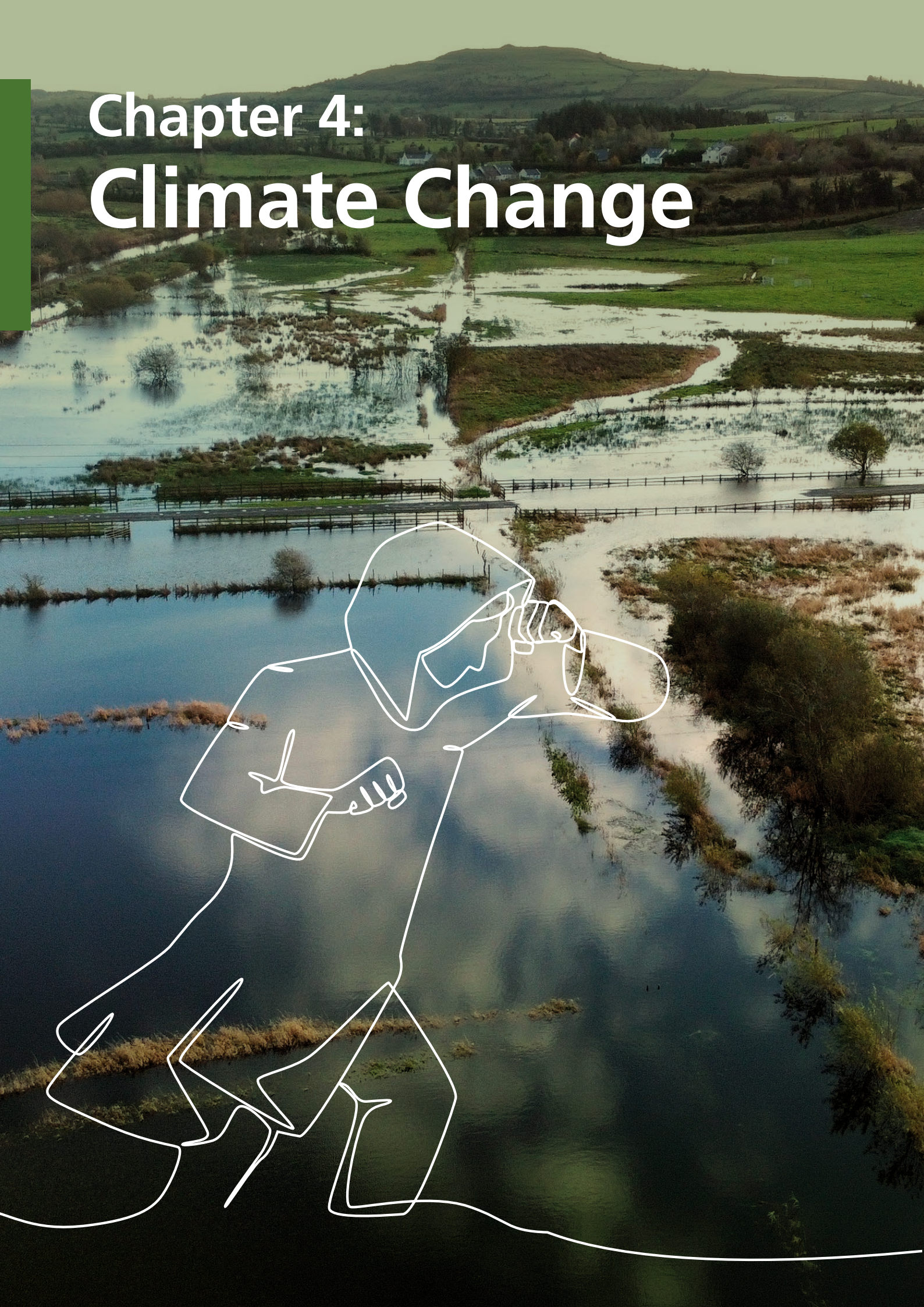


Chapter 4: Climate Change





Climate Change

1. Introduction

The findings of the 2023 Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (AR6, IPCC, 2023)¹ are clear, stark and challenging in relation to climate change. Widespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere have occurred. Continued greenhouse gas emissions will lead to increasing global warming, with the best estimates indicating that we will reach a decadal average of 1.5°C of warming in the near term without immediate and rapid reductions in greenhouse gas emissions. Indeed, the first 12-month period to exceed 1.5°C of warming as an average was February 2023 to January 2024: boosted by El Niño, the average global temperature was estimated to be 1.52°C higher than in 1850-1900, according to the Copernicus Climate Change Service. Every increment of global warming will intensify multiple and concurrent hazards.

Ireland's Climate Change Assessment (ICCA; Thorne *et al.*, 2024), modelled on the work of the IPCC, is Ireland's first climate assessment (Topic Box 4.1). It echoes what has been found globally and shows that our climate is changing in Ireland and that we are not prepared. In line with global trends, Ireland's annual average temperature has increased by approximately 1°C over the last 100 years, with 16 of the 20 warmest years occurring since 1990, and 2023 being the hottest year on record.

In terms of responding, the first comprehensive assessment of the world's progress on climate action – the Global Stocktake – took place in 2023 at the 28th United Nations Climate Change Conference (COP28). The COP28 agreement, known as the UAE Consensus, was reached by close to 200 countries and highlighted progress on mitigation, adaptation and means of implementation and support. However, it also revealed that parties are not yet collectively on track towards achieving the goals of the Paris Agreement. The UAE Consensus in particular highlighted the need to transition away from fossil fuels in energy systems and reach net zero, in line with the science provided by the IPCC (UNFCCC, 2023).

Environmental Protection Agency (EPA) greenhouse gas inventories and projections show that significantly more action is needed if Ireland is to meet its European Union (EU) and legally binding national emissions targets, which include staying within ambitious national carbon budgets and sectoral emissions ceilings. These data show that reaching the 2030 target will require full implementation of policies that deliver emissions reductions across all sectors of Ireland's economy in the short term to provide the foundation for longer term ambitions. These include large-scale and immediate emissions reductions across the energy system, which is currently heavily dependent on fossil fuels.

Climate adaptation has, until recently, struggled to compete with climate mitigation in terms of prioritisation, funding and attention. However, increasingly we can see that climate change is having and will have a wide-ranging impact on Ireland's environment, society and economic development, including on our ecosystems, water resources, agriculture, health and coastal zones. Short-term risks to Ireland from climate change are primarily associated with changes in extremes, such as floods, droughts and storms. Although there are uncertainties about the specific local impacts of climate change, a wait-and-see approach is not an option given the severity of these risks. Planned adaptation, which involves making decisions and implementing measures within society to respond to the adverse impacts of and avail of the opportunities presented by climate change, is essential to avoid an unacceptable level of risk.

From a societal perspective, the EPA's Climate Change in the Irish Mind project shows that people are positive about climate change in Ireland. People accept the science on climate change and understand that action is needed. However, while fairness and a just transition are highly valued, many have practical concerns about climate policies. Ongoing engagement and communication are vital to ensuring that policy is designed effectively so that the right path is also the easiest path for citizens.

1 www.ipcc.ch/assessment-report/ar6/ (accessed 17 July 2024).



Topic Box 4.1 Ireland's Climate Change Assessment

The ICCA report provides, for the first time, a comprehensive and authoritative assessment of the state of knowledge around all key aspects of climate change, with a central focus on Ireland (Thorne *et al.*, 2024; Noone, *et al.*, 2024; McGookin, *et al.*, 2023; Murphy, *et al.*, 2024; Moriarty, *et al.*, 2024).

Led by the EPA and undertaken by leading researchers, the report provides an assessment of our understanding of climate change, tying together all available lines of evidence to provide actionable information. This is based on scientific research and systematic observations in Ireland, linked to EU and global analyses. The ICCA report aims to provide summary information that can inform decision-making on climate actions.

Key findings:

1. Human activity has resulted in widespread and rapid changes in the climate, which are already having an impact on us.
2. The future climate is in our hands. Halting warming globally, and in Ireland, requires rapidly reaching at least net zero carbon dioxide emissions and substantially cutting other greenhouse gas emissions. Every action matters: with every additional increment of warming, impacts for Ireland will increase substantially.
3. Having peaked in 2001, Ireland's greenhouse gas emissions have reduced in all sectors except agriculture. However, Ireland currently emits higher levels of greenhouse gases per person than the EU average. A legal basis for deep, rapid and sustained national emissions cuts now exists, although current policies and actions remain insufficient to meet these aims. The pathway forward is clearer for energy, transport and the built environment than for agriculture and land use. For all sectors, there are many challenges to overcome.
4. Ireland needs to be resilient to ongoing and future climate change impacts (Figure 4.1). This requires increased focus on and investment in adaptation that can protect us from future climatic impacts. The current implementation of adaptation measures is too slow and fragmented. Doing better requires more financing, working with people and nature, monitoring and evaluating outcomes and increasing public and private sector involvement.
5. Effective and just transformative actions will have mitigation and adaptation benefits and will bring broader benefits for health, wellbeing, nature and sustainable economic development. The state has a central role to play in enabling the necessary transformations, supported through action across society. Decisions taken this decade will reverberate for generations to come.

Figure 4.1 The Línthe na Faraige (Lines of the Sea) project communicated the risks from future sea level rise through a series of light installations across Irish coastal locations and heritage sites. Spanish Arch, Galway.



Source: Pekka Niittyvirta, Línthe Na Faraige/Lines of the Sea²

² www.creativeireland.gov.ie/app/uploads/2023/04/Linte-na-Faraige.pdf



2. Climate change is happening

Observed impacts

Observations clearly show that Ireland's climate is changing. Monitoring records show increases in average temperature, changes in precipitation patterns, sea level rise and weather extremes. The most immediate risks to Ireland from climate change are predominantly those associated with changes in extremes, such as floods, droughts and storms.

In line with global trends, Ireland's annual average temperature has increased by approximately 1°C over the last 100 years, with 16 of the 20 warmest years occurring since 1990, and 2023 being the hottest year on record. Extremes of heat in Ireland (heatwaves) are becoming more frequent and more severe, while extremes of cold (cold waves) are becoming less frequent and less severe. Heatwaves, such as the 2022 heatwave, where temperatures reached 33°C (at Phoenix Park), have been made more likely by climate change.

Heavy rainfall events have been 7% more intense over the last 30 years than over the previous 30 years, with evidence linking these events to climate change (Figure 4.2). While there is evidence that average river flows increased across the country between 1972 and 2017, there is also evidence of an increase in recent years in the frequency and intensity of potential drought conditions, especially in the east of Ireland.

Satellite observations indicate that the sea level around Ireland has risen by approximately 2-3 mm a year since the early 1990s, with higher rates of increase observed in Dublin and Cork.

Both sea surface temperatures and ocean heat content have increased in Ireland's territorial waters, consistent with globally observed changes. In Irish waters, there have been changes in marine ecosystems, including changes in the seasonality and abundance of many species.

The main impacts of climate change on Irish species and habitats observed to date have been changes in species abundance and distribution, phenology, community composition, habitat structure and ecosystem processes. Ireland's network of monitoring stations is part of a global observing system (Topic Box 4.2).

Figure 4.2 Midleton flooding, October 2023



Topic Box 4.2 Global observation networks

The Global Climate Observing System National Committee works to ensure the sustained provision of reliable physical, chemical and biological observations and data records for the total climate system – across the atmospheric, oceanic and terrestrial domains, including hydrological and carbon cycles – for Ireland. The committee is chaired by Met Éireann and has representatives from the Marine Institute and the EPA, with additional support provided by Teagasc, as well as remote-sensing and other experts.

Ireland joined the Integrated Carbon Observation System in January 2023. The Integrated Carbon Observation System provides standardised and open data from more than 170 measurement stations across 16 European countries. The stations observe greenhouse gas concentrations in the atmosphere as well as carbon fluxes between the atmosphere, the land surface and the oceans. Ireland has a network of ten monitoring sites that measure greenhouse gases in grasslands, peatlands, forests, coastal areas and in the North Atlantic. Among the stations are four atmosphere stations, five ecosystem stations and two ocean stations.



Projected impacts

Projected climate change hazards experienced both in Ireland and further afield will result in direct, indirect, compound and transboundary risks to Ireland. There is also a risk that we will pass tipping points, which are low-probability, high-impact events that would irreversibly change our climate (Topic Box 4.3).

Topic Box 4.3 Climate tipping points

Climate tipping points have been identified within three types of climate sub-systems: the cryosphere (ice bodies), the circulation of the oceans and the atmosphere (circulation patterns), and the biosphere.

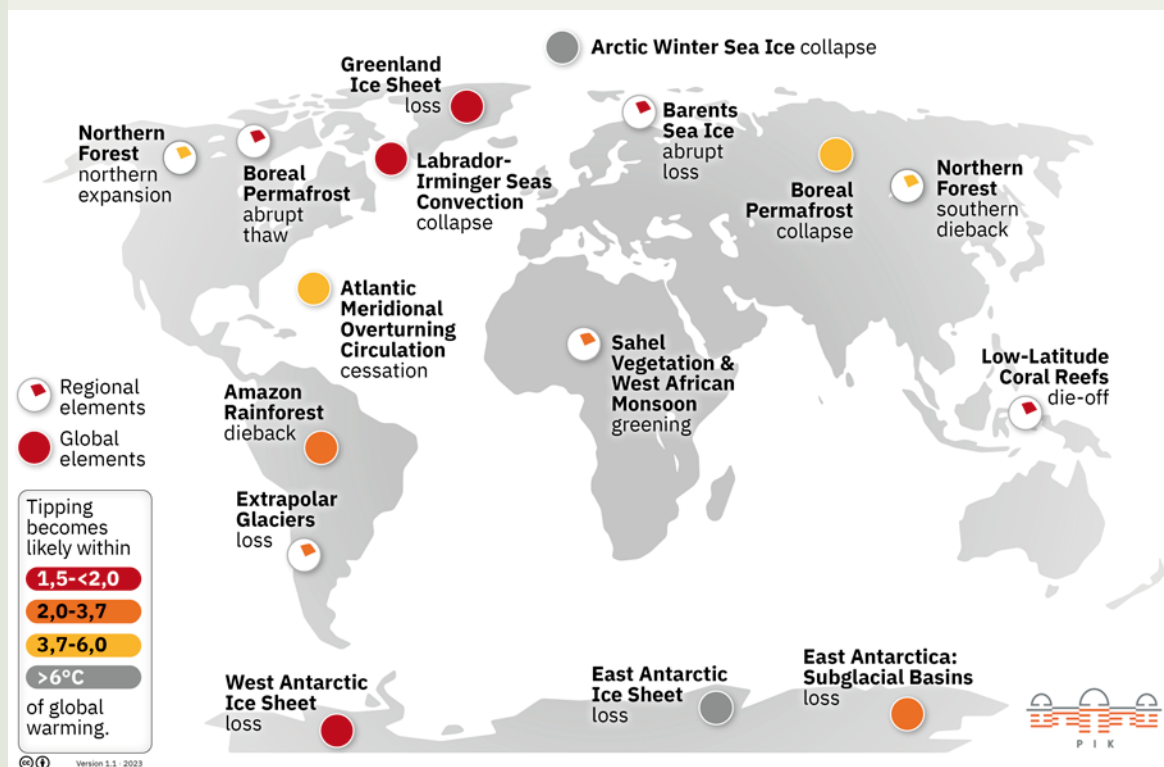
The most recent IPCC assessment – AR6 – summarises tipping points as large-scale singular events.

These encompass tipping points such as:

- loss of the Greenland Ice Sheet, loss of major Antarctic ice sheets and associated sea level rise, carbon release from thawing permafrost (cryosphere)
- shutdown of major ocean currents such as the Atlantic Meridional Overturning Circulation (AMOC), which includes the North Atlantic Gulf Stream (circulation patterns)
- dieback of the Amazon rainforest, biodiversity loss and widespread geographical changes (biosphere).

Climate tipping points are a source of growing scientific, policy and public concern (Lenton, 2021). Figure 4.3 depicts the most important tipping elements in the Earth system and the latest assessment of when they might be surpassed by global warming levels.

Figure 4.3 The most important tipping elements in the Earth system and when they might be surpassed by global warming levels



Source: Armstrong McKay *et al.*, 2022

The risk of reaching and exceeding climate tipping points increases as the global temperature increases. At current warming levels, the risks are already present, and new scientific understanding reflected in the IPCC’s AR6 suggests that the risks are more likely to occur at lower global warming levels than were previously envisaged.



Climate tipping points and Ireland

The ICCA report³ addresses climate tipping points as ‘low-likelihood high-impact’ outcomes. It indicates that climate tipping points that shift the global climate or alter the regional climate in the North Atlantic and in north-western Europe would have implications for Ireland.

For Ireland, the stability of the North Atlantic Ocean determines our climate and agricultural productivity. The stability of the AMOC is the most immediate potential tipping point. It is thought that the AMOC will almost certainly weaken over the 21st century, and a full collapse cannot be ruled out. This would have profound implications for Ireland’s climate and society as a result of considerably colder winters and warmer summers and a likely increase in storminess, with potential implications for sea levels.

Projections of global sea level rise past 2100 have large uncertainties and will be determined by the effectiveness of current global climate policy. Much of the uncertainty is related to the stability of major ice sheets in Greenland and Antarctica. Their loss may become inevitable at certain levels of global warming. The loss of the West Antarctic Ice Sheet could result in a sea level rise of several metres over time.

Currently, thawing permafrost⁴ is losing carbon to the atmosphere. Model projections and paleoclimate evidence indicates that, as the global climate warms, permafrost extent and volume will shrink, releasing further greenhouse gases into the atmosphere. The complete thawing of permafrost cannot be ruled out, and this would emit more carbon into the atmosphere than humans have emitted to date, leading to substantial additional warming.

Recent developments

The apparent acceleration of global warming and the increase in ocean temperatures have resulted in considerable focus on climate change impacts. Recent high-profile research publications have suggested that the AMOC may collapse abruptly during this century, see, for example, Van Westen *et al.*, 2024. These and other developments, as well as the high level of scientific uncertainty around climate tipping points, highlight the need for targeted and managed research.

The ICCA report (Thorne *et al.*, 2024) highlights that climate change impacts will directly and indirectly affect health and wellbeing, while vulnerability is likely to increase as Ireland’s population increases and ages over the coming decades. We may see reducing excess cold mortality rates as a result of fewer cold extremes in winter, but conversely we may see increased impacts of heat stress, particularly as our population ages in the coming decades. Longer growing seasons may lead to an increase in respiratory diseases, such as asthma, as a result of the increased circulation of pollen and spores and public health issues may also arise from poor water quality as a result of extreme rainfall and flooding. The consequences for psychological health and wellbeing that can result from the loss of valued places, flooding and other extreme conditions cannot be underestimated.

Projected increases in the frequency of extreme precipitation events may result in more waterborne disease (e.g. due to *Escherichia coli*) arising from contaminated drinking water because of overland flows of pollutants. Projected increases in annual average temperature, combined with wetter conditions, may result in enhanced environmental conditions for bacterial growth and viral survival, with a potential increase in food-borne disease.

Increases in the frequency of heatwaves and drought are projected to result in the increased frequency of wildfires damaging forests stands. Significant impacts on biodiversity are also anticipated, including an increase in the presence of invasive species, some of which may have negative impacts on the economy (e.g. via impacts on farming and fisheries). Local and transboundary risks related to impacts on local and imported food supplies may lead to increases in productivity for some crops and decreases for others.

3 www.epa.ie/our-services/monitoring--assessment/climate-change/irelands-climate-change-assessment-icca/ (accessed 17 July 2024).

4 Permafrost is defined as ground that remains below 0°C for 2 years or more (ACGR, 1988).

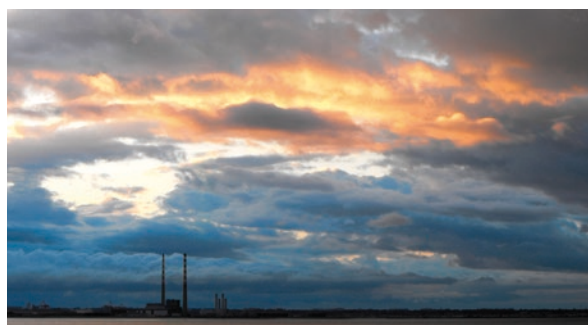


Impacts from both flooding and drought events include significant cascading and compound impacts on the water supply, biodiversity, the built environment, heritage sites and health. Tourism is an example of a sector that is highly exposed and vulnerable, as climate changes may lead to a lower environmental carrying capacity. There is a need for careful management to avoid putting sensitive and increasingly exposed and fragile heritage sites, environments and ecosystems at risk.

Impacts from sea level rise, which will continue during the 21st century and beyond, will result in the increased frequency of coastal flooding and erosion, with significant impacts for built and cultural assets, including coastal and heritage sites situated in proximity to the coast and on estuaries.

Ireland depends on critical infrastructure for delivering public services, economic growth and a sustainable environment. Transport infrastructure is exposed to increases in sea levels and flooding. For energy infrastructure, the key risks are extreme wind speeds, increased precipitation and saturated soils, given their impacts on the electricity distribution network, with flooding also a cause for concern. For information and communications technology infrastructure, extreme wind speeds and increased storminess are key concerns.

Failures in critical infrastructure can cascade across other sectors and present a multisector risk. For example, as many sectors electrify to reduce emissions, power supply interruption would have a significantly increased impact on transport, domestic heating, industry and health than previously.



Storm over Poolbeg, Dublin

3. International, EU and national policy contexts

This decade has brought a significant ramping up in national and international climate legislation and policy that aim to drive reductions in greenhouse gas emissions and support adaptation and resilience, to deliver on the aims of the Paris Agreement. The pace and scale of climate action implementation, however, are not yet on track to match the ambition of this legislation and policy at the global or national level. Rapid and sustained action can have significant co-benefits for health, wellbeing, jobs, businesses and biodiversity while reducing vulnerability to the adverse impacts of climate change.

Table 4.1 sets out the international, EU and national policy objectives and targets that Ireland has committed to meet (summarised in Figure 4.4)

Table 4.1 Ireland’s climate policy objectives and targets

Policy objectives and targets	Source	Target year
International		
Limit global temperature rise to well below 2°C and pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels	Paris Agreement 2015 (United Nations)	Long-term global goal
Balance GHG emissions and removals as informed by best available science	Paris Agreement 2015 (United Nations)	Second half of 21st century
Take urgent action to combat climate change and its impacts	United Nations Sustainable Development Goal 13	2030



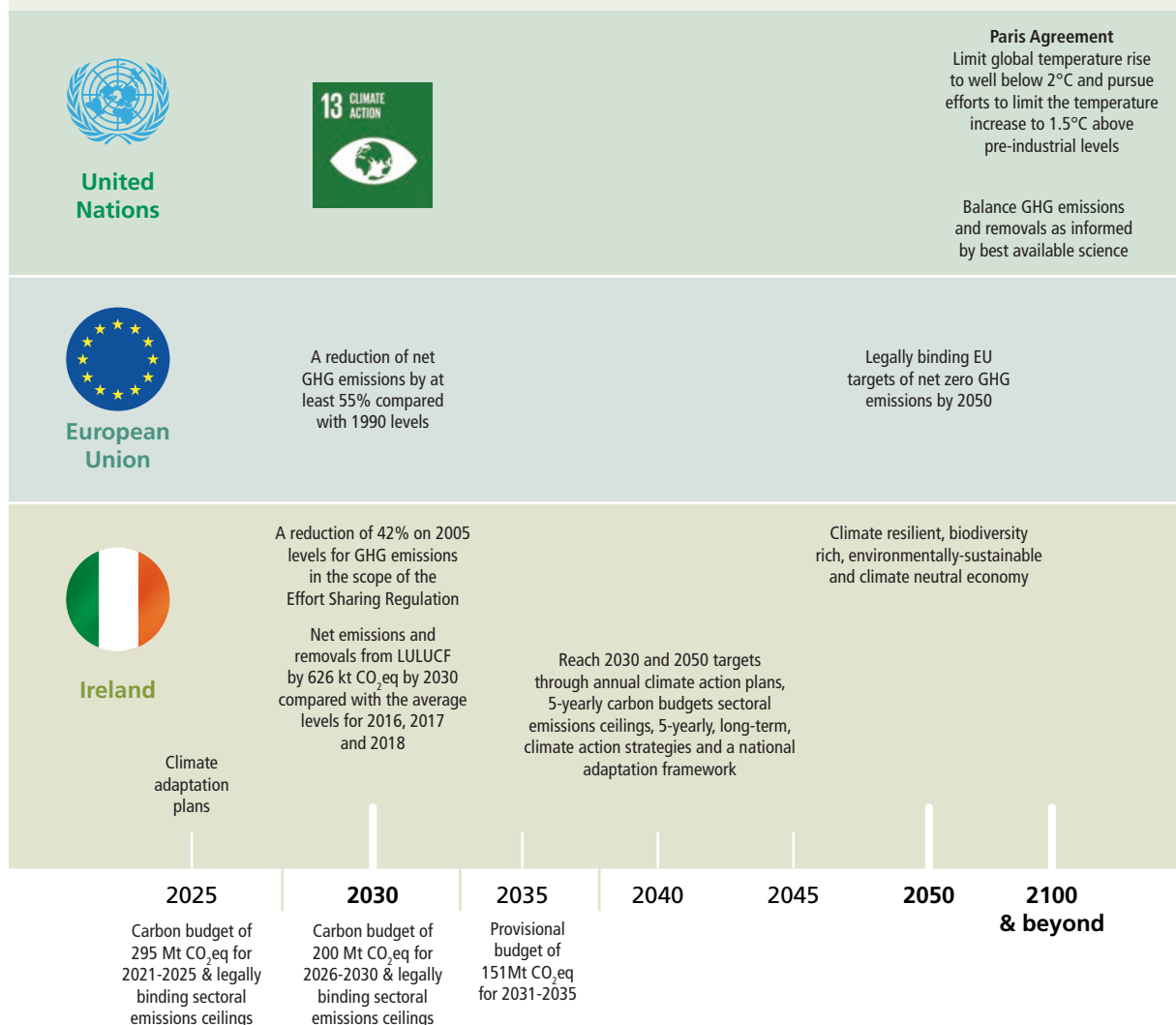
Policy objectives and targets	Source	Target year
EU		
Legally binding EU targets of net zero greenhouse gas emissions by 2050	EU climate law Implementing legislation includes:	2030 and 2050
A reduction of net greenhouse gas emissions by at least 55% compared with 1990 levels by 2030	<ul style="list-style-type: none"> ■ Effort Sharing Regulation (EU) 2018/842 amended by Regulation (EU) 2023/857 ■ Renewable Energy Directive ((EU) 2023/2413) ■ Energy Efficiency Directive ((EU) 2023/1791) ■ LULUCF Regulation (EU) 2018/841 amended by Regulation (EU) 2023/839) ■ ETS Directive ((EU) 2023/959) 	
Ireland must reduce greenhouse gas emissions within scope of the Effort Sharing Regulation by 42% compared with the 2005 level by 2030 (some flexibilities apply)	Effort Sharing Regulation (Regulation (EU) 2018/842 amended by Regulation (EU) 2023/857)	2030
Ireland must reduce net emissions and removals from LULUCF by 626 kt CO ₂ eq by 2030 compared with the average levels for 2016, 2017 and 2018	LULUCF Regulation (Regulation (EU) 2018/841 amended by Regulation (EU) 2023/839)	2030
National		
A national climate objective that supports the transition to a climate resilient, biodiversity-rich, environmentally sustainable and climate-neutral economy is to be pursued and achieved no later than 2050	The Climate Action and Low Carbon Development (Amendment) Act 2021	2050
Two 5-year carbon budgets, of 295 Mt CO ₂ eq for 2021-2025 and 200 Mt CO ₂ eq for 2026-2030, approved and intended to equate to a total net GHG emissions reduction of 51% over the period to 2030, relative to a baseline of 2018. Provisional budget of 151 Mt CO ₂ eq for 2031-2035	The Climate Action and Low Carbon Development (Amendment) Act 2021	2021-2025, 2026-2030 and 2031-2035
Legally binding sectoral emissions ceilings for each of the approved carbon budget periods applying to the following sectors: electricity, transport, built environment, industry and agriculture.	The Climate Action and Low Carbon Development (Amendment) Act 2021	2021-2025 and 2026-2030
The development of plans and strategies to reach 2030 and 2050 targets through: <ul style="list-style-type: none"> ■ annual climate action plans ■ 5-yearly, long-term, climate action strategies ■ 5-yearly carbon budgets ■ sectoral emissions ceilings ■ a national adaptation framework 	The Climate Action and Low Carbon Development (Amendment) Act 2021	2030 and 2050



Policy objectives and targets	Source	Target year
All local authorities are required to prepare climate action plans, to be updated at least every 5 years	The Climate Action and Low Carbon Development (Amendment) Act 2021	2030
Build sectoral and local-level resilience to climate change impacts	National Adaptation Framework (DECC, 2024a)	2025 and 2050
Prepare revised sectoral adaptation plans	The Climate Action and Low Carbon Development (Amendment) Act 2021 and National Adaptation Framework (DECC, 2024a)	2025
Pathway to meeting 2030 targets that is consistent with meeting the climate-neutrality carbon target by 2050	Annually updated climate action plans	2030 and 2050

ETS, Emissions Trading System; GHG, greenhouse gas; LULUCF, land use, land use change and forestry.

Figure 4.4 Visual summary of Ireland’s climate policy objectives and targets



GHG, greenhouse gas.



4. Greenhouse gas emissions trends and projections

Greenhouse gas emissions trends

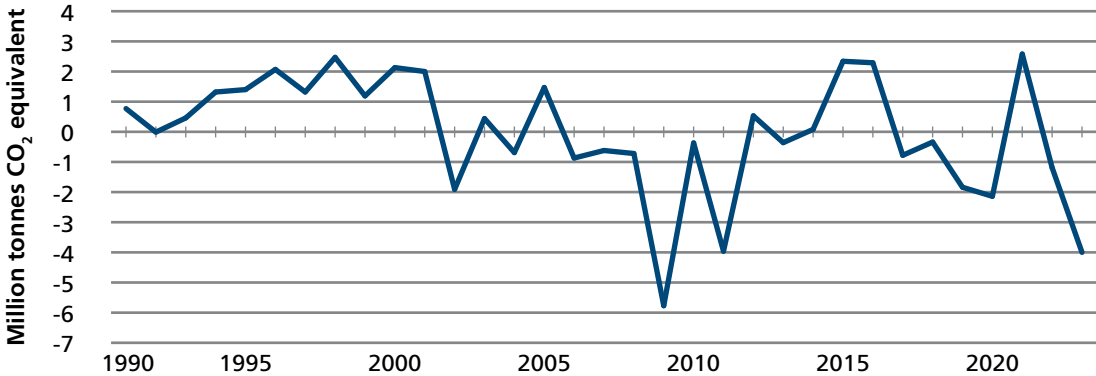
Ireland’s greenhouse gas emissions have decreased by 1.2% since 1990. In 2023, greenhouse gas emissions (excluding land use, land use change and forestry (LULUCF)) are estimated to have been 55.00 Mt CO₂ eq. This is 6.8% lower (or 4.00 Mt CO₂ eq) than emissions in 2022 (59.00 Mt CO₂ eq). Emissions in 2023 were 7.9% lower than pre-pandemic 2019 figures (EPA, 2024b).

Figure 4.5 shows the annual increases and decreases in national total emissions (excluding LULUCF) since 1990, with the largest decreases evident following the 2008 financial crisis and subsequent recession. Although 2023 represented the largest single-year reduction in

emissions outside a recessionary period, Ireland has yet to see the sustained and substantial annual decreases in emissions, as a result of greenhouse gas emission mitigation measures, that will be required to meet Ireland’s national targets and international obligations.

Ireland is one of the highest per capita emitters of greenhouse gases in the EU. Emissions per capita decreased from 11.4 tonnes CO₂ equivalent per person in 2022 to 10.4 tonnes CO₂ equivalent per person in 2023 (Figure 4.6). With recent Central Statistics Office (2024) population projections indicating an increased population of 5.2-5.6 million in 2031, per capita emissions will need to reduce significantly in order to meet emissions reduction targets.

Figure 4.5 Interannual changes in national greenhouse gas emissions, 1990-2023



Source: EPA, 2024b

Figure 4.6 Comparative per capita greenhouse gas emissions

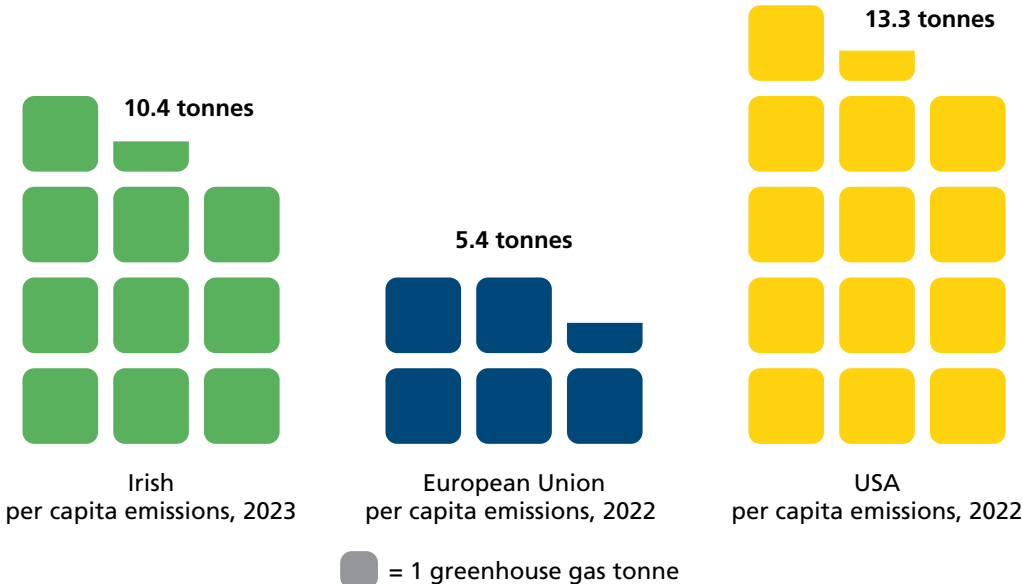
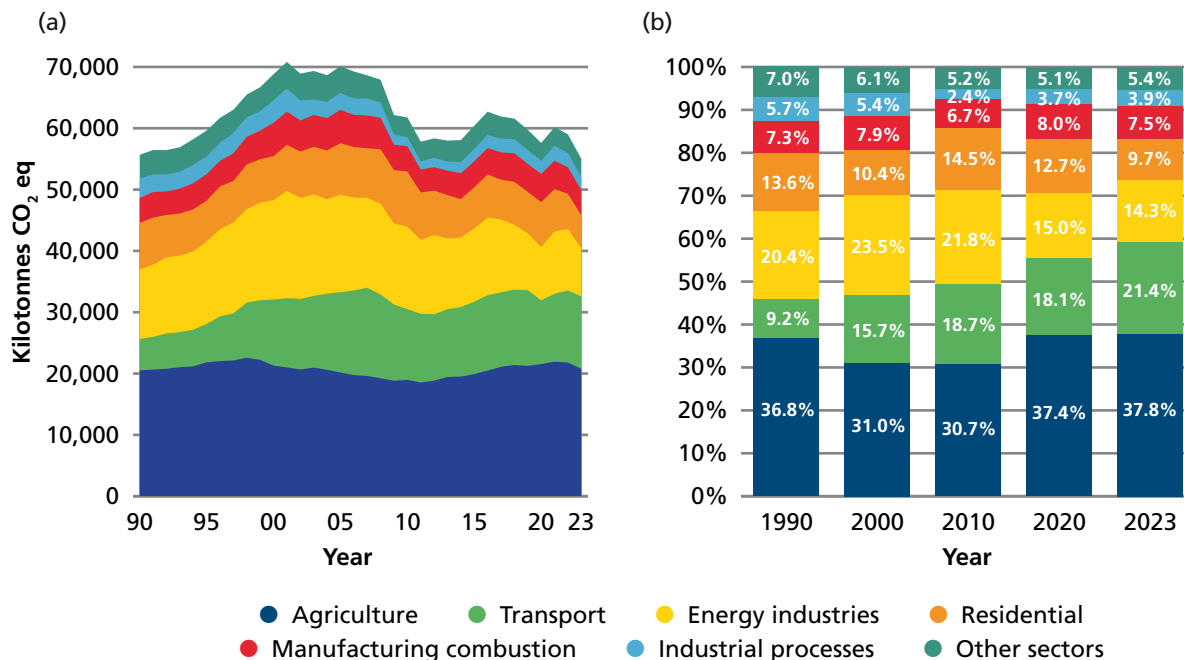




Figure 4.7 Trends in greenhouse gas emissions between 1990 and 2023 for the largest sectors in (a) kilotonnes CO₂ equivalent and (b) as percentages



Source: EPA, 2024b

National greenhouse gas emissions comprise emissions released from the sectors covered by the EU Emissions Trading System (ETS) and those outside the system. The ETS covers large stationary combustion emissions such as those from power generation, cement production and aviation. Emissions from sectors outside the ETS are known as Effort Sharing Regulation (ESR) emissions, which include emissions from the agriculture, transport and residential sectors. Since 2005, Ireland’s emissions that fall within the scope of the ETS have decreased by 45.7% or 10.25 Mt CO₂ eq, with electricity generators and cement plants responsible for the majority of the decrease. In contrast, emissions under the ESR decreased by 10.1% or 4.82 Mt CO₂ eq over the period 2005-2023.

In terms of sectors, agriculture is the largest contributor to overall emissions, accounting for 37.8% of total emissions (excluding LULUCF). The transport and energy industries are the second and third largest contributors at 21.4% and 14.3%, respectively. Residential and manufacturing combustion emissions account for 9.7% and 7.5%, respectively.

These five sectors accounted for 90.7% of total national emissions in 2023. The remainder is made up by the industrial processes sector at 3.9%, fluorinated gases at 1.3%, commercial services at 1.3%, public services at 1.2% and waste at 1.5%. Figure 4.7 shows the contributions from the key sectors from 1990 to 2023.

Compliance with national commitments

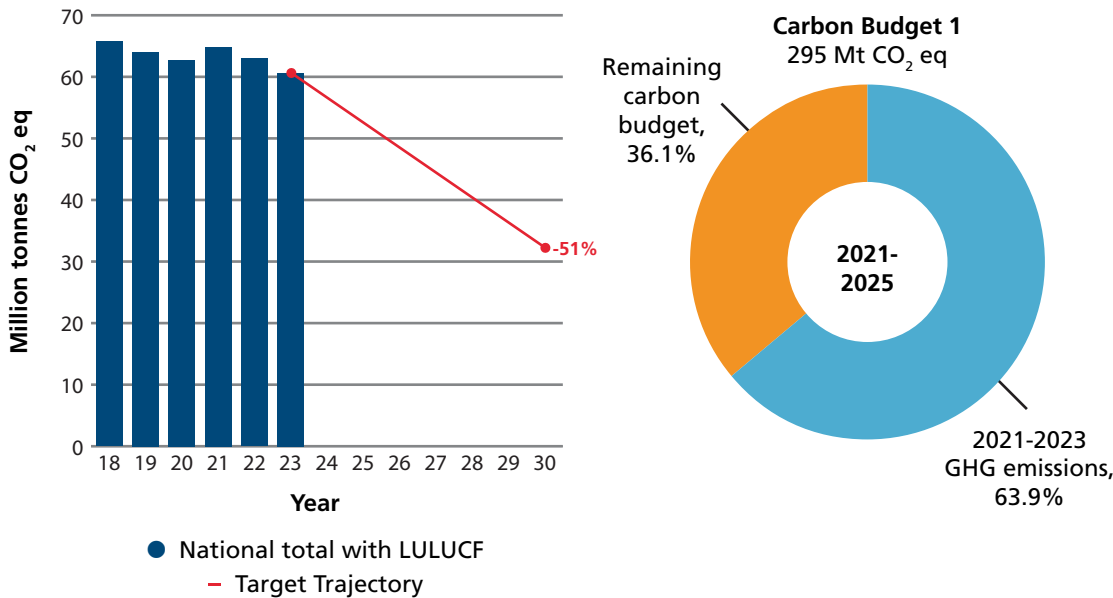
Three carbon budgets for the period up to 2035 have been approved by the Oireachtas and came into force on 6 April 2022 (DECC, 2022):

- Budget 1 from 2021 to 2025 has been set at 295 Mt CO₂ eq
- Budget 2 from 2026 to 2030 has been set at 200 Mt CO₂ eq
- Budget 3 from 2031 to 2035 has been set at 151 Mt CO₂ eq.

Figure 4.8 illustrates a linear emissions reduction trajectory towards achieving the 51% reduction target, along with the extent to which the first carbon budget (for the period 2021-2025) has been ‘used up’ based on emissions between 2021 and 2023.



Figure 4.8 Climate Action and Low Carbon Development (Amendment) Act 2021 target and carbon budgets



GHG, greenhouse gas.
Source: EPA, 2024b

Total national emissions (including LULUCF) from 2021 to 2023 are 188.43 Mt CO₂ eq, accounting for 63.9% of the first 5-year carbon budget of 295 Mt CO₂ eq. This leaves 36.1% of the budget available for the remaining 2 years.

To stay within budget for the first carbon budget period will require a substantial 8.3% annual emissions reduction in 2024 and 2025. Non-achievement of the first carbon budget would also see the excess emissions carried forward into the second budget period, and the second carbon budget would be reduced by that amount. If this occurs, it would make achieving the second budget substantially more difficult.

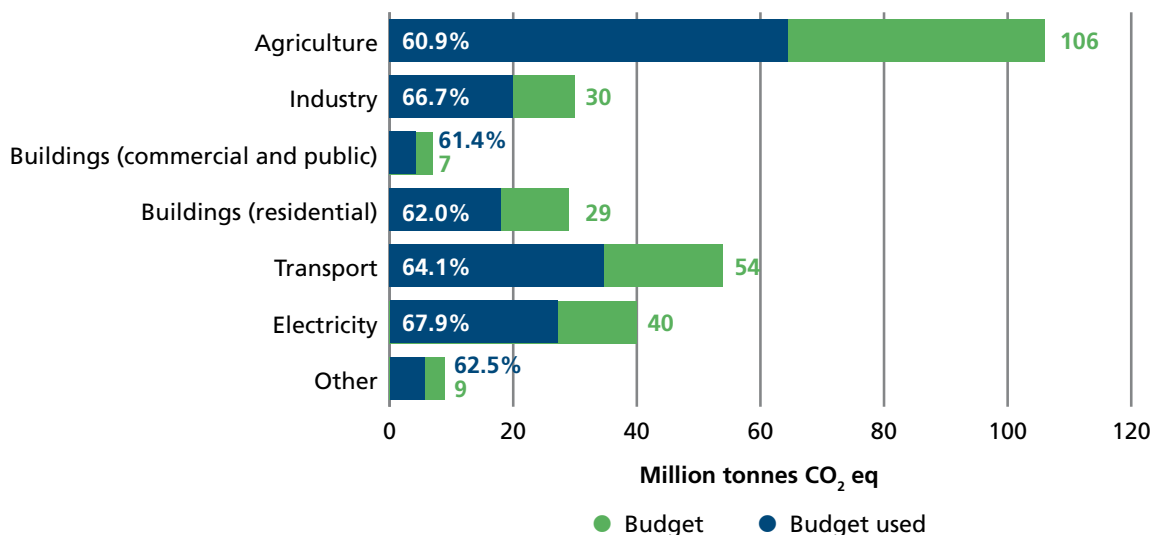
Looking at the sectors, the sectoral budgets already used up range from 60.9% in the agricultural sector to 67.9% in the electricity sector (see Figure 4.9).

In part, the extent of usage of the electricity budget is related to the continued use of coal in electricity generation. However, this use is in decline and coal generated only 3.5% of electricity in 2023 compared with 7.0% in 2022. The sectoral emissions ceilings were set with the expectation of achieving specific emissions reductions in each sector in 2030 relative to 2018, with interim targets for 2025 being set out in the 2023 Climate Action Plan and subsequently updated in the 2024 Climate Action Plan.

In relation to LULUCF, no sectoral ceiling has been set. However, the 2024 Climate Action Plan set out an ambition for the LULUCF sector that is aligned with the EU LULUCF Regulation target of a fixed reduction of 0.626 Mt CO₂ eq by 2030 below a baseline set at the average of 2016-2018 emissions.



Figure 4.9 First carbon budget (2021-2025) sectoral ceilings and usage



Source: EPA, 2024b

The amount of each budget that has already been used up significantly affects the level of emissions reductions required over the next 3 years to stay within budget. Across all sectors, average annual emissions reductions of 8.3% are required. For example, in the transport sector, with 64.1% of the budget already used up, annual emissions reductions of 12.4% are now required in 2024 and 2025 to stay within the first carbon budget. For residential buildings, however, the corresponding required emissions reduction is -2.1% per annum, i.e. this sector has exceeded its indicative percentage reduction target and is on track to be below its sectoral emissions ceiling in 2025.

Compliance with EU commitments

The EU ESR set a 2030 target for emissions reductions in sectors outside the ETS. Emissions from these sectors are collectively known as ESR emissions.⁵ Ireland's target is to reduce ESR emissions by 42% by 2030 compared with 2005 levels, with a number of flexibilities being available to assist in achieving this. In addition, the ESR sets out annual binding national limits for the period 2021-2030.

The year 2023 marks the third year in the 10-year period in which emissions data will be assessed to determine compliance with ESR targets. In 2023, Ireland's ESR emissions exceeded the annual limit by 2.3 Mt CO₂ eq (see Table 4.2). Cumulatively, from 2021 to 2023 and after using the ETS flexibility,⁶ Ireland is in compliance with the ESR by a net distance to target of 0.15 Mt CO₂ eq across these years. In 2023, agriculture and transport accounted for 76% of total ESR emissions.

5 The largest sectors included in ESR emissions are the agriculture, transport and residential sectors. LULUCF emissions are excluded along with most emissions from power generation and industry, as these are largely covered by the ETS.

6 Articles 6 and 7 of the ESR provide for the use of two flexibilities, the ETS flexibility and the LULUCF flexibility. The former is targeted at Member States who wish to cancel ETS allowances (and forgo auction revenues) in lieu of a reduced ESR emissions reduction requirement. For Ireland, this flexibility is up to 19.1 Mt CO₂ eq over the period 2021-2030. The second flexibility allows for the recognition of reduced emissions or additional removals in the LULUCF sector up to an agreed limit (26.8 Mt CO₂ eq for Ireland) to be counted towards ESR target compliance, although the level of flexibility used will depend on the actual emissions reduction/removals achieved. Ireland's proportionally greater access to flexibilities relative to its size in part reflective of an acknowledgement of the lower mitigation potential of the agriculture and land use sector.

**Table 4.2** Compliance with Effort Sharing Regulation targets 2021-2025 (kilotonnes CO₂ equivalent)

	2021	2022	2023	2024	2025
Total greenhouse gas emissions without LULUCF	60,191	59,003	55,007		
– Total verified emissions from stationary installations under Directive 2003/87/EC	15,320	14,686	12,189		
– CO ₂ emissions from domestic aviation	20	21	31		
Total ESR emissions	44,852	44,295	42,787		
EU ESR Targets†	43,479	42,357	40,520	38,683	36,845
Gross distance to target	-1372	-1938	-2267		
+ annualised ETS flexibility ^a	1908	1908	1908	1908	1908
Net distance to target	536	-30	-359		

a Set out in Annex II and Annex III of Commission Implementing Decision (EU) 2020/2126 with additional potential flexibilities arising from LULUCF

Source: EPA, 2024b

As outlined in the section below, 'Projected future emissions trends', in terms of EU compliance, it is projected that reaching the 2030 EU emissions reduction target of 42% will require full and rapid implementation of the 2024 Climate Action Plan measures with a requirement that further measures are identified and implemented.

It is important to note that none of the savings modelled in the EPA projections, whether in the With Existing Measures scenario or the With Additional Measures scenario, will be achieved until the implementation actions have been delivered and the resulting emissions reductions are seen in the annual greenhouse gas inventory.

Projected future emissions trends

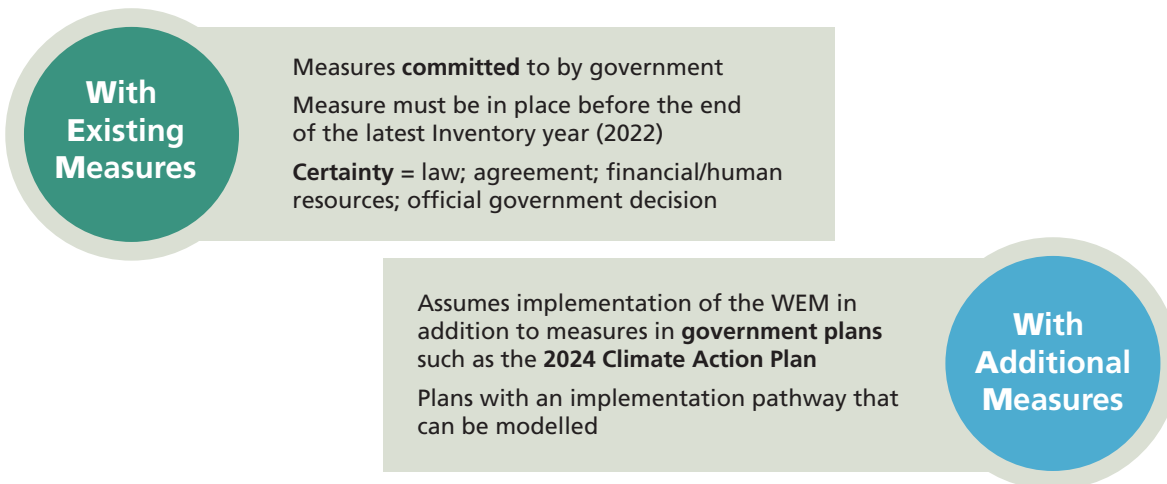
The EPA produces greenhouse gas emissions projections using two scenarios or levels of ambition, representing different possible trajectories for Ireland's greenhouse gas emissions (Figure 4.10). The first scenario, With Existing Measures, forecasts Ireland's emissions including all national policies and measures implemented by the end of the most recent inventory year available at the time of publication (2022 in the case of the most recent EPA projections). Implemented policies and measures such as those in the National Development Plan (DPER, 2021) and the climate action plans are included in this scenario.

The second scenario, With Additional Measures, has a higher level of ambition and includes planned government policies and measures to reduce emissions such as those in Ireland's 2024 Climate Action Plan. This plan was published in its final form in May 2024, and some policies and measures have yet to be implemented. As implementation happens, the policies and measures will be migrated into the With Existing Measures scenario.



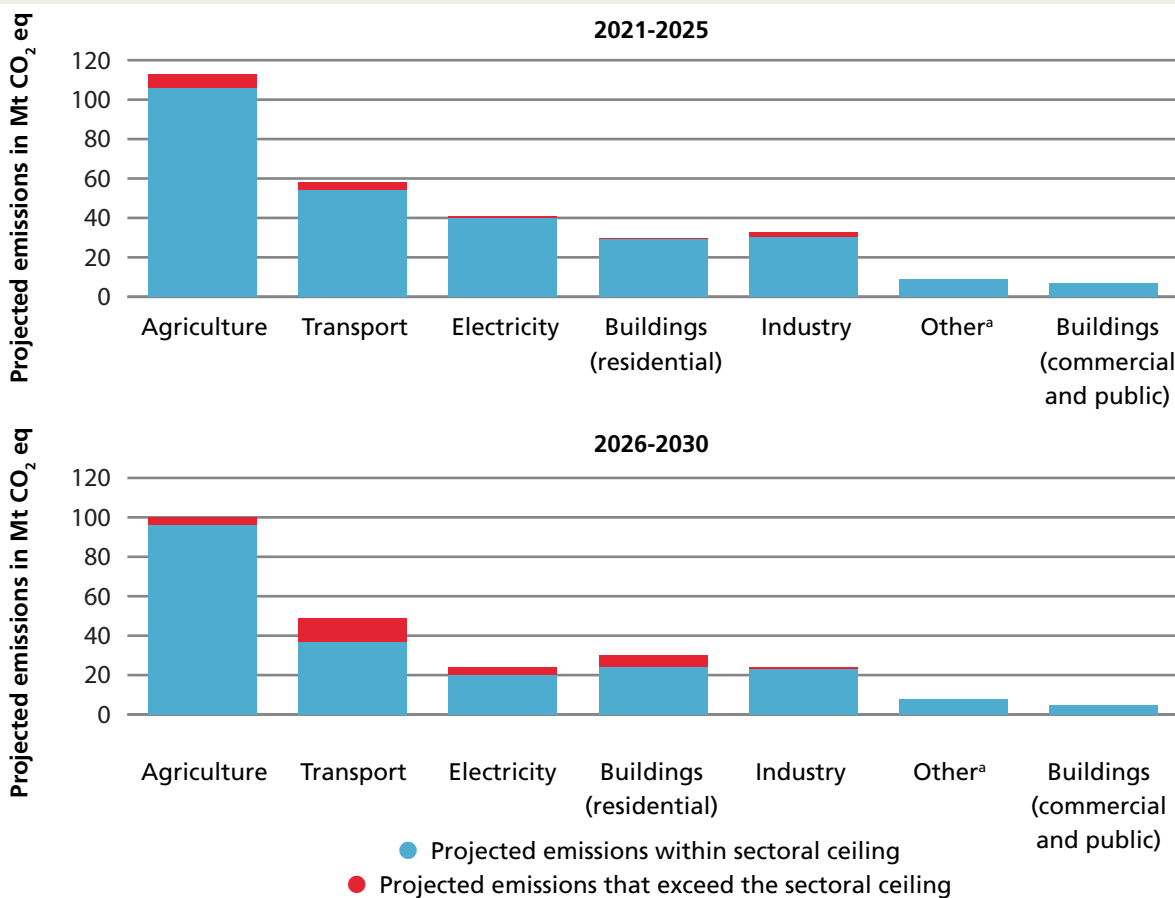


Figure 4.10 Greenhouse gas emissions projections: With Existing Measures and With Additional Measures scenarios



WEM, With Existing Measures.

Figure 4.11 Projected emissions versus sectoral emissions ceilings (With Additional Measures scenario) for (a) 2021-2025 and (b) 2026-2030



Notes: Total budget 2021-2025 = 295 Mt CO₂ eq; total budget 2026-2030 = 200 Mt CO₂ eq; ^aFluorinated gases, waste, petroleum refining.

Source: EPA, 2024a



Projected national compliance. According to EPA projections, Ireland is not on track to meet the 2030 target of a 51% emissions reduction (compared with 2018 levels), associated carbon budget targets and sectoral emissions goals. This is despite the projections including most measures from the 2024 Climate Action Plan and previous plans, indicating the scale of the challenge ahead. Further measures still need to be identified and implemented to achieve the 2030 target.

The first two carbon budgets (2021-2030), which aim to support the 51% emissions reduction goal, are projected to be exceeded by a significant margin of between 17% and 27%. Sectoral emissions ceilings for 2025 and 2030 are projected to be exceeded in almost all cases, including in agriculture, electricity, industry and transport (see Figure 4.11). Only the commercial and public buildings sector is projected to stay within its allotted ceiling, provided the ambitious measures outlined in the 2024 Climate Action Plan and in previous plans are implemented in full.

The projections show that implemented policies and measures in the With Existing Measures scenario can deliver an 11% reduction in greenhouse gas emissions by 2030 compared with 2018 levels. The With Additional Measures scenario, including policies and measures from the 2024 Climate Action Plan, is projected to deliver a 29% emissions reduction over the same period.

The EPA projections also highlight that approximately 8.75 Mt CO₂ eq of savings by 2030 identified in the 2024 Climate Action Plan were not included in the projections. If that level of savings could be realised in 2030, the percentage reduction in emissions achieved in total (including LULUCF) would be 42%, still short of the 51% emissions reduction goal. These measures were not included in the EPA projections because an implementation pathway to merit their inclusion could not be modelled at that point in time.

Some of the more significant excluded measures relate to agriculture diversification, a portion of Avoid-Shift measures in transport and the replacement of traditional construction materials with lower carbon alternatives. Also not included were unallocated emissions savings of 26.25 Mt CO₂ eq in the second carbon budget period (2026-2030) in the 2024 Climate Action Plan, which have not yet been attributed to any sector.

Projected EU compliance. Ireland's 2030 target under the EU ESR is to deliver a 42% reduction of emissions compared with 2005 levels by 2030. This target was set in April 2023 upon amendment of the ESR. The ESR includes sectors outside the scope of the EU ETS, such as agriculture, transport, residential, public/commercial services and waste, and is also referred to as a 'non-ETS'. EPA projections show that agriculture and transport

emissions form the majority of ESR emissions. Combined they represent 80% of projected ESR emissions in 2030 under both the With Existing Measures scenario and the With Additional Measures scenario.

Without the use of ETS and LULUCF flexibilities,⁶ the latest EPA projections show that currently implemented policies and measures (With Existing Measures) will achieve a reduction of 9% on 2005 levels by 2030. If policies and measures in the higher ambition (With Additional Measures) scenario are implemented, EPA projections show that Ireland can achieve a reduction of 25% by 2030. Both the With Existing Measures and the With Additional Measures scenarios indicate that Ireland will be significantly short of the 42% reduction target.

EPA projections show that use of ETS flexibility alone will not bring Ireland into compliance under the ESR. When ETS flexibility is applied, projections indicate that Ireland will cumulatively exceed the ESR 2021-2030 emissions allocation by 31.1 Mt CO₂ eq, even with the implementation of policies and measures from the With Additional Measures scenario.

Similarly, when both ETS and LULUCF flexibilities are applied, the projections still indicate that Ireland will cumulatively exceed the ESR 2021-2030 emissions allocation by 17.7 Mt CO₂ eq, even with the implementation of policies and measures from the With Additional Measures scenario.

Sectoral emissions

The following provides a summary of historical and projected emissions trends in key emitting sectors. For agriculture-, transport- and energy-related emissions, further analysis can be found in their respective chapters.

Agriculture emissions. Over the period 1990-2023, agriculture emissions have increased by 1.3%, mainly driven by a 4.9% increase in methane emissions from enteric fermentation and a 4.5% increase in emissions from manure management. After initially showing a rising trend in the 1990s, agriculture emissions began to decrease steadily between 1998 and 2011. However, since 2011, emissions have trended upwards again, with an overall peak in emissions reported in 2021. In the last 10 years, dairy cow numbers have increased by 40.6%, with a corresponding milk production increase of 56.0%. This reflects both national plans to expand milk production under Food Wise 2025 and the removal of the milk quota in 2015. In the same 10-year period, sheep numbers increased by 11.5%, pig numbers by 1.6% and poultry numbers by 29.4%.



In 2023, greenhouse gas emissions from agriculture decreased by 4.6% (or 1.01 Mt CO₂ eq) following a decrease in 2022 of 0.7% (EPA, 2024b). The most significant factor driving the lower emissions in 2023 was decreased synthetic fertiliser use (-18%) and decreased liming (-27%). The size of the dairy herd continued to increase, for the 13th consecutive year (+0.6% in 2023), with a 4.1% decrease in total national milk production. However, there was an overall decrease in livestock nationally, with non-dairy cattle down by 1.1%, sheep down by 1.2% and pigs down by 4.3%.

In terms of future emissions, agriculture emissions are projected to decrease by 1% and 18% over the period 2022-2030 under the With Existing Measures and With Additional Measures scenarios, respectively. The most ambitious scenario, the With Additional Measures scenario, assumes the implementation of Ireland's 2024 Climate Action Plan with the exception of diversification measures, which do not yet have a sufficiently elaborated implementation pathway to be included in the modelling.

The sectoral emissions ceilings for the agriculture sector are 106 Mt CO₂ eq for 2021-2025 and 96 Mt CO₂ eq for 2026-2030. If these ceilings are not exceeded, this would likely approximate a 25% reduction in the sector's greenhouse gas emissions in 2030 compared with 2018.

The most recent Teagasc marginal abatement cost curve⁷ publication sets out measures that are to be implemented in the agriculture sector, including the following:

- Methane emissions are expected to be reduced through a variety of measures, including expanding tillage, increasing organic farming and reducing the methane output from each animal (e.g. through selective breeding, feed additives and earlier slaughter ages). Measures such as an expansion of anaerobic digestion aim to capture more of the methane at source and use it to generate heat and power.
- Nitrous oxide emission reduction measures include those aimed at reducing the requirement for nitrogen fertilisers and ultimately reducing chemical nitrogen fertiliser usage to 300,000 tonnes by 2030. Some other related measures include the use of low-emission slurry spreading and the planting of clover and multi-species swards.

Transport emissions. Between 1990 and 2023, of all sectors transport shows the greatest overall increase of greenhouse gas emissions at 129.2%, with road transport increasing by 133.6%. Fuel combustion emissions from transport accounted for 9.2% and 24.4% of total national greenhouse gas emissions in 1990 and 2023, respectively. The increase in emissions up to 2007 can be attributed to general economic prosperity and an increasing population, with a high reliance on private car travel and rapidly increasing road freight transport. Over the period, passenger car numbers increased by 191% and commercial vehicle numbers increased by 177%. The increase in transport emissions up to 2007 and the subsequent fall during the financial crisis highlight that transport emissions have not yet been effectively decoupled from economic activity through sustainable planning or electrification.

Transport emissions in 2023 marginally increased by 0.3% (or 0.03 Mt CO₂ eq) compared with 2022 emissions. Emissions from road transport were relatively stable for the period 2015-2019, at an average of 12.2 Mt CO₂ eq, but reduced to 10.4 Mt CO₂ eq in 2020, driven by movement restrictions related to COVID-19. However, with the easing and ending of travel restrictions in 2021 and 2022, road transport emissions rebounded to 11.1 Mt CO₂ eq and 11.8 Mt CO₂ eq, respectively, with 2023 emissions still 4.3% below pre-COVID-19 levels.

Transport emissions are projected to decrease by 26% over the period 2022-2030 under the With Existing Measures and With Additional Measures scenarios, respectively. The more ambitious With Additional Measures scenario assumes that 943,600 electric vehicles will be on the road by 2030, biofuel blends of 10% for petrol and 20% for diesel will be achieved, and a 20% reduction in total vehicle kilometres by 2030 will have been brought about by Avoid-Shift measures.

The sectoral emissions ceilings for the transport sector are 54 Mt CO₂ eq for 2021-2025 and 37 Mt CO₂ eq for 2026-2030, which, if achieved, will approximate to a 50% reduction in the sector's greenhouse gas emissions in 2030 compared with 2018.

The measures planned in the transport sector are predicated on the Avoid-Shift-Improve hierarchy, where Avoid measures aim to result in a lower transport demand, Shift measures seek to move to less carbon-intensive transport modes and Improve measures change technologies to result in lower emissions. In the 2024 Climate Action Plan:

⁷ www.teagasc.ie/publications/2023/marginal-abatement-cost-curve-2023---executive-summary.php (accessed 13 September 2024).



- Avoid measures aim to result in a 20% reduction in total vehicle kilometres by 2030. Additional work is still needed in future climate action plans to set out how this reduction will be achieved. The proposed measure of a 65% increase in the pump price of petrol and diesel from 2018 to 2030 as part of the 20% reduction in total vehicle kilometres is not included in the latest EPA projections.
- Shift measures aim to achieve a 50% increase in daily active travel journeys by 2030 along with a 130% increase in public transport journeys.
- Improve measures build on those in the Climate Action Plan and would see 845,000 passenger car electric vehicles registered by 2030 (30% share of total passenger car fleet) along with a 20% electric vehicle share of the large goods vehicle fleet and 30% zero emissions share of new heavy goods vehicles.

Energy emissions. Energy sector⁸ emissions decreased by 30.8% from 1990 to 2023. Over this period, emissions specifically from electricity generation decreased by 32.1%, whereas total electricity consumption increased by 164%. Emissions from electricity generation increased from 1990 to 2001 by 54.3% and have decreased by 56.0% between 2001 and 2022. This decrease reflects the improved efficiency of modern gas-fired power plants, which have replaced older peat- and oil-fired plants, and the increased share of renewables, primarily wind power, along with increased interconnectivity. 2023 was the lowest year in the 34-year time series for peat-fired electricity generation, 39% less than in 2022. These reductions reflect the gradual ending of peat-fired electricity generation for market and climate policy reasons. Emissions from electricity generation decreased year-on-year from 2016 to 2020, but they increased in 2021 by 19% compared with 2020 due to an increase in coal and oil use, driven by a number of factors, including the war in Ukraine. Coal use in electricity generation decreased by 44.0% in 2023 compared with 2022.

Sectoral emissions in the energy industries sector show a decrease of 21.6% in 2023, the largest annual change in emissions ever recorded for the sector, and are now at an all-time low across the 1990-2023 time series at 7.8 Mt CO₂ eq. This reduction in emissions is partly due to a 12-fold increase in the amount of imported electricity, accounting for 9.5% of electricity supply in 2023. Imported electricity amounted to 3275 GWh, which would have resulted in additional emissions of over 1 Mt CO₂ eq if generated in Ireland. There was an increase in the renewable share in electricity generation,

which rose from 38.6% to 40.7% from 2022 to 2023, with wind accounting for 33.7% of electricity supply (up from 33.1%).

In terms of projections, emissions from the energy sector are projected to decrease by 57% and 62% over the period 2022-2030 under the With Existing Measures and With Additional Measures scenarios, respectively. Under the more ambitious With Additional Measures scenario, it is estimated that renewable electricity generation will increase by at least 80% by 2030 (as per the 2024 Climate Action Plan).

Measures for the electricity sector are intended to limit emissions over the first two carbon budget periods to 40 Mt CO₂ eq, for 2021-2025, and 20 Mt CO₂ eq, for 2026-2030. Achieving this is expected to reduce annual emissions from the sector to 3 Mt CO₂ eq by 2030 (a 75% reduction compared with 2018).

Planned mitigation measures for electricity are categorised across three broad headings:

- Accelerating renewable energy generation: this covers the scale-up of renewable electricity generation to reach 80% of electricity demand by 2030.
- Accelerating flexibility: these measures aim to facilitate the acceleration of renewable generation and include long-term storage, being able to facilitate 95-100% of renewables on the grid at any point in time, electricity generation from biomethane and hydrogen, and increased electricity interconnection capacity.
- Demand management: the measures on the demand side are aimed at ensuring zero growth in carbon demand and 20-30% demand-side flexibility by 2030.

Residential emissions. Residential sector emissions cover emissions from fuel combustion in households for domestic space and hot water heating. Over the period 1990-2023, residential sector emissions decreased by 29.4%. Increased housing stock and a growing population drove a gradual upwards trend in these emissions after 1997 following emissions reductions in the early 1990s due to fuel switching. Following a decline from 2010 to 2014, emissions remained relatively stable from 2015 to 2021 despite an increasing population. The number of households increased by 88.6% and the population increased by 50.7% between 1990 and 2023, with winter heating demand remaining an important annual variable driving emissions from this sector.

⁸ The majority of emissions within energy industries come from power generation and are largely regulated under the EU ETS. In addition, emissions from the manufacture of solid fuels, petroleum refining (also largely included within the ETS) and fugitive emissions are included.



At 17.8% below the previous lowest level in 2014, and 7.1% below 2022 levels, 2023 represents a new low point for residential sector emissions across the entire inventory time series since 1990. Notably, there were 6.2% fewer heating degree days in 2023 (i.e. the winter was warmer) than in 2022, and this, along with fuel prices and new solid fuel regulations, led to emissions per household in 2023 reducing to a new historic low of 2.8 tonnes CO₂ eq.

Emissions from the residential sector are projected to decrease by 15% and 27% between 2022 and 2030 under the With Existing Measures and With Additional Measures scenarios, respectively. The more ambitious With Additional Measures scenario assumes the full implementation of the measures in Ireland's 2024 Climate Action Plan, which includes the installation of 680,000 heat pumps by 2030, the retrofitting of homes to achieve the cost-optimal equivalent of a 'B2' building energy rating in 500,000 dwellings by 2030, no new oil (from 2022) or gas (from 2025) boilers being installed in new dwellings and district heating growing to 1.2 TWh in 2030 in this sector.

Land use, land use change and forestry

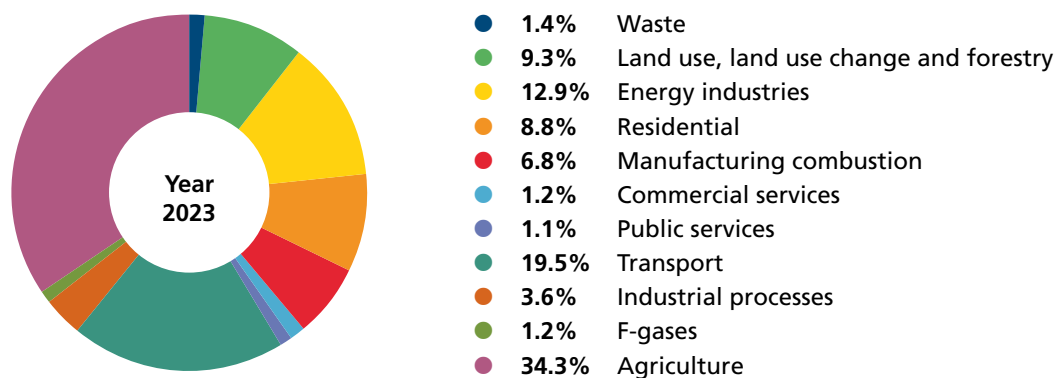
LULUCF emissions increased by 12.0% between 1990 and 2023. It has historically been the convention internationally that when referring to a country's 'total emissions' LULUCF is excluded (as above). However, given its inclusion in Ireland's Climate Action and Low Carbon Development (Amendment) Act 2021 targets, it is worthwhile also considering total emissions including LULUCF. LULUCF emissions in Ireland in 2023 were a net source of emissions amounting to 5.61 Mt CO₂ eq.

Total LULUCF emissions increased by 40.9% between 2022 and 2023, mainly as a result of lower emissions from wetlands and increased removals from the forestry category.

When LULUCF is included in the national total, it represents 9.3% of total emissions and is the fourth largest source of greenhouse gas emissions (Figure 4.12). This is unusual internationally, where the LULUCF sector is commonly a sink, providing net CO₂ removals on an annual basis. In Ireland, however, this sector was a net source of emissions in all years from 1990 to 2023. This is due to the large areas of drained organic soils including grasslands on peat, and the exploitation of wetlands for peat extraction. Significant emissions are reported from these land use categories that are greater than the removals resulting from forestry or other land uses.

In addition, there has been a considerable long-term decline in the area of land afforested annually, an increase in the level of harvest and an increase in emissions from forestry on organic soils, resulting in a reduction in the contribution of the forest land sector to the removal of CO₂ from the atmosphere. Afforestation rates have declined from an estimated 17,000 hectares annually in the 1990s to an estimated 1650 hectares by 2023, well below rates suggested in the 2024 Climate Action Plan, resulting in a decrease in the carbon sink provided by land converted to forest land. Forest land remaining as forest land is transitioning from a sink to an emissions source due to an increase in the level of harvest, from 1.7 million m³ in 1990 to 4.0 million m³ annually in recent years. Further increases in the level of harvest are projected as the forest estate matures.

Figure 4.12 Greenhouse gas emissions by sector in 2023, including land use, land use change and forestry



F-gases, fluorinated gases.

Source: EPA, 2024b



In terms of projections for the With Existing Measures scenario, emissions from the LULUCF sector are projected to increase by 99% between 2022 and 2030. This almost doubling of emissions is projected largely because of the levels of forest harvesting projected for the ageing forest estate. In the With Additional Measures scenario, emissions are projected to increase by 23% between 2022 and 2030. The more ambitious With Additional Measure scenario assumes the full implementation of measures under the 2024 Climate Action Plan, including:

- afforestation rates increasing to 8000 hectares per annum from 2026 to 2030
- water table management on 80,000 hectares of grassland on drained organic soils and improved management of 750,000 hectares grassland on mineral soils
- the use of cover crops and straw incorporation on cropland
- additional wetlands being rewetted, restored and rehabilitated over and above those included in the Bord na Móna Peatlands Climate Action Scheme.

5. Adaptation and resilience

Adaptation is the process of adjusting to actual or expected climate change and its effects. It is not a one-time emergency response, but a series of measures that are taken to build the resilience of our economy and society to the impacts of climate change. This can ultimately help minimise the emergency response that is necessary when severe weather events occur.

Adaptation can also ensure that slower onset impacts, such as sea level rise, biodiversity loss or water supply issues, are accounted for ahead of time, and that measures to minimise their future impacts are put in place.

Resilience is the outcome of adaptation and refers to the ability to maintain existing societal functions and environmental quality in the face of climate change. This is achieved by implementing effective adaptation and sustainable development measures, to reduce negative climate impacts while also taking advantage of any opportunities.

The wide-ranging impacts on Ireland's environment, society and economic development, driven by continued increases in the frequency and magnitude of climate hazards, will lead to a range of direct, cascading, compound and transboundary risks, including an increase in the frequency of wildfires; an increase in invasive species; local and transboundary risks to food supplies; increases in flood and drought events including significant cascading and compound impacts on water supply, biodiversity, the built environment, heritage sites and health; and an increase in the frequency of coastal flooding and erosion.

This will require us to think differently in terms of spatial and infrastructure planning and construction. This means that our roads, rail, energy, communications, food supply, water supply, health services and buildings will need to be constructed and situated in a way that makes them resilient to these changing future conditions (Figure 4.13).

Figure 4.13 Clonakilty flood relief scheme – retention infrastructure



Credit: Ward & Burke Ltd.



Recognising that climate mitigation and biodiversity action need to be incorporated into our adaptation responses means that we must choose nature-based solutions where possible to reduce our emissions and support biodiversity.

There is a limit to what infrastructure can achieve, and there is a need for dynamic and robust emergency planning and response systems and services to manage extreme events as they occur and to protect vulnerable populations in particular.

Effective climate adaptation is needed to avoid unequal health and wellbeing outcomes for communities and to realise the opportunities and benefits for individuals, public health and society. These include more green and blue spaces, more secure water and food supplies, improved indoor and outdoor air quality, increased active mobility and better-quality housing. Care must be taken to avoid maladaptation or actions that result in unequal health and wellbeing outcomes for affected populations, and adaptations should therefore be routinely assessed.

Ireland, as a small and open economy, is vulnerable to supply chain risks and climate change impacts and responses that occur in other parts of the world. Local risks to businesses are likely to arise from changes in extreme events. The scale of climate change risks for the banking and financial sectors has yet to be quantified, and climate risks are not currently reflected well in insurance, investment and lending.

The ICCA report highlights that climate adaptation is too slow and fragmented. Doing better requires more financing, working with people and nature, monitoring and evaluating outcomes and increasing public and private sector involvement. Importantly, a number of key developments have happened in recent years to help build the evidence base and inform national adaptation planning and decision-making.

Adaptation governance and planning

The new National Adaptation Framework (NAF) was published in 2024 and forms the basis of adaptation governance in Ireland's Climate Action Plan. A number of areas have been introduced or strengthened under the new NAF, including:

- the development of updated sectoral adaptation plans and the inclusion of a plan for the tourism sector, and the planning sector (as a scoping exercise)
- strengthened adaptation governance
- recognition of the principle of just resilience
- recognition of the importance of engagement and resourcing for adaptation
- ongoing development of the evidence base

- improved adaptation plan design and objective development
- monitoring and evaluation.

In addition, since 2021, the Adaptation Committee of the Climate Change Advisory Council has a statutory role in providing policy advice on adaptation and resilience to the Government.

Second iteration sectoral adaptation plans are due to be completed in 2025. The Climate Action Plan and the NAF indicate that there will be increased emphasis on monitoring and progress reporting in the future, with particular focus on meaningful adaptation indicators. The EPA and Transport Infrastructure Ireland have completed a pilot study to provide general recommendations to support the adoption of adaptation indicators across all sectors.

Climate action regional offices were established in 2018 and local authority training has been ongoing across the sector on climate action including on the leadership role that councils can take on climate change. Under the Climate Action and Low Carbon Development (Amendment) Act 2021, every local authority must produce a climate action plan covering mitigation, adaptation and citizen engagement. These plans were published in April 2024.

Adaptation evidence base

The National Framework for Climate Services (NFCS), led by Met Éireann, coordinates the standardisation of national climate data and facilitates collaboration between the producers and users of climate information.

The NFCS is underpinned by the TRANSLATE suite of standardised climate projections for Ireland (O'Brien and Nolan, 2023), which are provided for adaptation planning through the Climate Ireland platform. Climate services and data are also provided by several national stakeholders including the EPA, the Office of Public Works, Geological Survey Ireland and the Marine Institute as well as academic institutions.

Led by the EPA, Climate Ireland is a national adaptation platform providing climate and risk maps, capacity building and training, and risk assessment and adaptation planning guidance. It also convenes the Climate Ireland Adaptation Network for practitioners working in adaptation and holds an associated annual adaptation seminar.



National Climate Change Risk Assessment

The EPA has the responsibility of delivering Ireland's first NCCRA (Topic Box 4.4). The NCCRA, to be completed in early 2025, will comprise a semi-quantitative risk assessment from which a prioritised national climate risk register will be produced.

Resilience goals and adaptation planning

Ireland has set the national objective of transitioning to a climate-resilient, biodiversity-rich, environmentally sustainable and climate-neutral economy by 2050 at the latest, and it has put in place governance and support to help achieve this objective.

Adaptation progress would be further facilitated by specifying the climate scenario threshold that Ireland is planning to be resilient to by 2050. Internationally, there is a move towards minimum standards for adaptation planning that enable stakeholders to more clearly understand what range of potential futures should be planned for, requiring planning for resilience, for example, at stages along a climate projection of at least a 1.5-2°C global mean temperature rise by 2050. Such target ranges should be iterative and dynamic, and they should be updated as required based on climate observations and emissions inventory and projection updates.

Adaptation planning in Ireland would also be strengthened by the adoption of a common framework for decision-making under conditions of uncertainty. This would support dynamic and/or threshold-based decision-making from the national to sectoral and local levels, providing clarity for stakeholders and improving the consistency of actions and adaptation outcomes across sectors.

Adaptation plans should clearly establish the links required between specific plans and policies such as the Water Action Plan, the National Biodiversity Action Plan and the National Peatlands Strategy, with attention placed on nature-based solutions to adaptation where appropriate.

Implementation

The current implementation of adaptation measures is too slow and fragmented. We need to train and retain specialists and mainstream or 'future-proof' adaptation considerations among relevant professionals such as planners, engineers, ecologists, civil and public servants, financial professionals and health managers.

Effective, equitable and just transformative actions will have mitigation and adaptation benefits, and will bring broader benefits for health, wellbeing, nature and sustainable economic development. It is therefore important that wider non-financial value metrics are considered when evaluating, selecting and implementing adaptation actions to ensure that Ireland achieves just and equitable resilience to the impacts of climate change.

Topic Box 4.4 National Climate Change Risk Assessment

The EPA is leading the provision of an NCCRA for Ireland. NCCRAs are aimed at supporting planning for adaptation to and mitigation of climate change impacts in Ireland, by assessing sectoral, cross-cutting, cascading and other risks in a systematic and comparable way to prioritise risks at a national level.

The NCCRA will set out the priority impacts of climate change for Ireland in the form of a prioritised national climate risk register, which will provide a basis for making decisions on whether risks are acceptable to society or communities.

This will be a systematic semi-quantitative iterative three-stage risk assessment process that (1) identifies, (2) assesses and (3) prioritises climate change risks, underpinned by consistent climate information and by accounting for uncertainty in climate projections.

The NCCRA will:

- put in place a robust, common method to improve the standard of national and sectoral climate change risk assessment in Ireland
- identify and comparatively assess risks within and across sectors – including cascading, transboundary and cross-cutting risks
- ensure risks outside existing adaptation sectors are captured
- inform standardised adaptation planning and investment by producing a prioritised list of climate change risks at the national level
- identify linkages between other plans, policies and risk assessments.



6. Citizen engagement

Ireland is undertaking significant work in the area of climate action citizen engagement. The National Dialogue on Climate Action (NDCA) is a national-level citizen engagement initiative on climate action. It provides a systematic means of actively engaging stakeholders and the public with climate action across Ireland, enabling and empowering people locally and nationally. Key activities within the NDCA are the development and integration of quantitative, qualitative and experimental social and behavioural sciences to inform both the NDCA and wider climate action in Ireland.

The Climate Change in the Irish Mind survey, undertaken by the EPA and Yale University using Yale University's internationally recognised approach, is the first nationally representative survey of its kind in Ireland. The survey findings provide a clear picture of the beliefs, attitudes, policy preferences and behaviours of people in Ireland, and also provide an important means for improving people's understanding of climate change and what each of us, and society as a whole, must do to address it. The findings also provide an evidence base to raise awareness of climate change, support engagement campaigns and inform the design of national policy and climate action.

The work demonstrates that the Irish people overwhelmingly recognise the threat of climate change, feel personally affected by it and want to see real change. There was almost complete agreement (95%) that climate change is happening, and the majority of people (92%) think that climate change is caused, at least in part, by human activities. A large majority (91%) are worried about climate change,

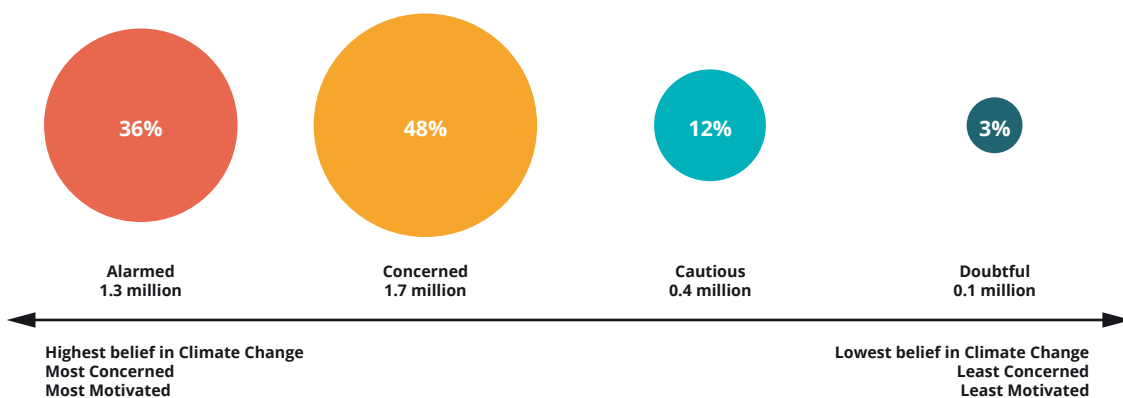
including 34% who described themselves as 'very worried' (O'Mahony *et al.*, 2024a).

A majority of people in Ireland also support policies such as higher taxes on cars that use diesel or petrol (51%) and banning peat, coal and oil for home heating (59%). It is important to note that most of the people who oppose these policies do not show a consistent pattern of attitudes that differentiate them from the national average. Their opposition to the highlighted policies does not appear representative of general underlying concerns or suspicions around climate change. Rather, their concerns are specific to the policies referred to and may reflect perceptions of there being practical issues in enacting these policies.

A segmentation analysis identified 'Climate Change's Four Irelands', which are four distinct climate change audiences among the Irish public (O'Mahony *et al.*, 2024b). The four climate audiences, labelled as the 'alarmed', 'concerned', 'cautious' and 'doubtful', strongly differ in their knowledge, levels of worry and willingness to take direct action on climate change and represent a spectrum of views about climate change (Figure 4.14). Importantly, the climate change audiences are not found to be clustered in a single demographic group or region but are found to cut across all levels of Irish society.

Climate scepticism is extremely rare in Ireland. Of the 4% of the Irish public who are doubtful, only about four in ten think that climate change is not happening. Many of those among the doubtful audience also express a lack of concern about climate change and feel that they do not know much about it.

Figure 4.14 Climate Change's Four Irelands



Source: O'Mahony *et al.*, 2024b

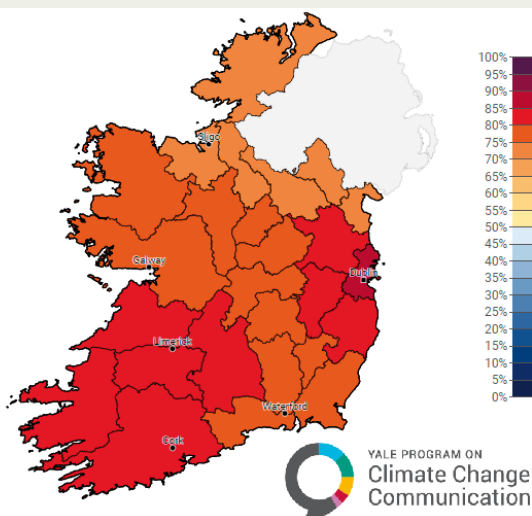


This novel way of looking at climate audiences strongly counters prevailing narratives of urban-rural divides in attitudes towards climate change, with both urban and rural residents found in all four of the climate audiences. Urban and rural respondents have similar views about the importance of climate change (Figure 14.15) and show similar levels of support for climate change mitigation and adaptation policies. Likewise, key employment categories (e.g. farmers) are not substantially different from the rest of the population in terms of their views on climate change.

The interactive climate opinion maps bring the data from the Climate Change in the Irish Mind study to life. At the national level, these maps show a consistent picture across the country of high levels of understanding about climate change and support for climate action, with little variation depending on where people live. We see a picture of attitudes, behaviours and policy preferences with regard to climate change across counties and regions that are closely aligned with high levels of awareness and worry about climate change in each area.

While the evidence is largely consistent across the country, there are minor regional variations in the levels of concern about climate risks with, for example, slightly more people worried about water shortages in Dublin and the mid-east region than in other regions. In addition, somewhat more people are worried about severe storms in the west, mid-west, and south-west regions. These spatial variations align with known environmental risks in these areas.

Figure 4.15 Climate opinion map showing response to 'Are you worried about climate change?'



Source: www.epa.ie/our-services/monitoring--assessment/climate-change/climate-opinion-maps/

7. Finance

Finance and climate action

Achieving national, EU and international climate action objectives requires aligning the financial system with these goals to drive the transition while continuing to support economic activity and societal development. Stewardship of the climate transition for the financial system must manage finance flows and risks related to both the transition to net zero, and the costs of physical risks from climate impacts. Achieving net zero by 2050 is now recognised as being the lowest cost option for society, the economy and the financial system for mitigating the effects of climate change (Central Bank of Ireland, 2024). While the achievement of a climate-neutral and resilient economy will incur costs that need to be managed, there will also be opportunities for sustainable growth, for example Ireland having the potential to become a net exporter of energy by 2050.

Finance flows

Public and private finance flows can act as either drivers of or barriers to progress, and they will need to be decarbonised and de-risked appropriately to support the achievement of climate goals.

Public finance

The National Development Plan (NDP) 2021-2030 (DPER, 2021) continues the trend of placing a greater focus on the transition needed to address climate change. The plan is underpinned by the principle of green recovery in line with the European Green Deal (EC, 2019) and includes a climate and environmental assessment for the first time. The total investment under the NDP of €165 billion, much of which is related to climate-favourable expenditure, will be complemented by the Climate and Nature Fund, which is expected to grow to €14 billion by 2030 (Department of Finance, 2024). This spending should be managed to deliver co-benefits for climate, biodiversity and broader environmental outcomes to achieve the transition to a low-carbon and climate-resilient economy. Funding for planned investment over the coming years will also come from state-owned enterprises and semi-state bodies and through investment such as green bonds.

Private finance

Private finance will provide an important element of funding to achieve the transition, and a Europe-wide target of €279 billion by 2030 has been identified under the European Green Deal to put Europe on the path to achieving the economy-wide transformation envisaged



by 2050. This private sector investment target will only be met through significant financing by banking or capital markets. In addition, private individuals and businesses may require support or incentivisation to finance their own decarbonisation journeys, for example, by the continued planned increase in the carbon tax rate up to €100 per tonne and provision of retrofitting and electric vehicle incentives.

International finance

Under the United Nations Framework Convention on Climate Change, Ireland as a developed country is committed to mobilising finance to assist climate action in developing countries. Ireland has committed to providing at least €225 million per year in climate finance to developing countries. Ireland will support a just transition beyond our borders by working towards this objective, with finance being directed to the Least Developed Countries and Small Island Developing States most vulnerable to climate impacts. It is also intended that this funding will be targeted at initiatives that support biodiversity, protection of the oceans, and loss and damage.

Risk management

Transition risk. The decarbonisation of the economy gives rise to potential risks for the financial system, which must be managed to progress the transition to net zero. Transition risks include the negative changes to business costs, revenues and profits as a result of future climate-related shifts in consumer or investor sentiment or government policy. Transition risks are unevenly spread, being more significant in carbon-intensive sectors, where support and regulation are likely to be required to drive decarbonisation.

Physical risk. Climate change is already leading to higher damage costs, with the World Meteorological Organization estimating that economic losses from weather, climate and water have increased sevenfold since the 1970s (WMO, 2023).

Businesses and households affected by flooding, for example, experience damage to buildings, possessions, machinery and stock, and disruptions to production and output. Such events may affect business costs, insurance coverage and revenues. These impacts affect the financial system in two ways: firstly, by increasing the risk of default on existing loans and, secondly, by reducing the value of collateral and the debtor's future access to finance.

The European Central Bank estimates that the Irish financial system's exposure to flood risk in the commercial sector is among the highest in the euro area (ECB, 2024). Development of flood protection schemes is advancing in Ireland, and it is critical that this continues, together with the management of the insurance market, to protect people, property and the stability of the financial system in the face of increasing flood risks. It is also likely that diversifying local climate risks through reinsurance will become more costly and restrictive as climate impacts increase globally. Therefore, managing risk through adaptation is important for enabling the insurance market in Ireland to function effectively in the future.

However, it will also be important for the financial sector to adapt its own practices by embedding the unique nature of climate risk considerations into operational models. The consideration of climate risk will require financial institutions to look beyond business cycles in the future towards multi-decadal time horizons to appropriately stress test their decisions for resilience.

8. Just transition

The European Commission's European Green Deal recognises that the climate transition must be just and inclusive, putting people first, and must pay attention to the regions, industries and workers who will face the greatest challenges. This represents a framework for understanding how the transition to a low-carbon society can be equitable and seek to leave no one behind. A just transition moves beyond protecting the rights of vulnerable individuals to understanding the causes of vulnerability and how responding to climate change is an opportunity to engage in justice. It is necessary to actively engage vulnerable and under-represented groups in terms of gender, ethnicity and socio-economic status while developing responses to climate change. Therefore, dialogue to develop successful policy responses needs to be considered and deliberate.

The projected economic impacts of the deep transformation are expected to be positive, despite the significant additional investments required in all sectors of our economy (EC, 2018). Ensuring that these benefits are shared equitably requires a just transition framework. The EU will support the transition through the introduction of the Just Transition Mechanism, including the Just Transition Fund, from which Ireland may receive up to €84.5 million by 2027.



To date, Ireland's transition away from fossil fuels has most affected the Midlands, owing to the cessation of the commercial extraction of peat for electricity generation. Exchequer and EU funding through the Just Transition Mechanism, including the EU Just Transition Fund, has targeted up to €169 million to this region by 2027.

Ireland's Just Transition Framework was established in the 2021 Climate Action Plan (DECC, 2021) and is based on four principles:

1. An integrated, structured and evidence-based approach is used to identify and plan our response to just transition requirements.
2. People are equipped with the right skills to be able to participate in and benefit from the future net zero economy.
3. The costs are shared so that the impact is equitable and existing inequalities are not exacerbated.
4. Social dialogue is used to ensure that the citizens and communities affected are empowered and are at the centre of the transition process.

In April 2024, the Just Transition Task Force made recommendations to the government about the task force's role and remit. For instance, the task force recommended that, to effectively support the achievement of a just transition, the Just Transition Commission carry out progress monitoring, provide recommendations for policy development and implementation, carry out research on the sectors most likely to require support, identify how this support should be provided and give advice to the government on how effective climate action social dialogue should be structured. It also recommended that the commission should engage with communities that face particular transition and resilience challenges.

To ensure the achievement of a just transition, public engagement and participation in transition management are essential. The outcomes of stakeholder engagement processes and in particular the voices of vulnerable citizens must be incorporated into climate policy. Additionally, to achieve a just resilience, the vulnerabilities of citizens to the climate impacts they face must be understood, planned for and managed all the way through from risk assessment to adaptation planning and implementation.

9. Research

In 2021, the EPA published EPA Research 2030, a 10-year framework to guide EPA research. Climate change evidence needs are identified as one of the four core elements of the framework. Specifically, the framework sets out that climate change is already having an impact in Ireland and that strong mitigation and adaptation measures are needed. Research is essential for providing the evidence necessary to improve our knowledge systems and inform policy decisions that will advance our ambitions to be carbon neutral and resilient to climate disruption (Figure 4.16).

The National Environmental Research Coordination Group (NERCG) was established by the EPA to coordinate research related to climate change in Ireland. The NERCG supports and promotes collaboration by research funding organisations. The objectives are to progress shared strategic goals for climate change research, to ensure coordination in climate change research expenditure in Ireland and to link these to European funding streams, including Horizon Europe and the Joint Programming Initiative Climate. Between 2020 and 2022, the EPA funded 59 climate-related projects to a total value of €14,354,000. The wider NERCG membership has funded a total of 368 projects, amounting to €201,800,000 in funding for climate-related projects during the same period.

Figure 4.16 Ireland's Climate Change Assessment: Synthesis Report (Thorne *et al.*, 2023)





10. Conclusions

In Ireland, we are living in and experiencing a changing climate. The year 2023 was the hottest on record, with global temperatures warming to close to the 1.5°C limit set by the Paris Agreement. Extreme weather events in Ireland continue to highlight the vulnerability of our people, environment, infrastructure and economy to climate change impacts.

However, early and rapid global action on emissions reductions is likely to leave an Irish climate that, at the end of the century, is still broadly recognisable in comparison with today. On the other hand, delaying action is very likely to result in an Irish climate that will become increasingly unrecognisable as the century progresses.

The Climate Change in the Irish Mind survey tells us that Irish people want to play their part, with 90% expressing a strong sense of national responsibility to do what they can to reduce greenhouse gas emissions.

Ireland must pick up the pace of action to reduce greenhouse gas emissions and adapt to its changing and future climate. More action is needed to meet Ireland's legally binding emissions targets, including large-scale and immediate emissions reductions across all sectors.



The latest EPA assessments have highlighted the challenges that Ireland faces in achieving the scale and pace of greenhouse gas emissions reductions required to stay within its first two carbon budgets and reduce emissions by 51% relative to 2018. EPA data make it clear that reaching our national and EU 2030 targets will require the urgent identification and implementation of policies that deliver the required emissions reductions across all sectors in the short term to provide the foundation for the longer term ambition of climate neutrality.

Current decarbonisation actions in Ireland are outpaced by increased energy demand across the economy and the heavy dependence on fossil fuels for energy generation (86%). This is despite the significant progress already made in increasing the share of renewable energy in our electricity sector. However, more needs to happen, particularly in the heat and transport sectors.

Significant emissions reductions are also needed in agriculture, Ireland's largest source of greenhouse gas emissions, and innovations to achieve reductions are emerging in areas such as feed additives and new fertilisers. Land could play a much stronger role than at present in reducing emissions, by moving from being a net source of emissions to a sink, including through a combination of enhanced afforestation on mineral soils and rewetting of drained organic soils.

A continued lack of delivery of large-scale practical actions to decarbonise activities in all sectors will see an exceedance of Ireland's first two carbon budgets. It is recognised that developing world-class infrastructure takes significant time and investment from conception to implementation. However, the time horizon for achieving national and EU commitments is getting ever shorter. The longer this is delayed, the longer it will be before we realise the significant opportunities – including the social and economic co-benefits for people, communities and business – that can be delivered through innovation and decarbonisation.

Ireland needs to be resilient to ongoing and future climate change impacts. Until now, mitigation has been the main policy focus. It is important that adaptation is mainstreamed across society to address current and future climate impacts.



Until recently, climate action in Ireland has focused on reducing emissions, with less attention being given to adapting to ongoing and future climate impacts.

Given the reality of climate change, we need a much stronger focus on adaptation to ensure the resilience of our homes, infrastructure and communities. Extreme weather events such as flooding and storms have exposed an adaptation deficit in Ireland. The impacts of climate change and extreme events can cascade from one sector to another; for example, impacts on energy supply can cascade into health services, transport or commercial activities. It is therefore important that risks are assessed in an integrated way.

Actions taken now to reduce vulnerability and exposure and increase resilience will shape the future and should be seen as investments rather than short-term costs. The development of Ireland's first NCCRA will inform adaptation planning and decision-making.

Immediate and sustained transformative mitigation and adaptation actions are likely to yield substantial benefits for health, wellbeing, the economy and biodiversity in Ireland, while reducing vulnerability to the adverse impacts of climate change.

The transition to a climate-neutral and climate-resilient society requires an integrated response that ensures fairness and a just transition for all. While there will be many opportunities in the transition, there will be challenges for some. Transition and transformation can be enabled through adopting a holistic and systemic way of thinking; developing an integrated long-term vision; addressing fragmented governance; capacity building and broad stakeholder engagement; and enabling a strong social contract with citizens and communities.

Finance is an important enabler of transitions and transformations, and public policy can set the conditions to steer investment in societally agreed directions. Public engagement and participation in the development and implementation of policy and climate action is essential. The genuine concerns that people have must be identified and addressed, and vulnerable populations must be identified, included and protected.



Key chapter messages

- 1.** The science is clear – climate change is already having an impact on people, animals and plants in Ireland. The evidence is unequivocal, Ireland is being affected by climate change now, and the severity of the impacts is likely to increase significantly in the coming years.
- 2.** Ireland needs to be resilient to ongoing and future climate change impacts. The implementation of climate adaptation measures is currently too slow and fragmented. More cross-sectoral and integrated adaptation actions can deliver multiple benefits. Doing better requires more financing, working with people and nature, monitoring and evaluating outcomes and increasing public and private sector involvement.
- 3.** Ireland is not currently projected to achieve its 2030 emissions reduction targets or to meet national or EU reduction targets. Despite Irish climate action ambitions, significantly faster progress is needed to decarbonise all sectors of Ireland's economy and implement adaptation actions to deliver a resilient and sustainable future for the benefit of all society.
- 4.** It is critical that people and communities are supported to achieve the changes required to address climate change. To overcome the practical barriers to climate action, and to ensure that objectives are both achievable and equitable, understanding the beliefs, attitudes and challenges facing people in Ireland is crucial. Policy should be designed and implemented so that the desirable action becomes the default action.





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