CLIMATE CHANGE ADVISORY COUNCIL

Annual Review 2019

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July 2019

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Climate Change Advisory Council

The Climate Change Advisory Council is an independent advisory body tasked with assessing and advising on how Ireland can achieve the transition to a low-carbon, climate-resilient and environmentally sustainable economy.

The Climate Change Advisory Council was established on 18 January 2016 under the Climate Action and Low Carbon Development Act 2015.

Climate Change Advisory Council Members:

Prof. John FitzGerald (Chair)
Prof. Alan Barrett (ESRI)
Prof. Gerry Boyle (Teagasc)
Laura Burke (EPA)
Jim Gannon (SEAI)
Prof. Peter Clinch
Prof. Frank Convery
Dr Joseph Curtin
Prof. Anna Davies
Prof. Ottmar Edenhofer
Prof. Alan Matthews

Climate Change Advisory Council – Adaptation Committee

At its meeting on 6 April 2016, the Climate Change Advisory Council established an Adaptation Committee to consider matters relating to climate change adaptation.

Adaptation Committee Members:

Prof. John FitzGerald (Chair)
Mark Adamson
Prof. Gerry Boyle (Teagasc)
Laura Burke (EPA)
Prof. Robert Devoy
Ciarán Hayes
Dr Ina Kelly
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Executive Summary

The Climate Change Advisory Council is an independent advisory body tasked with reviewing national climate policy, progress on the achievement of the national transition objective and progress towards international targets. As set out in the Climate Action and Low Carbon Development Act 2015, a key task of the Council is to conduct an annual review of progress made over the previous year in reducing greenhouse gas emissions and furthering the transition to a low-carbon, climate-resilient and sustainable economy and society by 2050. This is the Climate Change Advisory Council's third Annual Review of progress towards transition.

Ireland is already seeing the negative impacts of climate change and, regardless of the success of national or global mitigation measures, adaptation to climate change is essential due to the effects of continuing global emissions.

Mitigation, Transition and the National Policy Position

The Council welcomes the recent publication of the 'Climate Action Plan 2019: To Tackle Climate Breakdown', although it has not had the opportunity to consider this plan in detail. The Council recognises that the Plan proposes a robust governance framework within which new policy will be developed. For the first time the Plan also sets out sectoral targets which, if achieved, would see Ireland meet its objective for emissions reduction by 2030. The Council looks forward to considering the individual measures needed to achieve the sectoral targets in greater detail in the future.

The continued failure to set out detailed pathways on the cost-effective route to decarbonising the Irish economy by 2050 is a major obstacle to progressing policy on climate change.

While Ireland can comply with its EU targets by purchasing emissions allowances, this use of public funds – with no domestic benefit – would impose a current cost on the Exchequer and would leave Ireland with a bigger and more expensive task to meet its future targets to 2030 and beyond.

The most recent Environmental Protection Agency projections for future greenhouse gas emissions cover the period 2018 to 2040. The projections consider actions contained within the National Development Plan and the draft National Energy and Climate Plan.

The most recent projections, illustrated in Figure 1, demonstrate that, under different assumptions, Ireland will not meet its emissions reduction targets, even with the additional policies and measures included in the National Development Plan. It also shows that progress on reducing emissions is sensitive to the future path of fuel prices. A significant and sustained rate of emissions reduction of approximately -2.5% per year is required to meet our objectives for 2050. It is noted that additional measures within the recent Climate Action Plan are not included.

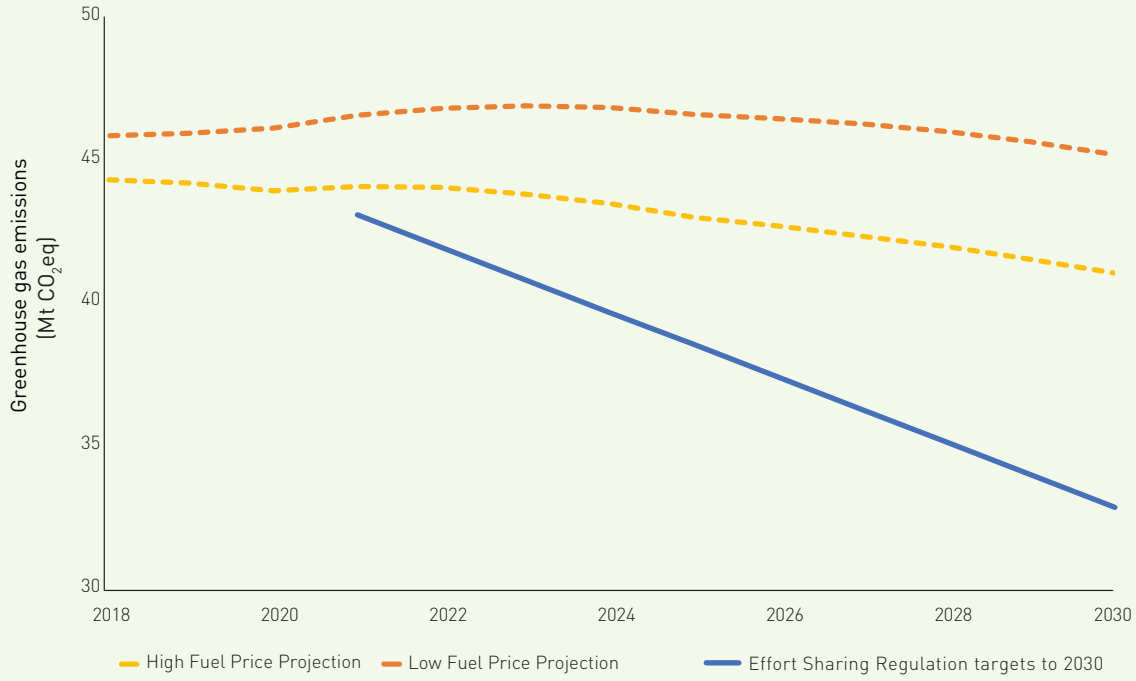

Figure 1: *Projected emissions under the 'With Additional Measures' scenario for activities covered under the Effort Sharing Regulation based on Low Fuel Price and High Fuel Price forecast.*[1,10] *Also shown are the annual targets for the activities under the EU Energy and Climate Package. Data Source: EPA Projections (2019).*[13]

Climate Resilience

The projected impacts of climate change often seem distant from everyday life, but Ireland experienced several extreme weather events in recent years which have shown the vulnerabilities of our society and economy. Failure to take action today will make it more expensive to adapt later.

The ongoing development of sectoral adaptation plans by 12 key sectors, alongside the preparation of 31 local authority adaptation strategies can play a key role in developing increased climate resilience. However, it is unclear how actions from these plans will be prioritised to address the key risks and maximise co-benefits. Review of the first cycle of adaptation planning is required to ensure priority risks and resource requirements are clear for the next five years.

Key areas where resilience and adaptation issues exist, which are not being addressed under the current plans, include our coasts, housing and planning.

Awareness of the need for adaptation remains poor, with corresponding low levels of willingness to take necessary actions. This is reflected in Government policy, where the need for adaptation remains under-recognised, there is little consideration of how it will be mainstreamed into decision-making, and co-benefits with mitigation are underexplored.

Adaptation will require significant investment from the private sector and households, as well as Government. It is important that investment decisions consider a range of global warming scenarios, including those with higher warming.

Sectoral Trends and Transition

Agriculture and Land

The Council has undertaken a detailed review and assessment of the Agriculture and Land sector.

Emissions in Agriculture are projected to continue increasing to 2030 due to growing cattle numbers, increased fertiliser use and ongoing carbon losses from land. If allowed to proceed unchecked, this would seriously undermine our ability to meet our 2030 target for a reduction in national emissions.

In framing recommendations for policy change in agriculture and land use, the Council seeks to ensure that there is a substantial reduction in greenhouse gas emissions while, at the same time, safeguarding the incomes of farmers and land managers and their long-term financial security.

The observed trend in the expansion of the national dairy herd has been the major contributor to increases in agricultural emissions in recent years. Teagasc has identified several mitigation options that can help to reduce emissions. It will be important to ensure the early and widespread uptake and adoption of these measures to obtain the maximum benefit from them. Continued reduction of the suckler herd would make an important and cost-effective contribution to mitigation within the sector, achieving a significant reduction in numbers of cattle by 2030. The potential release of land from beef production could support alternative uses, raise farm incomes and reduce exposure of the sector to external market shocks.

The forthcoming reform of the Common Agricultural Policy will provide an opportunity to incentivise the necessary changes in the Agriculture sector and ensure a significant reduction in greenhouse gas emissions by 2030, while at the same time safeguarding the financial well-being and security of farmers.

Reversing the recent declines in afforestation rates is a priority for policy action. Many aspects of the national transition objective are contingent on an expanded and sustainable domestic forestry sector.

Land use in Ireland is a net source of emissions, primarily due to the ongoing drainage of organic soils. Urgent assessment and implementation of appropriate management options for degraded peatlands is required.

Policies implemented to achieve mitigation may have social implications that need to be addressed for a just transition. Engagement with all relevant stakeholders will be important to ensure that the farming community benefits from the necessary changes in land use.

There is also an opportunity within the Agriculture, Forestry and Land Use sector to advance progress on the national policy position, while providing multiple co-benefits to society. Mitigation activities within this sector can provide additional ecosystem services including: protecting biodiversity; improving soil, air and water quality; ensuring resilience to climate change; and enhancing Ireland's natural environment.

Transport

There has been limited progress nationally towards the low-carbon transition in the Transport sector.

Putting transport onto a sustainable transition pathway will require fundamental policy change across spatial and infrastructure planning and investment in public, private and freight transport. The Council recommends prioritising early action that promotes sustainable settlement patterns and alternatives to use of private vehicles.

As electric vehicle range, price and model availability continue to improve, early action to ensure access to reliable and efficient electric vehicle charging infrastructure is essential.

The Council will undertake a review and assessment of the Transport sector in its Work Programme for 2020.

Energy

Emissions in Energy are projected to increase out to 2030.

Electricity generation from renewables increased in 2018. Additional investment in capacity and technologies in renewable energy is required to reach targets.

The continued use of coal and peat for electricity generation accounts for a significant proportion of Ireland's greenhouse gas emissions. The Council calls for a detailed implementation plan for the early removal of peat and coal from electricity generation in Ireland. Regulatory action and the implementation of a Carbon Price Floor across the EU are approaches that can deliver on national commitments to decarbonise electricity.

Support for biomass co-firing with peat has the effect of supporting continued burning of peat for electricity generation, contributing to higher emissions. The Council recommends the closure of Moneypoint by 2025, and cessation of peat-fired generation in 2020.

Residential

Focusing scarce resources on upgrading the publicly owned housing stock would fulfil a number of social and environmental objectives. The building sector needs to increase its capacity to deliver the necessary retrofit programme.

The Council recommends additional resources as part of the retrofit programme to enable the development of sufficient skills and capacity across the sector. Investment in local authority buildings and housing is an important opportunity for the Government to lead in this area.

Industry

Emissions in Industry are projected to increase to 2020, and 2030. This is not consistent with the long-term low carbon transition.

Governance, Policy and Strategy

Climate action needs to be fully integrated across all government plans, policies and programmes, including appropriate resourcing and implementation of the National Planning Framework and the National Development Plan. The governance structure outlined within the Climate Action Plan 2019 recognises the urgency of climate issues and establishes a framework for implementation and continual review.

Carbon Pricing:

The carbon tax is a key policy tool for transition. The Council recommends that it should be raised to €35 per tonne of carbon dioxide equivalent in Budget 2020, to make up for the missed opportunity in Budget 2019. Thereafter it should be steadily increased each year to reach at least €80 per tonne by 2030. Without this tax, it will not be possible to drive the necessary change

across all sectors of the economy. The Council believes that it is essential that the revenue raised by the tax is used to ensure that those on low incomes are not adversely affected by the change. Consideration is needed of how best to recycle the revenues arising from the tax to ensure a fair distribution of the burden.

Framing the Discussion:

The work of the Joint Oireachtas Committee on Climate Action, in response to the strong signals provided by the Citizens' Assembly, has added a new urgency to climate action in Ireland.

The Council believes that a properly mandated and resourced National Dialogue on Climate Action has the potential to work in and between sectors, communities, networks and individuals to drive the climate action agenda. As part of this, a 'just transition' framework can add depth to policy, create coherence and garner public support.

Contents

1. Introduction

Each year the Climate Change Advisory Council is charged with reviewing Ireland's performance regarding the achievement of the national transition objective and compliance with European Union (EU) and international obligations related to climate action. The Annual Review 2019 is the third annual review carried out by the Council and describes the results of this review. It documents Ireland's progress in the previous year in achieving reductions in greenhouse gas emissions and in furthering the transition to a low-carbon, climate-resilient and environmentally sustainable economy by the end of 2050 through climate change mitigation and adaptation.

The Annual Review 2019 follows the structure of the previous annual reviews, in accordance with the requirements of the Climate Action and Low Carbon Development Act 2015.[2]

Chapter 2 presents an overview of Ireland's 1990 to 2017 greenhouse gas emissions inventory data and draws attention to changes that occurred between 2016 and 2017.

Chapter 3 outlines Ireland's greenhouse gas emissions projections for the period 2018 to 2040.

Chapter 4 describes Ireland's performance against our EU 2020 emissions reduction target in 2017, our cumulative target from 2013 to 2020 and our own national transition objective to 2050.

Chapter 5 presents progress on potential indicators for transition.

Chapter 6 considers existing and recent developments in policies and measures across the sectors and at a national level and the cost-effective approach to achieve transition objectives.

Chapter 7 presents an overview of progress towards a climate-resilient Ireland, and outlines Ireland's progress in meeting the adaptation and resilience component of the national transition objective.

Chapter 8, the Special Focus Chapter, looks at the Agriculture, Forestry, and Other Land Use (AFOLU) sector, given its significance for Ireland.

Chapter 9 documents the activities of the Council in 2018.

A summary of the Advice and Recommendations to Government is presented in Appendix 4.

2. A Summary of the National Greenhouse Gas Emissions Inventory

Key Messages

- In 2017, total emissions of greenhouse gases increased by 1.7 million tonnes of carbon dioxide equivalent. This includes emissions from land use, land-use change and forestry.
- In 2017, emissions excluding land use, land-use change and forestry decreased by 0.5 million tonnes of carbon dioxide equivalent. The decrease in emissions was largely due to non-policy drivers and does not demonstrate a trend towards transition.
- Economic growth has been the main driver of the growth in emissions. Ireland's economy and emissions have not undergone the absolute decoupling that is required to put us on a pathway to a low-carbon transition and to meet EU targets.
- Increases in greenhouse gas emissions were recorded in the Agriculture and Industry sectors in 2017.
- Decreases in greenhouse gas emissions were recorded in the Energy Generation, Transport and Built Environment sectors in 2017. These decreases were primarily due to external factors not related to climate and energy policy.
- In 2017, a number of major fire events resulted in a significant increase in emissions reported from the land use sector. This highlights the importance of appropriate land use management in the context of long-term transition.

The Climate Action and Low Carbon Development Act 2015[2] tasked the Council, as part of its Annual Review, to provide a summary of the national greenhouse gas emissions inventory. This inventory in 2017, as prepared by the Environmental Protection Agency (EPA), the national competent authority, is provided below. It is the quantitative basis for the Council's review of progress in achieving reductions in greenhouse gas emissions.

2.1 Ireland's Greenhouse Gas Emissions Inventory

The annual greenhouse gas emissions inventory is central to the development of national climate change mitigation policy. It reflects the effectiveness of measures taken to achieve policy goals. Each year the EPA prepares and publishes Ireland's official greenhouse gas emissions inventory. The inventory is reported to the EU and the United Nations Framework Convention on Climate Change (UNFCCC) and is subject to in-depth international review. The current inventory, which provides data from 1990 to 2017, was submitted to the EU on 15 March 2019 and to the UNFCCC on 10 April 2019.

When emissions from land use, land-use change and forestry are included, total emissions are reported to have increased by 1.7 million tonnes of carbon dioxide equivalent (Mt CO_2eq), from 65.0 Mt CO_2eq to 66.7 Mt CO_2eq. Ireland's greenhouse gas emissions, excluding those associated with land use, land-use change and forestry, decreased by 0.5 Mt CO_2eq, from 61.3 Mt CO_2eq in 2016 to 60.7 Mt CO_2eq in 2017 (see Figure 2.1).[3] This followed two consecutive years of significant increases. Since 2005 the most significant reductions in emissions were largely due to the downturn in Ireland's economy over the period 2009 to 2011. Between 2006 and 2016 the

most significant increases were in the years 2015 and 2016. Notwithstanding the 2017 decrease, growth of Ireland's economy and emissions of greenhouse gases remain strongly coupled. The high proportion of non-CO_2 greenhouse gases in Ireland's emissions profile is a direct reflection of the importance of agriculture within the economy.

The national inventory also identified a significant source of emissions associated with wildfires across various land uses. Disturbances of this type can have an adverse impact on the annual reportable removals covered under the flexibilities allowed under the EU Energy and Climate Package to 2030. In 2017, fires across the country led to reported emissions of 1.9 Mt CO_2eq. This is the highest reported emission from biomass burning in the National Inventory, but levels of 1.6 and 1.4 Mt CO_2eq were reported in 2010 and 2003 respectively. The average annual emissions reported for biomass burning are 0.6 Mt CO_2eq. In addition, the management and control of biomass burning is an increasing cause of public concern due to the risk to life and property as well as the impact on biodiversity.

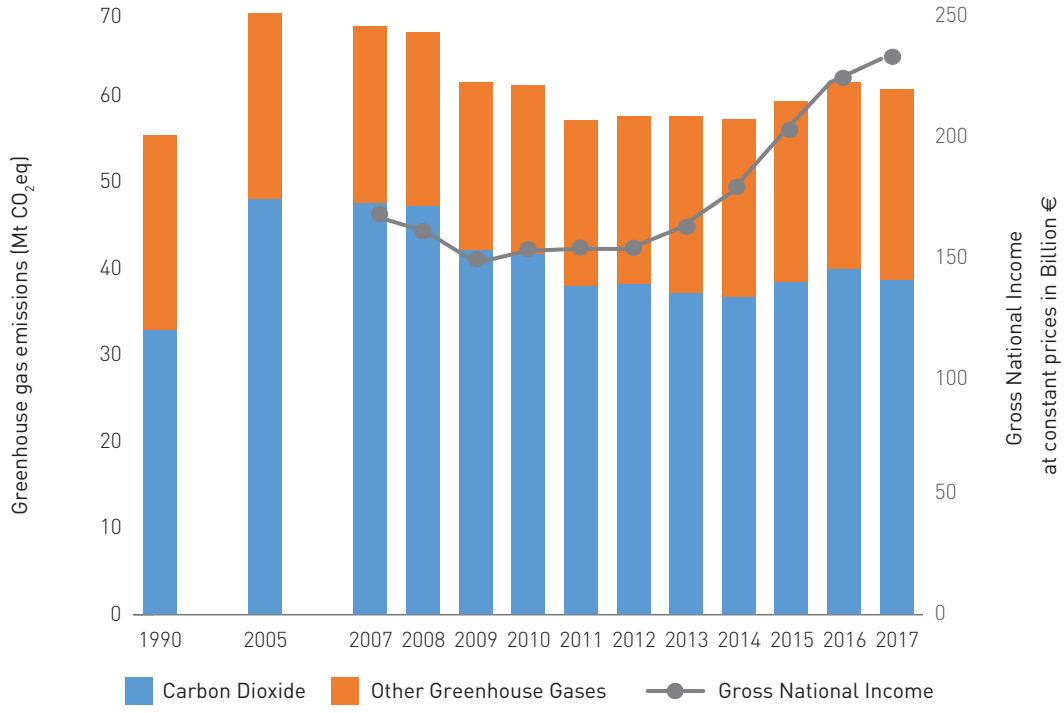

Figure 2.1: *Greenhouse gas emissions, excluding land use, land-use change and forestry, for base years 1990 (National Policy Position[4]) and 2005 (EU 2020 targets) and the period 2007 to 2017 showing carbon dioxide and other greenhouse gases. Gross national income at constant market prices in billions of euro is also shown.*
Data sources: *EPA National Emissions Inventory 2019[3] and Central Statistics Office, National Accounts 2018.*[5]

2.2 Sectoral Greenhouse Gas Emissions

The EPA provides an analysis of inventory data broken down into ten economic sectors, excluding emissions and removals from land use, land-use change and forestry, as these are not part of National Emissions for reporting purposes. A summary of greenhouse gas emissions from these sectors in 2017 is given in Table 2.1. Changes in sectoral greenhouse gas emissions and how each sector contributed to the overall decrease in 2017 are shown in Figure 2.2, as well as the trajectory of total emissions.

Increases in greenhouse gas emissions are evident in several sectors, with the largest absolute

increase in Agriculture at 0.6 Mt CO_2eq, with modest increases in emissions from Manufacturing Combustion and Industrial Processes of 0.1 Mt CO_2eq each. There were decreases in the Energy Industries of 0.9 Mt CO_2eq and the Transport and Residential sectors of 0.3 Mt CO_2eq each.

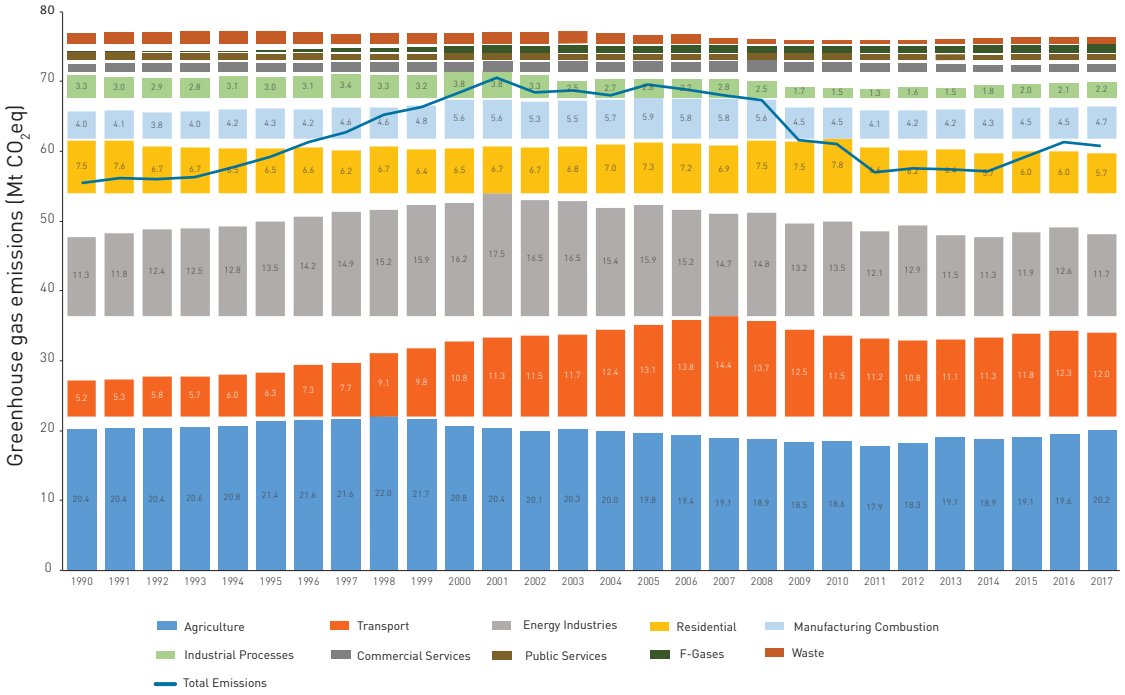

Figure 2.2: *Greenhouse gas emissions for economic sectors from 1990 to 2017. F-gases, fluorinated greenhouse gases.* **Data source:** *EPA National Emissions Inventory 2019.*[3]

Table 2.1: *Greenhouse gas emissions for base years 1990 (National Policy Position) and 2005 (EU 2020 targets), and for 2013 to 2017, broken down by sector and detailing the change in emissions in 2017 relative to 1990, 2005 and 2016. Data source: EPA National Emissions Inventory 2019*[3]

Sector (% of total greenhouse gas emissions in 2017)	Greenhouse gas emissions inventory							Change in 2017 relative to 1990		Change in 2017 relative to 2005		Change in 2017 relative to 2016		Key drivers from 2016 to 2017 from EPA Inventory (2019)
	1990	2005	2013	2014	2015	2016	2017							
	Mt CO_2eq							Mt CO_2eq	%	Mt CO_2eq	%	Mt CO_2eq	%	
Agriculture (32.1%)	20.4	19.8	19.1	18.9	19.1	19.6	20.2	–0.1	–0.7	0.4	2.1	0.6	2.9	Increased dairy cow numbers and fertiliser use
Transport (20.1%)	5.2	13.1	11.1	11.3	11.8	12.3	12.0	6.9	133.0	–1.1	–8.7	–0.3	–2.4	First reduction after four successive increases. Reduction in fuel tourism. Increase in diesel and biofuels.
Energy Industries (20.6%)	11.3	15.9	11.5	11.3	11.9	12.6	11.7	0.4	3.7	–4.2	–26.2	–0.9	–6.9	Decrease in available capacity at Moneypoint, which saw natural gas displace coal for electricity generation. Increase in renewable generation.
Residential (9.9%)	7.5	7.3	6.4	5.7	6.0	6.0	5.7	–1.8	–23.7	–1.5	–21.0	–0.3	–5.0	Decrease in heating demand due to mild winter, fewer cold days. Drop in coal and peat for heating.
Manufacturing Combustion (7.4%)	4.0	5.9	4.2	4.3	4.5	4.5	4.7	0.7	17.8	–1.2	–20.5	0.1	3.1	Increase in energy use in the food and drink and cement sectors.
Industrial Processes (3.5%)	3.3	2.8	1.5	1.8	2.0	2.1	2.2	–1.0	–31.7	–0.5	–19.1	0.1	4.1	Increase in cement production.
F-Gases (1.9%)	0.0	1.0	1.0	1.1	1.1	1.2	1.2	1.2	3,393.8	0.2	20.5	0.0	3.4	Increase in hydrofluorocarbon emissions from use as refrigerant.
Waste (1.6%)	1.5	1.3	0.7	0.9	0.9	1.0	0.9	–0.6	–39.7	–0.4	–27.7	0.0	–2.5	Decrease in methane emissions from landfill.
Commercial Services (1.6%)	1.1	1.5	1.1	1.0	1.0	1.0	1.1	0.0	–1.0	–0.4	–27.3	0.1	6.7	Increase in gas use slightly offset by increase in biomass/ biogas use.
Public Services (1.4%)	1.2	1.0	0.9	0.8	0.8	0.8	0.9	–0.3	–22.0	0.0	–4.9	0.1	6.7	Increase in gas use slightly offset by increase in biomass/ biogas use.
Total	**55.4**	**69.5**	**57.4**	**57.1**	**59.2**	**61.3**	**60.7**	**5.3**	**9.6**	**–8.8**	**–12.6**	**–0.5**	**–0.9**	

2.3 Analysing the drivers of carbon dioxide emissions

The Intergovernmental Panel on Climate Change (IPCC) and the European Environment Agency (EEA) use the Kaya identity to provide insights into the driving forces of carbon dioxide emissions. The Kaya identity separates, or 'decomposes', the change in carbon dioxide emissions into contributing factors including population, income and energy use. While the 2018 Annual Review presented a 'simple' Kaya, this year an 'extended Kaya' is presented. This gives deeper analysis of changes in energy technologies, further decomposing the carbon intensity of the energy system (CO_2/Energy) into changes in renewable energy, the shares of fossil fuels and the emissions from each fossil fuel.[†‡]

This approach allows analysis of the change in two important factors for mitigation policy: increasing the amount of renewable energy, and switching, or 'substituting', between different types of fossil fuels such as from coal to gas. While the Kaya identity frequently uses Gross Domestic Product (GDP) data, this analysis uses Gross National Income (GNI). Box 2.1 gives an overview of the challenges of using economic data for analysis of energy and emissions in Ireland.

Box 2.1: *The challenge of Irish economic data*

In considering the relationship between economic activity and emissions in Ireland for recent years, there is a serious problem with the nature of the national accounting data that are currently available from the Central Statistics Office (CSO). The data for GDP and GNI are significantly affected by the activity of certain foreign-owned multinational enterprises (MNEs), which are located or relocated to Ireland.

Irish GDP includes the profits made by some foreign-owned MNEs as part of their manufacturing of equipment in Asia. While all of the physical capital, labour and energy used in the production process of these goods is located in Asia, and hence the emissions related to their manufacturing activity are part of Asian emissions, the very large profits accruing from this activity are added to Irish GDP because the intellectual property used in the manufacturing process is owned by the MNEs located in Ireland. As a result, the relationship between GDP and emissions in Ireland is no longer straightforward.

This problem is especially acute for the years 2015–2017 because of a major relocation of firms' income to Ireland in 2015.

While GNI is a somewhat better measure of domestic activity, because it includes the very large depreciation on the intellectual property of the MNEs undertaking manufacturing in Asia, it is also seriously distorted. This distortion is particularly apparent in the very high growth rate for 2015, resulting from a relocation to Ireland of approximately €300 billion of intellectual property owned by foreign MNEs.

The CSO has provided an adjusted GNI series, GNI*, which removes the depreciation of foreign MNEs. However, these data are still distorted by the inclusion of the big increase in corporation tax attributable to the use of the foreign MNEs' Intellectual Property in manufacturing in Asia. Also, data at constant prices were not available at the time this review was finalised.

† This identity can be expressed in a simplified form as follows: Carbon Dioxide Emissions = Income per capita x Energy per unit Income x share of Renewable Energy x shares of Fossil Fuels x Carbon Dioxide Emissions per Fossil Fuel. For the full divisia index formulas to implement this identity see O'Mahony (2018)[6].

‡ The energy and related carbon dioxide emissions data are taken from standard Primary Energy Requirement in the SEAI Energy Balance Sheets.

In considering the drivers of carbon dioxide emissions, it is important to consider the longer-term trends rather than concentrating on the results for a single year, which may be affected by essentially temporary factors, as in 2017. In the longer term since 1995, Irish emissions have not decoupled sufficiently from economic growth to reduce emissions. While a 'relative decoupling' has occurred, and the economy has become relatively more energy and carbon efficient, an 'absolute decoupling' has not occurred, and therefore emissions are still higher than in 1995. As can be seen in Figure 2.3, strong economic growth and an increase in population have overwhelmed the driving forces of emissions reduction: improvements in the energy intensity of the economy, and increases in renewable energy and fuel-switching.

If economic growth continues, significant and continuous improvements in other driving forces will be necessary to achieve a low-carbon transition. Further understanding of driving forces is needed to monitor progress and to consider policies that will bring about emissions reductions.

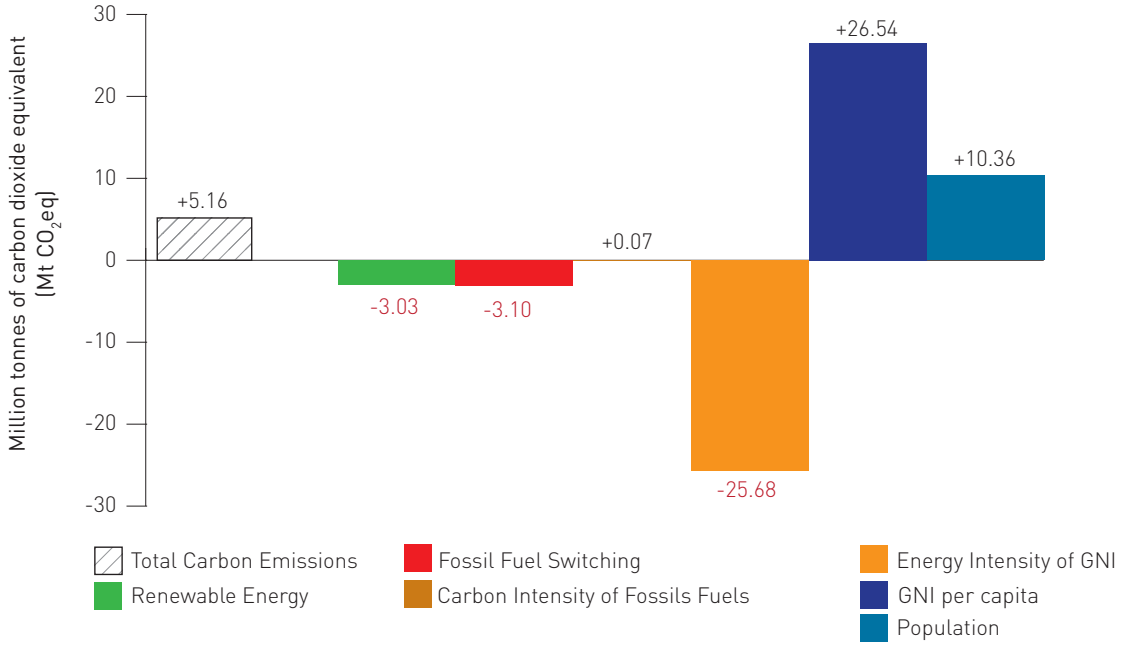

Figure 2.3: *Kaya identity of change in Ireland's carbon emissions from 1995 to 2017.* **Source:** *Update on O'Mahony (2018).*[6]

2.4 Advice and Recommendations

The macro drivers of emissions continue to expand. An absolute decoupling of economic growth from emissions has not occurred and development is not on a pathway consistent with low-carbon transition. If a transition is to occur while the economy and population are growing, the Government will need to consider how to substantially accelerate the rate of improvement in energy intensity, while also significantly increasing the deployment of renewable energy. As highlighted by successive reports from the Intergovernmental Panel on Climate Change,[7] this will require more than 'end-of-pipe' technological measures, through consideration of long-term 'sustainable development pathways' that are fundamentally and systemically lower in emissions.

Current economic indicators do not give an accurate measure of the activities with an emissions footprint in Ireland. The Council recommends the development of national accounts data that better reflect the impact of economic activities on national emissions.

3. A Summary of Future Greenhouse Gas Emissions

Key Messages

- Ireland remains unlikely to achieve its 2020 and 2030 targets, although the most recent projections of future greenhouse gas emissions show a potential improvement in progress towards emissions reduction.
- New and expanded actions contained within the National Development Plan and the draft National Energy and Climate Plan have been included for the first time in the 2019 projections. Additional measures within the recent Climate Action Plan are not included in the projections.
- Assumptions about fuel prices have a very significant impact on projected emissions. The 2019 projections include revised assumptions of higher future fuel prices compared to those assumed in the 2018 projections. The EPA has provided additional analysis to demonstrate the sensitivity of projections to these assumptions.
- Emissions in Energy, Agriculture and Industry are projected to increase to 2020, and 2030.
- The key sectors projected to contribute to emissions reduction include Residential and Transport.
- Uncertainty in the timing of removal of peat and coal electricity generation is a key component of future trends in the energy industry. Planned support for biomass co-firing with peat has the effect of supporting continued burning of peat for electricity generation, contributing to higher emissions.

The Climate Action and Low Carbon Development Act 2015[2] tasked the Council as part of its Annual Review to provide a summary of the most recent projections of greenhouse gas emissions. Ireland's future greenhouse gas emissions as prepared by the EPA are provided below[13] These projections are based on policies and measures provided for the period 2017 to 2040 and on the template for reporting to the EU under the Monitoring Mechanism Regulation.

3.1 Ireland's Greenhouse Gas Emissions Projections

Every year, the EPA releases greenhouse gas emissions projections for Ireland. In accordance with reporting requirements, these projections are submitted to the EU every second year, as part of the Monitoring Mechanism Regulation, and to the United Nations Framework Convention on Climate Change (UNFCCC) every four years. As with the greenhouse gas inventory, the projections are subject to in-depth international review. The current set of projections was published on 6 June 2019.

The projections are based on two scenarios from 2018 to 2040, known officially as 'with existing measures' and 'with additional measures'.[†] The 'with existing measures' scenario considers no

† In some sectors (F-Gases and Waste), projections under 'with existing measures' and 'with additional measures' use identical policies and measures are implemented to the same degree in both. In these sectors, there is no difference between the scenarios. The Industrial Processes sector has similar numbers for the two scenarios but not identical levels of implementation.

policies and measures beyond those already in place by the end of 2018. The 'with additional measures' scenario assumes the further implementation of planned policies and measures from 2020, including renewable and energy efficiency measures as described in the National Energy Efficiency Action Plan, the National Renewable Energy Action Plan and the draft National Energy and Climate Plan. The outcomes of these scenarios identify a significant shortfall in achieving Ireland's energy efficiency targets and renewable energy targets for electricity, transport and heat to 2020 and 2030.

Greenhouse gas emissions projections are prepared using data from several key sources. The energy forecast is provided by the Sustainable Energy Authority of Ireland (SEAI). This information was prepared with the Economic and Social Research Institute (ESRI) and University College Cork (UCC). The ESRI uses macroeconomic projections produced by the Core Structural Model of the Irish Economy (COSMO).[8] Projections of global economic activity are based on the National Institute Global Econometric Model (NiGEM) from the National Institute of Economic and Social Research in the UK.[9] Agricultural forecasts are provided by Teagasc. These include data on animal numbers, crop areas and fertiliser use.

For the 2019 projections, Ireland has decided to adopt the 2016 EU Reference Scenario fuel prices, which allows comparability across EU Member States.[10] The Reference Scenario projects higher fuel prices compared to the forecast from the UK Department for Business, Energy and Industrial Strategy (BEIS) 2017 publication used in previous analysis.[1] This higher price on fossil fuels provides the price signal to reduce fuel consumption and hence lower emissions. However, it is notoriously difficult to accurately forecast oil and energy prices over long timescales. The projected emissions reductions based on these assumptions are sensitive to real-world volatility in pricing. The Government, in the development of the National Energy and Climate Plan, has adopted the more conservative projection of a lower fuel price consistent with the BEIS analysis. The EPA has provided an analysis of the sensitivity of the projections to this choice of fuel price scenario. The results show that in a low fuel price scenario, Ireland will exceed the carbon budget over the period 2021–2030 by 86–101 Mt CO_2eq or by 40–56 Mt CO_2eq with full use of the ETS and Land Use Land-Use Change and Forestry (LULUCF) flexibilities.

Ireland's target under the Effort Sharing Decision is a 20% reduction in greenhouse gas emissions by 2020, relative to 2005 levels. The EPA's emissions projections indicate that, by 2020, a reduction of between 5% and 6% will be achieved. Projections indicate growth in emissions nationally and across key sectors in the coming decade. This is largely underpinned by strong economic growth and fuel prices. The main increases are seen in Agriculture and Transport, which dominate the Effort Sharing Decision emissions and account for 75% of these emissions.

The gap between 'with existing measures' and 'with additional measures' narrows in the period to 2020, indicating that mitigation options in the short term are largely fixed. After 2019 the scenarios diverge.

Box 3.1: *Impact of policies 2017 to 2030*

Impact of policies on emissions projections

Projected emissions for the 'with existing measures' and 'with additional measures' scenarios are similar until 2019 and then begin to diverge. The narrow gap between the two scenarios to 2019 indicates that in the short term, mitigation options are largely fixed. The divergence, rather unusually, sees the 'with additional measures' scenario with higher projected emissions. This is the result of assumptions related to electricity generation. The 'with existing measures' scenario reflects the ending of support for peat-fired electricity generation after 2019. This results in a significant decline in peat used in electricity generation. Under the 'with additional measures' scenario, peat-fired electricity generation receives indirect support through the Renewable Energy Feed in Tariff III,[11] which supports biomass that is co-fired with peat after 2019.

From 2026 the 'with existing measures' scenario returns to having the higher projected emissions as it assumes the accelerated phase-out of coal in electricity generation and the introduction of commercial interconnection after 2025.

The Renewable Energy Feed in Tariff III support for co-firing peat and biomass in electricity generation reduces the availability of biomass for use in the industrial processes sector under the 'with additional measures' scenario. The increase in price for biomass for heat in industrial processes results in increased emissions from fossil fuels compared with the 'with existing measures' scenario.

The most recent EPA emissions projections do not consider the impact of policies and measures under the recently announced Climate Action Plan 2018.[12] It is expected that Government departments and agencies will provide relevant data to the EPA to be included in next year's emissions projections.[13]

There is a need for national analysis of a more comprehensive set of plausible development pathways for the economy, including differing economic growth rates, alternative fuel price trajectories and alternative rates of development and deployment of low-carbon technologies. There is a need to expand national capacity, for example under the Technical Research and Modelling group, to enable this important analysis.

3.2 Future Sectoral Greenhouse Gas Emissions

The EPA provides projections broken down into sectors like those in the inventories. A summary of the projected emissions of greenhouse gases from these sectors for 2020, 2030 and 2040 is shown in Table 3.1. In 2020, the Transport and Agriculture sectors account for 54.5%, or 33.0 Mt CO_2eq, of total emissions and dominate emissions in the Effort Sharing Decision sector under the 'with additional measures' scenario.[14]

Emissions from transport are projected to increase by 5.7%–7.5%, or between 0.7 and 0.9 Mt CO_2eq, by 2020 relative to 2017 levels based on the two projected scenarios. Under 'with existing measures', growth in transport emissions continues to 2030, increasing by 11.2%, or 1.3 Mt CO_2eq on 2017. However, under 'with additional measures', which includes an accelerated

uptake of electric vehicles, emissions from transport decrease slightly, by 1.2% or -0.1 Mt CO_2eq on 2017.

Agricultural emissions are projected to increase by between 0.5% and 1.5%, or 0.1–0.3 Mt CO_2eq, by 2020 relative to 2017 levels, largely as a result of increased milk production. Emissions projections from this sector already reflect developments in the cattle population following the elimination of the milk quota system.

Emissions increase of 1.8% to 4.9%, or 0.2 to 0.6 Mt CO_2eq, relative to 2017 are projected in the energy industries sector by 2020 under the 'with additional measures' scenario.

Other sectors with projected increases in emissions include Residential, Manufacturing Combustion and Industrial Processes.

Emissions decreases are also predicted for F-Gases, for Waste and in the Commercial and Public Service sectors. Projections for 'with existing measures' and 'with additional measures', broken down by sector, are shown in Table 3.1 and Figure 3.1.

Table 3.1: *Projections of total greenhouse gas emissions by sector from 2016 to 2020, 2030, 2040 under the 'with additional measures' scenario.* **Data sources:** *EPA National Emissions Inventory 2019*[3] *and Ireland's Greenhouse Gas Emissions Projections 2017–2040*[13]

Sector (% of total greenhouse gas emissions in 2017)	Greenhouse gas emission inventory				Greenhouse gas emission projections for 'with additional measures'								Key assumptions as identified in Ireland's Greenhouse Gas Emissions Projections 2018 to 2040*
	1990	2005	2016	2017	2020	2030	2040	Change in 2020 relative to 2017		Change in 2030 relative to 2017		Change in 2040 relative to 2017	
	Mt Carbon dioxide equivalent				Mt Carbon dioxide equivalent			Absolute Mt Carbon dioxide equivalent	%	Absolute Mt Carbon dioxide equivalent	%	Absolute Mt Carbon dioxide equivalent	%
Agriculture –33.3%	20.4	19.8	19.6	20.2	20.3	20.9	21.1	0.1	0.5	0.6	3.2	0.9	4.6	Increase in dairy cow herd and nitrogen use Currently the only mitigation policy included in projections is deployment of Low Emissions Spreading technologies
Transport –19.8%	5.2	13.1	12.3	12	12.7	11.9	10.1	0.7	5.7	–0.1	–1.2	–1.9	–15.5	Increase in transport demand Accelerated deployment of EVs and higher mix of biofuels in conventional fuels
Energy Industries –19.3%	11.3	15.9	12.6	11.7	12	8.6	11.8	0.2	1.8	–3.1	–26.5	0	0.4	Increase in deployment of renewables Cessation of coal and peat power generation
Residential –9.5%	7.5	7.3	6	5.7	6.4	4.6	2.9	0.7	12	–1.2	–20.7	–2.8	–49.6	Increase in renewables in heating, improvement in energy efficiency

Sector (% of total greenhouse gas emissions in 2017)	Greenhouse gas emission inventory				Greenhouse gas emission projections for 'with additional measures'								Key assumptions as identified in Ireland's Greenhouse Gas Emissions Projections 2018 to 2040*
	1990	2005	2016	2017	2020	2030	2040	Change in 2020 relative to 2017		Change in 2030 relative to 2017		Change in 2040 relative to 2017	
	Mt Carbon dioxide equivalent				Mt Carbon dioxide equivalent			Absolute Mt Carbon dioxide equivalent	%	Absolute Mt Carbon dioxide equivalent	%	Absolute Mt Carbon dioxide equivalent	%
Manufacturing Combustion –7.7%	4	5.9	4.5	4.7	3.9	3.4	3.6	–0.8	–17.2	–1.2	–26.2	–1.1	–22.8	Further roll-out of energy efficiency programmes including existing SEAI Large Industry, Accelerated Capital Allowances and the Excellence in Energy Efficiency Design (EXEED).
Industrial Processes –3.7%	3.3	2.8	2.1	2.2	2.4	3	3.4	0.2	7.8	0.8	35	1.2	53.9	Increase in cement and lime production
F-Gases –2%	0	1	1.2	1.2	1	0.8	0.7	–0.3	–21	–0.4	–36.6	–0.5	–39.6	Saving associated with the impact of Directive 2006/40/EC*
Waste –1.5%	1.5	1.3	1	0.9	0.6	0.4	0.4	–0.4	–37.7	–0.5	–52.2	–0.5	–58	Decline in methane emissions from landfill
Commercial Services & Public Services –3.3%	2.2	2.4	1.9	2	1.3	1	0.9	–0.7	–33.3	–1	–50.9	–1	–52.8	Increase in energy efficiency
Total	**55.4**	**69.5**	**61.3**	**60.7**	**60.5**	**54.6**	**55.1**	**–0.2**	**–0.3**	**–6.2**	**–10.2**	**–5.7**	**–9.3**	

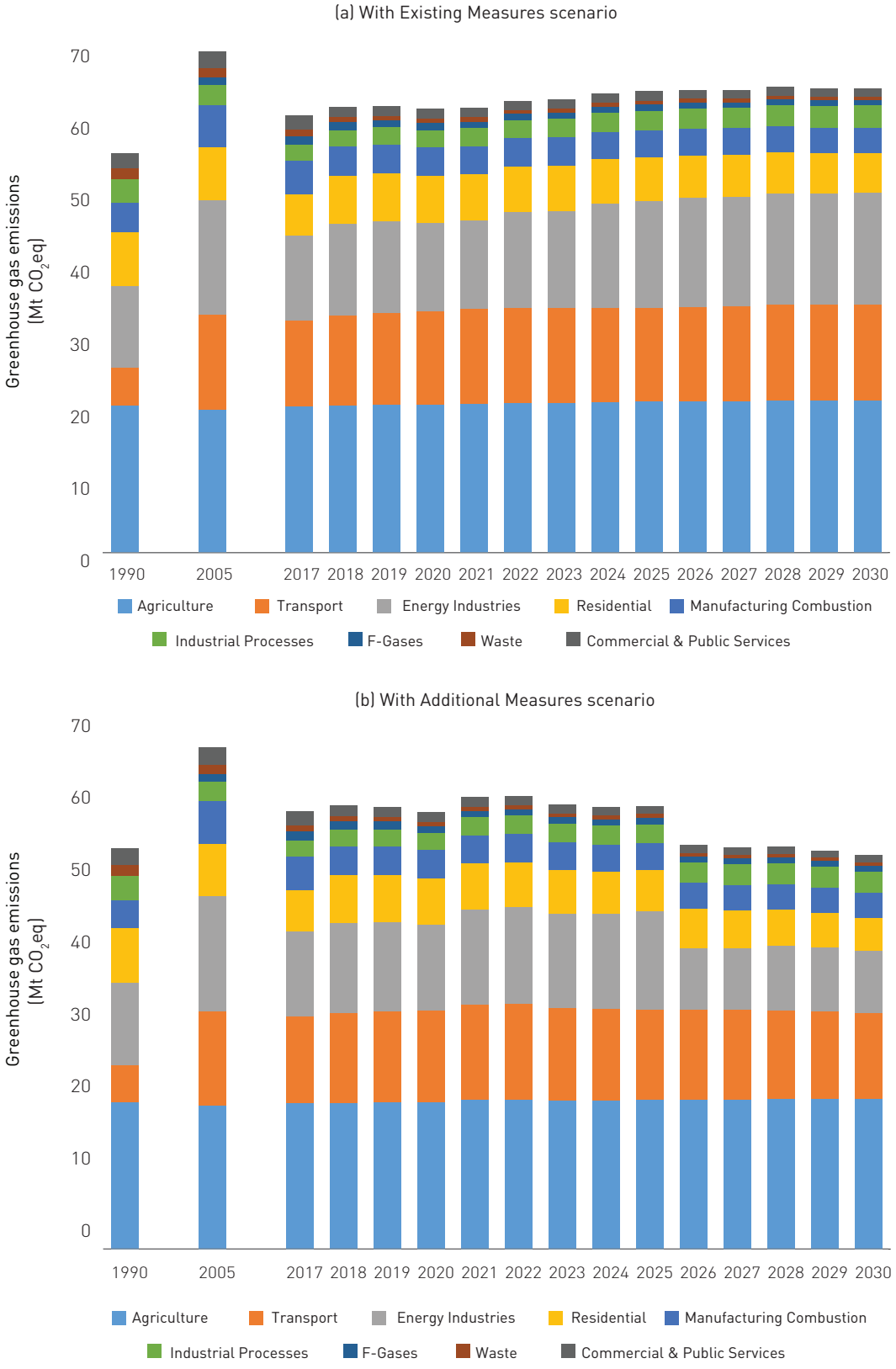

Figure 3.1: *Greenhouse gas emissions for (a) With Existing Measures and (b) With Additional Measures scenarios, base years 1990 (National Policy Position[4]) and 2005 (EU 2020 targets), 2016 data and projections to 2020 and 2030, broken down by sector in units of million tonnes of carbon dioxide equivalent.* **Data sources:** *EPA National Emissions Inventory 2019[3] and Ireland's Greenhouse Gas Emissions Projections 2018–2040.*[13]

3.3 Advice and Recommendations

The Council notes the additional analysis provided by the EPA in its projections of greenhouse gas emissions and the sensitivity of these projections to assumptions related to the trajectory of fuel prices. The projections analysis from the EPA is very useful but is constrained to address EU reporting requirements. There is a need for analysis of a more comprehensive set of plausible development pathways, including variable economic growth rates, alternative fuel price trajectories and alternative rates of development and deployment of low-carbon technologies. There is a need to expand national capacity, for example under the Technical Research and Modelling group, to enable this important analysis.

The Council recommends that Government provide resources to build additional modelling and projections capacity in order to expand the range of scenarios examined to inform policy design and enable evidence-led, economy-wide and sectoral target setting. Finally, the Council recommends that the suggestion in the Report of the Oireachtas Committee on Climate Change that the Council be given access to the data and expertise held by Government Departments relating to climate change should be implemented.

4. Performance Against Existing Obligations of the State

Key Messages

- A significant and sustained rate of emissions reduction is required to achieve the national policy position up to 2050. Due to exceptional circumstances, carbon dioxide emissions decreased by 1.2 million tonnes of carbon dioxide equivalent in 2017, excluding emissions within land use.
- Ireland's target under the Effort Sharing Decision is a 20% reduction in greenhouse gas emissions by 2020, relative to 2005 levels. Based on the high fuel price scenario, recent projections indicate that a reduction of between 5% and 6% will be achieved by 2020.
- Cumulative emissions of greenhouse gases to 2020 will see Ireland exceed its EU Effort Sharing Decision target of 338 million tonnes of carbon dioxide equivalent, by approximately 10 million tonnes.
- Cumulative emissions of greenhouse gases to 2030 will see Ireland exceed its EU Effort Sharing Regulation targets of 376 million tonnes of carbon dioxide equivalent, by between 52 and 67 million tonnes.
- Even if Ireland uses its full flexibilities from the EU Emissions Trading System and land use, land-use change and forestry (LULUCF), Ireland would still exceed its 2030 targets by between 7 and 22 million tonnes of carbon dioxide equivalent.

The Climate Action and Low Carbon Development Act 2015[2] tasked the Council, as part of its Annual Review, to provide advice and recommendations in relation to compliance with the state's existing obligations under EU law or international agreements. Ireland's performance in reducing greenhouse gas emissions is considered below.

4.1 Climate and Energy Package 2020

The Climate and Energy Package 2020 is a collection of directives and decisions to ensure that the EU meets its climate and energy targets for the year 2020. The package has three key objectives: (1) to cut greenhouse gas emissions by 20%, relative to 1990; (2) to produce 20% of EU energy from renewables; and (3) to improve energy efficiency by 20% by 2020.

The Emissions Trading System[14] and the Effort Sharing Decision relate directly to the objective to reduce emissions of greenhouse gases.[15] Under the Emissions Trading System, the EU aims to reduce emissions from large industrial and institutional facilities, especially electricity generation. The Emissions Trading System covers 45% of the EU's greenhouse gas emissions and aims to reduce these emissions to 20% below 2005 levels by 2020. The Effort Sharing Decision covers emissions that are not addressed in the Emissions Trading System. Each Member State has binding targets for reducing emissions in the non-Emissions Trading System sector between 2013 and 2020.

4.1.1 Emissions Trading System and Effort Sharing Decision

Between 2016 and 2017, total emissions, excluding land use, land-use change and forestry, decreased by 0.5 Mt CO_2eq. The Emissions Trading System saw a 4.7% or 0.8 Mt CO_2eq, decrease, while within Effort Sharing Decision sectors there was an increase of 0.7% or 0.3 Mt CO_2eq (see Figure 4.1).

In Ireland, the Emissions Trading System covers 28%, or 16.9 Mt CO_2eq, of total greenhouse gas emissions. The greater part (72%, or 43.8 Mt CO_2eq) of emissions is covered by the Effort Sharing Decision, in 2017. The European Commission manages the Emissions Trading System and has key responsibility for ensuring that activities within the system succeed in reducing the emissions across Europe. The Irish Government has primary responsibility for achieving the targets in the non-Emissions Trading System sector.

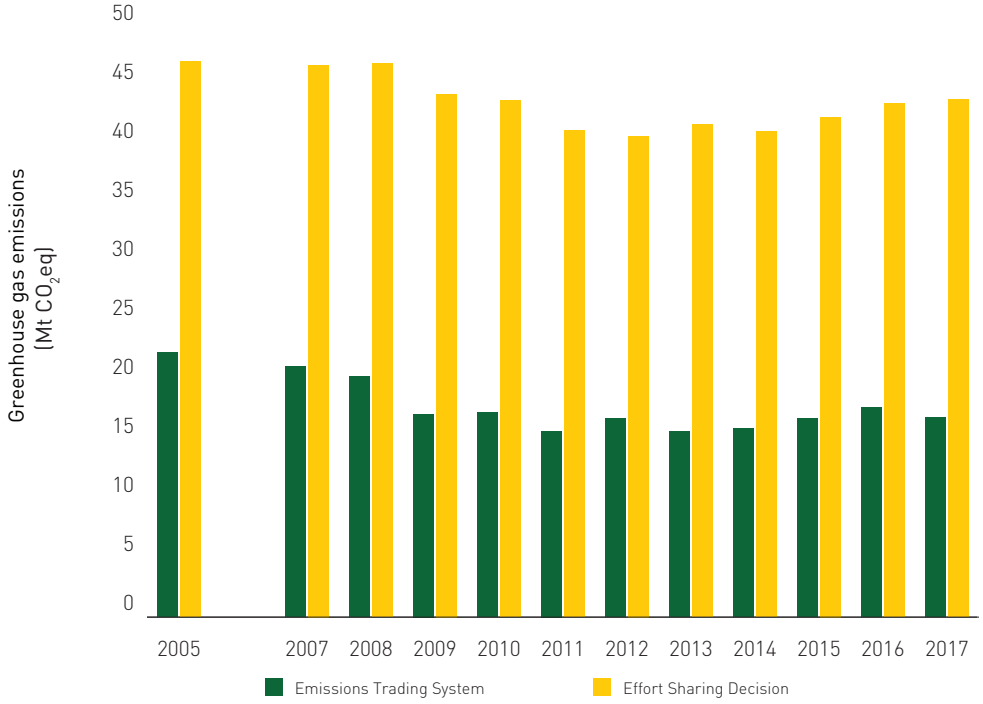

Figure 4.1: *Greenhouse gas emissions for the Emissions Trading System and the Effort Sharing Decision over the period 2007 to 2017 and in the base year 2005 of EU climate and energy 2020 target.* **Data source:** *EPA National Emissions Inventory 2019.*[3]

4.1.2 Effort Sharing Decision: Targets to 2020

Under the EU Effort Sharing Decision, Ireland has both annual targets and a cumulative target for reductions in greenhouse gas emissions from 2013 to 2020. Emissions in 2017 were above the annual limits under the EU Effort Sharing Decision for the second year in a row. Ireland's annual limit for 2017 was 43.5 Mt CO_2eq. This limit was exceeded by 2.9 million tonnes. In 2016, Ireland exceeded that target by 0.2 million tonnes. However, emissions in the years 2013, 2014 and 2015 were below the annual targets.

Figure 4.2 shows the most recent reported emissions from 2005 to 2017. Due to improvements in the inventory analysis, the recent emissions estimates are slightly lower than previous submissions. However, it should be noted that under Effort Sharing Decision rules for compliance, each Member State must submit emissions estimates annually. Figure 4.3 also shows these

compliance values. Progress towards targets is based on these annual submissions. Emissions savings accrued in these years contribute to meeting future annual targets to 2020 and the cumulative target from 2013 to 2020. Therefore, although Ireland has failed to meet annual targets for 2016 and 2017, there remains approximately 7.1 Mt CO_2eq in savings to contribute to the cumulative target for between 2018 and 2020.

Projections for both 'with existing measures' and 'with additional measures' scenarios indicate that emissions will continue to exceed the annual targets from 2018 onwards (see Figure 4.2 and Table 4.1). Over the period 2013 to 2020, greenhouse gas emissions are projected to exceed annual limits by a cumulative total of between 9.3 and 10.3 Mt CO_2eq. This takes into consideration emissions savings accrued from 2013 to 2015. These projections indicate that, despite existing and planned additional policies and measures, greenhouse gas emissions continue to increase, suggesting that our targets may be missed by a substantial margin.

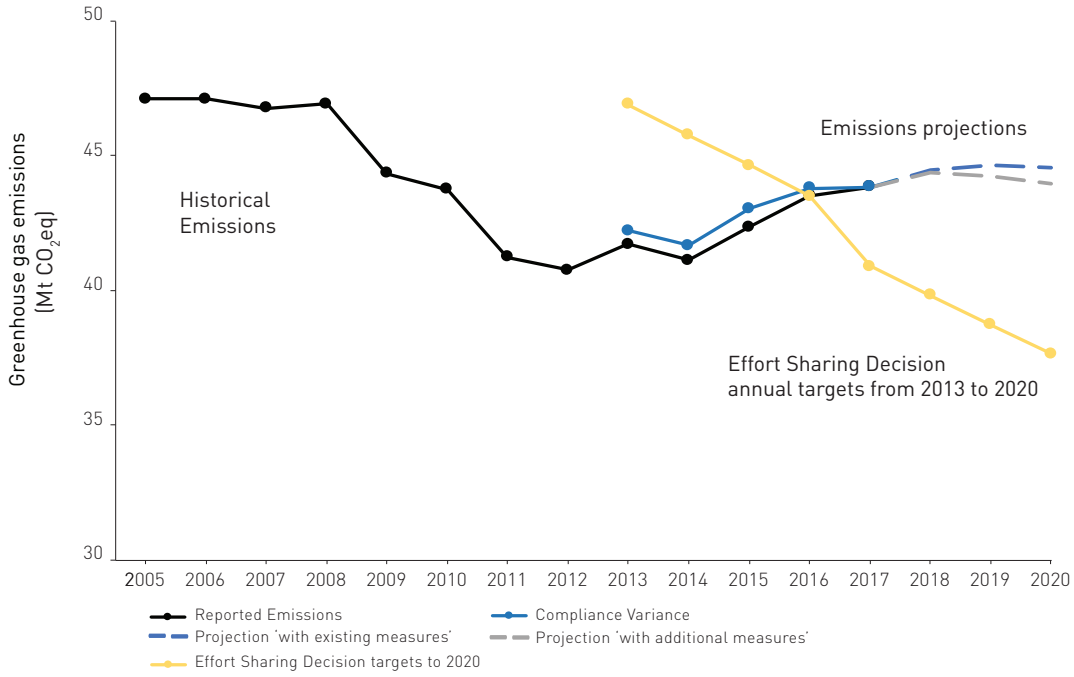

Figure 4.2: *Ireland's greenhouse gas emissions from 2005 to 2017. Emissions estimates submitted in previous compliance years, 2013–2016. Annual targets under the Effort Sharing Decision for the period 2013 to 2020, without use of flexibilities, and emissions projections for 'with existing measures' and 'with additional measures' are presented.* **Data sources:** *EPA National Emissions Inventory 2019,*[3] *Ireland's Greenhouse Gas Emissions Projections 2018–2040*[13] *and European Commission Decision (EU) 2017/1471 2017.*[16]

Table 4.1: *Summary of emissions under the Effort Sharing Decision, emissions to 2017, projections to 2020 and estimate of distance to target. Historical actual and projected greenhouse gas emissions, covered under the EU Effort Sharing Decision targets, relative to annual totals and total cumulative emissions targets.* **Data sources***: EPA National Emissions Inventory 2019,*[3] *Ireland's Greenhouse Gas Emissions Projections 2018–2040*[13] *and European Commission Decision (EU) 2017/1471 2017.*[16]

Year	Limits	Emissions		Distance to target	
	Mt Carbon dioxide equivalent	Mt Carbon dioxide equivalent		Mt Carbon dioxide equivalent	
Historical		**Actual**		**Actual**	
2013	46.9	*42.2*		*4.7*	
2014	45.8	*41.7*		*4.1*	
2015	44.6	*43.1*		*1.6*	
2016*	43.5	*43.7*		*–0.2*	
2017*	40.9	*43.8*		*–2.9*	
Cumulative (2013–2016)	221.7	214.5		7.2	
Projections		**With existing measures**	With additional measures	**With existing measures**	With additional measures
2018	39.8	44.46	44.36	–4.7	–4.6
2019	38.7	44.63	44.25	–5.9	–5.5
2020	37.7	44.57	43.98	–6.9	–6.3
Projected (2018–2020)	116.2			—	—
Total	**337.9**	**348.1**	**347.1**	**–10.3**	**–9.2**
Values for 2016 and 2017 have been submitted to EU Commission and are under review. Numbers may not sum exactly due to rounding					

4.1.3 EU Effort Sharing Regulation 2030

The Effort Sharing Regulation,[17] the successor to the Effort Sharing Decision, is part of the suite of EU climate policies and the EU Energy Union strategy. It was adopted on 14 May 2018. The objective of the Effort Sharing Regulation is to reduce EU-wide emissions in the non-Emissions Trading System sector by 30% by 2030, relative to 2005 levels. It sets annual national limits on Member States' emissions of greenhouse gases in the non-Emissions Trading System sector for the period 2021 to 2030. The agreed national target for Ireland is 30% by 2030, relative to 2005 levels (see Figure 4.3 and Table 4.2).

As with the Effort Sharing Decision, emissions savings accrued in one year can be carried over to meet annual limits in subsequent years. Member States can transfer or buy annual emission allocations (AEAs) to and from other Member States

In addition to the existing flexibilities, the proposed Effort Sharing Regulation offers two new flexibilities. The first is a one-off flexibility that allows Member States to achieve their targets using Emissions Trading System allowances that would otherwise be auctioned. The second flexibility acknowledges the difficulty of achieving emissions reductions in agriculture and allows the use of removals within the land-use sector to achieve the target. The flexibilities will be called upon at the end of the compliance period. If Ireland uses both these flexibilities, the effective national target will be a 20.5% reduction in annual emissions by 2030 relative to 2005 levels. The annual limits for Ireland, excluding impact of these flexibilities, are presented in Figure 4.3.

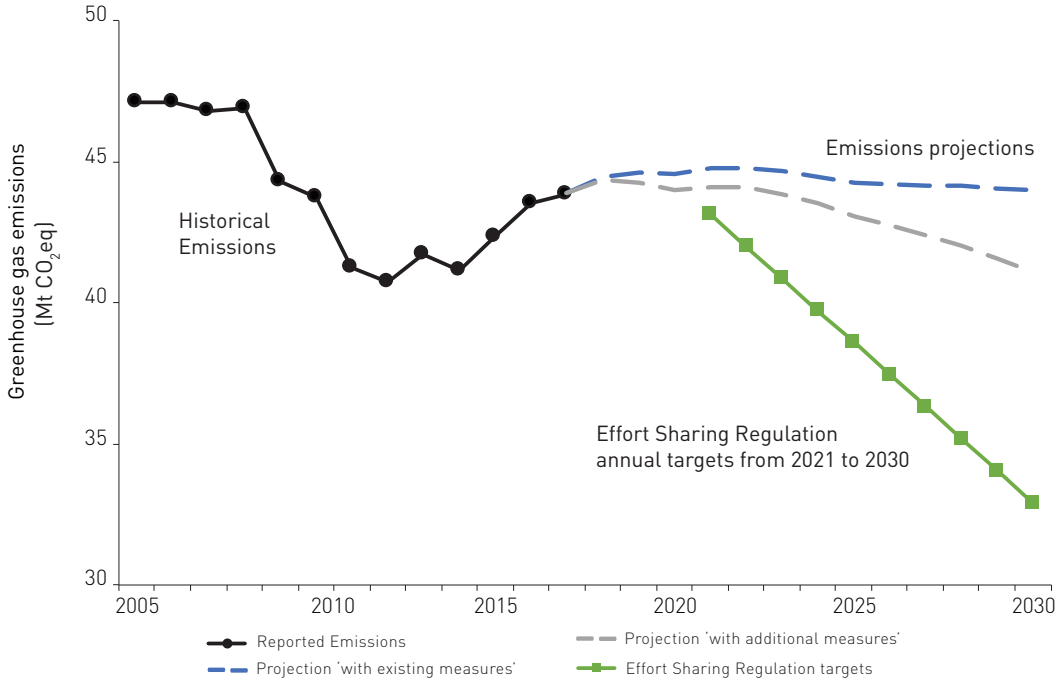

Figure 4.3: *Ireland's greenhouse gas emissions from 2005 to 2017. Annual targets as included under the Effort Sharing Regulation for the period 2021 to 2030 and emissions projections for 'with existing measures' and 'with additional measures' are presented.* **Data sources:** *EPA National Emissions Inventory 2019,*[3] *Ireland's Greenhouse Gas Emissions Projections 2018–2040*[13] *and Effort Sharing Regulation 2016.*[17]

Projections for both 'with existing measures' and 'with additional measures' scenarios indicate that, over the period 2013 to 2030, greenhouse gas emissions are projected to exceed annual limits by a cumulative total of between 67.3 and 52.4 Mt CO_2eq. Making full use of both total Emission Trading Scheme flexibilities and total land use, land-use change and forestry flexibilities, greenhouse gas emissions in Ireland are still projected to exceed annual limits by a cumulative total of between 21.8 and 6.9 Mt CO_2eq. The projections indicate that with existing measures, Ireland's Effort Sharing emissions increase slightly, while with planned additional policies and measures, greenhouse gas emissions decrease to approximately the same levels as 2014.† Although, arguably, the projections provide hope that Ireland has turned the corner, we remain off course to achieve our 2030 targets and longer-term low-carbon transition.

The projections are based on the specific assumptions of the rate of economic growth of between 2.6% and 3.3% in the period out to 2030 and beyond. Ireland has experienced higher rates of growth in recent years. However, higher rates of growth risk driving increased emissions given the observed lack of decoupling between economic growth and emissions across all sectors.

4.1.4 Use of Flexibilities

Ireland may use the purchase of emission allowances to comply with its EU Effort Sharing Decision targets to 2020 and Effort Sharing Regulation targets to 2030. The Council has previously expressed concern over Ireland's fiscal exposure to requirements for the purchasing of compliance with EU climate targets.[18] This use of public funds produces no notable local benefits or national investment in the low-carbon transition.

† In the Annual Review 2018, the Council commented on the unprecedented difference between the 'with existing measures' and 'with additional measures' where the additional measure to provide supports to biomass co-firing within peat generation led to an increase in emissions. The most recent projections include this measure within the 'with existing measures'.[13]

Purchase of compliance does not avoid the costs of emissions reductions but rather delays the cost to the post-2030 period, when even deeper emissions reductions are required. It also increases the challenge of achieving our national transition objective for 2050.

In the case of the EU Effort Sharing Regulation, there are three flexibility mechanisms: (1) the option to trade EU emissions allowances with other Member States; (2) the option to transfer EU emissions allowances from the EU Emissions Trading System; and (3) the option to use EU emissions allowances associated with land use, land-use change and forestry. If Ireland uses its total flexibility from the Emissions Trading System, amounting to 18.8 Mt CO_2eq, and the land use, land-use change and forestry flexibility, amounting to 26.8 Mt CO_2eq, net exceedance of 2030 targets will be reduced to between 21.8 and 6.8 Mt CO_2eq (see Table 4.2).

If Ireland needs to use these flexibilities in order to comply with its EU targets, its primary focus should be on allowances associated with land use, land-use change and forestry. These allowances, achieved predominantly through afforestation and the management of degraded peatlands, augment removals through the existing terrestrial carbon sink and have tangible environmental benefits where the afforestation is carried out and managed in an environmentally sustainable manner.

The use of the LULUCF flexibility is consistent with the longer term national transition objective of an approach to carbon neutrality in agriculture and land-use.

The secondary focus should relate to the other flexibilities mentioned above (1 and 2). If options 1 and 2 are considered, the concerns that the Council has previously expressed regarding the use of public funds to purchase compliance will also need to be considered. This is less of a concern in relation to complying with targets through land-use measures, whereby environmental benefits in Ireland could be achieved.

Table 4.2: *Actual (black) and projected (blue and grey text) greenhouse gas emissions, covered under the EU Effort Sharing Regulation targets, relative to annual totals and total cumulative emissions targets.* **Data sources**: *EPA National Emissions Inventory 2017,*[3] *Ireland's Greenhouse Gas Emissions Projections 2016–2035*[13] *and European Commission Decision (EU) 2017/1471 2017*[16]

Year	Projected limits		Emissions		Distance to target	
	Mt CO_2eq		Mt CO_2eq		Mt CO_2eq	
	With existing measures	With additional measures	With existing measures	With additional measures	With existing measures	With additional measures
2021	42.4	42.3	44.7	44.1	–2.4	–1.8
2022	41.3	41.3	44.8	44.1	–3.5	–2.8
2023	40.3	40.2	44.6	43.8	–4.4	–3.6
2024	39.2	39.2	44.5	43.5	–5.3	–4.3
2025	38.1	38.1	44.3	43.0	–6.1	–4.9
2026	37.1	37.1	44.2	42.7	–7.1	–5.7
2027	36.0	36.0	44.2	42.4	–8.2	–6.4
2028	35.0	35.0	44.1	42.0	–9.2	–7.1
2029	33.9	33.9	44.1	41.6	–10.1	–7.7
2030	32.9	32.9	44.0	41.1	–11.1	–8.2
Total	**376.1**	**376.0**	**443.5**	**428.4**	**–67.4**	**–52.4**
Total LULUCF flexibility	–26.8	–26.8	—	—	—	—
Total ETS flexibility	–18.8	–18.8	—	—	—	—
Net exceedance		—	—	—	**21.8**	**6.8**

ETS, Emissions Trading System; LULUCF, land use, land-use change and forestry.

4.2 International Agreements

Ireland is a party to the United Nations Framework Convention on Climate Change and has ratified both the Kyoto Protocol and the Paris Agreement under the Convention. The Kyoto Protocol, agreed in 1997, sets legally binding emission limitation and reduction targets based on levels of greenhouse gas emissions in 1990. As a Member State of the EU, Ireland participates in meeting the EU emission reduction targets. There are two distinct commitment periods, from 2008 to 2012 and from 2013 to 2020. The EU met its 2012 binding greenhouse gas emissions reduction target and is on track to meet its binding greenhouse gas emissions reduction targets to 2020.

The Paris Agreement was adopted in 2015 and entered into force in 2016. It requires countries to submit nationally determined contributions, which, for developed countries, include emissions reduction targets to 2025 or 2030. As a Member State of the EU, Ireland's contribution to the Paris Agreement is captured in the EU's nationally determined contribution. The EU contribution to the Paris Agreement reflects the EU-wide ambition and targets as set out in Section 4.1.

4.3 National Policy Position

Ireland's national transition objective, as defined in the National Policy Position[4] and the Climate Action and Low Carbon Development Act 2015,[3] is to transition to a low-carbon, climate-resilient and environmentally sustainable economy by 2050. In terms of mitigation, it has two components. The first aims to reduce emissions of carbon dioxide in three key sectors – electricity generation, the built environment and transport – by 80% by 2050, relative to 1990 levels. The second is related to agriculture, land use and forestry. It identifies 'an approach to carbon neutrality' without compromising sustainable food production as its primary objective.

The level of ambition expressed in relation to mitigation in the National Policy Position is broadly in line with European and international objectives. The National Policy Position brings focus to carbon dioxide emissions from fossil fuel sources. This recognises the importance of reducing carbon dioxide emissions that will continue to warm the planet long into the future. The targets under the National Policy Position are not legally binding.

4.3.1 Emissions of Carbon Dioxide

In 2017, total greenhouse gas emissions decreased by 0.9%, or 0.5 Mt CO_2eq, relative to 2016, while emissions of carbon dioxide decreased by 2.9%, or 1.2 Mt CO_2eq. Although emissions of carbon dioxide peaked at 48 Mt CO_2eq in 2005, they have not yet dropped below 1990 levels. Current levels are approximately 17.7%, or 5.8 Mt CO_2eq, higher than in 1990. Emissions dropped during the recession but the recovery has seen a growth in carbon dioxide emissions, demonstrating the continued coupling between emissions and economic growth. The most recent projections suggest carbon dioxide emissions will plateau at, or a little below, current levels between 2030 and 2040. The stepwise reductions in projected emissions for both 'with existing measures' and 'with additional measures' are due to assumptions regarding the timing of actions within the Energy Generation sector, specifically the phase-out of coal- and peat-fired power generation.

Annual carbon dioxide emissions reductions of the order of 2.5%, or 1 Mt CO_2eq equivalent, per year, relative to 2017, will be required to achieve an at least 80% reduction in carbon dioxide emissions by 2050. This would bring Ireland onto a pathway that is consistent with the low-carbon transition, as described in the National Policy Position (see Figure 4.4).

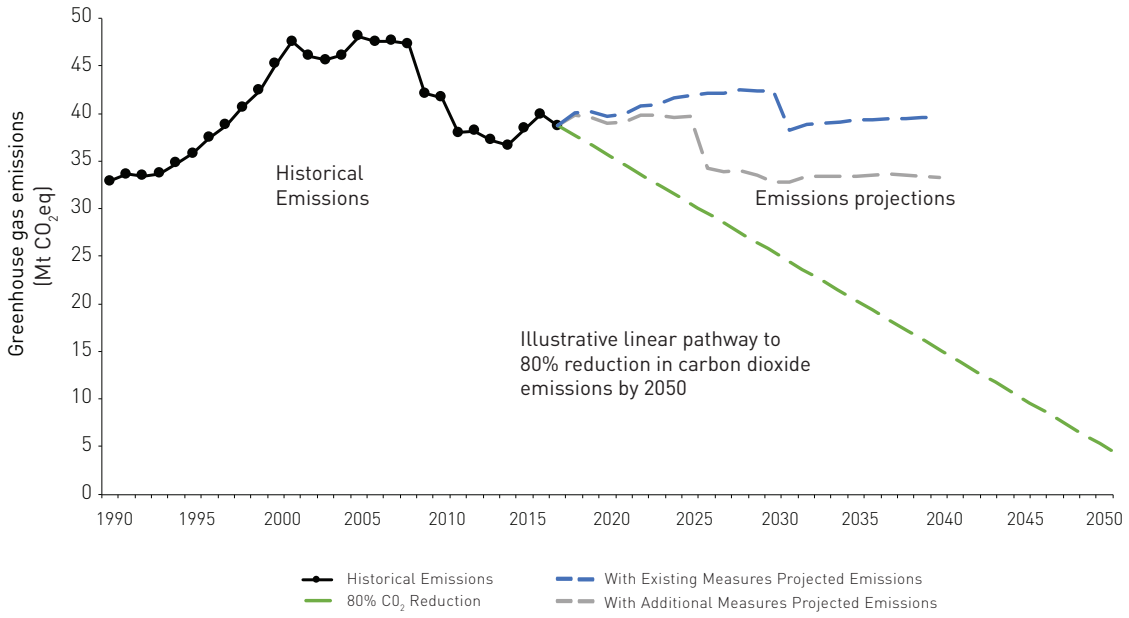

Figure 4.4: *Emissions of carbon dioxide in Ireland from 1990 to 2017 and 'with additional measures' (WAM) and 'with existing measures' (WEM) projections from 2018 to 2040. An illustrative linear pathway for achievement of the low-carbon transition to 2050 is also shown.* **Data sources:** *EPA National Emissions Inventory 2017*[3] *and Ireland's Greenhouse Gas Emissions Projections 2017–2040.*[13]

4.3.2 Agriculture and Land Use, Land-use Change and Forestry

The National Policy Position considers emissions sources from agriculture and removals from the terrestrial sink together, recognising the close relationship between reconciling sources and sinks and moving 'towards an approach to carbon neutrality'. In 2017, greenhouse gas emissions in the land use, land-use change and forestry sector increased significantly, by 59% or 2.3 Mt CO_2eq, relative to 2016. This increase in emissions from the land-use sector was primarily due to large losses due to biomass burning. However, if biomass burning and wildfires are considered a natural disturbance, there was a more modest increase of 3.6%, or 0.1 Mt CO_2eq in emissions from land use due to land management. Greenhouse gas emissions in 2017 from agricultural sources increased by 2.8%, or 0.53 Mt CO_2eq, relative to 2016. While research is ongoing funded by the EPA and the Department of Agriculture, Food and the Marine, there is currently no definition of 'an approach to carbon neutrality' or an indicative pathway for achieving this objective. The average annual emissions reported for biomass burning are 0.6 Mt CO_2eq. Where biomass burning can be avoided through improved land management practices, these should be encouraged. In addition, the management and control of biomass burning is an increasing cause of public concern due to the risk to life and property as well as impact on biodiversity. Current emissions trends within Agriculture and Land Use will make any target for the sector difficult to achieve, as discussed in Chapter 8.

The rate of afforestation in 2017 fell to 5,000 hectares, with provisional figures for 2018 falling further to 4,000 hectares. At these rates, Ireland will not attain the national forest policy goals for 18% forest cover in this century. This significantly undermines the potential for approaching neutrality within an effective timescale.

Bord na Móna has indicated that it will cease the extraction of peat for energy generation by 2028, with a number of sites ceasing production in the near future. It has legal responsibility for

appropriate management of sites post-production. The option to maintain and enhance carbon stores within its estate is recommended where appropriate. Bord na Móna can act as an exemplar in the sector in this regard.

Declining rates of removals and increasing emissions would lead Ireland further away from the neutrality objective of the National Policy Position.

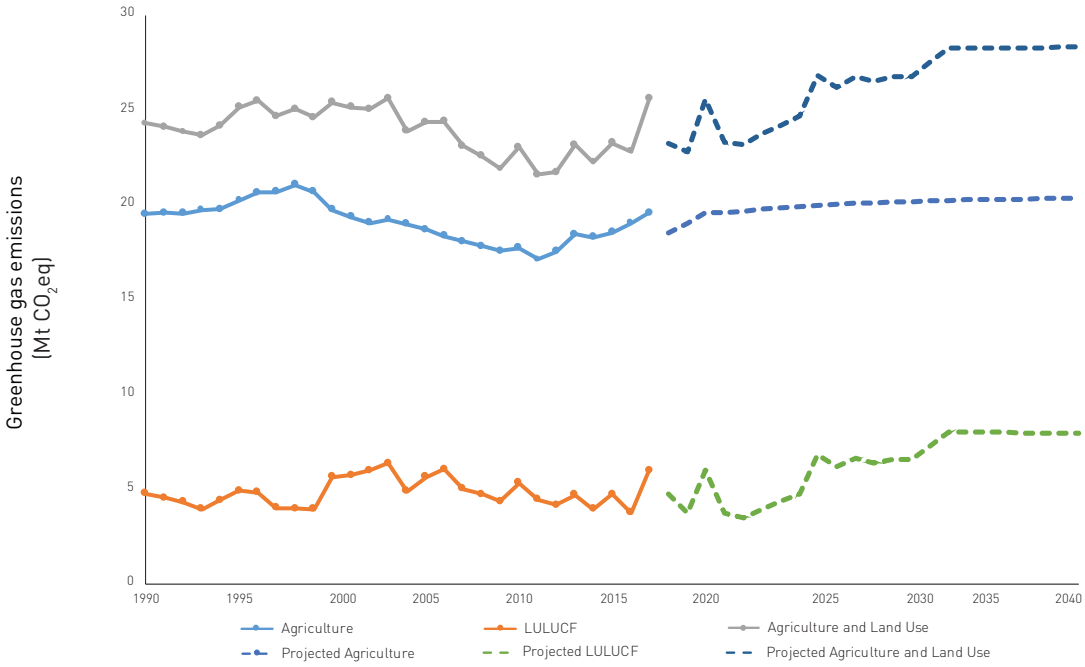

Figure 4.5: *Emissions of greenhouse gases from agriculture sources and net emissions and removals from Land Use, Land-use Change and Forestry (LULUCF) in Ireland from 1990 to 2017, and projections from 2018 to 2040.* **Data sources:** *EPA National Emissions Inventory 2019*[3] *and Ireland's Greenhouse Gas Emissions Projections 2018–2040.*[13]

4.4 Advice and Recommendations

The Council reiterates that Ireland is currently off course in relation to its EU targets to 2020 and 2030 and in relation to the National Policy Position. Without urgent action that leads to tangible reductions in greenhouse gas emissions, Ireland is unlikely to deliver on international, EU and national obligations and will drift further from a pathway that is consistent with a transition to a low-carbon economy and society.

The Council recommends that the anticipated National Energy and Climate Plan incorporates new policies and measures that are (1) coherent regarding reducing energy use and at the same time reducing emissions of greenhouse gases and (2) consistent with putting Ireland on a pathway to a low-carbon economy and society, including measures identified in the All of Government Plan (June, 2019).

Where Ireland is to employ flexibilities to comply with its 2030 EU targets, its primary focus should be national actions in the land use, land-use change and forestry sector. This would augment removals through the existing terrestrial carbon sink, contribute to the national transition objective and have tangible environmental benefits. Purchase or transfer of allowances should only be considered as a secondary flexibility measure.

There is still no official Government definition of 'an approach to carbon neutrality' for the agriculture and land sectors. The EPA and Department of Agriculture, Food and the Marine have funded research on this topic. This definition is necessary to assess the performance of these sectors and, more importantly, to develop a strategy in this area. Such a strategy would need to detail how to augment Ireland's emissions removals through terrestrial sinks and bring agricultural production into balance and onto a sustainable low-carbon pathway.

5. Progress Made in Furthering Transition

Key Messages

- The observed continued increase in agriculture emissions due to growing cattle numbers, increased fertiliser use and ongoing carbon losses from land use undermines our ability to achieve Ireland's transition objectives.
- Overall there has been limited progress nationally towards the low-carbon transition in the transport sector, even with a small increase in sales of electric vehicles.
- Total carbon emissions and emissions intensity in the electricity sector decreased in 2017. However, Ireland continues to use coal- and peat-fired electricity generation. Planned electrification in the heat and transport sectors requires low- to zero-carbon electricity.
- Industry emissions continue to grow: this is not consistent with the long-term transition and enhanced action is needed. Progress has been made under the Emissions Trading System, but emissions from smaller enterprises are increasing.
- The Department of Public Expenditure and Reform's publication of a revised public spending code which mandates a higher price of carbon when considering public investment is welcome.
- The work of the Joint Oireachtas Committee in response to the strong signals provided by the Citizens' Assembly has added a new urgency to climate action in Ireland.
- A properly mandated and resourced National Dialogue on Climate Action has the potential to work in and between sectors, communities, networks and individuals to drive the climate action agenda.
- A 'just transition' framework is essential and can add depth to policy, create coherence and garner public support.

The Climate Action and Low Carbon Development Act 2015 tasked the Council, as part of its Annual Review, to assess progress made in furthering transition to a low-carbon, climate-resilient and environmentally sustainable economy.

This is the third Annual Review by the Council. This year we review progress made across the sectors, including progress in public participation, institutions and governance, before presenting a potential range of indicators for transition in the sectors. The indicators look at data reflecting progress in behavioural, technical, structural and infrastructural changes that are key to long-term achievement of the national transition objective.

5.1 Indicators of Transition

In its proposals for an Energy Union Governance Regulation, the European Commission identifies the carbon dioxide and greenhouse gas intensity of Gross Domestic Product (GDP) as an indicator of transition. Ireland specific indicators are included in Table 5.1, but on their own they present

an incomplete picture. To assess progress in transition, it is important to understand whether practices and technology deployment are changing or whether we are experiencing continued lock-in of high-carbon technologies and practices. Table 5.1 thus presents an extended list of indicators to give a broader perspective on the state of transition across the sectors in Ireland. This is not an exhaustive list of indicators. Other indicators can also be informative.

Measuring progress in transition represents a movement away from historical comparisons of emissions against previous performance. Incremental improvements may no longer be enough. Instead, assessing progress in transition means comparing where we are with where we need to be.

The indicators may not fully reflect progress towards what we want to achieve. For example, the indicator for private vehicles, which shows the sales of new petrol and diesel cars, may not reflect the objective of switching the entire fleet to low-carbon vehicles. However, while we may expect that the distance travelled by private vehicle per capita should decrease with an increase in public transport, cycling and walking, it is not clear how the indicator might reflect decarbonisation when the vehicle stock transitions to a low- or zero-emissions or autonomous fleet. These uncertainties point to the need for a broader basket of indicators to be employed in measuring a low-carbon transition that will cut across all sectors in our economy and society.

Some additional indicators have been added since the first Annual Review in 2017, based on further consideration of the most pertinent and informative indicators for Ireland. The European Environment Agency has established a framework for indicator selection that could be useful in further developing the application of transition indicators for Ireland. These indicators are designed to answer key policy questions and support all phases of environmental policymaking, from designing policy frameworks to setting targets and from policy monitoring and evaluation to communicating to policymakers and the public.[20†]

Section 7.4.2 discusses the importance of developing and monitoring a set of indicators to assess Ireland's preparedness and the effectiveness and cost-efficiency of our planning for climate resilience. Appropriate indicators enable critical assessment and review of adaptation actions and early identification of issues, and can assist in communicating with the public on climate change issues. The Council recommends that an agreed set of climate change adaptation indicators should be developed and implemented as soon as possible and reported on through the Annual Transition Statement process.

† The five indicator categories include: descriptive (What's happening?), performance (Does it matter? Are we reaching targets?), efficiency (Are we improving?), policy effectiveness (Are the measures working?) and total welfare indicators (Are we, on the whole, better off?).[20]

Table 5.1: *Possible indicators of transition across sectors*

Sector	Name	2010	2014	2015	2016	2017	Unit
Total	GHG intensity of the economy	0.40	0.32	0.30	0.27	0.26	kt CO_2eq/€M GNI constant
	GHG per capita	13.42	12.29	12.63	12.93	12.67	t CO_2eq/Population
	CO_2 intensity of the economy	0.27	0.21	0.19	0.18	0.17	kt CO_2/€M GNI
	CO_2 per capita	9.15	7.89	8.20	8.42	8.08	t CO_2/Population
	Economy-wide efficiency	€2,494	€3,095	€3,479	€3,887	€4,081	GNI/t carbon dioxide equivalent €/t carbon dioxide equivalent
	Total primary energy requirement	171,307	154,032	161,447	167,512	168,305	Megawatt hour (MWh)
Power generation	Emissions from peat- and coal-fired electricity generation	5,738	6,349	7,052	6,841	5,796	kt CO_2
	CO_2 intensity of electricity	530	455	465	483	437	Gt CO2/kilowatt hour (kWh)
	% renewable of gross electricity consumption	15.60	23.50	25.50	26.80	30.10	%
Residential/ Commercial/ Public	% renewable heat	4.50	6.60	6.50	6.80	6.90	%
Residential	% residential energy from solid fuel (peat and coal)	15.58%	16.59%	15.32%	13.99%	12.93%	%
	A and B Building Energy Rating (BER)-rated residential 'dwellings'	–	–	12.00%	13.00%	14.00%	% of BER data set
Commercial	A and B BER-rated commercial buildings	–	–	14.00%	13.80%	13.60%	% of non-dwelling BER data set, excluding hospitals, health, community, nursing homes, schools and colleges
Public	Energy efficiency gains in public bodies	–	–	21.00%	20.00%	24.00%	% improvement from business as usual
	Energy consumption of public bodies	–	–	9,343	9,375	10,248	Gigawatt hours (GWh)

Sector	Name	2010	2014	2015	2016	2017	Unit
Transport	% renewable transport (RES-T)	2.50	5.20	5.90	5.20	7.40	%
	Distance by private car	31,734	32,645	35,020	36,623	37,181	Million kilometres
	Distance by private car per capita	6,967	7,027	7,470	7,727	7,758	Kilometres
	Distance by goods vehicles	6,870	7,259	7,021	7,410	7,785	Million kilometres
	Distance by public service vehicles	1,242	1,157	1,167	1,172	1,219	Million kilometres
	Private car new vehicles' fuel type	81,122	91,157	119,066	138,778	121,883	Number of new petrol and diesel vehicles (as % of all new)
		95.54%	98.70%	98.31%	97.78%	95.94%	
	New goods vehicles' fuel type	10,490	16,243	22,926	28,039	24,066	Number of new petrol and diesel vehicles (as % of all new)
		99.80%	99.90%	99.90%	100.00%	99.90%	
Agriculture and Land-Use	Forestry cover	731,576	752,890	758,383	764,082	769,395	Hectares
	Dairy cows	1,039	1,177	1,268	1,347	1,388	Thousands
	Other cattle	5,516	5,663	5,624	5,791	5,882	Thousands
	Sheep	4,328	5,019	4,870	4,844	5,194	Thousands
	Nitrogen fertiliser use	362,395	331,782	330,959	339,104	369,089	Tonnes of nitrogen
	Total area of drained organic soils	844,558	845,808	847,430	847,637	841,995	Hectares
	Farming efficiency	€99	€118	€123	€133	€136	GVA/t carbon dioxide equivalent €/t CO2eq
	Dairy production efficiency	-	0.79	0.77	0.75	0.73	kg carbon dioxide equivalent/kg milk
	Beef production efficiency	-	13.36	13.33	13.20	12.82	kg carbon dioxide equivalent/kg beef
Finance	International total climate-specific finance	–	€33,674,000	€36,003,000	€52,696,000	€64,471,435	Euros

GHG, Greenhouse Gas; GVA, Gross Value added at constant prices; GNI, Gross National Income at constant prices. See Appendix 2 for data sources.

5.2 Progress Across the Sectors

5.2.1 Electricity Generation

Decarbonisation of electricity generation is a critical component of the decarbonisation of the whole economy.

Emissions from electricity generation in 2017 decreased by about 7%, or 0.9 million tonnes of carbon dioxide equivalent, relative to 2016 levels. Electricity consumption in Ireland increased by 1.1% to 26 terawatt hours (TWh) between 2016 and 2017. Total consumption of electricity in Ireland has more than doubled since 1990, peaking in 2008. The recession saw an overall decrease; however, consumption is now approaching the previous peak figure. The contribution of renewable electricity to gross electricity consumption increased from 27.2% in 2016 to 30.1% in 2017 (see Table 5.1).[21] This resulted in avoiding 3.3 million tonnes of carbon dioxide equivalent emissions and the cost of importing the equivalent amount of fossil fuels, €278 million.[21] Around 500 megawatts (MW) of wind was installed in 2017. Wind generation accounted for 25.5% of electricity generated and continues to be the second-largest source of electricity generation in Ireland, after natural gas.

The emissions intensity of electricity generation (grams of carbon dioxide per kilowatt hour) has fallen by around 46% since 1990; however, it has started to increase again since 2014. In 2017, there was a decrease in the carbon intensity of electricity generation from 480 to 437 grams of carbon dioxide per kilowatt hour (g CO_2/kWh; see Table 5.1). The decrease in the carbon intensity of emissions and in absolute emissions from this sector in 2017 was largely a result of growth in renewable generation and a temporary reduction in peat and coal use. Ongoing use of peat and coal for electricity generation in Ireland will continue to keep the carbon intensity of this sector well above the EU average.

While the share of renewable electricity generation, particularly wind, is increasing, the pace of decarbonisation of the sector is not compatible with a low-carbon transition to 2050. It remains to be seen whether the changes in the Emissions Trading System, including the market stabilisation mechanism, will deliver the carbon price signal required to drive down emissions from electricity generation. It is promising that the recent carbon price on the Emissions Trading System has largely remained above €20 since August 2018. However, this is still too low compared to the signal required to drive major investment and is no guarantee of future market response.

The Renewable Energy Support Scheme provides supports for the development of renewables and to ensure that people and communities living adjacent to proposed installations are consulted and involved in the process. Plans are currently under development at the Sustainable Energy Authority of Ireland (SEAI) to increase individual and community engagement through distributed micro-generation of electricity. This is a step in the right direction in terms of effectively engaging with communities on these issues. All of these activities are crucial in increasing the pace of installation of renewables.

5.2.2 Industry

Industry is a significant emitter of greenhouse gases. Large industry is responsible for almost 70% of Industry emissions which fall under the Emissions Trading System. This is evident in Figure 5.1, which shows the remainder of emissions under the 'Effort Sharing Decision', predominantly smaller manufacturing industries that are below the thresholds to be included in the Emissions Trading System. This section considers the historical change in emissions, but also what is driving the observed changes and the policy levers available to reduce emissions.

Figure 5.1 shows the trends in greenhouse gas emissions from the sector split between those covered under the Emissions Trading System and the Effort Sharing Decision.

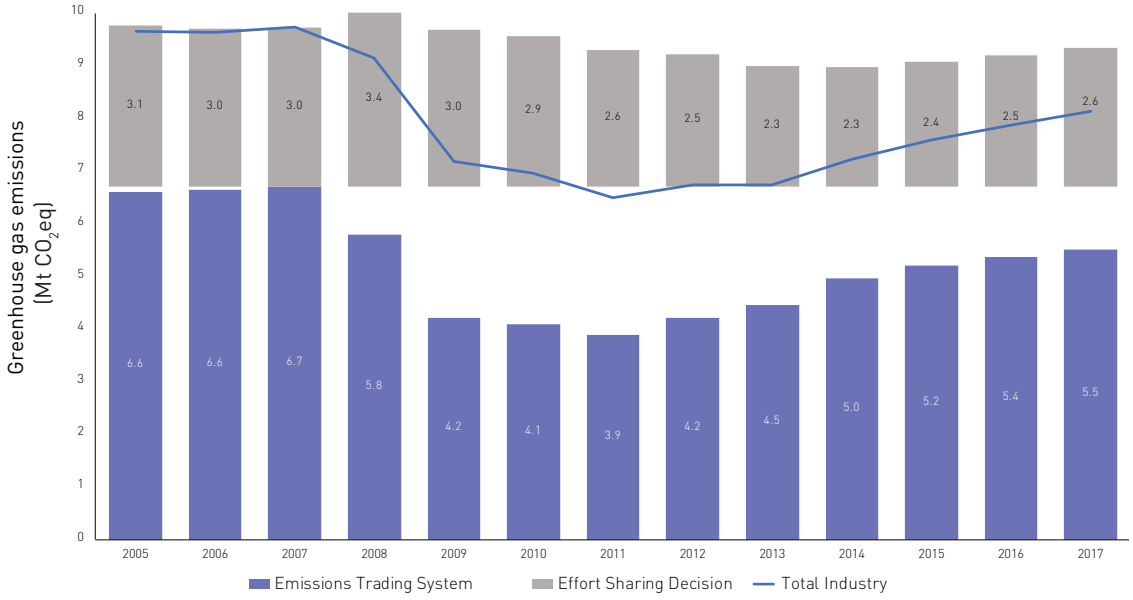

Figure 5.1: *Breakdown of Industrial emissions between Emissions Trading System and the Effort Sharing Decision for the period from 2005 and 2017.* **Data Source:** *EPA Emissions Inventories (2019).*[3]

Industry emissions grew by 3.4% in 2017 to 8.13 million tonnes of carbon dioxide equivalent, or 13.4% of total national emissions. Emissions in the national inventory chiefly arise from the combustion of fossil fuels for the heat required in the manufacture of goods (57.4% of industry emissions). In addition, there are industrial 'process' emissions and industry also drives emissions from power generation through demand for electricity. The two key categories in process emissions are the mineral source of cement production, as the mineral industry produced 91.3% of industry process emissions in 2017 (as carbon dioxide is given off while lime is produced in cement kilns), and 'fluorinated' gases such as those used in refrigeration.

The consumption of fossil fuels by industry mainly arises in the form of gas and oil burned for the heat and steam required by the production activities across industrial manufacturing. The largest emitters are food and beverages, minerals including cement and the metal sector, followed by the chemical and the electrical and electronic manufacturing sectors. Emissions from this 'Manufacturing Combustion' increased by 3.1% or 0.14 million tonnes of carbon dioxide equivalent (Mt CO_2eq) in 2017 to 4.67 Mt CO_2eq, with increases for all sub-sectors.

Emissions from industrial processes increased by 4.1% (0.09 Mt CO2eq) in 2017 following a 7.1% increase in 2016, mainly from increased cement production. Process emissions from cement

production increased by 169% from 1990 to the peak in 2007 (2.37 Mt CO_2eq). The decline in construction that followed the economic recession led to a significant reduction in emissions from cement production.

Economic recovery resulted in a boom in construction and a resurgence in emissions. In 2017, total emissions (combustion and process) from the cement sector increased by 2.1% and amounted to 2.78 Mt CO_2eq, or 4.6% of national total emissions across all sectors. Cement sector process emissions, despite a drop of 54.7% from 2008 to 2011, have since increased by 83% according to EPA data[3]. Fluorinated gases are modern synthetic chemicals with a wide variety of industrial uses; in Ireland most are used in cooling and air-conditioning. They are particularly problematic due to their very high global warming potential, and have grown significantly since 1990 (3,396%), standing at 1.23 Mt CO_2eq in 2017.

In addition to Manufacturing Combustion and process emissions, industry is a large consumer of electricity, commonly used for heating and motors. The SEAI energy balance sheets show that when these upstream electricity emissions are 'attributed' from the power generation sector to the consuming industrial sectors, a further 4.47 Mt CO_2eq is generated by manufacturing. This is a 6.5% increase since 1990, despite an annual drop noted in 2017 of 3.5%, mainly due to the lower carbon intensity of electricity. Sectoral emissions would further increase if freight activity in transport were also attributed to industry.

The energy intensity, or 'efficiency', of manufacturing depends on structural, technology and behavioural factors. 'Structural factors' depend on the types of goods produced and changes in product lines. The technical efficiency of processes is influenced by process design and technology choice. Management, control and behaviours are determinants at the end of the chain that influence efficiency. The cost of energy can help to drive these factors towards a more efficient use of energy in producing goods. Another technological factor is the energy mix. This can be in the fossil fuels of peat, coal, oil and gas (in decreasing order of carbon intensity), in electricity, or in renewable energy alternatives. This mix is dictated by how manufacturing processes are designed and the technologies chosen, and so can become locked-in for decades.

Switching between the fossil fuels, away from coal and oil to lower carbon intensity forms such as gas, can reduce emissions in the short term. The carbon intensity of electricity depends on the energy mix used in the power generation sector, including renewables. Where industry invests in technologies that use electric power, the emissions will move 'upstream' to the power generation sector.[23]

The Emissions Trading System puts a carbon price on power generation, large energy-intensive industry and commercial aviation. It covers 106 installations in Ireland and is the main policy approach to reducing emissions from industry in the EU. Emissions under this system fell by 24.5%, from 22.40 Mt CO_2eq in 2005 to 16.91 million tonnes in 2017, including a 4.7% drop in 2017. This is predominantly due to a reduction in power generation emissions of 4.38 million tonnes of carbon dioxide equivalent.

Manufacturing combustion has declined by 0.58 million tonnes and industrial processes by 0.51 Mt CO_2eq since the 2008 recession. Despite the reduction within the overall Emissions Trading System in Ireland, total Irish industry emissions including fluorinated gases have increased by 11.9% since 1990, to 8.13 Mt CO_2eq in 2017. This is not consistent with long-term transition, as deep reductions are required from all sectors.

Total emissions from Manufacturing Combustion and Industry are projected to remain relatively constant out to 2030, and then increase gradually to 2040. Much of the activity within the sector operates within the Emissions Trading System, accounting for 68% of emissions in 2017, and are projected to increase to between 5.6% to 7.5% by 2030. Emissions not covered under the Emission Trading System, accounting for 32% of emissions in 2017, are projected to decrease by approximately 20% by 2030.

This unsatisfactory trend reflects the failure to date of the EU Emission Trading System to deliver an appropriate price for carbon for industry within the Emission Trading System, and a failure to provide an appropriate signal to the 32.3% of industry emissions outside of the Emission Trading System.

5.2.3 Built Environment

The built environment sector includes residential, commercial and public buildings with emissions primarily due to energy demand for space and water heating. Consumption of electricity is not included in the built environment sector emissions.

There has been some progress on transition in the built environment in recent years. Emissions from this sector decreased by 165 kt CO_2eq. Residential emissions decreased from 2016 to 2017 by approximately 0.3 Mt CO_2eq. The latest European data analysed by SEAI show that, in 2015, the average Irish dwelling emitted 58% more energy-related carbon dioxide than the average EU dwelling, while the energy demand of the average Irish dwelling was just 7% above the EU average.[24] This reflects a high use of fossil fuels, particularly coal, peat and oil, for heating and minimal deployment of renewable and district heating.

New building regulations in the residential and commercial sectors have led to significant improvements in the efficiency of new building stock and will improve with the uptake of renewables.[25] Some private businesses have begun to offer biofuel on a competitive retail basis to private and commercial customers. This innovation is welcome and an important sign of transition. It will be crucial to the long-term transition that customers and Government can be confident of the environmental credentials of those fuels.

Residential Buildings

There are 2.25 million residential dwellings in Ireland, of which 1.7 million are occupied. There has been a major switch in fuel types used for residential heat since 1990, away from coal and peat fuels to oil and natural gas. Combined with more recent improvements in building regulations and standards, this has allowed emissions from the residential sector to decrease by 24% relative to 1990 while the population and number of private households increased by 37%.

More than 390,000 homes have benefited from SEAI's Better Energy Homes (BEH) and Better Energy Warmer Homes (BEWH) grants since 2000.[24] In total, 252,320 dwellings were upgraded under the BEH and 138,579 under the BEWH. The impact of these grants on emissions is not yet clear; however, recent estimates suggest that by 2020 the programme will contribute to a reduction in energy consumption of 1,900 GWh. SEAI is taking steps to improve the monitoring of outcomes in existing and future programmes.

To increase uptake, in September 2018 the programme was expanded to include new technologies: solar photovoltaic panels and heat pumps. Boiler upgrades are no longer included in the list of eligible technologies. However, as originally designed, these retrofit programmes were not

intended to bring existing buildings to the 'nearly-zero energy building' (NZEB) standards required for new buildings. Many of them would require additional investment to achieve the long-term transition objective.

EU and Building Energy Rating (BER) statistics and the 2016 Census all demonstrate the need for urgent additional action. The BER database shows that 24% of rated houses achieve poor energy efficiency ratings of E, F and G, unchanged from last year's report despite over 60,000 new ratings in the data set. This contrasts with annual energy data, as in Table 5.1, that show a decreasing trend in residential solid fuel use over the same period. Households dependent on burning solid fuel are more likely to experience energy poverty.

The floor area of new residential buildings has been increasing, with a 15% increase in average floor area across all homes from 2000 to 2016.[24] There was a slight decrease in floor area in 2017, reflecting an increase in the rate of multi-development housing granted permissions as the construction sector recovers further following the recession. While the BER of newer builds is improving, increased floor areas mean that any decrease in absolute energy demand may not be proportionate. The choice of fuel to meet residual energy demand therefore remains key. Over 42% of dwellings in the BER data set use solid fuel or heating oil as their main space heating fuel.[26] Of the 141,286 dwellings that achieve an A or B rating, 22.7% use oil or solid fuel as their main space heating fuel.

In 2017, the Central Statistics Office published its first annual New Dwellings Completion analysis, informed by the Housing Analytics Group in the Department of Housing, Planning and Local Government. The key message from this analysis is the need for coherence in data on housing to properly inform policy development.[27†]

Given the above, the confidence with which the reduction in GHG emissions can be attributed to policy interventions is limited. There is a need to investigate the interactions between dwelling type, occupation of dwellings (i.e. owner-occupied or rented), and lifestyle factors of individuals, as well as the number of houses that have been upgraded independently of Government grants.

Commercial and Public Sector Buildings

There are fewer publicly available data on the fuel use and efficiency of commercial and public buildings. Emissions from the commercial and public services sector saw an increase of approximately 125 kt carbon dioxide equivalent from 2016 to 2017, or about 6.8%. For public buildings, Table 5.1 shows that energy demand increased by 9.3% from 2016 to 2017.

Over 48,000 non-domestic buildings have undergone a BER audit, an increase of over 3,000 since the 2017 Annual Review.[28] Summary statistics are published by the Central Statistics Office (CSO) and SEAI. Overall, as Table 5.1 shows, in 2017, 13.6% of commercial buildings achieved an A or B rating compared with 13.8% in 2016. Although the data may be reflecting a broader cross-section of premises, this points to the scale of the retrofit task the commercial sector faces.

The data show that schools and colleges still have the highest proportion of A and B ratings at 49%, a 1% decrease from the last report; however, an additional 76 schools were assessed in 2017, 30 of which achieved BER of A or B. Nursing residential homes and hostels also have a high proportion of A and B ratings (46%, unchanged since last report). Restaurants and public houses

† For example, BER data are compiled based on unique meter point reference numbers (MPRNs). However, in the review of new housing data it emerged that less than half of MPRNs for new housing completions could be matched to a final BER.

have the lowest proportion of A and B ratings (7%, unchanged since last report). Workshops and maintenance depots have the highest proportion of F and G ratings (31%, unchanged since last report). The technical guidance document for the Building Regulations on Conservation of Fuel and Energy – Buildings Other than Dwellings, published in late 2017, came into effect on 1 January 2019,[29] and aims for a 'near-zero energy building' performance for new non-dwelling buildings. This is a significant improvement on previous standards, which had not been updated since 2008.

Public Sector Energy Efficiency

The Public Sector Energy Efficiency Strategy legislated under SI 426 requires that all public sector bodies report their energy use to SEAI through the Monitoring and Reporting system. At present 94% of public sector bodies report their energy use to SEAI; this excludes schools. The SEAI *Annual Report 2018 on Public Sector Energy Efficiency Performance* shows that in 2017 the total primary energy use for the public sector was 10,248 GWh, at a cost of €608 million. Compared to 2016, energy consumption reduced by 3,223 GWh, resulting in €191 million in savings, and avoided emissions of 667,000 tonnes of carbon dioxide.[30] Actions undertaken by public sector bodies include upgrades to lighting, heating and building fabric, awareness campaigns and energy management.

Public lighting is a significant energy demand and cost for local authorities in Ireland. For example, for Dublin City Council public lighting is 25% of total primary energy consumption and 32% of carbon dioxide emissions.[31] Converting from sodium lighting to LED lights coupled with central management systems (for dimming) has the potential for significant reduction in energy demand, costs and emissions. Public sector entities can implement the ISO 50001 standard to achieve their energy efficiency objectives or work with energy agencies to undertake projects. In 2016, Cork County Council was awarded the first ISO 50001 Energy Management System Certificate in Ireland and in 2017 Dún Laoghaire Rathdown County Council was the first Dublin local authority to be certified.[32]

Local authorities have also received funding to undertake social housing upgrades via a two-phase retrofit programme administered by the Department of Housing, Local Government and Planning. Under the programme, Dublin City Council has upgraded over 8,000 social housing units since 2013, and at present 30% of units are above a BER C3. Further, between 2009 and 2016 upgrades to social housing has resulted in a 15% decrease in emissions. Dún Laoghaire Rathdown County Council has been ambitious in undertaking upgrades to Passive House Standard on 34 units of affordable housing for older citizens, who have welcomed the improved levels of comfort. The Three Counties Energy Agency through SEAI's Better Energy Communities programme has upgraded 174 units of local authority owned and privately owned housing in the Butts area of Kilkenny. The project has been viewed positively by residents and the local authorities.

Commercial Sector Energy Efficiency – Large Industry Energy Network

The Large Industry Energy Network (LIEN) is a voluntary programme managed by SEAI to support companies with annual energy bills exceeding €1 million to develop energy management plans and projects. The latest publication by SEAI for 2017 shows that there was a 1,436 GWh reduction in primary energy use across all members, along with a 22% improvement in energy performance.[33]

Companies' progress is reported on the SEAI website and includes information on the factors affecting their ability to reach their targets, including measures undertaken through building management systems, chillers (physical changes) and awareness campaigns (behaviour change).

5.2.4 Transport

Transport sector emissions have grown by 133% between 1990 and 2017. This emission growth is a key challenge for 2020 to 2030 targets, but also as it shows a lack of progress towards long-term low-carbon transition. Transport is the second largest emitter in Ireland, behind agriculture, at 19.8% of the national total emissions (12.00 million tonnes of carbon dioxide equivalent), and 27.1% of the non-ETS emissions that make up the 2020 and 2030 targets. There was a small reduction in 2017, by 2.4% or 0.29 million tonnes of carbon dioxide equivalent, after four consecutive annual increases from 2013 to 2016. The growth in transport emissions is one of the key challenges to meeting emissions reduction targets in Ireland.

Transport emissions have broadly followed changes in the economy since 1990, with a limited decoupling of growth. As can be seen in Figure 5.1, emissions grew significantly until the economic recession and growth resumed in 2013. The figure shows the trend in real Gross National Income, alongside percentage change in total transport CO_2 emissions. It also illustrates the percentage change in emissions from the two largest emitters: private cars, standing at 52% of national transport CO_2 in 2017, and road freight at 19%.

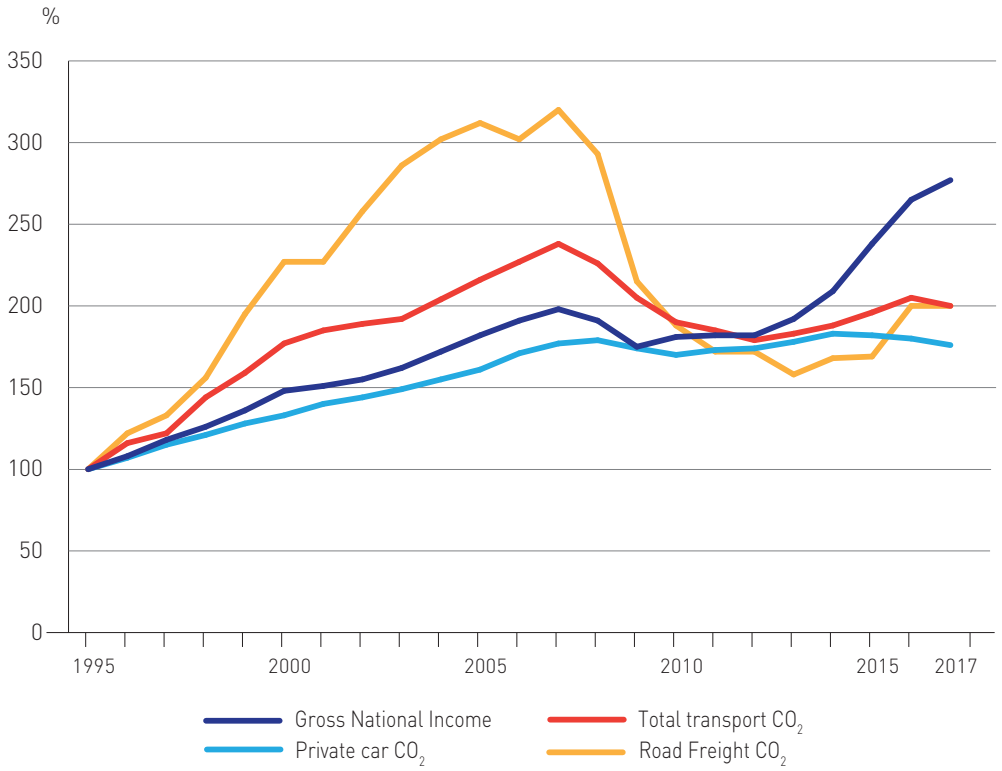

Figure 5.2: *Comparison of economic growth and growth in transport emissions.* **Data sources**: *SEAI (2018)*[34]*, CSO (2018).*[35]

The energy balance sheets from Sustainable Energy Authority of Ireland[34] report carbon dioxide emissions, which are 99.99% of transport greenhouse gas emissions. Figure 5.2 shows a more detailed breakdown by mode of where Irish transport emissions occur. This highlights the

dominance of the private car in transport emissions, with other significant sectors including road freight (lorries and trucks) and light goods vehicles (vans). This problematic pattern of the dominance of private car activity has also been noted by the Department of Transport, Tourism and Sport.[36]

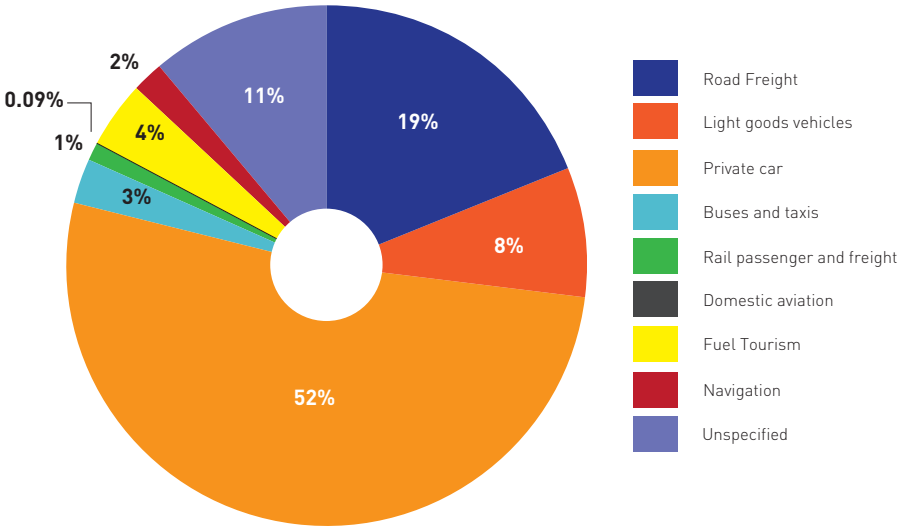

Figure 5.3: *Modal shares in Irish transport carbon dioxide emissions, 2017.* **Data source**: *SEAI, 2018*[21]

Key sectoral indicators are pointing in the wrong direction at a national level. As well as economic growth and higher levels of activity, past policies on investment, infrastructure, urban sprawl and spatial planning have caused higher levels of emissions, air pollution and also congestion on roads that lead to major centres of employment. The Intergovernmental Panel on Climate Change has noted repeatedly that transport mitigation requires consideration not just of 'end-of-pipe' technological measures, but of the fundamental development pathway, which for transport includes spatial and infrastructure patterns and choices on the priority on transport modes.[37] This is considered further in Section 6.5.4.

Passenger Transport

Dispersed patterns of spatial and infrastructure development implicitly increase mobility demand. This has coincided in Ireland with related long-term trends towards more private and motorised transport, and declines in the active modes of walking and cycling. In comparison to other European countries, a higher proportion of public transport in Ireland is by bus rather than by rail, and rural areas have limited availability of public transport in general.

The National Travel Survey 2016 found that, at a national level, journey distances and durations are increasing. More than two-thirds (69.4%) of all journeys were made by car in 2016, a +0.4% growth on 2013. Most car journeys were single-occupant, as the number of journeys as car passengers fell to 4.9%.[38] The 2016 Census found nationally that 65.6% of those commuting to work travelled by car.[39] The same data showed that just under half of commuters working in Dublin travelled by car.

The impact of the reliance on private vehicle transport on greenhouse gas emissions is compounded by increasing journey lengths (in time and distance) and fuel or technology choice. As shown in Table 5.1, the total distance travelled by cars rose by over 1.5% in 2017, continuing

five years of consecutive growth. The Central Statistics Office new vehicle registration data show that in 2017, only 0.7% of new passenger cars were zero-emissions capable, including plug-in hybrid and all-electric cars. The rate of uptake will need to expand exponentially if these vehicles are to become a sizable proportion of the national fleet.

In the period 2007 to 2018 a total of 3,700 electric cars were registered in Ireland; 1,200 were registered in 2018 alone. This rapid increase in the rate of switching to electric cars appears to be continuing, with 980 cars registered during January and February 2019. However, this is only 0.2% of the total number of private cars on the road in 2017 (2,066,122 vehicles).[40] A step shift in adoption will be needed over the next five years.

The National Travel Survey 2016 also shows that there was little overall change from 2013 to 2016 in the shares of the more sustainable modes of transport: walking, cycling and public transport have stayed at approximately 22%. However, a growth in cycling and decline in walking can be seen even at the national level. The survey shows that bus use at the national level fluctuated around 4% over the same period.

The Canal Cordon Count for Dublin shows a different picture to the National Travel Survey, with some change from the private car to walking and cycling. From 2006 to 2017, total use of more sustainable modes of travel into Dublin city – bus, train, Luas, walking and cycling – increased from 61% to 70%, with a 3% increase between 2016 and 2017. The National Travel Survey 2016 shows that journey distances in Dublin decreased over the period 2013 to 2016, suggesting either that people are living closer to their work and services such as shopping and leisure or that individuals are making fewer journeys. This could be an encouraging trend.

Nationally, there was a 2.1% reduction in carbon dioxide emissions from private cars in 2017.[31] The SEAI Energy in Ireland report [21] used National Car Test data to show that total private car mileage was relatively static, as was the average fuel consumption of new petrol and diesel engines for the three years from 2015 to 2017. However, energy efficiency was improved by the increased proportion of the total distance travelled by diesel engines, which are more fuel-efficient than petrol. In addition, carbon efficiency improved as biofuels increased to 4% of fuel demand in 2017.

International aviation is an important contributor to global emissions of greenhouse gases, and one of the most difficult for mitigation, due to continuing demand increases and technical limitations to emissions reduction. Box 5.1 discusses international aviation's significance for emissions.

Box 5.1: *International aviation and mitigation*

International aviation emissions are predominantly considered outside of the scope of national responsibility for mitigation. Ireland's international aviation emissions contributed 2.6 million tonnes of carbon dioxide equivalent to the atmosphere in 2016.[41] The contribution to climate change of each unit of aviation emissions is proportionately larger than those at ground level from other forms of transport, due to the effects that emissions have at higher altitudes.

As the global carbon budget tightens, international aviation could consume up to one quarter of that available in 2050 without appropriate action to reduce emissions.[42] Trade globalisation, lower airfares and increased incomes of more affluent groups are among the factors that have led to increased global demand for air travel. Airlines expect that demand will continue to grow by about 5% per year.

Air travel is the most carbon-intensive of all transport modes, yet it has largely escaped global regulation of emissions in recent decades. Provisions established in The Convention on International Civil Aviation in 1944 established tax exemptions for aviation fuels. Air travel has therefore continued to have a comparative advantage over other transport modes, despite its outsized climate impact. This implicit subsidy to aviation could be regarded as a market distortion. Many states also exempt it from value added tax, and it frequently receives public subsidies.

Some countries have implemented ticket taxes, including Austria, Italy, Norway, France, the UK and Germany. Others such as Malta, Denmark, The Netherlands and Ireland introduced aviation taxes but have since removed them. Ireland introduced an Air Travel Tax on departures of passengers from Irish airports in 2009. This applied to aircraft capable of carrying 20 or more passengers, to airports where the number of passenger departures in the previous year was more than 50,000. It implemented a charge of €3 per passenger, but Government ceased it in 2014.

The Kyoto Protocol directed wealthier countries to pursue emissions reductions through the International Civil Aviation Organization (ICAO). The ICAO adopted voluntary actions with industry, and aspirational goals to improve fuel efficiency by 2% per annum until 2050 and keep net emissions at the 2020 level.[43] The ICAO's own analysis shows that emissions from international aviation have continued to grow and will only be restrained by full transition to biofuels and improved efficiencies by 2050.[43] However, meeting global warming limits of 1.5 to 2°C may require deeper action. This will depend on how other sectors evolve globally in the coming decades, and ongoing developments in policy and pricing arrangements in response.

The EU, which accounts for 35% of global aviation emissions,[41] has attempted since 2012 to reduce aviation emissions through inclusion in the Emissions Trading System (EU ETS). Flights to and from non-European Economic Area countries were excluded to facilitate the development of a global agreement on aviation emissions under ICAO.

The ICAO adopted a 'Carbon Offsets and Reduction Scheme in International Aviation' (CORSIA) in 2016, to come into effect with a voluntary pilot phase in 2021. CORSIA's aim is to stabilise net emissions from aviation at 2020 levels. Airlines will be required to buy emissions reduction credits from other sectors to compensate for any increase in their own emissions, or alternatively to use lower carbon fuels. Concerns have been expressed about the environmental effectiveness of CORSIA within the EU. Once the scheme's rules are finalised, the European Commission will review the emissions impact, and consider its position with respect to both the EU ETS and this new global scheme.

Freight

Similar to passenger transport, freight is subject to spatial and infrastructural decisions that can 'lock in' emissions. SEAI data show that road freight emissions remained static in 2017 after increases in 2015 and 2016. At the same time, tonne kilometres increased by 1.7% and vehicle kilometres by 2.2%[36], suggesting some improvement in the energy and carbon efficiency of road freight. However, the SEAI points to the potential for significant growth in freight as economic and construction activity increases, potentially acting to drive further expansion of freight emissions.

Freight activity increased in all but one sector in 2017. The SEAI reports that from 2013 to 2017 delivery of goods to roadworks or building sites increased by 69% and of materials and fuels to factories by 53%, with a 5% increase in 'Import and export' and 'Other work' categories, but all remain well below the 2007 peak.

In addition to this 'heavier' road freight, light goods vehicles are a significant source of emissions as per Figure 5.2 – almost half as much as their heavier cousin. This has only been separated in SEAI data since 2014, and little is yet known about the factors influencing its development.

Successive Annual Reviews have noted that rail freight transport is a minor share of total freight and has experienced a steady decline in recent decades, which leads to a shift to road. While logistical and technical efficiency improvements are evidently necessary for road freight, reducing emissions from freight requires consideration of integrated mobility, spatial, infrastructure, investment and economic planning.

5.2.5 Agriculture and Land Use

In the absence of a definition of neutrality within the Agriculture and Land-Use sector, it is not possible to provide a detailed assessment of progress towards the national policy objective. Nevertheless, given the observed increase in agriculture emissions and ongoing carbon losses within land use, the sector is not on a trajectory to achieve the national transition objective towards neutrality. The Special Focus Chapter 8 provides a detailed discussion of the sector.

Agriculture

Annual agriculture emissions increased by 2.9% in 2017 compared to 2016, and by 6.9% relative to 2014. They are projected to increase further. This has largely been driven by the industry taking advantage of market opportunities enabled by the removal of quotas on dairy production.[44]

Animal numbers, animal types and farm management are fundamental drivers of emissions within the sector. In addition, much of our agricultural land is managed to produce fodder for the animals, leading to emissions associated with nutrient management and the use of nitrogen fertilisers.

The total number of livestock in the country is determined by the number of breeding females and the average age of slaughter. The number of dairy cows increased by 2.5% between 2016 and 2017, and a further 3.4% in 2018.[45] Meanwhile the number of non-dairy cows, sucklers, decreased by 2.1% between 2016 and 2017, and a further 3.1% in 2018. The increase in dairy cows and decrease in suckler cows continues trends that have emerged over the past decade. Since 2009, the number of dairy cows has increased by 35%, while suckler cow numbers have decreased by 13%. The larger number of total breeding cows has increased the number of calves for rearing, and driven an increase in the total cattle herd of 2% between 2016 and 2017, but there was a modest 0.1% decrease in 2018.

Noting that dairy cows have higher emissions per animal than suckler cows and other cattle, the improvements in efficiency of production documented in the Origin Green annual report 2016 have not been sufficient to avoid an increase in absolute emissions (see Box 8.2).

Challenges exist in providing analysis and indicators of progress towards transition within the Agriculture and Land Use sector. Many of the actions undertaken to mitigate emissions and improve efficiency cannot be readily reflected in national estimates of emissions and removals. Measures and policies identified in the National Mitigation Plan focus on improving production efficiency and land management. Quantifying these potential emissions reductions is essential for assessing their effectiveness.

Land Use

All land uses should be included in mitigation strategies. Policies and practices to maintain and enhance carbon stocks are needed as part of the overall achievement of an approach to neutrality.

The role of forest land is clear. National policy on forestry is largely consistent with enhancing the national carbon stocks as well as sustainable resource management. In the period 2008 to 2017, the average annual increase in forest area was 6,525 hectares. In 2018, forest area increased by 4,020 hectares. This low rate of afforestation is less than that required to achieve the long-term objective of 18% national coverage by mid-century.

The European Commission published legislative proposals for the reform of the Common Agricultural Policy post-2020 on 1 June 2018. This proposed reform is an opportunity to enable more effective supports and incentives for agriculture to maintain and enhance carbon stocks within the rural landscape, including in biomass and soils. This should be consistent with other environmental objectives, including enhancing the nature value of agricultural land and improving water and air quality. Current estimates of the change in carbon stocks on agricultural soils indicate a large net source of emissions due to the drainage of peat for use as grazing land.

Activities on non-agricultural peatlands continue to be a major source of greenhouse gas emissions, with a steady increase in drained organic soils reported (see Table 5.1). The increase is largely driven by ongoing peat extraction for domestic heat, electricity generation and horticultural use, and drainage to enable grazing and forestry activities. The reported increase in drained areas has occurred despite successful rewetting and restoration activities on specific sites. Policies and incentives to enable better management of organic soils across all land-use types are required. A large proportion of the land managed for peat extraction is in state ownership. The state can provide leadership in improved management of this resource.

The large reported emissions from biomass burning in 2017, and similar levels in 2010 and 2003, highlight the need for renewed efforts to enable more effective and sustainable management practices on vulnerable lands.

There is a clear need to move land management to a more sustainable pathway. This must also address emerging demands from the bioeconomy and renewable energy, as well as more conventional demands on land, such as agriculture, forestry, built environment, and habitat and ecosystem services.

5.3 Institutions and Governance

The Annual Transition Statement provides an overview of climate change mitigation and adaptation policy measures adopted across Government to reduce emissions of greenhouse gases and to adapt to the effects of climate change. It must be produced annually in accordance with the provisions of the Climate Action and Low Carbon Development Act, 2015.

The Minister for Communications, Climate Action and Environment, Richard Bruton TD, gave the third Annual Transition Statement to Seanad Éireann on 4 December 2018 and to Dáil Éireann on 6 December 2018.

Irish climate change policy is set within an international and European Union level framework and achieving the transition requires effective policy implementation and coherence at national, sectoral and local government levels. The Annual Transition Statement discusses international and European Union policy developments, as well as national policy developments.

There are considerable public governance challenges in the transition to a low-carbon economy and society, and progress is discussed below.

5.3.1 National Planning Framework and National Development Plan

Published in February 2018, the National Planning Framework is a high-level strategic plan by the Government to shape the growth and development of Ireland until the year 2040. Together with the National Development Plan as 'Project Ireland 2040', it aims to integrate strategic planning and investment. An objective is to plan for the jobs and homes required by an anticipated population increase of 1 million by 2040, creating opportunities and enhancing quality of life while protecting the environment. 'Transition to a Low-Carbon and Climate-Resilient Society' is one of the 10 strategic outcomes of the Framework.

The National Planning Framework, with its focus on spatial planning and long-term vision to 2040, has the capacity to address key drivers of transport emissions, the dislocation between places of residence and places of work, and the carbon efficiency of goods networks. However, the success of the Framework will be determined by the extent to which other plans, policies and measures follow through and maintain consistency with its aims and objectives.

One of the key policies under the National Planning Framework will be the regional spatial and economic strategies being prepared by each of the three regional assemblies, which published their draft regional spatial and economic strategies for public consultation in late 2018 and early 2019. When adopted, these should provide a long-term regional-level strategic planning and economic framework in support of the implementation of the National Planning Framework at regional and local level.

The planning process provides an established means through which climate change mitigation and adaptation objectives can be integrated and implemented at regional and local levels. The implementation of the National Planning Framework represents a key opportunity to ensure that the climate implications of our spatial choices are fully considered and addressed from the top of the planning hierarchy.

Government has stated its ambition to see much closer alignment between national, regional and local planning. Ensuring that alignment will be an important function of the new Office of the Planning Regulator (OPR). The Council notes that when reviewing future regional spatial and

economic strategies and development plans, the OPR will consider how they promote reducing emissions and adaptation to climate change. This is an important opportunity to mainstream the transition into wider policy, and a potentially significant initiative in ensuring that the aims and objectives of the National Planning Framework are implemented.

As noted by the EPA, one of the key mechanisms to ensure that environmental decision-making, planning and investment mainstreams climate change adaptation and mitigation into all levels of decision-making including plans, programmes and strategies is the Strategic Environmental Assessment (SEA) process.[46]

The National Development Plan sets out the almost €116 billion that will underpin the National Planning Framework and drive its implementation over the next 10 years. The Plan also contains commitments regarding the direction of future investment, and a number of policy commitments relevant to transition. The implementation of the National Development Plan is discussed in Section 6.3.1.

5.3.2 Sustainable Development Goals

Under the 2030 Agenda for Sustainable Development, countries are encouraged to incorporate the Sustainable Development Goals (SDGs) into planning and policy and develop their own national responses or plans to address the goals. The 17 SDGs cover the social, economic and environmental requirements for a sustainable future, with goal 13, 'Take urgent action to combat climate change and its impacts', making specific reference to addressing climate change.

Ireland's first Voluntary National Review[47] was submitted to the United Nations in June 2018, and formally presented to the High-Level Political Forum at the UN Headquarters in New York in July 2018. The review considers Ireland's performance against each of the 17 goals and discusses policies such as the National Mitigation Plan, National Adaptation Framework and National Planning Framework in the context of goal 13.

The Minister for Communications, Climate Action and Environment is responsible for promoting and overseeing the implementation of the SDGs, though all Ministers retain responsibility for implementing the individual SDGs relating to their functions. This should provide opportunities to align climate policy with the SDGs. The DCCAE hosted the third meeting of the National Sustainable Development Goals Stakeholder Forum in January 2019 in Dublin Castle, which included discussions on climate change. Close cooperation between the SDG consultative processes and the National Dialogue on Climate Action is recommended, given the potential for mutual benefits.

The importance of coherence across climate policy and the SDGs, in particular in relation to climate adaptation, is discussed in Chapter 7.

5.3.3 Updating the Public Spending Code

In late 2018, the Department of Public Expenditure and Reform published the reviews of the Central Technical Appraisal Parameters and on Valuing Greenhouse Gas Emissions in the Irish Government's Public Spending Code. The Public Spending Code provides the guidance for the Cost Benefit and Cost Effectiveness Analysis of all public expenditure, both capital and current. The aim is to facilitate best practice in the analysis and management of the spending of public monies. These reviews have recommended some key changes: the reduction of the social discount rate from five per cent to four per cent; the implementation of 'declining discounting';

consideration of longer time horizons in the analysis of cost and benefits; and changes to how greenhouse gas emissions are valued.

The Council has welcomed the publication of these papers, and the underlying research by the Irish Government Economic Evaluation Service, and noted that they provide a very good basis on which to update the Spending Code. The Council has made some recommendations on how the final version of the Code could be improved to take account of the challenges posed for Ireland in tackling the problem of climate change.

The Council notes that the review has recommended that the social discount rate should be reduced from 5% to 4%, and the implementation of a new approach of declining discounting into the future. The Council welcomes the proposed introduction of declining discounting and further commends the proposal that the discount rate be kept under review, in keeping with the clear trend towards lower discount rates throughout developed countries, as noted in the recent OECD survey.[48]

Ireland's objective of transitioning to a low-carbon, climate-resilient and sustainable economy and society by 2050 should guide the approach of the Public Spending Code. This implies that the damage done to society in 2050 by a tonne of carbon dioxide emitted by sectors covered by the ETS will be the same as that for emissions from the rest of the economy. As a result, we should use a single price of carbon in valuing long-lived projects, irrespective of differing prices today in the ETS and the non-ETS sector.

In the Draft Code, the present value of future costs and benefits of projects will be determined by the discount rate proposed by the Department. Accepting that discount rate, and taking the Department's proposed cost of carbon dioxide emissions in 2050 of €265 a tonne, is not consistent with the value for carbon proposed by the Department for non-ETS emissions at €32 per tonne in 2020. Using the Department's proposed discount rate, and the proposed 2050 value for the cost of carbon dioxide, would suggest that the appropriate price to use for 2020 is around €80 a tonne.

'Target consistent studies' in developed countries routinely give higher values, with the UK at £68 per tonne in 2020 (tonne CO_2eq in 2017 £ values), as have global studies detailed by the High-Level Commission on Carbon Prices. The other key empirical approach, as 'damage costs', often termed the 'social cost of carbon', also supports higher values.[†50,51]

In terms of the costs used in appraisal by governments in practice, both the average cost surveyed across the OECD countries at $49[‡] per tonne in 2020 (in 2017 dollar values) in the OECD survey and those specifically applied to Ireland by the European Commission[53] at €41 per tonne in 2020 (2017 euro values) also support the view that the proposed cost of €32 per tonne in 2020 is too low.

Noting the example of the investment in 100 hybrid buses detailed in Budget 2019, if the full welfare costs of this public spending were internalised in the appraisal of this spending decision, it is possible that a cost–benefit analysis could point to a different outcome – leading perhaps to the purchase of a zero-carbon fleet. To ensure the full welfare cost is evaluated requires consideration of the appropriate shadow price of carbon, the timespan of the analysis and the discount rate applied overall.

† A prominent damage cost in the literature is the US regulatory price estimated at $51 per metric ton of CO2 in 2020 (in 2017 dollar money values).[51] It has been widely acknowledged that this value is conservative and too low according to both the Intergovernmental Panel on Climate Change and the Interagency report itself. [52]

‡ This is skewed downwards by Ireland's lower price.

The Council believes that it is important that the complete lifetime costs of emissions and the benefits of the avoided emissions and of 'co-benefits' are fully capitalised throughout the technical lifespan of long-lived infrastructure. The Department's review of parameters noted the importance of the OXERA report for the UK in 2002,[54] which specifically addressed long-term impacts on welfare. To be consistent with the logic of this long-term focus in appraisals, impacts on welfare for many long-lived infrastructural projects are commonly included in Government appraisals on timescales up to 100+ years.[†, ‡ 55,56,57]

Applying a shorter timeframe for financial or economic appraisal of a road investment, such as a period of 30 years, would at a minimum, require a longer timespan to include the 'residual impact' on welfare. This residual impact must include the cost or benefit of emissions to welfare throughout its operational lifetime. Such longer timeframes are required for consistency with practices now common across OECD countries, and also with the provisions of the Climate Action and Low Carbon Development Act (2015) and the National Adaptation Framework.

In accordance with this longer-term time frame that has emerged in appraisal practices, it is important to consider not only emissions and mitigation. The Council believes that it is also necessary to consider climate change impacts and adaptation as part of the amendments to the Code, including for cost–benefit calculations that might take account of potentially increasing risk and damages over time. European Commission guidance on cost–benefit analysis of EU co-financing requires that climate change mitigation and adaptation needs, as well as disaster resilience, are demonstrably taken into account. It is important that public spending has due regard to adaptation using an appropriate range of global warming scenarios, including those of potential higher warming, in addition to cost-effective risk management.

The Council also recommends that, in planning future infrastructure, account be taken of the uncertainty about the possible future impacts of climate change on Ireland. The possibility that the outcome may be significantly worse than expected should be taken into account. For example, re-engineering key infrastructure to deal with an even bigger rise in sea level than currently expected could be very expensive. Instead, if the cost of planning infrastructure for more extreme outcomes is not too great, it may be wise to make suitable provision to cover such eventualities.

5.3.4 Joint Oireachtas Committee on Climate Action

The work of the Joint Oireachtas Committee and the positive reception it received in the Dáil chamber in response to the strong signals provided by the Citizens' Assembly has added a new urgency to climate action in Ireland. It recognises the urgency and scale of the need for action on climate change.

The report of the Joint Oireachtas Committee on Climate Action: A Cross-Party Consensus for Action was published in March 2019. The report concurs with previous Council recommendations on a number of issues, including:

† The example of France is pertinent, where the economic impacts are appraised to 2070 but the residual environmental and social impacts on welfare are analysed up to 2140

‡ The IGEES review notes two points to support applying shorter timeframes of analysis: (i) that discounting renders long-term costs and benefits negligible, and (ii) that uncertainty in forecasts makes longer-term analysis less desirable. However, as declining discounting will now be applied, this means that long-term costs and benefits will not be rendered negligible.[55] In addition, forecast uncertainty is dealt with in practice through a range of techniques that allow the required long-term timeframe to be applied. Examples include scenarios and sensitivity analysis in French[55] and Dutch national guidance.[56]

- Carbon Pricing recommendations intended to provide a sufficient price signal to encourage innovation within the economy.
- Reference to a pathway for an increase in the carbon tax to at least €80 per tonne in 2030, with supports for those in energy poverty.
- Recommendations on the EU Emissions Trading System and consideration of a carbon price floor with a coalition of Member States.

The report also contains recommendations on re-evaluating the co-firing subsidy for peat and biomass and on the implementation of a national programme of rewetting and peatland restoration. The importance of diversification within agriculture and land was highlighted by the Committee, recognising the need to reduce emissions and improve the sustainability of farming in Ireland.

The Council looks forward to the continuing momentum of this process.

5.3.5 Climate Action Plan 2019: To Tackle Climate Breakdown

The Climate Action Plan 2019 was released on 17 June 2019.[167] The Council welcomes this important initiative. This Plan explicitly sets out sectoral targets which, if achieved, will see Ireland meeting its 2030 targets. The intention of the Government is to update the Plan on an annual basis considering progress on implementation and potential new policies and measures. The Council notes that the Plan includes a number of actions which reflect previous advice and recommendations from the Council and the Joint Oireachtas Committee on Climate Action. The governance structure outlined within the Plan recognises the urgency of climate issues and establishes a framework for implementation and continual review. The Council welcomes the focus on achieving climate actions within and across sectors, recognising the potentials and opportunities to contribute to the low-carbon transition and the proposed carbon budgeting process to frame transition. The Council will consider the detailed actions identified in the Plan and the pathways to 2050 towards a low carbon, climate resilient and environmentally sustainable economy.

The analysis presented in the Plan identifies that a rate of emissions reduction of 2% per year is required to achieve Ireland's 2030 Effort Sharing Regulation targets. It also indicates that the rate of emissions reduction must increase to 7% per year after 2030 in to achieve an 80% emissions reduction by 2050 consistent with the National Policy Position. Additional detailed analyses of scenarios and pathways needs to be undertaken to achieve these goals, especially with respect to options to 'front load' some actions and measures to achieve early and sustained emissions reductions in the period to 2030. This may allow Ireland to exceed its 2030 targets, while greatly decreasing the burden to the economy of the major step-up in emissions reduction envisaged post 2030.

5.3.6 Public Participation

Public participation and community engagement have gained increased attention in climate change debates and policy strategies at national and international levels. Public participation addresses a spectrum of interactions between citizens, communities, stakeholders and public bodies.

According to the IPCC[7], public participation and input into climate action measures is a vital component of the transition to a low-carbon and climate-resilient economy and society. The latest version of the European Social Survey 2016[58] was released on 1 December 2018. It engaged respondents from 23 countries on various issues including climate change and energy. Of the 96% of Irish respondents to the survey who believe the climate is changing, a large majority of 91% believe this is at least partly caused by human activity, with nearly two-thirds of respondents believing that its impacts will be bad. Similarly, the EPA commissioned a RED C poll[59] of a sample of 1,009 nationally representative adults, conducted online between 9 and 13 November 2018, which found that more than a third of adults (36.7%) recognise climate change as the most pressing issue facing the country, while 61% cite it as one of the top three environmental concerns for us to tackle. The 18–34 age group placed the highest emphasis on climate change. This is reflected in the emerging grassroots movement of youth demanding action on climate change. In 2018 and early 2019, Ireland experienced an increase in citizen activism calling for stronger climate action from Government. Inspired by Greta Thunberg, students in Ireland have initiated Friday strikes from school calling for the Government to act on climate change and to protect their future. Awareness and knowledge of climate change and its impacts appears to be increasing in Ireland.

While the OECD in its 2018 'Better Life Index' ranked Ireland the fourth lowest in terms of 'stakeholder engagement for developing regulations',[60] there have been notable recent developments in the area of public participation on climate action in Ireland, including the development of Public Participation Network and the Citizens' Assembly.

In the Programme for Government, a commitment was made to convene a Citizens' Assembly on Climate Action in 2017. The Citizens' Assembly[61] climate change module made two specific voted recommendations and one ancillary recommendation (AR) in relation to public participation in the transition to a low-carbon economy:

> AR1: Greater emphasis should be placed on providing positive information to the public which encourages people to make changes to the aspects of their behaviour which impact on climate change. Such information should be targeted at all age groups using a wide variety of formats. The information provided should be focused on highlighting the economic, social, health and other benefits of taking action rather than focusing on the negatives associated with a failure to act.

The report from the Citizens' Assembly and the Report from the Joint Oireachtas Committee on Climate Action[62] (and its unanimous adoption) created a strong foundation for a citizens' engagement process. More recently, citizen engagement has featured strongly in chapter 15 of the Climate Action Plan 2019. Specifically, commitments for public participation are set out in Action 159.

> Action 159: Enhance the effectiveness of climate related communications, networks building and deliberative capacity within and through the National Dialogue on Climate Action; sets out 11 sub actions for immediate action, timelines for delivery and designated responsibilities.

Progress on commitments will be part of the reporting process set out under the Climate Action Plan 2019. The Council will seek to follow progress and report on this in future reporting periods. A number of other promising initiatives also exist in parallel to the National Dialogue on Climate Action: including SEAI Energy Communities, Leaders Group on Sustainability, and

Climate Action Regional Offices (CAROs). The need to link these initiatives with the National Dialogue on Climate Action is recognised in the Climate Action Plan 2019, which is welcomed by the Council. These commitments provide a positive emphasis on public engagement in order to effectively transition to a low-carbon society.

Case Box: National Dialogue on Climate Action

The National Dialogue on Climate Action is a Government of Ireland initiative, with a secretariat supplied by the EPA. It is aimed at engaging 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 two Regional Gatherings. These events sought to raise awareness, motivate and empower members of the public on climate change. Strong themes emerged, which merit deeper and more detailed interaction at the local level: communities raised their local concerns and showed interest in discussing the circular economy and in hearing about government plans for action, supports and funding initiatives.

Other activities under the National Dialogue on Climate Action include the Climate Lecture Series, open to the public, which held events in May and November 2018 and April 2019 with an average of 250 people attending in person. The EPA in collaboration with the Department of Communications, Climate Action and Environment (DCCAE) held the inaugural Climate Change Conference in May 2019. This event was open to the public and free to register.

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, in particular among disengaged communities, to empowerment and creating 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 system of community engagement to build public support for climate action, to enable it to expand its existing strategy. A properly mandated and resourced National Dialogue on Climate Action has the potential to work collaboratively and between sectors, communities, networks and individuals to drive this agenda.

5.3.7 Just Transition Progressing Climate Justice

The Council is committed to ensuring that the burden of policy measures necessary to tackle the problem of climate change is fairly distributed across the population, ensuring that those on lower incomes are not disadvantaged – in other words, that there is a 'just transition'.

Case Box: Key concepts in climate justice

Climate justice is one of three forms of justice that need to be considered in a just transition to a low-carbon future (see Figure 5.3).[63] The other two are energy justice and environmental justice.

Climate justice links human rights and development to achieve a human-centred approach, safeguarding the rights of the most vulnerable and sharing the burdens and benefits of climate action. Climate justice is informed by science, responds to science and acknowledges the need for equitable stewardship of the world's resources.[64]

Energy justice aims to ensure that people have access to energy to maintain a decent quality of life, while guaranteeing that energy is produced and distributed in a manner that causes no harm.[65] Environmental justice is concerned with the inclusion of citizens in the development, implementation and enforcement of laws, regulations and policies on the environment; central to this is equity. Therefore, in a just transition, justice is considered not merely as an outcome of policy but within the policy process.

Consent and reconciliation are needed to have an equitable distribution of the burdens and opportunities of responding to climate change.[68] A dialogue that is respectful, deliberate and considerate, and aimed at understanding the barriers and challenges faced by at-risk individuals and communities, is valuable to the effectiveness of climate action. The policy development process should consider underlying causes of individuals' and communities' increased risk and vulnerability to climate change.

Figure 5.4: *Elements of Just Transition*

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 restorative justice.[66] It is necessary to actively engage vulnerable and underrepresented groups in terms of gender, ethnicity and socio-economic status while developing responses to climate change.

There are two dimensions to the Just Transition in the Irish context: (1) achieving a just transition in the domestic sphere; and (2) contributing to the Just Transition internationally. Achieving a just transition is not without challenges, locally and internationally. Ireland has the potential to be a leader and show how a nation can transition from fossil fuel dependence and greenhouse gas intensive food production to an equitable low-carbon society by designing and implementing policy that leaves no one behind.

5.3.8 Climate Justice within Ireland – A Just Transition

It is known that the impacts of climate change will affect individuals and communities differently, with those facing resource constraints being the most adversely impacted. Policy should respond to these inequalities.

Fiscal instruments such as carbon taxes are routinely analysed and assessed for their impact on different sectors of society. The distributional impacts of the carbon tax are discussed in Chapter 6. The impact of other policies and measures on vulnerable people and communities is less routinely assessed. During the low-carbon transition, some activities may become uneconomic, with consequences for employees and local communities. Individuals and communities dependent on high-carbon activities or assets should be supported in finding new employment and new economic value in the low-carbon economy. Revenue from carbon pricing measures could fund such support.

The distribution of the benefits of transition also needs to be considered. Where incentives or supports are offered for changes in behaviour or investment in technologies – for example, electric vehicles, home upgrades, public transport, cycling to work – it is important to ensure that they also reach poorer and more vulnerable communities. Careful targeting of measures and, in some cases, additional supports, may be required to achieve this broad deployment so that vulnerable people and communities are part of the transition and experience associated benefits such as energy cost savings, improved air quality, warmer homes, and greater access to services.[67]

The inclusion of the recommendations of the Citizens' Assembly in the Joint Committee on Climate Action's Report is a welcome step in achieving a just transition, and progression towards collaborative policy development.

Engaging people that would not normally engage with Government will be a challenge. At present individuals participating in the National Dialogue on Climate Action are voluntarily attending and have an interest in climate change. In working to engage the wider population, it will be important to understand the barriers and challenges of individuals and communities. Applying a Just Transition framework aims to minimise any potential adverse impacts of the responses to climate change on at-risk populations by actively involving them in the development and implementation of policy.[68] An opportunity for applying these approaches exists within the Agriculture and Electricity Generation sectors (see Special Focus Chapter 8 for Agriculture and the 'Bord na Móna' box below for Electricity Generation), where there are concerns over income and job loss impacts on communities.

Climate action is about not just the current generation of workers, but also future generations. Job creation is about ensuring that those currently in carbon-intensive jobs are supported with retraining and education opportunities to gain access to employment in the low-carbon economy. This means ensuring that education institutions are offering programmes and courses that prepare the future workforce for the low-carbon economy, and that the job market is prepared for students already enrolled in programmes that are directed towards a low-carbon future. Ireland must not lose this talent to countries that are prepared to use their skills.

The ongoing development and review of the National Curriculum may also need to respond to the demands of young people. The current focus of the DCCAE on integrating the Sustainable Development Goals (SDG 13 is Climate Action) into all Government departments is an opportunity to assess the readiness of the education system to provide young people with the skills they need in a low-carbon future.

Case Box: Bord na Móna and the Just Transition

Bord na Móna has committed to end the burning of peat by 2030 and to transition to 100% renewables. Reaching this target will change the communities where Bord na Móna operates. Currently, it supports 4,000 jobs directly (2,000) and indirectly (2,000) through its operations. The history of the company is deeply linked with the communities, with many workers being third-generation turf cutters.

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

5.3.9 Ireland's Role in the Just Transition Internationally

One aspect of the Just Transition is reducing our own contribution to climate change through the reduction of our greenhouse gas emissions on both production and consumption bases. A second aspect is to help developing countries in their response to climate change. Climate finance is the main vehicle for delivery of such support. Ireland has signed up for international commitments in this regard. Under the UNFCCC, Ireland as a developed country is committed to jointly mobilising with other developed countries US$100 billion per annum by 2020 for climate action in developing countries, with the possibility to mobilise such resources from public, private and alternative sources.

International climate finance reported by Ireland increased from approximately €36 million in 2015 to €52 million in 2016.[70] In both years, the reported climate finance was entirely public grant-based. Most of Ireland's international climate finance is directed towards adaptation – 67% in 2015 and 74% in 2016. Most of the finance is directed towards support to the least developed countries. While project-level information provided by Ireland on disbursed climate finance is very good – in 2015 Adaptation Watch graded Ireland as second among developed countries in the transparency of its adaptation climate finance information[69] – the data on total climate finance disbursed by Ireland each year are not readily accessible and should be made available on a Government website.

In 2017, Finance Green Ireland (FGI) was launched by Sustainable Nation to respond to the call for mobilising finance to address climate change. It is supported by the Irish Government's IFS2020 Strategy. There is an estimated €28 billion in green finance divided across Green UCITS Funds (€4 billion), Green Infra Funds (€7 billion), Listed Green Equities (€6 billion) and Listed Green Bonds on the Irish Stock Exchange (€11 billion).[70] The programme has sought to consolidate Ireland's expertise and experience in green finance and renewable energy finance, and to progress Ireland as a leader in green finance by connecting capital with talent.

FGI's focus is both global and local, with the objective of making Ireland a leader in the transition to a low-carbon economy. This aligns with Ireland's foreign policy objectives to scale up funding and to explore innovative approaches for climate action (for example, smart agriculture). In October 2018, the National Treasury Management Agency (NTMA) issued Ireland's first Green Bond; the €3 billion investment will fund projects that address climate change mitigation and adaptation, clean water and waste treatment.

The recently released *A Better World – Ireland's Policy for International Development* by the Department of Foreign Affairs reaffirms the Irish Government's commitment to allocating 0.7% of GNI to official development assistance, with a specific focus on gender equality, reducing humanitarian need, climate action and strengthening governance.[71] There is a recognition that climate change is a threat to progress made on ending poverty, to future economic growth, to ending gender inequality and to food security.

Future-proofing all development cooperation to include climate action is a priority for the Irish Government to ensure that no one is left behind and that no one is harmed. Recognising that climate change will compound poverty and malnutrition, Ireland is 'supporting developing countries and vulnerable communities to develop their own national response to environmental degradation, natural resource management and efforts to conserve and promote biodiversity'.[68] Ireland's foreign policy aligns with the principles of a Just Transition and is consistent with Ireland's broader foreign policy objectives, which are based on the fundamental principles of justice, human rights, the rule of international law, and supporting peace and friendly cooperation between nations. This is a progressive policy that can be better supported by Ireland actively demonstrating its success on the global stage, namely leading by example with agriculture policy. This is discussed in more detail in the Special Focus Chapter.

5.4 Advice and Recommendations

The Irish economy is not on a pathway towards low-carbon transition. The Government needs to describe comprehensively the pathway Ireland will follow to achieve the national transition objective.

The Council welcomes the development of new initiatives within policy including under the National Energy and Climate Plan and the proposed Climate Action Plan 2019: To Tackle Climate Breakdown. A commitment to implementation is critical. For example, the Joint Oireachtas Committee on Climate Action recommends that certain aspects of the National Development Plan be revisited to better address the investment needs to put Ireland on a low-carbon transition. The Council recommends that policy initiatives of this type include timelines, steps and responsibilities for implementation.

Just Transition helps to ensure engagement, ownership and equity in climate action. The Council recommends using a just transition framework to add depth to policy and foster public support.

Carbon intensity in the electricity sector decreased in 2017, on foot of external, reversible drivers. Planned electrification in the heat and transport sectors requires low- to zero-carbon electricity. Opposition to the deployment of renewables and the accompanying infrastructure is a major concern in increasing Ireland's capacity for renewables. Good planning guidelines and community engagement are key in increasing the social acceptability of wind energy. Further policies and measures and the development of robust planning guidelines are required in this sector to achieve progress.

Energy efficiency in the built environment sector, crucial to decarbonisation, is not progressing fast enough. More houses need to be reached and deeper retrofits achieved. Many high-performing buildings still rely on fossil fuels for their remaining energy demand. Increased progress in both energy efficiency upgrades and switching to renewable energy sources will be important to achieve true low-carbon transition in this sector. The Council recommends additional resources as part of a programme to enable the development of sufficient skills and capacity required across the sector. Investment in local authority building and housing is an important opportunity for the Government to lead in this area.

The observed increase in agriculture emissions and ongoing carbon losses from peat extraction and land drainage undermine our ability to achieve the national transition objective towards neutrality. Implementation of further policies and measures is required to achieve progress in this area.

The National Dialogue on Climate Action is an important initiative in engaging the public on issues of climate change. The Council recommends a properly mandated and resourced National Dialogue on Climate Action, which has the potential to work in and between sectors, communities, networks and individuals to drive this agenda.

6. Achieving the National Transition Objective in a Cost-Effective Manner

Key Messages

- Climate action needs to be fully integrated across all Government plans, policies and programmes including appropriate resourcing and implementation of the National Planning Framework and the National Development Plan.
- The continuing failure to map out the cost-effective pathways to decarbonising the Irish economy is a major obstacle to progressing policy on climate change.
- A number of cost-effective measures for the Agriculture and Land Use sector have been identified including those described in the Teagasc Marginal Abatement Cost Curve. Implementation of measures is crucial.
- The carbon tax is a key policy tool for transition and requires successive increases. Consideration is needed of how best to recycle the revenues arising from the tax to ensure a fair distribution of the burden.
- Putting transport onto a sustainable transition pathway will require fundamental policy change across public, private and freight transport. As electric vehicle range, price and model availability continue to improve, a lack of access to reliable and efficient electric vehicle charging infrastructure will become a barrier to their uptake.
- Electricity generation from renewables increased in 2018; however, use of coal and peat for generation continues. Additional renewable capacity and technologies are required to reach targets.
- Regulatory action and implementing a carbon price floor are approaches to deliver on national commitments to enable effective transition from coal- and peat-fired generation to low-carbon options.
- Focusing scarce resources on upgrading the publicly owned housing stock would fulfil a number of social and environmental objectives. Consideration of the capacity required of the building sector and the timing and financing of the retrofit programme is necessary

The Council is mandated under the Climate Action and Low Carbon Development Act 2015[2] to provide advice on cost-effective approaches to achieve the transition objective. This chapter addresses that mandate, exploring how Government and other actors bring about the required change and the cost-effectiveness of this approach.

It is important not to lose sight of the overall motivation for climate action and the potential benefits of mitigation actions.† The overall projected costs of mitigation do not approach the potential costs of uncontrolled climate change. The Fifth Assessment Report (2015) of the Intergovernmental Panel on Climate Change (IPCC) found that:

† Adaptation and the transition to climate resilience are addressed in Chapter 7

> Without additional mitigation efforts beyond those in place today, and even with adaptation, warming by the end of the 21st century will lead to high to very high risk of severe, widespread and irreversible impacts globally (high confidence). Mitigation involves some level of co-benefits and of risks due to adverse side effects, but these risks do not involve the same possibility of severe, widespread and irreversible impacts as risks from climate change, increasing the benefits from near-term mitigation efforts.[72]

The International Renewable Energy Agency (IRENA) found that the cost savings of the long-term transition away from fossil fuels towards energy efficiency and renewable energy would far outweigh the costs of transition due to benefits associated with reduced air pollution, better health and lower environmental damage.[73]

In assessing the most cost-effective manner to achieve reductions in greenhouse gas emissions, the Council's 2017 Annual Review found that action to reduce greenhouse gas emissions would have significant co-benefits such as improved air quality, reduced congestion and reduced nitrate pollution to be important factors. Economic opportunities from efficiency gains and the green economy should also be considered.

6.1 Assessing a Cost-Effective Approach

The Council intends to monitor and review implementation and performance of the National Mitigation Plan each year, as it is the primary statutory instrument supporting national transition. The first National Mitigation Plan under the Climate Action and Low Carbon Development Act 2015[1] was published on 17 July 2017. The National Mitigation Plan contains 106 actions; however, the Council was concerned at the lack of detail or commitment on new policies and measures. The Council recommends that actions should be linked to expected outcomes or impacts to allow effective monitoring of implementation and progress.

In the 2018 Annual Review the Council established seven factors that can assist in achieving a cost-effective approach and how these might be employed sectorally and cross-sectorally:

- effective implementation
- monitoring the impact and effectiveness of measures
- development and use of an up-to-date marginal abatement cost curve as one part of the evidence base
- pursuit of co-benefits to increase effectiveness
- integration of behavioural and societal responses in the design of policies and measures
- avoidance of contradictory or conflicting policy
- enabling and encouraging innovative responses.

The Council gives due consideration to mobilising alternative resources, and reducing costs to Government where appropriate, in the development of advice and recommendations on policies and measures.

The Council has developed advice and recommendations to address gaps in policies and measures to achieve transition and to improve the cost-effectiveness of transition. This is not a comprehensive analysis of all policies relevant to greenhouse gas emissions and drivers, but aims to consider significant developments in the past year and the most important policies and measures already in place. The Intergovernmental Panel on Climate Change has recently provided a robust set of policy criteria.[74] Based on economic, distributional and environmental objectives, and taking account of institutional and political feasibility, it provides a framework to achieve a cost-effective transition while balancing policy objectives. Strategically this could lead to minimisation of the losses that arise through trade-offs and a maximisation of the 'win–win' synergies available across multiple goals, facilitating a more cost-effective transition and optimal outcomes.

6.2 Availability of Evidence

The Council has previously highlighted the need to develop cost-effective scenarios that meet targets and facilitate a low-carbon and climate-resilient transition to 2050. This remains a pressing priority to help guide and assess progress towards 2020 and 2030 targets, and the long-term National Policy Position. Sectoral pathways could also assist in this process, including considering the alternative pathways available for priority emissions sectors such as Agriculture, Transport and Power Generation. A strategic focus on delivering 'win–wins', minimising trade-offs and overcoming lock-in, could have policy benefits. The implications for national transition of the 1.5°C report from the Intergovernmental Panel on Climate Change (2018) could also be an important frame to consider.

As national mitigation and transition policy continues to evolve, the need to address gaps in knowledge and provide enhanced evidence to support policymaking will grow. In addition to technical and economic studies, tools used to support cost-effective transition frequently involve improving knowledge of drivers and policy levers, and considering the visions and development pathways that support low-carbon transition as a strategic objective.

The Council has previously noted the gaps in provision of data and estimates of the cost and effectiveness of measures in the National Mitigation Plan and in the Annual Transition Statement. The Council welcomes the progress in the improved estimates of emissions reductions and Exchequer costs in the supporting update to the 2018 transition statement, and also the publishing of the analysis of the initial National Energy and Climate Plan. Teagasc published a second iteration of the Teagasc Marginal Greenhouse Gas Abatement Cost Curve for Irish Agriculture in 2018[75] and the new Climate Action Plan 2019 included an updated National Marginal Abatement Cost Curve on the SEAI study from 2009.[76] It is important to note that while these 'MAC' curves may be useful, they also have limitations as analytical and decision-support tools,[†] and need to be accompanied by other types of analysis and knowledge to support policymaking.

Research could also contribute to understanding the breadth of policies and measures available, including the contribution of approaches such as behaviour, investment and aspects of successful governance and policy implementation.

On adaptation, the development of sectoral and local authority adaptation plans and strategies is progressing. Understanding how adaptation to climate change is being measured and evaluated

† Including the range of measures that can be included, uncertainty over time, crucial social and political aspects and the need to consider more than just the 'cheapest measures' in policy implementation.

will be useful, as there will be learnings across sectors and local authorities. This is discussed in Chapter 7. For example, geographic information systems (GIS) maps are critical in informing flood adaptation actions for local authorities and the Office of Public Works, in response to flood risk from extreme weather events and sea-level rise.

6.3 National Plans and Processes

6.3.1 National Planning Framework and National Development Plan

The ambition in the National Development Plan 2018–2027 must be turned into delivery, with monitoring of results. Sufficient funding and institutional capacity will be required to deliver on all the commitments made.

Last year's Annual Review recommended that the analysis supporting the National Development Plan be published to enhance transparency and inform the prioritisation of measures. The Council notes that this has not happened.

The Annual Transition Statement 2018 states that the Department of Communications, Climate Action and Environment is to progress the following National Development Plan priorities ahead of the next Annual Transition Statement:

- energy efficiency upgrades of 45,000 homes per annum from 2021 and providing support for a major roll-out of heat pump technologies;
- delivering energy upgrades to BER 'B' level in all public buildings and a minimum of one-third of commercial buildings;
- implementing the new renewable electricity support scheme to deliver an additional 3,000–4,500 MW of renewable energy, with the initial focus on shovel-ready projects that could contribute to meeting our 2020 targets;
- the roll-out of the Support Scheme for Renewable Heat (SSRH) and national smart metering programme;
- transitioning the Moneypoint plant away from coal by the middle of the next decade;
- having at least 500,000 electric vehicles on the road by 2030, with additional charging infrastructure to cater for planned growth;
- no new non-zero emission cars will be sold in Ireland post-2030 and no NCT will be issued for non-zero emission cars post-2045; and
- a Climate Action Fund of at least €500m will leverage investment by public and private bodies in climate action measures that contribute to achievement of Ireland's climate and energy targets.

The Department of Communications, Climate Action and Environment has responsibility for implementing a Climate Action Fund under the National Development Plan. The Council welcomes the announcement of successful projects under the first round of funding. The implementation of projects under the fund should closely link to national, local and regional policy and structures. Future funding calls should more explicitly consider adaptation projects or those that harness co-benefits.

The Department of Housing, Planning and Local Government has responsibility for implementing an Urban Regeneration and Development Fund under the National Development Plan, which is primarily to support the compact growth and sustainable development of Ireland's five cities and other large urban centres. In line with the objectives of the National Planning Framework and alongside a new Land Development Agency, the Fund is designed to leverage a greater proportion of residential and commercial development, supported by infrastructure, services and amenities, within the existing built 'footprint' of our larger settlements. The implementation and lessons of the first 88 projects supported under the fund should be closely reviewed to further ensure that Ireland follows more sustainable development patterns into the future.

The National Development Plan, as a plan for investment, focuses on achieving change through direct investment in action or investing in change through subsidies and incentives. The Council restates that it is important not to lose sight of the potential role that disincentives such as legislation, costs (such as carbon pricing) or penalties can play in achieving emissions reductions, often at a low cost.

6.3.2 Finance and Investment

Finance and investment are key determinants of 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. The Global Commission on the Economics of Climate Change has stated that the coming years are a unique 'use it or lose it' moment in economic history.[78] The Commission establishes priority actions as: carbon pricing; disclosure of climate-related financial risks; accelerating investment in sustainable infrastructure; harnessing the power of the private sector; and ensuring a people-centred approach for a just transition.

A successful transition will require a redirection of investment towards 'green growth'. This offers many employment opportunities and economic benefits, but the Commission has noted that early action is essential. Each additional euro invested in the emissions-intensive economy is not only a lost opportunity for clean growth, but further locks in a high emissions path in the long term. If finance and investment are to be steered towards supporting transition, this will involve a key role for public funds as enabler and as leader, but also necessitates that the redirection of private investment is central. The Council is also interested in the transaction costs that apply to all policies and measures.

The Network for Greening the Financial System of Central Banks has noted that climate change, through both physical impacts and transition policy, is a core source of economic and financial risk.[79] It has made key recommendations for central banks, supervisors, policymakers and financial institutions to enhance their role in the greening of the financial system and the managing of environment and climate-related risks including integrating sustainability factors into own-portfolio management and the development of a taxonomy of economic activities to understand their risk and contribution to transition to a green and low-carbon economy.

The Joint Committee on Climate Action has noted that a Just Transition model means new jobs, new industries, new skills, new investment opportunities and a chance to create a more equal and resilient economy for Ireland. The role of international climate finance in the Just Transition is discussed in section 5.4.2. The Council notes that many potential 'win–wins' are available, but harnessing these benefits requires an integrated strategic approach that includes finance and investment, and a long-term focus in both policy and analysis.

6.3.3 Government Budget

The annual budgetary process is a key opportunity to support climate action and to consider the impacts of Government fiscal policy on greenhouse gas emissions, climate resilience and the low-carbon transition. The Council was disappointed about the lost opportunity in Budget 2019 to enhance the carbon tax, despite considerable evidence in its favour. This is discussed in Section 6.4. The Council once more notes the lack of analysis of the climate and greenhouse gas emission impacts of budgetary decisions.

The Council notes that the Budget potentially allows for changes to taxes, to harmful and distorting subsidies and to public expenditure. Aligning the Budget with strategic vision for transition would enable 'green growth', and the many economic and employment opportunities this entails.

The Council welcomes the Department of Public Expenditure and Reform's introduction of 'Green Budgeting' in Budget 2019. This could offer a framework to align budgetary policy and supporting analysis with transition. The process has begun with estimates of 'climate-related Exchequer expenditure' as part of the Revised Estimates for Public Service 2019. The Council notes that the Department has adopted a wide definition: *'Any expenditure which promotes, in whole or in part and whether directly or indirectly, Ireland's transition to a low carbon, climate-resilient and environmentally sustainable economy'*.[80]

This broad definition provides a large estimation of €1.61 billion in projected climate-related Exchequer expenditure for 2019. It leads to the inclusion of the funding for tasks such as the operation of the National Parks and Wildlife Service and the Environmental Protection Agency, the Water Quality and Rural Water programmes and all social housing regeneration. This definition appears excessively broad for 'climate-related expenditure' and requires refinement. Refinements have been attempted in the European Commission regulation[†] 'climate markers'. Based on international standard 'Rio markers', these describe categories of expenditure accounted for at different rates: direct 100% (e.g. energy), indirect 40% (e.g. biodiversity) and non-climate measures 0% (e.g. roads). While also broad, these are more targeted than the approach in Budget 2019.

The Council has previously recommended that measures with significant environmental impacts be included in a cross-sectoral assessment of the climate and environmental impact of the Budget. The cost-effectiveness of such interventions should also be assessed in terms of the likely cost per tonne of carbon dioxide avoided. Some notable measures that require consideration are the Climate Action Fund, the Disruptive Technologies Fund, the Beef Environmental Efficiency Pilot Scheme (BEEPS) and the higher forestry grants and premiums.

The Department of Public Expenditure and Reform has noted that the Green Budgeting process is at an early stage of development internationally. The Parliamentary Budget Office[81] has already recommended four possible approaches for the development of the process in Ireland (Box 6.1). The Council is also concerned about fiscal exposure to the need for purchasing for compliance with EU climate change and energy targets.

† The common methodology for tracking of climate expenditure is adopted by the Commission Implementing Regulation (EU) No 215/2014 of 7 March 2014 and amended by the Commission Implementing Regulation (EU) No 1232/2014 of 18 November 2014

Box 6.1: *Possible approaches to Green Budgeting as described by the Parliamentary Budget Office (2018*

A. Having a section in the Annual Budget Statement. This maintains and potentially expands the current state of play, which entails a short summary in the Annual Budget Statement (or Budget speech) of the Minister for Finance and Public Expenditure and Reform of what is done in the Budget in relation to climate change.

B. Publishing a Supplementary Report alongside the Budget. This would go beyond having a section in the financial statement where only some selected new Budget measures are mentioned. This document would deal with: the identification of the main Budget allocations and tax measures that can have a significant impact on climate change; the quantification of the implications for greenhouse gas emissions of the above identified climate-relevant measures; and an analysis of how such measures will contribute to the achievement of the EU and national targets.

C. Strengthening the Performance-Based Budgeting Framework. The third option would entail reinforcing the current performance-oriented budgeting framework. This could be done by improving linkages between performance indicators and funding; by providing a short analysis of the most important drivers of the changes in these indicators; and by setting targets and impact indicators over the medium term and not only for the current year.

D. Making use of Public Expenditure Reviews. Public expenditure reviews are instruments used to assess Government expenditure on the basis of the principles of efficiency, effectiveness and impact. They can play a key role in mainstreaming climate change considerations into the budgetary process. For the Spending Review 2017, two out of 18 papers covered environmental and climate change issues. However, up to now, there are no papers dealing with climate change as a part of the Spending Review 2018 (26 papers were published in July). There is potential to build on this work and regularly produce spending review papers addressing climate-related topics.

This year the Annual Review presents a 'Traffic Light Assessment' of progress in terms of the emissions and climate implications of budgetary measures in summary Table 6.1. The full table is presented in Appendix 3. This is a useful approach to summarise changes in trends or themes in sustainability assessment. It is used here to provide a high-level summary assessment of the measures contained in Budget 2019. The assessment is specifically concerned with provisions in Budget 2019 with direct implications for GHG emissions and other relevant functions.

It is important to note that this does not attempt to consider what may be absent from the Budget, or the indirect emissions implications of expenditure in the wider areas of development. The assessment identifies the *Budget provision*, the *topic description* that the provision seeks to address and the *outcome in Budget 2019*. Finally, an *assessment* posits the emissions implications of each provision and a traffic light on progress.

Table 6.1: *Summary of Traffic Light Assessment of emissions and climate implications of Budget 2019 measures*

Sector/Budget provision	Topic description	Budget outcome	Assessment	Progress
Cross-sectoral: Change to price of carbon in carbon tax	Effectiveness of carbon tax may be improved by progressive increases in the cost per tonne. CCAC previously recommended increase to at least €30 per tonne CO2 in 2019, and €80 by 2030.	Early indications of increase did not lead to budget change.	Opportunity missed to further develop carbon tax regime and potentially temper growth in energy-related greenhouse gas emissions.	
Agriculture: Beef Environmental Efficiency Pilot Scheme (BEEPS)	Income boosting measure which also attempts to make beef herd more efficient by improving efficiency through management practices. Assumption is that this leads to reduced emissions growth.	The BEEPS maximum of 500,000 suckler cows – at a €40/head payment.	May lead to small efficiency improvement but does not address scale growth issue and could exacerbate it. Overall, growth in emissions trends unlikely to be substantially affected by efficiency-induced reduction.	
Forestry: grants and premiums for afforestation	Need to increase uptake to facilitate accelerated afforestation.	Grants and premiums increased towards meeting forestry programme target of 8,000 ha of new plantings and construction of 125 km of new forest roads.	Positive to see incentives increased. However, appears to function as industry output growth measure. It is not clear if optimised for sequestration and/ or biodiversity benefits or for flood management.	
Transport: capital and current expenditure	To 'develop and manage transport infrastructure by providing for the maintenance and upgrade of our road network and the delivery of public transport services' through the NDP.	Department overall allocation €2.34 billion in 2019. Additional funding for MetroLink, BusConnects, Greenways, Luas and DART expansion schemes. Also 'significant additional investment in local and regional roads projects'.	Roads and motorised transport remain central in NDP, can deepen lock-in to carbon-intensive development. Public transport investment can lead to modal shift. Priority transition measures of demand reduction and active transport not substantially addressed. Budget likely to lead to increased transport emissions.	
Policymaking: Green Budgeting	Need to align Government fiscal approach with climate and environmental goals. Ireland committed to joining other OECD countries in the Paris Collaborative on Green Budgeting to develop ways to embed climate change in the budgetary process.	First attempt in this year's Revised Estimates Volume (REV) lists Exchequer climate-related expenditure.	Positive development signalling institutional change. Approach requires development from this initial step and there is a need to estimate impact on emissions and cost-effectiveness, *ex post* and *ex ante*.	

6.3.4 The National Mitigation Plan

The first National Mitigation Plan under the Climate Action and Low Carbon Development Act 2015[1] was published on 17 July 2017 as a 'living document'. The Council intends to monitor and review the implementation of the National Mitigation Plan each year, as it is the primary statutory instrument supporting national transition.

The National Mitigation Plan contains 106 actions, 29 of which were due for delivery in 2017. Some of these actions have been delivered, for example the roll-out of the EXEED programme for grants to business for energy upgrades.[82] Some actions do not appear to have been delivered yet, for example the National Mitigation Plan included an action to finalise the Bioenergy Plan in 2017 but information is only available on the draft plan and consultation. For many actions, it is not clear what progress has been made. To support robust implementation of the National Mitigation Plan, it is crucial that information is made available in a transparent manner on the progress in implementation to date of actions and commitments. The actions should be linked to expected outcomes or impacts to allow effective planning for further efforts required to close the emissions gap.

Since its publication, developments such as the Renewable Heat Incentive, the National Planning Framework and the National Development Plan have added to the array of measures in place to address climate change. As a living document, the National Mitigation Plan should be regularly and transparently updated to reflect newly committed policies and measures and to re-estimate the distance to target for 2020, 2030 and beyond.

6.4 Cross-sectoral Measures

In the interests of achieving a 'cost-effective approach' to reducing greenhouse gas emissions, The Council has consistently recommended the introduction of appropriate 'carbon pricing' instruments. Carbon pricing includes carbon taxes, emissions trading schemes and the shadow pricing of investments.† The importance of continuing to support research that expands and refines the evidence base is also recognised. A Climate Action Fund with an initial allocation of €100 million was announced in the National Development Plan to leverage investment by public and private bodies in climate action measures. Efforts to leverage private funding would be a very welcome complement to public funding sources.

6.4.1 Carbon Tax

A carbon tax is a levy on the carbon content of the fossil fuels: peat, coal, oil and gas. The levy seeks to include, or 'internalise', the costs of the damage caused to society by each tonne of carbon dioxide emitted from the use of fossil fuels. These costs are known in economics as an 'environmental externality', as the damage costs of climate change are imposed on others, and is considered a 'market failure' when not included in the price of fossil fuels.

Carbon taxes encourage investment by companies and individuals in developing and implementing technologies and equipment which will reduce or eliminate greenhouse gas emissions. They encourage us all to reduce our emissions by increasing efficiency and changing our behaviour. Finally, they produce significant revenue for governments that can compensate for any undesirable distributional effects arising from the taxes.

† Such as applying a cost to greenhouse gas emissions in the cost–benefit analysis of public or private spending. This is alluded to in Section 5.3.3, 'Updating the Public Spending Code'.

A carbon tax aims to make individuals and firms pay the full social cost of carbon pollution. In the presence of rational consumers, firms, and complete markets, carbon taxes can achieve emissions reduction in a cost-effective manner. Economic instruments like carbon taxes offer simplicity and broad scope, evoking the cost-minimising combination of changes to inputs in production and technologies, including moves away from fossil fuels, to changing behaviour as manifested in consumption choices and lifestyles.[83]

Carbon Taxes in Review

The Global Commission on the Economics of Climate Change has highlighted how carbon taxes and emissions trading, the key carbon pricing approaches from environmental economics, are now in place or planned in 70 jurisdictions. However, these countries only account for one-fifth of global emissions, with half of all carbon prices less than US$10 per tonne carbon dioxide equivalent. A variety of global bodies have noted this 'implementation gap' between aspirational carbon prices and those that can practically be enforced.[84] This led the Intergovernmental Panel on Climate Change to note that carbon pricing alone may not be sufficient, particularly in the absence of transfers to compensate unintended distributional effects.

A key aspect of policy design is how the revenue generated by the tax is used. This could align with the principles of a just transition by ensuring that the costs and benefits are shared equitably. Acknowledging that political feasibility and social acceptability of carbon taxes may be relevant, strategic examination of how revenue can be used may assist policymakers. A prominent international paper from 2018,[85] 'Making carbon pricing work for citizens', outlined individual and mixed options for revenue recycling and allocation across firms, households and the Government budget. These were ranked based on criteria of efficiency, equity and acceptability, and usefully placed in a decision-tree for policymakers. The authors' conclusions highlighted that the 'ideal' recycling of carbon pricing revenue strongly depends on the national political context. They identified a variety of recycling mechanisms – reductions in employment taxation, capital or corporate taxation, directed transfers, uniform transfers and green spending – and emphasised that combination packages of these approaches may also be useful.[†]

Another key aspect is the relationship of a carbon tax with the overall policy mix for transition, as this relates to key elements of policy design including the rate at which the tax is set. While carbon taxes offer simplicity and scope and they are potentially more efficient than regulation, in practice they are not adopted as much as would be expected, and rarely at the higher levels considered 'target-consistent'.[84] The Intergovernmental Panel on Climate Change noted challenges that hamper implementing and increasing carbon taxes globally: lobbying from vested interests; high public visibility; risks to competitiveness and employment; and the distribution of costs and institutional path dependencies. Implementing regulations and other instruments as a policy mix – for example, regulation, subsidies and standards – may allow achievement of targets, despite difficulties in increasing carbon taxes, enhancing the political feasibility and social acceptability of transition in general.

Examining the actual outcomes of carbon pricing has shown that experiences have varied in different sectors. The Intergovernmental Panel on Climate Change stated that for the built

† The authors propose that where distributional concerns are an obstacle to higher carbon prices, transfers directed to those in poverty are useful. When efficiency and competitiveness concerns are the greatest obstacle (and trust in the Government is high), reimbursing firms through transfers or tax cuts can be useful. Earmarking the revenue for green spending is suggested as an option of choice if the main obstacle is that citizens are unconvinced of the environmental benefits of higher carbon prices. Uniform lump-sum recycling may facilitate broad public support through being perceived as progressive.

environment, experience has shown that pricing is less effective than energy efficiency programmes and regulation.[86] In contrast, for the transport sector, taxes and pricing can assist in avoiding a rebound in emissions that can result where vehicles become more efficient.[37] Additional policies can be complementary to carbon pricing. An emerging body of studies have been highlighted by the last two Intergovernmental Panel on Climate Change reports[87] that examine the application of both carbon pricing and other policies and measures at the same time. These studies have shown that a robust policy mix can drive transition when applied with a moderate carbon price, compared to higher prices proposed in previous carbon tax studies.[†88] The range of conclusions from the global literature, on the theory and practical experience with carbon taxes, suggest the merits of considering together: the balance with other policies for reducing emissions; the rate of the carbon tax; and policy design including the use of revenue.

The Carbon Tax in Ireland

In recent decades, a rich literature on carbon taxes in Ireland has been developed, including numerous contributions from the Economic and Social Research Institute. The Institute released a study alongside Budget 2019[89] estimating that a doubling of the carbon tax from €20 to €40 would lead to a 5% drop in emissions. Noting that these results were static and short-term, this reduction in emissions could deepen in real-world application. The price of carbon commodities increased by on average 3.4%, with natural gas supply and the transport sectors being the most affected. However, these price changes were placed in context by emphasising that this was less than the fuel price volatility experienced in 2018. The authors noted that distributional considerations are important. The impacts on incomes and on heating consumption were regressive, pointing to the need to protect people from energy poverty.

A carbon tax was first introduced in Ireland in 2010 and currently stands at €20 per tonne. The Council's Annual Review of 2018[90] found that both the rate of the carbon tax in Ireland and the market price of carbon in the EU Emissions Trading System are insufficient to incentivise the changes required for the low-carbon transition. In the 2018 Review, the Council recommended a carbon tax of €30 per tonne of carbon dioxide in 2019 rising to at least €80 per tonne by 2030, in line with the range proposed by World Bank Commission on Carbon Prices.[91] Given that no increase was implemented in Budget 2019, in order to make up for this lost time, for Budget 2020 the Council now recommends an increase in the carbon tax of €35 per tonne of carbon dioxide in 2020, rising to at least €80 per tonne in 2030. The Council also recommended that any increase in carbon taxation be accompanied by measures to address distributional considerations including energy poverty and potential negative impacts on households.

A recent paper from the ESRI[92] has found that while the carbon tax could reduce household emissions in Ireland, by 4% at €30 per tonne and by 10% at €80, it is also regressive. However, the paper also found that recycling revenue can lead to a net progressive effect. A 'carbon cheque' that distributes the revenues equally to every household leads to a small reduction in income inequality, while a targeted mechanism that directs more of the revenues towards less affluent households is more progressive, and can reduce income inequality. A targeted recycling of the revenues through the tax and welfare system can also have lower administrative costs than a 'carbon cheque'. Other potential approaches to revenue recycling include 'green

† Kriegler et al. is one of the global studies that applied 'moderate carbon pricing' (between 5–20 USD2010 tCO_2^{-1} in 2025 in most world regions and average prices around 25 USD2010 tCO_2^{-1} in 2030)[88]. It also assumed global implementation of a mix of regionally existing best-practice policies (mostly regulatory policies in the electricity, industry, buildings, transport and agricultural sectors) with this moderate carbon pricing. It found that early action mitigation pathways are generated that reduce global CO_2 emissions by an additional 10 $GtCO_2e$ in 2030 compared to the NDCs.

spending' on emissions reduction, and international climate finance that supports climate justice initiatives, as committed to under the Paris Agreement (see section 5.3.9). The Council welcomes the recommendation of the Joint Oireachtas Committee on Climate Action's 'Climate Change: A Cross-Party Consensus for Action' on an increasing trajectory for the carbon tax and recognition of distributional considerations. Following on from the recommendations of the Citizens' Assembly, the Joint Committee included as one of its priority recommendations a carbon price trajectory increasing to €80 per tonne by 2030. The Joint Committee also included recommendations on implementation of specific measures to protect those on low incomes, ring-fencing of revenue generated and implementation as part of a comprehensive package.

6.4.2 Carbon Price Floor

The Irish Government joined the 'Powering Past Coal Alliance' in 2018, committing to closing Moneypoint coal-fired power generation by 2025. The analysis from the Council's Annual Review 2018 suggested that the best way to achieve this would be to introduce a 'Carbon Price Floor' in Ireland.

The Council welcomes the Report of the Joint Committee on Climate Action – 'Climate Change: A Cross-Party Consensus for Action' – which included a priority recommendation for Government to promote the introduction of a carbon price floor in a coordinated approach with EU colleagues.

Bord na Móna has indicated that it plans to cease peat-fired generation of electricity. The Council believes that peat-fired generation should be closed next year, with provision made to avoid an adverse impact on the workers or communities involved. This would simultaneously reduce emissions of greenhouse gases by 2.5 million tonnes, reduce the cost of electricity and help build more sustainable employment and communities.

Weakness in the price signal provided by the EU Emissions Trading System prompted the European Commission to implement enhanced measures.† The Council has commissioned analysis of measures that could supplement the carbon price specifically in the electricity sector to achieve significant decarbonisation. It held a related seminar for European experts and policymakers in Dublin in November 2018. The analysis considered the implications of applying a carbon price floor to electricity generation across the full EU,[93] and specifically to Ireland in a second paper.[94]

The analysis showed that a substantial reduction in emissions of participating countries, including Ireland, could be achieved by the implementation of a carbon price floor strategy. An alternative strategy that would achieve a similar reduction in emissions would be the closure of Moneypoint by regulatory action.

The research showed that if a Carbon Price Floor was implemented by a coalition of Member States in North-Western Europe, this would minimise any negative competitiveness effects from the policy action. Some aspects were identified that require further refinement of technical knowledge, such as cancellation of unused emissions permits.

† The legislative framework of the EU ETS for its next trading period (Phase 4) was revised in early 2018 to enable it to achieve the EU's 2030 emission reduction targets in line with the 2030 climate and energy policy framework and as part of the EU's contribution to the 2015 Paris Agreement. The revision includes strengthening the EU ETS as an investment driver by increasing the pace of annual reductions in allowances to 2.2% as of 2021 and reinforcing the Market Stability Reserve, the mechanism established by the EU in 2015 to reduce the surplus of emission allowances in the carbon market and to improve the EU ETS resilience to future shocks.

The Council recommends the closure of Moneypoint by 2025, and peat-fired generation in 2020, supported through introduction of a carbon price floor in the electricity sector with as many European countries as possible. The Council further recommends the cancellation of the unused allowances to prevent a 'waterbed effect' driving increases in emissions elsewhere. While noting the impact of changes made by the European Commission to apply to Phase 4 of the scheme from 2021 to 2030, including the Market Stability Reserve, the Council considers that a price floor would act as a safeguard against the failure of these reforms as a 'no regrets' measure. Given the timeline, the planning of provisions to support the closure of Moneypoint is now required as a matter of priority.

6.4.3 Research

The EPA has a statutory role in coordinating environmental research in Ireland. The Climate Research Coordination Group (CRCG) is identified in the Government's National Mitigation Plan (NMP) as the body representing the key actors in Ireland's climate change-related research activity. The EPA is responsible for Action 11 of the NMP. The Action requires that the CRCG reports annually on its activities and provides an assessment and synthesis of key findings from the research programme and wider research activities every five years. The CRCG includes members across Government departments, local authorities and state agencies.

The main function of the CRCG is to coordinate climate change-related research in Ireland, to support and promote coordination between relevant funding organisations and to provide a platform to exchange knowledge and disseminate research findings. Its cross-sectoral approach enhances its ability to achieve its statutory obligations and ensure that research in the field is strategically planned.

The first report of this group was issued in May 2019. It provides an overview of climate change research funded by CRCG members over the period of June 2017 to December 2018, the activities of the group and the wider landscape for funding research in this area.

The research during this period focused on four themes, which are informed by the structure used by the IPCC but are not directly aligned with its operational structure:

(i) Carbon stocks, GHG emissions, sinks and management options;

(ii) Ireland's future climate, its impacts and adaptation options;

(iii) Socio-economic and technological solutions and transition management opportunities;

(iv) Air science (air pollution and short-lived climate forcers).

During the reporting period of June 2017 to December 2018, five CRCG meetings and one event were held; 220 research projects were identified as ongoing with 104 awarded during the reporting period with budget reaching €25 million. €2.97 million was awarded to researchers in Ireland under EU Horizon 2020, with 14 successful projects. Co-funding of 19 new research projects also took place, demonstrating good collaboration with members of the group.

6.5 Sectoral Measures

6.5.1 Electricity Generation

In 2018 there were several developments in relation to policy surrounding this sector. These are documented below.

The National Development Plan recognises the role of investment in renewable energy, ongoing capacity renewal and new technology in decarbonising electricity generation. It signals that investment in renewables must be accompanied by (1) energy efficiency measures that reduce demand, (2) diversification of energy sources, (3) greater interconnection to international energy networks, (4) electricity storage, and (5) the roll-out and utilisation of smart meters. Complementing the investment in renewables in this manner will increase capacity to electrify heat and transport in the future.

The National Planning Framework also supports the shift towards renewable electricity generation, highlighting the importance of the forthcoming Renewable Electricity Policy and Development Framework, the development of Wind Energy Guidelines and the Renewable Energy Development Plan.

The Budget for 2019 has allocated €164.4 million for the energy programme, which is focused on policy that will ensure Ireland's energy system is secure, competitive and sustainable. The budget will be used for energy efficiency upgrades, deep retrofits, and the development of innovative technologies to support the transition to a low-carbon economy and society.

To date, there has been no assessment of the level of emissions reductions that might be expected from these developments, or analysis to establish the cost per tonne of CO_2 saving so that prioritisation of options can occur. The Annual Transition Statement 2018 did not identify any new policies or measures in relation to this sector. While there are welcome developments in this area, some will need further work to move from aspiration to implementation, namely the assessment of the cost per tonne of CO_2 abated to inform prioritisation of actions.

Peat and Coal Phase-out

In March 2018, Minister Naughten TD announced that Ireland had joined the Powering Past Coal Alliance, a global initiative that brings together a wide range of Governments, businesses and organisations taking action to accelerate clean growth and climate protection through the rapid phase-out of traditional coal power.[95,96] This announcement is supported by the National Development Plan 2018–2027, which makes a commitment to end the burning of coal in Moneypoint, Ireland's 915 MW coal-fired energy plant, by 2025 and identify options for low-carbon generation to replace the generation capacity. The ESB has indicated that the conversion is likely to require a significant investment of around €1 billion; it is unclear which technology will be implemented to replace the generation capacity. The Council recommends an immediate decision on the closure and replacement of alternative low-carbon capacity to ensure an orderly shutdown of Moneypoint by 2025.

Table 6.2: *Ireland's energy fuel mix*

	2014		2015		2016		2017		2018	
Fuel mix	**GWh**	**%**	**GWh**	**%**	**GWh**	**%**	**GWh**	**%**	**GWh**	**%**
Coal	3,956.7	14.2	4,874.4	16.9	4,695.7	15.9	3,644.6	12.1	2,108.1	7.3
Oil	258.4	0.9	406.8	1.4	292.8	1.0	161.0	0.5	53.8	0.2
Peat	2,496.1	8.9	2,518.2	8.8	2,317.9	7.9	2,164.4	7.2	2,247.7	7.7
Gas	12,634.5	45.2	12,366.6	43.0	15,328.4	52.0	15,679.5	52.2	14,869.3	51.2
Wind	5,140.1	18.4	6,573.0	22.8	6,148.5	20.8	7,444.5	24.8	8,389.9	28.9
Hydro	708.7	2.5	806.5	2.8	681.0	2.3	691.6	2.3	687.0	2.4
Other renewables	542.7	1.9	477.8	1.7	680.4	2.3	742.7	2.5	181.5	0.6
Other non-renewables	69.6	0.2	74.1	0.3	72.8	0.2	159.3	0.5	524.8	1.8
Net imports	2149.1	7.7	673.4	2.3	–711.7	–2.4	–678.5	–2.3	–27.7	–0.1
Total demand	27,955.7	100.0	28,770.8	100.0	29,505.8	100.0	30,009.0	100.0	29,034.5	100.0
Renewables	6,391.4	22.9	7,857.3	27.3	7,509.9	25.5	8,878.8	29.6	9,258.5	31.9

Bord na Móna has committed to end burning peat for electricity generation by 2030 and to have a 1 GW portfolio of renewable energy generation comprising wind, solar and biomass. Projects include a joint venture with Electricity Exchange DAC to increase the provision of Virtual Power Plant services, which enable better demand-side management; and the financial close of a joint venture with ESB, the Oweninny wind farm, a 93 MW project that will be completed by October 2019.

Further, the ESB has made a commitment to reduce the carbon intensity of its emissions to below 200 grams of carbon dioxide per kilowatt hour (g CO_2/kWh) by 2030, meaning that there will be no peat or coal in its generation portfolio. To achieve this, it is anticipated, subject to planning permission, that the Lough Ree plant will commence 30% biomass co-firing with peat for power generation in December 2019 and the West Offaly plant in January 2020. The plants will cease burning of peat entirely by 2027. However, a concern is that electricity generation from peat increased from 2017 to 2018. Greater clarity is needed from the ESB with regard to its plans for decarbonisation and replacement of capacity.[97]

Infrastructure

Specific proposals related to infrastructure include investment by the commercial state sector to ensure that in the long-term Ireland's electricity network infrastructure will be sustainable, secure, competitive and compatible with the projected levels of renewable energy through the ongoing reinforcement of the power grid. Enhanced electricity interconnection including the proposed Celtic Interconnector (increased capacity of 700 MW) to France and further interconnection to the UK will enhance energy security and diversify energy sources available to the network. The Celtic Interconnector is designated a European Project of Common Interest, as it will contribute to the European energy market and subsequently Europe's energy and climate targets. It is estimated that the proposed sub-sea electricity cable will cost €1 billion. Interconnection is essential to achieving Ireland's renewable energy targets.

In February 2019, the Supreme Court ruled in favour of upholding planning permission for the southern section of the North–South interconnector that will increase Ireland's energy security of supply. EirGrid and SONI are awaiting a decision on the northern section of the interconnector.

This interconnector is vital as it will simultaneously enhance security of supply and reduce greenhouse gas emissions

Developments are also proposed in relation to the gas infrastructure, specifically to support regional and rural development and the low-carbon transition. The Climate Action Fund awarded Gas Networks Ireland €8.5 million to install the first central grid injection (CGI) facility built specifically for renewable gas and to develop a grant scheme to support the purchase of compressed natural gas vehicles.

Smart Meters

The roll-out of the National Smart Energy Metering programme is key to a low-carbon society. Smart meters have the potential to reduce energy consumption by enabling citizens to manage their household energy use, and a three-phase roll-out has been developed.[98] Phase 1 will start in autumn 2019: 250,000 smart meters will be installed across the country by request in houses and businesses and will replace meters that need to be replaced.[99] It is estimated that phase 1 will cost €1.1 billion.[100] Subsequent phases will see 500,000 meters installed in two phases of four-year periods. The phased roll-out of smart meters is anticipated to be completed by 2028.†

Renewables

The International Energy Agency's recent World Energy Outlook Report 2018 shows that the costs of solar photovoltaic and wind are falling while the costs of oil and gas are volatile. Global renewable generation capacity is increasing rapidly, with solar photovoltaic set to surpass wind by 2025, and overtake coal generation by the mid-2030s. Policies that continue to support the growth of renewables in Ireland are necessary and welcomed. With an appropriate price of carbon such support mechanisms may prove unnecessary in the long run; however, due to the uncertainty about the future carbon price, the support schemes can provide important certainty for investors.

The Renewable Electricity Support Scheme (RESS), which emphasises community and citizen engagement to achieve the zero-carbon energy transition, will support up to 4,500 MW of additional renewable electricity by 2030 and has been submitted to the EU for State Aid approval.[37] It is anticipated that the first auction under RESS will occur in 2019. Highlights of the RESS submitted to the EU include an emphasis on community participation in the development of renewable energy projects through community ownership. Broadening the mix of renewable energy technologies is necessary to ensure security of supply and to meet the stated 2030 ambitions in the RESS, with a target of 55% renewable generation. There is a focus on shovel-ready projects to achieve Ireland's 2020 targets. More recently, the Minister has made the important announcement that Ireland will achieve 70% renewables by 2030.

While the RESS is a welcome progression, there is concern about the absence of planning guidelines for wind (onshore and offshore) and solar photovoltaic, which are critical to achieving 2020 and 2030 targets. Wind energy guidelines were to be released in 2018, but there has been no progression by Government. Further, planning guidelines for solar photovoltaic have yet to be provided by Government. Recent research from the ESRI demonstrated that the Public Service Obligation (PSO) support for renewable electricity generation has delivered a reduction in wholesale electricity prices, lowering household energy bills.[102]

† At completion in 2028 there will 1.3 million meters installed in residential and commercial buildings. It should be noted that there are 2.25 million residential dwellings and 109,000 commercial buildings at present.

There is strong public and industry support for additional incentives for community-based renewable energy projects. These may include mandatory investment opportunities for those in closest proximity to the projects and technical, financial and infrastructural support measures for community-led projects.

The Government has also shown support for the continued development of offshore renewable energy by allocating budget funding to the test site infrastructure in 2018. The interim review of the Offshore Renewable Energy Development Plan was released in May 2018. It included the actions to be taken by Government and industry, and an emphasis on cooperation. A key barrier to the development of offshore wind is the continued delayed release of the Maritime Area and Foreshore (Amendment) Bill: it is important that this be addressed to avoid further delays in renewable deployment.

Waste-to-Energy

On 30 November 2017, the Covanta Dublin Waste-to-Energy plant became fully operational.[103] Provisional data from EirGrid indicate that the plant appears to have generated approximately 360 GWh of electricity. Under the Climate Action Fund, Dublin City Council has secured €20 million to capture waste heat (up to 90 MW) from the Covanta plant under the Dublin District Heating scheme to heat approximately 50,000 homes in the Poolbeg, Ringsend and Docklands areas.

6.5.2 Industry

The major policy initiative for Industry is the EU Emissions Trading System, a carbon pricing initiative that applies to large industrial activities in all Member States of the EU. This scheme is envisaged as the most cost-effective approach to reducing industry emissions across the EU. As was noted in Section 6.4.2, there have been challenges to this scheme as the price has remained too low to adequately incentivise change. The historical emissions changes in Ireland (Section 5.2.2) show that most of the change in Irish emissions under this system has occurred in power generation, attributable to energy policy rather than the carbon price. Phase 4 of the EU scheme will try to address this to achieve the EU's 2030 emission reduction targets in line with the 2030 climate and energy policy framework and as part of the EU's contribution to the 2015 Paris Agreement. In addition, as noted in Section 6.4.2, the Council has recommended that the Irish Government consider a carbon price floor for power generation that puts a limit on how far the market price of carbon can fall, retaining a price signal that incentivises emissions reduction in circumstances where the carbon price is falling.

There are also roles for other programmes including the renewable heat programme (discussed in Section 6.5.3) and energy efficiency measures such as the Large Industry Energy Network (LIEN) and the Excellence in Energy Efficiency Design (EXEED) programme of the SEAI. Energy efficiency measures are now subsumed under the National Energy and Climate Plan. The 2018 annual transition statement assumed that by 2030 the LIEN would achieve 825 Mt CO_2eq cumulative reduction, while the EXEED programme would deliver cumulative emissions reductions of 1.76 million tonnes of carbon dioxide equivalent.

The range of long-term low-carbon transition policy options for industry are well understood globally,[104] and include shifting the structure of the economy and demand reduction through behavioural choices for sustainable consumption. Technical options include changing product lines and process designs towards less resource- and energy-intensive systems, and changing the technologies to more energy- and carbon-efficient forms. Carbon efficiency can be improved

by moving from peat, coal, oil and gas -fossil fuel consumption for processes on-site, to electricity and renewables. Organisational and behavioural change in the management and control of manufacturing offers further scope for emissions reduction. Specific issues are acknowledged on the supply-side for the 'hard-to-decarbonise' sectors of industry, including high-temperature processes. The Energy Transition Commission report of 2017 [105] has explored fuel substitution through liquid biofuels, other bioenergy forms and hydrogen, and carbon capture and storage, as potential options for decarbonisation. The Commission noted that these technologies have not matured and face significant barriers. The difficulty in decarbonising some industry sectors prompted the IPCC to conclude that long-term step-change options could include radical product innovations such as alternatives to cement, once demonstrated, sufficiently tested, cost-effective and publicly accepted.[101]

To ensure that new technologies are developed and implemented to decarbonise the industrial sector it is essential the EU ETS is made to work producing a suitably rising price for carbon.

6.5.3 Built Environment

There have been significant developments in policies and measures addressing emissions and drivers in industry, households and the public sector built environment since the 2018 Annual Review. The developments below have been drawn from Budget 2019, the Annual Transition Statement by the Minister in December 2018, the Long-Term Renovation Strategy 2017–2020 and the National Development Plan 2018, among other sources. This is not a comprehensive analysis of policies relevant to the built environment but aims to consider significant developments and the most important policies and measures already in place. An important action has been the Budget 2019 allocation of €164 million to support energy efficiency programmes in the residential, commercial and public buildings sector – a significant increase from 2018.

Renewable Heat Incentive

A commitment to launch a support scheme for renewable heat was announced in 2017, with an allocation of €6.8 million to fund the initial phase included in Budget 2018.[106] In 2018 the Support Scheme for Renewable Heat opened; it is being administered by SEAI. This enables progress towards encouraging the uptake of renewable heat systems by commercial, industrial, agriculture, district heating and non-domestic heat users. This will assist in meeting EU targets for renewable heat but it is unlikely to deliver significant emissions reductions to contribute to 2020 targets. However, it may be important to enable the development of the market for renewable fuels, with incentives for research and innovation. Both customers and producers will need reassurance and confidence that there is a competitive and efficient market before investing in renewable technologies. Policy needs to ensure that these competitive markets develop.

There are two strands to the renewable heat support scheme: (1) a price support mechanism to encourage switching of fossil fuel heating systems to biomass or anaerobic digestion sources; and (2) grants for the installation of renewable heating systems such as air, ground and water source heat pumps. To ensure that deployment levels are achieved, it will be important that supply chains for renewable fuels, conversion of heating systems and installation of renewable energy-based systems are established and viable. This includes ensuring the availability of a skilled workforce through appropriate apprenticeship and training opportunities.

Where biofuel heating systems are supported, eligibility criteria for technologies and feedstocks should consider potential air-quality impacts to avoid unnecessary costs to society. The

sustainability criteria for biofuel feedstock should include consideration of life-cycle direct and indirect emissions.

Residential Buildings

There have been some advances in committed policies and measures to address residential sector emissions since the publication of the National Mitigation Plan in 2017. The National Development Plan, published in February 2018, included commitments for energy efficiency in terms of both policies and resources allocated. The investment directed towards supporting improved energy efficiency in homes aims to realise upgrades to a minimum Building Energy Rating of B for between 30,000 and 45,000 units per annum from 2021. If this were delivered it would be a welcome step forward in long-term transition; however, the demand for housing is currently rising, placing significant constraints on the resources available within the sector to achieve high levels of ambition in the short term.

Delivering on the commitment to upgrade between 30,000 and 45,000 units per annum from 2021 faces two major challenges:

1. The building and construction sector is currently operating at capacity and the result is rapidly rising costs. To allocate scarce building resources to housing upgrades in the next three years could impact on the ability of the sector to increase its output of new dwellings.

2. The building and construction sector currently does not have the necessary skills to undertake a major upgrade of the housing stock in an efficient manner.

What is needed is a comprehensive plan to ramp up investment in retrofitting the housing stock. Initially it should focus on gradually building up the supply capacity of the sector, which will take a number of years. The objective should be to ensure that the sector can deliver the necessary upgrading of the housing stock (e.g. 40,000 units a year) in a cost-efficient manner by the middle years of the next decade.

To achieve this objective, consideration will need to be given to the following: technology choices with a focus on renewables and their availability; skills and training of the construction sector and the available labour force; financial capacity of homeowners and the rental sector, specifically how they interact with each other. This will inform what can be done in the short, medium and long terms, as this transition will take time and resources, particularly skilled labour, that may not be currently available.

Probably the best way to achieve the goal of decarbonising the housing stock would be to first concentrate the state's scarce resources on upgrading the part of the housing stock owned by the state – local authority houses. In any event, the state, as a landlord, has the responsibility for this segment of the housing stock.

Such a programme would reduce emissions from the built environment, it would particularly benefit those on low incomes and, if managed appropriately, it could develop the necessary skills and expertise of the building and construction sector to undertake this task across the economy.

By offering gradually increasing contracts for retrofitting the local authority housing stock it would encourage builders to specialise into this segment of the sector. As the owners of the rest of the housing stock saw a successful roll-out in the local authority sector, it would provide reassurance that it is both feasible and desirable to undertake this task for their own homes. By

developing a competitive market to provide the necessary advice and building work, the state would ensure that the long-term costs for the household sector of climate-proofing their homes would be minimised.

According to the ESB's report *Ireland's Low Carbon Future – Dimensions of a Solution*, it will cost an average of €20,000 per dwelling to upgrade.[107] The SEAI estimates that over €35 billion will be required over 35 years to make the existing housing stock low-carbon by 2050.[108] This aligns with estimates by the Irish Green Building Council and preliminary findings of a forthcoming EPA project that 1.7 million dwellings in Ireland need deep retrofits. To achieve this level of upgrade by 2050 will require approximately 60,000 units per year from the middle years of the next decade. The Council believes that it is urgent to address the constraints on undertaking this task.

The National Development Plan projects exchequer investment of €4 billion in the period 2018 to 2030, along with taxation and regulatory measures, which it anticipates would see a step-change in energy performance in the residential sector. This is approximately 30% of the total investment required to upgrade 60,000 units per year to 2030.

In 2018, the SEAI introduced a grant for deep retrofits of older homes with low Building Energy Ratings (BER) under the Better Energy Programme. This takes lessons from the 2017 pilot scheme. One challenge is the large proportion of older dwellings within the housing stock in Ireland which are difficult to upgrade. Based on data from the CSO, 31% of houses were constructed before 1970. The current Better Energy Homes grant scheme does not support all the appropriate technology options available on the market. It is interesting to note that the BER assessor report provided to homeowners often alludes to these technology options. Opening the programme to a wider range of technologies introduces flexibility that may be better suited to the household needs and housing typology.

Participation in the Better Energy Programme has declined in recent years. The SEAI, through its Behavioural Economics Unit, is investigating ways to improve participation, for example through expanding the technology choices eligible for supports.

There is potential to expand the role of BER assessors to actively engage and inform householders on the options for upgrades that suit their house and energy needs. This presents an opportunity for the SEAI to collaborate with standards and training institutions, for example the Irish Green Building Council[109] and Waterford Wexford Training Services, to upskill construction workers. Recognising that training alone is not sufficient to ensure standards and effectiveness of training, it will be necessary to monitor and track outcomes.

Case Box. Building Standards – Applying QualiBuild

QualiBuild started in 2013 as an EU project under the European Commission BUILD UP Skills Initiative, as an effort to create employment and assist Ireland in meeting its EU 2020 Energy Efficiency target; it was completed in July 2016. The achievements of the programme were:

(a) developed and rolled out the Foundation Energy Skills Programme for 200 construction workers;

(b) developed and rolled out the Train the Trainers programme to increase the knowledge and competency of trainers involved in construction training;

(c) developed and rolled out a communications campaign to homeowners on the importance of employing trades upskilled in quality and energy efficiency.

The QualiBuild programme is an asset to retrofitting existing buildings and to constructing new buildings. The programme has trained 200 individuals; however, data are not available on how effective the training has been in changing work practice and application on site. Data should be collected on how many dwellings individuals have retrofitted and/or constructed in a given year, as well as the type of dwelling, its BER rating and its location. This could also help to capture households that are undertaking retrofits outside of the Better Energy Programme.

Research by the ESRI and the SEAI suggests that grant schemes have been taken up by socio-economic groups that have the financial resources to pay for upgrades up front. This poses a particular danger of deadweight – people receiving grants for undertaking work that they would have done without the state's support. Lower socio-economic groups and vulnerable individuals can avail of the Better Energy Warmer Homes programme. Those in local authority provided housing benefit from upgrades funded by the Department of Housing, Local Government and Planning for retrofits. It is possible that individuals and households that do not fall into these socio-economic groups but would benefit from energy retrofits are not able to do so. It is important that support is targeted in a just and equitable way to ensure that all have access to upgrades that align with their needs and income. The current option for financing requires homeowners to pay for the upgrades upfront and complete the works within six months; this is a limitation on who may avail of grants. Innovative options for financing upgrades for the segment of the population that fall outside current programmes, which account for their financial and domestic circumstances, need to be considered. A recent initiative in this area includes a collaboration between SEAI and Credit Unions to provide low-interest loans for retrofit.

An emerging challenge is the retrofit of dwellings in the rental sector. Landlords and tenants are both eligible to apply for grants independently, but to date neither group has participated in the programme. A rationale for this may be that, for example, landlords would incur the costs but not gain the benefits of an energy-efficient dwelling or increased return on their investment. Where the tenants would benefit from lower energy bills and improved living conditions, they may not apply due to restrictions in their rental agreement, and possibly view renting as a short-term situation.

The Government is proposing to provide assistance to landlords to undertake upgrades. Acknowledging the existing housing crisis, specifically the rising costs and demands for housing

in the rental market, the Government needs to carefully consider the design and implementation of such policies, as there are risks. The Joint Oireachtas Committee has provided recommendations on this issue. However, the Council believes that the first priority should be the housing stock where the state is itself the landlord.

One concern is the potential displacement of existing tenants while upgrades are being undertaken. In a strained rental market, this is not ideal. The Government may need to consider compensation for tenants as part of any proposed grant scheme, such as temporary housing. Further, existing regulations permit landlords to raise rent (or evict tenants) to undertake significant upgrades to a dwelling. 'Significant upgrades' is not clearly defined. The Council recommends that Government considers including requirements to improve energy efficiency as a component of a 'significant upgrade'.

This is a complex problem, and there is an opportunity to address the housing crisis and energy efficiency simultaneously. It will require collaboration and consultation with the Department of Housing, Local Government and Planning, the Residential Landlords Association of Ireland, the Residential Tenancies Board, and possibly others to develop a policy that achieves energy efficiency gains without contributing to a growing affordability crisis.

Commercial sector

The commercial sector has significant potential to contribute to reducing greenhouse gas emissions. This is supported by data from the SEAI's Excellence in Energy Efficiency Design (EXEED) pilot programme introduced in 2017, which supported both public and private businesses in reducing their energy use. A total of 2.62 GWh of efficiency gains was achieved across the 24 projects in the programme, a 28% improvement in energy efficiency. The SEAI committed an additional €10 million in 2018 to expand the pilot.[110]

Building on the success of the Large Industry Energy Network, the SEAI has developed guidelines for small and medium-sized enterprises to help them reduce their energy costs, with recommendations on office design for energy efficiency and eco-driving tips to reduce emissions from work-related travel.

Dublin City Council's Economic Development unit in partnership with the Eastern Midlands Waste Region is actively supporting businesses with the launch of Modos.[111] The programme is focused on the circular economy and works with businesses to identify actions to make them more efficient and sustainable, while contributing to Ireland's low-carbon future. This is an example of local authority leadership, which recognises that businesses will choose to locate in places where Government prioritises responding to climate change.[112]

Public Sector

The public sector built environment can be an important enabler of transition, especially with regard to reducing its own direct greenhouse gas emissions. The sector also has the potential to act as a leader and exemplar of best practice. The National Development Plan includes a commitment to support deep energy retrofit of schools built before 2008. The high visibility of schools in the community has the potential to greatly increase understanding of the retrofit process and its benefits. These actions should be accompanied by an active sharing of information in local communities.

Through the Climate Action Fund, the Road Management Office will be investing €17.5 million in a Local Authority Public Lighting Energy Efficiency Project to replace all remaining 326,000 non-LED public lights.[113] It is estimated that the project will deliver 40,000 tonnes of CO_2 savings per annum. Separately, some local authorities have piloted smart lighting projects using central management systems in addition to LEDs.

Case Box – Dublin Local Authority Climate Change Action Plans

The four Dublin local authorities have released their Draft Climate Change Action Plans. Each plan outlines actions for reducing energy consumption and improving energy efficiency. A key action for all four is the upgrading of social housing with a focus on fabric upgrades, window and door replacement and boiler upgrades, and piloting of deep retrofits where possible. The local authorities acknowledge that in some instances tearing down and rebuilding is more cost-effective than upgrading. It would be advisable going forward to learn from local authority practitioners currently undertaking retrofit works to inform future policy. For example, Dún Laoghaire Rathdown County Council undertook a deep retrofit of housing for seniors. The Rochestown House project involved the upgrade of 34 one-bedroom units to Passive House standards and has been well received by residents. Moreover, as the Budget for 2019 has allocated funding for 10,000 new social housing units, this will be an opportunity to see the implementation challenges of nZEB standards in Part L of the building regulations.

Local authorities are also addressing energy use in their other buildings. Dublin City Council has installed solar PV panels on the roof of the Civic Offices at Wood Quay and there are plans to upgrade the existing HVAC system. There are also plans to undertake deep retrofits of depots to nZEB standards. The local authorities are using energy performance contracting to undertake energy retrofits of leisure centres.

South Dublin County Council has been awarded €4.5 million under the Climate Action Fund for the South Dublin County Council Tallaght District Heating Scheme. This project will provide low-carbon heat to public sector, residential and commercial customers.

Lastly, all four Dublin local authorities are undertaking energy mapping, to identify areas of the city where improvements can be made.

6.5.4 Transport

Transport is a major source of greenhouse gas emissions in Ireland. The EPA has projected that even with additional measures coinciding with a high oil price acting to dampen emissions, this will not change.[12] The EPA has projected under its 'with additional measures' scenario that emissions will peak at 12.7 Mt CO_2eq in 2020, remaining more than 10 million tonnes in 2040. Under its 'with existing measures' scenario it is projected at 12.7 million tonnes in 2040. On its current pathway, transport will not contribute to meeting targets, or to delivering long-term transition. Changing to a transition pathway will require fundamental and significant policy change. Given the importance of the sector in the Effort Sharing Regulation, and the difficulty in reducing emissions from the sector, the Council has prioritised transport and this will be the subject of the Special Focus chapter in the 2020 Annual Review.

International best practice for transport mitigation and low-carbon transition has sought to move from a focus on road-building and vehicle efficiency to a comprehensive and systemic 'Avoid–

Shift–Improve' (ASI) framework. Internationally this has occurred with parallel recognition of the crucial role for investment in driving change. The Intergovernmental Panel on Climate Change has noted the rise in global transport emissions as transport activity has increased, while becoming more individual and motorised. These developments have driven the adoption of the Avoid–Shift–Improve approach to frame responses across both passenger and freight transport, by the Intergovernmental Panel on Climate Change,[37] the European Environment Agency, the German Federal Ministry and many others. This framing has recently been recommended by policy research in the Irish context.[114] Avoid–Shift–Improve involves: 'Avoid' – avoiding journeys where possible, including densifying development and spatial planning; 'Shift' – shifting mode to low-carbon transport systems of walking, cycling and public transport; 'Improve' – improving the energy and carbon efficiency of vehicles including engine performance and switching to biofuels and electric vehicles. In Ireland, such a fundamental approach would require responses that mitigate existing spatial and infrastructural 'lock-in', and also preventing further lock-in while accommodating the future projected growth in population.

The following section addresses passenger and freight transport, both of which are significantly influenced by spatial planning and infrastructure. These are two key determinants of Irish transport emissions and a challenge to achieving cost-effective emissions reduction. Other key determinants include the policy and investment priority given to the different modes of transport. The Annual Transition Statements have noted the challenges for the sector, but without appearing to propose new approaches or analysis that could frame a change of path. The 2018 Statement discusses a set of incremental interventions, predominantly based on modal shift and efficiency; however, it does not frame a response in line with the scale of the challenge. This is sub-optimal and will impose higher costs on the economy. It will not lead to transition and will deepen lock-in to carbon-intensive patterns. The long-term cost-effectiveness of the different alternative mobility and technology pathways is an important consideration.

In developing an integrated policy response to these challenges, many European countries and cities have sought first to incentivise high-density development through planning regulation. This enables provision of cost-effective and profitable public transport systems, based on fixed lines such as light rail and metro. Ireland's low-density development has made it difficult to provide high-quality transportation networks based on active modes and mass transit rail and bus. This deepens 'lock-in' to high-carbon private car transport, with increases in associated greenhouse gas emissions, air pollution and congestion. It is crucial that national spatial and infrastructure planning and investment, through the National Planning Framework and the National Development Plan, supports transition to high-density spatial planning integrated with low-carbon transport. Low-carbon transport involves providing an alternative to the private car through appropriate priority on active and public transport modes.

At the same time, greater incentives to switch away from the use of the private car are required, based on the 'polluter pays principle'. Options include: switching fixed taxes to variable charges on vehicle use and emissions; congestion charges on entry into cities; pricing for free-parking in workplaces that indirectly subsidises motorists; and provisions that support car-pooling and working from home. The Council recommends that these measures be examined to more appropriately reflect the true costs of private motoring, while prioritising early action through integrated spatial and infrastructure planning that promotes sustainable settlement patterns and modal alternatives.

Passenger: Private Car

The private car is the most significant source of Irish transport emissions. Once demand reduction and modal shift measures are in place, improvements in the energy and carbon efficiency of the private car are required. In supporting the transition, the Government has established flagship measures: The National Development Plan includes a commitment to at least 500,000 electric vehicles on the road by 2030, increased to 840,000 in the Climate Action Plan 2019; additional charging infrastructure to cater for planned growth; no cars that are not zero-emission capable will be sold in Ireland post-2030; and National Car Test certification will only be issued for zero-emission capable cars post-2045. While the Government has made important commitments on electric cars and charging infrastructure, firm action plans for implementation are now a priority. As electric vehicle range, price and model availability continue to improve, a lack of access to reliable, efficient electric-vehicle charging infrastructure could become a roadblock to EV uptake.

Transport transition will therefore require planning for the decarbonisation of power generation, including the enhanced demand from transport. Charging infrastructure needs to be integrated into local and regional spatial planning, dwelling and non-dwelling building regulations, and planning of the electricity transmission and distribution network. Alternative drive trains and the place of biofuels also require consideration.

Accompanying the 2018 recommendation on increasing the carbon tax, the Council also recommended that the excise tax on diesel should be raised to that on petrol. This action would bring environmental and health co-benefits due to the air pollution associated with diesel.

The public sector can act as a leader in rolling-out of electric vehicles, as can the taxi service. New vehicle registration data from the CSO show that in 2016, only 0.7% of new taxis were either hybrid or zero-emission capable. This rose to 1.8% in 2017 (see Table 5.1). Acceleration of the rate of investment in low-emissions taxis could increase the visibility and acceptance of low-emissions technologies by the public.

Passenger: Walking and Cycling

Increased rates of cycling seen at a national level, mostly in the Dublin region, have been the most positive development in sustainable transport in recent years. However, feasibility and safety concerns may be practical and behavioural barriers to walking and cycling, even where distances are short. The active modes may not be feasible for all users, or for all trip types. As the most sustainable forms of mobility, a long-term modal shift to walking and cycling would require an integrated strategic pathway that recognises the different mobility needs for different trip types and for urban–rural contexts.

Passenger: Public Transport

Cost-effective and carbon-efficient mobility options for passengers require provision of accessible, affordable and reliable public transport options. Light and heavy rail are the most carbon-efficient forms of public transport. For rail to contribute significantly to transition, integrated long-term spatial, economic, infrastructure and investment plans would be required. Taxi services provide road-based alternatives mainly for short distances. Along with buses, they may be particularly important in rural locations to avoid dependence on the private car, while facilitating community mobility. The decarbonisation of buses and taxis requires consideration of electrification, alternative drive trains and alternative fuels.

Investment in public transport is needed to facilitate modal shift. All forms of public transport grew by number of journeys in 2017, apart from Bus Éireann.[115] Research by the European Commission highlights that, based on its measurement, access to public transport is relatively low in Dublin compared with other European cities.[116] Low population density is a factor in increasing the costs of public transport provision in Ireland, but these costs need to be compared against the benefits of low-carbon transition, decreased congestion, social inclusion and road safety.

Public transport investment was one of the most high-profile areas of the National Development Plan, with plans and investments announced for the Metro Link Dublin, elements of the Dublin Area Rapid Transit (DART) expansion and investment in BusConnects in Dublin, Cork and Galway. The five city regions are also planned to benefit from sustainable transport projects over the period to 2027 to provide additional sustainable travel options to complement increased capacity and faster, higher quality public transport in the cities, including traffic management, bus priority and walking and cycling routes.

Public transport investment will also include park and ride facilities, a national train control centre, rail and bus station improvement and ticketing systems. The technology and fuels underpinning public transport provision are addressed with a planned transition to low-emissions vehicles, including electric buses, for the urban public bus fleet, with no diesel-only buses purchased from 1 July 2019.

Freight: Road and Rail

All economies require the movement of physical goods, particularly in more globalised markets. These freight movements involve supplying final goods to customers and the movement and international trade of the physical resources and intermediates that become these final goods. In comparison to passenger transport, freight therefore involves different demand drivers, spatial patterns and technologies to decarbonise. Nevertheless, as per international experience, key determinants of emissions are the density of spatial planning and the structure of freight by mode.

The 2018 Annual Review observed that the National Development Plan included provisions to expand the refuelling network for alternatively fuelled freight vehicles, and while this is welcome, it is not sufficient. Technological potentials, energy source supply chains and business models, driver behaviour and logistics management trends all need to be considered. The Review also noted a pressing need for the Department of Transport, Tourism and Sport, together with the Department of Communications, Climate Action and Environment, to develop a strategy for low-carbon transition in the freight sector, and to reflect the complexities and economic importance of the sector. Some of these complexities are discussed in Box 6.1.

Box 6.1: Compressed Natural Gas and alternative drive trains for road freight

The internal combustion engine (ICE) is the standard technology for road freight. Currently heavy goods vehicles use diesel engines that allow them to pull heavy weights over long distances. The technical efficiency of all vehicles can be improved through redesign, 'hybrid' drive trains and, crucially, how much of the capacity is used during transport in the organisation of logistics. However, there are technical limits to how much can be achieved, and transition ultimately requires the 'decarbonisation' of road freight. In response to this challenge, 'alternative drive trains' are being considered around the world. This involves replacing the conventional engine with new motor technologies. These have different technical characteristics that suit different haulage tasks, involve different types of infrastructure to supply the fuel, and can have a wide range of economic costs and environmental implications.

'Biofuels' are often used as an alternative as they usually do not require changes to standard engines. These liquid fuels can be made from many different renewable biological sources. Biodiesel is the most common in the EU and can be produced from sources such as soy, palm oil and algae. However, the history of biofuels policy in the EU has proved challenging. This led the EU to acknowledge that the available resource must be limited based on sustainability criteria,[117] and has driven change in EU targets for biofuels.

Other drive trains that are being developed include electric, hydrogen and Compressed Natural Gas (CNG). The electric option has potential but batteries are considered to require more research and development, particularly for the larger trucks used over longer distances. Hydrogen fuel cells can be used over longer distances and are a highly efficient option in comparison to the standard ICE. Hydrogen can be generated from a variety of renewable resources and is regarded as an option for the long term, but remains relatively costly.

CNG is currently receiving attention in Ireland. A technical challenge is that the range of emissions of carbon dioxide from CNG vehicles has been shown to be similar to, and sometimes more than, that of conventional diesel engines.[37] A long-term decarbonisation of transport using CNG would therefore necessitate a sustainable 'biomethane pathway', a large and reliable source of renewable gas that is sufficient to avoid using non-renewable fossil gas in the future.

All technological options require some changes to infrastructure or technology, as well as investment, and present the risk of locking-in an approach for decades. Other options that can be used include demand management and systems efficiency, logistics and behaviour, and modal shift. Shifting freight from road to rail is a key emissions reduction approach across the EU, but rail freight in Ireland has dropped to one of the lowest percentages in the EU.[†118]

† At 0.9% of total freight carried in 2016, Irish rail freight is the third lowest in the EU 28 behind the islands of Malta and Cyprus, according to DGTREN.[117]

6.5.5 Agriculture and Land Use

The Special Focus Chapter of this Annual Review examines the Agriculture and Land Use sector. Here we summarise existing measures and Chapter 8 presents our recommendations for action in the agricultural sector.

The sector is not on a trajectory to achieving the National Policy Objective. A number of initiatives have been identified that may enable the rural economy to contribute significantly to renewable energy generation. However, the observed and projected expansion of livestock and dairy production in Ireland increases the challenges to achieving emission reduction targets in 2020 and 2030.

Ireland's Rural Development Programme 2014–2020 will provide support of €3.4 billion for climate change objectives. The annual EU and Government supports to agri-environment schemes, forestry, biofuels and the Beef Data Genomics Programme (BDGP) are presented in Table 6.1. Although much of the spending under these headings is not directly aimed at climate mitigation or adaptation, co-benefits are often realised. For example, support for new hedgerow planting is primarily aimed at addressing biodiversity and heritage issues, but new hedgerows are also effective at carbon sequestration to biomass and soils.

An evaluation of the Green, Low-Carbon, Agri-Environment Scheme (GLAS) published in 2016 found a very limited number of studies that monitored and analysed the scheme with respect to its impact on climate mitigation and adaptation.[119,120] The review also presented a template for the development of monitoring and modelling capacity to enable necessary evaluation of the Green, Low-Carbon, Agri-Environment Scheme.[121] On the basis of this review, robust indicators of the impacts of measures supported under the scheme can be developed.

Table 6.1: *Supports provided to enable environmentally sustainable agriculture, forestry and biofuels*

Activity	Spending (million euros)		
	2015	2016	2017
Rural Environment Protection Schemes	131	148	221
Forestry and Bio-fuels	104.2	103.8	102
Beef Data Genomics Programme	34.7	62	45

A number of programmes provide supports and incentives to farmers and other landowners to enable beneficial environmental outcomes and sustainable management practices.

The Beef Data and Genomics Programme (BDGP) was launched in May 2015, with the aim of delivering accelerated genetic improvement in the quality of the beef herd, and associated climate benefits. Measures included completion of the Carbon Navigator, genetic profiling of the herd, and actions over time to improve the genetic merit of the herd through selective replacement with animals with lower greenhouse gas emissions. Over 23,000 participants have signed up to a six-year contract to implement measures under the programme.[122]

The 2017 evaluation of the Rural Development Programme found that participation in the Beef Data and Genomics Programme is beginning to improve herd fertility, but it remains at an early stage of development. It is too early in the reporting phase of the Beef Data and Genomics Programme to analyse whether actions under the Carbon Navigator, such as a longer grazing season, have been implemented.

The Beef Environmental Efficiency Pilot Scheme (BEEPS) may perversely incentivise further growth in herd numbers and in related emissions; the emissions reduction benefits are unknown. These concerns will require consideration in the reform of the Common Agricultural Policy.

In the case of forestry grants and premiums, this is an important agriculture mitigation measure but planting rates may not respond adequately to such incentives, and other factors could be at play. In addition, if the programme is not optimised for sustainability and mitigation criteria, it may not deliver the expected emissions reductions and/or may cause indirect problems for biodiversity, river water quality and other environmental dimensions.

A total of 53,174 farmers have been approved for entry into the Green, Low-Carbon, Agri-Environment Scheme, surpassing the target participant rate of 50,000 by 2018. The scheme supports actions on 943,332 hectares of farmland, approximately 32% of all agricultural land in Ireland. The 2017 evaluation of the Rural Development Programme reports lower greenhouse gas emissions per hectare on Green, Low-Carbon, Agri-Environment Scheme farms compared with non-participants. However, dairy sector participation is relatively low, therefore the comparison may overestimate the impact of the scheme.

Bord Bia's Origin Green programme is a high-profile initiative that provides supports to farm, manufacturing, retail and food service sectors to adopt best practice. The most recent 2016 report outlines significant potential for emissions reduction within beef (7%) and dairy (14%), based on successful achievement of the individual improvement targets by the cohort of participating farmers.[123] Demonstrating progress in achieving this potential emissions reduction will be important as Origin Green develops.

The Smart Farming initiative led by the Irish Farmers' Association, in conjunction with the Environmental Protection Agency, complements Origin Green, but has a broader environmental scope.[124] In its 2017 report, the Smart Farming programme estimated a 10% average potential greenhouse gas emissions reduction on participating farms. Realising and verifying these potential emissions reductions through robust data analysis and monitoring is required. Data on the uptake of these practices and real-world impact on carbon stocks are needed to ensure they are reflected in national reporting of emissions and removals.

In 2018, Teagasc published a revised Marginal Abatement Cost Curve for greenhouse gases in the Agricultural and Land Use sector, which identifies a large number of cost-effective mitigation measures. This is discussed in detail in the Special Focus Chapter.

Similar to 2017, the Annual Transition Statement 2018 did not identify new measures further to the National Mitigation Plan. The timing of policy development and implementation is closely aligned with the roll-out of the Common Agricultural Policy and other EU mechanisms and supports for agricultural development. There have been no new initiatives in forestry since the last Annual Review. The rate of afforestation has dropped to 4,000 hectares per year, which is of concern to the Council.

The National Peatlands Strategy outlines a vision, values and principles that will guide Government policy in relation to all peatlands.[125] These are to be applied through their incorporation into the sectoral plans, policies and actions adopted and undertaken for each policy area. The National Planning Framework states the intention to prepare a medium- to longer-term national land use plan for peatlands in state ownership to manage their most appropriate future use, building on the existing National Peatlands Strategy and other national policy related to peatlands conservation and management.

6.6 Advice and Recommendations

The Council reiterates the need for a national roadmap or a comprehensive plan towards achieving the 2050 objectives.

The Council highlights the lost opportunity in Budget 2019 to enhance fiscal instruments, such as the carbon tax and fuel excise duties, despite considerable evidence in their favour. A robust carbon price can support low-carbon transition across the sectors at a lower cost to Government than extensive provision of subsidies. Revenue from a carbon tax could support low-income households. The Council recommends a carbon tax of €35 per tonne in 2020 rising to at least €80 per tonne by 2030.

The Council considers the mobilisation and use of other sources of funding to support transition to be appropriate and necessary. The participation of the private sector in driving and funding mitigation action is important to successful transition. Strategies and instruments will be required to mobilise and engage the private sector in meeting climate challenges. It will be crucial to have clarity on how private sector investment will be mobilised by Government in support of the national actions on climate change. Robust carbon pricing could play a role.

The commitment to increase the annual rate of energy efficiency home upgrades by 50% is ambitious and necessary. However, more attention is required on the building sector supply side, for appropriate phasing of work. The Council recommends initially targeting scarce public resources to upgrading the local authority housing stock.

Making decisions on retrofit easier, such as having clear standards and advice on the appropriate technologies for a given task and house type, improves uptake rates. Trusted intermediaries can play a key role. A robust supply chain of appropriately qualified building contractors and tradespeople such as plumbers and electricians, who can provide the appropriate advice and guidance to households, should be actively developed to avoid constraints to deployment.

It will be important to have a long-term plan for upgrading the commercial building stock, which has a high share of low-performing buildings. This plan should consider how to promote efficiency upgrades in the long term without reliance on fiscal support. Robust carbon pricing could play a role.

The success of the National Planning Framework will be determined by the extent to which other plans, policies and measures follow through and maintain consistency with its aims and objectives. Robust implementation and review will be required to ensure that measures are fit for purpose.

The implementation of the National Development Plan is contingent on resources. Continued funding and development of institutional capacity will be required to deliver on all the commitments made. If resources are constrained, it will be important to have clarity and transparency on how different elements in the plan should be prioritised. Prioritisation should take account of the revised shadow price of carbon.

To support robust implementation of the National Mitigation Plan, the National Energy and Climate Plan and other initiatives, it is crucial that information is made available in a timely and transparent manner on the progress in implementation to date of its actions and commitments. The actions should be linked to expected emissions reductions to allow effective planning for further efforts required to close the emissions gap.

The Council has welcomed the Government commitment to end the burning of coal at Moneypoint by 2025. It is urgent that the Government provide an appropriate timeline for the cessation of activities in Moneypoint. The Council recommends closing peat in 2020 with measures to ensure a just transition. The Council believes that the current plans for continued support for peat indirectly through a subsidy for biomass co-fired with peat are not appropriate given our commitments to tackle climate change.

Emissions from passenger and freight travel are projected to remain a large proportion of national emissions. Innovative measures will be required across passenger and freight if a low-carbon transition is to be delivered. The Council recommends learning from international best practice. The Council recommends putting in place the necessary infrastructure to allow a rapid electrification of road transport. To facilitate the proposed increase in electric vehicles, the Government needs to establish an appropriate nationwide charging infrastructure, supported by both public and private investment, concrete implementation plans and monitoring mechanisms to ensure ramp-up to meet evolving needs.

The Council recommends prioritising early action through integrated spatial and infrastructure planning that promotes sustainable settlement patterns and modal alternatives. It also recommends examination of greater incentives to switch away from the use of the private car based on the 'polluter pays principle' including: variable charges on vehicle use and emissions; congestion charges on entry into cities; pricing for free-parking in workplaces that indirectly subsidises motorists; and provisions that support car-pooling and working from home.

The Agriculture and Land Use sector must adopt all appropriate cost-effective measures to reduce emissions and enhance removals within the sector. There remains a need to define the carbon neutrality objective for the sector. Reform of the Common Agricultural Policy presents the opportunity to provide support for measurable environmental benefits, including greenhouse gas emissions reductions. The Council notes that a reduction in the national herd would deliver a significant reduction in national greenhouse gas emissions, but would need to be pursued with due regard to ensuring a just transition within the rural economy. The recently published analysis by Teagasc on a Marginal Abatement Cost Curve identifies measures that should be employed to reduce emissions. Additional specific recommendations are made in Chapter 8.

The Council will turn its focus to transport and heat in the autumn and winter of this year. Findings will form the Special Focus Chapter in the 2020 report.

7. Progress Towards a Climate-Resilient Ireland

Key Messages

- We are already seeing the negative impacts of climate change and, regardless of the success of national or global mitigation measures, adaptation to climate change is required due to the effects of past and ongoing emissions.
- The projected impacts of climate change often seem distant from everyday life, but Ireland experienced several notable weather and climate events in recent years which have shown vulnerabilities in our society and systems that may be exacerbated as our climate changes further.
- Awareness of the need for adaptation remains poor, with corresponding low levels of willingness to engage. This is reflected in Government policy, where the need for adaptation remains under-recognised, with little consideration of how it will be mainstreamed into decision-making and co-benefits with mitigation underexplored.
- Adaptation will require significant investment from the private sector and households as well as Government. It is important that investment decisions consider a range of global warming scenarios, including those of potential higher warming.
- The ongoing development of sectoral adaptation plans and local authority adaptation strategies can play a key role in developing a pathway to increased climate resilience.
- Adaptation in key areas such as coasts, housing and planning is not being addressed. To ensure that priority risks and resource requirements for the next five years are clear, a review of the first cycle of adaptation planning is required.
- Failure to address adaptation today may make it more expensive and disruptive to adapt later.

7.1 Introduction

Human-influenced climate change is happening now, and future climate-related risks depend on the rate, peak and duration of warming. They can be reduced by the upscaling and acceleration of climate mitigation but, due to past and ongoing emissions, adaptation† to the observed and projected impacts of climate change is also required. This may require 'grey', 'green', 'soft', 'incremental' and 'transformational' measures.

The Climate Action and Low Carbon Development Act 2015[126] (the Climate Act) requires the Council to conduct an annual review of progress made in 'furthering transition to a low-carbon, climate-resilient' economy. The National Adaptation Framework[127] published by the Government in January 2018 defines climate resilience as *'the capacity of a system, whether physical, social or ecological, to absorb and respond to climate change and by implementing effective adaptation*

† The Council has adopted the definition of adaptation in the Climate Action and Low Carbon Development Act 2015, adaptation 'means any adjustment to: any system designed or operated by human beings, including an economic, agricultural or technological system, or any naturally occurring system, including an ecosystem, that is intended to counteract the effects (whether actual or anticipated) of climatic stimuli, prevent or moderate environmental damage resulting from climate change or confer environmental benefits'.

planning and sustainable development (including governance and institutional design) to reduce the negative climate impacts while also taking advantage of any positive outcomes. This will allow the system to either return to its previous state or to adapt to a new state as quickly as possible.' In this chapter, the Council discusses the implementation of adaptation policy under the Climate Act and the National Adaptation Framework and assesses our progress towards climate resilience.

The projected impacts of climate change often seem distant from everyday life. The need to plan and invest in actions to address impacts therefore receives less priority; however, in response to the increasing evidence for its urgency, the Paris Agreement[128] has pushed adaptation up the international agenda, recognising that it is required at national, regional and local levels and that action should follow a country-driven, gender-responsive, participatory and fully transparent approach, taking into consideration vulnerable groups, communities and ecosystems.

The global adaptation goal within the Paris Agreement explicitly links adaptation to sustainable development and to the mitigation goal of limiting global temperature rise to well below 2°C, and makes clear that if mitigation activities succeed in limiting the rise in global temperature, less adaptation will be needed. However, the current trajectory is not promising and, critically for Ireland's policymakers, whereas the impact of mitigation depends greatly on a global response, effective adaptation to climate change is within Ireland's control.

According to the UN, climate change is a 'priority issue affecting both human systems, including human health, and natural systems – air, biological diversity, freshwater, oceans and land – and which alters the complex interactions between those systems', making it 'a global driver of environmental, social, health and economic impact and heightened society-wide risks'.[129] Therefore cross-sectoral coordination that addresses these interdependencies is particularly important in adaptation. This is confirmed by the recent global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services,[130] which highlights the projected impacts of climate change and other processes on biodiversity and the need for context-appropriate and nature-friendly climate change mitigation and adaptation policies.

Parties to the United Nations Framework Convention on Climate Change (UNFCCC) are requested under Article 12 of the Convention to communicate information relating to their national climate mitigation and adaptation policies. Ireland's seventh National Communication (NC7) relating to the period 2014–2017 was submitted to the UN in March 2018, with Chapter 6 addressing 'Vulnerability Assessment, Climate Change Impacts and Adaptation Measures'.[131] This was followed by an in-country visit to provide a comprehensive technical assessment of Ireland's implementation of its commitments.

7.2 Observations and Projections

The Intergovernmental Panel on Climate Change's (IPCC) Special Report on Global Warming of 1.5°C,[132] published in 2018, unequivocally confirms that we are already seeing the adverse impacts of climate change. Observations show that Ireland's climate is changing, and the observed scale and rate of change are consistent with regional and global trends.

Last year's Annual Review[90] presented a comprehensive outline of observed and projected climate change for Ireland, explaining that to prepare for the impacts of climate change, we need to first understand our historical and current climate, along with our weather and its

variability, and its impacts and our ability to cope and adapt to these. Together these form the basis for understanding our future climate and the nature and scope of the actions (adaptation and mitigation) needed.

For Ireland, although underlying warming trends will continue, natural climate variability will continue to dominate through to the 2050s. That is, climate events will be broadly consistent with those observed in the historical record, although as climate science is beginning to demonstrate, climate change is contributing to the magnitude and probability of those events. The change will be subtle at first, but will become steadily more pronounced. The severity of impacts after 2050 will strongly depend on the effectiveness of global action to reduce greenhouse gas emissions.

Ireland will continue to experience relative extremes of cold and heat, drought and heavy precipitation, and wind. It is expected that we will experience winters that are generally wetter and summers that are generally drier. Winters are likely to warm faster than summers, leading to fewer frost days. Rainfall episodes are likely to be more intense, leading to greater rates of surface run-off and higher risk of flooding. There is also the possibility that, although average wind speed may decrease, the intensity of individual storms may increase. Predicted changes in mean sea level will be the primary driver in magnifying the impacts of changing storm surge and wave patterns in coastal areas.[133]

7.3 Review of Progress

This section presents a commentary on significant policy developments in relation to climate adaptation and increasing Ireland's climate resilience since the publication of the Council's last Annual Review.

7.3.1 Institutions and Governance

Implementation of the National Adaptation Framework

Ireland's first National Adaptation Framework (NAF) was published on 19 January 2018 and the Council welcomed this important advance in adaptation policy. As anticipated in last year's Annual Review, the 2018 Annual Transition Statement[134] provided more detail on the implementation of adaptation policy than its predecessor; however, the information presented on adaptation remains at a high level.

The 2018 Annual Transition Statement includes a table on the implementation of the 12 actions contained in the National Adaptation Framework. Positively, most of these are completed or in progress, but limited information is provided on how important actions such as the integration of climate adaptation in all relevant national policy and legislation (mainstreaming) are being progressed.

The National Adaptation Framework also includes 13 'supporting objectives'. These were not reported on in the 2018 Annual Transition Statement and they are not set against a timeline or list of stakeholders. Some of these supporting objectives are potentially very significant. How they are to be monitored, and their progress and status evaluated and reported on, is unclear and a methodology for this should be developed.

To ensure that adaptation is adequately considered in national decision-making, further clarity is required on the interaction and reporting between the National Adaptation Steering Committee (which was revised under the Framework and comprises the sectors preparing sectoral

adaptation plans, the new Climate Action Regional Offices and other stakeholders), the Climate Action High Level Steering Group (or revised arrangements under the Government's Climate Action Plan), the National Local Authority Climate Action Steering Group, the Climate Action Regional Offices Group and each region's own Climate Action Regional Office Regional Steering Group. How key priorities and actions from the 12 sectors are to be monitored at national level should be clarified.

EU Strategy on Adaptation and National Energy and Climate Plan

There is no specific binding legislation on climate change adaptation at EU level. The European Commission published a White Paper[135] on adapting to climate change in 2009, and the EU strategy on adaptation to climate change[136] in April 2013. The EU Strategy has an overall aim of contributing to a more climate-resilient Europe, and focuses on three key objectives:

- Promoting action by Member States – the Commission has been encouraging all Member States to adopt comprehensive adaptation strategies and provides funding to help Member States build up their adaptation capacities and take adaptation action. It also supports adaptation in cities and eligible municipalities through the Covenant of Mayors for Climate and Energy.

- 'Climate-proofing' action at EU level – the Commission has promoted the integration of adaptation into EU policies in key vulnerable sectors such as agriculture, fisheries and cohesion policy to help to ensure that Europe's infrastructure is made more resilient. It is also promoting the use of insurance against natural and man-made disasters.

- Better informed decision-making – the Commission is attempting to address gaps in knowledge about adaptation and has developed a European climate adaptation platform (Climate-ADAPT) as a 'one-stop shop' for adaptation information in Europe.

In November 2018, the European Commission published an evaluation of the EU strategy on adaptation,[137] which found it to be fit for purpose with its future revision being subject to a number of events up to 2020, including the outcomes of COP24 and the initial implementation of the Regulation on the Governance of the Energy Union and the associated National Energy and Climate Plans.

The findings include:

- The current strategy is still relevant and the Commission will be guided by its objectives going forward;

- Major infrastructure projects financed by the EU budget are climate-proofed and will withstand sea-level rise, flooding or intense heat;

- Adaptation must support and be supported by the protection of the EU's biodiversity (nature-based solutions/green adaptation actions);

- The contribution of the private sector to enhancing society's resilience must be encouraged;

- Climate services for specific adaptation needs should develop into business opportunities, based on reliable and standardised data and the incentives provided by Copernicus and other European Earth observation initiatives.

The published evaluation package also contains assessments of each EU Member State's national adaptation policies under an adaptation preparedness scoreboard prepared by the Commission. This scoreboard identifies key indicators for measuring Member States' level of progress in terms of adaptation policy.

The assessment of Ireland's performance[138] under the scoreboard shows that it has made significant progress, particularly in terms of putting in place the coordinating structure required for adaptation at national level, putting in place climate observations systems, filling knowledge gaps and with regard to knowledge transfer.

The assessment also showed a number of areas where further progress is required, including in terms of integrating climate change into national disaster risk management plans, mainstreaming adaptation into insurance instruments and monitoring of progress on adaptation at local and regional levels. Ireland's draft integrated National Energy and Climate Plan, published in December 2018, considered climate adaptation and included sections on the alignment of disaster risk reduction and adaptation and the role of insurance in incentivising risk reduction. This is welcomed, as these aspects of adaptation policy were identified as requiring further development in the Commission's assessment of Ireland's performance, but further detail is required. The Council notes that the European Commission considers Ireland an example of good practice on how to cover adaptation goals and measures in its assessment of draft National Energy and Climate Plans.[139]

The 2014 European Union greenhouse gas Monitoring Mechanism Regulation (MMR) sets the EU's own internal reporting rules based on its internationally agreed obligations. The MMR tracks low-carbon development strategies, greenhouse gas inventories, registries and financial and technology support provided, in addition to adaptation to climate change. The Energy Union Governance Regulation will replace the MMR. The first MMR adaptation reporting by Member States took place in 2015; the second and final one took place in 2019 with the information on climate adaptation for Member States, including Ireland, presented on the online platform Climate-ADAPT [(https://climate-adapt.eea.europa.eu)].[140]

British–Irish Council

The British–Irish Council was established under the Good Friday Agreement and comprises representatives of the Irish and British Governments and the devolved institutions in Northern Ireland, Scotland, Wales, the Isle of Man, Jersey and Guernsey. It addresses issues of common concern, including the environment.

In March 2018, Ireland hosted a ministerial-level meeting of the British–Irish Council environment work sector which focused primarily on climate adaptation.[141] Ministers agreed that shared challenges offer significant potential for cooperation in terms of sharing information and best practice across the administrations and that possibilities for better coordinated and co-funded research should be examined.

The meeting agreed that the private sector, local government, communities and civil society all have a key role in increasing climate resilience, and all administrations are committed to sharing their experiences on supporting and engaging these sectors. The adaptation agenda is to be progressed at an official level and Ministers will review progress at a future meeting of the council.

Given the shared geographic location and socio-political similarities between the administrations, this represents a significant opportunity. The Climate Change Advisory Council considers that structures should be put in place to encourage information-sharing between all Government Departments and their British–Irish Council counterparts about adaptation.

Climate Action Regional Offices (CAROs)

Local authorities will play a critical role in addressing climate change adaptation. Under the National Adaptation Framework, each local authority has been set a deadline of 30 September 2019 for the completion of its local adaptation strategy. Local authorities are being supported by the four Climate Action Regional Offices as they prepare their strategies.

The Council welcomes the establishment of the Climate Action Regional Offices. They offer significant potential to drive mitigation and adaptation action at local and regional levels, but coherence with national policy, local development plans and regional policy is essential. Sectors and the regional offices must ensure that actions in sectoral plans or local adaptation strategies relevant to each other are coherent and deliverable. Nine Irish local authorities are signatories of the Covenant of Mayors for Energy and Climate, and links between the regional offices and this process, and learning from the experience of Irish signatories to date, should be strengthened.

Coastal adaptation and marine spatial planning

The coastal zone is a critical environment for Ireland, as an island, and 1.9 million people live within 5km of the coast.[142] Coastal areas contain extensive environmental systems, e.g. estuaries, rivers and wetlands, which are particularly sensitive to the impacts of climate warming. All these systems are integrated and, to some degree, dependent on each other for their sustainability.

The planning and management of the coastal zone is fragmented but it is essential that the critical role for people, and the whole-island environment, of the coast is considered in adaptation planning. This may be achieved by either the coastal zone being recognised as an overarching theme for action, or by coastal matters being a specific matter for attention by each of the existing sectors under the Framework and by local authorities in their local adaptation strategies as appropriate.

The National Marine Planning Framework baseline report[143] published by the Department of Housing, Planning and Local Government in September 2018 is part of the process of developing Ireland's first marine spatial plan. As set out in the Baseline Report, the marine spatial plan is to consider climate change from two perspectives: how actions under the plan may help mitigate climate change, and how they need to be adapted to take account of the effects of climate change. Coordinating a strategic and policy-driven response to erosion and other coastal issues can be challenging, and the marine spatial planning process provides some opportunities to explore these issues. Continued information-sharing regarding best practice in integrating climate adaptation and marine spatial planning is essential.

The National Adaptation Framework notes that in areas such as the marine, where statutory responsibilities lie across a number of Government Departments, existing structures such as the Interdepartmental Marine Coordination Group can facilitate cooperation. The engagement of this Interdepartmental Group in adaptation planning to date is unclear and should be clarified in the final National Marine Planning Framework.

Sectoral Planning Guidelines for Climate Change Adaptation

Sectoral Planning Guidelines for Climate Change Adaptation were published by the Department of Communications, Climate Action and Environment in May 2018 for use by the 12 sectors required to prepare statutory sectoral adaptation plans by 30 September 2019 under the National Adaptation Framework and Climate Act.[144] They were originally developed as part of an Environmental Protection Agency research project ('A Climate Information Platform for Ireland') by the Climate Ireland research team in UCC's MaREI (Centre for Marine and Renewable Energy), with funding provided by the Department of Communications, Climate Action and Environment.

The guidelines are based on international best practice and were developed in close consultation with the Department of Transport, Tourism and Sport, the Department of Agriculture, Food and the Marine and other key sectors tasked with the preparation of sectoral adaptation plans. They aim to ensure a coherent and consistent approach to adaptation planning by the key sectors in Ireland. Sectors preparing sectoral adaptation plans under the National Adaptation Framework are required to prepare their plans in line with the process described in these guidelines while also considering overall requirements regarding the development of sectoral adaptation plans in the Climate Act and the Framework.

Local Authority Adaptation Strategy Development Guidelines

Local Authority Adaptation Strategy Development Guidelines[145] were published by the Department of Communications, Climate Action and Environment in December 2018 for use by the 31 local authorities preparing local adaptation strategies. The guidelines were originally developed as part of an Environmental Protection Agency research project, 'Local Authority Adaptation Strategy Development Guidelines'.[146] The original research guidelines have been updated to reflect subsequent changes in adaptation policy at national level, including the establishment of the four Climate Action Regional Offices.

The Council welcomes the publication of both the sectoral and local authority guidelines, but these should be reviewed following the current adaptation planning cycle to reflect lessons learned from their application.

7.3.2 Review of Sectoral Adaptation Planning

The National Adaptation Framework identifies 12 key sectors under the remit of seven Government Ministers where sectoral adaptation plans are to be prepared. The National Adaptation Framework groups the sectors across four themes, presented in Table 7.1. The sectors in the National Adaptation Framework do not cover some important areas, for example tourism, sport, housing and planning, emergency management, the financial sector and coasts.

Table 7.1: *Sectors and lead Departments/agencies for the preparation of sectoral adaptation plans*

Theme	Sector	Lead Department
1. Natural and Cultural Capital	Seafood	Department of Agriculture, Food and the Marine
	Agriculture	
	Forestry	
	Biodiversity	Department of Culture, Heritage and the Gaeltacht
	Built and Archaeological Heritage	
2. Critical Infrastructure	Transport Infrastructure	Department of Transport, Tourism and Sport
	Electricity and Gas Networks	Department of Communications, Climate Action and Environment
	Communications Networks	
3. Water Resource and Flood Risk Management	Flood Risk Management	Office of Public Works
	Water Quality	Department of Housing, Planning and Local Government
	Water Services Infrastructure	
4. Public Health	Health	Department of Health

In line with the requirements of the Climate Act, the Council is engaging with all sectors preparing adaptation plans. The Council has agreed criteria of assessment for the sectoral adaptation plans and local adaptation strategies, which have been made available to sectoral departments and the Climate Action Regional Offices. These include, for example, that plans and strategies should be consistent with the published guidelines and that they should demonstrate consideration of potential co-benefits and trade-offs with respect to climate change mitigation and other policy objectives (for example, air quality, water resources).

The Council provided comments and advice on previous non-statutory sectoral adaptation plans that remain relevant. In the development of sectoral and local authority adaptation plans, it may be useful to assess the extent to which current climate variability has impacted operations and maintenance of assets and infrastructure. For example, extreme events may have resulted in demands on resources and response systems that were beyond the original designed thresholds of buildings or infrastructure (such as roads or water systems). The adaptation plans should also elaborate on changes already introduced in response to anticipated climate change, including modified operational or strategic processes, modified processes within contingency planning, or existing measures and planning for other purposes such as emergency planning or spatial planning.

Many actions in sectoral adaptation plans may depend on others for funding and implementation. Early engagement to ensure 'buy-in' on actions such as this is essential. The sectoral adaptation plans must also carefully consider implementation, monitoring and evaluation.

Though the impacts of climate change will increase environmental and societal stresses, the Climate Act and National Adaptation Framework also reference the need to consider any positive effects of climate change, and these (including action to realise those effects) would be expected to be considered in the sectoral adaptation plans.

General comments regarding the development of sectoral adaptation plans specific to the four themes in the National Adaptation Framework are presented briefly below.

Theme 1: Natural and Cultural Capital

The National Adaptation Framework identifies five sectors under this theme. The Department of Agriculture, Food and the Marine is the lead for development of adaptation plans for the seafood, agriculture and forestry sectors. The Department of Culture, Heritage and the Gaeltacht is assigned the lead for developing plans for the biodiversity and for the built and archaeological heritage sectors.

Cross-sectoral workshops and events have been organised by all sectors in this theme. While a non-statutory adaptation planning document for the agriculture and forestry sectors has previously been prepared, this will be the first seafood sectoral adaptation plan and its interaction with ongoing marine spatial planning processes must be explicit. The built and archaeological heritage sector is an area where Ireland can be at the forefront of climate change risk assessment, adaptation planning and action.

Theme 2: Critical Infrastructure

Under the Critical Infrastructure theme, the National Adaptation Framework identifies three sectors: electricity and gas networks and communications networks (both led by the Department of Communications, Climate Action and Environment), and transport infrastructure (led by the Department of Transport, Tourism and Sport). Two of these published non-statutory adaptation plans which are to be revised and updated in line with the requirements of the Climate Act and the National Adaptation Framework before 30 September 2019.

A cross-sectoral seminar organised in December 2018 focused on the critical infrastructure sectors, but there is a risk that the sectors remain too focused on their particular portfolios without due attention to other sectors, thereby missing critical dependencies and interdependencies associated with both risks and potential adaptation impacts. Given the importance of critical infrastructure, it is essential that plans do not focus on too narrow a range of future change in key climate variables.

Ways to increase the resilience of critical infrastructure in light of the lessons from recent weather events such as ex-Hurricane Ophelia and the 'domino' effect of disruption to electricity supply on other infrastructure and services must be considered in the forthcoming sectoral adaptation plans and are a key area for further cross-sectoral coordination. Given the location of much of our critical infrastructure on the coast, coastal erosion, flood risk and land-use changes must be carefully considered by plans in this sector.

Theme 3: Water Resource and Flood Risk Management

The National Adaptation Framework identified three sectors under this theme. The Office of Public Works is identified as the lead authority to develop an adaptation plan for flood risk management. The development of adaptation plans for water quality and for water service infrastructure is being led by the Department of Housing, Planning and Local Government. Plans under this theme will have significant cross-cutting relationship with plans in each of the other three themes as well as with local government, and cross-sectoral cooperation and coordination is particularly important here. Similar to the critical infrastructure theme, it is particularly important that plans for these sectors do not focus on too narrow a range of future change in key climate variables.

Theme 4: Public Health

The Department of Health is identified as the lead for development of a sectoral adaptation plan under this theme. It is important that development of the adaptation plan for public health considers cross-sectoral and cross-theme linkages as well as the resilience of current health infrastructure and the mental health aspects of climate change.

7.3.3 Support and Information Systems

The report of the Joint Oireachtas Committee on Climate Action recognises that adaptation measures may have high costs and that it is important to get the risk analysis right. The Committee considered that key to this is having the best possible data, models and tools available to inform understanding and decision-making.[59] It is of critical importance that this information represents the uncertainties and range of future change in key climate variables and is transparent about the limitations of data being used for adaptation planning. Where costly decisions are required, it is imperative that approaches to stress testing decisions to uncertainties in future climate change impacts are developed.

Adaptation research and the availability of evidence is also considered in Chapter 6 of this review.

Climate Ireland is a web-based platform primarily focused on providing climate information to sectoral and local authorities' adaptation planning in line with the published adaptation planning guidelines. The Council recommends that the provision of information resources such as Climate Ireland be further developed and consolidated, with appropriate funding, governance and technical advisory structures. It is noted that though the action in the National Adaptation Framework regarding Climate Ireland has not progressed significantly, putting in place 'arrangements to ensure Climate Ireland is developed to its full potential as an operational support for climate adaptation and climate action in Ireland' is an action in the Government's climate action plan 2019.

As highlighted in last year's Annual Report, adaptation is not solely the responsibility of Government; it is a shared responsibility across all sectors of society, supported by an effective partnership engaging all levels of Government, business, industry, communities and individuals. Ultimately, behaviour and investments by the private sector and citizens shape our resilience to climate change. Private actors therefore bear primary responsibility for the protection of their well-being and property, and their adaptation investment will be very important at local and individual levels. Climate change, however, has the potential to have a disproportionate impact on vulnerable and marginalised communities and individuals. Awareness of the need for adaptation remains poor, with correspondingly low levels of willingness to engage. Resources such as Climate Ireland (particularly in terms of visualisation of climate change and impacts) may have a role here.

The Network for Greening the Financial System (NGFS) was launched in December 2017 and provides a platform for central banks and supervisory authorities to share knowledge and develop common strategies. Its first comprehensive report acknowledges that climate-related risks are a source of financial risk across all sectors and financial systems must be resilient to them.[147] The NGFS report highlights that though the effects of climate change will become more significant in the medium to longer term, more immediate action is required – this underscores the need for an effective partnership engaging business and Ireland's financial community, the climate stress-testing of the financial sector's planning, and the supervisory strategies of central banks and financial regulators.

The Governor of the Central Bank of Ireland has noted the challenges posed by climate change for the Irish financial system, with an increase in the frequency of severe weather events having implications for macroeconomic outcomes, asset prices, house prices, credit risks and the cost and coverage of insurance contracts. He notes that the Central Bank will need to ensure that these financial stability risks are contained by improving the climate resilience of the financial system, while the Central Bank also has a lead role in ensuring that financial firms incorporate climate change into strategic and financial plans, and that consumers have sufficient information to navigate the financial risks posed by climate change.[148]

Projected changes in climate are expected to have wide-ranging impacts and economic effects on natural and human systems in Ireland. Inaction would result in large economic costs, even under optimistic climate change scenarios. Adaptation has an extremely important role in reducing the economic costs of climate change. However, there is currently limited information on these costs, and further work is urgently needed to build the evidence base to facilitate informed, cost-effective and proportionate adaptation. As noted in the Council's December 2018 response to proposed changes to the Public Spending Code, European Commission guidance on cost–benefit analysis of EU co-financing requires that climate change mitigation and adaptation needs, as well as disaster resilience, are demonstrably taken into account. It is important that public spending has due regard to adaptation using an appropriate range of global warming scenarios, including those of potential higher warming, in addition to cost-effective risk management.[149] A model to quantify costs due to severe weather across all sectors and Departments is also required.

The National Dialogue on Climate Action continues as a very useful mechanism to engage stakeholders and to identify and address barriers to adaptation at local, regional and national levels, and it could be utilised further to advance the adaptation agenda. The Climate Action Regional Office structure may also have an important role to play in this regard, and further consideration of this role is warranted.

7.4 Measuring Ireland's Preparedness

7.4.1 Lessons from Specific Events

Last year's Annual Review discussed weather events in 2017 and early 2018 including ex-Hurricane Ophelia and flash flooding in Donegal. In contrast, the summer of 2018 will be remembered for heatwave and drought conditions that affected many parts of the country.

Box 7.1: *Summer 2018 heatwave*

Globally, 2018 was the fourth warmest year on record, with above-average temperatures widespread and the World Meteorological Organization describing the summer as an exceptionally warm and dry period in the United Kingdom and Ireland.[150] Another study concluded that last summer's concurrent heatwave across the Northern Hemisphere – including many European and Asian countries and the United States – could not have occurred without human-induced climate change. The study also finds that summer heatwaves on the scale of that seen in 2018 could occur every year if global temperatures reach 2°C above pre-industrial levels. If global warming is limited to 1.5°C such heatwaves could occur in two of every three years.

In Ireland, a heatwave is defined as five days with temperatures over 25°C and drought is defined as a period of 15 or more consecutive days on which no significant rain fell. 32°C, recorded at Shannon Airport, Co. Clare on 28 June 2018, is the highest temperature ever recorded at a synoptic station in Ireland. Official heatwave conditions were recorded at 15 stations at various times between 24 June and 4 July. Drought conditions were recorded across the country from late June onwards.[151]

A preliminary analysis of the heatwave across northern Europe by the World Weather Attribution (WWA) network found that human-caused climate change made it five times more likely to have occurred. The findings suggest that rising global temperatures have increased the likelihood of such hot temperatures by five times in Denmark, three times in the Netherlands and two times in Ireland.[152]

Although temperatures fell back in July, rainfall amounts remained well below average for the summer season. This meant that there was little or no alleviation in the drought conditions. These conditions were reflected by falling water levels in rivers and groundwater, with several rivers reaching their lowest levels on record. These conditions were compounded by the normal seasonal cycle, whereby the driest period usually occurs from August to the end of September, leading to a longer recovery time for normal moisture levels. Sustained rainfall would be needed during autumn to restore both groundwater and river levels to near-normal conditions.

Water temperatures in our rivers and lakes were significantly higher than normal during June and July, with low flows adversely affecting fish and aquatic life at some locations. Issues arising from such conditions included maintaining water supplies and water quality, preventing wildfires, managing the effects on inland fisheries, minimising the effects on agriculture, water safety and caring for vulnerable populations.

Irish Water introduced a water conservation order (ban on the use of hose pipes in domestic settings) with effect from midnight on 5 July 2018, urging people everywhere to conserve water. Water pressure was reduced in many areas at night to further conserve supply. The conservation orders remained in place on a national basis until 31 August and in specific regions until 30 September.

The Soil Moisture Deficit (SMD: the mm amount of rain needed to bring the soil moisture content back to field capacity) for the Teagasc centres (Moorepark, Oak Park, Ballyhaise and Johnstown Castle) was 49 for the period June–September 2018. The corresponding average SMD for these sites was 24 for the previous five years. According to Pasturebase Ireland, there was a 30% reduction in grass growth in 2018 compared to the average daily grass growth rate for the years 2013–2017. A shortfall in supply compared to demand resulted in significant supplementation with conserved forages and concentrate feedstuffs – purchased concentrate costs increased by 42% at 1,364kg per cow, on average. Expenditure on purchased bulky feed also increased strongly (by 85%), to €5,966 on average.[153] Also, the Department of Agriculture, Food and the Marine issued a condition red forest fire danger rating notice in June given the high risk of wildfire development and spread.

Importantly, early analysis shows that while the summer 2018 drought was intense, it was considerably more short-lived than previously identified historical droughts. Contrary to prevailing perceptions, Ireland is drought-prone. Research shows that during the years 1850–2015 there were seven major drought-rich periods with an island-wide fingerprint, in 1854–1860, 1884–1896, 1904–1912, 1921–1924, 1932–1935, 1952–1954 and 1969–1977.[154] During the 2018 drought record low river flows were not typically observed in monitoring stations that have been active for more than 20 years, with lower flows observed during 1995 and 1976 in many regions.

This, reinforced by the experience of the summer of 2018, should strengthen the evidence base for future drought and water resource planning in Ireland. More widely, it demonstrates the benefits of 'low regret' and 'no regret' adaptation actions for all sectors.

The impact of increasing temperatures on incidences of heat stress and on conditions for patients in hospitals due to the nature of the hospital building stock requires consideration, as does the potential for delayed health impacts (e.g. skin damage). How building standards reflect potential changes in Ireland's climate – such as an increased likelihood of the occurrence of heatwave events as well as changes in rainfall patterns – will also be key to ensuring homes and buildings are climate-ready, efficient, comfortable and safe. Similarly, how housing and planning policy considers impacts such as urban heat islands will also be important.

In the Advisory Council's view, how the emergency management system links with adaptation planning, particularly in relation to ensuring the resilience of critical infrastructure and health, remains unclear. It is essential that learning from recent severe weather events is circulated widely and that findings are made available promptly to inform adaptation planning.

In March 2019, a snow event caused disruption to some of the motorway network, particularly in County Kildare. Though the event was forecast and a yellow weather warning was in operation, it demonstrated difficulties that can arise when communicating with the public and for emergency responders and infrastructure providers in mobilising resources to address a rapidly evolving situation (in this instance it was reported that snow ploughs were caught in traffic).[155]

7.4.2 Indicators

As shown above, weather and climate events in recent years have revealed strengths and weaknesses in Ireland's capacity to respond to and recover from extreme events. A wider set of indicators is required to assess Ireland's preparedness and the effectiveness and cost-efficiency of our planning for resilience. Appropriate indicators enable critical assessment and review of adaptation actions and early identification of issues, and can also assist in communicating with the public on climate change issues.

Many 'rankings' of countries' performance on climate action do not include an adaptation component – this risks underestimating the importance of adapting to an already changing climate while diluting opportunities to share best practice and learning across countries.

The evaluation of the EU adaptation strategy acknowledges that 'there is margin to improve implementation and monitoring, for example by developing meaningful indicators to monitor the socio-economic impacts of national strategies and to assess the value of the prevention and

management of risks linked to climate change'.[156] Assessment of climate change adaptation in Ireland has, to date, been mainly process-oriented and needs to urgently shift to incorporate actions.

The National Adaptation Framework notes that a priority for Ireland will be a project to develop a range of adaptation indicators to enable progress in preparing for the long-term effects of climate change to be monitored. Considering the nature of adaptation (a continuous learning and improvement process), a project should be seen as initiating such an effort by developing an initial set of indicators and should be used to identify a programme to sustain an effective set of such indicators.

The 2018 EPA study 'National Preparedness to Adapt to Climate Change: Analysis of State of Play' describes a 'pressing need for a national monitoring framework and indicator set for Ireland', saying that such an indicator set should 'be able to track adaptation progress, monitor effectiveness and communicate on the transition to climate resilience across all levels and spheres of decision-making (horizontal and vertical)'.[157]

Ireland's adaptation scoreboard, published as part of the evaluation of the EU's adaptation strategy, found that sub-national monitoring of adaptation in Ireland was yet to take place. Given the emphasis on local and regional adaptation in the National Adaptation Framework and through the Climate Action Regional Offices, indicators should be locally relevant and relate to reporting processes under the Covenant of Mayors for Climate and Energy.

A research project considering 'selecting and using indicators of climate resilience' has recently begun under the EPA's climate research programme.[158] The Council notes that researching appropriate adaptation indicators has been a component of a number of recent research projects[159,160,161] and recommends that in line with the National Adaptation Framework, a robust set of indicators be adopted by Government as quickly as possible and reported on as part of the Annual Transition Statement process.

Indicators should be as user-friendly as possible while being suitable to inform policy, and take Irish circumstances and sectoral priorities fully into account. They should rely on information that is already being collected at sectoral or national level where possible and should be capable of being updated regularly. Data sets currently compiled by the Central Statistics Office, EPA and Met Éireann would be useful starting points. Indicators should be compatible and reflect information required under EU and international reporting processes.

7.5 Advice and Recommendations

To address issues with monitoring and reporting on adaptation at national level, an agreed set of climate change adaptation indicators should be developed and implemented as quickly as possible and reported on through the Annual Transition Statement process. Progress on the 'supporting objectives' of the National Adaptation Framework should also be recorded.

In the draft sectoral adaptation plans to date, much of the discussion on monitoring and evaluation has been generic and drawn from the guidelines, with little detail on how it will be applied in the context of the sector. The implementation and funding of these sectoral adaptation plans will be a key focus for the Council in the coming years.

The private sector and citizens bear primary responsibility for the protection of their well-being and property, and their adaptation investment will be very important at local and individual levels. Awareness of the need for adaptation remains poor, with corresponding low levels of willingness to engage. The National Dialogue on Climate Action and the recently established Climate Action Regional Offices, working through local authorities, can play a significant role in addressing this gap, but the Government must do more in terms of guiding and regulating the actions of individuals, communities and enterprises to enable adaptation actions. This should be addressed in sectoral adaptation plans and in local adaptation strategies.

Recent weather events confirm the importance of continuing to build Irish capacity in terms of impact-based forecasting while also increasing public understanding of the current weather warning system. In this context, the finalisation of a national Flood Forecasting and Warning Service is also essential. The Council considers that the increased application of impact-based forecasting will increase public awareness, understanding and confidence in weather warnings, thereby playing an important role in raising awareness of the need for enhancing resilience and adaptation actions.

With regard to the available consultation draft sectoral adaptation plans, a statement at the beginning of the plan/strategy demonstrating how the Climate Act, National Adaptation Framework and the relevant adaptation guidelines have been considered would be useful. They should also be explicit about the climate data and projections/scenarios they have used in the process. Projections of future climate are not perfect and should not be treated as such. High-resolution modelling may give a false sense of confidence for example, therefore decision-makers should give due regard to the uncertainties which are evident in the range of models available. Development of a common set of climate projections that capture the range of change in future climate projections for use in adaptation, infrastructure and investment planning to 2050 and beyond should be advanced.

In developing adaptation plans and strategies, sectors and local authorities should ensure that ways to identify maladaptation early are identified and strategies to counter this are put in place.

Though some topics may not fit neatly into sectoral bounds, with implications for all sectors and all levels of decision-making (e.g. health, biodiversity), this does not diminish the responsibilities of the Minister preparing the plan under the Climate Act and Framework to consider what actions they can put in place to increase Ireland's climate resilience.

It is important that plans and strategies are specific about the structures they are using to integrate/mainstream adaptation considerations into other plans and policies, both within their Department and externally. How resilience is built in important areas such as tourism, sport, emergency management, housing and planning and coasts should also be considered across the developed plans as appropriate.

The sectoral adaptation guidelines discuss considerations and questions to pose when assessing adaptation actions. Any actions in sectoral plans must be carefully considered, targeted and realistic, particularly identifying risks to implementation and mitigation plans when their delivery might rely on external stakeholders and there is a risk of a low level of commitment to implementation from responsible bodies. The sectoral adaptation plans must consider how the impacts of events are captured at a sectoral level. A common approach to funding repair of public infrastructure and collating information on the economic losses, costs and damage arising from extreme events should be developed.

Investment decisions should be evaluated and stress tested against a wide range of climate models, greenhouse gas emissions scenarios and data types. Last year's Annual Review commended the Office of Public Works for its robust and comprehensive analysis of river basin flood risk across the country; this continues to be a possible model for other sectors, including in capturing costs and benefits of adaptation interventions.

Given that the Climate Action Regional Offices are to progress climate action at local level in terms of both mitigation and adaptation, it is essential that potential co-benefits are strongly considered at this level and that any synergies are exploited, and any conflicts addressed. This is particularly relevant with regard to energy supply, biodiversity, spatial planning and land use and the built environment. Synergies with the Covenant of Mayors for Climate and Energy should be utilised.

Links between marine spatial planning (MSP), integrated coastal zone management/ integrated coastal management (ICZM/ICM) and sectoral and local adaptation planning must also be strengthened, with the ownership of adaptation within coastal and marine governance and coordination structures clarified.

Further work is required on the areas identified as not advanced in the European Commission's scoreboard assessment of Ireland – in particular those relating to integration with disaster risk reduction planning and insurance.

It is important that policy coherence between the Paris Agreement climate goals, the Sustainable Development Goals and the Sendai Framework is considered in the preparation of sectoral adaptation plans. It is unclear how 'Lead Government Departments' for emergencies are linking with sectoral adaptation planning and local-level adaptation. The Government Task Force on Emergency Planning should ensure that climate resilience is adequately considered and that there is regular engagement with the sectors responsible for sectoral adaptation plans and local authorities.

In the preparation and communication of adaptation planning, clarity should be provided on the assessment of risk, exposure, vulnerability, resilience and adaptive capacity, and the decision-making framework under which options are considered. This should include criteria for prioritisation, implementation, monitoring and evaluation. These would set the stage for consideration of the types of options to develop and the need for a robust and credible portfolio of measures.

Once in place, a review of statutory sectoral adaptation plans should be undertaken to identify priority risks which need to be addressed and resourced over their five-year span with a clear process for the implementation and monitoring of plans through national, as well as sectoral, governance structures.

Adaptation is a continuous learning and improvement process. As such, the plans and strategies need to recognise the areas where further improvements are needed and the process for progressing their respective plans and strategies.

The role and reach of the National Dialogue on Climate Action could be extended to cover climate impacts and adaptation as a responsibility.

8. Special Focus: Agriculture, Forestry and Other Land Use

Key Messages

- Considerable opportunities exist within the Agriculture, Forestry and Other Land Use sector to address climate change while providing multiple co-benefits to society.
- In framing recommendations for policy change in agriculture and other land use, the Council seeks to ensure that there is a substantial reduction in greenhouse gas emissions while, at the same time, providing that necessary policy changes will safeguard the incomes of farmers and land managers, and their long-term financial security.
- The observed trend in the expansion of the national dairy herd has been the major contributor to increases in agricultural emissions in recent years. Continued reduction of the suckler herd would make an important and cost-effective contribution to mitigation within the sector. The potential release of land from beef production could support alternative uses, raise farm incomes and reduce exposure of the sector to external market shocks.
- The forthcoming reform of the Common Agricultural Policy will provide an opportunity to help motivate the necessary changes in the Agriculture sector to ensure a significant reduction in greenhouse gas emissions by 2030, while at the same time ensuring growth in the financial well-being and security of farmers.
- Addressing the recent declines in afforestation rates is a priority for policy action. Many aspects of the national transition objective are contingent on an expanded and sustainable domestic forestry sector. Ways to address barriers to afforestation require consideration and urgent implementation.
- Land use in Ireland is a net source of emissions, primarily due to the ongoing drainage of organic soils. The drainage of peatlands for different uses needs to be addressed. Urgent assessment and implementation of appropriate management options for degraded peatlands, notably regarding rewetting, is required.
- Mitigation activities within the Agriculture and Land Use sector can provide additional ecosystem services including: protecting biodiversity; improving soil, air and water quality; flood alleviation; ensuring resilience to climate change; and enhancing Ireland's natural environment.
- Policies implemented to achieve mitigation may have social implications that need to be addressed for just transition. Engagement with all relevant stakeholders and their empowerment via re-skilling and investment in low-carbon opportunities will be key.

This chapter is informed by the findings of an expert working paper on climate change mitigation within Irish Agriculture, Forestry and Other Land Use.[162] The working paper collates information from relevant literature and expert opinion and is available on the Council website.

8.1 Irish Agriculture, Forestry and Other Land Use

8.1.1 Setting the Scene

Agriculture utilises approximately 65% (4.5 million hectares) of the land area of Ireland.[163] Forests cover 11% (0.77 million hectares), while peatlands including bogs and heath are estimated to account for 16% (1.1 million hectares). Approximately 56 thousand hectares of peatlands is classified as currently utilised for either domestic or industrial peat extraction. [3,164] Of the agricultural area, 91% (4.1 million hectares) is utilised for livestock, with 9% (0.35 million hectares) under cereals, fruit or horticultural production.

8.1.2 Agriculture

Agriculture accounts for 32% of Ireland's greenhouse gas emissions and is the largest sectoral emitter, emitting 19.6 Mt CO_2eq in 2017 excluding associated energy use.[3] In the EU, agriculture accounts for approximately 10% of EU greenhouse gas emissions, highlighting the unique significance of the sector within the Irish context.[165] Emissions in Irish agriculture have steadily increased by 14% since 2011, largely due to increasing dairy cow numbers and nitrogen fertiliser use. [3,166] Methane (CH_4), nitrous oxide (N_2O) and carbon dioxide (CO_2) represent approximately 66%, 32% and 2% of Irish agricultural emissions respectively.

Bovine production systems dominate land use and agricultural greenhouse gas emissions in Ireland. The Joint Oireachtas Committee on Climate Action and the Climate Action Plan 2019 recognise the potential value of land use diversification.[62,167]

Cattle generated 92% of agricultural methane emissions, representing approximately 60% of total agricultural emissions and 19% of national greenhouse gas emissions in 2017.[3] Figure 8.1. shows the principal bovine production systems in Ireland and provides a simplified overview of the interactions between dairy and beef systems.

As of 2018, the national herd stood at about seven million animals, representing a slight (0.7%) decline from 2017 levels.[168] Compared to 2005, the base-year for European Effort Sharing Regulation (ESR) emission reduction targets, the overall herd is at approximately the same size, with a slight increase of 0.3%. Dairy cow numbers have increased by 39% over the same period. In contrast, suckler (non-dairy) cow numbers have been declining, with a 9% reduction observed since 2005. Other livestock make relatively minor contributions to greenhouse gas emissions.

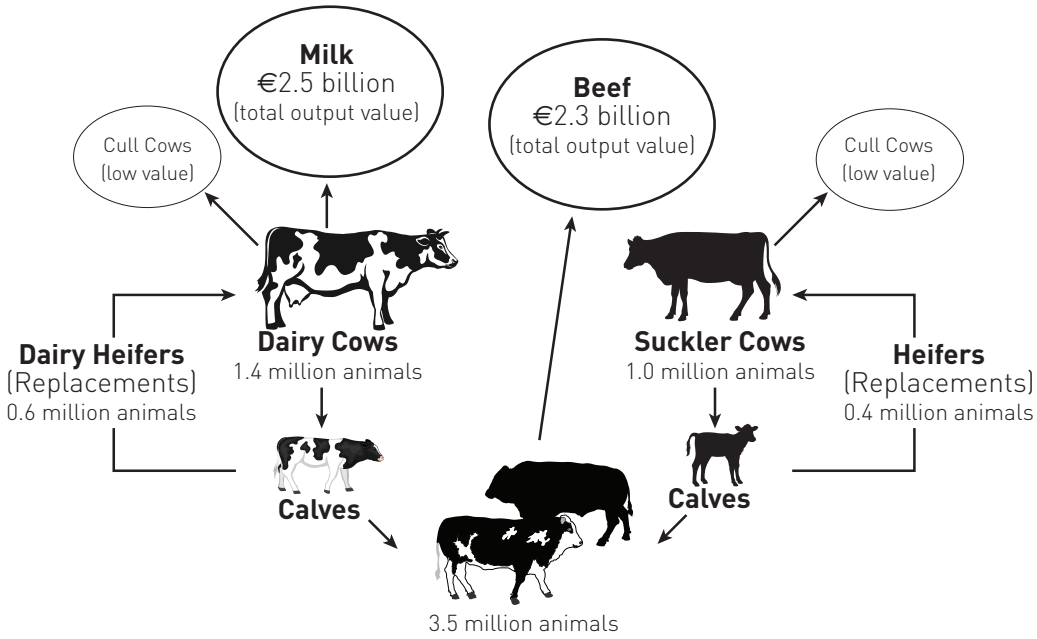

Figure 8.1: *A schematic of the structure and integration of Ireland's cattle production systems (based on CSO 2018 livestock numbers and provisional output values)*

Box 8.1: *Drivers of agricultural expansion*

Several key drivers have promoted expansion of agricultural production in Ireland during the past decade.

Global market demand for beef and dairy products has increased, with the expansion of the global middle class.

Abolition of the Milk Quota in 2015 removed constraints and enabled farm enterprises to expand production to meet growing demand.

There have been successive industry-led development strategies for the agri-food sector including Food Harvest 2020 and FoodWise 2025. FoodWise 2025 has sought to increase the value of production; for example, it aims for an 85% increase in the value of agri-food exports along with a 65% increase in the value of primary production.[169]

Several other policies and measures may have provided indirect incentives for production.

Beef sector supports such as the Suckler Welfare Scheme and, more recently, the Beef Environmental Efficiency Pilot Scheme (BEEPS), though designed to enhance production efficiency, are administered as livestock headage payments, arguably leading to the maintenance of livestock numbers.

The Targeted Agricultural Modernisation Scheme (TAMS) provides support for capital investment on farms including selected dairy equipment, enabling improved efficiency and emissions reduction on farms and production expansion.

An increase in agricultural greenhouse gas emissions to 2030 is projected. In its 'with additional measures' scenario, the EPA projected a 3% increase on 2018 levels by 2030, driven by increases of 11% in the dairy cow herd and 6% in fertiliser use between 2020 and 2030.[13]

Agriculture is also responsible for 99% of Ireland's ammonia (NH_3) emissions, which currently are in breach of legislative targets.[170,171] Agriculture was identified as a contributor to river water pollution and a threat to biodiversity.[172,173,174] As a general principle, sustainable agricultural production should only occur within all environmental boundaries, not just impacts on climate.

Maintenance of current levels of production, which principally supply export markets, has been rationalised by the relatively low carbon footprint that Irish bovine production systems have in a global context (Box 8.2) and the risk of emissions leakage if production in Ireland declines.[185,75] In the context of agriculture, leakage may occur when a reduction in national emissions due to a reduction in production in Ireland leads to a market response whereby production is displaced and occurs elsewhere, and possibly with a higher carbon footprint.

The extent to which leakage may occur is unclear and dependent on multiple factors, including international trade agreements, the carbon footprint of production in other countries and their own commitments to emission reductions.

In addition, Ireland has committed to an absolute reduction in greenhouse gas emissions under the EU Effort Sharing Regulation (Section 8.2), which encompasses agricultural emissions. Therefore, the carbon footprint of production in Ireland is relevant to targets only in so far as it can contribute to reductions in national emissions.

Box 8.2: *Do Irish bovine production systems have low carbon footprints?*

A number of studies have investigated the carbon footprint of different livestock production systems. Comparison between studies is difficult and must be considered with caution due to differences in methodology and definitions of system boundaries.[175]

Dairy Production

Life Cycle Assessment (LCA) analysis indicates that temperate grass-based milk production may have a lower carbon footprint compared to other dairy systems in other regions.[176,177]

In a major study that compared different countries, Ireland was found to have one of the lowest levels of emissions per unit of milk across the EU-27, at 1 kg carbon dioxide equivalent per kg of milk, compared to an average of 1.4 kg carbon dioxide equivalent per kg of milk.[177] In contrast, in a study using different LCA modelling assumptions and methodology, Ireland was found to have the fourth highest emissions per kg milk across the EU-27 at approximately 1.6 kg CO_2eq/kg milk compared to an average of 1.3 kg CO_2eq/kg milk.[178] A further study found high-performance Irish grass-based systems to have a 5% to 7% lower footprint compared to confinement systems in the UK and the USA respectively. Importantly, carbon sequestration to grassland soils within the Irish system makes a significant contribution to lowering the footprint in these studies.[179] Ploughing of additional lands to produce feed, either in Ireland or for import from other countries, may adversely impact on the carbon footprint of confinement systems. The Origin Green Sustainability Report in 2016 indicated that participating dairy enterprises have an average carbon footprint of 1.1 kg carbon dioxide equivalent per kg of milk product. The report notes a large variation in performance, from 0.8

to 1.7 kg carbon dioxide equivalent per kg.[180] Teagasc also reported variation in greenhouse gas emissions between dairy enterprises and showed better economic performance was associated with lower carbon footprint of milk.[181]

The available evidence suggests that Ireland has a relatively low carbon footprint for dairy production. There is room for improvement across the sector in closing the gap with the best performers. Recent analysis by Teagasc indicates research and advisory support is helping to reduce this gap and thus milk's emissions.[181]

Beef Production

Ireland is the fifth largest beef exporter in the world, exporting principally to Europe and estimated to account for 9% of total EU beef production.[182,183]

Life Cycle Analysis studies indicate that Ireland has the fifth lowest carbon footprint within the EU-27: 19 kg carbon dioxide equivalent per kg of beef compared to an EU average of 22.[177] Using different methodology, Ireland was found to have the ninth highest carbon footprint within the EU-27 at approximately 28 kg CO_2eq kg beef compared to an average of 22.6.[178] A separate review explored the carbon footprint for global beef production regions (Canada, USA, EU, Australia, Brazil). This study suggests Ireland is closer to the average footprint. The study also highlighted the importance of accounting for land-use change, which may not always be considered in life cycle analysis, where Ireland may have a considerably lower footprint than some non-EU countries.[184] The Origin Green Sustainability Report of 2016 indicates that participating beef enterprises have an average carbon footprint of 11.6 kg carbon dioxide equivalent per kg of beef liveweight. The report notes a large variation in performance, from 5 to 18 kg carbon dioxide equivalent per kg.[180] Similarly, Teagasc has indicated variation according to economic performance of enterprises and type of beef cattle i.e. suckler or dairy breeds.[181]

Ireland has an average-to-low carbon footprint for beef production, though inconsistencies in studies make definitive conclusions difficult. There is room for improvement across the sector in Ireland, through closing the gap with the best performers.

The Agriculture sector provides important socio-economic benefits, notably in the rural economy.[185] The value of primary outputs from livestock, milk and cereals was approximately €2.7, €2.6 and €0.24 billion respectively in 2017.[163] Overall, the agri-food sector accounted for 7.9% of total employment in 2017 and generated €13.6 billion in exports in 2018.[186,182] Most of the food produced in Ireland is exported, with for example 91% of the beef produced exported in 2017.[168] A reduction in the consumption of animal-sourced food in Ireland is unlikely to have significant impact on Ireland's dairy and beef production or absolute agricultural greenhouse emissions, due to the high level of access to export markets. Ireland supplies to large EU and growing global markets and therefore changes in domestic consumption will have negligible impacts on the market forces influencing production. The Teagasc 2017 National Farm Survey (NFS) indicated an increase in average family farm income, though this was largely attributed to gains made within the dairy sector.[187] Average farm income across all farm types was €31,412. Estimated average farm income per system and the associated proportional contribution of direct payments are outlined in Table 8.1. Dairy farming was the most profitable system, while beef and sheep production were the least profitable. Only 25% of beef enterprises were classified

as economically viable, with direct payments contributing 114% and 96% of farm income for cattle rearing and cattle finishing enterprises respectively.[187,181] In other words, cattle rearing systems are loss-making while cattle finishing enterprises are barely making a profit. Average farm income of cattle rearing enterprises was €12,529, with gross margins of €782 per hectare. In an economic context, farmers on average generate sufficient returns from dairy production and are paid the world market price for milk. Therefore, this sector is not at risk from changes in trade regulations. Beef farmers on average, however, make very little. They are also paid a price well above the world market price. Thus, beef enterprises are vulnerable to market shocks including changes to market access under free trade agreements.

Table 8.1: *Breakdown of average farm income and contribution of Direct Payments by farming system according to the Teagasc National Farm Survey* [187]

Production System	Dairy	Arable	Cattle Rearing	Cattle Finishing	Sheep
Farm income	€86,069	€37,028	€12,529	€17,199	€16,586
Gross margins per hectare	€2,856	€1,202	€782	€927	€643
Direct payments	€19,328	€23,239	€14,242	€16,436	€19,145
Contribution of direct payments to farm income	22%	63%	114%	96%	115%

The age and social profile of farmers is a matter of concern. For example, the average age of beef rearing and beef finishing farmers is 56 and 57 years respectively.[187] Approximately 32% of beef farmers are above 60 years of age with no other household member less than 45 years. In addition, 23% of beef farmers were identified as living alone and at risk of isolation. Both isolation and age profile are negatively correlated with economic performance.[181] On small farms, where output is valued at less than €8,000 per annum, 32% are managed by farmers older than 65 years, while 28% are single-person households.[188] Teagasc, in collaboration with Mental Health Ireland, has highlighted these factors and others that may increase the risk of mental health concerns, including depression and anxiety, within farming communities. In addition to isolation, financial burdens, taxation, and livestock health or loss can cause stress and negatively impact mental health.[189]

8.1.3 Forest

Forests are an important carbon sink (–3.7 Mt CO_2eq reported in 2017), and afforestation is a key mitigation strategy.[3,190,72] At 11%, or 770,020 hectares, Ireland has one of the lowest levels of forest cover in Europe. Irish forest coverage increased from 1% in the early 1900s to 7% in the 1990s, with a target of 18%, or 1.2 million hectares, coverage by 2046.[3,191] Approximately half (51%) of the current stand is in public ownership and the remainder privately owned, of which 71% was supported by grant aid.

Deciduous trees represent 29% and conifers 71% of the national stand.[164] The biomass sequestered to Irish forests was estimated to contain 74 tonnes carbon per hectare in 2012, a 34% increase from 2006.[3] It is worth noting that 45% of the national stand is less than 20 years old and consequently a large portion will reach harvestable maturity from 2025 onwards, potentially impacting the rate of carbon sequestration.

For maximum carbon sequestration in forestry, monoculture conifer stands on mineral soils are the most productive. However, this may negatively impact biodiversity, water quality and landscape aesthetics, while also potentially reducing resilience of the stand to outbreaks of disease. The importance of diversity within afforestation has been emphasised.[192]

Current afforestation rates are approximately 4,000 hectares per year (Figure 8.2), a significant shortfall from the 15,000 hectares per year necessary to achieve 18% cover by 2046.[190,191] Research has shown that there is sufficient suitable land available for afforestation, though there may be competition with other land uses. Approximately 4.65 million hectares was estimated to be technically suitable for forestry in Ireland. Of this, 52% is productive agricultural land and 19% designated for existing habitat conservation. The remaining 1.3 million hectares includes marginal agricultural land and degraded peatlands.[193] Disturbance of relatively intact peatlands for afforestation by lowering the water table, causing carbon emissions, should be avoided. The recent Climate Action Plan 2019 sets a target for annual afforestation rates of 6,500 hectares by 2025, increasing to 10,000 hectares by 2030. This is a serious challenge given recent trends.

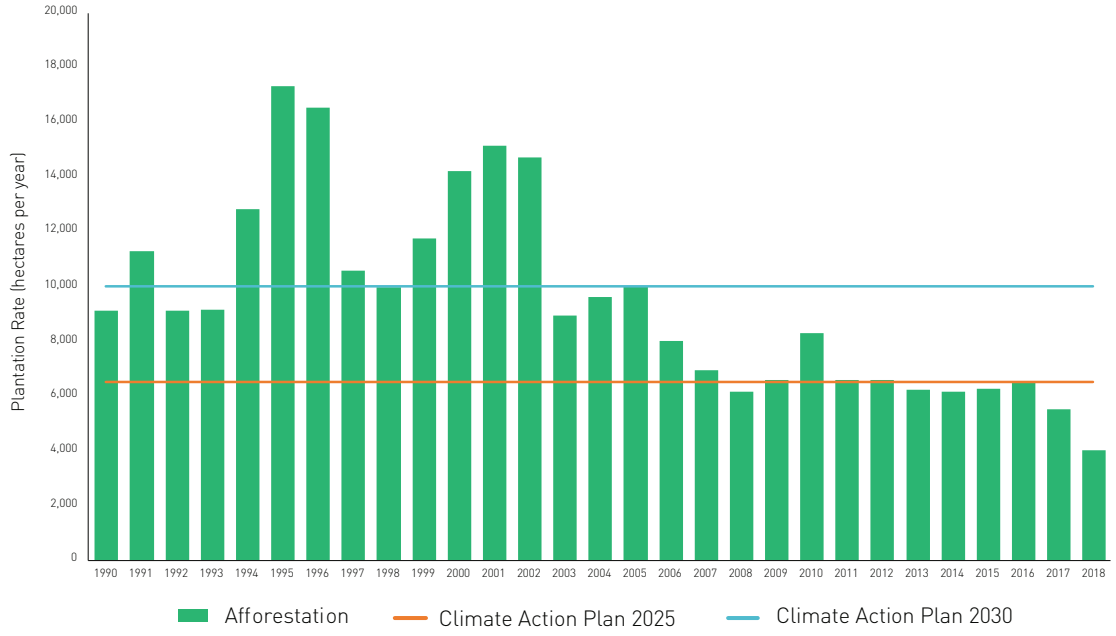

Figure 8.2: *Historic afforestation rates and afforestation targets for 2025 and 2030 as set out by the Climate Action Plan 2019 (Source: DAFM Forest Statistics and Climate Action Plan 2019)*

Despite economically attractive incentives, afforestation rates are low, suggesting that considerable non-financial barriers exist. Research indicates that attitudes and social barriers are preventing uptake, including misgivings over the condition that entry into forest schemes requires permanent conversion of agricultural land. [194,195,196]

8.1.4 Other Land Use

Total Land Use, Land Use Change and Forestry (LULUCF) net emissions in Ireland were almost 6.0 Mt CO2eq in 2017.[175] Wetlands are an important source, 3.57 Mt CO_2eq, mainly due to the drainage of peatlands. Peatlands contain up to 75% of Ireland's soil carbon stock. Over 80% of peatlands are considered degraded because of historic and ongoing drainage to facilitate peat extraction, agriculture or forestry.[197]

An estimated 300,000 to 375,000 hectares of peatland is under grassland, which can be categorised as nutrient-rich or nutrient-poor with deep drainage or shallow drainage.[198] Nutrient-rich grasslands are typically significant emission sources regardless of drainage class. Nutrient-poor grasslands, often under extensive grazing management, tend to undergo shallow drainage where a high water table is maintained (less than 25 cm depth), and tend to have a low potential for carbon losses.[199,200]

Peat has historically been extracted for fuel, notably by Bord na Móna for electricity generation.[3] Both cutover and cutaway peatlands are considerable sources of carbon emissions.[197] In 2017, 56,000 hectares was estimated to be subject to active drainage and peat extraction.[175]

The national inventory identified a significant source of emissions associated with wildfires across various land uses.[176] Disturbances of this type may have an adverse impact on the annual reportable removals under the flexibilities allowed by the EU Energy and Climate Framework to 2030.

Although it is possible to discount emissions due to natural disturbance of this kind in reporting and accounting for targets, the affected lands cannot be included in future assessments of progress to targets until they have recovered to a condition equal to their status prior to the disturbance. Therefore, measures to manage the risk of natural disturbance in the first instance should be advanced from a mitigation and adaptation perspective. In addition, it would be prudent to enhance the carbon removal potential from all land uses in order to ensure maximum access to the flexibilities allowed under the EU Energy and Climate Package to 2030.

8.1.5 Cross-sectoral Connections

The Agriculture, Forestry and Land Use sector can play an important role in contributing to mitigation within other sectors and therefore enabling transition within the wider economy: for example, the production of biomass for heat or electricity generation, or as a source of biomethane production through anaerobic digestion, displacing the use of fossil fuels. Teagasc projects that the steady roll-out of anaerobic digestion of grass and slurry for heat, energy and gas production over the period 2021 to 2030 could displace an average of 0.224 Mt CO_2eq annually, although at a high cost of €115 per tonne of carbon dioxide equivalent abated. Further refinement of the gas generated to produce methane for injection into the national grid could displace 0.15 Mt CO_2eq per year, at a cost of €280 per tonne of carbon dioxide equivalent abated.[205] The sector also represents a key source of material for the bioeconomy, providing raw materials for valorisation or value adding and additional processing.[201]

Where carbon dioxide emissions are displaced, other emissions or unfavourable externalities may occur and trade-offs are possible within mitigation. For example, the production of grass for anaerobic digestion may involve high fertiliser inputs, the manufacture of which generates significant emissions. It is critical that the use of grass for anaerobic digestion meets sustainability criteria as outlined by the Sustainable Energy Authority of Ireland (SEAI), notably regarding European Commission greenhouse gas threshold values.[202]

Agriculture, Forestry and Land Use sector mitigation measures may also contribute to climate change adaptation.[203] For example, agroforestry may improve nutrient retention, soil stability and drainage properties, which would improve resilience to extreme rainfall events; multi-species swards may increase drought resistance; and hedgerow maintenance may enhance carbon sequestration and provide physical barriers to the spread of infectious diseases among livestock.

8.2 Policy

Current efforts to reduce Agriculture, Forestry and Land Use sector emissions are guided by (i) the National Policy Position that takes an approach towards carbon neutrality by 2050 and (ii) the European Effort Sharing Regulation (ESR) requiring a 30% reduction relative to 2005 levels in non-ETS sector emissions by 2030.[204,205]

8.2.1 National Policy

The Irish Government, following an initial National Economic and Social Council report, proposed an approach towards carbon neutrality by 2050 as a policy objective.[206,204] Teagasc explored the concept of carbon neutrality in the context of current reporting and accounting rules.[207] A key finding from the study was that Ireland should consider an approach towards neutrality rather than adopt neutrality as an endpoint. Further research funded by the EPA and the Department of Agriculture, Food and the Marine into neutrality, including its definition, commenced in April 2019, as directed under the National Mitigation Plan.[12] Importantly, the approach towards carbon neutrality requires maintaining and enhancing the store of carbon held under all land uses, as well as potential use of advanced technologies such as Carbon Capture and Storage and Direct Air Capture. Currently, Land Use, Land-Use Change and Forestry is a net source of emissions and at a minimum, this needs to be addressed. The current absence of a definition of neutrality should not prevent the implementation of cost neutral or negative mitigation measures.

Box 8.3: *Carbon neutrality*

There is currently no internationally agreed definition of carbon neutrality regardless of its application to specific sectors such as Agriculture, but it is possible to discuss the main concepts involved. It is important to note that the atmospheric lifespans of different greenhouse gases also need to be considered in the context of neutrality. Discussion on metrics is provided in Section 8.3.

One of the principal goals of the UNFCCC is to achieve the stabilisation of the global climate. The 2015 Paris Agreement develops this, stating that the global temperature increase should not exceed 2ºC with an ambition of stabilisation of temperature at 1.5ºC above pre-industrial levels. Elimination of anthropogenic emissions of all greenhouse gasses is not possible, especially those associated with food production. Therefore, a balance between emissions and sequestration and removals from the atmosphere is required, with a goal of achieving this globally in the second half of this century. To date, the most effective mechanism for removing carbon dioxide from the atmosphere has been sequestration in biomass and soils. However, there are complex interactions and competing demands on land use and climate change mitigation. There is need for careful land management at local and national scales to facilitate and optimise multiple land functions, while managing possible trade-offs. Other removal technologies are in development, including carbon capture and storage (CCS) and direct air capture (DAC), but have yet to be demonstrated at scale.

As mentioned, the properties and behaviour of the greenhouse gases differ. The question of balance or neutrality for long-lived greenhouse gases (for example carbon dioxide and nitrous oxide) is relatively straightforward. Emission of long-lived gases can be balanced by an equivalent removal of other long-lived greenhouse gases. In this way, the concentration of long-lived greenhouse gases in the atmosphere does not increase and, in the medium and long terms, the climate will stabilise.

Balancing emissions of short-lived greenhouse gases such as methane is more complex. If the rate of emissions of these is kept constant, the impact on climate will ultimately stabilise. However, a change in the rate of emission will have an additional impact on climate. If there is an increase in the rate of emission, removals from the atmosphere will be required to offset additional climate impacts. If the rate of emission decreases, the global climate will stabilise at a slightly lower temperature, reducing the need for removals to achieve a given temperature target therefore the choice of metric has important implications on the need for emissions reduction and removals. This highlights the potential benefit of reducing short-lived greenhouse gas emission rates in addressing short-term climate impacts.

Concepts of neutrality and greenhouse gas balance are expected to be further developed in the Intergovernmental Panel on Climate Change's Sixth Assessment Report.

Ireland should continue to support research into the concepts of balance and neutrality, while promoting international research and policy development on this topic.

National Planning Framework and National Development Plan

The National Planning Framework identifies the role of planning and development in providing a mechanism for the maintaining and enhancing of carbon stocks, especially in the context of forest and peatland protection.[208] This is highlighted again in the Annual Transition Statement. Regarding agriculture and land use, the National Development Plan is focused on implementation of adaptation measures to manage flooding in vulnerable areas, including nature-based solutions, which would also manage carbon stocks.

8.2.2 International Policy

The EU Energy and Climate Package to 2030 treats agriculture and land use separately. However, Ireland has negotiated the flexibility to use removals within the Land Use, Land-Use Change and Forestry sector in contributing to the Effort Sharing Regulation reduction targets to a maximum level of 5.6% of non-Emissions Trading System. This flexibility amounts to 26.8 Mt CO_2eq.[205]

Utilisation of Land Use, Land-Use Change and Forestry credits is dependent on land management leading to a net sink, with all emission sources being accounted for prior to credit transfer.

8.3 Discussion on Metrics and Mitigation

Ireland's EU 2030 emission reduction targets are accountable and measured in terms of Global Warming Potential over a hundred-year period (GWP_{100}). The scientific community has raised issues concerning the validity of this metric in the accounting of short-lived greenhouse gases in comparison to carbon dioxide.

The sustained emission of short-lived gases generates the same global temperature response as a once-off pulse emission of carbon dioxide.[209] The emission of carbon dioxide causes a long-term elevation of atmospheric concentration of the gas. In contrast, the atmospheric lifetime of methane is approximately 11 years (effectively a measure of its half-life) as methane is gradually removed from the atmosphere. At its current atmospheric concentration and without sustained emissions of methane, the atmospheric concentration would fall to zero after approximately 60 years. However, there are many natural and anthropogenic sources of methane emissions which have led to the very significant increase in the concentration in the atmosphere, now reaching approximately 1,800 parts per million, 2.5 times the pre-industrial concentration.

When the rate of emission is constant, the atmospheric concentration will stabilise as will its impact on climate. If the rate of methane emissions changes, the atmospheric concentration will also change and the climate will respond. For example, if there is a reduction in the rate of emissions leading to a decline in atmospheric concentration, a corresponding climate 'cooling effect' will occur. This property of methane and other short-lived gases is not reflected in the current agreed metric (GWP_{100}) A revised metric, GWP*, is one of a number of new metrics that has been proposed. GWP* considers the rate of emissions of gases and aims to reconcile the impact of long-lived or cumulative climate effect gases (carbon dioxide and nitrous oxide) with the ongoing emissions of short-lived gases. Modest changes in the rate of methane emissions in Ireland were projected to have a notable impact on the contribution to global climate change; a reduction in methane emissions could reduce Ireland's historic contribution to warming.[210]

Issues around metrics do not impact Ireland's obligations under the EU Effort Sharing 2030 emission targets, as the metrics under the Energy and Climate Package have been determined. However, the concern over metrics is relevant to the long-term transition objective and pursuing neutrality within agriculture and potentially, post-2030 EU targets. The use of alternative metrics to reflect the emerging science could have implications for the prioritisation of mitigation options involving methane within the livestock sector.

8.4 Options for Mitigation

Greenhouse gas mitigation within agriculture and land use requires the adoption of multiple measures, with no quick-fix or single measure available sufficient to enable the sector to make a significant contribution to the national targets. The recent Marginal Abatement Cost Curve (MACC) produced by Teagasc details 27 measures related to agriculture, land-use change and fossil fuel displacement which can form part of an effective mitigation plan. Based on these measures, the study estimated a maximum technical mitigation potential of 8.99 Mt CO_2eq per year by 2030, though not all of this can be accounted for within the Agriculture, Forestry and Other Land Use sector.[75] Cost-effective agricultural mitigation measures, equating to a carbon price of €50 per tonne abated, are estimated to deliver 2.9 Mt CO_2eq per year by 2030.

The cost per tonne of carbon dioxide equivalent mitigated ranged from –€602, a cost saving for farmers implementing beef genomic indices, to €280 for biomethane production from anaerobic digestion. Importantly, the MACC analysis accounts for technical costs but not transactional costs, including to the Exchequer or opportunity costs incurred by land managers or farmers. The projected level of mitigation depends on immediate commencement of implementation and linear adoption to 2030. Not all mitigation measures are appropriate in every situation, and at farm and landscape levels, optimal combination of measures will need to be assessed and deployed.

Many of the mitigation measures and associated changes in land management are likely to bring multiple co-benefits to society, help to address negative externalities of agriculture and therefore contribute to broader environmental, social and economic sustainability objectives. A recent International Monetary Fund (IMF) study has indicated that a shift in the French agri-food system, including the adoption of more environmentally sustainable practices within agriculture, will ultimately bring macro-economic benefits.[211]

Not all the measures outlined in the Teagasc MACC are presented in this discussion; here the emphasis is on those that are believed to be readily implementable. Additional measures identified in the expert working paper are also included.[162] The agricultural mitigation options discussed focus on grass-based livestock systems, due to their prominence in the national emissions profile.[3]

8.4.1 Immediate Actions

A number of measures have the potential to deliver significant emission reductions but require deployment at scale in the short to medium term in order to contribute to existing targets.

Bovine-related measures

Animals grazing on fresh grass have been shown to generate less methane compared to a diet of conserved grass. Extension of the grazing season increases the level of fresh grass consumed and reduces the quantity of manure stored during housing. Extension of the grazing season was estimated to potentially reduce emissions by 0.065 Mt CO_2eq annually at a cost of –€96 per tonne of carbon dioxide equivalent abated.[75] The cost savings arise due to the reduced need to house animals and manage manure. The impact of the measure on emissions can be captured through the National Farm Survey activity data and revised animal and manure storage and field deposition emission factors. Extended grazing should only be implemented where soil conditions allow, as trampling of soil in wet conditions may cause soil compaction.

Breeding indices can be used to enhance genetic traits relating to efficiency (feed intake, live-weight gain and animal health) and methane emissions, helping to reducing greenhouse gas emissions per unit of output.[212] Utilisation of the dairy Economic Breeding Index (EBI) and beef equivalents regarding both maternal and terminal traits could reduce emissions annually by 0.43, 0.025 and 0.061 Mt CO_2eq respectively, at costs of –€200, –€602 and –€215 per tonne of carbon dioxide equivalent abated.[75] However, emission factors associated with genetic traits have not been developed and would require research to enable accounting within the inventory. Furthermore, on-farm management may be challenging, depending on farming system and cattle handling facilities.

Improvements in herd health were estimated to reduce emissions by 0.131 Mt CO_2eq annually at a cost of –€46 per tonne of carbon dioxide equivalent.[75] Poor animal health and welfare negatively impacts production efficiency and increases absolute emissions.[213,214,215] These impacts are captured indirectly in the inventory by animal type and age class. Knowledge transfer and changes in on-farm management may be required in order to improve herd health.

Soil management measures

Calcium ammonium nitrate is the predominant nitrogen fertiliser used in Ireland. Its substitution with protected urea has been shown to reduce nitrous oxide emissions by 70% without causing yield penalties.[216,217] Teagasc estimates emission reductions of 0.52 Mt CO_2eq per year at a cost of €8.31 per tonne of carbon dioxide equivalent, where 50% of the calcium ammonium nitrate applied nationally is substituted with protected urea over the period 2020 to 2030. Recently developed country-specific emission factors would allow emission reductions to be easily captured within existing inventory accounting, while implementation requires minimal changes to on-farm management.[218]

Although some concern has been expressed over the fate of the inhibitor chemical in protected urea. Teagasc has indicated that these concerns are unfounded.[219] Therefore, the substitution of calcium ammonium nitrate with protected urea could take place with immediate effect.

Teagasc estimated that 88% of Irish grasslands have sub-optimal soil fertility.[220] Farmers are likely to compensate for reduced soil fertility with increased application of nitrogen fertiliser. Potential emission reductions of 0.112 Mt CO_2eq per year were estimated as a result of soil

pH optimisation by liming, at a cost of –€124 per tonne of carbon dioxide equivalent abated.[75] Emissions associated with liming are captured within existing inventory methodology. Although soil fertility management techniques are well established, low adoption rates suggest that behavioural barriers on the part of farmers and the fertiliser industry would also need to be addressed.

Animal slurry spreading is an important means of returning nutrients to agricultural land, though also a potential source of greenhouse gas and ammonia emissions. The type of application technology and conditions at time of spreading greatly influence emissions. Splashplate spreading is the most common system used in Ireland and is associated with high rates of volatilisation and therefore emissions. The appropriate use of other systems, including trailing shoe and band spreading, would reduce the risk of sward contamination, reduce ammonia and indirect nitrous oxide emissions and improve the fertiliser replacement value of the slurry, reducing the requirement for use of artificial fertiliser and lowering associated nitrous oxide emissions and input costs. Diversion of slurry to biomethane production is an option in providing resources to support the Renewable Energy Sector and bioeconomy.

Teagasc estimates that the use of low-emission slurry spreader systems for 50% of the slurry applied would mitigate 0.117 Mt CO_2eq per year at a cost of €187 per tonne of carbon dioxide equivalent.[75] Solely in terms of nitrous oxide emissions, low emissions spreading technologies are expensive to implement; however, the co-benefits in terms of reduced ammonia emissions and enhanced nitrogen-use efficiency reduce the total implementation costs significantly. Support is available through the Targeted Agricultural Modernisation Scheme (TAMS) for low-emission technologies, and uptake is strong. However, a bottleneck in delivery of equipment from manufacturers has delayed deployment.

A high proportion of grasslands in Ireland are on wet mineral soils. Improved drainage of 10% of this area is estimated to reduce emission by 0.2 Mt CO_2eq per year at a cost of €16 per tonne of carbon dioxide equivalent.[75] Reduced emissions are a result of improved soil aeration, which limits nitrous oxide emissions. A significant co-benefit to the farmers is improved soil condition and productivity, with the additional mitigation potential of requiring less fertiliser input to maintain grass growth.

Emission factors for soil drainage classes have been developed for nitrous oxide emissions, though activity data could be difficult to collate. Improved drainage may also facilitate extended grazing seasons while increasing soil resistance to soil structural damage. Soil structure underpins soil quality, or the ability of a soil to support important functions, including production and water filtration. Soil structure is damaged by soil compaction.[221] Livestock treading or machinery passage can cause compaction, especially when soils are wet.[222,223] Soil compaction can also lead to soil conditions that are favourable to nitrous oxide emissions. [224,225,226]

Carbon sequestration by afforestation

Teagasc estimated that afforestation of 7,000 hectares per annum would sustain an average carbon sink of 2.1 Mt CO_2eq annually at a cost of €45 per tonne of carbon dioxide equivalent abated.[75] Such an afforestation rate is ambitious considering the considerable social barriers that have emerged in recent years, while existing stocks reaching harvestable maturity will limit accountable carbon removals to 2030. Continued low afforestation rates will further limit mitigation capacity to 2050.

Carbon stock management in organic soils

Managed rewetting of organic soils (peatlands) presents considerable opportunity in preventing carbon emissions and, in certain cases, may sequester carbon.[227.228,197] The methodology for reflecting management of organic soils in the inventory accounting is well established.[229] The average cost of rewetting industrial cutaway and cutover bogs was estimated to be approximately €4 per tonne carbon dioxide equivalent avoided.[197] Rewetting a cutaway blanket bog was found to mitigate 75 tonnes carbon dioxide equivalent per hectare over six years.[243]

Grasslands on organic soils can also be rewetted, for example typical extensive agricultural activity could be curtailed and drainage systems allowed to naturally deteriorate. Allowance for likely associated rush (*Juncus* L.) encroachment within Common Agricultural Policy (CAP) Cross-Compliance regulations is required. Teagasc has estimated that a programme that saw the water table management of 40,000 hectares of organic soils under grasslands improved over the period 2021 to 2030 would avoid an average of 0.44 Mt CO_2eq per year over this period, at a cost of €10.9 per tonne of carbon dioxide equivalent.[75]

The impact of rewetting forest and grassland organic soils is highly variable and requires site-specific assessment.[197]

Reduction in on-farm energy consumption

The increased deployment of plate coolers, solar photo voltaic panels, heat recovery systems and variable speed drive vacuum pumps on dairy farms could reduce on-farm energy consumption.[75] On the basis of a plausible scenario for sectoral uptake of these emerging technologies over the period 2021 to 2030, Teagasc estimated 0.029 Mt CO_2eq displaced annually at a cost of –€359 per tonne of carbon dioxide equivalent. Associated emission reductions are easily captured under existing inventory accounting methodology. Minimal changes in on-farm management would be required, though behavioural and economic barriers including access to finance may delay adoption.

8.4.2 Longer-Term Actions

A reduction in bovine numbers

The national herd is a major and increasing source of greenhouse gas emissions.[3,13] The collective impact of existing mitigation measures is likely to be insufficient in achieving reductions in agricultural emission.[230,75] A reduction in the national herd is necessary to reduce absolute greenhouse gas emissions while potentially improving farm incomes and making the agricultural sector less vulnerable to market volatility. In addition, a reduction in national bovine numbers would significantly help combat localised environmental degradation, for example reducing ammonia emissions and improving water quality and biodiversity, where negatively impacted by intensive production.[172,173,231]

A reduction in bovine numbers would be achieved gradually and potentially through extensification, restructuring, re-scaling and diversification within existing enterprises, or by some enterprises switching out of food production altogether, for example towards afforestation.

Dairy production is currently economically viable.[181,187] However, dairy production is associated with greater risk of environmental degradation, for example generating on average twice the level of greenhouse gas emissions per hectare as beef production, while negatively impacting biodiversity.[232,233] Further expansion of the dairy herd should only occur within environmental

limitations and not increase the risk of adverse environmental impacts at farm and catchment scales. Derogation from the Nitrates Directive, which may have facilitated dairy production expansion in certain cases, is currently under review. This may play an important role in ensuring that production is maintained within certain environmental limitations.[234]

The majority of beef enterprises are currently economically unviable.[181,187] At farm scale, a reduction in the number of animals may actually increase farm income due to the current situation where basic farm payments are diverted to support production. From a wider rural economy perspective, beef farming provides important socio-economic and cultural benefits that must be considered.[185] Extensification, a potential means of achieving number reductions, could be encouraged by linking part of the Common Agricultural Policy payments to stocking limits or maximum nitrogen fertiliser applications per hectare as well as management of biodiversity habitats. This would have important co-benefits in terms of biodiversity, water quality and lower ammonia emissions. Farmers who agreed to participate in an extensification scheme would continue to receive their full direct payments. Indeed, it would be possible to recycle a share of direct payments from more intensive producers to top up the payments for farmers who agreed to extensification if the Government wished to do this. A reduction in beef supply would also likely lead to higher prices for the remaining cattle and for other beef farmers all things being equal assumptions.

From a greenhouse gas mitigation perspective, the impact of a gradual reduction in suckler cow numbers, in the absence of other agricultural mitigation measures, can be illustrated with three simple scenarios, as presented in Box 8.4, with additional details on the assumptions provided in the accompanying working paper.[162]

Box 8.4: *Simple scenarios exploring impacts of gradual reductions in bovine numbers on greenhouse gas emissions*

The impact of a reduction in suckler cow numbers on total agricultural greenhouse gas emissions can be explored through the following simple scenarios for the period 2019 to 2030.

Scenario A

- The dairy herd is maintained at 2018 levels
- The suckler herd declines by 15% relative to 2018

The suckler herd has been steadily declining at a rate of approximately 1.4% per annum over the past decade (2008 to 2018). If this trend is encouraged to continue, the suckler herd will reduce by approximately 15% by 2030. In this scenario, total agricultural emissions are projected to be 19.2 million tonnes carbon equivalent in 2030, or 2.9% greater than 2005 levels and 1.7% below 2017 levels (Table 8.2).

Scenario B

- The dairy herd is maintained at 2018 levels
- The suckler herd declines by 30% relative to 2018

In this scenario, total agricultural emissions are projected to reach 18.5 million tonnes carbon equivalent, or 0.9% below 2005 and 5.4% below 2017 levels (Table 8.2). This is approximately the level of reduction within the suckler herd suggested in the Teagasc baseline (S1) emissions projection for 2030.[75]

Scenario C

- The dairy herd is maintained at 2018 levels
- The suckler herd declines to pre-Milk Quota (1984) levels

The reduction in suckler cow numbers required to reach the level observed in 1984 (~479,000 cows), the year the Milk Quota was introduced, was explored. It was estimated that approximately a 53% reduction relative to 2018 would be required. With this level of reduction in conjunction with stabilisation of the dairy herd at 2018 levels, total agricultural emissions are projected to reach 17.4 million tonnes carbon equivalent in 2030. This is 6.7% less than 2005 levels and 10.9% less than 2017 levels (Table 8.2).

Table 8.2: *Summary of some projected impacts from gradual reductions in suckler cow numbers*

	2005	2017	2018[a]	2030 Scenario A	2030 Scenario B	2030 Scenario C
Dairy Cows (000s)	1,025	1,388	1,425	**1,425**	**1,425**	**1,425**
Suckler cows (000s)	1,121	1,050	1,015	**863**	**711**	**479**
Total cattle (000s) [b]	6,951	7,306	7,402	**7,002**	**6,594**	**5,973**
Bovine enteric fermentation CH_4 emissions (kt CO_2eq)	9,840	10,720	**10,855**	**10,537**	**10,005**	**9,193**
Bovine manure CH_4 emissions (kt CO_2eq)	925	999	**1,010**	**960**	**910**	**835**
Total agricultural emissions (kt CO_2eq)	18,699	19,581	**19,919**	**19,244**	**18,531**	**17,445**

Data Source: CSO, 2019; Duffy *et al.*, 2019 and EPA inventory methodologies. All projected figures are outlined in bold.
a 2018 emission values were not available at the time of publishing and therefore projections are outlined.
b Total cattle numbers differ from CSO figures due to differences in accounting methodology used within EPA emissions inventories. As these scenarios explore impacts on emissions, EPA inventory methodology was employed.

Changes in emissions from a reduction in bovine numbers would be easily captured by existing inventory methodology. It is important that where land is released from beef production, it is not utilised for more intensive and potentially environmentally damaging activities, and that adequate supports are in place to support sustainable alternative land uses such as afforestation where appropriate. Altered farm or land management, including extensification, restructuring, re-scaling and diversification or exiting from bovine production entirely, should be sufficiently supported to ensure that the mitigation actions are valued and contribute to higher farm incomes and protect socio-economic benefits to wider rural communities. It is emphasised that any encouraged reduction in suckler cow numbers must address potential adverse socio-economic and cultural impacts. It is vital that a just transition is actively pursued (see Section 8.5.4).

Carbon stocks and sequestration potential in grasslands

Irish grasslands represent the second largest stock of soil carbon after wetlands and are estimated to contain 53% of the national soil carbon stocks, with 769 (± 163) million tonnes of carbon within the top 50 cm of soil. [235,236] The Royal Irish Academy has indicated scope for further carbon sequestration in Irish grasslands.[237] Research indicates that livestock and sward management systems can be optimised to achieve carbon sequestration in mineral soils. As discussed, it may be more advantageous to rewet grasslands on organic soils. The level of farming intensity that can be sustained is farm- and site-specific. Assessment of best practice management options for optimum environmental and production outcomes requires research. Capturing impacts from changes in management and developing associated emission factors will be challenging and will require the establishment of long-term monitoring sites.

Multi-species swards

The inclusion of clover, herbs such as chicory (*Cichorium intybus L.*) and plantain (*Plantago lanceolota L.*) and diverse grass species within swards may potentially enhance livestock health, improve sward drought resistance, and reduce nitrogen leaching and the requirement for nitrogen fertiliser application.[238,239,240] Nitrogen fixation by clover indirectly reduces nitrous oxide emissions associated with fertiliser use, with benefits easily captured with inventory accounting methodology.

However, research and knowledge transfer are required regarding best on-farm management of such swards. Farm surveys in Ireland have indicated considerable scope for the establishment of multi-species swards.[241] Teagasc estimates that a programme in which 25% of beef and 15% of dairy farms achieved the inclusion of clover in swards from 2021 to 2030 would result in average annual emission reductions of 0.069 Mt CO_2eq at a cost of –€6.9 per tonne of carbon dioxide equivalent abated.[75]

Agroforestry

Agroforestry refers to the low-density planting of trees within livestock or crop production systems and provides multiple co-benefits, including enhanced land functionality, landscape value, nutrient retention, soil structural quality and hydrology, while also potentially increasing carbon sequestration. The sequestration capacity varies depending on agroforestry systems. However, 7.2 t CO_2eq per hectare per year is considered reasonable for the introduction of agroforestry on temperate grasslands.[242] Agroforestry may also promote more stable forms of soil organic carbon.[243]

Agroforestry is currently supported under forestry grants that require permanent reclassification of land and a minimum plantation density. Similar agricultural schemes that do not require the reclassification of land may be needed to enable accelerated uptake. Therefore, the definition of agroforestry used by the Department of Agriculture, Food and the Marine may require modification. Inventory methodology requires minor modification to carbon sequestration models for these less dense woodland landscapes. Significant changes in on-farm management and infrastructure may be required, while behavioural barriers may also prevent adoption.

Small-scale native woodland plantations

Agricultural grant schemes to support the planting of small-scale native deciduous woodlands, without the permanent reclassification of land as forestry, may help meet afforestation rates and bring multiple co-benefits similar to those associated with agroforestry. The associated carbon capture would be easily accounted within existing inventory methodology.

Such schemes could be directed at farms under intensive management, notably dairy production, and require the planting of a certain area percentage of holdings. The establishment of woodland is straightforward, although the reduction in farmland area and associated returns may limit adoption.

Carbon sequestration by farm hedgerows

Hedgerows are recognised as important carbon stocks and provide important co-benefits such as enhanced biodiversity, habitats, wildlife corridors and improved landscape aesthetics.[244,245,246] Hedgerows in Ireland are estimated to cover 276,460 hectares, extend for 689,000 km and, with other semi-natural habitat, may cover up to 13% of farmland area.[3,247,232] Preliminary estimates suggest that hedgerows and non-forest woodlands sequester between 0.66 and 3.3 tonnes carbon dioxide per hectare per year, providing a net removal of between 0.27 and 1.4 million tonnes carbon dioxide annually.[247]

A significant proportion of hedgerows are suggested to be inadequately maintained, exhibiting unfavourable features such as low basal density or gappiness.[248,249] Improved knowledge on optimal management for carbon sequestration is required along with further initiatives to encourage appropriate management. Additionally, the development of inventory accounting methodology for hedgerows is required.[247,3]

Energy from biomass

Teagasc estimated that the use of thinnings and sawmill residues for electricity and heat generation, short-rotation coppice (SRC) willow and miscanthus for heat generation and willow for electricity production could annually displace 0.759, 0.179 and 0.187 Mt CO_2eq respectively at costs of –€30.7, –€20, –€10 per tonne of carbon dioxide equivalent displaced.[75] The ESRI recently published a study that questions the value of diverting biomass to electricity generation.[250] Displacement of carbon dioxide should be easily captured by existing inventory methodology, although it would not be attributable to the Agriculture and Land Use sector.

However, the adoption of bioenergy crop production may be unattractive to farmers due to past experiences of market instability. The use of biomass for energy generation may be appropriate in the short term, but biomass may have greater value within the bioeconomy.

The need for anaerobic digestion of grass and slurry for energy, heat or biomethane production to satisfy European Commission greenhouse gas offsetting thresholds has been discussed (see

Section 8.1.5). Anaerobic digestion was highlighted by the Joint Oireachtas Committee on Climate Change as an important aspect of the energy transition, while the assessment of national feasibility and potential establishment of associated co-ops was recommended. The demand for grass for anaerobic digestion may provide alternative enterprise options for land released from bovine production systems. However, the sustainability of such systems requires research.

Development of the bioeconomy and circular bioeconomy

The bioeconomy comprises all activity dependent on biological resources, inducing products, systems and processes with emphasis on renewable inputs.[251] A circular economy is an economic model in which the waste of one process forms an input to another.[252] The development of the Irish bioeconomy and circular bioeconomy is recognised as a strategy in achieving decarbonisation, energy security, regional development and environmental protection.[253]

There is considerable opportunity for primary production from agriculture and forestry to provide raw materials to drive the bioeconomy. Taking a circular approach, waste generated higher up in the value-chain can be used as inputs into primary agricultural or forestry activities. This would displace fossil hydrocarbon-based or resource-intensive inputs, such as synthetic fertiliser, on which agriculture currently relies.[201,254]

8.5 Enabling Mitigation

8.5.1 Common Agricultural Policy Reform

The Common Agricultural Policy currently includes two tranches of support. Pillar 1 provides farmers with a Basic Farm Payment provided they satisfy a number of cross-compliance standards. Pillar II provides support for rural development and environmentally sustainable practices.

In 2018 the European Commission published proposals for Common Agricultural Policy reform post-2020 for the period to 2027.[255,256] Changes include simplification of the policy and greater control of support design by individual Member States. Emphasis is placed on performance- or result-based support, with nine common objectives included. Three relate to environmental management, specifically landscape and biodiversity provision, environmental care and climate change action, with 40% of the overall Common Agricultural Policy budget expected to be spent on climate mitigation. The EU will continue to oversee CAP to ensure its integrity and consistency regarding policy objectives and spending. The opportunity for greater national control of policy should be fully utilised to facilitate support for specific mitigation measures as appropriate in an Irish context.

8.5.2 Improved Knowledge Exchange

The success of climate change mitigation policies and measures within agriculture depends on farmers' lived experience, knowledge and understanding of climate change. Equally important is the active participation of farmers in the development of responses and mitigation measures. Research conducted in 2014 suggests that there is a lack of awareness and understanding of climate change among farmers.[257] Given that since 2014, Ireland has experienced an increased frequency of extreme weather events, additional research is needed to assess if farmers' awareness has changed.[258]

One-way transfer of knowledge undermines the future success of climate mitigation policy. It inherently implies that farmers' and land managers' experience with, and knowledge of, the land are not valued. At present, the perception is that the suite of policies is prescriptive and has been implemented in a top-down manner. This approach, which is perceived as focusing on the direct economic outcomes of climate action, has been progressed in the absence of appropriate active participation from farmers and land managers. In practice, local knowledge of the land can inform science and best practice and vice versa. Initiatives such as Smart Farming Initiative and European Innovation Partnership EIP-AGRI scheme form a useful template for engagement at this level. Further, local knowledge of the social and cultural values of communities can inform how to communicate scientific evidence, and in turn can inform the design of policy and enable flexible implementation of actions.

Knowledge exchange between farmers, rural communities and policymakers is critical to enabling the development and implementation of holistic policy responses that can address the wider social and environmental impacts of climate change on rural Ireland. This will also enable a just transition.

8.5.3 Agriculture and the Just Transition

Climate action within agriculture will require collaboration between all stakeholders and decision makers involved in food production, distribution and consumption. This includes farmers, processors, retailers and communities. Ideally, solutions contributing to a low-carbon transition would also add to Ireland's food security and environmental sustainability.[259]

Just Transition enables climate action by demonstrating an understanding of the root causes of the concerns of individuals and communities, and their empowerment to address the challenges. At the core of this is fostering a culture of respect and dignity between all stakeholders. Respectful and open dialogue with individuals and communities about their 'hopes and concerns' is imperative.

International analysis of consultation processes with farmers shows a tendency to focus on the economic challenges: the dialogue and policies may not have fully considered the importance of the social and cultural aspects of agriculture.[260] Agriculture is at the core of rural communities and identity across Ireland. Examples of good practice do exist, including the consultation process that informed the development of the Royal Canal Greenway in Ireland and, in a different context, the fossil fuel sector in Alberta, Canada.[65]

It is recognised that changes in policy require consideration of the role of agriculture in Ireland and the social and cultural values placed on the land. Another consideration is the decline of the sector as an attractive and viable profession. Farming is a challenging livelihood where incomes can be relatively low, work can be labour-intensive and often undertaken in isolation. The risks to health and well-being are high from external shocks to the system, isolation and climate-related impacts such as flooding and drought.[261]

Ireland can demonstrate leadership by working with the agriculture and agri-food sector to make it more resilient while still supplying food locally and globally. An example of this is the Smart Farming programme developed by the Irish Farmers' Association to enable farmers to protect the environment while saving on costs associated with, for example, energy use, fertiliser and water use.

The Irish Government has developed the policy tools and resources to ensure that the transition to decarbonisation is just. The Citizens' Assembly is recognised internationally as an effective model of public participation in national Government policy development. Opportunities exist nationally to work with the National Dialogue on Climate Action to convey what is needed to achieve the transition, explore pathways for the sector and contribute to the further development of policy. The farmers' representative organisations have a role in this, as well as other stakeholders. In addition, as local authorities develop their climate action plans with the support of Climate Action Regional Offices; and Government departments develop their respective Sectoral Adaptation Plans, there is an opportunity for active and continued public participation that supports the agricultural sector and achieves social and economic growth in rural Ireland.

8.5.4 Research and Development

Review of literature and consultation with experts has indicated a considerable need for additional research concerning both new and existing mitigation measures, the evaluation of developments and refinement of national inventory accounting in terms of emission factors and activity data collection.

From examining mitigation measures, specific requirements are identified. Considering bovine-related measures, the importance of comprehensive analysis of likely impacts of bovine number reduction, regarding required level, sectoral source, effective achievement and socio-economic impacts, is emphasised. International studies on bovine dietary additives, including seaweed extracts and enzyme inhibitors, have indicated promising results.[262,263,264,265,266] However, opportunities for administration of additives within grass-based systems may be limited and therefore problematic. Additionally, the long-term maintenance of effects within the rumen may be challenging. Research into the use of dietary additives within Irish systems and assessment of potential side-effects is required, in conjunction with establishment of associated inventory accounting methodology.

Regarding grassland management, it is clear that sward quality or digestibility can be improved by adopting rotational grazing instead of set stocking, and by grazing pasture at the correct covers or heights. In addition, there is scope to improve grass silage quality by mowing meadows at the right stage and before their heading date. Both options reduce bovine emissions intensity and could be implemented on-farm. Furthermore, these management practices can be recorded using on-line platforms e.g., Pasturebase Ireland.[267] The impact of these measures is likely to be significant, but further research is required to determine their mitigation potential. Furthermore, the national emission inventories need to be revised to capture this mitigation potential.

In terms of soil management, few technical barriers to soil fertility optimisation exist as methods are well established. Therefore, assessment of social barriers to adoption is necessary to address low uptake. Several mitigation measures require research into on-farm or 'real-life' scenarios to determine best practice. For example, studies over the past 60 years have focused on the management of ryegrass monocultures. Research is therefore required into on-farm management of multi-species swards. Similarly, it is recommended that field research be conducted into hedgerow and grassland management on mineral soils to allow modelling of biomass production and carbon sequestration under different scenarios. This will not only inform best practice guidelines but also generate monitoring data for necessary inventory accounting methodology development. The likely impacts of small-scale native woodland establishment on greenhouse gas mitigation and production require quantification.

In terms of organic soils, assessment of the suitability of specific peatlands for rewetting is required with consideration to wider catchment impacts. This is urgent, as the longer rewetting is delayed, the greater is the potential risk to long-term viability of the peatland to re-establish a carbon sink function.[197] Peatlands that are drained but remain somewhat intact (e.g. retaining surface vegetation) should be prioritised. Further research into the most appropriate management for afforested peatland is required.

In addition, scoping of the capacity of the Agriculture and Land Use sector in driving the bioeconomy at local, regional and national levels is required. This will involve the identification and quantification of potential primary products including wastes, discards or residues, along with appropriate markets or value-chains. Considering a circular approach, assessment of likely outputs higher in the value chain that could be used as inputs in agricultural and forestry production is also required. Finally, research is required for understanding the social implications of mitigation and adaptation measures in the Agriculture and Land Use sector in order to ensure that action aligns with the core goal of achieving the required transition in a just manner.

8.6 Advice and Recommendations

There is considerable opportunity within the Agriculture, Forestry and Other Land Use sector to address climate change while providing multiple co-benefits to society. A review of existing literature and collation of expert opinion outlined in the supporting working paper has identified a clear and urgent need for changes in management and associated policy within the sector. Issues are complex and interlinked and have social bearing, with no quick-fix solutions. However, the Council recommends the implementation of the following;

- **A reduction in bovine numbers.** Further expansion of the dairy herd will increase national emissions and may cause other environmental issues. Expansion is sustainable only if it takes place within a scenario in which overall agricultural emissions are declining. Accelerated decline in suckler cow numbers would be an important contribution to emissions reductions. Reductions should be facilitated by long-term and consistent supports and incentives to provide favourable environmental outcomes and alternative economic opportunities. When combined with the benefits of alternative land use, such measures could safeguard farm incomes in the long run and increase farmers' financial security.

- **Address the drainage of peatlands.** Land use in Ireland is a net source of emissions, primarily due to the ongoing drainage of organic soils for different uses, including peat extraction, grazing and to a lesser extent forestry. Management options for wetlands require urgent assessment and implementation.

- **Increase afforestation rates.**

- **Agroforestry should be considered.** Agroforestry appears to bring multiple co-benefits, including enhanced carbon sequestration in agricultural systems, and, pending further research, should be pursued.

- **Implement cost-effective agricultural mitigation measures identified in the Teagasc Marginal Abatement Cost Curve.** The Common Agricultural Policy provides a useful mechanism for implementation of many of the measures identified.

- **Support additional research into mitigation options.** Research requirements concern existing and new mitigation measures, their technical implementation, potential impacts or trade-offs and developing inventory accounting methodology.

- **Provide resources for effective knowledge exchange**. Adoption and successful implementation of climate change mitigation policy and measures depends on farmers' acceptance based on their lived experience, knowledge and understanding.

- **Implement a process for stakeholder engagement and just transition.** To facilitate engagement and strong stakeholder ownership of mitigation policies, which would help achieve just transition.

- **Verification and monitoring of green credentials.** Engage with national and international experts to demonstrate and validate Ireland's environmental sustainability or 'green' credentials regarding food production.

- **Support research on carbon neutrality**. Continue support of research into carbon balance and neutrality concepts while promoting international research and policy development on this topic.

It is emphasised that many climate mitigation measures within the Agriculture and Land Use sector generate co-benefits, including enhanced air quality, biodiversity, ecological interaction, landscape protection, recreation and tourism potential, economic diversity and human well-being. Such benefits are associated with economic, environmental and social sustainability and are the result of good land stewardship.

9. Activities of the Council

As required under Section 12(f) of the Climate Action and Low Carbon Development Act 2015,[2] the activities of the Council in 2018 are listed here.

Activities of the Climate Change Advisory Council 2018			
Date	**Organisation**	**Subject**	**Attendees**
10/01/2018	Vita	Climate justice	Prof. John FitzGerald
24/01/2018	ICOS	Launch of a Report called 'Positive steps toward a low carbon future for the Irish dairy sector'	Prof. John FitzGerald
30/01/2018	Joint Oireachtas Committee on Communications, Climate Action and Environment	1. National Climate Dialogue – Opening the National Power Grid to Community and Non-Profit, Renewable Energy Providers	Prof. John FitzGerald, Climate Secretariat
		2. Ireland's Emissions Targets as Set by the European Union in The Context of The Paris Agreement	
		3. National Mitigation Plan	
19/02/2018	Department of Communications, Climate Action and Environment	Carbon Floor Pricing and Scenarios	Prof. John FitzGerald, Climate Secretariat
20/02/2018	German Embassy	Introductory meeting	Prof. John FitzGerald
21/02/2018	ESB		
26/02/2018	Royal Irish Academy	Breakfast briefing with Professor Mike Jones, MRIA, on the latest European Academies Science Advisory Council report: 'Negative emission technologies: What role in meeting Paris Agreement targets?'	Prof. John FitzGerald
27–28/02/2018	National Climate Change Committees	International workshop of national climate change committees	Prof. John FitzGerald, Climate Secretariat
22/02/2018	Irish Wind Energy Association	Charting a path to decarbonisation in Ireland: Key role of renewables	Prof. John FitzGerald
29/03/2018	Department of Communications, Climate Action and Environment	Meeting with the Minister – Carbon Price Floor	Prof. John FitzGerald, Climate Secretariat, Department of Communications, Climate Action and Environment
12/04/2018	Muckross Park College	Climate Change discussion	Prof. John FitzGerald
12/04/2018	Department of the Taoiseach	National Risk Assessment	Prof. John FitzGerald

Activities of the Climate Change Advisory Council 2018			
Date	**Organisation**	**Subject**	**Attendees**
12/04/2018	Irish Social Policy Association		Prof. John FitzGerald
01/05/2018	University College Cork	EU ETS Reform, Emissions Trading and Brexit	Prof. John FitzGerald
29/05/2018	International Energy Agency	In-Depth Review and Emergency Response Review of Irish Energy Policy	Prof. John FitzGerald
19/06/2018	Energy Ireland	Energy Ireland Conference: Addressing climate change: A pathway to a low carbon future	Prof. John FitzGerald
20/06/2018	Department of Communications, Climate Action and Environment	Project 2040: Charting a course towards achieving a low carbon and climate resilient future	Prof. John FitzGerald; Prof. Alan Barrett; Laura Burke; Joe Curtin; Prof. Anna Davies
27/06/2018	Sustainable Energy Authority of Ireland	SEAI Board Meeting Presentation	Prof. John FitzGerald
27–28/06/2018	Department of Finance	National Economic Dialogue 2018	Prof. John FitzGerald
05/07/2018	Sustainable Energy Authority of Ireland	SEAI Scenarios	Prof. John FitzGerald, Climate Secretariat
25/07/2018	Launch of the Annual Review 2018	Launch of the Annual Review 2018	Prof. John FitzGerald, Climate Secretariat, Laura Burke, Joe Curtin
06/09/2018	Ibec	Ibec Low Carbon Roadmap	Prof. John FitzGerald
11/09/2018	Department of the Taoiseach	Discussion regarding upcoming meeting with Taoiseach, Ministers and Climate Change Advisory Council	Prof. John FitzGerald, Climate Secretariat
12/09/2018	Joint Committee on Climate Action	Address and give evidence in the Committee's consideration of the Third Report and Recommendations of the Citizens' Assembly entitled 'How the State can make Ireland a Leader in Tackling Climate Change'	Prof. John FitzGerald, Laura Burke
27/09/2018	Ervia	Carbon Capture and Storage	Prof. John FitzGerald, Climate Secretariat
28/09/2018	Department of the Taoiseach	Meeting with the Climate Change Advisory Council, the Taoiseach, Minister Naughten, Minister Creed, Minister Murphy and Minister Ross	Prof. John FitzGerald, Climate Secretariat

Activities of the Climate Change Advisory Council 2018			
Date	**Organisation**	**Subject**	**Attendees**
02/10/2018	Irish Wind Energy Association	Launch of study re: Renewable electricity	Prof. John FitzGerald
04/10/2018	Irish Academy of Engineering	Annual Review 2018	Prof. John FitzGerald
04/10/2018	Environment Ireland	A strategy for meeting Ireland's climate change challenge	Prof. John FitzGerald
06/10/2018	Western Development Commission	What is Climate Change? Proposed Mitigation and Adaptation Measures in Ireland	Prof. John FitzGerald
18/10/2018	Dublin City University	Climate change mitigation in transport	Laura Burke, Frank Convery, Climate Secretariat
	Fingal County Council	Article on climate change and its economic impacts for Fingal County Council publication	Prof. John FitzGerald
05/11/2018	Embassy of France in Ireland	Creative Responses to Climate Change	Prof. John FitzGerald
23/10/2018	Department of Communications, Climate Action and Environment	Climate Change Advisory Council	Prof. John FitzGerald
25/10/2018	DG CLIMA	Climate and Energy Challenges facing Ireland	Prof. John FitzGerald, Climate Secretariat
07/11/2018	Devenish Beyond Nutrition	Carbon Storage and Farm Scale Management Demonstration	Prof. John FitzGerald
09/10/2018	KPMG	Budget 2019	Prof. John FitzGerald
09/10/2018	IAEA	Budget 2019	Prof. John FitzGerald
09/10/2018	Trinity Economics Society	Budget 2019	Prof. John FitzGerald
04/11/2018	Humanist Association of Ireland	Climate Change	Prof. John FitzGerald
06/10/2018	Western Development Commission	Climate Change Conference	Prof. John FitzGerald
	Alex Chisholm, Permanent Secretary, Business, Energy and Industrial Strategy (BEIS)	Climate Change	Prof. John FitzGerald

Activities of the Climate Change Advisory Council 2018			
Date	**Organisation**	**Subject**	**Attendees**
08/11/2018	EIB, European Commission, SBCI and SEAI	Moderator at Energy and Finance Conference	Prof. John FitzGerald
	Irish Farmers' Journal	Climate Change	Prof. John FitzGerald

ICOS, Irish Co-Operative Organisation Society; ESB, Electricity Supply Board; DG Clima, European Commission Directorate-General for Climate Action; IIEA; the Institute of International and European Affairs; EIB, European Investment Bank; SBCI, Strategic Banking Corporation of Ireland; SEAI, Sustainable Energy Agency of Ireland.

Date	Purpose	Attendees
25/04/2018	Climate Change Advisory Council Meeting	Prof. John FitzGerald (Chair), Prof. Alan Barrett, Prof. Gerry Boyle, Laura Burke, Prof. Peter Clinch, Joseph Curtin, Prof. Anna Davies, Prof. Ottmar Edenhofer, Jim Gannon, Prof. Alan Matthews
23/05/2018	Climate Change Advisory Council – Adaptation Committee Meeting	Mark Adamson, OPW; Laura Burke, EPA; Prof. Robert Devoy, UCC; Prof. John FitzGerald, Chair; Ciarán Hayes, CCMA; Dr Ina Kelly, HSE; Roger Street, UKCIP
20/06/2018	Climate Change Advisory Council Meeting	Prof. John FitzGerald (Chair), Prof. Gerry Boyle, Laura Burke, Prof. Peter Clinch, Prof. Alan Matthews
25/07/2018	Launch of Annual Review 2018	Prof. John FitzGerald (Chair), Laura Burke, Joseph Curtin
19/09/2018	Climate Change Advisory Council Meeting	Professor John FitzGerald, Laura Burke, Professor Alan Barrett, Alan Matthews, Peter Clinch, Dr Jim Scheer, Frank Convery, Anna Davies, Ottmar Edenhofer (video link), Trevor Donnellan (observer)
24/10/2018	Climate Change Advisory Council – Adaptation Committee Meeting	Prof. John FitzGerald, Chair; Conor Murphy, NUIM; Keith Lambkin, Met Éireann; Prof. Robert Devoy, UCC; Roger Street, Oxford University; Prof. Gerry Boyle, Teagasc
30/11/2018	Climate Change Advisory Council Meeting	Professor John FitzGerald, Laura Burke, Professor Alan Barrett, Professor Alan Matthews, Professor Peter Clinch, Jim Gannon, Professor Frank Convery, Professor Anna Davies, Joseph Curtin, Professor Gerry Boyle, Professor Ottmar Edenhofer
13/12/2018	Climate Change Advisory Council – Adaptation Committee Meeting	Mark Adamson, OPW; Laura Burke, EPA; Prof. John FitzGerald, Chair; Ciarán Hayes, CCMA; Dr Ina Kelly, HSE; Dr Conor Murphy, Maynooth University; Eoin Moran, Met Éireann

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Appendix 1 Legislation on Annual Review Report

Annual Review by, and annual report of, Advisory Council

12. (1) The Advisory Council shall—

(a) conduct a review (in this section referred to as the 'annual review') in each year of the progress made during the immediately preceding year in achieving greenhouse gas emissions reductions, and furthering transition to a low carbon, climate resilient and environmentally sustainable economy, and

(b) not later than 30 days after the completion of the annual review, prepare and submit to the Minister a report (in this section referred to as the 'annual report') on its findings and recommendations consequent upon that annual review.

(2) Without prejudice to the generality of subsection (1), the annual report shall contain—

(a) a summary of the findings set out in the most recent national greenhouse gas emissions inventory prepared by the Agency,

(b) a summary of the most recent projection of future greenhouse gas emissions prepared by the Agency,

(c) such recommendations as the Advisory Council considers necessary or appropriate, in relation to the most cost-effective manner of achieving reductions in greenhouse gas emissions in order to enable the achievement of the national transition objective,

(d) such recommendations as the Advisory Council considers necessary or appropriate, in relation to compliance with an existing obligation of the State under the law of the European Union or an international agreement referred to in section 2,

(e) such other recommendations or advice as the Advisory Council considers necessary or appropriate in order to enable the achievement of the national transition objective, and

(f) a summary of—

(i) the activities of the Advisory Council under section 11 (2), and (ii) any information gathered in accordance with section 11 (2).

(3) Not more than 30 days after submitting an annual report to the Minister under this section, the Advisory Council shall publish the annual report by such means as the Agency may advise.

Appendix 2 Data Sources for Transition Indicators

Name	Unit	Sources
GHG Intensity (GNI*)	kt CO_2e/€M GNI*	CSO (2019): Table N1624: Annex 1. Gross National Income at Constant Market Prices by Item and Year, EPA (2019) National Inventory Report and Common Reporting Format, Ireland Submission to the UNFCCC, (online)
Per Capita GHG	t CO_2eq/Population	CSO table PEA01: Population Estimates (Persons in April) by Age Group, Sex and Year, EPA (2019) National Inventory Report and Common Reporting Format, Ireland Submission to the UNFCCC, (online)
CO2 intensity of the economy	kt CO_2/€M GNI	CSO (2019): Table N1624: Annex 1. Gross National Income at Constant Market Prices by Item and Year, EPA (2019) National Inventory Report and Common Reporting Format, Ireland Submission to the UNFCCC, (online)
CO2 per capita	t CO_2/Population	CSO table PEA01: Population Estimates (Persons in April) by Age Group, Sex and Year, EPA (2019) National Inventory Report and Common Reporting Format, Ireland Submission to the UNFCCC, (online)
Economy wide Efficiency	GVA/GHG €/tCO_2eq	CSO table T06 National Accounts at Constant Prices, EPA (2019), National Inventory Report and Common Reporting Format, Ireland Submission to the UNFCCC, (online)
Total Primary Energy Requirement	MWh	SEAI (2018); Ireland's Energy Balance 2017
Emissions from Coal & Peat	kt CO_2	SEAI (2018); Ireland's Energy Balance 2017, EPA (2019) National Inventory Report and Common Reporting Format, Ireland Submission to the UNFCCC, (online)
CO_2 Intensity of Electricity	gCO2/kWh	SEAI (2018); Ireland's Energy Balance 2017, EPA (2019) National Inventory Report and Common Reporting Format, Ireland Submission to the UNFCCC, (online)
% Renewable of gross electricity consumption	%	SEAI (2017) Energy In Ireland Report 1990-2017;
% Renewable Heat	%	SEAI (2017) Energy In Ireland Report 1990-2017;
% Residential Energy from Solid Fuel (coal & peat)	%	SEAI (2018); Ireland's Energy Balance 2017
A & B BER Rated Residential "Dwellings"	%	SEAI (2019), BER Research Tool, Online. Accessed 7 June 2019
A & B BER Rated Commercial Buildings	%	CSO (2017), Non-Domestic Buildings Energy Ratings Q1 2019, Online. ; and SEAI (2018) SEAI Reporting "Energy Performance of Buildings Directive (EPBD)" Online. https://www.seai.ie/resources/publications/Non_domestic_BER_statistics.pdf
Energy Efficiency Gains in Public Bodies	% improvement from BAU	SEAI (2018), Annual Report 2017 on Public Sector Energy Efficiency Performance; http://www.seai.ie/Publications/Your_Business_Publications/Public_Sector/Annual-Report-2017-on-Public-Sector-Energy-Efficiency-Performance.pdf

Name	Unit	Sources
Energy Consumption of Public Bodies	GWh	SEAI (2018), Annual Report 2017 on Public Sector Energy Efficiency Performance; http://www.seai.ie/Publications/Your_Business_Publications/Public_Sector/Annual-Report-2017-on-Public-Sector-Energy-Efficiency-Performance.pdf
% Renewable Transport	%	SEAI (2018) Energy In Ireland Report 1990-2017;
Distance by Private Vehicles	million km	CSO (2019), Road Traffic Volumes by Type of Vehicle, Year and Statistic, Table THA10 (online).
Distance by Private Vehicles per capita	km per capita	CSO (2019), Road Traffic Volumes by Type of Vehicle, Year and Statistic, Table THA10 (online); CSO (2019): Population Estimates (Persons in April) by Age Group, Sex and Year; Table PEA01 (online)
Distance by Goods Vehicles	million km	SEAI (2018) Energy In Ireland Report 1990-2017;
Distance by PSVs	million km	SEAI (2018) Energy In Ireland Report 1990-2017;
Private Car New Vehicles' Fuel type	# new vehicles Petrol & Diesel	CSO (2019), New Vehicles Licensed for the First Time by Type of Vehicle Registration, Type of Fuel and Year, Table TEA03; CSO (2017), Road Traffic Volumes by Type of Vehicle, Year and Statistic, Table THA10 (online).
	% new vehicles Petrol & Diesel	
New Goods Vehicles' Fuel Type	# new vehicles Petrol & Diesel	CSO (2019), New Vehicles Licensed for the First Time by Type of Vehicle Registration, Type of Fuel and Year, Table TEA03; CSO (2019), Road Traffic Volumes by Type of Vehicle, Year and Statistic, Table THA10 (online).
	% new vehicles Petrol & Diesel	
Forestry Cover	ha	EPA (2019) National Inventory Report and Common Reporting Format, Ireland Submission to the UNFCCC, (online).
Dairy cows	Thousands	EPA (2019) National Inventory Report and Common Reporting Format, Ireland Submission to the UNFCCC, (online).
Other cattle	Thousands	EPA (2019) National Inventory Report and Common Reporting Format, Ireland Submission to the UNFCCC, (online).
Sheep	Thousands	EPA (2019) National Inventory Report and Common Reporting Format, Ireland Submission to the UNFCCC, (online).
Nitrogen fertiliser use	Tonnes of nitrogen	EPA (2019) National Inventory Report and Common Reporting Format, Ireland Submission to the UNFCCC, (online).
Total Area of Drained Organic Soils	ha	EPA (2019) National Inventory Report and Common Reporting Format, Ireland Submission to the UNFCCC, (online).
GHG Intensity of Farming	GVA/GHG €/tCO_2eq	CSO (2019) table T04, Gross Value Added at Constant Basic Prices by Sector , EPA (2019) National Inventory Report and Common Reporting Format, Ireland Submission to the UNFCCC, (online)

Name	Unit	Sources
Dairy production efficiency	kg carbon dioxide equivalent/kg milk	Teagasc Sustainability report 2019
Beef production efficiency	kg carbon dioxide equivalent/kg beef	Teagasc Sustainability report 2019
International total climate-specific finance	Euros	Article 16 "[Greenhouse gas] Financial and technology support provided to developing countries" Article 16 Support provided, Article 16 Report for Ireland, 2017, 2016, 2015, 2014. https://ec.europa.eu/clima/policies/international/finance/transparency_en [see Member State Reporting] http://cdr.eionet.europa.eu/

Appendix 3 Traffic Light Assessment of Emissions and Climate Implications of Budget 2019 measures

Sector/Budget provision	Topic description	Budget outcome	Assessment	Progress
Cross-sectoral: Change to price of carbon in carbon tax	Effectiveness of carbon tax may be improved by progressive increases in the cost per tonne. CCAC previously recommended increase to at least €30 per tonne CO_2 in 2019, and €80 by 2030.	Early indications of increase did not lead to budget change.	Opportunity missed to further develop carbon tax regime and potentially temper growth in energy-related greenhouse gas emissions.	
Cross-sectoral: ESRI research paper on effects of changes in carbon price	Impact of increases from €25, €30, €35 and €40 per tonne. Impacts on fuel price shown to be small. Larger for diesel at 7% (at €40 per tonne), but consumers accustomed to fuel price fluctuation in this category. Distributional impacts found to be regressive as a proportion of income. Effect on emissions –1.2% GHG reduction at €5 increasing to ←–5% at €40 per tonne.	Study complete and published with Budget 2019.	Progress made to have this updated knowledge, particularly the emissions and distributional implications.	
Transport: Cessation of investment in diesel-only public service buses	As part of energy decarbonisation, need to shift away from diesel-only buses, particularly in new expenditure. Dublin Bus and Bus Éireann have requirement for about 100 new buses each per annum.	To be implemented in July 2019, after 200 buses have been purchased by NTA.	Future change to be welcomed. Continuing with diesel-only appears difficult to defend despite capacity issues; alternatives are available as per London. Emissions higher than with lower-carbon technologies. Potential expense of later upgrades or early decommissioning. Applies to only 10% of bus fleet but gives perverse signal.	
Agriculture: Beef Environmental Efficiency Pilot Scheme (BEEPS)	Income-boosting measure which also attempts to make beef herd more efficient by improving efficiency through management practices. Assumption is that this leads to reduced emissions growth.	The BEEPS maximum of 500,000 suckler cows – at a €40/head payment.	May lead to small efficiency improvement, but does not address scale growth issue and could exacerbate it. Overall, growth in emissions trends unlikely to be substantially affected by efficiency-induced reduction.	

Sector/Budget provision	Topic description	Budget outcome	Assessment	Progress
Transport: Vehicle Registration Tax	Attempts to incentivise move away from air-polluting diesel to more fuel-efficient hybrids.	A new 1% surcharge on the Vehicle Registration Tax (VRT) charged on all new diesel cars. Extended hybrid VRT relief to end 2019.	Diesel change mostly symbolic. Hybrid relief useful. Given growth in transport distances, unlikely to be sufficient to affect emissions trends.	
Transport: Capital scheme for gas-propelled commercial vehicles/ extension of benefit-in-kind on electric vehicles	Attempt to incentivise switching away from petrol and diesel vehicles by focusing on commercial vehicles and income tax arrangements for electric company cars.	Accelerated Capital Allowances (ACAs) on gas-propelled vehicles, and extension of 0% benefit-in-kind rate when including company car in income tax calculations (extended by 3 years, capped at €50,000).	Income tax arrangements useful in long term, gas-propelled vehicle arrangements may lead to minor improvements but could be leapfrogged by going straight to electricity. Effect on emissions marginal.	
Forestry: Grants and premiums for afforestation	Need to increase uptake to facilitate accelerated afforestation.	Grants and premiums increased towards meeting forestry programme target of 8,000 ha of new plantings and construction of 125 km of new forest roads.	Positive to see incentives increased. However, appears to function as industry output growth measure. It is not clear if optimised for sequestration and/ or biodiversity benefits or for flood management.	

Sector/Budget provision	Topic description	Budget outcome	Assessment	Progress
Transport: Capital and current expenditure	To 'develop and manage transport infrastructure by providing for the maintenance and upgrade of our road network and the delivery of public transport services' through the NDP.	Department overall allocation €2.34 billion in 2019. Additional funding for MetroLink, BusConnects, Greenways, Luas and DART expansion schemes. Also 'significant additional investment in local and regional roads projects'.	Roads and motorised transport remain central in NDP, can deepen lock-in to carbon-intensive development. Public transport investment can lead to modal shift. Priority transition measures of demand reduction and active transport not substantially addressed. Budget likely to lead to increased transport emissions.	
Transport: Civil aviation expenditure	Perceived need for expansion of capacity and travel demand countered by need to reduce use of carbon-intensive modes of transport.	Budget of €36.7m. Growth target of excess of 34 million passengers through all airports. Capital funding for Knock airport runway. Dublin Airport new runway spending of €320 million from own resources.	This is the most carbon-intensive transport mode. Measures will further increase emissions.	
Policymaking: Green Budgeting	Need to align Government fiscal approach with climate and environmental goals. Ireland committed to joining other OECD countries in the Paris Collaborative on Green Budgeting to develop ways to embed climate change in the budgetary process.	First attempt in this year's Revised Estimates Volume (REV) lists Exchequer climate-related expenditure.	Positive development signalling institutional change. Approach requires development from this initial step and there is a need to estimate impact on emissions and cost-effectiveness, *ex post* and *ex ante*.	

Sector/Budget provision	Topic description	Budget outcome	Assessment	Progress
Policymaking: Revision to Public Spending Code	*Public Spending Code* (PSC) stipulates how to implement cost-benefit analysis and cost-effectiveness analysis for *all current and capital expenditure over €20 million*. Sets shadow price of carbon and, more importantly for valuing GHG emissions, the framing and technical parameters of the analysis itself, by the time horizon and the discount rate. Wide-ranging implications for direction of public investment for mitigation and adaptation.	Two reviews published in November 2018. With consultation on valuation of emissions. Central Technical Appraisal Parameters – Discount Rate, Time Horizon, Shadow Price of Public Funds and Shadow Price of Labour.	Council welcomed the proposed changes and made a number of recommendations, including: reconsideration of the carbon price; a long time horizon in analysis; and the new discount of 4% rate to be kept under review.	
Cross-sectoral: Climate Action Fund	Funding support for initiatives that contribute to meeting climate and energy targets.	€500 million provided.	Already announced under NDP and emissions implications unclear.	–
Cross-sectoral: Disruptive Technologies Fund	Funding support for development and deployment of disruptive innovative technologies and applications, on a commercial basis, targeted at tackling national and global challenges.	Disruptive Technologies Innovation Fund of €500m available for co-funded projects involving enterprise and research partners over the period to 2027.	Already announced under NDP and emissions implications unclear.	–

Sector/Budget provision	Topic description	Budget outcome	Assessment	Progress
Energy: Energy and emissions savings	Multifaceted support for homes, communities, SMEs, large energy users, public sector, growth in electric vehicles and applied energy research.	DCCAE Programme C €175.4 million. Grant funding including deep retrofit works in further 28,000 homes; and support for public sector bodies to achieve the 33% energy efficiency target.	Positive development, but: (a) not clear if additional funding beyond that already committed; (b) without emissions estimates it is unclear if these measures are environmentally effective or indeed cost-efficient.	
Environmental Protection and Waste Management	Strategic and monitoring functions of EPA, waste awareness programmes and technical research and modelling on mitigation and policy measures.	Programme F – Environment and Waste Management Environment and Climate Action (€85.2m).	Funding increased for waste management but declined for the EPA by 1.3%. Funding may need to be enhanced to support operational functions of environmental protection and sustainable development, but also to build capacity and evidence base for strategic approaches and technical studies for societal pathways transformation.	

Appendix 4 Summary of Advice and Recommendations

Chapter 2:

The macro drivers of emissions continue to expand. An absolute decoupling of economic growth from emissions has not occurred and development is not on a pathway consistent with low-carbon transition. If a transition is to occur while the economy and population are growing, the Government will need to consider how to substantially accelerate the rate of improvement in energy intensity, while also significantly increasing the deployment of renewable energy. As highlighted by successive reports from the Intergovernmental Panel on Climate Change,[7] this will require more than 'end-of-pipe' technological measures, through consideration of long-term 'sustainable development pathways' that are fundamentally and systemically lower in emissions.

Current economic indicators do not give an accurate measure of the activities with an emissions footprint in Ireland. The Council recommends the development of national accounts data that better reflect the impact of economic activities on national emissions.

Chapter 3:

The Council notes the additional analysis provided by the EPA in its projections of greenhouse gas emissions and the sensitivity of these projections to assumptions related to the trajectory of fuel prices. The projections analysis from the EPA is very useful but is constrained to address EU reporting requirements. There is a need for analysis of a more comprehensive set of plausible development pathways, including variable economic growth rates, alternative fuel price trajectories and alternative rates of development and deployment of low-carbon technologies. There is a need to expand national capacity, for example under the Technical Research and Modelling group, to enable this important analysis.

The Council recommends that Government provide resources to build additional modelling and projections capacity in order to expand the range of scenarios examined to inform policy design and enable evidence-led, economy-wide and sectoral target setting. Finally, the Council recommends that the suggestion in the Report of the Oireachtas Committee on Climate Change that the Council be given access to the data and expertise held by Government Departments relating to climate change should be implemented.

Chapter 4:

The Council reiterates that Ireland is currently off course in relation to its EU targets to 2020 and 2030 and in relation to the National Policy Position. Without urgent action that leads to tangible reductions in greenhouse gas emissions, Ireland is unlikely to deliver on international, EU and national obligations and will drift further from a pathway that is consistent with a transition to a low-carbon economy and society.

The Council recommends that the anticipated National Energy and Climate Plan incorporates new policies and measures that are (1) coherent regarding reducing energy use and at the same time reducing emissions of greenhouse gases and (2) consistent with putting Ireland on a pathway to a low-carbon economy and society, including measures identified in the All of Government Plan (June, 2019).

Where Ireland is to employ flexibilities to comply with its 2030 EU targets, its primary focus should be national actions in the land use, land-use change and forestry sector. This would augment removals through the existing terrestrial carbon sink, contribute to the national transition

objective and have tangible environmental benefits. Purchase or transfer of allowances should only be considered as a secondary flexibility measure.

There is still no official Government definition of 'an approach to carbon neutrality' for the agriculture and land sectors. The EPA and Department of Agriculture, Food and the Marine have funded research on this topic. This definition is necessary to assess the performance of these sectors and, more importantly, to develop a strategy in this area. Such a strategy would need to detail how to augment Ireland's emissions removals through terrestrial sinks and bring agricultural production into balance and onto a sustainable low-carbon pathway.

Chapter 5:

The Irish economy is not on a pathway towards low-carbon transition. The Government needs to describe comprehensively the pathway Ireland will follow to achieve the national transition objective.

The Council welcomes the development of new initiatives within policy including under the National Energy and Climate Plan and the proposed All of Government Climate Plan. A commitment to implementation is critical. For example, the Joint Oireachtas Committee on Climate Action recommends that certain aspects of the National Development Plan be revisited to better address the investment needs to put Ireland on a low-carbon transition. The Council recommends that policy initiatives of this type include timelines, steps and responsibilities for implementation.

Just Transition helps to ensure engagement, ownership and equity in climate action. The Council recommends using a just transition framework to add depth to policy and foster public support.

Carbon intensity in the electricity sector decreased in 2017, on foot of external, reversible drivers. Planned electrification in the heat and transport sectors requires low- to zero-carbon electricity. Opposition to the deployment of renewables and the accompanying infrastructure is a major concern in increasing Ireland's capacity for renewables. Good planning guidelines and community engagement are key in increasing the social acceptability of wind energy. Further policies and measures and the development of robust planning guidelines are required in this sector to achieve progress.

Energy efficiency in the built environment sector, crucial to decarbonisation, is not progressing fast enough. More houses need to be reached and deeper retrofits achieved. Many high-performing buildings still rely on fossil fuels for their remaining energy demand. Increased progress in both energy efficiency upgrades and switching to renewable energy sources will be important to achieve true low-carbon transition in this sector. The Council recommends additional resources as part of a programme to enable the development of sufficient skills and capacity required across the sector. Investment in local authority building and housing is an important opportunity for the Government to lead in this area.

The observed increase in agriculture emissions and ongoing carbon losses from peat extraction and land drainage undermine our ability to achieve the national transition objective towards neutrality. Implementation of further policies and measures is required to achieve progress in this area.

The National Dialogue on Climate Action is an important initiative in engaging the public on issues of climate change. The Council recommends a properly mandated and resourced National Dialogue on Climate Action, which has the potential to work in and between sectors, communities, networks and individuals to drive this agenda.

Chapter 6:

The Council reiterates the need for a national roadmap or a comprehensive plan towards achieving the 2050 objectives.

The Council highlights the lost opportunity in Budget 2019 to enhance fiscal instruments, such as the carbon tax and fuel excise duties, despite considerable evidence in their favour. A robust carbon price can support low-carbon transition across the sectors at a lower cost to Government than extensive provision of subsidies. Revenue from a carbon tax could support low-income households. The Council recommends a carbon tax of €35 per tonne in 2020 rising to at least €80 per tonne by 2030.

The Council considers the mobilisation and use of other sources of funding to support transition to be appropriate and necessary. The participation of the private sector in driving and funding mitigation action is important to successful transition. Strategies and instruments will be required to mobilise and engage the private sector in meeting climate challenges. It will be crucial to have clarity on how private sector investment will be mobilised by Government in support of the national actions on climate change. Robust carbon pricing could play an important role.

The commitment to increase the annual rate of energy efficiency home upgrades by 50% is ambitious and necessary. However, more attention is required on the building sector supply side, for appropriate phasing of work. The Council recommends initially targeting scarce public resources to upgrading the local authority housing stock.

Making decisions on retrofit easier, such as having clear standards and advice on the appropriate technologies for a given task and house type, improves uptake rates. Trusted intermediaries can play a key role. A robust supply chain of appropriately qualified building contractors and tradespeople such as plumbers and electricians, who can provide the appropriate advice and guidance to households, should be actively developed to avoid constraints to deployment.

It will be important to have a long-term plan for upgrading the commercial building stock, which has a high share of low-performing buildings. This plan should consider how to promote efficiency upgrades in the long term without reliance on fiscal support. Robust carbon pricing could play a role.

The success of the National Planning Framework will be determined by the extent to which other plans, policies and measures follow through and maintain consistency with its aims and objectives. Robust implementation and review will be required to ensure that measures are fit for purpose.

The implementation of the National Development Plan is contingent on resources. Continued funding and development of institutional capacity will be required to deliver on all the commitments made. If resources are constrained, it will be important to have clarity and transparency on how different elements in the plan should be prioritised. Prioritisation should take account of the revised shadow price of carbon.

To support robust implementation of the National Mitigation Plan, the National Energy and Climate Plan and other initiatives, it is crucial that information is made available in a timely and transparent manner on the progress in implementation to date of its actions and commitments. The actions should be linked to expected emissions reductions to allow effective planning for further efforts required to close the emissions gap.

The Council has welcomed the Government commitment to end the burning of coal at Moneypoint by 2025. It is urgent that the Government provide an appropriate timeline for the cessation of activities in Moneypoint. The Council recommends closing peat in 2020 with measures to ensure a just transition. The Council believes that the current plans for continued support for peat indirectly through a subsidy for biomass co-fired with peat are not appropriate given our commitments to tackle climate change.

Emissions from passenger and freight travel are projected to remain a large proportion of national emissions. Innovative measures will be required across passenger and freight if a low-carbon transition is to be delivered. The Council recommends learning from international best practice. The Council recommends putting in place the necessary infrastructure to allow a rapid electrification of road transport. To facilitate the proposed increase in electric vehicles, the Government needs to establish an appropriate nationwide charging infrastructure, supported by both public and private investment, concrete implementation plans and monitoring mechanisms to ensure ramp-up to meet evolving needs.

The Council recommends prioritising early action through integrated spatial and infrastructure planning that promotes sustainable settlement patterns and modal alternatives. It also recommends examination of greater incentives to switch away from the use of the private car based on the 'polluter pays principle' including: variable charges on vehicle use and emissions; congestion charges on entry into cities; pricing for free-parking in workplaces that indirectly subsidises motorists; and provisions that support car-pooling and working from home.

The Agriculture and Land Use sector must adopt all appropriate cost-effective measures to reduce emissions and enhance removals within the sector. There remains a need to define the carbon neutrality objective for the sector. Reform of the Common Agricultural Policy presents the opportunity to provide support for measurable environmental benefits, including greenhouse gas emissions reductions. The Council notes that a reduction in the national herd would deliver a significant reduction in national greenhouse gas emissions, but would need to be pursued with due regard to ensuring a just transition within the rural economy. The recently published analysis by Teagasc on a Marginal Abatement Cost Curve identifies measures that should be employed to reduce emissions. Additional specific recommendations are made in Chapter 8.

The Council will turn its focus to transport and heat in the autumn and winter of this year. Findings will form the Special Focus Chapter in the 2020 report.

Chapter 7:

To address issues with monitoring and reporting on adaptation at national level, an agreed set of climate change adaptation indicators should be developed and implemented as quickly as possible and reported on through the Annual Transition Statement process. Progress on the 'supporting objectives' of the National Adaptation Framework should also be recorded.

In the draft sectoral adaptation plans to date, much of the discussion on monitoring and evaluation has been generic and drawn from the guidelines, with little detail on how it will be applied in the context of the sector. The implementation and funding of these sectoral adaptation plans will be a key focus for the Council in the coming years.

The private sector and citizens bear primary responsibility for the protection of their well-being and property, and their adaptation investment will be very important at local and individual levels.

Awareness of the need for adaptation remains poor, with corresponding low levels of willingness to engage. The National Dialogue on Climate Action and the recently established Climate Action Regional Offices, working through local authorities, can play a significant role in addressing this gap, but the Government must do more in terms of guiding and regulating the actions of individuals, communities and enterprises to enable adaptation actions. This should be addressed in sectoral adaptation plans and in local adaptation strategies.

Recent weather events confirm the importance of continuing to build Irish capacity in terms of impact-based forecasting while also increasing public understanding of the current weather warning system. In this context, the finalisation of a national Flood Forecasting and Warning Service is also essential. The Council considers that the increased application of impact-based forecasting will increase public awareness, understanding and confidence in weather warnings, thereby playing an important role in raising awareness of the need for enhancing resilience and adaptation actions.

With regard to the available consultation draft sectoral adaptation plans, a statement at the beginning of the plan/strategy demonstrating how the Climate Act, National Adaptation Framework and the relevant adaptation guidelines have been considered would be useful. They should also be explicit about the climate data and projections/scenarios they have used in the process. Projections of future climate are not perfect and should not be treated as such. High-resolution modelling may give a false sense of confidence for example, therefore decision-makers should give due regard to the uncertainties which are evident in the range of models available. Development of a common set of climate projections that capture the range of change in future climate projections for use in adaptation, infrastructure and investment planning to 2050 and beyond should be advanced.

In developing adaptation plans and strategies, sectors and local authorities should ensure that ways to identify maladaptation early are identified and strategies to counter this are put in place.

Though some topics may not fit neatly into sectoral bounds, with implications for all sectors and all levels of decision-making (e.g. health, biodiversity), this does not diminish the responsibilities of the Minister preparing the plan under the Climate Act and Framework to consider what actions they can put in place to increase Ireland's climate resilience.

It is important that plans and strategies are specific about the structures they are using to integrate/mainstream adaptation considerations into other plans and policies, both within their Department and externally. How resilience is built in important areas such as tourism, sport, emergency management, housing and planning and coasts should also be considered across the developed plans as appropriate.

The sectoral adaptation guidelines discuss considerations and questions to pose when assessing adaptation actions. Any actions in sectoral plans must be carefully considered, targeted and realistic, particularly identifying risks to implementation and mitigation plans when their delivery might rely on external stakeholders and there is a risk of a low level of commitment to implementation from responsible bodies. The sectoral adaptation plans must consider how the impacts of events are captured at a sectoral level. A common approach to funding repair of public infrastructure and collating information on the economic losses, costs and damage arising from extreme events should be developed.

Investment decisions should be evaluated and stress tested against a wide range of climate models, greenhouse gas emissions scenarios and data types. Last year's Annual Review commended the Office of Public Works for its robust and comprehensive analysis of river basin flood risk across the country; this continues to be a possible model for other sectors, including in capturing costs and benefits of adaptation interventions.

Given that the Climate Action Regional Offices are to progress climate action at local level in terms of both mitigation and adaptation, it is essential that potential co-benefits are strongly considered at this level and that any synergies are exploited, and any conflicts addressed. This is particularly relevant with regard to energy supply, biodiversity, spatial planning and land use and the built environment. Synergies with the Covenant of Mayors for Climate and Energy should be utilised.

Links between marine spatial planning (MSP), integrated coastal zone management/ integrated coastal management (ICZM/ICM) and sectoral and local adaptation planning must also be strengthened, with the ownership of adaptation within coastal and marine governance and coordination structures clarified.

Further work is required on the areas identified as not advanced in the European Commission's scoreboard assessment of Ireland – in particular those relating to integration with disaster risk reduction planning and insurance.

It is important that policy coherence between the Paris Agreement climate goals, the Sustainable Development Goals and the Sendai Framework is considered in the preparation of sectoral adaptation plans. It is unclear how 'Lead Government Departments' for emergencies are linking with sectoral adaptation planning and local-level adaptation. The Government Task Force on Emergency Planning should ensure that climate resilience is adequately considered and that there is regular engagement with the sectors responsible for sectoral adaptation plans and local authorities.

In the preparation and communication of adaptation planning, clarity should be provided on the assessment of risk, exposure, vulnerability, resilience and adaptive capacity, and the decision-making framework under which options are considered. This should include criteria for prioritisation, implementation, monitoring and evaluation. These would set the stage for consideration of the types of options to develop and the need for a robust and credible portfolio of measures.

Once in place, a review of statutory sectoral adaptation plans should be undertaken to identify priority risks which need to be addressed and resourced over their five-year span with a clear process for the implementation and monitoring of plans through national, as well as sectoral, governance structures.

Adaptation is a continuous learning and improvement process. As such, the plans and strategies need to recognise the areas where further improvements are needed and the process for progressing their respective plans and strategies.

The role and reach of the National Dialogue on Climate Action could be extended to cover climate impacts and adaptation as a responsibility.

Special Focus Chapter:

There is considerable opportunity within the Agriculture, Forestry and Other Land Use sector to address climate change while providing multiple co-benefits to society. A review of existing literature and collation of expert opinion outlined in the supporting working paper has identified a clear and urgent need for changes in management and associated policy within the sector. Issues are complex and interlinked and have social bearing, with no quick-fix solutions. However, the Council recommends the implementation of the following;

- **A reduction in bovine numbers**. Further expansion of the dairy herd will increase national emissions and may cause other environmental issues. Expansion is sustainable only if it takes place within a scenario in which overall agricultural emissions are declining. Accelerated decline in suckler cow numbers would be an important contribution to emissions reductions. Reductions should be facilitated by long-term and consistent supports and incentives to provide favourable environmental outcomes and alternative economic opportunities. When combined with the benefits of alternative land use, such measures could safeguard farm incomes in the long run and increase farmers' financial security.

- **Address the drainage of peatlands.** Land use in Ireland is a net source of emissions, primarily due to the ongoing drainage of organic soils for different uses, including peat extraction, grazing and to a lesser extent forestry. Management options for wetlands require urgent assessment and implementation.

- **Increase afforestation rates.**

- **Agroforestry should be considered.** Agroforestry appears to bring multiple co-benefits, including enhanced carbon sequestration in agricultural systems, and, pending further research, should be pursued.

- **Implement cost-effective agricultural mitigation measures identified in the Teagasc Marginal Abatement Cost Curve.** The Common Agricultural Policy provides a useful mechanism for implementation of many of the measures identified.

- **Support additional research into mitigation options**. Research requirements concern existing and new mitigation measures, their technical implementation, potential impacts or trade-offs and developing inventory accounting methodology.

- **Provide resources for effective knowledge exchange**. Adoption and successful implementation of climate change mitigation policy and measures depends on farmers' acceptance based on their lived experience, knowledge and understanding.

- **Implement a process for stakeholder engagement and just transition**. To facilitate engagement and strong stakeholder ownership of mitigation policies, which would help achieve just transition.

- **Verification and monitoring of green credentials.** Engage with national and international experts to demonstrate and validate Ireland's environmental sustainability or 'green' credentials regarding food production.

- **Support research on carbon neutrality**. Continue support of research into carbon balance and neutrality concepts while promoting international research and policy development on this topic.

It is emphasised that many climate mitigation measures within the Agriculture and Land Use sector generate co-benefits, including enhanced air quality, biodiversity, ecological interaction, landscape protection, recreation and tourism potential, economic diversity and human well-being. Such benefits are associated with economic, environmental and social sustainability and are the result of good land stewardship.

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