adopted ahead of the Paris Agreement but reflects elements of the ambition in that agreement.

International Policy Context

Ireland and the EU are Parties to the United Nations Framework Convention on Climate Change (UNFCCC) and its 2015 Paris Agreement. The Paris Agreement enters its implementation phase in 2020, and in doing so replaces the 1997 Kyoto Protocol as the framework for achievement of the objective of the UNFCCC, which is to prevent dangerous anthropogenic interference with the climate system. The Paris Agreement established goals relating to temperature, climate resilience and financial flows. Specifically, these are to:

- hold the global average temperature increase to well below 2°C and pursue efforts to limit the increase to 1.5°C
- enhance adaptive capacity and foster climate resilience and low-emission development in a manner that does not threaten food production
- make finance flows consistent with a pathway towards low GHG emissions and climate-resilient development.

To meet the temperature goal, global GHG emissions should be balanced with removals during this century. In order to achieve this, Parties to the Paris Agreement, including Ireland, have agreed to formulate long-term low GHG emission development strategies, which are to be communicated to the UNFCCC by 2020. At the EU level, the 2050 long-term strategy includes the 2050 Climate Neutrality Goal (EC, 2019a). This effectively guides the development of shorter term Nationally Determined Contributions (NDCs) through which the Paris Agreement is implemented. NDCs, which set out GHG emissions and other targets, are communicated or updated every 5 years. Ireland's contribution is included in the EU NDC. It is based on the 2030 emissions targets adopted by the EU. The adequacy of global NDCs in achieving the Paris Agreement goals will be assessed every 5 years under a global stocktake. The first global stocktake is scheduled to take place in 2023.

² <https://climate.copernicus.eu/surface-temperature> (accessed 5 October 2020)



To inform the Parties on the development of low GHG emissions strategies and NDCs to 2030 the UNFCCC requested the IPCC to provide a *Special Report on Global Warming of 1.5°C*. This report was published in 2018 and indicated that:

- to limit warming to below 2°C, global carbon dioxide emissions need to be reduced by about 20 per cent from 2010 levels by 2030, and reach net zero around 2075 (2065-2080)
- to limit warming to 1.5°C, global carbon dioxide emissions need to be reduced by about 45 per cent from 2010 levels by 2030, reaching net zero around 2050 (2045-2055)
- emissions of non-carbon dioxide GHGs should also be reduced but do not need to reach zero; these reductions are similar for 1.5°C and 2°C pathways
- carbon dioxide removal (CDR) technologies, including removals by terrestrial sinks such as forests, are needed to offset any overshoot in carbon dioxide emissions and to offset the emissions of non-carbon dioxide GHGs, which cannot be reduced to net zero.



An overview of selected international, EU and national policy objectives and targets is given in Table 2.1.


Table 2.1 Overview of selected international, EU and national policy/plan objectives and targets

POLICY OBJECTIVES AND TARGETS	SOURCES	TARGET YEAR
Limit global temperature rise to well below 2°C and pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels	Paris Agreement 2015 (United Nations)	Long-term global goal
Balance GHG emissions and removals as informed by best available science	Paris Agreement 2015 (United Nations)	Second half of this century
Take urgent action to combat climate change and its impacts	United Nations Sustainable Development Goal 13	2030
EU ETS sectors to reduce emissions by 21% (compared with 2005)	EU 2020 Climate And Energy Package	2020
Non-ETS (Effort Sharing Regulation) sectors to reduce emissions by 20% (compared with 2005) – main sectors are agriculture, transport, commercial, residential and waste		
EU ETS sectors to reduce emissions by 43% (compared with 2005)	EU 2030 Climate and Energy Framework	2030
Non-ETS (Effort Sharing Regulation) sectors to reduce emissions by 30% (compared with 2005) – main sectors are agriculture, transport, commercial, public, residential and waste.	EU 2030 Climate and Energy Framework	2030
Fundamental national objective to achieve transition to a competitive, low-carbon, climate-resilient and environmentally sustainable economy by 2050	National Policy Position (2014)	2050
Statutory basis for the national transition objective; to achieve the transition to a low-carbon, climate-resilient and environmentally sustainable economy by the end of 2050	Climate Action and Low Carbon Development Act (2015)	2050
Reduce emissions of CO ₂ in electricity generation, the built environment and transport by at least 80% compared with 1990	Climate Action and Low Carbon Development Act (2015)	2050
Identify an approach to 'carbon neutrality' for the agriculture and land use sector	National Mitigation Plan (2017)	2050
Build sectoral and local-level resilience to climate change impacts	National Adaptation Framework (2018)	Ongoing
Pathway to meeting EU 2030 targets that is consistent with net zero carbon target by 2050 (in line with EU vision)	Climate Action Plan (2019)	2030 and 2050

Note: ETS, Emissions Trading System.



EU Climate Policy: Mitigation

EU climate policy has been informed by the work of the IPCC and largely implemented through structures and mechanisms such as emissions trading, the 'basket' of GHGs³ and land use, land use change and forestry (LULUCF) regulation rules, which were developed under the 1997 Kyoto Protocol to the UNFCCC. The Kyoto Protocol was designed to enable developed industrial countries to lead on climate actions to collectively reduce their emissions relative to those in 1990. This required domestic actions by the Parties with targets to reduce emissions. Ireland's targets were established under the EU Burden and Effort Sharing Decision (ESD) (Decision 406/2009/EC), which covered the periods from 2008 to 2012 and from 2013 to 2020, respectively (EU, 2009). In the period to 2012 Ireland was allowed to increase its emissions while overall EU emissions were reduced. A series of market and trading mechanisms were established at EU and UN levels to reduce the costs of actions. This included an Emissions Trading System (ETS), the Clean Development Mechanism and the use of land-based removal, which focused on carbon removals due to afforestation. It also established a 'basket' of gases, which could be traded as carbon dioxide equivalence based on a common metric of GWP100 (global warming potential); this created sectoral and cross-sectoral trading based on a carbon price.

The EU emissions reduction targets to 2020 and 2030 were adopted ahead of the UNFCCC meetings in Copenhagen in 2009 and Paris in 2015. At the EU level these retain 1990 as a base year reference point. They also fit into the EU roadmap to 2050. This was informed by the IPCC Fourth Assessment Report (IPCC, 2007). The EU Green Deal, including its Climate Law and climate neutrality goal for 2050, are informed by the IPCC Fifth Assessment Report, the IPCC *Special Report on Global Warming of 1.5°C* and the goals of the Paris Agreement. This may result in revisions to the 2030 emissions reduction ambition.

The 2020 targets established under the 2020 Climate and Energy Package established one EU-wide target for large-scale emitters under the EU ETS and another set of targets for each EU Member State under the ESD (see Topic Box 2.1). This package did not allow the use of forest or other land use-based offsets. Ireland will meet its 2020 targets through a combination of national actions and the use of flexibilities, which allow the purchase of emissions reductions from other Member States.

The EU emissions reduction targets established for 2030 were communicated to the UNFCCC in the EU NDC under the Paris Agreement (see above). These are to be achieved through the 2030 Climate and Energy Framework.

EU Climate Policy: Adaptation

The EU strategy on adaptation to climate change was published in 2013 (EC, 2013). The strategy has an overall aim of contributing to a more climate-resilient Europe and focuses on three key objectives:

1. promoting action by Member States
2. 'climate-proofing' action at EU level
3. better informed decision-making – addressing gaps in knowledge about adaptation.

The European Commission published an evaluation of the strategy in November 2018, which found that, while it had delivered on its objectives, Europe was still vulnerable to climate impacts (EC, 2018a). Under the European Green Deal 'a new, more ambitious EU strategy on adaptation to climate change' will be adopted in 2021, building on the 2013 strategy (EC, 2019b). The EU has embarked on a consultation process on the next EU adaptation strategy and has adopted an Adaptation Mission under Horizon Europe. The EU and the World Meteorological Organization have developed a series of climate services to support decision-making within and across sectors. Relevant EU-wide information and data are available on the Climate Adapt information portal (<https://climate-adapt.eea.europa.eu>). The Copernicus Climate Change Service supports adaptation and mitigation policies of the EU by providing consistent and authoritative information on climate change.⁴

³ Under the Kyoto Protocol a basket of GHG was adopted, which included carbon dioxide, methane and nitrous oxide, as well as the F-gases (hydrofluorocarbons and perfluorocarbons) and sulphur hexafluoride (SF₆). These are weighted relative to carbon dioxide by a 100-year global warming potential value and aggregated carbon dioxide equivalent emissions.

⁴ <https://climate.copernicus.eu/what-copernicus> (accessed 5 October 2020)



Topic Box 2.1 EU Climate and Energy Framework from 2021 to 2030

The **EU Climate and Energy Framework**⁵ includes three components to enable progress on the mitigation of emissions: the ETS,⁶ the Effort Sharing Regulation (ESR) (EC, 2016) and the LULUCF regulation.⁷ Each component covers specific activities leading to GHG emissions and removals:

- The ETS covers large-scale energy generation, industry and aviation. Across the EU, the ETS covers 45 per cent of total emissions, although in Ireland it covers approximately 28 per cent of emissions and includes about 100 facilities. The EU has agreed a 2030 target of 43 per cent emissions reductions relative to emissions in 2005.
- The ESR includes emissions from transport, agriculture, residential and commercial activities, F-gases (hydrofluorocarbons and perfluorocarbons) and waste. Across the EU, the ESR covers 55 per cent of total emissions; in Ireland it covers 72 per cent, where agriculture is the largest sector at 46 per cent of the ESR, in contrast to approximately 17 per cent for the EU as a whole. Each Member State has agreed a national target for emissions reductions across the ESR activities, with Ireland agreeing a target of 30 per cent emissions reductions relative to emissions in 2005.
- The LULUCF regulation is intended to give EU Member States incentives to improve land management to reduce carbon losses and maintain and enhance carbon stocks associated with land use. The LULUCF regulation sets a binding commitment for each Member State to ensure that accounted emissions from land use are entirely compensated for by an equivalent removal of carbon dioxide from the atmosphere through action in the sector. This is known as the 'no debit' rule. In addition, if a Member State can demonstrate an increase in carbon removals, the Climate and Energy Framework provides a mechanism by which a proportion of these can be offset towards its ESR target.

Other flexible mechanisms exist within the Climate and Energy Framework. This allows for overachievement on targets within one component to contribute to targets within the ESR. Access to these flexibilities is limited. For example, in recognition of the challenges to achieving emissions reductions within agriculture, and to stimulate additional action in the land use sector, Member States can use carbon dioxide removals from LULUCF towards their ESR targets. Ireland can use flexibilities from LULUCF to contribute up to 26.8 million tonnes of carbon dioxide equivalent (Mt CO₂eq) of the 2021-2030 ESR target.

The ESR allows nine Member States the choice to use a limited amount of ETS allowances for offsetting emissions in the effort sharing sectors in the period 2021-2030. Ireland can potentially use 4 per cent of its 2005 effort sharing emissions annually from 2021 to 2030 to offset emissions in the effort sharing sector. Finally, Ireland can also trade emissions reductions with other Member States that have either under- or overachieved on their ESR targets.

Ireland's Policy Context

National climate policy and legislation has been evolving and strengthening in recent years and Ireland is now at the stage where implementation needs to be the priority.

The National Policy Position on Climate Action and Low Carbon Development was adopted in 2014 (DCCAE, 2014). It recognised the threat that climate change poses for humanity and established a long-term national mitigation objective of low-carbon transition based on an aggregate reduction in carbon dioxide emissions of at least 80 per cent by 2050 compared with 1990 levels, across the electricity generation, built environment and transport sectors. In parallel, it adopted an approach to carbon neutrality in the agriculture and land use sector, including forestry, which does not compromise capacity for sustainable food production. It recognises

the challenges and opportunities of the broad transition agenda for society and aims, as a fundamental national objective, to achieve transition to a low-carbon, climate-resilient and environmentally sustainable economy by 2050. The National Policy Position is the basis for the transition objective established in the Climate Action and Low Carbon Development Act 2015 (Government of Ireland, 2015). That Act established the National Mitigation Plan (NMP)⁸ and National Adaptation Framework (NAF) processes, which are designed to address the causes and consequences of climate change in Ireland. These are to be updated every 5 years. The Act also established the Climate Change Advisory Council (CCAC), to advise the government on climate policy and review progress on the achievement of targets annually.

5 https://ec.europa.eu/clima/policies/strategies/2030_en

6 https://ec.europa.eu/clima/policies/ets/revision_en

7 https://ec.europa.eu/clima/policies/forests/lulucf_en

8 *In July 2020 the Supreme Court found that the National Mitigation Plan fails to comply with the Climate Action and Low Carbon Development Act 2015 because it does not set out how the national transition objective of decarbonising Irish society is to be achieved – <https://www.gov.ie/en/press-release/410b1-minister-ryan-welcomes-the-judgement-of-the-supreme-court-today-in-relation-to-national-mitigation-plan/> (accessed 1 October 2020).*



In 2018, the government tasked the Citizens' Assembly with considering the question of Ireland becoming a leader in climate action. The findings of the Assembly were then considered by a special Joint Oireachtas Committee on Climate Action, which subsequently published its report and recommendations (Houses of the Oireachtas, 2019). Following this, the government published the Climate Action Plan in 2019.

In 2020, the new government committed to an average 7 per cent per annum reduction in overall greenhouse gas emissions from 2021 to 2030, equivalent to a 51 per cent reduction over the decade and to achieving net zero emissions by 2050. New measures are expected to be announced over the next year to realise this ambition.

Implementation of the National Policy Position: Mitigation

The Climate Action Plan 2019 charts a course towards meeting EU emissions reduction targets for Ireland to 2030 (DCCAE, 2019a). The plan is an important step towards reaching the longer term target of net zero emissions by 2050; however, it assumes a very significant increase in the rate of decarbonisation post 2030. International analysis suggest that early actions can lead to more cost-effective decarbonisation. Systemic change is needed to enable low-carbon technologies and practices to flourish; this has to be aligned with behavioural change to enable individuals, communities, businesses and organisations to play their part. The plan also requires building the required enterprises and upskilling the workforce to enable households and business to adopt low-carbon technologies. In addition, enhanced governance arrangements are envisaged in the plan, including carbon-proofing policies, establishing carbon budgets, a strengthened Climate Change Advisory Council and greater accountability to the Oireachtas.

An amendment to the 2015 Climate Action and Low Carbon Development Act is needed to give a legislative basis to the Climate Action Plan and to enact in legislation the 2050 climate target. In parallel, Ireland's Long-term Strategy on Greenhouse Gas Emissions Reduction, which underwent public consultation in late 2019 (DCCAE, 2019b), seeks to identify transition pathways beyond 2030 to 2050 across all key sectors of the economy, including energy, buildings, transport, enterprise, waste, agriculture and land use.

Implementation of the National Policy Position: Adaptation

In Ireland, the first statutory National Adaptation Framework (NAF) was published in 2018 (DCCAE, 2018a). It sets out the national strategy to reduce the vulnerability of the country to the negative effects of climate change and to avail of positive impacts. The NAF was developed under the Climate Action and Low Carbon Development Act 2015.

Implementation of the National Policy Position: Other Policies

In terms of wider national policy, both the National Planning Framework and the National Development Plan (Project 2040; DPER, 2018) are key policy instruments to facilitate the transition to a low-carbon society and economy in Ireland.

It is increasingly recognised that climate action is cross-sectoral and will need to incorporate policy developments across a broad range of domains and systems. For example, the United Nations (UN) Sustainable Development Goals emphasise the connections and interlinked goals to ensure resilient societies, productive economies, and a healthy environment for present and future generations. The European Green Deal, published in December 2019 (EC, 2019b), is also a broad package of measures to support a sustainable green transition, emphasising a systems approach to tackling climate change. Measures aim to reduce emissions, increase resource efficiency, invest in research and innovation and preserve Europe's natural environment. It is envisaged that the Green Deal will be a platform for sustainable EU growth, supported by investments in green technologies, sustainable solutions and new businesses. A foundation for the implementation of the Green Deal was the publication of a draft EU Climate Law in March 2020, which would legislate for an EU goal of net zero greenhouse gas emissions by 2050 (EC, 2020).





4. Key Greenhouse Gas Trends for Ireland

Tracking greenhouse gas emissions, and projecting future trends, provides the evidence base to inform required emissions reductions and build a low-carbon and resilient society and economy.

The EPA is responsible for compiling inventories and projections of GHG emissions for Ireland and for reporting the data to the EU and UN. The inventories and projections are subject to EU and UN expert review to ensure transparency, accuracy, completeness, consistency and comparability with those of other Parties.

National Greenhouse Gas Emissions Trends

Ireland's GHG emissions increased by 10.1 per cent from 1990 to 2019. The latest projections show that full implementation of additional policies and measures, outlined in the 2019 Climate Action Plan, will result in a reduction in Ireland's total GHG emissions by up to 25 per cent by 2030 compared with 2020 levels.

In 2019, Ireland's GHG emissions were 59.9 Mt CO₂eq; this is an increase of 10.1 per cent since 1990, when emissions were 54.4 Mt CO₂eq. The trend in GHG emissions from 1990 to 2019 is shown in Figure 2.2.

Agriculture is the single largest contributor to the overall emissions, at 35.3 per cent. Transport, Energy Industries and the Residential sector are the next largest contributors, at 20.3 per cent, 15.8 per cent and 10.9 per cent, respectively (Figure 2.3).

Figure 2.2 Trends in GHG emissions from 1990 to 2019 (Source: EPA, 2020b)

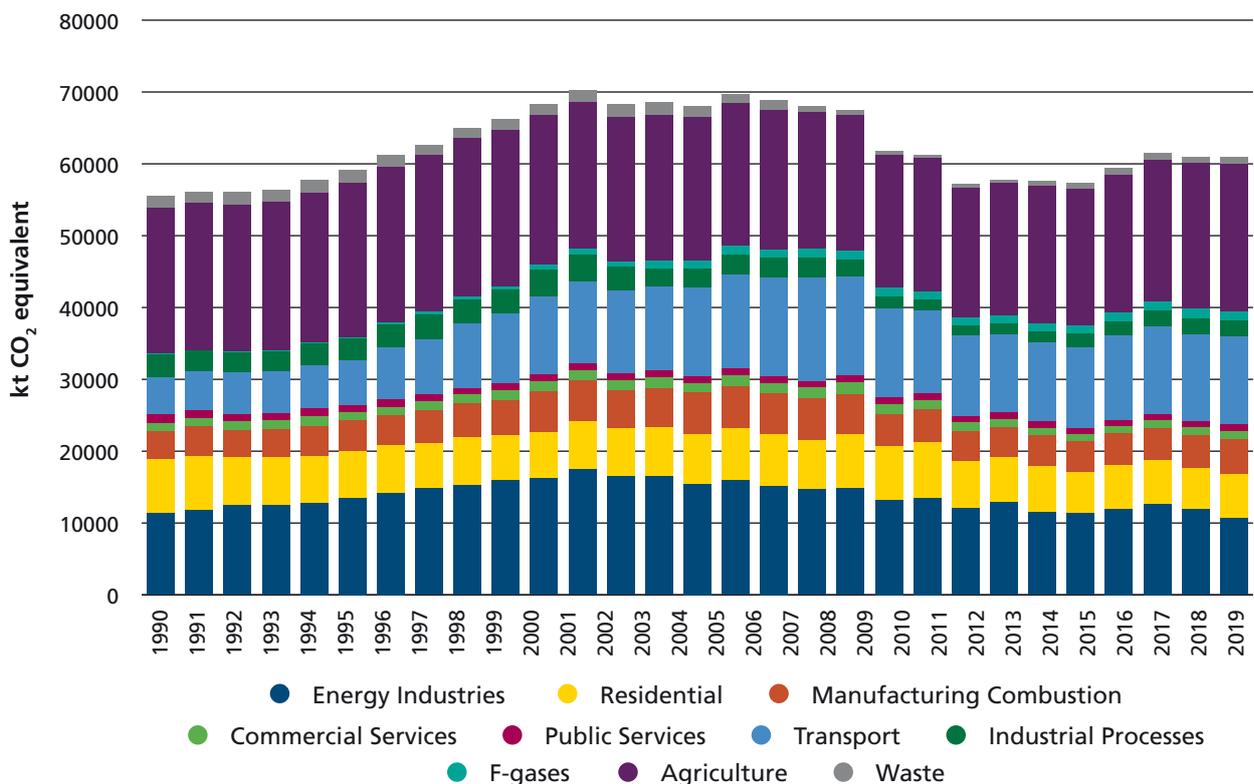
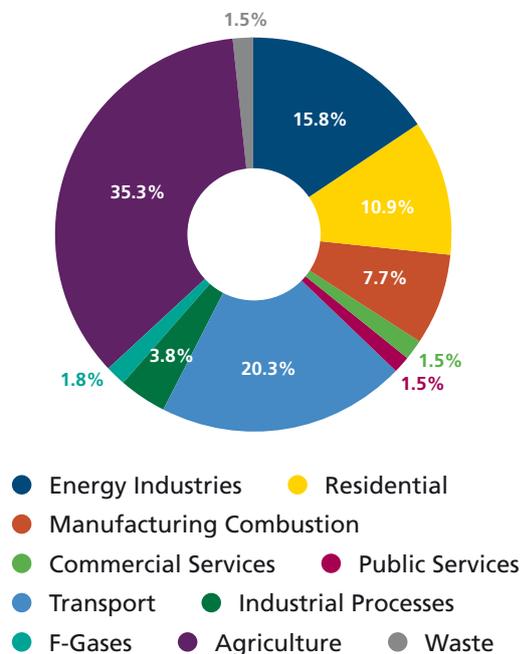




Figure 2.3 Sectoral contribution to overall GHG emissions in 2019 (Source: EPA, 2020b)



The share of carbon dioxide in total GHG emissions increased to 62.2 per cent in 2019 compared with 60.6 per cent in 1990. In contrast, methane and nitrous oxide emissions, primarily from the agriculture sector, fell from 39.4 per cent of total GHG emissions in 1990 to 36.0 per cent in 2019. Emissions from F-gases accounted for 1.8 per cent of the total in 2019.

Ireland's latest projections show total emissions decreasing by 6 per cent from 2020 levels by 2030 under the 'with existing measures' scenario. This scenario assumes that no additional policies and measures beyond those already in place by the end of 2018 are implemented. Under the 'with additional measures' scenario, emissions are estimated to decrease by 25 per cent by 2030. This scenario assumes implementation of the 'with existing measures' scenario in addition to the implementation of planned government policies and measures adopted after the end of 2018. Importantly, this includes Ireland's 2019 Climate Action Plan.

The following sections provide a summary of the agriculture, transport and energy sectors; for a deeper analysis see Chapters 11-13.

Agriculture Sector

In 2019, GHG emissions from agriculture were 9.5 per cent above 1990 levels, mainly driven by a 16.1 per cent increase in methane emissions from enteric fermentation and a 21.8 per cent increase in emissions from manure management. Agriculture accounted for over one third (35.3%) of Ireland's total national emissions.

Greenhouse gas emissions from agriculture accounted for 35.3 per cent of Ireland's total national emissions in 2019. Over the period 1990-2019, after an initial rising trend in emissions in the 1990s, the sectoral emissions began to decrease steadily between 1998 until 2011. Since 2011, emissions have trended upwards again with an overall peak in emissions reported in 2018. In the last 10 years, dairy cow numbers have increased by 38.3 per cent with a corresponding milk production increase of 66.9 per cent. This reflects national plans to expand milk production under Food Wise 2025 and the removal of the milk quota in 2015.

Emissions projections show that agricultural emissions are projected to increase by 3.5 per cent over the period 2021-2030 to 21.1 Mt CO₂eq under the 'with existing measures' scenario (scenario doesn't assume any additional actions are taken by the sector). Under the 'with additional measures' scenario, emissions are projected to decrease by 11.3 per cent by 2030 compared to 2020 levels. The 'with additional measures' scenario assumes a total of 16.5 Mt CO₂eq of mitigation over the period 2021-2030 with the implementation of Ireland's Climate Action Plan, including those measures in the Teagasc marginal abatement cost curve (Lanigan *et al.*, 2019).

Transport Emissions

Increases in GHG emissions from transport have been recorded in 5 out of the last 7 years. they account for over 20 per cent of Ireland's total national emissions in 2019.

Greenhouse gas emissions from transport accounted for 20.3 per cent of Ireland's total national emissions in 2019. Between 1990 and 2019, emissions from transport showed the greatest overall increase, at 136.9 per cent, with road transport increasing 142.4 per cent. Transport emissions have decreased by 15.4 per cent below peak levels in 2007, primarily because of the economic downturn, improving vehicle fuel efficiency as a result of changes to the vehicle registration tax, the increase in use of biofuels and significant decreases in fuel tourism in recent years. However, more recently, increases in transport emissions have been recorded for 5 out of the last 7 years as the economy has grown and transport movements have increased.



Emissions projections show transport emissions decreasing by 11.6 per cent over the period 2021-2030 to 11.2 Mt CO₂eq under the 'with existing measures' scenario. Emissions are projected to decrease by 38.6 per cent over the period 2021-2030 to 7.6 Mt CO₂eq under the 'with additional measures' scenario, which assumes that 936,000 electric vehicles, including approximately 840,000 passenger cars, will be on the road by 2030.

Further information on the climate impact of the transport sector and the future mobility challenge is presented in Chapter 11.

Energy Industries

In 2019, emissions from energy industries have decreased by 11.2 per cent on 2018, mainly because of the replacement of coal and peat with natural gas and wind generated electricity. Overall, GHG emissions from energy industries accounted for 15.8 per cent of Ireland's national total emissions in 2019.

This sector, which mainly covers power generation, oil and natural gas refining, showed a decrease in emissions of 16.6 per cent over the period 1990-2019. Over this time period, emissions from electricity generation have decreased by 18.0 per cent, whereas total electricity consumption has increased by 139.5 per cent. This decrease reflects the improvement in efficiency of modern gas fired power plants replacing older peat and oil-fired plants and the increased share of renewables, primarily, wind power along with increased interconnectivity. This year was the lowest year in the 30-year time series for coal fired electricity generation, 70% less than in 2018, and the lowest year in the last 15 years for peat fired electricity, 8% less than 2018. These reductions reflect the gradual ending of coal and peat fired electricity generation for market and climate policy reasons.

Projections show emissions from energy industries decreasing by 23.3 per cent between 2021 and 2030 to 8.7 Mt CO₂eq under the 'with existing measures' scenario. Emissions from energy industries are projected to decrease by 40.2 per cent between 2021 and 2030 to 7.0 Mt CO₂eq under the 'with additional measures' scenario. Under this scenario it is estimated that the share of renewable energy generation will increase to approximately 70 per cent by 2030.

Combined fossil energy use across transport, heating and industry, including electricity generation, consistently makes up Ireland's largest source of GHG emissions; in 2019 this was 35.2 Mt CO₂eq.

Residential Sector

Greenhouse gas emissions from the residential sector accounted for over 10.9 per cent of Ireland's total national emissions in 2019. Improvements in the building standards and insulation of older buildings and the shift to less carbon-intensive fuels have driven emissions reductions in this sector but further work is needed.

Emissions from the residential sector were 13.2 per cent lower in 2019 than their 1990 level while the housing stock increased by 78 per cent in the same period. The improved emissions profile of the residential sector reflects major improvements in the building standards and insulation of older buildings and also the shift from carbon intensive fossil fuels (coal and peat). However, the sector remains highly dependent on fossil fuels, particularly oil and natural gas. Winter heating demand is the most important variable determining emissions from this sector.

Emissions projections show emissions from the residential sector decreasing by 15.5 per cent between 2021 and 2030 to 5.3 Mt CO₂eq under the 'with existing measures' scenario (EPA, 2020c). Emissions are projected to decrease by 52.4 per cent between 2021 and 2030 to 2.9 Mt CO₂eq under the 'with additional measures' scenario. This scenario assumes full implementation of the measures in Ireland's Climate Action Plan, which include upgrades to homes, deep retrofits and significant supports for domestic heat pumps.

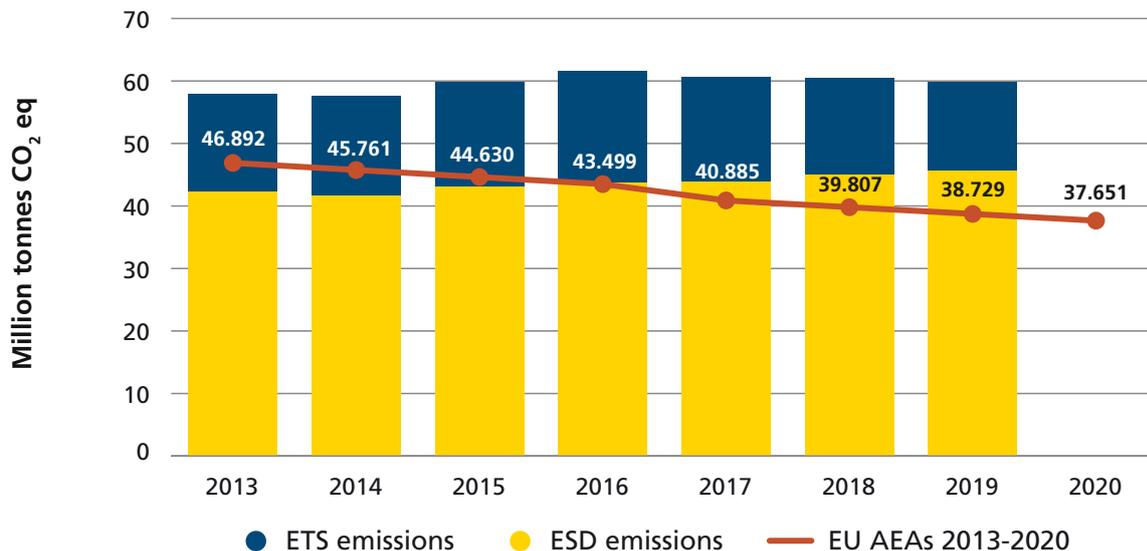
Meeting European Union and International Commitments

Ireland will likely need to rely on purchasing credits or allowances in order to comply with its 2020 targets.

The EU's ESD (Decision 406/2009/EC) sets 2020 targets for sectors outside the ETS – mainly agriculture, transport, residential, commercial and waste emissions – with annual binding limits for the period 2013-2020 (EU, 2009). Ireland's target was to reduce these emissions by 20 per cent by 2020 compared with 2005 levels while meeting the annual limits each year to ensure that emissions were on the required trajectory to 2020. Compliance under the ESD has been assessed for 6 years from 2013 to 2018, and 2019 will be assessed in 2021. The latest figures show that in 2019 Ireland exceeded its annual EU emissions budget for the fourth year in a row, by almost 7 million tonnes, and is therefore not on the pathway required to meet its 2020 targets.



Figure 2.4 Compliance status of Ireland's emissions over the period 2013-2020 (Source: EPA, 2020b)



The latest emission projections indicate that Ireland's ESD emissions are projected to be 2 per cent and 4 per cent below 2005 levels in 2020 under the 'with existing measures' and 'with additional measures' scenarios, respectively (EPA, 2020c). The impact of coronavirus (COVID-19) on 2020 emissions is not included in these figures, as this will be incorporated into the next round of projections. The dramatic decline in economic activity and travel will translate into emissions reductions in the short term, particularly affecting transport and electricity generation emissions. It is very unlikely, however, that the impact on emissions in 2020 will be sufficient for Ireland to avoid needing to purchase allowances or credits to achieve compliance for the full 2013 to 2020 ESD period. Figure 2.4 shows the compliance status of emissions over the period 2013-2020.

Ireland's 2030 target is to reduce GHG emissions by 30 per cent compared with 2005 levels, with annual limits ensuring the required downwards trajectory to 2030. The Climate Action Plan 2019 has indicated the government's intention to make full use of the LULUCF regulation flexibility.

Projections published in 2020 indicate that under the 'with existing measures' scenario Ireland will exceed the carbon budget of 378.3 Mt CO₂eq by 50.8 Mt CO₂eq over the period 2021-2030, assuming that the LULUCF regulation flexibility is fully utilised. If the ETS flexibility is also used, the exceedance will reduce to 32 Mt CO₂eq. Under the 'with additional measures' scenario, the projections indicate that Ireland will have a surplus of approximately 8.9 Mt CO₂eq over the period 2021-2030, assuming that the LULUCF regulation flexibility is fully utilised. If the ETS flexibility is also used, the surplus would increase to 27.8 Mt CO₂eq.

The National Policy Position and Greenhouse Gas Emissions in 2050

There are major challenges for Ireland to meet the ambitions set out for significantly reducing carbon dioxide emissions, achieving carbon neutrality in agriculture, maximising land use as a carbon sink and meeting a net zero emissions target by 2050.

The National Policy Position (DCCA, 2014) envisages an aggregate reduction in carbon dioxide emissions of at least 80 per cent (compared with 1990 levels) by 2050 across the electricity generation, built environment and transport sectors. In parallel, an approach to carbon neutrality in the agriculture and land use sector, including forestry, which does not compromise capacity for sustainable food production, is envisaged. The Climate Action Plan builds on this, putting in place a mitigation pathway to 2030, which would be consistent with the adoption of a net zero target in Ireland by 2050. The Climate Action Plan also commits to evaluating in detail the changes that would be necessary in Ireland to achieve this target.



Figure 2.5 Historical and projected carbon dioxide emissions from the electricity generation, built environment and transport sectors (Source: EPA, 2020b; EPA, 2020c)

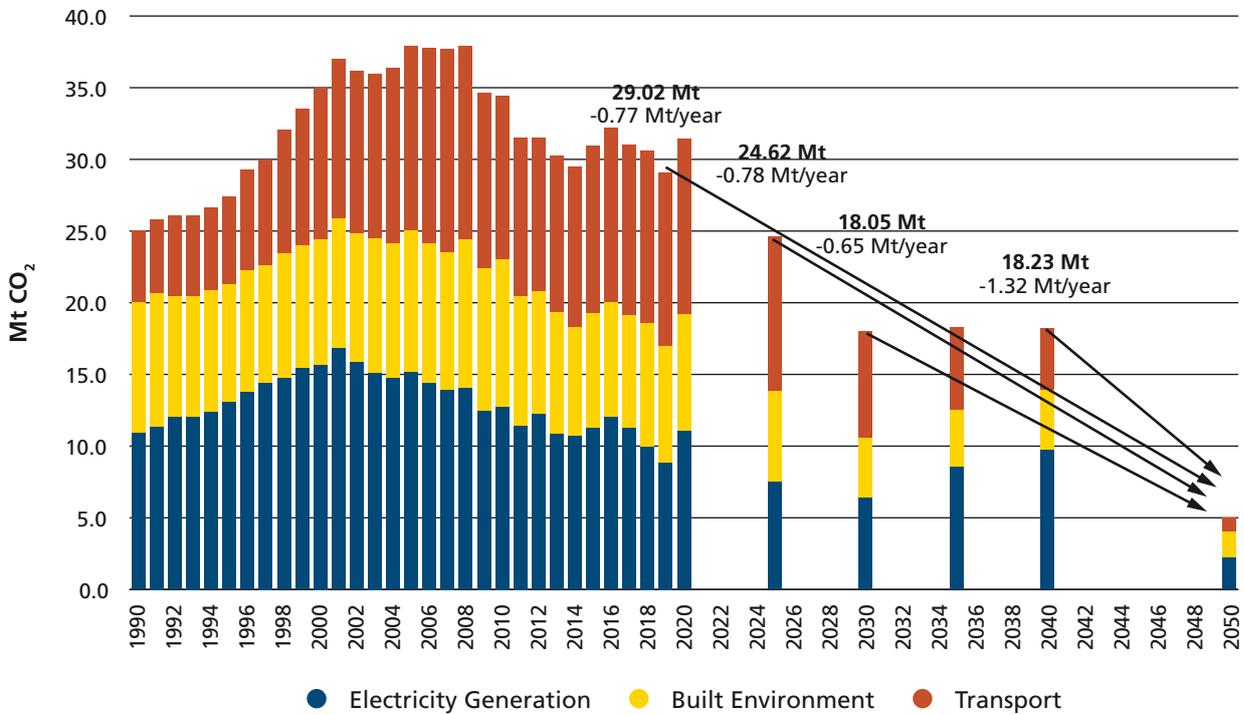


Figure 2.5 shows the latest historical and projected emissions (published in 2020) for carbon dioxide only (under the 'with additional measures' scenario) from the electricity generation, built environment and transport sectors, along the 2050 target pathway as set out in Ireland's National Policy Position (DCCAE, 2014). The pathway required to meet the target of an aggregate reduction in carbon dioxide emissions of at least 80 per cent, and to go even further in terms of zero carbon emissions, demonstrates the extent of the challenge, according to the latest projections.





5. Impacts, Vulnerability and Adaptation: Natural and Managed Ecosystems, Forests, Sectors and Infrastructures, and Social and Economic Impacts

Climate change will have diverse and wide-ranging impacts on Ireland's environment, society, economic sectors and natural resources.

In general, the climate trends observed in Ireland follow the global average. For Ireland, mid-century mean annual temperatures are projected to increase by between 1.0°C and 1.6°C depending on the emissions trajectory. Heat wave events are expected to increase by mid-century and this will have a direct impact on public health and mortality. These changes may affect the phenological phases in many plant and animal species. By mid-century there are projected increases in both dry periods and heavy precipitation events, meaning that we will have to consider increased flood risk and droughts risks. There is also the possibility that, although the average wind speed may decrease, the intensity of individual storms may increase (Nolan, 2015).

Building performance will be challenged by a changing climate and will need to cope with more extreme summer temperatures, intense rainfall events and potential changes in wind and storm patterns. This will require appropriate design and building standards, as well as adaptation of the existing building stock.

As our climate changes, it will create new conditions that may allow existing pests and diseases to spread and new threats to become established in Ireland. Our infrastructure (e.g. electricity, water, communications, transport) are likely to be affected by an increase in disruptive events, and our water quality and supply might be affected.

Global mean sea level rise by 2100 is likely to be in the range of 0.29-1.10 m (depending on the emissions scenario) and sea levels will continue to rise far beyond the year 2100 (IPCC, 2019a). The coastal zone is a critical environment for Ireland, as an island, with 1.9 million people living within 5 km of the coast (CSO, 2017). Predicted changes in mean sea level will be magnified by changing storm surge and wave patterns in coastal areas. Sea level rise varies regionally but increasing sea levels around Ireland would result in increased coastal erosion and flooding and damage to property and infrastructure. For example, in Limerick, an estimated 1122 residential properties and 248 business properties are currently at risk from flooding during a 1-in-200-

year event. With a sea level rise of 1 m, the number of residential and business properties at risk would more than double (OPW, 2019). Therefore, continuing to build the resilience of our coasts and furthering our understanding of sea level rise in a changing climate is essential (Desmond *et al.*, 2017).

Ireland has experienced several extreme weather events in recent years, including flooding, droughts and ex-Hurricane Ophelia in 2017 (Photo 2.1), which was the first strong East Atlantic hurricane on record ever to reach Ireland. These events reveal the cost of extreme weather events and the vulnerabilities of our society and economy. For example, between 2014 and 2018 local authorities spent approximately €101 million responding to extreme weather events, such as Storm Darwin in 2014, ex-Hurricane Ophelia in 2017 and Storm Emma and Storm Eleanor in 2018 (Clarke and O'Donoghue-Hynes, 2020). A review of severe weather in 2017 and 2018 by the National Directorate for Fire and Emergency Management highlights how a 'domino' effect can affect services during extreme events (e.g. when power outages affect water services or blocked roads impede access to damaged communications masts) (National Directorate for Fire and Emergency Management, 2020). Such interdependencies and cascading impacts must inform adaptation planning.

Photo 2.1 Storm Ophelia approaching Ireland (Source: Met Éireann, EUMETSAT METEOSAT High Resolution Visible Satellite image on Monday 16 October 2017 at 11:30 IST)



It is vital that policymakers, but also households, businesses and the public sector, consider the lessons from events such as these, given that they may become more frequent in a changing climate.



6. Near-term Responses and Long-term Transition

Transition to climate neutrality and climate resilience requires investment in planning and implementation of mitigation and adaptation responses.

The mitigation of climate change through reducing GHG emissions and adaptation to its consequences will affect all sectors of the economy and society. Responses are needed across the whole of government, business and society. The pathways to achieving climate neutrality and resilience by 2050 should also be made clear to all of society. Effective policy implementation will be required to achieve transition, including meeting 2030 and 2050 targets. Securing societal support for actions requires that the national vision, objectives and potential opportunities are clearly set out and communicated.

Towards a Climate-neutral Resilient Society

The temperature goal established in the Paris Agreement frames global GHG emissions during this century. The Paris Agreement also recognises the importance of removals in achievement of that goal.

Ireland's GHG emissions trajectory to 2050 is expected to follow pathways that are compatible with the Paris Agreement and the EU climate neutrality goal. The IPCC *Special Report on Global Warming of 1.5°C* (IPCC, 2018) has outlined that globally this requires that carbon dioxide reaches net zero emissions between 2045 and 2080 (see section 3). Emissions of non-carbon dioxide GHGs and other warming agents, such as black carbon (diesel/soot), are also reduced but do not reach zero. CDR technologies, including removals by terrestrial sinks such as forests, are needed to offset any overshoot in carbon dioxide emissions and to offset the emissions of non-carbon dioxide GHGs that cannot be reduced to net zero. For the EU to achieve climate neutrality these are to be achieved by 2050. This implies that net zero carbon dioxide is achieved earlier and that large-scale carbon dioxide removals are in place by 2050. This requires rapid and far-reaching transitions in energy, land, built environment and infrastructure, including transport and buildings and industrial systems. These are unprecedented in terms of scale, but not necessarily in terms of speed.

The IPCC (2019) highlighted that planned actions by Parties to 2030 were not sufficient to meet the Paris Agreement temperature goal. The annual United Nations Environment Programme *Emissions Gap Report* for 2019 (UNEP, 2019) indicated that an annual global emissions reduction from 2020 of 7.6 per cent would be needed to meet the 1.5° C Paris goal. Both the IPCC and UNEP have highlighted the importance of near-term actions (i.e. actions in the period to 2030) to achieve the Paris Agreement temperature goal and to avoid reliance on very large-scale removals of carbon dioxide from the atmosphere, which would be high risk.

For Ireland, near-term actions have been outlined in the 2019 Climate Action Plan. This plan has a focus on sectoral accountability, which is important in terms of assigning clear lines of responsibility for delivery of actions. In addition, in terms of project appraisal and implementation across the sectors, the recent reforms to the Public Spending Code will drive public expenditure towards lower carbon options and prevent lock-in to high-carbon alternatives. An appropriate price for carbon will also be central to driving low-carbon investment and, in this regard, the commitment in the Climate Action Plan to increase the price of carbon to €80/tonne by 2030 must be supported through increases over the period between now and 2030.

In 2018, Ireland was 89 per cent dependent on fossil fuels, which will need to change if Ireland is to meet its low-carbon ambitions. The Climate Action Plan commits to phasing out fossil fuels and in particular ending the burning of coal in the Electricity Supply Board (ESB) Moneypoint generation plant by 2025. Bord na Móna announced in June 2020 that all peat harvesting is to be suspended and that work will commence on an Enhanced Peatland Rehabilitation Scheme.⁹ This will accelerate the transition away from peat, with Lough Ree and West Offaly power plants to close by the end of 2020 and Edenderry expected to transition to 100 per cent biomass fuel. Exiting from coal and peat burning (including co-firing with biomass) in energy production will drive decarbonisation in transport, residential and other sectors with a high dependence on electricity and deliver co-benefits in terms of air quality.

⁹ <https://www.bordnamona.ie/company/news/articles/bord-na-mona-to-commence-enhanced-peatland-rehabilitation-scheme/>



Transport is the fastest growing sector in terms of GHG emissions and will require a multi-faceted response in terms of mitigation solutions. Electric vehicles currently occupy a central position in terms of a policy response in Ireland, with the Climate Action Plan envisaging at least 936,000 electric vehicles, both passenger and commercial, on the road by 2030 and additional charging infrastructure to cater for planned growth. This is an ambitious and challenging target, which will require ongoing support if consumers are to make the switch. Expansion of the infrastructure for electric vehicles to keep pace with the projected increase in electric vehicles in the car fleet will be imperative to underpin this transition.

Other responses required by the transport sector include developing a strategy for freight transport in Ireland, which is an important component of the transport emissions profile. In addition, it is critically important for the public sector to show leadership and decarbonise all public transport across bus and rail networks to the lowest carbon alternatives. While not an option for everyone, people should be encouraged and supported to walk and cycle where possible. Improving walking and cycling facilities in cities and large urban centres to encourage these modes of travel in a safe and sustainable way is an important part of the response. Improving the safety of rural roads for walking and cycling would also have multiple co-benefits for rural communities. Chapter 11 of this report examines in more detail approaches to reducing the environmental impact of transport through use of an 'avoid-shift-improve' hierarchy of measures, from planning changes to technological solutions.

In relation to agriculture, the Climate Action Plan sets out measures to reduce cumulative emissions in the range of 16.5-18.0 Mt CO₂eq over the period 2021-2030. Underpinning policies and measures must be prioritised to ensure full delivery of these savings, as Ireland cannot achieve its climate ambitions without the agricultural sector delivering its contribution. The Department of Agriculture, Food and the Marine's roadmap 'Ag-Climate', which is a national climate and air roadmap to 2030 and currently under development, is critically important in this regard. In particular, the commitment to identify actions that can be adopted quickly and effectively to stabilise methane emissions at 2020 levels should be underpinned by policy measures. The Department of Agriculture, Food and the Marine and the EPA have embarked on a programme of research to determine how carbon neutrality for this sector can be achieved.

Emissions from households represented 10 per cent of Ireland's national GHG emissions in 2018. Improving the energy efficiency of the existing housing stock and phasing out fossil fuel use will be a key priority in reducing emissions further from this sector. The Climate Action Plan reported that buildings in Ireland are 70 per cent reliant on fossil fuels, including oil-fired boilers. The plan also highlighted that over 80 per cent of homes and other buildings assessed for their Building Energy Rating have a rating of C or worse and stated that the current annual retrofit activity for existing stock is far too limited at approximately 23,000 (mainly shallow) retrofits. Many of the easier-to-achieve reductions options have already been delivered within this sector and the challenge now is to develop new funding delivery models that move beyond individual grants in a way that drives large-scale retrofitting to bring economies-of-scale benefits and to signal advanced performance requirements.



In addition to the development of scenarios and pathways to reduce fossil carbon emissions to zero, equal emphasis must be placed on the development of a 'removals' pathway to 2050. The Paris Agreement is explicit in terms of the need for carbon removals and Parties must collectively aim to achieve a balance of emissions and removals during this century. The IPCC *Special Report on Global Warming of 1.5°C* (IPCC, 2018) outlines a range of emissions pathways that achieve the Paris Agreement temperature goal. These rely on managed removals of carbon dioxide from the atmosphere through land management and through the use of technologies such as bioenergy with carbon capture and storage. The scale of the required removals varies according to near-term ambition and action.



In Ireland, forest-based solutions are currently the main focus for removals. The development of wider solutions across all land use types and systems is, however, needed. This should focus on sustainable land management to enable the accumulated removal of carbon. Additional technologies will also be needed, including direct air capture and bioenergy with carbon capture and storage. Many information and knowledge gaps exist with respect to these areas and technologies are not yet fully mature. Steps to address these gaps and to expedite this process are needed.

Finance Flows

A successful transition to a low-carbon economy will require a re-direction of investment towards 'green growth'. This offers many employment opportunities and economic benefits.

Finance flows are crucial to a country's ability to transition to a low-carbon, climate-resilient economy and society and can act as either a driver or a barrier to progress. Public investment will not be sufficient to achieve transition. Individuals, households and businesses will have to step up with some of the required investment to achieve the low-carbon transition. Every investment in the low-carbon climate-resilient transition represents a business opportunity for a green entrepreneur to provide goods or services. Ireland already has world-leading home-grown businesses supplying energy efficiency and energy service solutions. A scale-up in domestic action on climate change means further opportunities for green businesses to expand and grow, leading to innovation and green jobs.

Public Finance

The National Development Plan 2018-2027 prioritises €21.8 billion in public investment to achieve the transition to a low-carbon and climate-resilient economy (DPER, 2018). Housing retrofits are expected to require €3 billion of this total. Other investments include €13.7 billion in the energy system for renewables, the grid and interconnection, €1 billion for flood defences and the establishment of a Climate Action Fund of €500 million. As noted in the plan, not all of this can be funded directly from the Exchequer. Funding for this investment will also come from state-owned enterprises and semi-state bodies. A new funding mechanism launched by the National Treasury Management Agency has raised €5 billion from the sale of Irish sovereign green bonds over 2018 and 2019 (NTMA, 2020). The success of the Irish green bonds to date will enable the government to raise more finance for investment in sustainable infrastructure at a low cost. But even this will not be sufficient. In the area of housing retrofits alone, the Sustainable Energy Authority of Ireland (SEAI) estimates that over €35 billion will be required over 35 years to make the existing housing stock low carbon by 2050.

Private Finance

Private sources of finance flows will be required to achieve the economy-wide transformation envisaged to 2050. Individuals, households and businesses will have to be motivated, supported or incentivised to finance their decarbonisation efforts. This is already happening. Thousands apply every year for grants to support their energy retrofit in order to achieve warmer, more comfortable homes with lower energy bills. Ireland needs to scale up this activity by making it easier for households or homeowners to invest in retrofitting, for example through new retail banking services that support energy efficiency or energy service contracts.

Businesses will also need to find new ways to access finance for energy efficiency and low-carbon transformation.

Realising the Opportunities

Opportunities and significant co-benefits could emerge from transforming our economy to avoid the worst climate impacts. At a broad level the IPCC (2018) points out that potential benefits could include:

- Economic opportunities, jobs and innovation from efficiency gains and the green economy.
- Scaling-up of technological innovations in energy, buildings, transport, industry and agriculture sectors. This could be accelerated by breakthroughs in digitalisation, information and communication technology, artificial intelligence and biotechnology (EC, 2018b).
- Cost savings from the long-term transition from fossil fuels to energy efficiency and renewable energy. This is projected to far outweigh the costs of transition as a result of efficiency gains, reduced air pollution, better health and lower environmental damage (IREA, 2018).
- Co-benefits of improved air quality, reduced congestion, reduced nitrate pollution, improvements in health and wellbeing, enhanced nature and ecosystem services¹⁰ (as covered in Chapters 3, 6, 7, 11 and 14), as well as reduced poverty and inequality, food and water security and reduced disaster risk.

Nationally, groups such as Sustainable Nation Ireland promote Ireland as a world-leading hub for sustainable finance, business and innovation, accelerating Ireland's transition to a low-carbon economy. With continued support, this could lead to additional economic activity and revenue in Ireland's financial and services sector. Ireland already has world-leading businesses in areas such as home heating, insulation and electricity services. Support for climate action at home can act as a springboard for

¹⁰ *The EU Biodiversity Strategy 2030 – Bringing nature back to our lives (COM(2020)380) – "https://ec.europa.eu/info/sites/info/files/communication-annex-eu-biodiversity-strategy-2030_en.pdf*



the development of new businesses with the potential for export. For example, Irish expertise in integrating variable renewables into electricity transmission networks is respected worldwide given its experience built on ambitious action in Ireland to date.

Climate action can also be the lever to attract more international finance flows to Ireland. The European Investment Bank has a mandate to increase the share of its financing dedicated to climate action and environmental sustainability to reach 50 per cent of its operations in 2025. This represents a huge increase in finance available for climate action and is a key opportunity for Ireland if appropriate proposals can be developed.

Supporting International Climate Action

Under the UNFCCC, Ireland as a developed country is committed to mobilising finance to assist climate action in developing countries. Ireland has increased its international climate finance from €33.7 million in 2015 to €77.2 million in 2018, with a focus on least developed countries and regular contributions to the Green Climate Fund. International climate finance represents an opportunity for Ireland to enhance its relationship with developing countries, which have been focused on adaptation and resilience for a number of years, and sharing learning on the response to climate change. Engagement has the potential to open up new markets for green and low-carbon goods and services for the benefit of all Parties.

Adaptation Planning and Governance: Towards a Climate-resilient Ireland

Key sectors and all local authorities now have climate change adaptation frameworks in place. Effective and timely implementation of these frameworks will need good governance and oversight. They will also need to be supported by the availability of information and knowledge systems.

To prepare for the impacts of climate change, the 2018 NAF required 12 priority sectors to prepare 5-year sectoral adaptation plans¹¹ and each local authority is required to have a local adaptation strategy in place. *Sectoral Planning Guidelines for Climate Change Adaptation* (DCCAE, 2018b) and *Local Authority Adaptation Strategy Development Guidelines* (DCCAE, 2018c) were published by the Department of Communications, Climate Action and Environment to guide the development of these plans and strategies. Nine sectoral adaptation plans for 12 priority sectors were published in 2019 (Figure 2.6).

A governance framework has emerged that provides oversight and enhanced coordination and aims to maximise resources in this area.

Figure 2.6 Nine sectoral adaptation plans for 12 priority sectors published in 2019



The four local authority Climate Action Regional Offices (CAROs) are a new and important layer in the climate governance structure. The offices supported local authorities as they prepared their local climate adaptation strategies and they will be a key structure in furthering their implementation, as well as in local adaptation and mitigation research, communications and behavioural change, training and education.

Support and Information Systems

Easy access to the most up-to-date data, information and tools is essential for effective adaptation planning. Climate Ireland¹² is the national web-based resource of up-to-date and fit-for-purpose climate and adaptation information and tools (Figure 2.7). Climate Ireland provides this service for local, regional and sectoral decision-makers in line with the published adaptation strategy development guidelines. Climate Ireland also plays a key role in increasing awareness of and building capacity for adaptation planning through one-to-one support and the provision of tailored adaptation planning workshops, training and seminars.

¹¹ Approved sectoral adaptation plans are available at <https://www.gov.ie/en/publication/10221107-sectoral-planning-guidelines-for-climate-change-adaptation/>

¹² <http://www.climateireland.ie>



Figure 2.7 Ireland's Climate Information Platform, Climate Ireland



Public Participation: Societal Transitions

Initiatives such as Ireland's Citizens' Assembly climate module and the National Dialogue on Climate Action highlight the benefits of citizen engagement and collaborative approaches to developing recommendations and solutions to the national climate emergency.

Public participation and community engagement have gained increased attention in climate change debates and policy strategies at national and international levels.

Recent opinion polls (EC, 2019c) and grass roots activities demonstrate that there is a high level of awareness of climate change in Ireland. The 2020 EPA RED C poll (EPA, 2020a) found that the 18-34 years age group placed the highest emphasis on climate change as an issue.

The Constitutional Convention and the subsequent Citizens' Assembly have shown the value of engaging the public in a deliberate manner to develop policy responses; they have further highlighted the need for reform in public consultation processes and how the processes may be improved. The Citizens' Assembly's climate module made recommendations in relation to public participation in the transition to a low-carbon economy. This was subsequently addressed in the Report of the Joint Committee on Climate Action, which recommended enhanced climate roles for local authority Strategic Policy Committees, the establishment of a one-stop shop to provide practical advice to households and businesses on reducing GHG emissions and utilising advice from the SEAI and the CAROs, and a community engagement strategy.¹³ More recently, citizen engagement has featured strongly in the Climate Action Plan 2019.

A number of promising models exist to drive this initiative further, including the National Dialogue on Climate Action (Topic Box 2.2) and, in addition, SEAI Energy Communities, the Business in the Community Leaders' Group on Sustainability and the CAROs.



¹³ <https://www.oireachtas.ie/en/committees/32/climate-action/>



Topic Box 2.2 The National Dialogue on Climate Action

The National Dialogue on Climate Action is a Government of Ireland initiative, with a secretariat supplied by the EPA (DCCA, 2020). It aims to engage the public on the challenge of climate change, motivating changes in behaviour and creating structures at local, regional and national levels to support the generation of ideas and their transition into appropriate actions.

In 2018, the National Dialogue on Climate Action hosted regional gatherings in Athlone and Tralee. These events sought to raise awareness and motivate and empower members of the public with regard to climate change. The formats included expert presentations, workshop sessions, drop-in areas and interactive panel discussions to maximise engagement (Figure 2.8). These were followed up by a series of local level events in 2019.

Figure 2.8 Regional gatherings, National Dialogue on Climate Action (Source: EPA)



Continued and more intensive engagement with communities and individuals will require the development and deployment of different methods and approaches as we move from raising awareness across all of society, including traditionally disengaged communities, to empowerment and co-creating climate action. This view is supported by the Joint Oireachtas Committee on Climate Action's recommendation to further support the National Dialogue on Climate Action, which has been working towards a process of community engagement to build public support for climate action.

Just Transition: Progressing Climate Justice

The European Commission's European Green Deal emphasises that the transition away from fossil fuels and reducing GHG emissions must be just and inclusive, putting people first, and must pay attention to the regions, industries and workers who will face the greatest challenges.

The ethical framing of climate actions has become increasingly core to discussions, including calls for a movement towards a 'just transition'. This is not a move away from 'climate justice' but rather an enhancement of the framework for understanding how the transition to a low-carbon society can be equitable and seek to leave no one behind. Current international examples are the coal transitions in Alberta, Canada, and the Appalachia region in the USA. Within the EU, Poland's transition away from coal and Ireland's transition away from peat, for example, are shaping the debate EU policy for achieving a just transition (Topic Box 2.3). Climate justice (sharing the burdens and benefits of climate change and its resolution equitably) is one of three forms of justice that needs to be considered in a just transition to a low-carbon future (Mary Robinson Foundation, 2018). The other two are energy justice (ensuring that people have access to energy to maintain a decent quality of life and that the production and distribution of energy is conducted in a manner that causes no harm, environmentally or socially) and environmental justice (the inclusion of citizens in the development, implementation and enforcement of environmental legislation and policy) (Jenkins *et al.*, 2016).

A just transition moves beyond protecting the rights of vulnerable individuals to understanding the causes of vulnerability and how responding to climate change is an opportunity to engage in justice. It is necessary to actively engage vulnerable and under-represented groups in terms of gender, ethnicity and socio-economic status while developing responses to climate change. Therefore, dialogue to develop responses needs to be considered and deliberate, in order to understand the hopes and concerns of individuals and communities, and to reduce the risk of policy failure.

The projected economic impacts of the deep transformation are expected to be positive despite the significant additional investments required in all sectors of our economy (EC, 2018b). Ensuring that these benefits are shared equitably requires a just transition framework.



The European Green Deal emphasises that the transition must be just and inclusive, putting people first, and must pay attention to the regions, industries and workers who will face the greatest challenges (EC, 2019b). The EU will support this through the introduction of a Just Transition Mechanism, including a Just Transition Fund. The Climate Action Plan 2019 commits to delivering a just transition for communities, low-income groups and households.

As recognised in the Climate Action Plan, investing in the reskilling and upskilling of Ireland's population is essential so that nobody is left behind. The National Economic and Social Council has recommended 'continuous, pre-emptive workforce development' as part of a just transition 'that is fair, participative and place-based both in process and in outcome' (NESC, 2020).

Topic Box 2.3 Bord na Móna and the Just Transition (EU, 2018)

Bord na Móna recognises its role in the community and has taken steps to prepare individuals and communities to transition away from peat production, with skills training for workers

The transition from peat to renewable energy is necessary, but it cannot be done without a consideration of the hopes and concerns of communities where peat production is not just a source of income but also of identity and community.

Currently, Bord Na Móna supports 4000 jobs directly and indirectly through its operations. The history of the company is deeply linked with the communities, with many workers being third-generation turf cutters. Given this, the government appointed Kieran Mulvey as Just Transition Commissioner in November 2019 to engage with key stakeholders in the Midlands, and created a Just Transition task force.

The first progress report by the Just Transition Commissioner, released in May 2020, has driven home the challenge ahead to transition Ireland away from peat and towards a low-carbon future (Mulvey, 2020). The report considers issues including employment creation, regulation, heritage, carbon taxation and current and future funding.

The Budget 2020 committed €6 million to a Just Transition Fund for the Midlands (on the announcement that it is to close its two power plants at Lanesborough and Shannonbridge, the ESB committed to a contribution of €5 million to this fund, so it now stands at €11 million). In addition to this, €5 million is to be dedicated to bog restoration and rehabilitation, and €20 million to group housing upgrades in the Midlands. In May 2020 the first call for proposals under the Just Transition Fund was launched. Priorities for the fund include retraining workers and generating sustainable employment in green enterprise in the region.



Bord na Móna recognises its role in the community and has taken steps to prepare individuals and communities to transition away from peat production, with skills training for workers:

- its Eco-Rangers programme, for school children to learn about biodiversity in wetlands, is changing the next generation's relationship with peatlands, from sources of energy to places of ecological importance
- critically, Bord na Móna recognises the risks to a just transition, namely the social costs, as outlined in the Irish Congress of Trade Unions Report *Building a Just Transition: The Case of Bord na Móna* (ICTU, 2019).



7. Research

Central to informing actions on climate change are national and international research and data from systematic observations made in the atmosphere, in the oceans and on land.

Innovation 2020 is Ireland's 5-year strategy for research and development, science and technology. In 2018, the Department of Business, Enterprise and Innovation (DBEI) published research priority areas for 2018-2023 (DBEI, 2018), which revised the themes and priority areas established in 2012. The most significant changes have been to the 'Energy' theme. Based on developments since 2012, including the urgent need to address climate change and sustainability challenges, this theme has evolved and been renamed 'Energy, Climate Action and Sustainability', with the two priority areas being updated to 'Decarbonising the Energy System' and 'Sustainable Living'. Work is currently being undertaken by the DBEI to develop a successor to Innovation 2020, offering an opportunity to reinforce climate as a key tenet in the next national research and innovation strategy.

The EPA has a statutory role in the coordination of environmental research in Ireland, which includes climate research. Since 2016, the EPA has funded over 90 research projects relevant to the Climate area, representing a commitment of €18 million. These projects were funded mostly under the Climate and Sustainability Pillars of the EPA Research Programme 2014-2020. The country's climate science research capacity and supporting infrastructure are key national resources to inform action on climate change. Ireland's dependency and urgency for climate research has never been greater as it transitions to a climate-neutral economy and climate neutrality by 2050 and asks citizens and businesses to undertake behavioural, lifestyle and cultural changes. Research informs understanding and provides evidence of the current and projected impacts of climate change and action on the Irish environment, society and economy. It also informs policy development and enables an assessment of its effectiveness as the country plans and implements climate action, mitigation and adaptation measures.

At an international level, the importance of research on climate change is epitomised by the work of the IPCC, the UN body responsible for assessing the science related to climate change. It provides authoritative information on the scientific understanding of climate change and responses to mitigate climate change through actions to reduce emissions and enhance removals by sinks for carbon such as forests. Its reports inform policy, from UN to national levels.

Ireland strongly supports the work of the IPCC and hosted key meetings for the delivery of the *Special Report on Climate Change and Land* (IPCC, 2019b). This and other IPCC reports also reflect the research carried out by scientists in Ireland. The EPA leads on the development and coordination of climate change research in Ireland. Under the EPA Research Strategy 2014-2020, climate research is advanced along four thematic areas:

- understanding GHG emissions and removal, and options to manage these
- Ireland's future climate, projected impacts, vulnerabilities and adaptation options
- socio-economic solutions, technological solutions and transition to a net zero emissions, climate-resilient Ireland in 2050
- air pollutants and their impacts on health, ecosystems and climate.

These areas are currently under review, as part of the preparation of the new EPA Research Strategy, which is due to be published in 2021.

The EPA also provides regular assessments of findings from climate research in Ireland and linked work at European and global levels that can inform effective science-based actions in Ireland. Details of the EPA research programme and research publications can be found at www.epa.ie.

The Climate Research Coordination Group (CRCG) was established under the EPA 2014-2020 Research Strategy. The CRCG acts to coordinate climate change-related research in Ireland. It does so by supporting and promoting coordination between relevant research funding organisations and by providing a forum for the exchange of information on activities and plans. A key objective is to advance shared strategic objectives for climate change research and ensure coherence in climate change research investments in Ireland and the effective linking of these to EU funding streams. The EPA has prepared on behalf of the CRCG the first two reports on the CRCG Activities, namely:

- First Report of Activities (June 2017-December 2018)
- Second Report of Activities (January-December 2019).

The next report is due in June 2021.

The EPA, along with Met Éireann, the Marine Institute and Teagasc, coordinates the development of observations systems in the atmosphere, oceans and land. These data, including temperature, rainfall, vegetation, river flows, ocean colour and sea level data, contribute to our understanding of the trends and changes that are happening around us, which go largely unnoticed on a day-to-day basis but which point to a potentially changed Ireland in the future.



8. Conclusions

Climate Impacts

Climate change has been described as the defining challenge of our age. In line with global trends, Ireland is experiencing temperature increases of about 0.8°C (compared with 1900). Recent national-scale extreme weather events demonstrate Ireland's vulnerability to such events, with the resilience of our infrastructure and economy severely tested. Projections indicate that climate change will continue and intensify over the coming decades.

The Climate Challenge

In Ireland, GHG emissions are coupled to economic activity, with little sign of decoupling. Rapid and deep cuts to GHG emissions are essential to avoid the most dangerous impacts of climate change but we still need to respond to the known expected impacts. The scale of the climate challenge for Ireland is significant but, as a wealthy country with significant capital, innovation and technological resources, it is well placed to address the transformation required. Advances have already been made in some sectors, such as penetration of renewables in power generation. However, the transition needs to be deepened and speeded up in other sectors, such as transport, the built environment and agriculture. The transition will spur growth in new sectors. Further investment in industrial modernisation, energy transformation, the circular economy, clean mobility, green and blue infrastructure and the bioeconomy will create new, local, high-quality employment opportunities. Ireland must be positioned to capitalise on these opportunities.

Transformative Change

Nevertheless, making the transformation towards a climate-neutral economy and climate neutrality by 2050 is not just about technologies and jobs. A number of sectors, businesses and individuals will find the transition challenging. Therefore, the ensuing deep decarbonisation process will have to be managed well, ensuring a fair and socially acceptable transition for all in the spirit of inclusiveness and solidarity. This is about people, communities, businesses and regions. Moving towards a climate-neutral and resilient economy and society can be successful only when people understand the changes needed, are engaged and experience it as beneficial for their lives.

Ireland's Climate Actions and Ambitions

The 2019 Climate Action Plan sets a course for meaningful action in Ireland that is aligned with EU and international commitments and ambitions. This must now be backed

up with strong measures to deliver on these commitments, including targeted financing. It is now time to build on the momentum and engagement that is evident across the public, communities and businesses.

The transition to a climate-neutral, climate-resilient society requires an integrated response ensuring fairness and a just transition for all. It must be planned and managed to underpin both systemic change – to enable low-carbon technologies and practices to flourish – and also behavioural change, to enable individuals, communities, businesses and organisations to play their part.

The main conclusions from this assessment of climate change issues are that:

- Ireland's climate is changing. We have already experienced warming of approximately 0.8°C since 1900.
- Disruption from extreme weather events demonstrates the vulnerability of Ireland's infrastructure and economy. To build the resilience of society and the economy requires planned adaptation to current and future impacts of climate change.
- Ireland must play its part in the global effort to achieve rapid and deep cuts to emissions to avoid the most dangerous impacts of climate change.
- GHG projections from the EPA indicate that full implementation of policies and measures identified by the government, including the Climate Action Plan, can deliver on Ireland's commitments for 2030 and is compatible with moving towards the longer term ambition of achieving net zero emissions by 2050 (DCCA, 2019a).
- The longer we delay in reducing our GHG emissions, the greater the effort and costs. Ireland's current high dependency on fossil fuels is particularly challenging.
- Implementation will be critical and the pace of emissions reduction must accelerate beyond 2030. This requires far-reaching transformative change across the economy and society.
- Public awareness, engagement and behavioural change are crucial to achieving the transition.
- COVID-19 has taught us that while the dramatic decline in economic activity and travel may have resulted in a reduction in greenhouse gases in the short term, long-term improvements can only be achieved with targeted climate and environmental actions that change consumption and production systems in a sustainable and lasting manner
- The transition must be equitable and just.



Chapter Highlights for Climate Change



Ireland's climate is changing. Mitigation and adaptation action that is planned, coordinated and prioritised is required to build the resilience of society and the economy in the face of current and projected climate change impacts.



The next decade needs to be one of major developments and advances in relation to Ireland's response to climate change. We need to start implementing ambitious policies now. Full and early implementation of ambitious policies and measures can deliver Ireland's current and future commitments to a climate-neutral economy and climate-resilient society by 2050.



The scale and pace of greenhouse gas emissions reductions must accelerate. Reducing emissions requires far-reaching transformative change across the whole economy, including in agriculture, energy, transport, waste, land use, food, buildings and industry. Ireland's greenhouse gas emissions profile – with over one-third of emissions coming from agriculture and a high dependency on fossil fuels – is particularly challenging. Ireland must also maximise the use of land as carbon stores, for example through grasslands, wetlands and forestry, to meet targets.



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