Ireland's

State of the Environment Report 2024

Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil

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2024

Editors

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Foreword

This is the eighth State of the Environment Report from the EPA, marking nearly three decades of rigorous assessment. Each report spans 4 years, delivering the single most definitive evaluation of Ireland's environment – our air, waters, soil, biodiversity – and how our society impacts on it.

I urge you to read this report: this is your country, your environment, and safeguarding it is not optional – it is essential. The protection of our environment is critical to our health and wellbeing, and is core to our economic success and the safety and prosperity of generations to come. Our shared future depends on the shared actions we take now. Ireland's environment is priceless, and when we harm it, we jeopardise our societal progress and the very resources upon which we all depend. What this report outlines, in stark detail, is that collectively we need to make transformational change to shift our society to a sustainable trajectory. The need for this change – and the urgency of that need – cannot be overstated.

In the 50 years that we have been members of the European Union, Ireland has been transformed. We now look back to a time when we had serious industrial pollution of our rivers, when we relied on over a hundred municipal dumps, when we burned smoky fuel in our cities – and we can never go back to that. The quality of our lives has been dramatically enhanced with far greater numbers of people living substantially longer lives, far greater numbers in high-quality and rewarding employment, and far greater numbers taking part in healthy outdoor leisure activities. We have made immense progress as a nation. But what we may not recognise sufficiently – if we make the connection at all – is how much of this progress absolutely depends on the quality of our environment. We must ensure that the natural resources and environmental conditions essential to the economy and to social wellbeing of Ireland are protected, or we risk undoing so much of our socioeconomic progress to date.

Our membership of the EU has been critically important in safeguarding our environment. Environmental legislation in Ireland, mostly derived from EU law, regulates key dimensions such as waste management, nature protection, chemicals, air quality, the environmental effects of agriculture and industry, and pollution of our waterways. The extensive monitoring systems we now have allow for a much better understanding of the complex issues facing us. Without this legislation and understanding, there is no question that Ireland's environment would be substantially more degraded than it currently is.

EU membership has helped us get to where we now are. But where we now are, while better on some fronts, is nowhere near good enough. We need to take a major step towards a better environment to secure our future health, wellbeing, and economic prosperity. This is not just about meeting rules and regulations, or just about targets. This report is about Ireland's environment, but it is also more than that: it is about the most important issue facing the future viability of our society and it demands a transformational leap in our environmental performance for ourselves, for our health and for our economy.

We now need a vision for our environment, so that our environmental performance matches our economic performance. But first, we need to acknowledge that the very lives we aspire to – healthy lives for ourselves and our families – the homes we live in, the jobs we do, the food we eat, the water we drink, the air we breathe, the nature we walk and run through, swim and cycle in all depend on the quality of our environment, the very environment that we continue to damage year on year.

In Chapter 17, we have an Environmental Scorecard for Ireland – our grades on five key environmental themes: Climate, Air Quality, Nature, Water and Waste. Across all five headings our scores range from Moderate to Poor and Very Poor. The scorecard indicates that we are not making the progress needed. We have seen where concerted effort can deliver results as shown by the reduction of greenhouse gas emissions, which were at their lowest level in 30 years in 2023. This positive achievement must be followed, year on year, by similar progress. We must now make good on all of our international commitments. That is only a minimum requirement but would still go some way towards putting us on a sustainable path.

We can of course take pride in all we have achieved, at both the policy and systemic levels, and all the positive changes people have made and continue to make in their lives. But we must also recognise that what we are doing is not enough. We now have cleaner air in our cities, but we have increasing evidence that even low levels of air pollution harm our health. We have addressed serious pollution in our rivers, but many of our best water bodies have lost their pristine status. We recycle more, but we also generate more waste overall, much of which is exported. We are taking individual positive actions across multiple fronts, but they are not keeping pace with the growing pressures, and the environment is being squeezed. In many areas, such as biodiversity and water quality, we are not halting environmental decline.

In short – we must do better. Vastly better. For too long we have merely aimed to 'get by', aspiring to only minimum standards, and in many instances, not even reaching those. Our policy responses to date have been insufficient to halt the decline in our environment. We have made progress in some areas, but the scale and the speed of it has been too small and too slow. The responsibility for protecting and managing our environment is a shared responsibility that involves government departments, industry, and all citizens of Ireland. Businesses, industry, landowners and members of the public all have an essential role to play.

Ireland has set a national objective to transition by 2050 to a climate-resilient, biodiversity-rich, environmentally sustainable and climate-neutral economy. Achieving this multifaceted objective will be the most complex and interconnected societal challenge for the next 25 years, and each step towards its achievement will present opportunities and challenges. Efficiencies will not get us there. Incrementalism will not get us there. Collectively we must shift our society to a sustainable trajectory.

In this report, we set out five priorities, which, if acted upon, would move us in the right direction, namely:

- We urgently need to have a national policy position on the environment to align our actions.
- We must rigorously implement existing environmental plans and programmes and comply with environmental law.
- We need to transform our energy, transport, food and industrial systems to achieve climate neutrality and drive down pollution.
- We must scale up investment in water, energy, transport and waste management infrastructure.
- We must protect our environment to protect our health.

We can no longer put off these changes and the urgency cannot be overstated. It will not get easier or cheaper, and year on year the need will become even greater. The environment underpins every sector of the economy and every aspect of our lives, our health and our wellbeing. Delaying now will further degrade our precious environment. We must transform, not to meet some targets or some deadlines, but because it is the right thing to do, for our environment, for our economy, and above all, for the health and wellbeing of ourselves and our families, now and into the future. Every change that we put off making now becomes harder next year, and more costly to achieve.

The Climate Change 2023 Synthesis Report from the Intergovernmental Panel on Climate Change has made it clear: there is a rapidly closing window of opportunity to secure a liveable and sustainable future for all. We, in Ireland, must do our part in making this sustainable future a reality.

Clear, accurate and timely information is vital to raising awareness among the public and those responsible for policy and for making critical decisions. I extend my deepest thanks and appreciation to all those who contributed to this report. With their help, I sincerely hope that this stock-take of the Irish environment serves as a stark reminder: preserving our environment is not a 'nice-to-have' – it is an act of self-preservation. The time for half measures is over. It is our responsibility to act decisively and ambitiously, for if we fail, we risk leaving behind a legacy of irreversible damage and lost opportunities. We must choose a future where Ireland thrives.

Laura Burke
Director General
Environmental Protection Agency

October 2024

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Abbreviations and Acronyms

ACRES	Agri-Climate Rural Environment Scheme
AMOC	Atlantic Meridional Overturning Circulation
AMR	Antimicrobial resistance
ANCA	Aircraft Noise Competent Authority
AR6	Sixth Assessment Report (IPCC)
ASSAP	Agricultural Sustainability Support and Advice Programme
BAT	Best available technique
BEV	Battery electric vehicle
BoCCI	Birds of Conservation Concern in Ireland
BSBI	Botanical Society of Britain and Ireland
CAP	Common Agricultural Policy
CAP24	Climate Action Plan 2024
CDW	Construction demolition waste
CJEU	Court of Justice of the European Union
CSR Directive	Corporate Sustainability Reporting Directive
CSS	Chemicals Strategy for Sustainability
DAFM	Department of Agriculture, Food and the Marine
DECC	Department of the Environment, Climate and Communications
DHLGH	Department of Housing, Local Government and Heritage
DMAP	Designated maritime area plan
EAP	Environment Action Programme
8th EAP	Eighth Environment Action Programme
ECDC	European Centre for Disease Prevention and Control
ECHA	European Chemicals Agency
EEA	European Environment Agency
EFSA	European Food Safety Authority
EIA	Environmental impact assessment
EIP	European Innovation Partnership
EIR	Environmental Implementation Review
EMF	Electromagnetic field
EPB	Energy Performance of Buildings Directive
END	Environmental Noise Directive
EPA	Environmental Protection Agency
ESR	Effort Sharing Regulation
ETS	Emissions Trading System
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross domestic product
GES	Good environmental status
GHG	Greenhouse gas
GVA	Gross value added
HSE	Health Service Executive
ICCA	Ireland's Climate Change Assessment
IE	Industrial emissions
IED	Industrial Emissions Directive
IPC	Integrated pollution control
IPCC	Intergovernmental Panel on Climate Change
IMPEL	Network for the Implementation and Enforcement of Environmental Law
IMR	Irish Manufacturing Research
IPBES	Intergovernmental Science–Policy Platform on Biodiversity and Ecosystem Services
IUCN	International Union for Conservation of Nature
LAWPRO	Local Authority Waters Programme
LULUCF	Land use, land use change and forestry
MAC	Maritime Area Consent

MACC	Marginal abatement cost curve
MARA	Maritime Area Regulatory Authority
MCPA	2-methyl-4-chlorophenoxyacetic acid
MNP	Mircoplastics and nanoplastics
MPA	Marine protected area
MSFD	Marine Strategy Framework Directive
NAF	National Adaptation Framework
NAP	Nitrates Action Programme
NBDC	National Biodiversity Data Centre
NBS	Nature-based solution
NCCRA	National Climate Change Risk Assessment
NDCA	National Dialogue on Climate Action
NDP	National Development Plan
NEC Directive	National Emissions reduction Commitments Directive
NECP	National Energy and Climate Plan
NEMN	National Ecosystems Monitoring Network
NEP	National Enforcement Priority
NERCG	National Environmental Research Coordination Group
NFCS	National Framework for Climate Services
NIECE	Network for Ireland's Environmental Compliance and Enforcement
NLC	National Land Cover
NLUP	National land use plan
NMVOC	Non-methane volatile organic compound
NO_x	Nitrogen oxides
NPF	National Planning Framework
NPS	National priority site
NPWS	National Parks and Wildlife Service
NTA	National Transport Authority
NWESC	National Waste Enforcement Steering Committee

OECD	Organisation for Economic Co-operation and Development
OEE	EPA's Office of Environmental Enforcement
PAH	Polyaromatic hydrocarbons
PBDE	Polybrominated diphenyl ether
PFAS	Per- and polyfluoroalkyl substances
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctane sulfonate
PG	Propylene glycol
PIA	Priority important area
$PM_{2.5}$	Fine particulate matter (diameter < 2.5 μm)
PM_{10}	Particulate matter (diameter < 10 μm)
POP	Persistent organic pollutant
RBMP	River basin management plan
SAC	Special area of conservation
SAP	Sectoral adaptation plan
SPA	Special protection area
STEC	Shiga toxin-producing *E. coli*
SUV	Sport utility vehicle
TFC	Total final consumption
TII	Transport Infrastructure Ireland
TOD	Transport-orientated development
TPA	Tonnes per annum
TPER	Total primary energy requirement
UN	United Nations
VTEC	Verocytotoxin-producing *E. coli*
WBF	Well-being Framework
WERLA	Waste Enforcement Regional Lead Authority
WFD	Water Framework Directive
WHO	World Health Organization

Executive Summary

This is the eighth State of the Environment Report published by the Environmental Protection Agency since the first report in 1996. The report provides thematic assessments in Part 1, focusing on key trends in and challenges and actions for air, climate change, noise, water, marine, nature, land use and soil. Part 2 provides detailed integrated assessments of key economic sectors: transport, energy, agriculture, industry and the circular economy and the interactions between human health and the environment. Finally, Part 3 provides an in-depth assessment of how Ireland is performing in the area of environmental policy implementation. The key messages emerging from each chapter are appended to this summary for ease of reference. The report also provides mid-term commentary on the many plans and programmes in place that have 2030 in their sights (e.g. Climate Action Plan, Sustainable Development Goals).

The value of Ireland's environment cannot and should not be underestimated. Our terrestrial and water environments host exceptionally rich ecosystems that support diverse populations of flora and fauna. These ecosystems provide essential services to people, including food, construction materials and manufacturing resources. They provide the pollination on which our crops depend, are the source of our drinking waters and attenuate floods. They improve the air we breathe and provide places for the recreation necessary to our health and wellbeing. In this context, this summary provides a summary environmental scorecard on environmental protection and sets out key priorities that the EPA has identified need to be progressed to improve our performance in environmental protection.

Environmental Scorecard for Ireland

The summary scorecard analysis shown in Table 1 highlights that the scale of improvements that are being made across a variety of areas is insufficient to meet national long-term environmental objectives and targets, especially where they require coordinated action across thematic areas. In all cases, the outlook is not positive with substantial challenges to deliver on climate, air, nature, water and the circular economy.

There is a need to continue intensifying our activities to address climate change and biodiversity decline while also addressing Ireland's other environmental priorities. These include tackling water pollution from nutrients, physical damage to our waterways and deficits in the safety of our water supplies, improving our waste segregation and increasing recycling rates, while at the same time reducing our overall consumption of our resources. A further priority is improving air quality to protect our health, including reducing ambient pollution from particulates and nitrogen dioxide.

Table 1 Summary scorecard for selected environmental policy areas

INDICATOR	CURRENT ASSESSMENT	OUTLOOK	NOTES
Overall climate assessment			While there has been progress in terms of beginning to reduce greenhouse gas emissions and in strengthening adaptation governance structures and support services, overall current assessment for climate is 'poor' (a slight improvement from 'very poor' in 2020). Full implementation of actions set out in the Climate Action Plan and additional actions are needed if Ireland is to meet its 2030 and 2050 climate targets.
Overall air assessment			The overall current assessment for air is 'moderate' (the same as in 2020). Ireland is compliant with current air quality standards for many air pollutants. However, Ireland is not meeting the guidelines set by WHO for multiple pollutants, including fine particulate matter, and Ireland is non-compliant with the EU reduction target for ammonia and will remain so in the short term. Achieving the ambitions of the Clean Air Strategy and complying with the limit values of the proposed EU Air Quality Directive from 2030 onwards will be challenging but will have a significant and positive impact on health.
Overall nature assessment			The overall current assessment for nature is 'very poor' (the same as in 2020). Deteriorating trends dominate, especially for protected habitats and bird populations, and Ireland is not on track to achieve policy objectives for nature. While the recent expansion of marine protected areas is welcome, additional far-reaching measures are needed to address the declines in nature and biodiversity.

INDICATOR	CURRENT ASSESSMENT	OUTLOOK	NOTES
Overall water assessment			Overall current assessment for water is 'poor' (the same as in 2020). Trends remain mixed, with no net improvement in river or lake water quality in recent years, a sharp decline in the number of monitored estuaries in satisfactory ecological condition and continued direct discharges of raw or inadequately treated sewage to water from 19 agglomerations. Significant challenges remain for achieving full compliance with relevant EU obligations and national policy objectives.
Overall circular economy and waste assessment			The overall current assessment for the circular economy and waste is poor (the same as in 2020) but progress is being made in a number of areas to improve performance. Waste generation continues to grow, in absolute and per capita terms, and Ireland remains overly reliant on export markets for recycling and for treating municipal residual waste. Recycling rates for municipal and plastic packaging waste streams are at risk and need to increase urgently to achieve 2025 targets. Recent interventions, such as the Deposit Return Scheme, statutory roll-out of the organic waste collection service, recovery levy and national end-of waste and by-product decisions, are positive developments but the effects of these remain to be seen. The circular material use rates remains very low by comparison to the European average and Ireland needs to address specific sectoral challenges to accelerate moving from a linear to a circular economy.

	SUMMARY OF CURRENT ENVIRONMENTAL PERFORMANCE, POLICY AND IMPLEMENTATION IN IRELAND
	Very poor – significant environmental and/or compliance challenges to address.
	Poor – environmental and/or compliance challenges to address.
	Moderate – on track generally/local or occasional challenges to address.
	Good – mainly achieving objectives.
	Very good – fully achieving objectives.

	OUTLOOK OF CURRENT PROSPECTS OF MEETING POLICY OBJECTIVES AND/OR TARGETS
	Largely not on track to meet policy objectives and targets. Significant challenges remain to achieving full compliance. Systemic and transformative change needed.
	Partially on track to achieving full compliance or measures in place or planned that will improve the situation. However, the outlook is dependent on existing and planned actions and measures and plans being fully implemented and effective.
	Largely on track to achieving full compliance. Measures in place provide prospect of meeting policy objectives and targets.

Key messages for Ireland on the state of the environment in 2024

This report shows not only that there is a need for urgent interventions to address climate change and biodiversity decline but also that there are other environmental priorities for Ireland. These include tackling water pollution, investing in critical water services, improving waste segregation and recycling rates, continuing to improve our air quality and mitigating radiological risks. In addition, this assessment indicates that how we use our land is a significant contributor to the climate, biodiversity and water quality challenges.

To protect the environment, we need to look at multifunctional approaches to land management, which will require extensive engagement with landowners.

More urgent system-wide change is needed across the energy, transport, industrial and food sectors and in the built environment to improve sustainability and reduce emissions that are damaging to our environment, our climate and our health.

The overall key priorities identified for Ireland's environment are summarised below. Further details about these priorities can be found in Chapter 17.

Figure 1 Five key priorities from the State of the Environment Report 2024

Delivering a national policy position on the environment

We urgently need to have a national policy position on the environment to address the complex interactions, synergies and trade-offs across environmental policy areas and to deal with its interactions with other policy domains.

Driving policy implementation

We must rigorously implement existing environmental plans and programmes to achieve the benefits that they were developed to deliver.

Transforming our systems

Transformation of our energy, transport, food and industrial sectors is critical to achieving a sustainable future.

Scaling up investment in infrastructure

Investment in water, energy, transport and waste management infrastructure is essential to protect the environment now and into the future.

Protecting the environment to protect our health

Protecting the environment is key to protecting our health and we must act to reduce the modifiable risks to our health from environmental exposures.

Delivering a national policy position on the environment

Since the EPA published its last State of the Environment Report in 2020, Ireland has set a national objective to transition to a climate-resilient, biodiversity-rich, environmentally-sustainable and climate-neutral economy by 2050. Achieving this ambitious multifaceted objective will be the most complex and interconnected environmental challenge for the next 25 years and each step towards its achievement will present opportunities and challenges. There will be many complex issues to overcome and trade-offs to be addressed along the way which will require significant collaboration to address issues across climate, land use, air pollution and biodiversity.

The EPA again recognises the need for a coherent national policy position on the environment. We need this policy to bring together our action and align our activities to protect our waters, air, soil, ecosystems and biodiversity so that those systems can provide the essential supporting services that we depend on for our economy and health. A national policy position would promote improvements in policy coherence and set out, in an integrated manner, the country's ambition for the environment for the next generation.

While aspects of environmental protection can be achieved through developing and implementing good government policy, the active engagement and participation of everyone will be essential if real and meaningful change is to be made. A national policy position could serve as the starting point for the development of an inclusive national contract across the economy and society so that we live sustainably in a healthy environment that is valued and protected by all.

Driving policy implementation

Ireland has a comprehensive set of laws, policies and plans aimed at protecting the environment and human health. This report shows that serious deficits remain in Ireland's implementation of environmental legislation such as the Urban Waste Water Directive, Water Framework Directive, climate law and related plans and programmes. The EU, in its national Environmental Implementation Review, has highlighted the challenges that remain for Ireland to achieve compliance with EU waste water treatment legislation; access to justice in environmental matters; conservation matters on marine nature sites; and the conservation of bogs. There are currently nine Court of Justice of the European Union cases and 16 infringements open against Ireland for failures in implementing EU environmental legislation. Resolving the current infringement procedures will require proactive action and prioritising legislation and implementation.

In addition, Ireland is not making adequate progress towards meeting our own nationally set targets and objectives. This report shows that substantial gaps remain between what has been committed to and what is being delivered. The plans and programmes already in place, if fully implemented, will go a long way to resolving our persistent environmental issues.

An essential part of implementation is the enforcement of environmental law. While the EPA has a broad remit on environmental regulation and enforcement, local authorities also have a vital statutory responsibility to protect our environment. They are responsible for enforcing much of Ireland's environmental protection legislation within their functional areas. While the scale of enforcement carried out by local authorities is significant, in many respects it is not delivering the necessary environmental outcomes such as improved water and air quality, reduced noise exposure, protection of biodiversity and improved circularity in the management of our resources. Continuing to focus on delivering environmental outcomes via this implementation and regulatory work is critical to protecting Ireland's environment.

Transforming our systems

Ireland, like Europe, faces persistent problems in areas such as biodiversity loss, inefficient resource use, climate change impacts and environmental risks to health and wellbeing. These risks are inextricably linked to economic activities and lifestyles, in particular the societal systems that provide us with food, energy and mobility. All aspects of how we live, from the homes and communities we inhabit, to the places we work and how we move ourselves and goods, have the potential to impact and be impacted by the environment.

In recent decades we have seen Irish law progress from seeking to limit pollution at the end-of-pipe stage towards driving improved efficiency. This approach has delivered substantial benefits. While this is important, we need to go beyond reducing pollution and incremental efficiency improvements. Collectively, we must transform many of the entrenched wasteful systems to shift our society onto a sustainable trajectory, such as moving from transport based largely on private vehicles to sustainable mobility enabled by good planning and accessible public transport, delivering more efficient buildings and replacing fossil fuel-based heating systems in our homes and businesses. Taking action now makes good economic and environmental sense. Making this transition will impact on all members of society as we will all have to change our behaviours and the technology we adopt in our daily lives. In so doing we need to make the right sustainable choices easier to implement.

Many of the activities in this report related to energy, food and transport are endeavouring to make the shift to more sustainable societal systems. Progress is not, however, keeping pace with the pressures and is happening too slowly to address the growing locked in pressures for the next decade. In this context we need to speed up the transition to avoid costly lock-ins into carbon-intensive and unsustainable production and consumption practices. This will require concerted action engaging diverse policy areas and actors across society in accelerating transformation in the core areas of energy, circular economy, transport, food systems and the just transition.

Clearly, we also have to look at how we manage our land so that land management practices and the allocation of land to meet the many environmental and economic targets are addressed from a multifunctional perspective. This will include recognising the need for a substantial increase in Ireland's afforestation rates and space for nature. Phase 1 of the Land Use Review has given us valuable information on which aspects to develop and the ongoing phase 2 will support progress in this space. Given that the majority of land in Ireland is held privately, dialogue and engagement with landowners is a critical element of planning for, and delivering, sustainable and just land use that supports the necessary transitions in our societal systems.

Scaling up investment in infrastructure

The combination of a growing economy and an increasing population will continue to exert pressure on Ireland's environment. In light of these circumstances, it is imperative that we make substantial long-term investments in key infrastructure to make environmental protection a cornerstone of our future development.

In this context there is a need for continued large-scale investment in waste water treatment systems to bring them up to standard. Similarly, many drinking water supplies lack robust treatment to guarantee their long-term resilience and safety requiring improvements in existing infrastructure. Delivering on national ambition for renewable electricity will require substantial investment in wind and solar and will require unprecedented levels of change in the National Grid up to 2030. In the case of transport, substantial investment is needed to deliver on the key strategic public transport construction projects. There is also a substantial need to deliver housing for our growing population. In resource management, a substantial investment gap exists in delivering the circular economy transition which will require investment in repair, reuse and remanufacturing capacity and in delivering infrastructure for waste segregation, collection, treatment and recycling.

Collectively, these infrastructural needs constitute an extremely large delivery challenge to provide Ireland with the assets needed to meet the challenges of its growing population and economy while providing the systems that protect the environment. Investment decisions made in this decade will define the infrastructure that will be available to our society for the next 50 years and these need to be fully aligned with achieving the transition to a low-carbon society. Maintaining and enhancing current investment will be key to delivering this infrastructure and will need to be a critical facet of national development over the coming decade.

Protecting the environment to protect our health

Creating healthy places free from environmental hazards is key to creating a healthier and fairer society in which everyone can thrive. There is substantial evidence of the positive impact of engaging with nature and our environment. On the other hand, harmful exposures including air, water, radiation and noise pollution can have substantial negative impacts on our health and wellbeing. The impacts of environmental hazards and exposures are not equal across society. Identifying and increasing the visibility of environmental exposure and inequalities at a local scale will be key to informing policies to address health and environment. The impacts of our environment on our health, both positive and negative are, in the main, modifiable (i.e. they can be changed) and addressing harmful exposures (such as radon, air pollution, noise and water pollution) will have a substantially beneficial impact on our health. Addressing these risks by reducing pollution, adapting to and mitigating climate impacts, and restoring ecosystems means that people can be healthier and live longer.

Conclusion

This assessment of the state of Ireland's environment shows that the challenges facing it are closely linked and interrelated. Our understanding of these issues is greater than ever before, underpinned by comprehensive monitoring systems, evidence and research. While some welcome progress is being made on climate action, we are still well off track in meeting our 2030 targets. Critically this level of delivery is not evident across other areas of the environment. We need to build momentum towards delivering on not only climate but also our biodiversity, water, circular economy and pollution reduction goals. Delivering on these goals will require transformational change in many of the core systems of our society and will involve everyone.

The immense value of Ireland's environment cannot be taken for granted. Societal progress will be severely hampered if our actions continue to damage this essential asset on which we all depend for our air, water, food and resources.

A clean and healthy environment will deliver economic and health benefits and improve the resilience of our environment to the shocks that will inevitably come from climate change. There are substantial benefits in us acting now: it will reduce the overall cost to our society, deliver many new employment opportunities, provide more plentiful access to clean, renewable energy and afford us a healthy environment that we can enjoy.

For us as individuals and as a society, our task now is to address the challenges set out in this report so that the next generation does not have to. We have much to do, but by acting now we can make good in providing a healthy, clean and resilient environment for ourselves and for future generations.

Key messages from chapters

Introduction

1. A national policy position for Ireland's environment is critical to addressing complex and interrelated challenges on climate, biodiversity and pollution and prevent damaging lock-ins.
2. Our growing economy and population are increasing the pressure on our environment. We need to invest in our infrastructure to prevent this growth impacting on our natural environment.

Air

1. While air pollution has reduced over recent decades, our understanding of the level at which it impacts health has grown. The World Health Organization (WHO) says that there is no safe level of air pollution.
2. Currently, Ireland is not meeting the guidelines set by WHO for multiple pollutants including fine particulate matter and nitrogen dioxide. We can actively improve our local air quality by changing to more sustainable forms of transport and heating.
3. Achieving Ireland's ambition, set out in the Clean Air Strategy, to move towards meeting the health-based WHO air quality guideline limits will be challenging but will have a significant and positive impact on health. A road map of actions is required to deliver on the overall ambition and the 2026 and 2030 interim targets.
4. Ireland is non-compliant with the EU reduction target for ammonia and will remain so in the short term. Meeting the 2030 emission reduction commitment is dependent on fully executing all known ammonia abatement measures at the farm level.

Environmental Noise

1. Environmental noise is the second biggest environmental cause of health problems in the EU. In Ireland, over 1 million people are likely to be exposed to noise levels above the mandatory reporting thresholds.
2. National policy for environmental noise is not as well advanced as in other environmental areas. There is a need for coordinated national policy and actions around planning, health and transport infrastructure to reduce noise exposure.
3. Local authorities, in collaboration with transport infrastructure bodies, need to focus implementation of noise action plans on the priority areas identified using strategic noise mapping.

Climate Change

1. The science is clear – climate change is already having an impact on people, animals and plants in Ireland. The evidence is unequivocable, 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.

Land
1. Ireland's land is in demand. Our current land use is a net source of greenhouse gas emissions. Some of our current land use practices such as agriculture, forestry and urbanisation are exerting pressures on water quality and nature that show no immediate signs of abating.
2. We cannot make more land, so must use our land wisely. Part of this challenge is to understand how best to use our land for social and economic benefit in a way that supports, rather than damages, the environment. The national land use review has a vital role to play in identifying land use opportunities and constraints.
3. Land use offers natural, social and economic benefits. We can use our land in ways that support climate action, nature restoration, protection of water quality and a sustainable economy through implementing a multiple benefits approach. To do this we must reframe how we approach national land use decisions. We must take a holistic and integrated view across all the demands there are on Ireland's land. Emerging evidence shows that we can implement solutions that deliver natural, social and economic capital together.
4. Land use is about using land to benefit people. Landowners and other stakeholders need to be engaged in decisions that impact them. Evidence shows that to reframe how we use our land will require engaging people in the process and providing positive supports to incentivise change.

Soil
1. Ireland's soils play important roles in storing carbon, in regulating both water flow and water quality and in growing food and raw materials. Soils are under threat from excess nutrients, compaction, soil sealing and loss of soil biodiversity, in Ireland and across the EU. Soil health must be prioritised to ensure food security, protect the soil biome, and safeguard the important environmental services that soil provides.
2. The protection of soils lacked a legal and policy framework until recently and the publication of the EU Soil Strategy in 2021 and the proposed soil monitoring law in 2023 are significant. Ireland faces challenges in achieving the objectives of the EU Soil Strategy and in implementing the proposed soil monitoring law. However, getting this right would significantly advance the protection of Ireland's soil health.
3. To support the proposed soil monitoring law and soil health assessment, Ireland should advance soil mapping and modelling, through a cross-public sector approach, which would rapidly improve our knowledge of soil health at a national level.

Nature
1. The Irish landscape is heavily modified by humans. Many of the few remaining natural and semi-natural habitats are in a poor or bad state. Research in Ireland highlights that 85% of our protected habitats and almost one-third of our protected species of flora and fauna are in unfavourable status, over half our native plant species are in decline and more than 50 bird species are of high conservation concern. The leading causes of these declines are changes in agricultural practices, including intensification; pollution; the increasing spread of invasive species; and our changing climate.
2. Our natural habitats and biodiversity have been squeezed to the margins of our landscape and policies, while food production and economic development have been prioritised. However, nature underpins our food production, food security and economic development. We risk our future if we continue to marginalise nature, and its protection, and fail to deliver adequate, achievable, impactful, evidence-based and coordinated action to protect and restore it.
3. Biodiversity loss affects everyone. It is essential that nature protection, enforcement, management and restoration are mainstreamed across government, social and economic sectors and are fully considered at all levels of national, regional and local decision-making.
4. Nature can recover if given the opportunity. For example, Ireland's corncrake population has risen by more than 35% in recent years, reflecting the outcome of a multi-million euro conservation investment that began in 2019. Positive actions to halt declines and to restore the key elements of our natural world must be implemented.

Water

1. There needs to be immediate, substantial and sustained reductions in nitrogen pollution, especially in catchments of concern in the south and south-east, to prevent any further deterioration in the quality of our estuaries and coastal waters. Targeted measures to reduce phosphate run-off could deliver significant improvements in inland waters and offer multiple benefits for climate and biodiversity.
2. We need to see full implementation of existing environmental legislation and high compliance rates across all regulated activities. A regulatory regime to address activities that impact hydromorphology is also required. All measures must be sufficiently targeted to the water quality issue and location to ensure that they deliver improvements.
3. Water governance structures need to be reviewed to ensure that they operate effectively. Detailed tracking and reporting of measures in Ireland's Water Action Plan 2024 is required to improve accountability among implementing bodies, public access to information and, ultimately, Ireland's water quality.
4. It is essential to build climate resilience into water quality management and into water services. Plans – such as the Water Action Plan, the Water Quality and Water Services Climate Adaptation Plan, and Uisce Éireann's National Water Resources Plan – are key to identifying risks and adaptation measures.

The Marine Environment

1. Our wider marine environment is generally clean and healthy, but legislation to maintain this needs to be enforced more rigorously and new priorities addressed more quickly. For example, the delayed marine protected areas legislation is an essential part of the marine spatial planning approach that will ensure that marine developments do not occur at the expense of the wider marine environment.
2. Key pressures are still causing impacts on the biodiversity and productivity of marine ecosystems. Fishing at unsustainable levels is impacting both habitats and the food chain. Nearshore nutrient enrichment has the potential to affect coastal amenity. Measures to combat these issues need to be implemented and enforced, as current trends are indicating that environmental status is not moving in the right direction.
3. There have been many recent changes in marine policy. Policy coherence and coordination needs to be improved to avoid damaging our marine environment and to maximise the benefits of protecting it.

Environment and Agriculture

1. Agriculture is an integral part of the fabric of Irish society. It has a key role in delivering, and depends on, a healthy environment. However, our food systems are not currently meeting our sustainability targets and need urgent transformational change.
2. There are many plans and programmes in place, with positive actions being implemented at farm scale, but there is no clear evidence that the current measures will collectively achieve the scale of environmental outcomes that are needed.
3. A shared vision for 2050 for land use and the food system is urgently required. A clear pathway for the agriculture and land use sector, and adequate supports to achieve it, must be put in place. Implementation and an evidence base for assessing progress must be a priority.

Environment and Transport
1. The transport sector is a major consumer of energy and material resources and is a source of environmental pollution, particularly greenhouse gases, air pollutants and noise.
2. A sustainable, accessible and efficient transport system is not only important for the environment and wellbeing but is also a key enabler for the economy.
3. High-level integration between land use planning and transport planning is needed to achieve more compact development, incentivise a move away from private cars, and move trips to rail, bus, cycling and walking. Shifting to these modes is an essential part of a sustainable and climate-neutral transition for the transport sector.

Environment and Industry
1. Industrial pollution in Ireland is decreasing, thanks to a blend of regulation, developments in manufacturing, control technology and environmental initiatives. Continued investment and change are needed to ensure compliance with tighter environmental standards and to achieve the targets and reductions that are required under industry's climate requirements.
2. Compliance with environmental regulation across industry in Ireland is high overall. Many sectors have advanced environmental systems in place that demonstrate a maturity in their approach to environmental compliance. However, a disproportionate number of sites in the food and drink sector, in particular dairy processing sites, and in the waste sector are not performing optimally and are regularly cited on the EPA's list of national priority sites for not complying with their licence conditions.
3. The unauthorised harvesting and extraction of peat on an industrial scale is causing destruction of Ireland's natural habitats and compromising the vital role of peatlands in helping society mitigate the impacts of and adapt to climate change. It is essential that planning policy clearly prioritises the regulation and control of these operations. The EPA will continue to exercise its authority over operators and other regulators to ensure the cessation of such unauthorised activities.

Environment and Energy
1. Established technologies, such as wind energy, solar photovoltaics and bioenergy, will be key in meeting short-term emission reduction targets (i.e. 2030), whereas significant growth in offshore wind infrastructure is expected to be the key essential element of future energy systems. Enhanced regulatory and planning frameworks, and support schemes, are required to accelerate the deployment of renewables, realise co-benefits and manage trade-offs.
2. Growing demand for electricity is an anticipated by-product of the expected electrification of the heat and transport sectors. However, additional and rapidly increasing electricity demand growth from large energy users is putting pressure on energy systems.
3. World class infrastructure takes significant time and investment from conception to implementation. The time horizon for achieving national and EU commitments is getting ever shorter. Planning in the broadest sense needs to be fast tracked to achieve the ambitious national renewable energy targets.
4. Substantial challenges remain for high-intensity hard-to-decarbonise sectors, e.g. high temperature users, and the development of low or zero carbon fuels to meet these applications are needed. Negative emissions technologies and solutions will also be required to deliver a climate-neutral Ireland.

Environment, Health and Wellbeing

1. Our health and wellbeing is inextricably linked to our surrounding environment. The health benefits of a vibrant natural world are countless, providing us with breathable air, drinkable water, productive soils and spaces for us to spend time in and enjoy, enhancing both our physical and mental health and wellbeing.
2. The harmful environmental exposures causing disease and early death are modifiable. Reducing pollution, adapting to and mitigating climate impacts, and restoring ecosystems can have enormous benefits for our health and wellbeing. Solutions that can help tackle one issue can have multiple co-benefits for others. Implementation of solutions that can maximise benefits across multiple domains should be prioritised.
3. The impacts of environmental hazards and exposures are not equal across society. More efforts are required to assess inequalities in both levels of exposure and impact at a finer geographical scale to determine whether measures implemented are helping to bridge the gap.

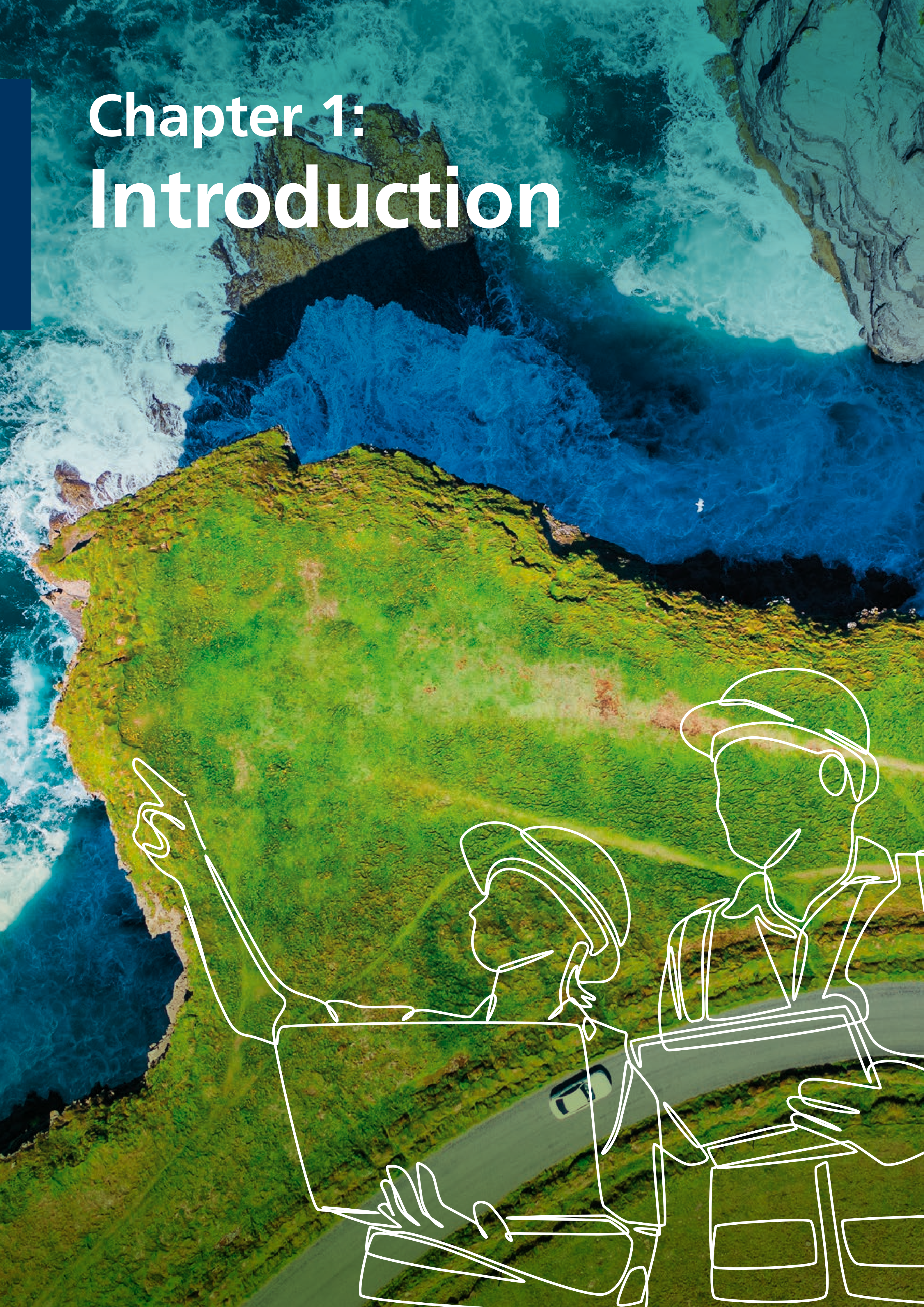
Circular Economy and Waste

1. Ireland has a damaging linear economy characterised by the overconsumption of materials and goods and the growing volumes of waste and greenhouse gas emissions. While recycling tonnages are increasing, these increases are being cancelled out by the growing amount of waste generated. Current trends pose a high risk of not meeting mandatory recycling targets. The challenge for Ireland is to reverse these trends and significantly reduce waste production.
2. Ireland's capacity to collect and treat waste is vulnerable and underperforming, with an over-reliance on other countries to treat our recycling materials, general municipal and hazardous wastes.
3. Systemic change is needed to accelerate the transition to an accessible, fair and affordable circular economy. Effective regulation, incentives and enforcement are required to influence businesses and consumers to adopt best practices in production, supply, purchasing, use and reuse of goods, products and services.

Environmental Policy Implementation and Performance

1. Serious deficits remain in Ireland's implementation of environmental legislation and related plans and programmes. We need to scale up and speed up the implementation of measures and critical infrastructure in energy, transport, waste and water to protect our environment and human health.
2. Environmental policy responses to date have been insufficient to halt or reverse environmental decline. A national policy position on protecting Ireland's environment is urgently required to provide a shared whole-of-government vision for protecting our environment to guide decision-making, support policy coherence and improve the coordination of environmental protection efforts nationally.
3. Looking ahead to 2050, more ambitious and transformative policy responses are needed that set out a roadmap for achieving the transitions required across our food, energy, mobility, and production and consumption systems. These policies need to be supported by clear governance structures and the necessary investment plans to implement them.

Chapter 1:
Introduction



Introduction

1. Introduction

This report by the Environmental Protection Agency (EPA), *Ireland's State of the Environment Report 2024*, presents current information on the quality of Ireland's environment.

Our previous 4-year assessment in the series, published in 2020, found that the outlook for Ireland's environment was not good. We urged the need for a decade of action and transformation, particularly in the context of escalating climate and biodiversity emergencies. We argued that sustained and focused action would be needed to achieve sustainability not only across sectors such as agriculture, energy, transport and industry but also across the whole of society. The assessment also highlighted the greater awareness of the positive benefits of a clean environment for both health and wellbeing (EPA, 2020).

From an environment and climate viewpoint, a similar conclusion was put forward by the European Environment Agency in its 4-year assessment, *The European Environment – State and Outlook 2020*, which stated that Europe and the world face urgent, unprecedented sustainability challenges that require systemic solutions (EEA, 2019). This report painted a bleak picture of the EU's prospects of meeting its policy objectives.

The seven hottest days since records began in the 1850s were recorded in July 2023. The global average temperature over the past 12 months (July 2023 to June 2024) is the highest on record, at 0.76°C above the 1991-2020 average and 1.64°C above the 1850-1900 pre-industrial average (Copernicus Climate Change Service, 2024). 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 (Thorne *et al.*, 2023).

About 1 million species are at direct risk of extinction, prompting experts to argue that the Earth is already experiencing a sixth 'mass extinction event' (IPBES, 2019). There are an estimated 350,000 different types of manufactured chemicals on the global market (Wang *et al.*, 2020). Pollution levels from chemicals and new entities[1] alone exceed our ability to monitor their extent and impact on the planet (Persson *et al.*, 2022). These are all evidence of the triple planetary crisis – climate change, biodiversity loss and pollution – and a stark reminder of the environmental challenges facing humanity (UNEP 2020, 2022).

Environmental risks – as identified by 1500 global leaders across academia, business, government, international community and civil society – continue to dominate the risks landscape (WEF, 2024). The World Economic Forum reports that extreme weather events, critical changes in Earth systems, biodiversity loss and ecosystem collapse, and natural resource shortages are the top four threats facing humanity in the coming decade (WEF, 2024).

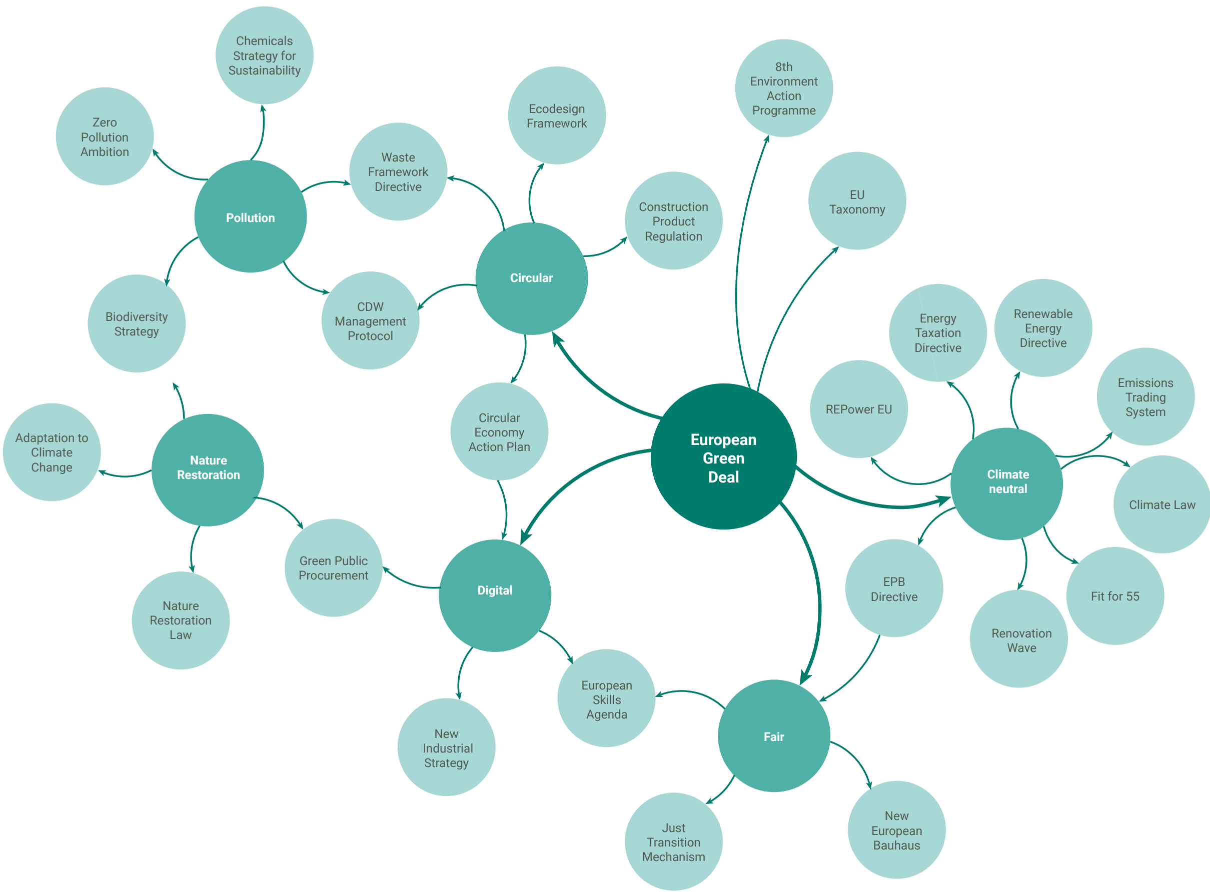
2. Wider context of protecting Ireland's environment

A broad range of EU directives and regulations provide a framework for the management of our environment. These legal instruments and their implications for Ireland are outlined in more detail in each of the relevant thematic chapters in this report.

The EU has set out clear ambitions for decarbonisation, with a target to reduce greenhouse gas emissions by at least 55% by 2030, supported by the comprehensive Fit for 55 legislation package, and the long-term objective of becoming the first climate-neutral continent by 2050, as set out in the European Green Deal policy initiatives and anchored in European Climate Law (EC, 2019). Associated with the EU Green Deal there has been extensive legislation strengthening traditional EU climate, energy and environmental policy instruments with brand new policy instruments. The latter include the Just Transition Fund, a new, separate Emissions Trading System (ETS 2) covering buildings and road transport, the Social Climate Fund, and the world's first Carbon Border Adjustment Mechanism (Figure 1.1).

1 synthetic chemicals including plastics

Figure 1.1 European Green Deal and associated policy initiatives



CDW, construction and demolition waste; EPB Directive, Energy Performance of Buildings Directive

Source: Compiled from data from EEA and ETC Circular Economy and Resource Use

Topic Box 1.1 Eighth Environment Action Programme

The long-term priority objective is that, by 2050 at the latest, Europeans live well, within the planetary boundaries and in a 'wellbeing economy' where nothing is wasted. Growth will be regenerative, climate neutrality will be a reality and inequalities will have been significantly reduced.

There are six priority objectives to 2030

- achieving the 2030 greenhouse gas emission reduction target and climate neutrality by 2050
- enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change
- advancing towards a regenerative growth model, decoupling economic growth from resource use and environmental degradation, and accelerating the transition to a circular economy
- pursuing a zero pollution ambition, including for air, water and soil, and protecting the health and wellbeing of Europeans
- protecting, preserving and restoring biodiversity and enhancing natural capital
- reducing environmental and climate pressures related to production and consumption (particularly in the areas of energy, industry, buildings and infrastructure, mobility, tourism, international trade and the food system).

The Eighth Environment Action Programme (8th EAP) is the EU's joint programme for implementing the European Green Deal on the ground until 2030, guided by a long-term vision to 2050 of achieving wellbeing for all while staying within the planetary boundaries (Topic Box 1.1). A significant difference between the 8th EAP and its predecessors is its emphasis on the systemic character of sustainability challenges and the resulting need for similarly systemic solutions. The European Commission recently published its mid-term review of overall progress on the 8th EAP (EC, 2024a). The report noted that the EU's 2030 climate and environment targets are within reach if the actions planned are fully implemented. This is further discussed in Chapter 16 of this report.

This report is being finalised against a backdrop of recent European elections and some delay in implementing elements of the European Green Deal, in particular the Nature Restoration Law (Regulation 2024/1991), which has only recently come into force. Crises in political, economic and social spheres, including the wars in Ukraine and the Middle East, add to the complexity of maintaining political momentum on the green agenda, and ensuring that existing targets and instruments are implemented.

Adopted by the European Council in 2024, the Strategic Agenda 2024-2029[2] sets the EU's priorities for the next 5 years in line with Europe's ambition to become the first climate-neutral continent, focusing on green and digital industries and technologies. Agreed priorities include more support for scaling up Europe's manufacturing capacity for net zero technologies and products, while further simplifying rules on planning, tendering and permitting. There is a continued commitment in the Strategic Agenda 2024-2029 to protect nature, reverse the degradation of ecosystems and improve water quality.

Closer to home the third cycle of Ireland's River Basin Management Plan (known as the Water Action Plan) has just been published and the first revision of the National Planning Framework is at consultation stage. A central message of the 2020 State of the Environment Report was a call for a national policy position on the environment. Delivering this policy position remains critical to addressing complex and interrelated challenges on climate, biodiversity and pollution and prevent damaging lock-ins.

3. A different Ireland

Ireland has changed radically over the past 50 years since joining the EU (Figure 1.2).

Our population which now stands at 5.3 million people has grown by over 2.3 million over the past 50 years and is projected to grow to over 6.5 million and 7 million by 2057 in medium- and high-growth scenarios, respectively (CSO, 2024). Population growth and increased urbanisation impact the environment in a variety of ways, including changes in land use, increased traffic flows and the need for more infrastructure such as housing, water supply and sewerage.

Life expectancy has greatly increased, and almost all private dwellings now have a piped water supply. The number of people in employment has increased by 1.5 million. Since joining the EU, our economy has moved from one based on agriculture to one in which pharmaceuticals and chemicals and related products account for the majority of our total net sales (Chapter 13).

Car ownership has changed dramatically, and there are now almost 2.5 million more cars on the road than 50 years ago. This high car dependency has a very significant impact in terms of both greenhouse gas and air pollutant emissions.

The tourism sector is very important for the Irish economy. However, a significant increase in tourist numbers has put pressure on the water, waste and road infrastructure in many popular tourist destinations.

Eurostat's most recent progress report on the Sustainable Development Goals (SDGs) (Eurostat, 2024) shows that Ireland is performing well on the SDGs associated with macroeconomic stability and fairness, but, concerningly, is performing poorly on a number of SDGs related to environmental sustainability. It is clear that, over the past 50 years, Ireland has become a modern and prosperous country and the gross pollution of our urban air environment and rivers has greatly reduced (Figure 1.2).

2 www.consilium.europa.eu/media/4aldqfl2/2024_557_new-strategic-agenda.pdf (accessed 15 July 2024).

Figure 1.2 Changes in socio-economic and environmental indicators in Ireland over a 50-year period[a]

Population

1973	1998	2023
3.0m	3.63m	5.3m

Number of people employed

1973	1998	2023
1.07m	1.59m	2.55m

Enrolment of full-time third level students

1973	1998	2023
26,490 (1972-73)	104,439 (97-98)	198,970 (2022)

Life expectancy at birth (years)

1973	1998	2023
71	75.1 (1990)	82.6 (2022)

Overseas tourists

1973	1998	2023
1.47m	5.7m	11.3m (2019)

Car ownership

1973	1998	2023
476,721	1,066,131 (1996)	2,890,975

Cattle numbers

1973	1998	2023
7.1m	7.3m	7.3m

Balance of trade in goods

1973	1998	2023
-€340m	€17.6bn	€55.7bn

People employed in agriculture

1973	1998	2023
24%	9%	4%

High quality river sites

1973	1998	2023
31.6% (1987)	25.7%	17.7%

Chemical and related products exports

1973	1998	2023
€74.5m	€8.54bn	€126bn

Private dwellings with piped water supply

1973	1998	2023
78.8% (1971)	98.6% (1991)	99.9% (2021)

Seriously polluted rivers

1973	1998	2023
7% (1971)	0.6%	0.1%

Lead emissions (t)

1973	1998	2023
700	85.1	7.1 (2022)

SOx emissions (kt)

1973	1998	2023
190	179	9.5

SO_2 in Dublin city ($\mu g/m^3$)

1973	1998	2023
83	14 (1999)	1.6

Fish kills (3 year moving average)[b]

1973	1998	2023
23	61	28 (2021)

[a] The information provided under the various years relates to the closest year in parenthesis where data is available.

[b] The peak in fish kills reported in the 1980s coincided with an intensification of agriculture in Ireland (Matson and Kelly, 2024).

Sources: Numbers compiled from AFF, 1985; CSO, 2023; EPA, 2016; and various EPA data and publications

Figure 1.3 Restored landfill near Cork City

Focusing on changes in environmental indicators over the past 25 years or so in areas where there are more reliable environmental data yields interesting results (Table 1.1). There has been a large decrease in the number of discharges of untreated sewage in the past 20 years. Investment in waste water treatment infrastructure continues to bring improvements for our environment via fewer untreated waste water discharges, but it is concerning that Ireland has still not met all its obligations under the Urban Waste Water Treatment Directive (Council Directive 91/271/EEC), and raw sewage continues to be discharged to our waters.

Our air quality has improved significantly. Following on from bans on smoky coal and leaded petrol in the 1980s more stringent industrial regulation has seen air pollutants from combustion sources significantly reduced (primarily due to fuel switching in power generation and other industrial sectors).

In terms of waste management our dependence on landfill has been significantly reduced to three operational landfills at present, down from 35 in 2002 and 125 in 1996. Many of these historical waste disposal sites have been restored and transformed into amenity areas for the local community (Figure 1.3). Municipal waste generation has increased in the past 20 years, and an additional 2 million tonnes of municipal waste is recovered (Table 1.1).

Bathing water quality has remained of very high quality. However, over the past two decades, Ireland has consistently reported one of the highest incidences of serious gastrointestinal illness caused by a strain of *E. coli* (STEC/VTEC), which is of particular concern because of the high proportion of rural dwellers who rely on private wells.

We have established a prosperous nation and economy; however, this success has been heavily dependent on our environmental resources, particularly in sectors such as tourism, agriculture and industry. Consequently, we have depleted these finite resources to some extent. The combination of a growing economy and an increasing population will continue to exert pressure on the environment. In light of these circumstances, it is imperative that we make substantial investments in key infrastructure to prioritise environmental protection as a cornerstone of our future development.

Table 1.1 Changes in environmental indicators in Ireland over the past 25 years

PARAMETER	1998	2023
Greenhouse gas emissions (Mt)	65.5	55.0
Sulphur dioxide emissions (kt)	179	9.5
Discharges of untreated sewage (no.)	95 (1996)	16
Operational landfills (no.)	125 (1996)	3
Municipal waste generated (Mt)	3.0	3.2
Municipal waste recovered (Mt)	0.7	2.6 (2021)
Air quality exceedances (days)[a]	59	0
Bathing water compliance (%)	98.5%	97%
VTEC (incidence per 100,000 population)	1.4 (1999)	19.2 (2022)

[a] Days when particulate matter levels exceeded 50 µg/m^3 at one monitoring station in Dublin city centre. No exceedances recorded anywhere nationwide in 2023.

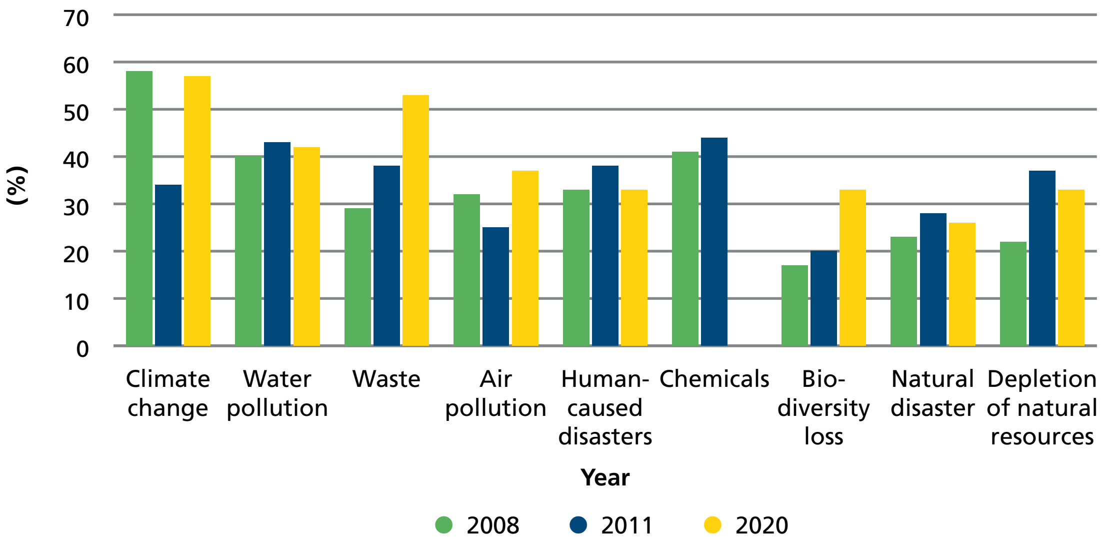
Source: VTEC incidence compiled from NDSC (1999) and HPSC (2024). All other data compiled from various EPA data and publications

4. Public perceptions and the environment

Protecting our environment and becoming a more climate-neutral and climate-resilient society may often require policies and measures that place unwelcome demands on the public. Therefore, the better informed the public is on environmental matters and issues, the more likely it is that these policies and measures will be supported.

The environmental issues of most concern to Irish citizens in three Europe-wide surveys carried out over the past 16 years include climate change, water pollution and waste, followed by disasters caused by human activities and air pollution (Figure 1.3). Biodiversity loss (species decline) became more of a concern in the 2020 survey.

Figure 1.3 Environmental issues of most concern to Irish citizens



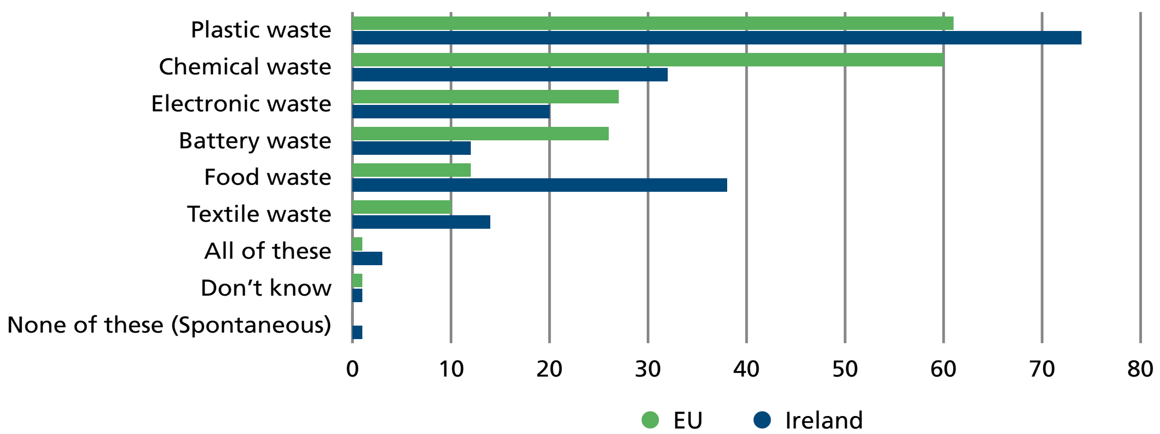
Sources: Compiled from EC,2008; EC 2011; EC 2020

About three-quarters of Irish (74%) and European (78%) citizens agree that environmental issues have a direct effect on their daily lives and their health (EC, 2024b). It is notable that, in several Eurobarometer surveys over the past decade, Irish people have consistently positively recognised the value of EU environmental legislation (values range from 80% to 88%) (EC, 2014, 2017, 2020, 2024b).

An interesting finding in the most recent Eurobarometer survey was much greater concern about plastic waste and food waste reported by Irish people than by other Europeans (Figure 1.4) (EC, 2024b).

The EPA's Climate Change in the Irish Mind[3] project shows that people in Ireland are positive about climate action (O'Mahony *et al.*, 2024). The findings indicate that 89% of people report that climate change is important to them personally and 79% say that climate change should be either a 'very high' or 'high' priority for government, with high overall support for a range of climate action policies. Moreover, Irish people think that climate action will increase economic growth and create jobs (56%) and that actions to reduce climate change will improve quality of life in Ireland (74%) (O'Mahony et al., 2024).

Figure 1.4 Waste types considered most problematic in 2024 Eurobarometer survey (% of responses)



Source: EC, 2024b

3 See also Chapter 4 of this report.

5. Content of the report

This is the eighth State of the Environment Report published by the EPA since the first report in 1996, 28 years ago.

The report provides thematic assessments in Part 1, focusing on key trends in and challenges and actions for air, climate change, noise, water, marine, nature, land use and soil. Part 2 provides detailed integrated assessments of key economic sectors: transport, energy, agriculture, industry and the circular economy and the interactions between human health and the environment. Finally, Part 3 provides an in-depth assessment of how Ireland is performing in the area of environmental policy implementation. The report also provides mid-term commentary on the many plans and programmes in place that have 2030 in their sights (e.g. Climate Action Plan, SDGs).

Most of the key environmental issues that concern us have developed over lengthy time frames and are unlikely to be remedied in the short term. Our understanding of Ireland's environment is constantly changing as a result of evidence from ongoing monitoring programmes and supplementary novel research efforts. In this complex context, we will continue to be guided by science that helps us understand the pressures on the environment and can provide the foundation for evidence-based decision-making. There are many examples throughout the report describing how we now have substantially developed national capability for monitoring air, radiation, waste water and the impacts of pollutants on ecosystems which are vital to characterise and describe the state of the environment.

Recognition of the importance of research and innovation (R&I) in informing and underpinning the green transition was prominent in the first R&I Strategy published by the Department of the Environment, Climate and Communications (DECC, 2024). An important key action of the strategy is a commitment to support the EPA, Inland Fisheries Ireland and the Sustainable Energy Authority of Ireland in performing their R&I functions and delivering policy-relevant research evidence. The continued strong investment in environmental research is crucial, as today's environmental research will become tomorrow's environmental protection (EPA, 2021).

Examples of national research are included throughout this report that highlight the valuable role research plays in environmental protection and in moving towards a sustainable future for Ireland.

Key chapter messages

1. A national policy position for Ireland's environment is critical to addressing complex and interrelated challenges on climate, biodiversity and pollution and prevent damaging lock-ins.

2. Our growing economy and population are increasing the pressure on our environment. We need to invest in our infrastructure to prevent this growth impacting on our natural environment.

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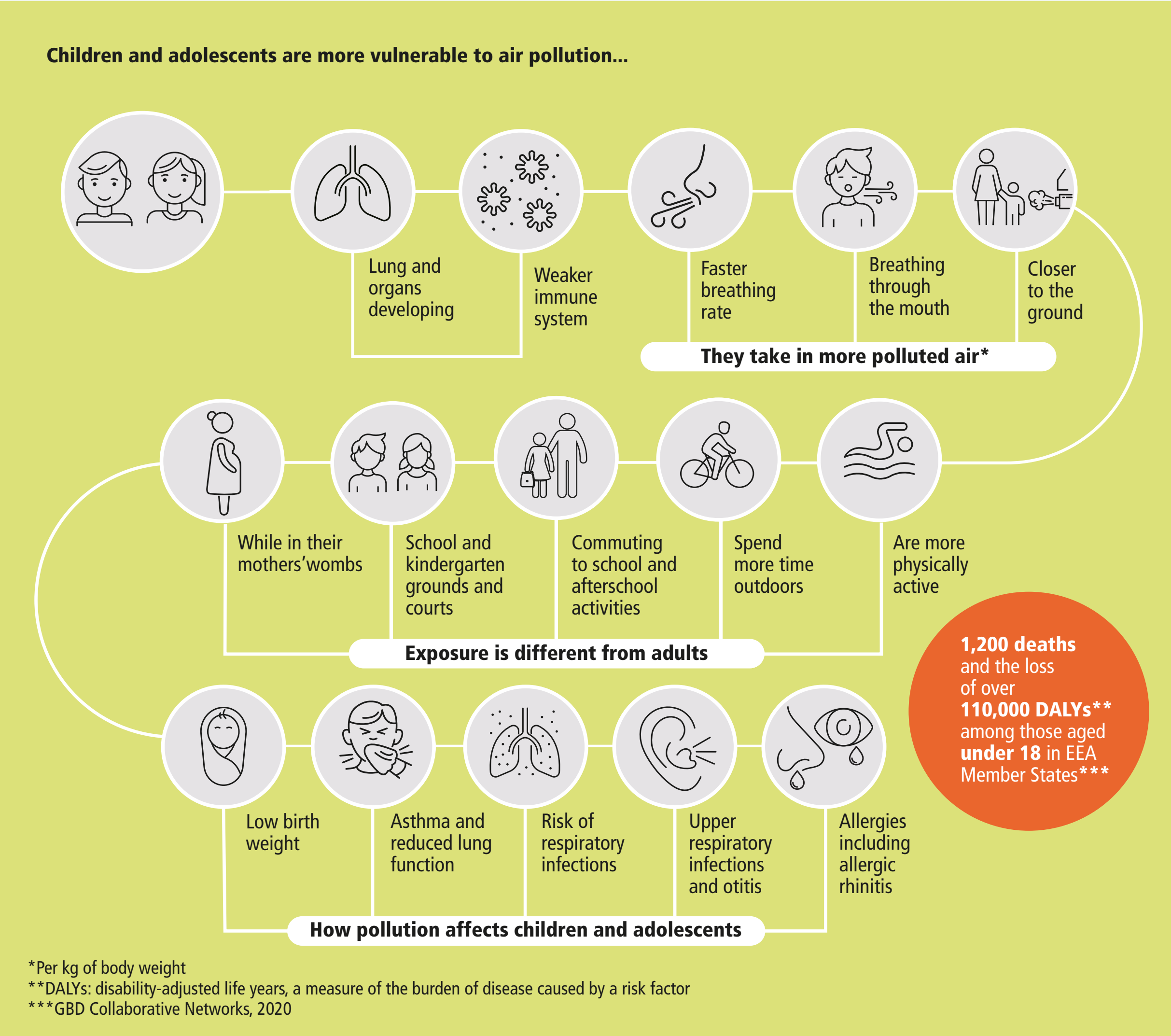
Chapter 2:
Air

Air

1. Introduction

The quality of the air we breathe is of critical importance to our health and the health of our ecosystems. As an island on the periphery of Europe with south-westerly prevailing winds, Ireland is less frequently affected by transboundary air pollution from its neighbours than other parts of Europe. However, national emissions of air pollutants contribute to poorer air quality throughout the year, be they from home heating, transport, agriculture or energy. The national emissions are added to by episodes of transboundary air pollution from continental Europe. Overall, there is an increasing understanding of the negative, pervasive impacts on our health of air pollutants, including impacts on the health of children (Figure 2.1).

Figure 2.1 Health impacts of air quality on children in the EU

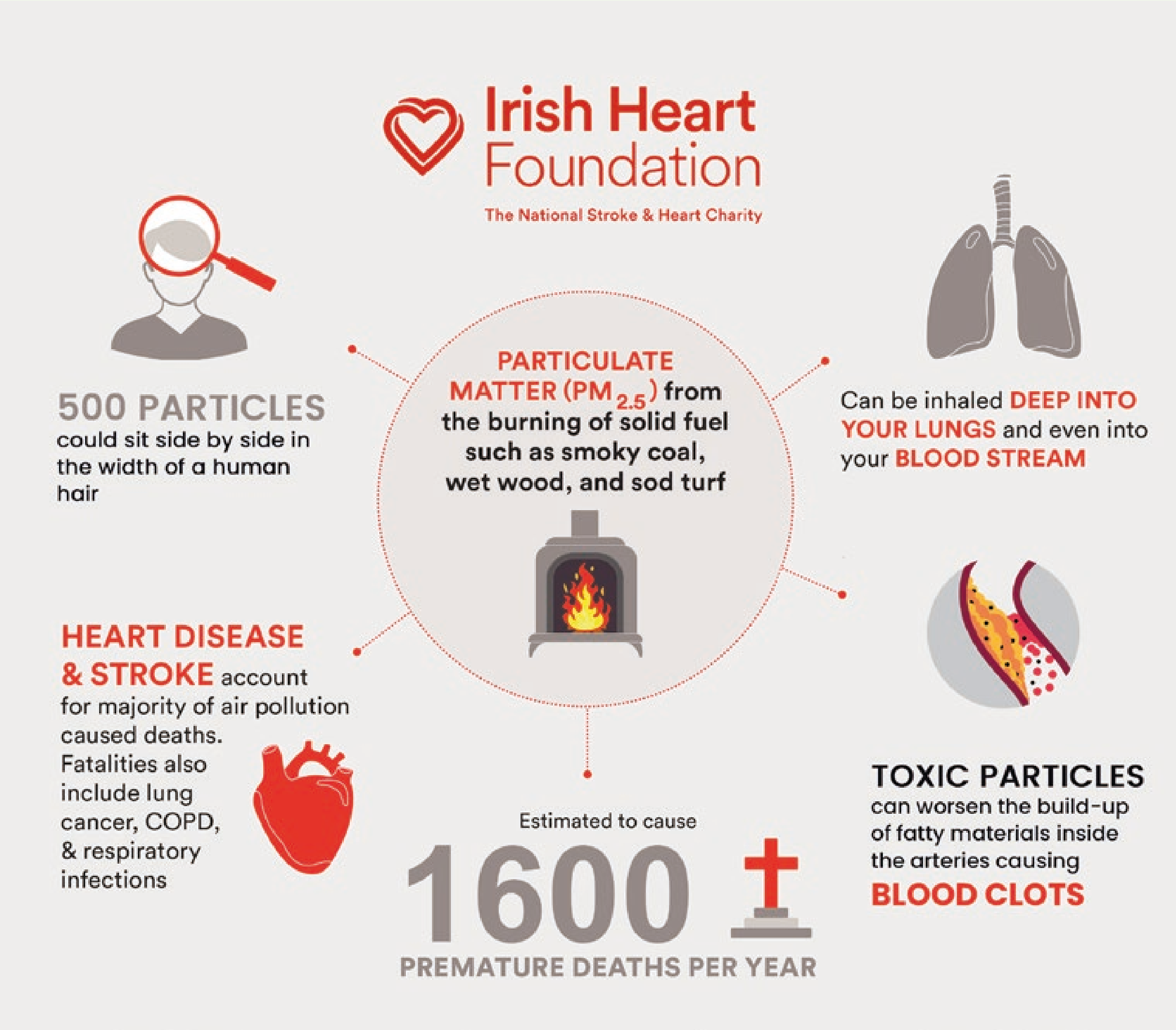


Source: Adapted from EEA, 2023a

The World Health Organization (WHO) has identified poor air quality as the single largest threat to public health (WHO, 2021). Poor air quality is linked to premature death and life-limiting conditions such as dementia (Wood *et al.*, 2022), type 2 diabetes and neonatal mortality (GBD 2019 Risk Factors Collaborators, 2020). Long-term exposure to particulate matter contributes to the risk of developing cardiovascular and respiratory diseases, as well as lung cancer (WHO, 2024).

The European Environment Agency (EEA) estimates that in excess of 1600 premature deaths in Ireland annually are due to air pollution from causes including cardiovascular disease and respiratory illnesses (EEA, 2023b). Irish research has shown the impacts of poor air quality on older citizens (Ó Domhnaill *et al.*, 2022) and the increased incidence of stroke due to air pollution (Byrne *et al.,* 2020). Recently published research also shows estimated healthcare costs of €56 million over 4 years for five conditions attributable to air pollution (ESRI, 2023). Irish research also shows that, for the older population, higher fine particulate concentrations (Figure 2.2) are associated with an increase in the prevalence of both depression and anxiety (ESRI, 2023).

Figure 2.2 Health impacts of air pollution



Source: Irish Heart Foundation

WHO stresses that even extremely low levels of air pollution can have health impacts, such that there is no safe level of air pollution. Therefore, taking action even at low levels of pollution can deliver health benefits.

The pollutants of concern in Ireland are fine particulate matter, nitrogen dioxide and ammonia (Table 2.1).

Table 2.1 Fine particulate matter ($PM_{2.5}$), nitrogen dioxide (NO_2) and ammonia (NH_3)

Pollutant	Description	Sources and solutions
Fine particulate matter	Particulate matter is a mixture of very small solid and liquid particles suspended in air. $PM_{2.5}$ particles have a diameter of < 2.5 µm. Small particles can penetrate the lungs and enter the blood system, causing damage. $PM_{2.5}$ is a strong indicator of anthropogenic (human-generated) emissions and it is responsible for significant negative impacts on human health.	Levels of $PM_{2.5}$ are particularly problematic in or near urban centres, villages, towns and cities, because of the cumulative effects of multiple sources of the pollutant, with the dominant source being solid fuels used in home heating. $PM_{2.5}$ pollution can be reduced by changing how we heat our homes, specifically by moving away from smoky fuels and choosing cleaner options.
Nitrogen dioxide	While not as impactful on health as $PM_{2.5}$, NO_2 can have negative impacts on respiratory and cardiovascular health. Nitrogen oxides (NO_x) also contribute to the acidification of soils and surface waters, and to ground level ozone (O_3) formation. They can contribute to excess nitrogen in terrestrial ecosystems.	The dominant sources of NO_2 are from transport, particularly diesel- and petrol-powered vehicles. NO_2 pollution is particularly an issue in urban areas due to transport emissions. NO_2 pollution could be decreased by reducing overall traffic volumes in towns and cities, increasing the electrification of the fleet and giving consideration to low emission zones in our largest urban centres.
Ammonia	NH_3 emissions to air are associated with nitrogen deposition, acid rain and the formation of secondary particulate matter. Excessive deposition of reactive nitrogen negatively affects terrestrial ecosystems, including biodiversity loss, through eutrophication and acidification.	Agriculture is the dominant source of NH_3 emissions in Ireland. To decrease concentrations, there is an urgent need for a significant uptake of abatement techniques such as low-emission slurry spreading, the use of inhibited fertiliser products and reduction in the crude protein concentration of livestock feeds.

2. Air quality standards in Ireland

European directives on air quality and emissions

The EU zero pollution targets for 2030 include a reduction of more than 55% in the number of premature deaths across Europe as an indicator of the overall reduced health impacts of air pollution. The EU's comprehensive Clean Air Policy (EC, 2018) is based on three pillars: ambient air quality standards, national emission reduction targets and emission standards for key sources of pollution. Collectively, these pillars combine to tackle air pollution and achieve the EU's zero pollution vision for 2050 (EC, 2021) including the 2030 target.

Emission standards are used in the regulation of industry and the power generation sector. Industrial Emissions Directive (2010/75/EU) licences, which are granted and enforced by the Environmental Protection Agency (EPA), work to curb emissions from industry and the power generation sector in Ireland. Installations with a power generation capacity of 50 MWth (thermal input) and above are covered by this directive. The Medium Combustion Plant Directive ((EU) 2015/2193), applies to installations with on-site combustion plants with a rated thermal input capacity of 1-50 MWth. To continue to ensure that industrial facilities do not affect the quality of air in the surrounding environment, industrial emissions of pollutants to air are controlled. Industry's impact on the environment is discussed in Chapter 13.

Ambient air quality directives

European ambient air quality legislation sets out concentration limits for 13 air pollutants that have impacts on human health and on vegetation.[1] These pollutants are NO_2, particulate matter (both particulate matter < 10 µm (PM_{10}) and $PM_{2.5}$), O_3, sulphur dioxide (SO_2), benzene, lead, carbon monoxide (CO), arsenic, cadmium, nickel and benzo(a)pyrene. The relevant directives include the Cleaner Air For Europe (CAFE) Directive and one current daughter directive, the fourth daughter directive. When a Member State does not meet the standards in the directives, it must prepare an air quality plan to ensure compliance in future.

The EU ambient air quality directives have been subject to a review since 2022. This review is substantially informed by the revised WHO air quality guidelines (Topic Box 2.1). At the time of writing, this review was at the end stage of the EU's approval process. The proposed CAFE Directive sets out to move Europe's air quality standards towards the health-based WHO guideline limits in a stepwise manner. Its new provisions include tighter limits on air pollutants, including new air pollutants such as ultrafine particles and black carbon, and a strengthened regime for Member States' air quality plans when new limits have not been met. Innovatively, it obliges Member States to put in place air quality roadmaps when they anticipate future issues with complying with the revised air quality standards. This means that action needs to be taken proactively rather than waiting until a standard has been breached. The roadmaps are intended to set out the steps to ensure compliance when potential breaches of standards are considered likely.

Topic Box 2.1 WHO air quality guidelines

Based on extensive scientific evidence, the WHO sets human health-based guideline limits for pollutants in ambient air. In 2021, it issued a new set of guidelines (WHO, 2021), the first global update since 2005. The guidelines reflect the growing volume of understanding and medical evidence showing the impacts of air pollutants at increasingly lower concentrations. The guidelines cover the pollutants most critical for health, i.e. for which the evidence for health effects arising from exposure has advanced in the past 15 years. Based on the evidence, they provide recommendations on air quality guideline limits for key air pollutants: $PM_{2.5}$ and PM_{10}, O_3, NO_2, SO_2 and CO. The 2021 guideline limits are significantly lower for particulate matter and NO_2. WHO also included interim targets to guide reduction efforts towards achieving the air quality guideline limits (Figure 2.3). According to WHO, meeting the interim targets could have a notable benefit for health, especially in those regions where exposure far exceeds the interim targets.

1 Directive 2008/50/EC on ambient air quality and cleaner air for Europe (CAFE Directive) and Directive 2004/107/EC relating to arsenic, cadmium, nickel and polycyclic aromatic hydrocarbons in ambient air.

Figure 2.3 Air quality guideline (AQG) limits and interim targets recommended by the WHO, by pollutant

Pollutant	Averaging time	Interim target				AQG level
		1	2	3	4	
Fine particulate matter ($PM_{2.5}$), μg/m^3	Annual	35	25	15	10	5
	24-hour[a]	75	50	37.5	25	15
Particulate matter (PM_{10}), μg/m^3	Annual	70	50	30	20	15
	24-hour[a]	150	100	75	50	45
Ozone (O_3), μg/m^3	Peak season[b]	100	70	–	–	60
	8-hour[a]	160	120	–	–	100
Nitrogen dioxide (NO_2), μg/m^3	Annual	40	30	20	–	10
	24-hour[a]	120	50	–	–	25
Sulphur dioxide (SO_2), μg/m^3	24-hour[a]	125	50	–	–	40
Carbon monoxide (CO), mg/m^3	24-hour[a]	7	–	–	–	4

a 99th percentile (i.e. 3-4 exceedance days per year).

b Average of daily maximum 8-hour mean O_3 concentration in the six consecutive months with the highest six-month running-average O_3 concentration.

Source: WHO, 2021

EU National Emission Reduction Commitments Directive

The National Emission Reduction Commitments (NEC) Directive ((EU) 2016/2284) set 2020 and 2030 commitments to reduce emission of five air pollutants,[2] based on 2005 levels. The directive incorporates the reduction commitments for 2020 agreed by the EU and its Member States under the 2012 revised Gothenburg Protocol (UNECE, 2016). The reduction commitments for 2030 have been designed to reduce the health impacts of air pollution by half compared with 2005. The directive also requires that Member States, including Ireland, draw up a National Air Pollution Control Programme (DECC, 2021) to help ensure that national emission reduction commitments are met. It also obliges Member States to create a network to monitor the effects of air pollution on ecosystems.

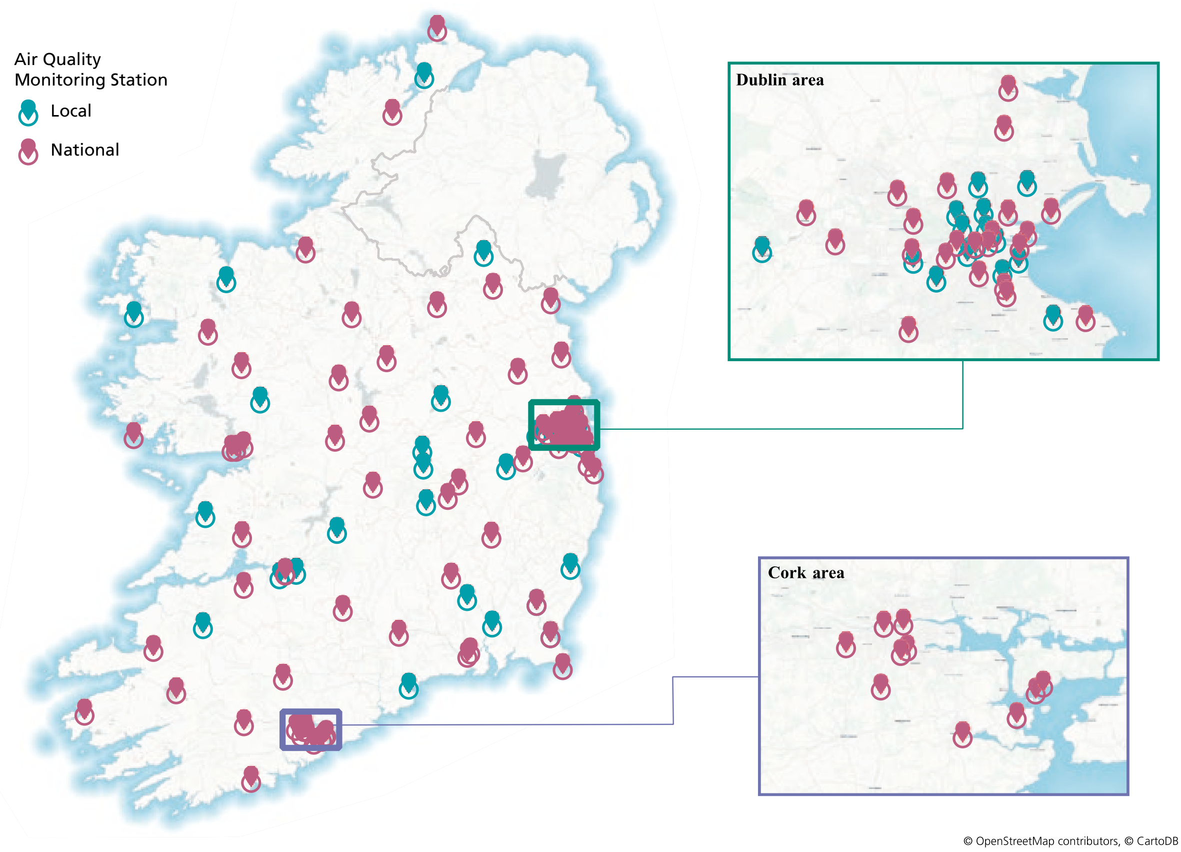
National air quality policy, monitoring and enforcement

The Department of the Environment, Climate and Communications (DECC) has responsibility for ensuring that Ireland meets its air quality obligations under EU legislation and international agreements. In 2023, the government launched Ireland's first Clean Air Strategy (DECC, 2023), which sets out a high-level strategic policy framework to reduce air pollution and promote cleaner ambient air.

The EPA coordinates ambient air quality monitoring, modelling, assessment and reporting nationally. Its air-related activities also involve regulating industrial and waste activities, including air emissions associated with these activities; maintaining the national solid fuel register; compiling, and reporting the national inventory of air emissions; and overseeing the environmental enforcement activities undertaken by local authorities. Local authorities also regulate some activities that give rise to air pollution and some also undertake local air monitoring programmes.

2 The five pollutants are NH_3, NO_x, $PM_{2.5}$, non-methane volatile organic compounds (NMVOCs) and SO_2.

Figure 2.4 Map showing the network of 115 air quality monitoring stations



National ambient air quality monitoring and modelling

The EPA, in partnership with other national bodies, monitors air pollutants across the National Ambient Air Quality Monitoring Network. The monitoring network has almost quadrupled in size since 2017 from 29 stations to the current network of 115 stations (Figure 2.4) in 2024. Pollutants monitored include PM_{10} and $PM_{2.5}$, NO_2, ground level O_3, SO_2, CO, benzene, heavy metals and polycyclic aromatic hydrocarbons. The EPA makes real-time monitoring information available online (www.epa.ie and www.airquality.ie). It provides public information based on the Air Quality Index for Health, developed in conjunction with the Health Service Executive (HSE).

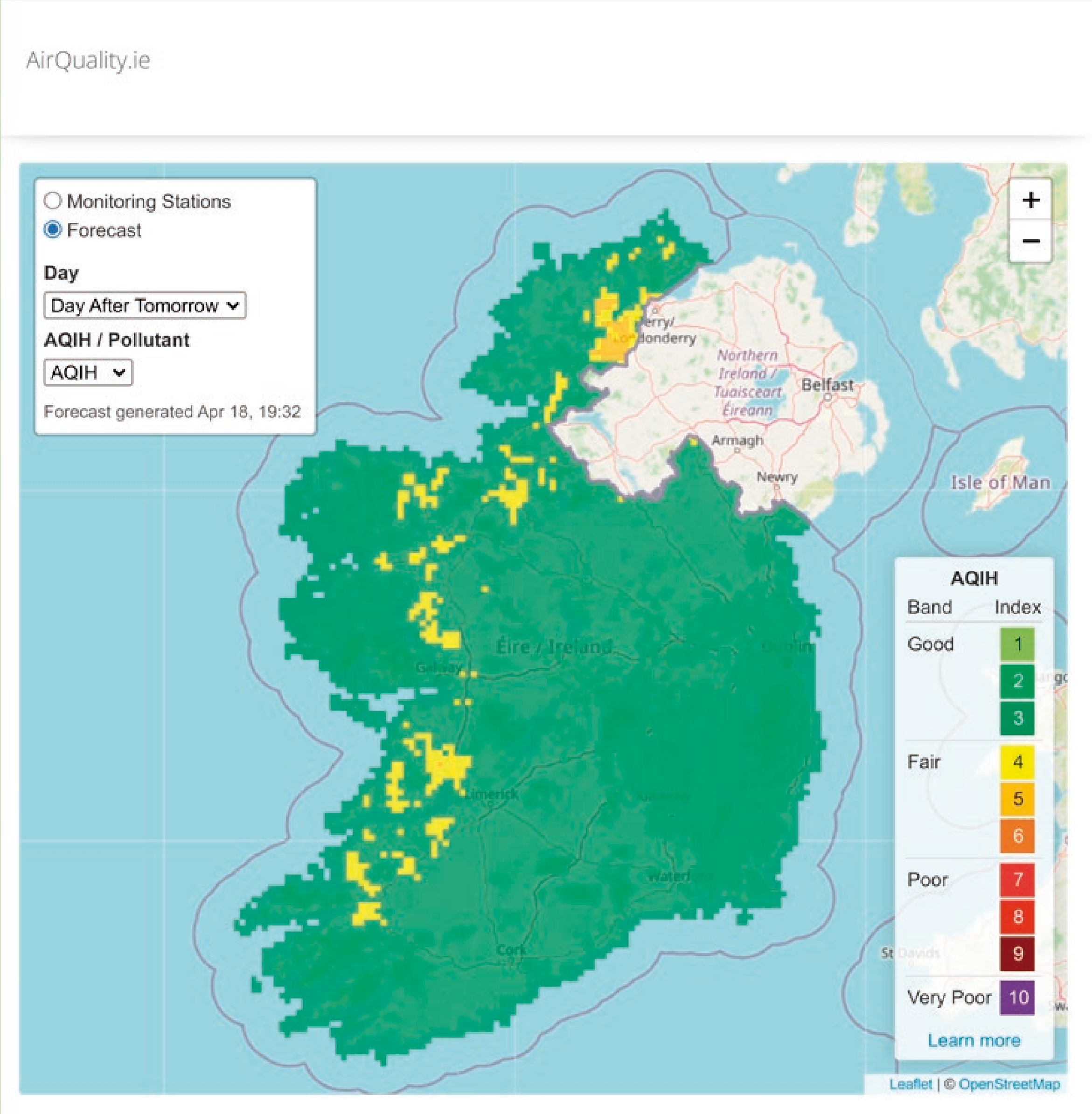
Modelling concentrations of air quality across the country improves our ability to understand and manage air pollution. High-resolution models provide maps essential to understanding air pollution and exposure across the country. These models are produced under the EPA's LIFE Emerald project (EPA, 2023a) and from previous modelling focused on Dublin (EPA, 2019). Such maps have been used as part of the LIFE Emerald project to review the effectiveness of national plans and our monitoring network, while also informing an assessment of national health impacts and improving our ability to highlight areas with high emission levels. Such models will be key to highlighting current and potential future air pollutant concentrations across Ireland, assessing strategies to reduce emissions while also maximising the co-benefits of efforts to reduce greenhouse gas emissions by targeting areas where air pollution is also an issue. The EPA's LIFE Emerald project has also developed an air quality forecast (Topic Box 2.2) and hourly updated Air Quality Index for Health maps.[3] Building on previously published modelling scenarios (EPA 2019, 2023a), new annual air quality maps will be provided to show the annual average air quality for all areas.

3 All are available on the air pages of www.epa.ie and on www.airquality.ie (both accessed 28 May 2024).

Topic Box 2.2 EPA LIFE Emerald air quality forecast

The EPA's LIFE Emerald 3-day air quality forecast, launched in November 2023, consists of maps showing the Air Quality Index for Health and concentrations of four air pollutants (PM_{10}, $PM_{2.5}$, NO_2 and O_3) for today, tomorrow and the day after tomorrow (Figure 2.5). Live data collected from the EPA's air quality monitoring network, weather forecasts, and geographical information are input to the computer model to produce the forecast, validated in line with EU standards. Users can zoom in to their local area to a scale of 3 km and can see the predicted air quality for that area. The maps are updated twice a day. The forecast enables members of the public to make informed decisions about their planned activities that can positively affect their health.

Figure 2.5 LIFE Emerald forecast as presented on www.epa.ie and www.airquality.ie



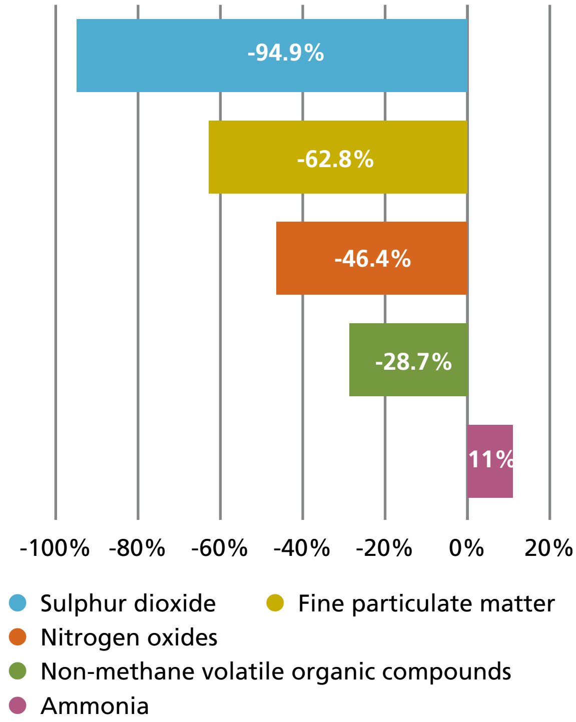
3. Emissions and national emission reduction commitments

National emissions of air pollutants

Total annual national emission levels of five air pollutants are subject to emission reduction commitments specified in the NEC Directive. The pollutants are NO_x, non-methane volatile organic compounds (NMVOCs), SO_2, NH_3 and $PM_{2.5}$.

Ireland has seen substantial reductions in the emissions of all pollutants except NH_3, which have increased over the last 30 years (see Figure 2.6). Despite this progress, challenges remain in maintaining a decreasing trend in the face of increasing economic activity, particularly in relation to emissions from the transport and agriculture sectors.

Figure 2.6 Percentage change in the five air pollutants covered by the NEC Directive, 1990-2022



Source: EPA, 2024a

The reduction commitment for each pollutant is a proportional reduction in emissions relative to the reported national emissions in 2005. These emission reduction commitments are in force for the period 2020-2029 and then from 2030 onwards (Table 2.2).

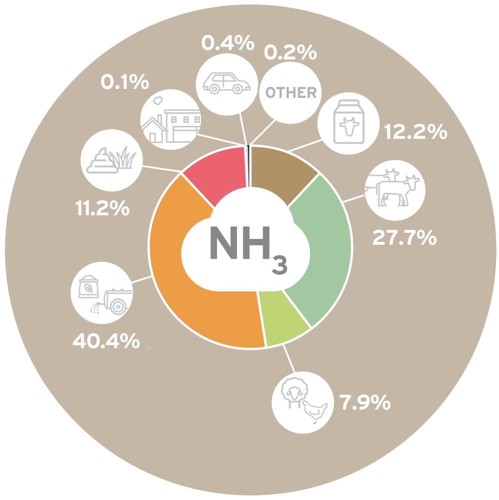
Table 2.2 National emission reduction commitments for 2020-2029 and 2030 onwards

Pollutant	2020	2030
Sulphur dioxide (SO_2)	-65%	-85%
Nitrogen oxides (NO_x)	-49%	-69%
Ammonia (NH_3)	-1%	-5%
Non-methane volatile organic compounds (NMVOCs)	-25%	-32%
Particulate matter < 2.5µm ($PM_{2.5}$)	-18%	-41%

Source: EPA, 2024a

Ammonia. NH_3 emissions are associated with nitrogen deposition, acid rain and the formation of secondary particulate matter. The agriculture sector accounts for virtually all (99.4%) NH_3 emissions in Ireland (Figure 2.7).

Figure 2.7 Sources of ammonia emissions in Ireland



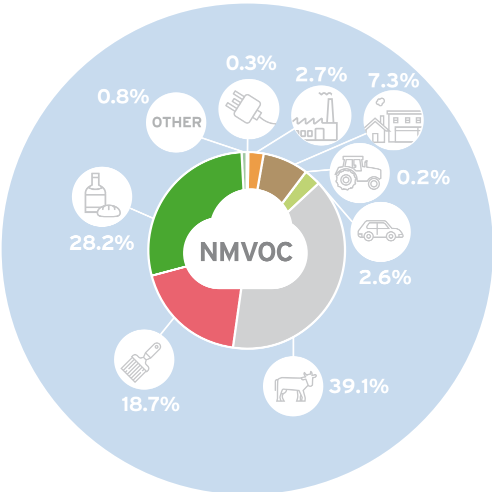
Source: EPA, 2024a

Ireland's national emission reduction commitment for NH_3 for 2020-2029 under the NEC Directive is a 1% reduction compared with the 2005 baseline level. As emissions in 2020, 2021 and 2022 were, respectively, 3.2%, 4.2% and 3.0% higher than in 2005, Ireland is currently one of eight Member States that is not compliant with its emission reduction commitment for 2020-2029 (EEA, 2024). Ireland was served with an infringement notice in January 2023 and a reasoned opinion in November 2023 by the European Commission for failing to meet its emission reduction commitments under the NEC Directive. Polices and measures contained in national plans indicate that compliance can be achieved over the coming years (Department of Agriculture, Food and the

Marine Ag Climatise,[4] Teagasc marginal abatement cost curve[5] and the Climate Action Plan (DECC, 2024) for example) should the uptake of abatement techniques be substantial. Techniques include low-emission slurry spreading, use of inhibited fertiliser products, and reductions in the crude protein concentration of livestock feeds. Ammonia is further discussed in Chapter 10.

Non-methane volatile organic compounds. NMVOCs are emitted as gases from a wide array of products including paints, paint strippers, glues, cleaning agents and adhesives. They also arise as a product of incomplete combustion of fuels, from the storage and handling of animal manure and fertilisers in agriculture, and from the food and beverage industry (Figure 2.8).

Figure 2.8 Sources of non-methane volatile organic compounds emissions in Ireland



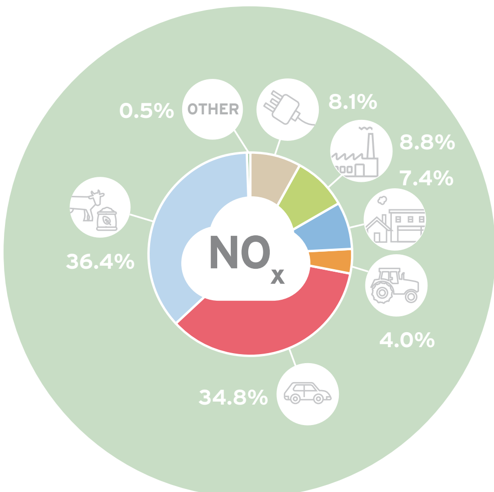
Source: EPA, 2024a

In terms of Ireland's national emission reduction commitment for NMVOCs, the NEC Directive has a flexibility mechanism that allows Member States to make an adjustment to their national inventory estimates for compliance purposes (Article 5(1)). This is allowed when non-compliance with national emission reduction commitments would result from applying improved emission inventory methods that have been updated in accordance with scientific knowledge. This flexibility ensures that countries are not penalised for updating estimates with information that could not have been envisaged when the emission reduction commitments were agreed in 2012. Ireland was non-compliant with national emission reduction commitments for NMVOCs for 2022 as a result of applying improved emission inventory methods that consist of using more up-to-date emission factors and recognising new sources of emissions. When the flexibility mechanism adjustment is made, Ireland will be compliant with the emission reduction commitment for NMVOCs for 2020, 2021 and 2022.

There has been significant expansion in whiskey production over recent years. With respect to the 2030 emission reduction commitment, it is projected that Ireland will be non-compliant. However, under the scenario in which emissions from spirit production are not included in the 2030 emission reduction commitment, as is currently the case for 2020-2029, compliance is expected. The adjustment to exclude spirit production is subject to annual review and approval by the European Commission.

Nitrogen oxides. NO_x contribute to the acidification of soils and surface waters, ground-level O_3 formation and excess nitrogen or saturation in terrestrial ecosystems. The principal sources of NO_x come from agriculture (as a result of using both organic and synthetic nitrogen-containing fertilisers) and fossil fuel combustion in the power generation and transport sectors (Figure 2.9). For the purposes of assessing compliance with the emission reduction commitments for this pollutant, emissions from agriculture are not included. Ireland is currently compliant with the emission reduction commitment for NO_x for the period 2020-2029 and is also projected to be compliant with the 2030 reduction commitment.

Figure 2.9 Sources of emissions of nitrogen oxides in Ireland



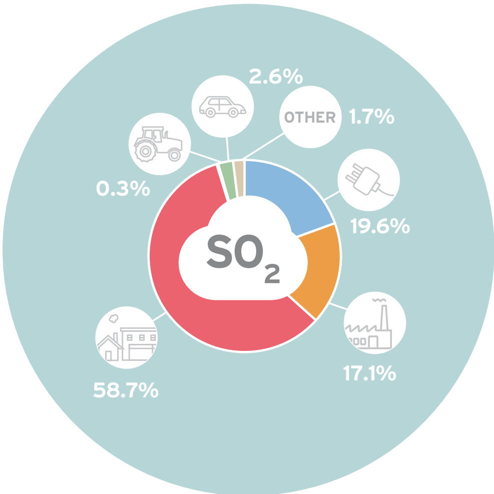
Source: EPA, 2024a

4 www.gov.ie/en/publication/07fbe-ag-climatise-a-roadmap-towards-climate-neutrality/ (accessed 28 May 2024).

5 www.teagasc.ie/media/website/publications/2020/NH3-Ammonia-MACC.pdf (accessed 28 May 2024).

Sulphur dioxide. SO_2 is the major contributor to acid deposition, which is associated with the acidification of soils and surface waters and the accelerated corrosion of buildings and monuments (Figure 2.10). Emissions of SO_2 are derived from the sulphur in fossil fuels such as the coal and oil used in combustion activities. Ireland is currently compliant with the emission reduction commitment for SO_2 for the period 2020-2029 and is also projected to be compliant with the 2030 reduction commitment.

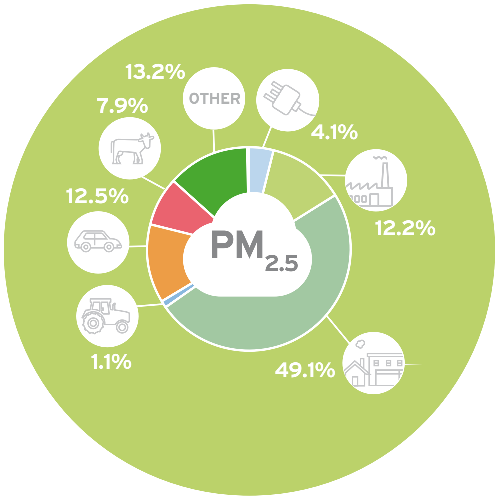
Figure 2.10 Sources of sulphur dioxide emissions in Ireland



Source: EPA, 2024a

Fine particulate matter. Ireland is currently compliant with the emission reduction commitment for $PM_{2.5}$ for the period 2020-2029 and is projected to also be compliant with the 2030 reduction commitment. However, the narrow margin between compliance and non-compliance in 2030 is of concern and further abatement above and beyond that currently proposed may be required. Figure 2.11 sets out the sources of $PM_{2.5}$ emissions in Ireland.

Figure 2.11 Sources of fine particulate matter emissions in Ireland



Source: EPA, 2024a

4. National ambient air quality monitoring network

The EPA's ambient air monitoring network of 115 stations provides data for the assessment of Ireland's air quality and supports reporting required under EU legislation. In this context, Ireland is divided into four zones for ambient air quality monitoring and management under the EU directives: zone A, Dublin city; zone B, Cork city; zone C, large towns with a population over 15,000; and zone D, the remainder of the country. The following section summarises the assessment of monitoring results for particulate matter, NO_2, O_3 and other pollutants in these zones.

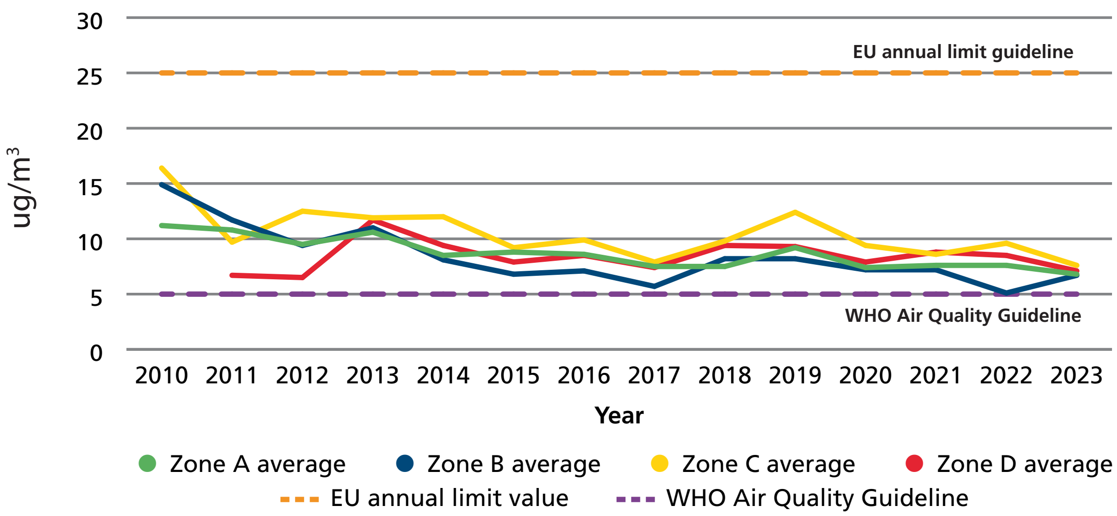
Particulate matter

Particulate matter in air consists of very small particles that have a significant negative impact on health. Primary particulate matter is emitted into the atmosphere from human activities (e.g. burning solid fuel, vehicle exhaust discharges, tyre and road surface wear and construction works) and natural events (e.g. sea salt from sea spray). Secondary particulate matter is formed in the atmosphere from precursor compounds (e.g. NH_3 emissions arising from agricultural activities).

In Ireland, research has shown that the dominant sources of particulate matter from human activities are solid fuels used in home heating, transport and agricultural activities that lead to the formation of secondary particulate matter (Ovadnevaite *et al.*, 2021). Peat is a significant contributor to particulate matter in our air (Ovadnevaite *et al.*, 2021). Moreover, EPA-funded research estimates that around 90% of sod turf comes from non-traded sources (informal markets, gifted or harvested from own land) as opposed to formal traded sources (supermarkets, garages or other companies that specialise in supplying fuel), meaning that significant air pollution will remain in some areas of the country, affecting householders and those in the locality (Eakins *et al.*, 2022). A range of policy measures is needed to encourage the transition away from using peat and other solid fuels towards more sustainable alternatives. An examination of the implementation of policy measures in other countries suggests that measures to tackle solid fuel use are most effective when implemented as a suite of supportive interventions (Eakins *et al.*, 2022).

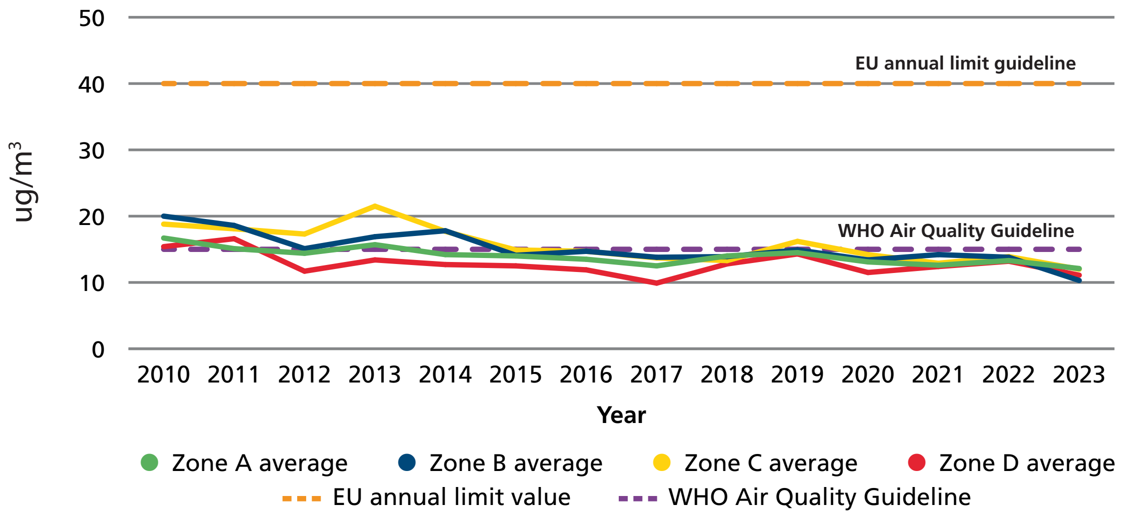
The annual average levels of $PM_{2.5}$ from 2010 to 2023 are displayed in Figure 2.12. Annual average levels in Ireland have remained below the EU annual limit value since 2010. However, they did not meet the 2021 WHO air quality guideline limits (5 µg/m³ in all zones). During winter, spikes of short duration occur across the monitoring network, particularly on still, cold evenings. These spikes can move the Air Quality Index for Health[6] at monitoring stations to a poor or very poor status, indicating the localised impacts of air pollution levels.

Figure 2.12 Annual mean levels of fine particulate matter ($PM_{2.5}$) 2010-2023 (µg/m³). Annual average levels across monitoring stations in zones A, B, C and D



6 The EPA's Air Quality Index for Health indicates the level of air quality being recorded at each monitoring station and what effect it might have on human health. The index provides a sliding scale from 1 to 10, where 10 indicates very poor air quality and 1-3 indicates good air quality.

Figure 2.13 Annual mean levels of particulate matter (PM_{10}), 2010-2023 (µg/m³). Annual average levels across monitoring stations in zones A, B, C and D

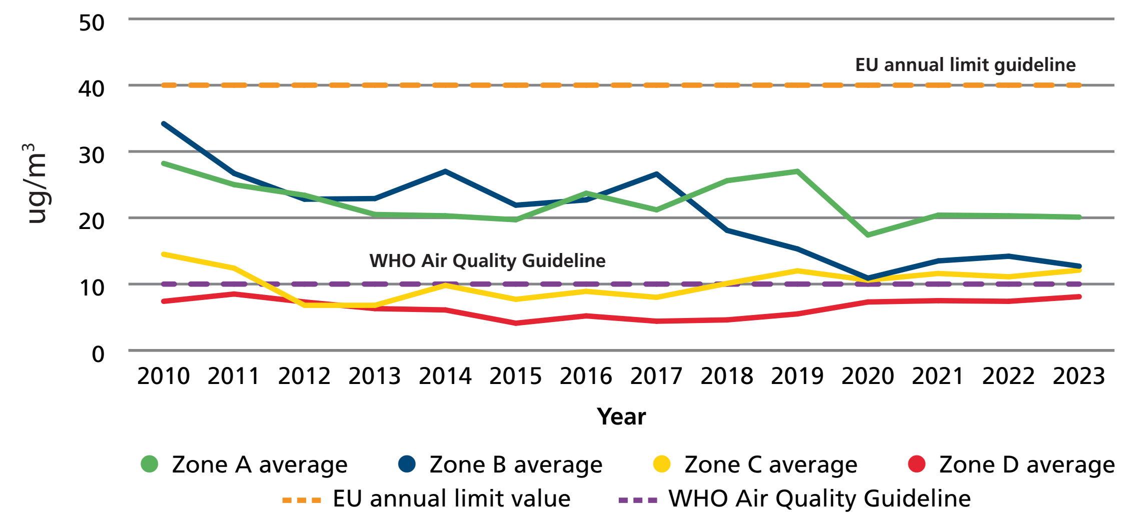


The annual average levels of PM_{10} in Ireland from 2010 to 2023 are illustrated in Figure 2.13. Annual averages are well within the EU annual limit value (40 µg/m³). There is an overall downwards trend in all zones. Since 2020, the annual averages for all zones have been below the 2021 WHO air quality guideline for PM_{10} (15 µg/m³).

Nitrogen dioxide

Measured annual average concentrations of NO_2 have decreased overall in zones A, B and C, while in zone D they have remained generally constant. During the COVID-19 pandemic, traffic volumes drastically reduced, with commensurate falls in the levels of NO_2 concentrations measured at traffic monitoring stations (EPA, 2021). Levels of NO_2 in our larger urban centres, zone A (Dublin) and zone B (Cork) have increased since COVID-19 restrictions were lifted. However, annual average levels of NO_2 in these zones have not moved back to their full pre-COVID levels. Figure 2.14 details the annual average concentrations of NO_2 across the country from 2010 to 2023.

Figure 2.14 Annual mean nitrogen dioxide (NO_2) concentrations, 2010-2023 (µg/m³). Annual average levels across monitoring stations in zones A, B, C and D



Recorded levels of NO_2 have generally been below the EU annual limit value of 40 µg/m^3. However, Ireland exceeded the annual limit for NO_2 in 2019 at the St. Johns Road West monitoring station in Dublin when the station measured an annual average concentration of 43 µg/m3 (EPA, 2020). Measures to combat this were set out in an air quality plan (DCC *et al.*, 2021) submitted to the European Commission in December 2021. There were no further exceedances in 2020, 2021, 2022 or 2023.

As transport emissions are one of the most significant elements that affects air quality in Ireland, the Urban Transport Related Air Pollution Working Group acts as a subgroup of the new Clean Air Strategic Implementation Group. It is a joint working group of DECC and the Department of Transport providing a forum for ongoing engagement among the key transport stakeholders. Actions such as the roll-out of no idling campaigns at schools, whereby drivers of all parked vehicles are requested to turn off their engines, should be progressed.

Annual NO_2 levels recorded at individual stations show that heavily trafficked cities and towns, i.e. Dublin (zone A), Cork (zone B) and large towns (zone C), would not meet the more stringent WHO air quality guideline limits for NO_2 (10 µg/m^3). Studies, including modelling conducted by the EPA (EPA, 2019, 2023a), have shown high indicative concentrations in locations in Dublin where the requirements of the directives on air quality do not apply, such as on the carriageway of the M50 and at major junctions, and also in areas not directly covered by the monitoring network. In partnership with Dublin City Council, the EPA is conducting further NO_2 tube studies in areas with the highest indicative concentrations.

Ozone

Ground-level O_3 is formed as a secondary pollutant when other air pollutants chemically react in the presence of strong sunlight. Elevated concentrations of ground-level O_3 can decrease lung function and also aggravate respiratory ailments in sensitive individuals such as those with asthma or a lung disease.

O_3 is readily transported to Ireland from Atlantic and European regions by the natural movement of air masses. O_3 concentrations tend to be highest in spring and summer and are a combination of transboundary O_3 and locally produced O_3. Concentrations of ground-level O_3 are reduced through its reaction with traffic-emitted pollutants; therefore, levels of O_3 are higher in rural areas than in urban areas.

O_3 concentrations in Ireland for the period 2008-2023, measured as 8-hour averages, show levels generally well below the maximum allowed number of exceedances per year (25 occurrences). In recent years, there have been short periods of time when O_3 levels were high. This has occurred after periods of hot and sunny weather, which facilitates the build-up and formation of O_3. Ground-level O_3 could become a problematic pollutant in Ireland during sustained hot and sunny weather conditions in the future. Of concern from a transboundary point of view are continental O_3 and particulate matter events, which occur most often during summer and spring, respectively.

Other air pollutants

The EPA monitors a range of other air pollutants. These include SO_2, CO, volatile organic compounds (benzene, toluene, ethylbenezene, m- and p-xylene and o-xylene), heavy metals (lead, arsenic, cadmium and nickel) and polycyclic aromatic hydrocarbons. Ireland meets the current EU limit values for these pollutants but is above the WHO air quality guideline limits for SO_2 and the EEA reference level for polycyclic aromatic hydrocarbons.

Impact of revision of ambient air quality directives

The updated WHO guideline limits (see Topic Box 2.1) are tighter than current EU legislation (EC, 2022). In particular, the annual average guideline limits for $PM_{2.5}$ have been halved (from 10 µg/m^3 to 5 µg/m^3) and for NO_2 have been reduced to a quarter of the previous level (from 40 µg/m^3 to 10 µg/m^3) (WHO, 2021). Table 2.3 identifies the number of national ambient air monitoring stations that, while meeting current EU levels, were above the WHO air quality guideline limits based on the data collected in 2023. Specifically, 80 out of the 101 stations monitored in 2023 for $PM_{2.5}$, the pollutant with the greatest impact on health, did not meet the WHO air quality guidelines. For NO_2 a similar picture was found, with 29 of the 36 stations monitored for this pollutant not meeting the WHO air quality guidelines. Similarly, WHO air quality guidelines were not met for PM_{10}, SO_2 and O_3. The revision of the ambient air quality directives moves EU limit values towards the tighter WHO air quality guidelines.

Table 2.3 Number of national ambient air monitoring stations recording levels above WHO air quality guideline limits in 2023

Pollutant	Number of stations where parameter was monitored in 2023	WHO Air Quality Guideline (AQG) level or EEA reference level[a]
Particulate matter (PM_{10})	106	Above annual WHO AQG value at 5 stations. Above daily WHO AQG value at 10 stations
Fine particulate matter ($PM_{2.5}$)	101	Above annual WHO AQG value at 79 stations. Above daily WHO AQG value at 80 stations
Nitrogen dioxide (NO_2)	36	Above annual WHO AQG value at 24 stations. Above daily WHO AQG value at 29 stations
Ozone (O_3)	23	Above Peak Season WHO AQG level at 6 stations. Above 8hr av. daily WHO AQG value at 18 stations
Sulphur dioxide (SO_2)	15	Above WHO 24 hour AQG level at 1 station

[a] stations with at least 50% data capture

Source: EPA, 2024b

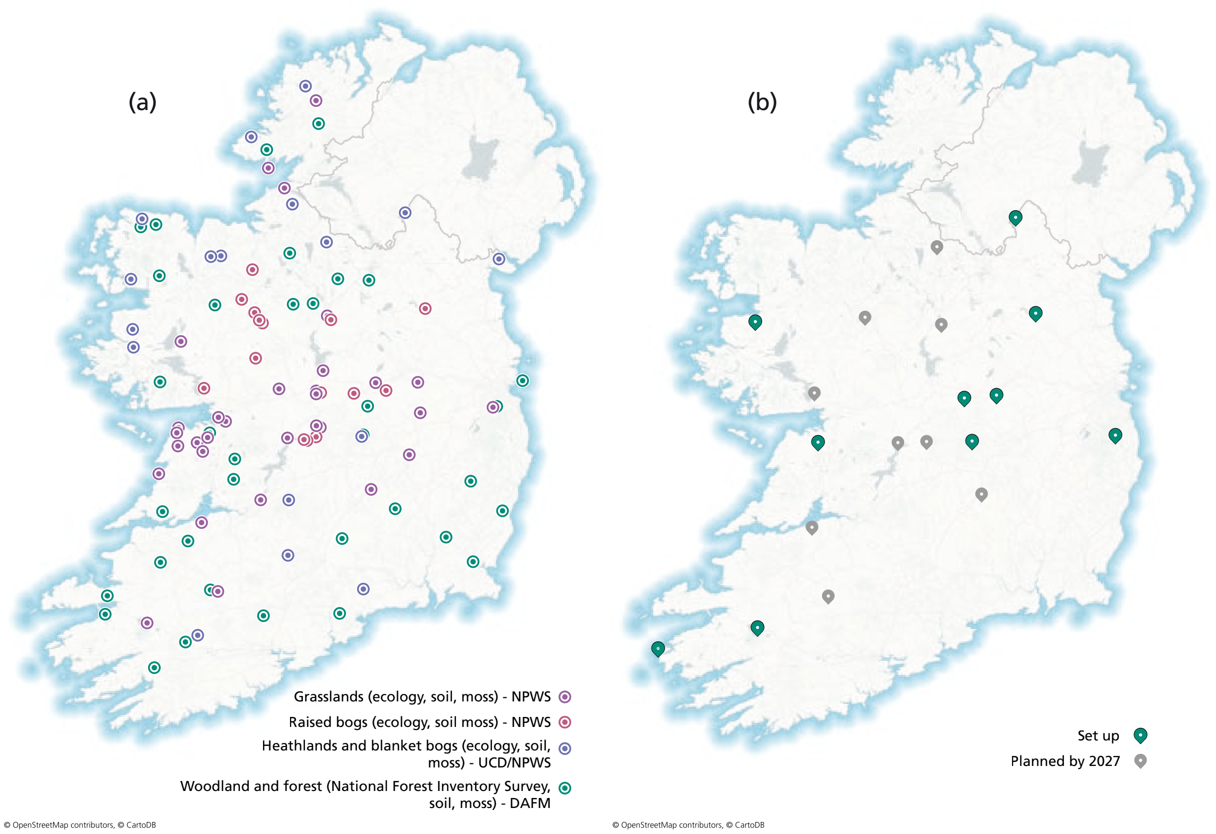
National Ecosystems Monitoring Network

Excessive deposition of reactive nitrogen can have negative impacts on terrestrial ecosystems, including biodiversity loss, through eutrophication and acidification (Maskell *et al.*, 2010; Payne *et al.*, 2017). While deposited reactive nitrogen is principally composed of NH_3 and ammonium from agriculture, it also includes NO_x. Even if Ireland succeeds in meeting its emission reduction commitments for NH_3 at a national level, high ambient NH_3 concentrations and deposited nitrogen are still likely to occur in certain locations.

A goal of the European Commission's Zero Pollution Action Plan is to reduce the size of the area of ecosystems at risk from nitrogen deposition by 25% by 2030. A recent report from the EEA highlighted that, while the size of the potentially affected area fell by 10% across Europe, it increased by 1% in Ireland in 2021 relative to 2005 (EEA, 2023c). This EEA report, modelling carried out on behalf of the EPA (Aherne *et al.*, 2021; Bealey *et al.*, 2024) and recent work measuring NH_3 at Natura 2000 sites (Kelleghan *et al.*, 2021) highlight that nitrogen deposition exceeds the level considered safe for many important sensitive habitats and species across Ireland.

The NEC Directive requires every Member State to monitor the impacts of air pollution on sensitive ecosystems within its territory. Ireland's response to this requirement has been to develop the National Ecosystems Monitoring Network (NEMN), which focuses on atmospheric NH_3 and other nitrogen-containing pollutants. The network is coordinated by the EPA and is reliant on input from various partners including the National Parks and Wildlife Service, Department of Agriculture, Food and the Marine and Met Éireann. The network consists of adapted botanical and forest surveys carried out by the National Parks and Wildlife Service and the Department of Agriculture, Food and the Marine across a variety of habitats including bogs, grasslands and woodlands (level 1 sites – see Figure 2.15a). These surveys are intended to determine any changes in the diversity of the plant communities in those habitats due to variations in atmospheric nitrogen deposition or NH_3 concentrations. The surveys are supplemented by atmospheric monitoring managed by the EPA on a smaller network of sites (level 2 sites – see Figure 2.15b), which are a subset of the level 1 network. Air quality monitoring for NH_3 is currently carried out at ten of these sites and it is anticipated that this will increase to approximately 19 sites by 2027.

Figure 2.15 National Ecosystems Monitoring Network, 2021-2022. (a) Level 1 sites: ecological, moss and soil monitoring (b) Level 2 sites: atmospheric and lake monitoring



There are plans to install wet deposition monitoring samplers at selected sites on a phased basis. Figure 2.16 shows a typical planned site set-up. The NEMN also utilises water quality monitoring carried out on upland lakes by the EPA, which is also reported under the United Nations Economic Commission for Europe International Cooperative Programme[7] on the assessment and monitoring of the effects of air pollution on rivers and lakes.

Figure 2.16 Example of a National Ecosystems Monitoring Network atmospheric level 2 site

7 www.unece.org/modelling-and-mapping (accessed 28 May 2024).

Every 4 years, Member States submit data collected from their respective networks to the European Commission. Ireland's first submission in 2019 was heavily reliant on historical data collected on the International Cooperative Programme's forest sites. Since 2020, the NEMN has undergone substantial development, with effects monitoring carried out through ecological surveys at raised bogs, heathlands and grasslands. The network has grown from 44 predominantly forestry sites to a network of 130 sites encompassing a number of sensitive habitats. The data collected feed into reporting at a European level through the EEA. Ireland's latest data submission, made in 2023, is available on the EEA website.[8]

All data collected from the NEMN will provide evidence on atmospheric nitrogen and NH_3 emissions and their impacts on sensitive habitats, while also contributing to an improved understanding of effects at a European scale through links with the International Cooperative Programme (ICP) on Modelling and Mapping[9]. While some of the NEMN sites are located on previous ICP Forests[10] sites, many terrestrial sites have not previously been monitored for species variety and abundance and air quality. Consequently, the data from the surveys undertaken since 2021 will serve as a baseline for future surveys against which impacts and recovery of habitats can be monitored. Ireland's NEMN will also contribute to developing the wider EU monitoring network, improving our understanding of air pollution impacts on ecosystems across Europe.

5. National air quality policy

Clean Air Strategy

The government launched Ireland's first Clean Air Strategy in 2023 (DECC, 2023). It includes an ambition to achieve full alignment with WHO air quality guideline limits by 2040 and its interim targets by 2026 and 2030 (interim targets 3 and 4, respectively; see Topic Box 2.1).

The strategy sets out measures and actions to support continuous improvements in air quality. These relate, for example, to parameters such as SO_2, particulate matter (e.g. actions on solid fuel regulations, enforcement, communication), NO_2 (e.g. transport actions) and NH_3 (e.g. agriculture actions). The strategy has a focus on improving enforcement, particularly of the Solid Fuels Regulations (S.I. No. 529/2022). It also seeks to increase the evidence around how to address air quality issues and to ensure the integration of clean air considerations into policy development across government. To provide the necessary governance to support and monitor implementation of the strategy, DECC set out that it would establish and lead the Clean Air Strategic Implementation Group and the Strategic Clean Air Communications Group.

The Clean Air Strategy also proposes additional citizen engagement that builds on the successful GLOBE and Clean Air Together[11] projects, developed by the EPA and the Environmental Education Unit of An Taisce in recent years.

Ireland is not currently meeting the WHO air quality guideline limits at a national level. A roadmap of concrete actions is required to achieve the targets and deliver on the ambition of the Clean Air Strategy, including achieving the interim targets. Full and timely implementation of the framework measures will be of substantial benefit to the overall achievement of cleaner air.

Dublin Air Quality Plan

In 2019, the St. John's Road West monitoring station in Dublin measured an annual average concentration of 43 μg/m^3 for NO_2 (EPA, 2020). The four Dublin local authorities prepared an air quality plan, submitted to the European Commission in December 2021, to address the exceedance of the EU annual limit value (DCC *et al.*, 2021). To achieve compliance with the limit value for NO_2, 14 measures were included in the air quality plan. While there have been no exceedances in the intervening years, full implementation of the plan by the local authorities is necessary to maintain compliance with the air limit value for NO_2. Updates on the 14 measures are reported each year to the European Commission.

Solid Fuels Regulations

In 2022, the new Solid Fuels Regulations for Ireland (S.I. No. 529/2022) set out additional restrictions on the retail, online and commercial sale of smoky fuels, including smoky coal, turf and wet wood, to protect and improve air quality. The sale and distribution of solid fuels that are not approved under the regulations was prohibited. The regulations set national minimum technical standards

8 www.cdr.eionet.europa.eu/ie/eu/nec_revised/monitoring/envzj3asw/ (accessed 28 May 2024).

9 International Cooperative Programme on Modelling and Mapping of Critical Levels and Loads and Air Pollution Effects, Risks and Trends: www.unece.org/modelling-and-mapping

10 International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests: www.unece.org/environmental-policy/air/forests

11 www.epa.ie/take-action/in-the-community/citizen-science/clean-air-projects/#d.en.84492

for residential solid fuels to allow only products with low smoke emissions to be sold. These changes limit the smoke emission rate and the permitted moisture and sulphur content of fuels, leading to lower particulate matter and SO_2 emissions when burned. Overall, these measures reduce emissions and positively influence air quality. Ten local authorities participated in a pilot project, funded by DECC, on implementing the Solid Fuels Regulations. This funding allowed the local authorities to raise awareness, monitor local air quality and test solid fuels offered for sale in the marketplace. Inspections by local authorities following the introduction of the new regulations showed that the overall compliance rates among the fuel merchants and retailers inspected was high (EPA, 2023b). Concerningly, however, sulphur sampling results from the fuels tested confirmed that a small percentage of non-compliant coal products was sold on the Irish market. The *Focus on Local Authority Environmental Enforcement – Performance Report 2022* (EPA, 2023b) highlighted areas where further action is required by local authorities to ensure that only approved solid fuels are available for sale to reduce air pollution from the combustion of solid fuels for home heating.

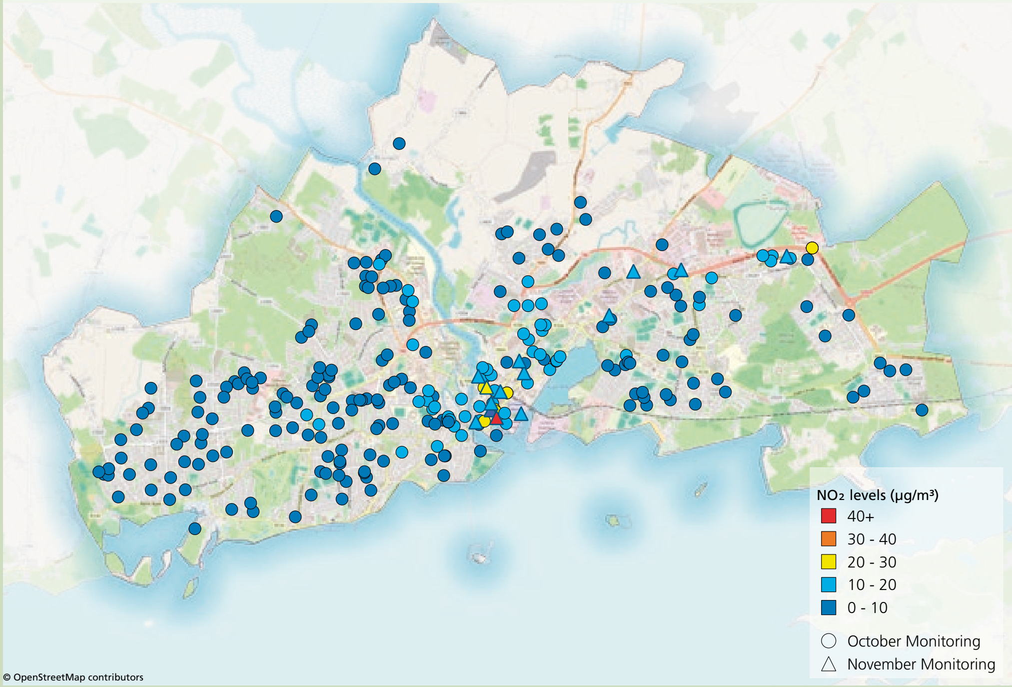
Topic Box 2.3 Clean Air Together – Dublin, Cork and Galway

Clean Air Together is a citizen science project led by the EPA in partnership with the Environmental Education Unit of An Taisce and local authorities. Participants measure levels of the traffic pollutant NO_2 near their home, business or school. The project has four main objectives:

1. increase public knowledge and engagement with the topic of air pollution
2. provide data that will help validate EPA air quality models
3. assess the impacts of citizen-based air quality monitoring on awareness, attitudes and the potential to lead to behaviour change
4. inform policy by working in partnership with stakeholders.

Following the success of Clean Air Together in Dublin and Cork cities, the large-scale citizen-based air pollution monitoring project moved to Galway city in 2023. Figure 2.17 shows monitoring results for Galway. In 2024, Clean Air Together moves to Limerick city – more information is available on www.cleanairtogether.ie.

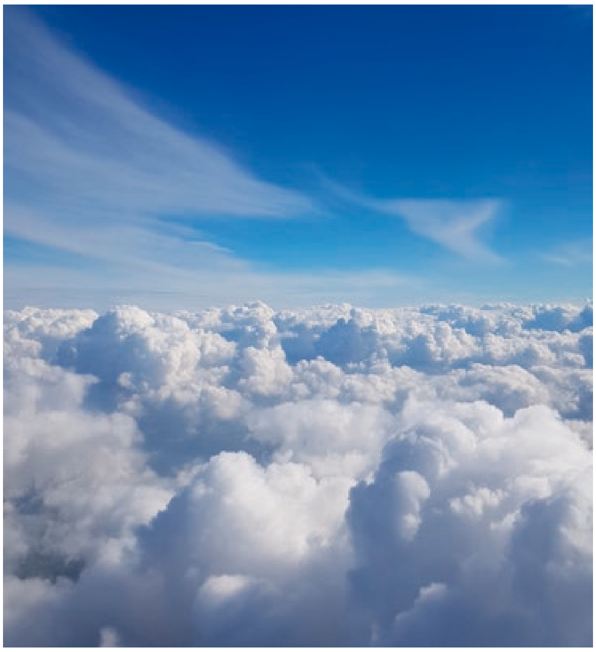
Figure 2.17 Map of results for Clean Air Together, Galway



Research

Ireland has a vibrant environmental research community, including internationally recognised centres for atmospheric research. Significant funders of such research include the EPA, Sustainable Energy Authority of Ireland, Science Foundation Ireland, the Irish Research Council, the Department of Transport, and the Department of Agriculture, Food and the Marine. Communicating the findings and recommendations of such research to as wide an audience as possible, and to the relevant policymakers, is one of its most important outcomes, as it ensures that policy development is based on the most up-to-date evidence. To achieve this, the Air Quality Unit of DECC has established a Clean Air Research Forum, which brings together researchers, policymakers and other key stakeholders to share information and results and to discuss knowledge gaps and future research priorities. There is a broad range of published and ongoing air quality research. Ongoing research includes EPA-funded projects on the sources of air pollutants including ports (the PortAIR project), railways (the STATION-AIR project) and agriculture (the IMAGE project).

Recently published projects include Irish research on the knowledge, attitudes and perception of air pollution in Ireland (Kelly and Quintyne, 2023) and sources of air pollution in Ireland (Ovadnevaite *et al.*, 2021). There is also a growing volume of Irish research on the assessment of the health impacts of air pollution (Byrne *et al.*, 2020; Ó Domhnaill *et al.*, 2022; ESRI, 2023, 2024; Lyons *et al.*, 2024). The health impacts of air pollution are further discussed in Chapter 14.



6. Conclusions

Health and air quality

There is no safe level of air pollution, as reflected in the 2021 revision of the WHO air quality guidelines, which substantially tightened guideline limits for $PM_{2.5}$ and NO_2. Ireland's Clean Air Strategy ambition is to move towards meeting these air quality guideline limits by 2040. The review of the Cleaner Air for Europe Directive will set a similar trajectory towards compliance with WHO guidelines at EU level.

While the positive impact on health would be significant, achieving the WHO interim and final guideline limits will be challenging, and the scale of the challenge has been highlighted in recent EPA air quality reports. Key to achieving this ambition will be implementing the Clean Air Strategy, the Dublin Air Quality Plan and related actions from the Climate Action Plan (DECC, 2024).

Action on air quality

Air quality can be improved by changing our behaviour, individually and collectively, so that we burn fewer fossil fuels to heat our homes and businesses and fuel our vehicles. Protecting health will require the engagement of the public to support and implement actions that achieve this reduction in fossil fuel use.

Ammonia emissions

NH_3 emissions from agriculture have a negative impact on sensitive plant and animal species. NH_3 is also responsible for the formation of secondary $PM_{2.5}$ during the atmospheric transport of NH_3. National emissions are currently breaching Ireland's emission targets. Implementing all currently planned actions will be needed to reduce the emissions of this pollutant to meet Ireland's international commitments.

Expanding the evidence base

There has been an extensive expansion in the monitoring of air pollutants in Ireland. The number of stations has increased from 29 in 2017 to the current 115 station network. Air quality information from the expanded network, supplemented by hourly modelled maps, is updated hourly and available on www.epa.ie and www.airquality.ie. A forecast, predicting air quality for today, tomorrow and the day after tomorrow, has also been available on www.epa.ie and www.airquality.ie since November 2023. The forecast enables members of the public to make informed decisions about their planned activities. $PM_{2.5}$, NO_2 and NH_3 continue to be our pollutants of concern.

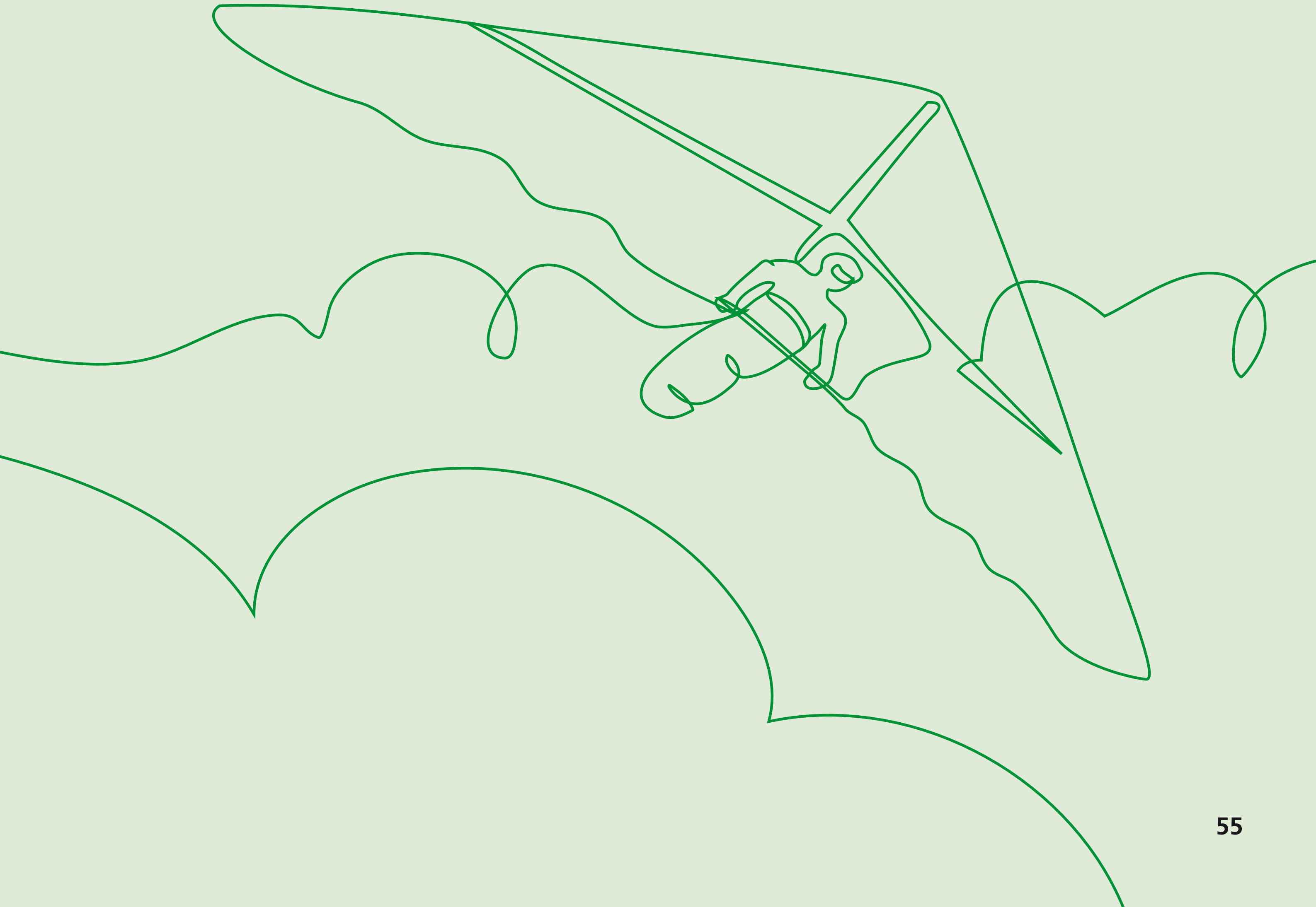
Key chapter messages

1. While air pollution has reduced over recent decades, our understanding of the level at which it impacts health has grown. The World Health Organization (WHO) says that there is no safe level of air pollution.

2. Currently, Ireland is not meeting the guidelines set by WHO for multiple pollutants including fine particulate matter and nitrogen dioxide. We can actively improve our local air quality by changing to more sustainable forms of transport and heating.

3. Achieving Ireland's ambition, set out in the Clean Air Strategy, to move towards meeting the health-based WHO air quality guideline limits will be challenging but will have a significant and positive impact on health. A road map of actions is required to deliver on the overall ambition and the 2026 and 2030 interim targets.

4. Ireland is non-compliant with the EU reduction target for ammonia and will remain so in the short term. Meeting the 2030 emission reduction commitment is dependent on fully executing all known ammonia abatement measures at the farm level.



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Chapter 3: Environmental Noise

Environmental Noise

1. Introduction

Environmental noise is unwanted or harmful outdoor sound arising from all areas of human activity. Although noise is a product of many human activities, including neighbourhood, industrial, commercial and entertainment activities, the most widespread sources of noise pollution and exposure in Ireland are various forms of transport.

Reducing noise pollution is an ambition of the European Union (EU) Zero Pollution Action Plan (EC, 2021) and the Environmental Noise Directive (END) (2002/49/EC). Environmental noise has become a significant environmental health concern for European citizens and policymakers (EC, 2023), although in Ireland noise is often regarded as the forgotten pollutant (King and Murphy, 2016). The data from a recent noise mapping exercise in Ireland indicate that noise exposure from transport sources requires further investigation and follow-up action through local authority noise action plans, as over 1 million people are exposed to noise levels above the reporting thresholds set in the END.

The human ear hears sound pressures over a wide range of frequencies. Measurements in decibels (dB) correspond to the way our ears interpret sound pressures and are given on a logarithmic scale (Figure 3.1).

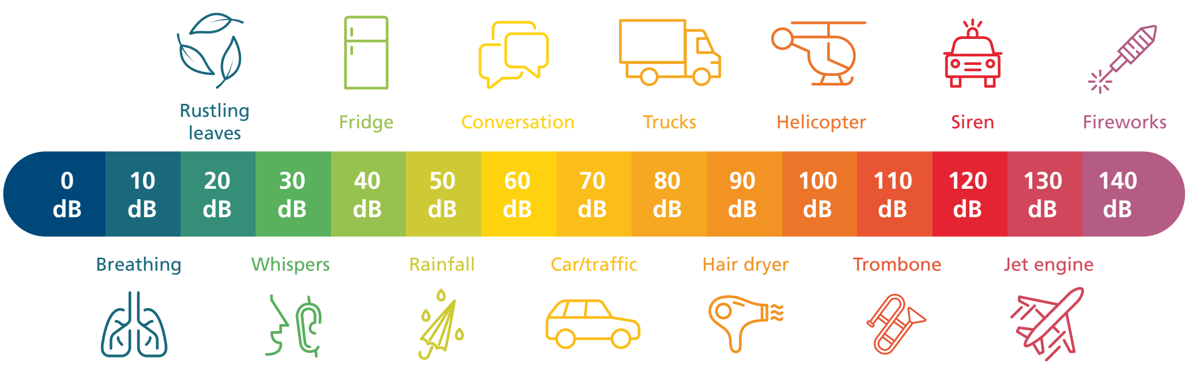
The EU's END mandatory noise level reporting thresholds are 55 dB L_{den} and 50 dB L_{night}:

- L_{den} is the day-evening-night long-term average noise indicator. It is 'weighted' to account for extra annoyance in the evening and during night-time periods.
- L_{night} is the night-time long-term average noise indicator and is used in the assessment of sleep disturbance.

These indicators are based on year-long averages for the day-time (07:00-19:00), evening (19:00-23:00) and night-time (23:00-07:00) periods.

Under EU legislation, Ireland must produce strategic noise maps every 5 years. The fourth round of noise mapping is the most recent undertaken (round 4). The maps cover major roads, major railways, one major airport (Dublin Airport) and the cities of Dublin, Cork and Limerick (i.e. agglomerations of more than 100,000 inhabitants).

Figure 3.1 Human auditory range



Source: Adapted from Nuheara[1]

1 www.nuheara.com/usa/news/human-hearing-frequency-range/ (Accessed 26 September 2024).

2. Impacts of environmental noise

Harmful effects of environmental noise

Research shows that at least one in five people in the EU is exposed to long-term noise levels considered harmful to their health. Health issues related to these exposures include annoyance, sleep disturbance, cardiovascular and metabolic issues (EEA, 2023a). There is also evidence of an association between transport noise and cognitive impairment in children (EEA, 2023a).

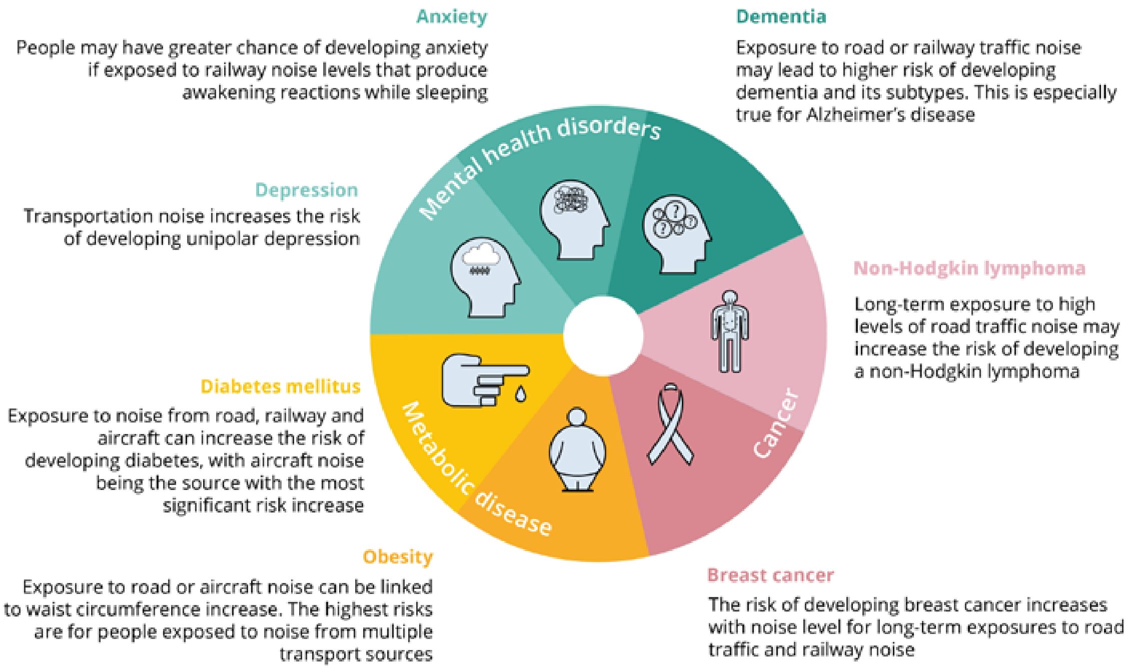
Long-term exposure to environmental noise is an important public health issue (Figure 3.2). Across the EU, the most recent collated data show that 22 million people suffer chronic high levels of annoyance, 12,500 schoolchildren suffer learning impairment in school caused by aircraft noise, and 12,000 premature deaths are caused by long-term exposure to environmental noise (EC, 2023). People in urban areas are the most affected, particularly by road traffic noise (EEA, 2023a). The European Environment Agency (EEA) is planning to provide an updated assessment of strategic noise mapping across Europe in late 2024.

The World Health Organization (WHO) has established that excessive noise, particularly from transport sources, has negative impacts on health and wellbeing. WHO guidelines show that environmental noise affects sleep and cardiovascular and metabolic functions (WHO, 2018).

Other impacts of environmental noise

Anthropogenic noise remains a pressure on marine mammals and other wildlife (see Chapter 9) as reported by OSPAR, the government and EU body that works to protect the marine environment in the North-East Atlantic (OSPAR, 2023). Its latest assessment has prompted OSPAR to commit to developing a regional action plan to reduce marine noise. The EEA also reports that noise pollution can affect wildlife, causing various physical and behavioural issues in animals and increasing their levels of stress (EEA, 2023b).

Figure 3.2 Growing evidence of the health impacts of environmental noise



Source: EEA, 2022a

3. Assessment of environmental noise from transport sources in Ireland

Strategic noise mapping

The EU END deals with environmental noise from major transport infrastructure including roads, railways and airports. The directive sets out a two-stage process for addressing environmental noise by requiring Member States to:

- establish the scale of the noise problem by preparing 'strategic noise maps' for major roads, railways, airports, agglomerations and industries
- develop noise action plans to reduce the level of noise where necessary and to maintain environmental noise quality where it is good.

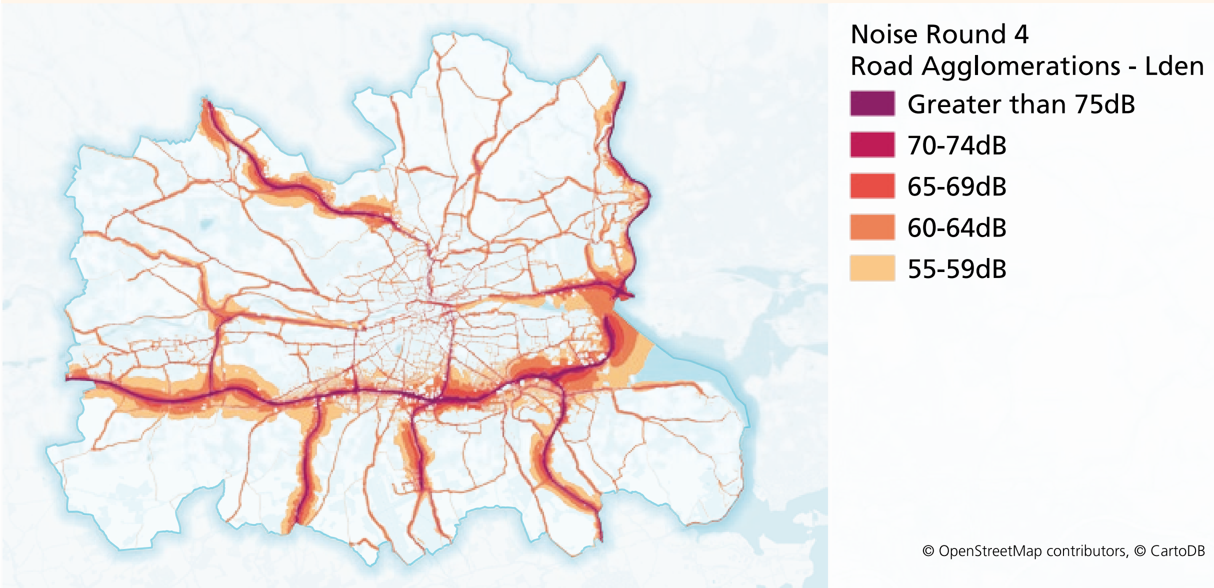
Strategic noise maps show noise exposure levels in terms of two noise indicators, L_{den} and L_{night}. Mapping is not undertaken across the whole of each Member State but within designated major cities, in the vicinity of major road and rail transport corridors, and around major airports. The thresholds that apply to the noise mapping are:

- major roads – more than 3 million vehicle passages per year
- major railways – more than 30,000 train passages per year
- major airports – more than 50,000 air movements per year
- major cities – in excess of 100,000 population, which in Ireland includes Dublin, Cork and Limerick.

Strategic noise maps are prepared using computer modelling techniques that use various types of source data to estimate noise levels, including traffic flow, types of road and rail, types of vehicles and vehicle speeds. As the designated national authority for the purposes of noise regulations (S.I. No. 549/2018 and S.I. No. 663/2021), the Environmental Protection Agency (EPA) has responsibility for overseeing their implementation. Responsibility for the preparation of the strategic noise maps lies with the designated noise mapping bodies. These include Transport Infrastructure Ireland (TII), the various local authorities, Iarnród Éireann-Irish Rail and Dublin Airport Authority.

Presenting information on strategic noise maps increases public awareness of noise exposure and provides data for the identification of priority areas for noise action plans. Round 4 strategic noise mapping uses 2021 data as the representative year. The maps can be viewed on the EPA Maps section of the EPA website.[2] An example for Cork is shown in Figure 3.3.

Figure 3.3 Illustrative strategic noise map (L_{den}) for Cork city agglomeration using data from the environmental noise maps, available on gis.epa.ie/EPAMaps/ (June 2024)



2 gis.epa.ie (accessed 20 July 2024).

Environmental noise and exposure modelling data for major transport sources

In Ireland, road traffic, particularly inside urban areas, is the predominant source of transport noise (EEA, 2021a). Results from round 4 noise mapping indicate that approximately 41% of the total population living in the three urban areas of Dublin, Cork and Limerick were exposed to noise levels above the END mandatory reporting threshold of ≥ 55 dB L_{den} from road traffic noise, while the preliminary data would suggest that approximately 53% were exposed to road traffic noise above the 53 dB L_{den} WHO guideline level. Of those people living outside these areas, approximately 22% of the total population living in the mapped areas were exposed to a noise level of ≥ 55 dB L_{den} (the END reporting threshold) from road transport noise.

In noise modelling for round 4 mapping, the estimated number of people in the areas modelled exposed to noise levels above the mandatory reporting thresholds for road traffic set in the EU regulations was just over 1.03million (L_{den}). This figure is comprised of approximately 690,000 people for all roads in the three urban areas listed above and approximately an additional 343,000 in major roads elsewhere nationwide. In Ireland, an estimated 1,326,000 people are exposed to road traffic noise from major roads above the WHO guidance levels of 53dB $L_{den.}$ This preliminary data includes 885,000 people in Cork, Dublin and Limerick and an additional 441,000 people outside these cities. Table 3.1 shows the numbers of people exposed to road traffic at the different noise level bands, as modelled for Dublin, Cork and Limerick (L_{den}).

Table 3.1 Number of people in dwellings in Cork, Dublin and Limerick exposed to road traffic noise – L_{den}

	Cork		Dublin		Limerick	
Noise level (dB) L_{den}	**All roads (No. people)**	**Major roads (No. people)**	**All roads (No. people)**	**Major roads (No. people)**	**All roads (No. people)**	**Major roads (No. people)**
53-54	23,300	13,400	160,000	88,900	11,400	8300
55-59	50,200	22,900	287,400	151,000	24,500	13,600
60-64	32,800	10,900	160,500	78,800	13,100	5000
65-69	10,400	5800	78,700	53,600	4700	2800
70-74	1700	1600	23,100	20,700	600	600
≥ 75	300	300	2500	2400	0	0
Total number of people exposed to noise above 55[a]	95,400	41,500	552,200	306,500	42,900	22,000
Total number of people exposed to noise above 53[b]	118,700	54,900	712,200	395,400	54,300	30,300
Total population	**219,287**	**219,287**	**1,355,968**	**1,355,968**	**101,029**	**101,029**
Proportion (above 55)[a]	**44%**	**19%**	**41%**	**23%**	**42%**	**22%**
Proportion (above 53)[b]	**54%**	**25%**	**53%**	**29%**	**54%**	**30%**

Note: Exposure statistics rounded to the nearest 100.

[a] EU reporting threshold (END).

[b] WHO guideline level (as road traffic noise above 53 dB L_{den} can be associated with adverse health effects).

When noise modelling data for round 4 mapping using the END threshold are compared with data using the threshold in the WHO *Environmental Noise Guidelines for the European Region* (WHO, 2018), the preliminary results show that the proportion of people exposed is higher using the WHO guideline level, as shown in Table 3.1. For the major rail and major airport areas that were also modelled, the numbers of people exposed to noise levels above the L_{den} mandatory reporting thresholds were approximately 82,600 and 13,400, respectively.[3]

L_{night} figures are given in Table 3.2 for comparison with Table 3.1. Figure 3.4 is an illustrative map showing population exposure to road traffic noise at night for Limerick city (L_{night}).

Table 3.2 Number of people in dwellings in Cork, Dublin and Limerick exposed to road traffic noise – L_{night}

	Cork		Dublin		Limerick	
Noise level (dB) L_{night}	**All roads (No. people)**	**Major roads (No. people)**	**All roads (No. people)**	**Major roads (No. people)**	**All roads (No. people)**	**Major roads (No. people)**
45-49	49,200	25,600	301,500	186,600	22,600	16,200
50-54	20,800	12,400	169,200	104,800	10,000	7200
55-59	5400	4400	78,400	54,700	800	700
60-64	1900	1900	33,000	29,000	400	400
65-69	400	400	6300	6200	100	100
≥ 70	0	0	400	400	0	0
Total number of people exposed to noise above 50[a]	28,500	19,100	287,300	195,100	11,300	8400
Total number of people exposed to noise above 45[b]	77,700	44,700	588,800	381,700	33,900	24,600
Total population	**219,287**	**219,287**	**1,355,968**	**1,355,968**	**101,029**	**101,029**
Proportion (above 50)[a]	**13%**	**9%**	**21%**	**14%**	**11%**	**8%**
Proportion (above 45)[b]	**35%**	**20%**	**43%**	**28%**	**34%**	**24%**

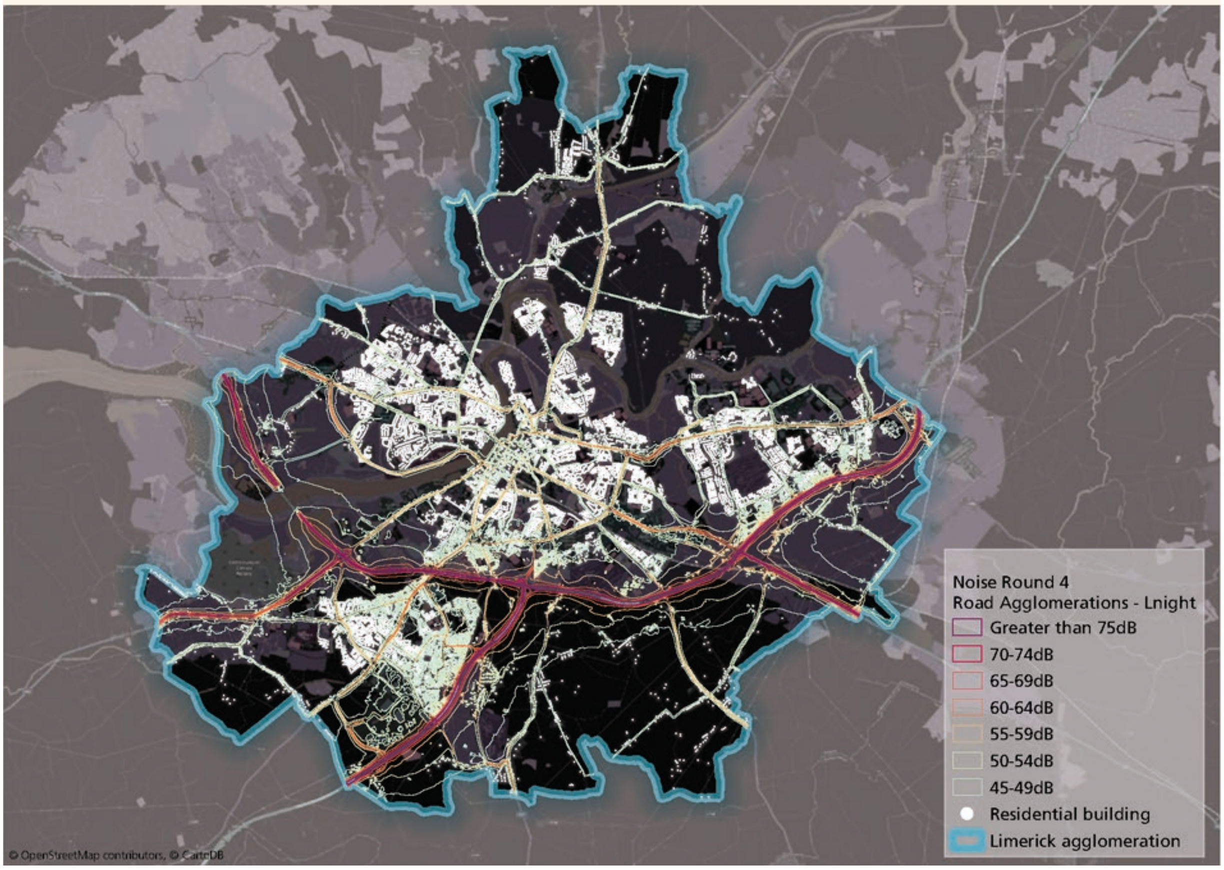
Note: Exposure statistics rounded to the nearest 100.

[a] EU reporting threshold (END).

[b] WHO guideline level (as night-time road traffic noise above 45 dB L_{night} can be associated with adverse effects on sleep).

3 Noise modelling for round 4 mapping used 2021 data (per the requirements of the END), when there were 8.5 million passengers using Dublin Airport, while in 2023 there were 32 million passengers using the airport. This was due to the removal of COVID-19 restrictions and the opening of the new north runway.

Figure 3.4 Illustrative population exposure to road traffic noise at night (L_{night}) for Limerick city agglomeration using data from the environmental noise maps, available on gis.epa.ie/EPAMaps/ (June 2024)



Assessment of harmful effects from transport noise

Annex III of the END describes the methods for assessing the harmful effects caused by long-term exposure to specific noise sources. The methods include dose-effect relationships for a set of health end points such as cardiovascular disease, annoyance and sleep disturbance. These dose-effect relationships in the revised Annex III are based on a scientific review of the health effects, as contained in the WHO *Environmental Noise Guidelines for the European Region*. In 2021, Ireland transposed the revised Directive (EU) 2020/367, which amended Annex III to the END, through the Environmental Communities (Environmental Noise) (Amendment) Regulations 2021 (S.I. No. 663/2021).

Preliminary data from the Annex III assessment, available for round 4 noise action plans, provide statistical information on the effects of exposure to the harmful effects of environmental noise on representative populations. The harmful effects that were assessed and reported on were the:

- number of people who were highly annoyed by noise from roads, railways and aircraft
- number of people who were highly sleep disturbed by noise from roads, railways and aircraft
- incidence of ischaemic heart disease caused by exposure to noise from roads.

When combined with the statistical analysis of harmful effects, the preliminary mapping results categorised around 8% of the urban populations in Dublin, Cork and Limerick as highly annoyed due to their exposure to road traffic noise and approximately 2% as highly sleep disturbed (Table 3.3). Within the areas mapped alongside major roads outside the agglomerations, approximately 4.6% of the population were highly annoyed and an estimated 1.4% were highly sleep disturbed.

Table 3.3 Number and proportion of the population estimated to be at risk of harmful effects from exposure to road traffic noise in Cork, Dublin and Limerick (preliminary results)

Harmful effect	Cork				Dublin				Limerick			
	All roads		Major roads		All roads		Major roads		All roads		Major roads	
	No. people[b]	%	No. people[b]	%	No. people[b]	%	No. people[b]	%	No. people[b]	%	No. people[b]	%
Highly Annoyed[a]	17,724	8.08	8,200	3.74	108,380	7.99	62,765	4.63	7,916	7.84	4,331	4.29
Highly Sleep Disturbed[a]	3,382	1.54	2,075	0.95	28,996	2.14	19,636	1.45	1,387	1.37	1,022	1.01
Ischaemic Heart Disease	17	0.01	8	0.00	101	0.01	61	0.00	7	0.01	4	0.00
Total Population	**219,287**		**219,287**		**1,355,968**		**1,355,968**		**101,029**		**101,029**	

[a] Based on WHO guidelines including statistical analysis of noise level bands, in which the noise levels above which health effects begin to occur are > 53 dB L_{den} for highly annoyed and > 45 dB L_{night} for highly sleep disturbed.

[b] For No. people, the numbers are rounded to whole numbers.

Improvements in round 4 noise mapping and action planning

While a lot remains to be done to tackle environmental noise, as set out later in this chapter, there have been considerable advances in mapping noise, and determining priority areas, following recommendations made in the previous State of the Environment Report (EPA, 2020) and EPA research projects.

This fourth round of noise mapping has seen many improvements:

- incorporation of the CNOSSOS-EU methodology, including a standardised approach for population exposure estimation[4]
- revision of the extent of agglomerations (Dublin, Cork and Limerick)
- industrial noise assessments included in agglomerations
- all roads within the agglomerations are now modelled
- a more centralised mapping process.

The fourth round of action planning has also delivered many improvements:

- revision of the priority matrix to include a harmful effects assessment using WHO thresholds and links to the EU Zero Pollution Action Plan
- a recommended approach for local authorities to follow when determining actions throughout the noise action planning cycle
- a more centralised and consistent noise action planning process at local authority level.

Noise action plans

Following the preparation of strategic noise maps, designated action planning authorities, i.e. the relevant local authorities, are required to consult with the noise mapping bodies, the EPA and the public in the preparation of their noise action plans. The primary objective of these action plans is to avoid, prevent or reduce on a prioritised basis the harmful effects, including annoyance, of exposure to environmental noise. Furthermore, the plans must also seek to identify and maintain areas where environmental noise quality is good. Public consultations on the draft noise action plans were underway or just completed for many of the draft plans at the time of writing (August 2024).

4 The new EU common noise assessment method (CNOSSOS-EU) used in round 4 noise mapping calculates noise emissions, propagation and residential population exposure differently from the methods used in previous rounds. As a result, round 4 strategic noise maps are not directly comparable with maps generated under rounds 1-3.

The development of these noise action plans provides an opportunity for sections within a local authority to work collaboratively with other departments, particularly where synergies exist with issues such as road maintenance and traffic management, to get the most out of existing projects, in addition to considering noise measures in their own right.

Noise action plan guidance

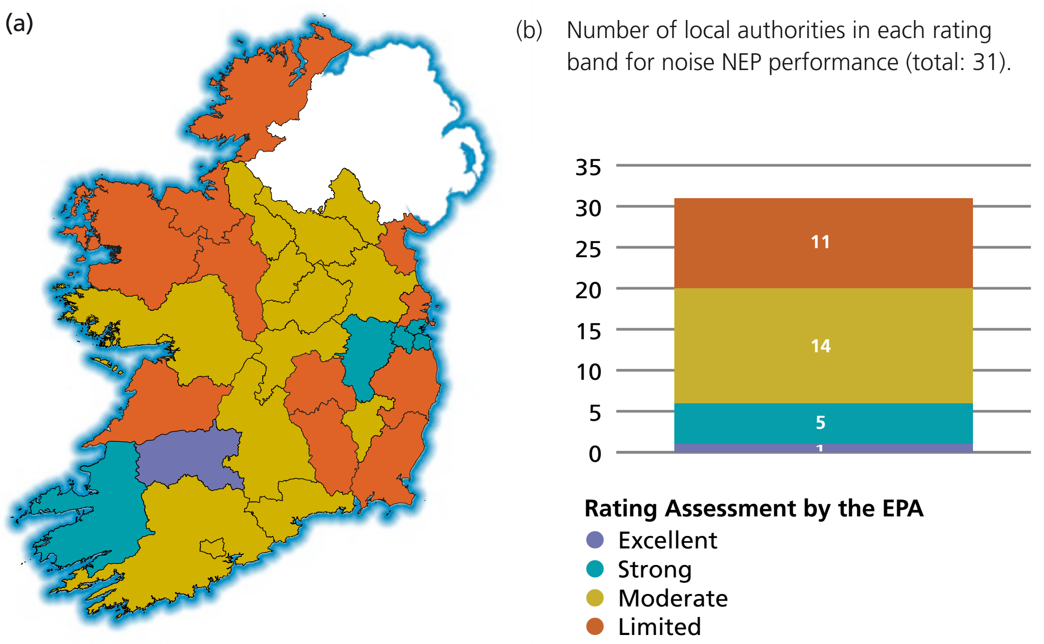
New EPA draft noise action planning guidance recommends that the action planning authorities (i.e. local authorities) consider several aspects in selecting priority important areas (PIAs), including a history of noise complaints. These locations are identified by a local authority as areas to be assessed during the implementation of their noise action plan. The guidance also recommends that the development of noise action plans is undertaken through a collaborative local authority working group that includes team members from various departments who have knowledge of noise and complaints. Organisations with responsibilities for roads, including TII, should be involved in the PIA selection process.

Noise action plan progress reports

Local authorities are required to report annual progress on their noise action plans to the EPA under the European Communities (Environmental Noise) Regulations (S.I. No. 549/2018). END compliance is assessed as a national enforcement priority (NEP) under the ‘air and noise’ thematic area in the EPA Local Authority Environmental Enforcement Performance Framework.[5] The EPA’s evaluation of performance in relation to noise is based on information contained in each local authority’s noise action plan progress report.

Each local authority is required to set out the steps that have been taken to prevent, protect against and reduce excessive environmental noise, as identified in their noise action plan. The plans are assessed by the EPA regarding the effectiveness of plan implementation and associated actions (Figure 3.5). In 2022, only 19% of local authorities achieved the required standard in this NEP, compared with 33% in 2021 (EPA, 2023a). Noise was the lowest performing enforcement priority across the entire performance framework.

Figure 3.5 (a) Summary assessment of the 2022 noise action plan progress reports covering round 3 and (b) Summary assessment of END compliance in 2022 showing the number of local authorities in each rating band for noise NEP performance.



Source: EPA, 2024

5 Local authority performance is evaluated by the EPA against the NEPs, which are focused on achieving environmental outcomes. The NEPs fall under four themes: governance processes, waste, water, and air and noise. There are 20 NEPs in total with five in each of the four thematic areas.

The EPA summary noise action plan progress report for 2022 (EPA, 2024) relates to round 3 plans. It demonstrates that, in many cases, local authority reports did not outline any specific actions that were implemented in 2022. Where progress was reported by local authorities, such as Limerick (excellent) and Dublin (strong), action mainly related to the use of low-noise road surfaces (such as stone mastic asphalt during pavement rehabilitation), traffic calming measures to reduce speeds, noise monitoring at residential locations, or identifying quiet areas – an important aspect of the END aimed at providing spaces away from noise pollution. However, most local authorities show only moderate or limited progress. Figure 3.6 shows an example of noise mitigation for roads.

Figure 3.6 Lower noise road surface using stone mastic asphalt (left) and traditional coarse road surface using hot-rolled asphalt (right) on the M4 near Kilcock, Co. Kildare.

Credit: John O'Neill, Kildare Co. Co.

Noise research

The EPA-funded research project, Noise-Adapt (Murphy *et al.*, 2021), provided a transitional needs assessment and guidance for adapting common noise assessment methods in Europe (CNOSSOS-EU) to the Irish context for road and rail sources. It was used by the EPA in generating draft technical guidance and round 4 mapping guidance for the noise mapping bodies.

Another EPA-funded research project, Noise-Health Ireland (Murphy *et al.*, 2022), assessed the relationship between environmental noise and health in a national and international context. The project identified some key policy recommendations such as developing an ambient noise strategy for Ireland and centralising the strategic noise mapping process. It also proposed that the noise mapping bodies include the complete road networks of Cork, Dublin and Limerick when preparing strategic noise mapping data.

4. Impacts of noise and noise complaints

Sources of noise complaints

Apart from transport noise, environmental noise can also arise from a variety of other sources including the night-time economy (pubs, clubs and other hospitality and event venues), domestic or neighbourhood noise, industrial or commercial activity, wind farms, marine noise and some relatively new sources such as drone noise.

In Ireland, noise complaints about different sources normally fall into three main categories under various regulatory authorities:

1. local domestic noise nuisance including industry and commercial – local authority
2. major industrial and waste licensed sites – EPA
3. transport – TII, Iarnród Éireann-Irish Rail, Dublin Airport Authority, local authorities, etc.

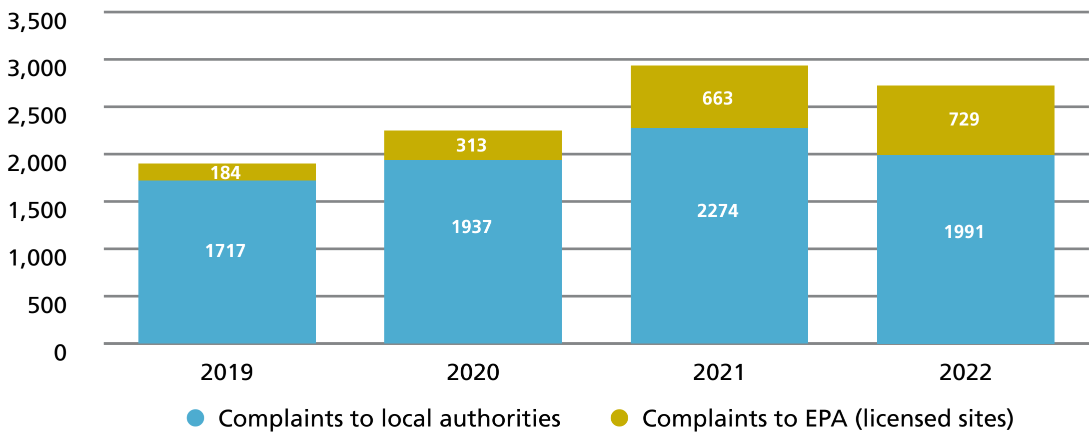
Noise complaints received by local authorities

Figure 3.7 shows the noise complaints received by local authorities for the years 2019-2022. Compared with 2019 levels, the number of noise complaints received by local authorities increased by approximately 32% in 2021 and 15% in 2022. The increases may be understood in the context of the COVID-19 lockdowns and increased working from home. In the 2021-2022 period, local authorities issued over 500 noise warning letters. They also issued a significant number of notices requiring action[6] (43 in 2021, 32 in 2022) to be taken in relation to excessive noise. During this 2-year period, no prosecutions for non-compliance with these notices were made.

6 Section 107 of the EPA Act 1992 gives powers to the local authority or the EPA to require measures to be taken to prevent or limit noise from a permitted or licensed facility.

A national protocol for local authorities to deal with noise complaints (NIECE, 2016) provided a more integrated approach to addressing noise issues in Ireland. However, in view of the increasing number of noise complaints nationally, this could be an area to consider further, and the protocol is due to be revised in 2024.

Figure 3.7 General noise complaints received by local authorities and noise complaints about EPA-licensed sites received by the EPA (2019-2022)



Noise complaints made about industrial activities licensed by the EPA

At least half of all complaints received by the EPA about EPA-licensed sites in 2022 related to noise issues (EPA, 2023b). Figure 3.7 shows the number of noise complaints received for the years 2019-2022 for industrial emissions-licensed facilities regulated by the EPA. While the data show that noise complaints have been increasing since 2019, over 300 complaints each year (2021-2022) relate to just one facility. Between 2019 and 2022, 13 compliance investigations addressing noise concerns at EPA-licensed sites were undertaken by the EPA. Eight of these were new with five having been instigated before 2019. The noise complaints mainly related to food and drink licensed sites. See Chapter 13 for more information about the regulation of industry.

Noise complaints made about transport sources

The main bodies responsible for investigating road traffic noise complaints are TII and local authorities. TII is responsible for the management of motorways and the national road network in Ireland. Local authorities are largely responsible for all other roads in Ireland (regional, public and local roads). While Iarnród Éireann-Irish Rail provides information on environmental noise and strategic noise maps on its website,[7] it does not have a specific section there that deals with noise complaints.

Dublin Airport's WebTrak Flight Monitoring System allows members of the public to monitor flights and submit noise complaints (Topic Box 3.1).

7 Iarnród Éireann-Irish Rail; www.irishrail.ie/en-ie/search?q=noise&c=3055 (accessed 24 April 2024).

Topic Box 3.1 Airport noise: monitoring system

The WebTrak Flight Monitoring System[8] is a web-based service that monitors and provides information on flights and noise levels related to aircraft using Dublin Airport. It offers near-real-time information on flight origin and destinations, aircraft types, altitudes and flight paths, and noise levels registered at Dublin Airport's noise monitoring terminals. The system also provides a simplified way for members of the public to monitor flights and submit noise complaints. Users can identify their location by Eircode or on the map provided and view related flight data. The automated noise complaint system supplements existing electronic, telephone and postal options.

Managing rail and aircraft noise

Iarnród Éireann-Irish Rail is in the process of designing for increasing capacity on the rail network in Ireland. At present, three railway order applications are under consideration by An Bord Pleanála, for DART+ West, DART+ South West and infrastructural improvements on the Cork-Middleton line. Railway order applications are essentially a combined planning application and compulsory purchase application and are subject to environmental assessment.[9] To prevent future noise issues arising, the implications for noise impacts and its mitigation using best international practice should be an important factor in the design and development of these infrastructure projects. Project owners should also consult with and take into consideration the relevant noise action plans within which the rail infrastructure resides.

The Aircraft Noise Competent Authority (ANCA)[10] is an independent directorate within Fingal County Council and is the designated competent authority in Ireland for the purposes of Regulation (EU) No 598/2014 (Aircraft Noise Regulation). ANCA has a remit to monitor and, where appropriate, make decisions and conditions for the management of aircraft noise at Dublin Airport using the balanced approach of the International Civil Aviation Organization.

ANCA publishes annual noise monitoring reports on its website together with noise contour maps that display the evolving aircraft noise impact on the communities around Dublin Airport. Maps for 2023 are available from ANCA that cover the first full year of operation of the new north runway, following the commencement of operations in September 2022.

Fingal County Council is responsible for developing the Dublin Airport Noise Action Plan. This plan is designed to manage noise issues and effects associated with Dublin Airport and, where necessary and practical, present measures to reduce the adverse effects of aviation noise.

5. Outlook for noise policy and mitigation measures

Noise in the Zero Pollution Action Plan

Reducing the share of people chronically disturbed by transport noise by 30% is the EU-wide target for 2030 under the EU Zero Pollution Action Plan (EC, 2021). However, the EEA's transport noise outlook for 2030 estimates that noise pollution is unlikely to decrease significantly (EEA, 2022b). Under an optimistic scenario that includes the implementation of a large set of ambitious measures, the number of people highly annoyed by transport noise is predicted to decline by about 19% by 2030. Under a less ambitious scenario, the number of people affected by noise is predicted to increase by 3%. The best practice case studies contained in the European Commission's Phenomena study demonstrate how measures such as reducing traffic speed limits, redesigning roadways, creating low-noise-emission zones or retrofitting trains with quiet brakes and pads can contribute towards the aims of the 2030 zero pollution objectives.

Road noise remains the largest source of negative health effects due to noise exposure across Europe and is likely to be the focus for noise mitigation actions in the coming years. According to the EEA, low-noise tyres and pavements should be further promoted, as increased demand for such products will also encourage tyre manufacturers and road contractors to innovate and make them available (EEA, 2022b).

8 Process of lodging a complaint on WebTrak (dublinairport.com) (accessed 24 April 2024).

9 Environmental impact assessment report rail information: www.dartplus.ie/en-ie/railwayorder/dartwest; www.dartplus.ie/en-ie/railwayorder/dart-south-west-railway-order; gmttrailwayorder.ie/; www.fingal.ie/aircraftnoiseca; www.metrolinkro.ie/ (accessed 24 April 2024).

10 www.fingal.ie/aircraftnoiseca (accessed 24 April 2024).

The need for better implementation of noise action plans

While some local authorities are making progress on their noise action plan implementation, there remains significant room for improvement in the overall implementation of the plans (EPA, 2024). A new approach for the development of round 4 noise action plans should assist the local authorities in developing more consistent plans that focus on priority important areas (PIAs).

The approach involves the initial screening of noise-exposed sites based on strategic noise mapping. This process identifies important areas and most important areas (areas of greatest exposure to environmental noise using the results of the strategic noise mapping and harmful effects assessment), from which PIAs are to be selected to provide the greatest noise mitigation returns, in terms of reducing harmful effects. It is anticipated that each action planning authority will focus on these areas within their noise action plans.

When implementing noise action plans, on-site noise measurements around PIAs should also be undertaken. These measurements will confirm the extent of noise exposure and can be used to validate the strategic noise models as a baseline for the assessment of noise mitigation measures.

Candidate quiet areas

To avoid the harmful effects of environmental noise in the future, it is useful to consider measures that could provide some protection from the potential impacts of increasing noise sources and exposure and that would look to preserve and maintain areas where environmental noise levels are deemed to be good. These quiet areas may be delimited[11] (defined) under the environmental noise regulations and, in addition to their good environmental sound quality, may also be considered for other amenity and social benefits.

For round 4, 10-20 candidate quiet areas have been identified in Cork and Limerick by the local authorities and over 100 in Dublin, using available parks, gardens and green space data sets and the results of strategic noise mapping. During the noise action plan implementation, some of these candidate quiet areas can be evaluated further through measurements, soundscape assessment and other criteria with a view to identifying areas that could be delimited as quiet areas, as set out in the noise regulations.

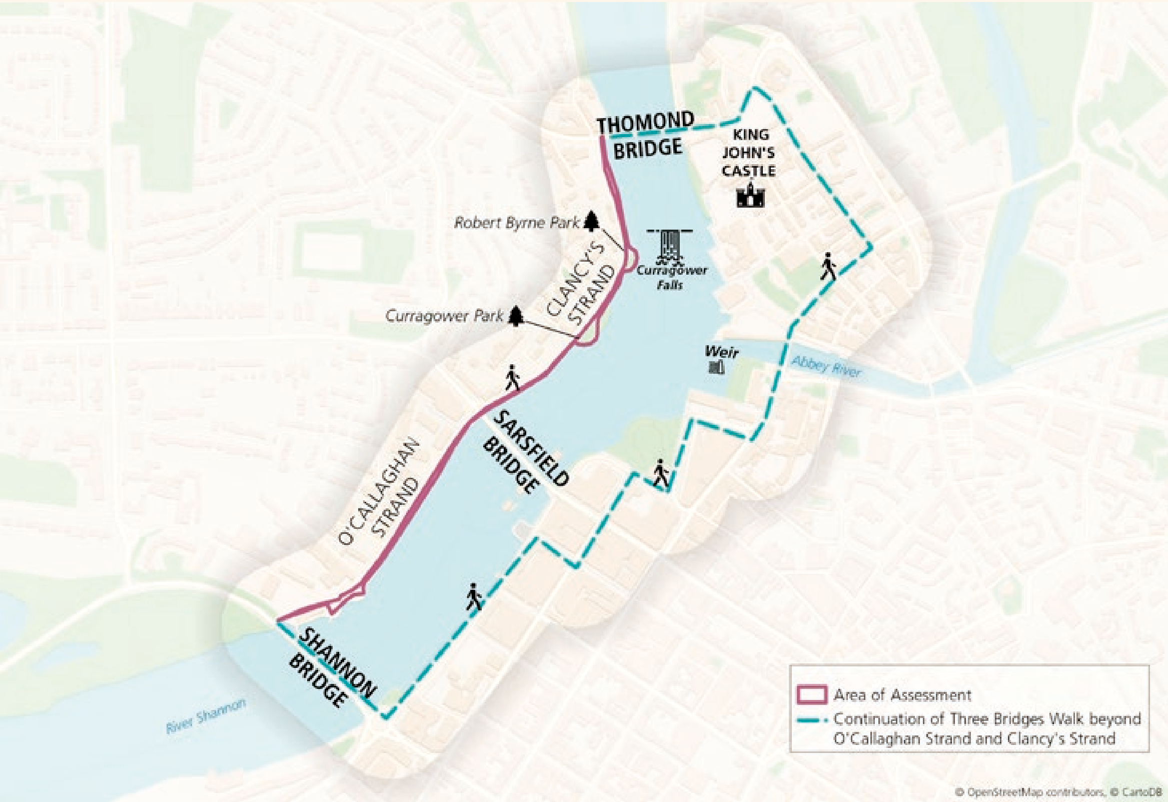
A 'soundscape' is defined as the acoustic environment as perceived or experienced and/or understood by a person or people in context (ISO, 2014). The soundscape assessment is a valuable investigation tool that can be used in the evaluation of candidate quiet areas. Pilot soundscape assessments have been used to evaluate candidate quiet areas in Limerick city (Topic Box 3.2).

11 Article 10 (1) of the Environmental Noise Regulations (S.I. No. 549/2018) www.irishstatutebook.ie/eli/2018/si/549/made/en/print#:~:text=The%20fundamental%20objective%20of%20action%20plans%20is%20the%20prevention (accessed 24 September 2024).

Topic Box 3.2 Investigation of quiet areas for Limerick city

To evaluate the acoustic environment of a principal walkway in Limerick city beside the River Shannon (Figure 3.8), a citizen science and soundscape approach was taken (Jennings *et al.*, 2023). The project used the citizen science mobile app Hush City to allow the public to evaluate the acoustic environment and the multidimensional experiential qualities of the publicly accessible spaces being assessed. The use of the citizen science mobile app was shown to be a reliable method for evaluating the quality of the acoustic environment. The results demonstrate the potential of using this approach to complement quantitative analyses (based on the review of strategic noise maps) for considering the suitability of locations for designation as quiet areas under the END as well as to help local authorities to identify infrastructural improvements that would benefit the acoustic environment for the public.

Figure 3.8 Area of assessment in Limerick City: Clancy's Strand/O'Callaghan Strand section of the Three Bridges Walk



Source: Adapted from Jennings, *et al,* 2023

National Planning Framework in Ireland

The roll-out of policy objective 65 in the *Project Ireland 2040: National Planning Framework* (DHLGH, 2019a) was seen as a first step in developing environmental noise policy in Ireland. Policy objective 65 requires the following:

Promote the pro-active management of noise where it is likely to have significant adverse impacts on health and quality of life and support the aims of the Environmental Noise Regulations through national planning guidance and Noise Action Plans.

While progress on this policy objective has been delayed, there remains a clear need to develop national noise planning guidance for local authorities. Such guidance would ensure better consistency in avoiding, preventing or reducing, on a prioritised basis, the harmful effects of exposure to environmental noise, including annoyance, as specified in the environmental noise regulations. In some instances, local authorities are developing their own guidance. The first revision of the NFP is currently underway. It would be important that it clarifies roles and responsibilities and includes concrete measures around the practical implementation of the proposed new policy objective 91 on environmental noise (DHLGH, 2024).

Wind energy

In the State of the Environment Report 2020 (EPA, 2020) it was reported that the Department of Housing, Local Government and Heritage undertook a public consultation on the draft revised wind energy guidelines (DHLGH, 2019b). It was envisaged that the guidelines would be published by the end of 2020. This has not been the case and these revised guidelines are still pending and the work is ongoing. With Ireland seeking to develop and improve the conditions necessary for the delivery of wind energy targets it is important that this type of technical guidance, which also covers noise, is available for the sector, local communities and relevant enforcement authorities.

World Health Organization noise guidelines for the protection of human health

WHO published noise guidelines for policymakers on the noise levels above which it considers that adverse effects on health and sleep occur (WHO, 2018), as shown in Table 3.4. The guidelines supplement earlier WHO guidance (WHO, 1999, 2009).

Table 3.4 Summary of WHO noise guideline values

Level of effect	Source of noise	Level	WHO guidelines
No effects on sleep are observed	Any	Below 30 dB L_{night}, inside Below 42 dB L_{Amax}, inside	WHO, 2009
Lowest observed adverse effect level for night noise	Any	40 dB L_{night}, outside	WHO, 2009
Noise above these levels is associated with adverse health effects and adverse effects on sleep	Aircraft	45 dB L_{den}, outside 40 dB L_{night}, outside	WHO, 2018
	Railways	54 dB L_{den}, outside 44 dB L_{night}, outside	WHO, 2018
	Roads	53 dB L_{den}, outside 45 dB L_{night}, outside	WHO, 2018
	Wind Turbines	45 dB L_{den}, outside	WHO, 2018

Sources: WHO, 2009, 2018

L_{Amax}, maximum sound level.

The purpose of the guidelines is to provide recommendations for protecting human health from exposure to environmental noise originating from various transport sources (road traffic, railways and aircraft). The guidelines formulate recommendations, based on the available evidence, and maximum exposure values based on increasing risk of adverse health effects. The 2018 WHO guidance levels are below the END mandatory noise level reporting thresholds of 55 dB L_{den} and 50 dB L_{night}.

6. Noise initiatives

Low-traffic neighbourhoods

Dublin City Council, in partnership with the National Transport Authority, has published the draft Dublin City Centre Transport Plan 2023. Meanwhile, the Dublin City Development Plan 2022-2028 sets out a vision for the city, and in the area of transport sets out very challenging and ambitious targets to be achieved, including a 40% reduction in general traffic volume and significant increases in walking, cycling and public transport use.

The traffic management changes envisaged as part of the draft transport plan aim to significantly reduce volumes of car traffic in the city centre, opening up space for sustainable transport modes and significantly improving the public realm by allowing greening and the development of new public spaces for residents, workers and visitors to the city centre.[12] A public consultation was undertaken as part of this process. Other local authorities, such as Dun Laoghaire-Rathdown County Council, are also looking at similar proposals to reduce traffic volumes.

Centralisation of resources in the local authority sector

The Department of the Environment, Climate and Communications (DECC) is looking to develop a business case for an enhanced enforcement structure known as REGAIN to support the provision of improved coordination, expertise and advice to underpin the consistent implementation of environmental noise, noise nuisance and air quality legislation across the country. Establishment of a suitable support structure will be essential in providing advice, guidance, training, advocacy and other supports, which would ensure a more consistent approach to air and noise enforcement and the successful undertaking of statutory functions such as the delivery of strategic noise maps, noise action plans and health assessments across the state.

7. Emerging issues

Night-time economy

The night-time economy includes cultural activities, entertainment, hospitality, festivals, sport and retail activities, with the aim of providing a safe and secure space in which to work and/or socialise.[13]

Noise is an issue that needs serious consideration if the protection of residential amenity and the operation of new initiatives such as the night-time economy are to be managed in a balanced manner, allowing our cities and towns to develop as vibrant places to live, socialise and work.

There are proposals for the reform and streamlining of licensing laws to support and stimulate the night-time economy, and this will inevitably be associated with an increased need for noise management. It is important that steps are taken early to ensure that robust noise mitigation actions are taken to minimise any need to address breaches in the first place.

Drones (unmanned aircraft systems)

The EEA has stated that drones are a technology with uncertain potential for reducing greenhouse gas emissions from e-commerce and the logistics industry, with concerns over increased noise pollution and threats to wildlife (EEA, 2021b). The Irish Aviation Authority supervises and implements the Unmanned Aircraft Systems Regulation in Ireland (S.I. No. 24/2023). The perception of drones by the public has been negatively affected by the noise they make, often perceived as annoying. Some recent research has studied how the impact of drone noise on communities can be reduced by both diverting their flight paths away from quieter areas and optimising vehicle design.[14]

12 Draft Dublin City Centre Transport Plan: consultation.dublincity.ie/traffic-and-transport/draft-dublin-city-centre-transport-plan/ (accessed 24 April 2024).

13 Night-Time Economy Taskforce: www.gov.ie/en/publication/d86df-night-time-economy-taskforce/ (accessed 24 April 2024).

14 researchoutreach.org/articles/how-make-noisy-drones-little-less-irritating/ (accessed 24 April 2024).

Heat pumps

Electrical heat pumps use a compressor to draw heat from a low-temperature source, such as external air or the ground, to heat the building interior. Most modern air source heat pumps should not make more than a low whirring sound when working properly. The outdoor unit should be sited as far away from windows and neighbouring property as possible. As their use and uptake increases, there may need to be further information on noise mitigation and guidance.

8. Conclusions

Environmental noise can have an adverse impact on health and quality of life

Local authorities and other organisations implementing noise legislation, in collaboration with those authorities responsible for transport infrastructure, need to focus more on resolving noise issues, including the increasing numbers of complaints, particularly in more urban areas with high exposure from road traffic noise and around Dublin Airport.

In relation to urban renewal and development projects, the Healthy Ireland initiative highlights the potential to maximise the health and environmental co-benefits of such projects by involving health and local authorities in their design and implementation. The Sláintecare Healthy Communities Programme, the Healthy Ireland Fund and the Healthy Cities and Counties initiative are all ways in which local communities, local authorities, the health system and national policy can be linked to improve facilities and supports for health and wellbeing at the local level.

There is a need for better implementation of local authority noise action plans

Most local authorities struggle to implement their noise action plans and reduce overall exposure to excessively noisy environments. Protection of areas where environmental noise quality is good should be prioritised through the designation of quiet areas in the action plans.

The noise action plan progress reports show that many of the local authorities have not been prioritising their noise action plan-related actions. There has also been an issue in which some local authorities have been unsuccessful in securing funding for possible remedial measures for roads from relevant funding agencies such as TII. Thus, clarity on roles, responsibilities and funding is a critical issue that will need to be addressed going forward.

Meeting the targets set in the EU Zero Pollution Action Plan – a major challenge

Specific measures are needed to allow Ireland to contribute to the overall 30% reduction target across the EU to reduce the negative impacts of exposure to transport noise by 2030, as set out in the EU Zero Pollution Action Plan (EC, 2021).

A range of options should be considered in relation to better noise management, including better urban and transport planning and significant reductions in road traffic noise. Other measures could include better acoustic design for developments, reducing speed limits on Irish roads, redesigning roadways using low-noise road surfaces, a balanced approach around airport operations, and creating low-noise-emission zones and quiet areas.

National Planning Framework supporting the proactive management of noise

Statutory planning guidance would be useful to set out how our approach and actions to avoid, mitigate or reduce environmental noise should be implemented on the ground at a local level. This guidance could also consider the proactive implementation of the 2018 WHO noise and health guidelines, similar to the way that the WHO air quality guidelines are being integrated into the Clean Air Strategy for Ireland.[15] Furthermore, the implementation of the noise policy objective in the National Planning Framework 2040 (DHLGH, 2019a) would be a welcome step in improving planning and noise management.

Urban sound planning refers to the task of managing and improving the acoustic environment within the scope of urban planning projects (EPA Network, 2021). Local authorities, urban planners and landscape architects could take into account acoustic components in their design choices. When considering the acoustic design of developments and construction, urban and transport planning needs to consider potential noise impacts to prevent new high-exposure situations developing. To help reduce overall noise exposure all organisations with responsibilities for roads, including TII and the

15 www.gov.ie/en/publication/927e0-clean-air-strategy/ (accessed 30 April 2024).

Department of Transport, have a key part to play and should actively work to incorporate measures for noise reduction and mitigation for national roads into local authority noise action plans, including considerations around low-noise road surfaces (Topic Box 3.3).

Topic Box 3.3 Low-noise road surfaces

The interaction between tyres and the road surface is generally one of the most common sources of traffic noise. Noise-reducing road surfaces, such as porous asphalt, can have significant benefits in reducing noise. In Ireland, we sometimes categorise stone mastic asphalt (SMA) of 12-14 mm diameter as a low road noise surface, but this is not in line with the CNOSSOS-EU categorisation in which a low road surface should have an SMA stone grading of 6-8 mm. TII has published interim CNOSSOS-EU road surface correction factors (TII, 2022) based on research undertaken on three common road surfaces used on national roads in Ireland. The research shows that all three surfaces result in noise emissions above those of the CNOSSOS-EU reference surface. For comparison, the SMA 10 mm surfaces currently in use in the Netherlands' strategic road network may be up to 6 dB less noisy (Shilton *et al.*, 2023) than the Irish road surfaces examined. Given the link between road surface type and noise generation, this is an area that merits further research in the Irish context.

A national noise strategy would drive improvements

In Ireland, noise is often regarded as a forgotten pollutant. As demonstrated in the 2018 WHO noise guidelines, excessive noise is an important public health issue, while the round 4 noise maps have clearly shown that road noise, particularly in the larger urban areas, is affecting a significant portion of the population. In this context, a national noise policy statement or strategy has the potential to provide the framework within which integrated noise measures could be identified and promoted across government, industry and society.

The national noise strategy could also consider a cross-sectoral approach to noise pollution. Strategies that may be effective for mitigating both environmental noise and air pollution from transport include traffic calming measures, improvements in cycling and walking infrastructure, the use of environmentally friendly vehicles, urban planning measures, improvements in public transport and increases in greenery, and the use of energy-efficient buildings.

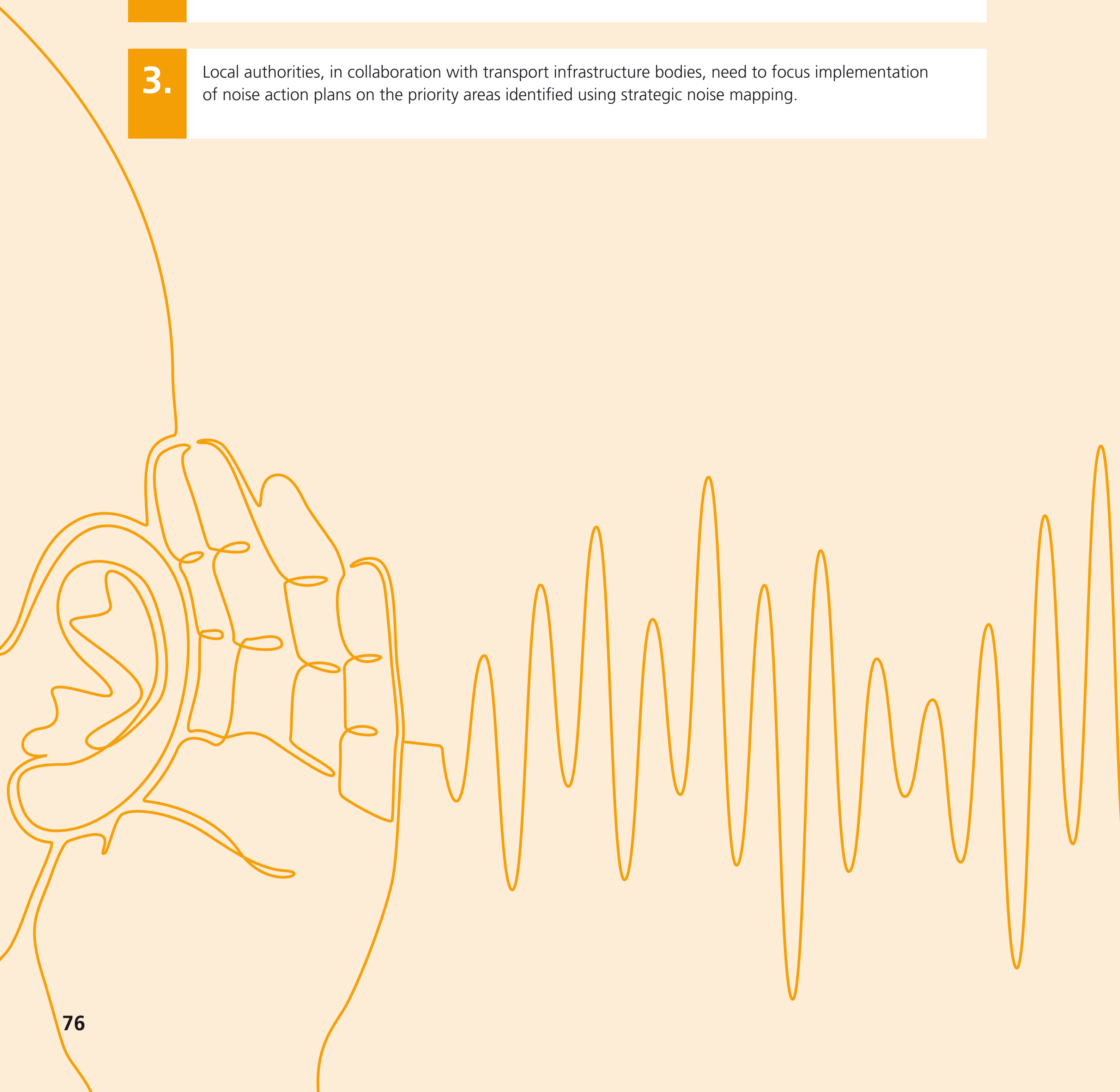
Overall, in the transport noise area there is also a need for clarity about the funding available for noise mitigation measures, about the responsibility for measures for national roads identified in the noise action plans, and about linking the plans to a national strategy for environmental noise and the development of noise planning guidance. These systemic issues and uncertainties make it challenging for local authorities to progress their noise action plans.

Key chapter messages

1. Environmental noise is the second biggest environmental cause of health problems in the EU. In Ireland, over 1 million people are likely to be exposed to noise levels above the mandatory reporting thresholds.

2. National policy for environmental noise is not as well advanced as in other environmental areas. There is a need for coordinated national policy and actions around planning, health and transport infrastructure to reduce noise exposure.

3. Local authorities, in collaboration with transport infrastructure bodies, need to focus implementation of noise action plans on the priority areas identified using strategic noise mapping.



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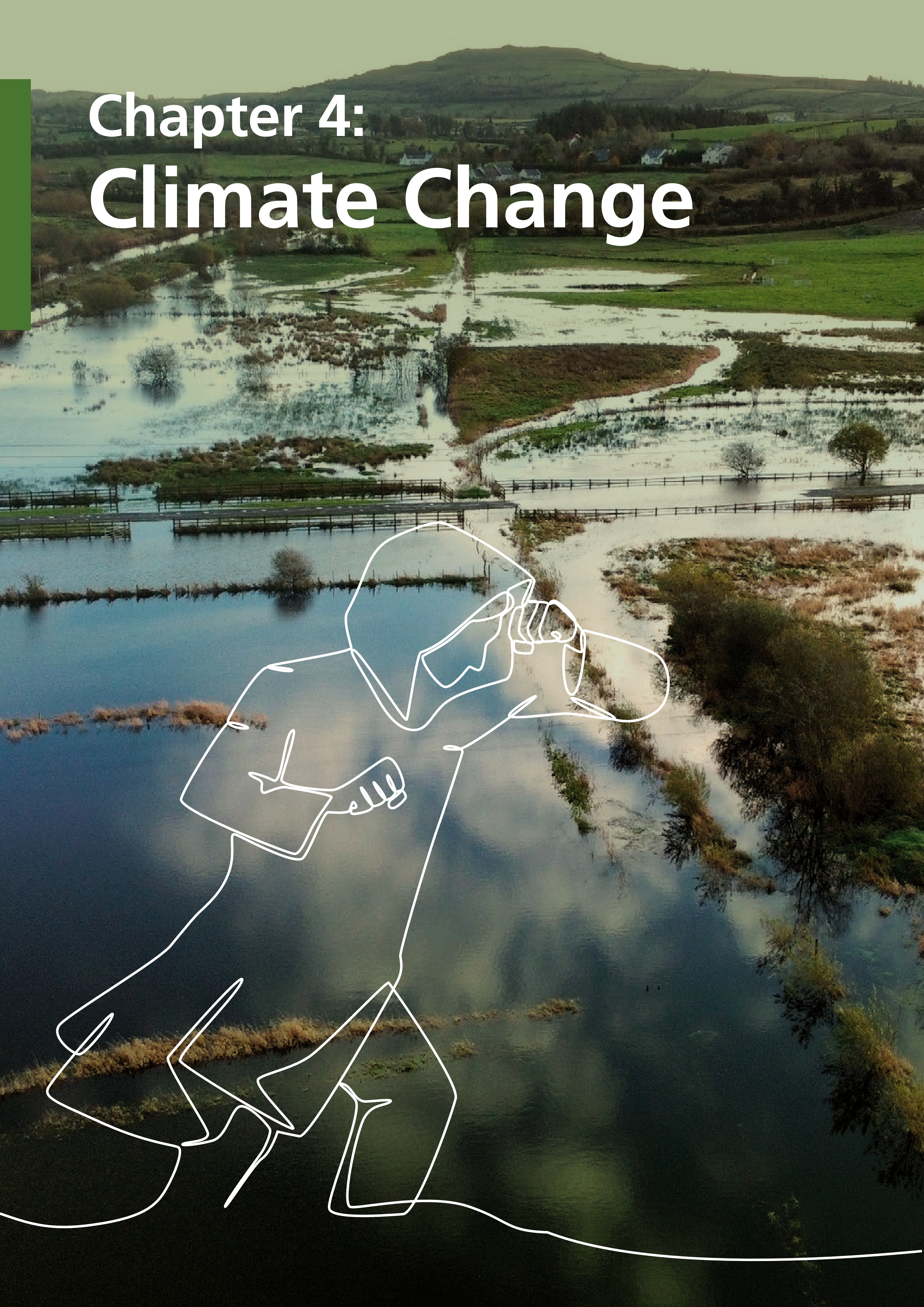
Chapter 4: Climate Change



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 action 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 Línte na Farraige (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, Línte Na Farraige/Lines of the Sea[2]

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

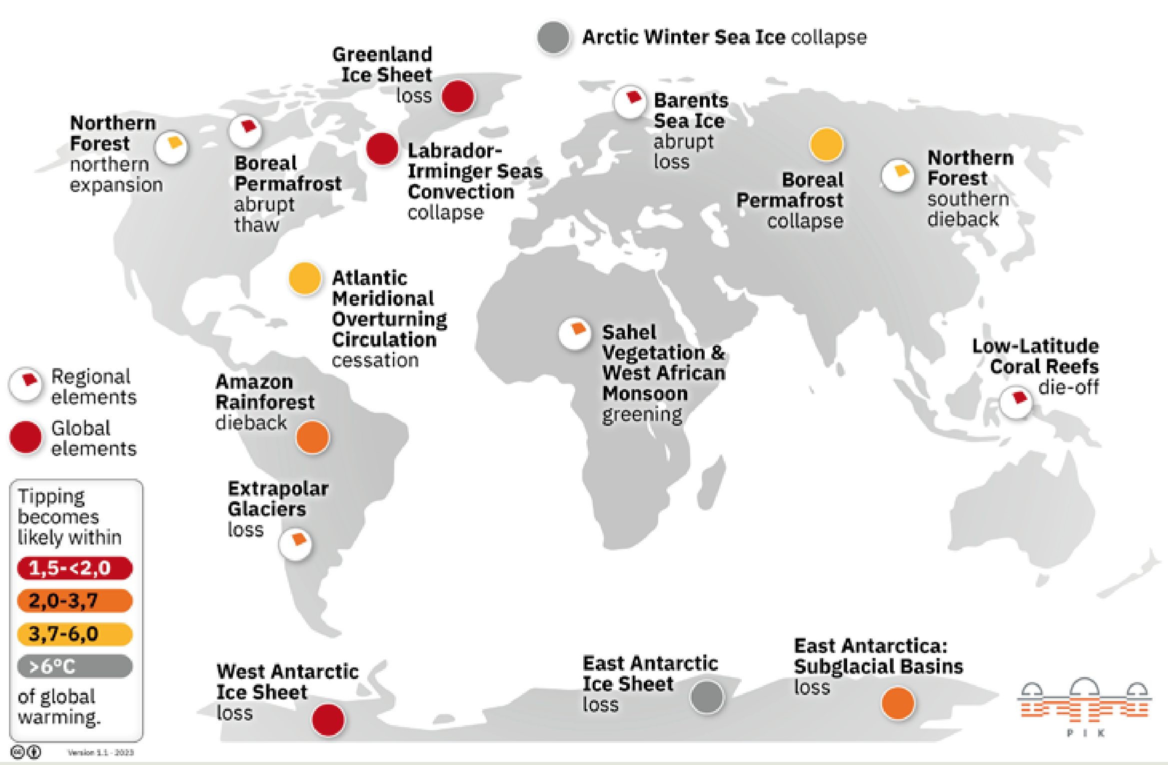
The most recent IPCC assessment – AR6 – summarises tipping points as large-scale singular events.

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 report[3] 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 permafrost[4] 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).

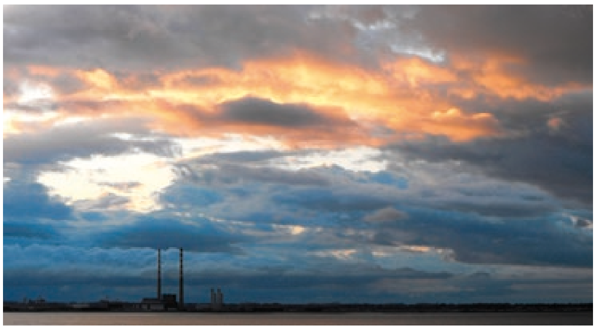
4 Permafrost is defined as ground that remains below 0°C for 2 years or more (ACGR, 1988).

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

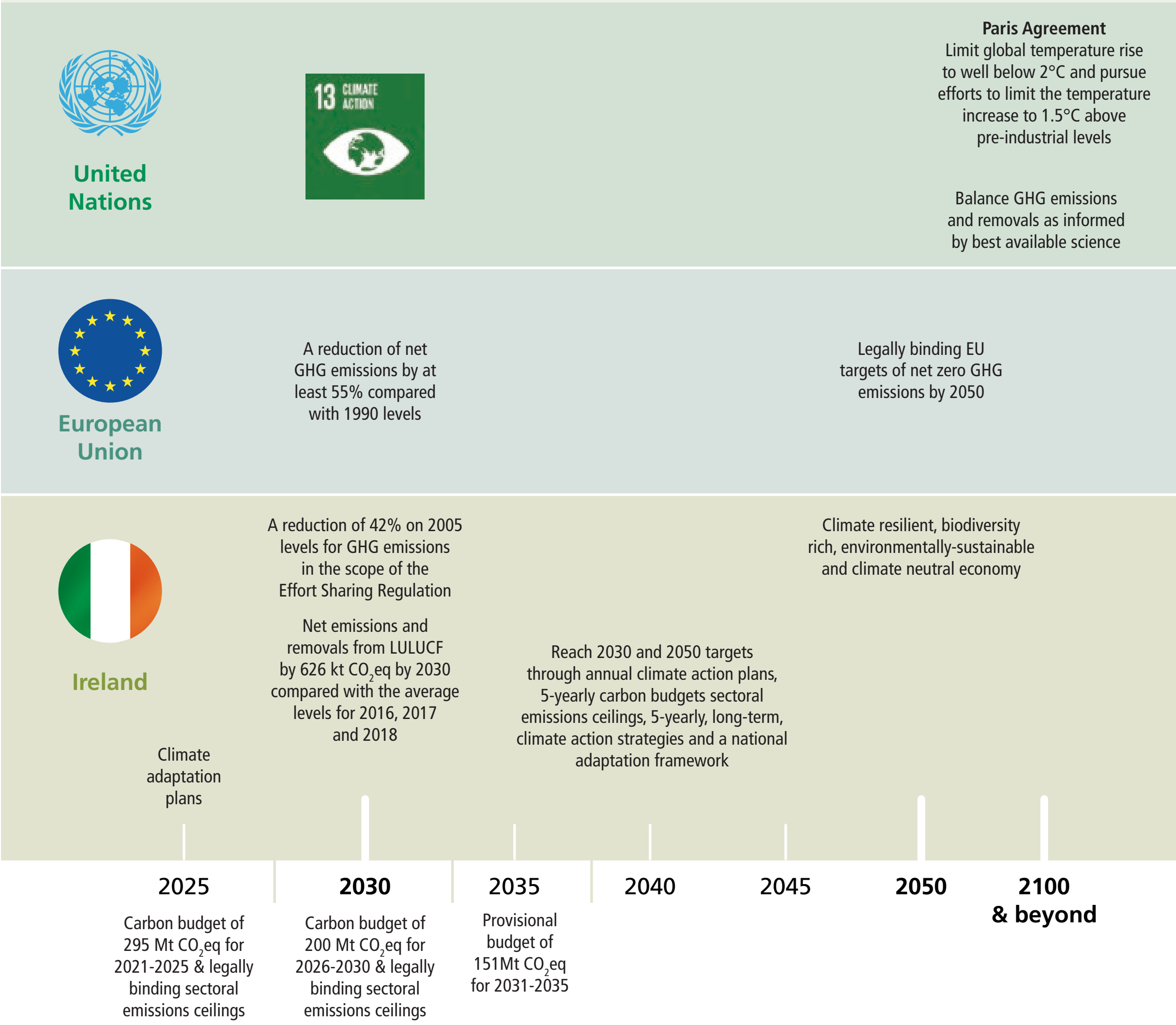
Policy objectives and targets	Source	Target year
International		
Limit global temperature rise to well below 2°C and pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels	Paris Agreement 2015 (United Nations)	Long-term global goal
Balance GHG emissions and removals as 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 A reduction of net greenhouse gas emissions by at least 55% compared with 1990 levels by 2030	EU climate law Implementing legislation includes: ■ 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)	2030 and 2050
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: ■ 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

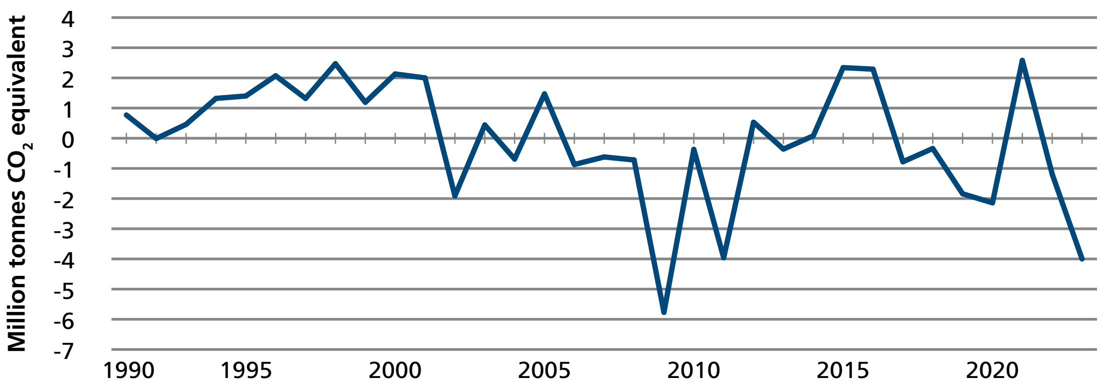
Greenhouse gas emissions trends

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 CO_2 eq. This is 6.8% lower (or 4.00 Mt CO_2 eq) than emissions in 2022 (59.00 Mt CO_2 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 CO_2 equivalent per person in 2022 to 10.4 tonnes CO_2 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

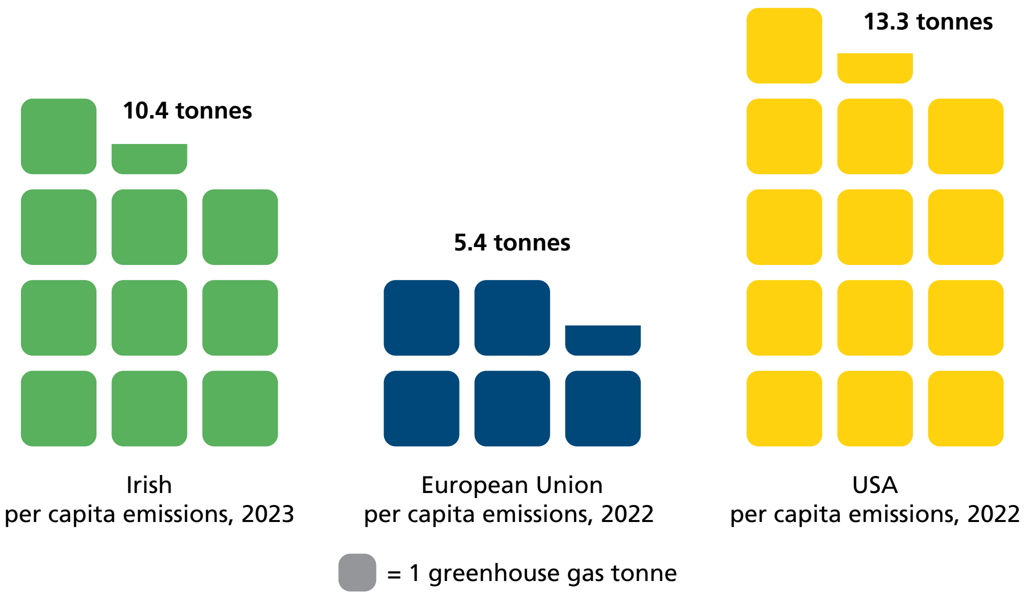
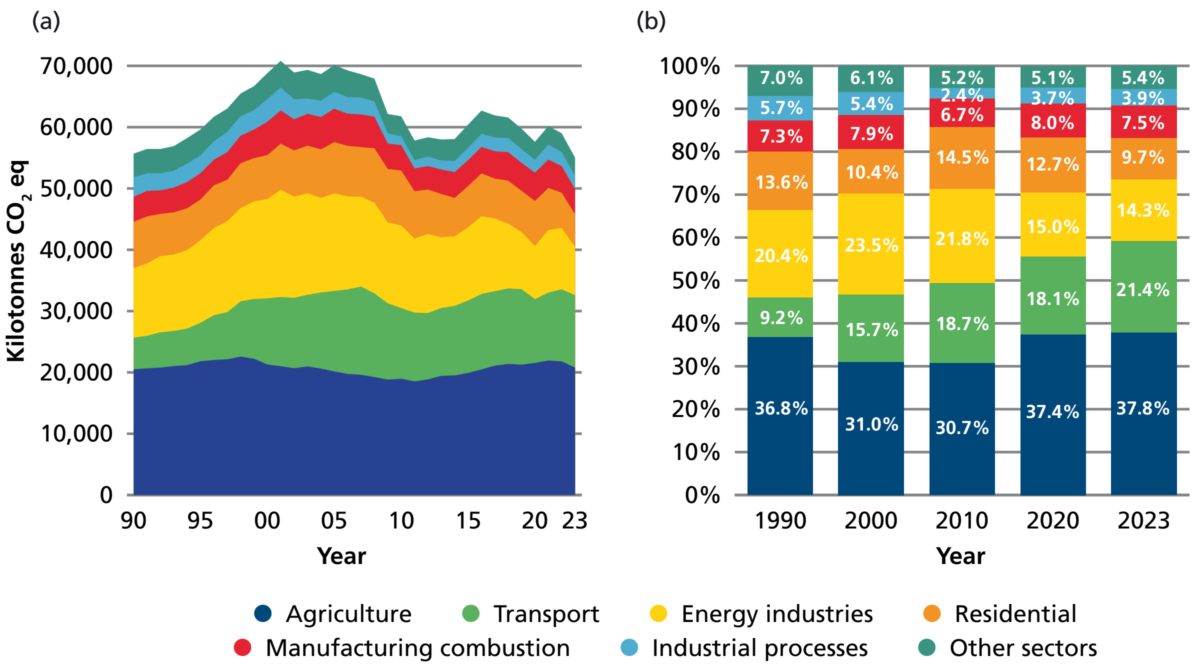


Figure 4.7 Trends in greenhouse gas emissions between 1990 and 2023 for the largest sectors in (a) kilotonnes CO_2 equivalent and (b) as percentages



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 CO_2 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 CO_2 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.

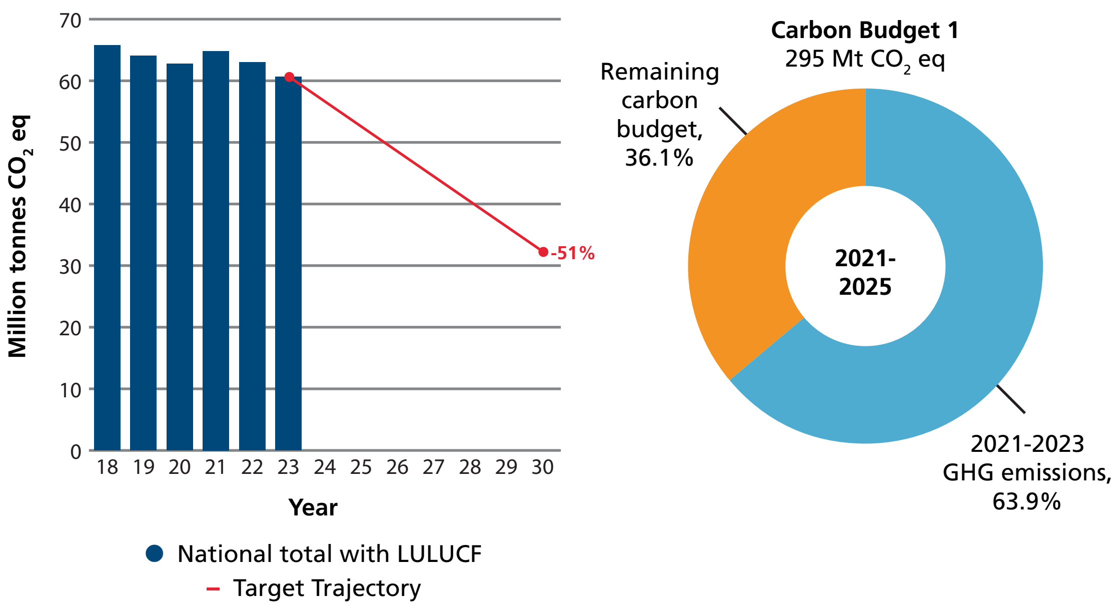
Compliance with national commitments

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 CO_2 eq
- Budget 2 from 2026 to 2030 has been set at 200 Mt CO_2 eq
- Budget 3 from 2031 to 2035 has been set at 151 Mt CO_2 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 CO_2 eq, accounting for 63.9% of the first 5-year carbon budget of 295 Mt CO_2 eq. This leaves 36.1% of the budget available for the remaining 2 years.

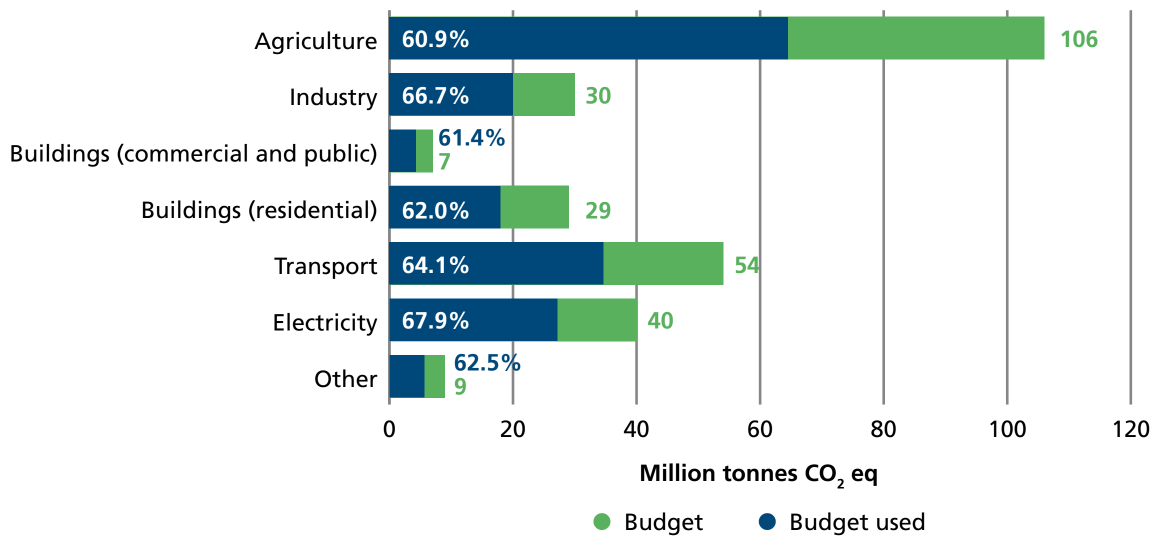
To stay within budget for the first carbon budget period will require a substantial 8.3% annual emissions reduction in 2024 and 2025. Non-achievement of the first carbon budget would also see the excess emissions carried forward into the second budget period, and the second carbon budget would be reduced 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 CO_2 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 CO_2 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 CO_2 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 CO_2 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 CO_2 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 CO_2 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.

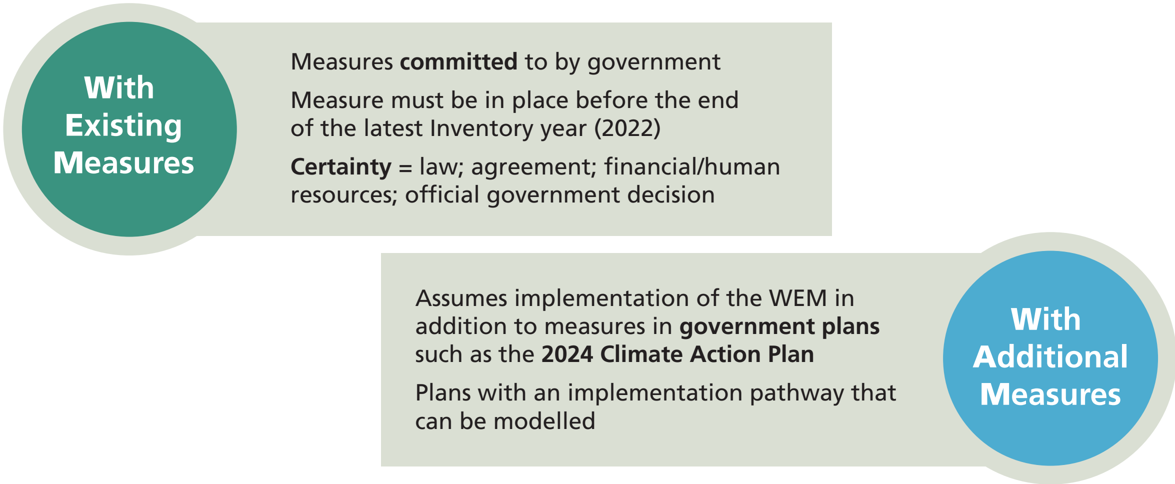
Projected future emissions trends

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.

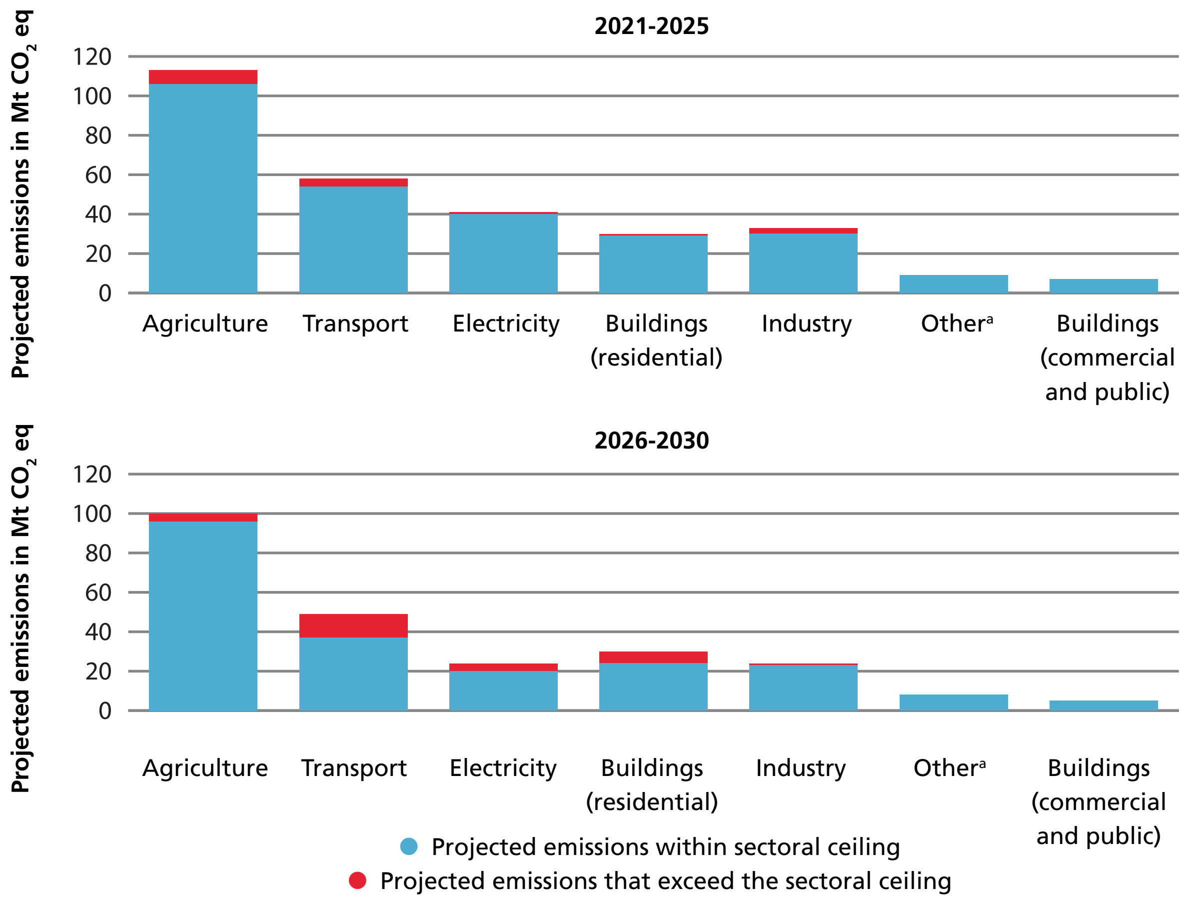
It is important to note that none of the savings modelled in the EPA projections, whether in the With Existing Measures scenario or the With Additional Measures scenario, will be achieved until the implementation actions have been delivered and the resulting emissions reductions are seen in the annual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

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 CO_2 eq; total budget 2026-2030 = 200 Mt CO_2 eq; [a]Fluorinated 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 CO_2 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 CO_2 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 an '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 CO_2 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 CO_2 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 CO_2 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 CO_2 eq for 2021-2025 and 96 Mt CO_2 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 curve[7] 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 CO_2 eq) compared with 2022 emissions. Emissions from road transport were relatively stable for the period 2015-2019, at an average of 12.2 Mt CO_2 eq, but reduced to 10.4 Mt CO_2 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 CO_2 eq and 11.8 Mt CO_2 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 CO_2 eq for 2021-2025 and 37 Mt CO_2 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 sector[8] 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 CO_2 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 CO_2 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 CO_2 eq, for 2021-2025, and 20 Mt CO_2 eq, for 2026-2030. Achieving this is expected to reduce annual emissions from the sector to 3 Mt CO_2 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 CO_2 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

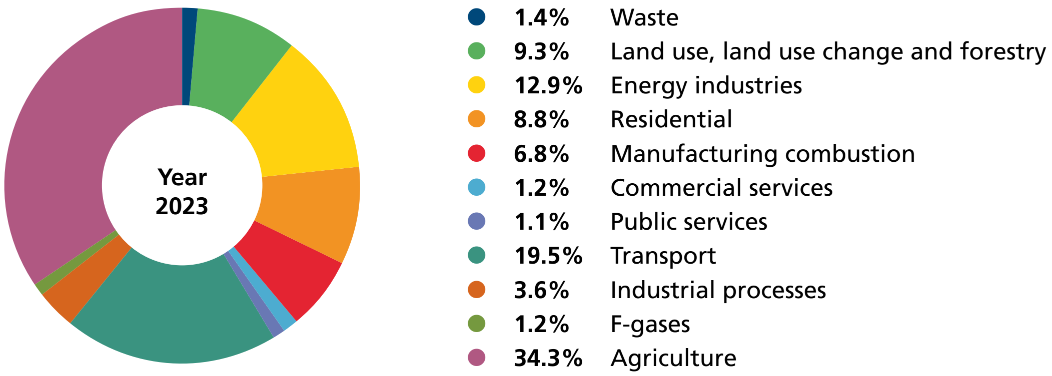
LULUCF emissions increased by 12.0% between 1990 and 2023. It has historically been the convention internationally that when referring to a country's 'total emissions' LULUCF is excluded (as above). However, given its inclusion in Ireland's Climate Action and Low Carbon Development (Amendment) Act 2021 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 CO_2 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 CO_2 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 CO_2 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 m^3 in 1990 to 4.0 million m^3 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 adademic 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.

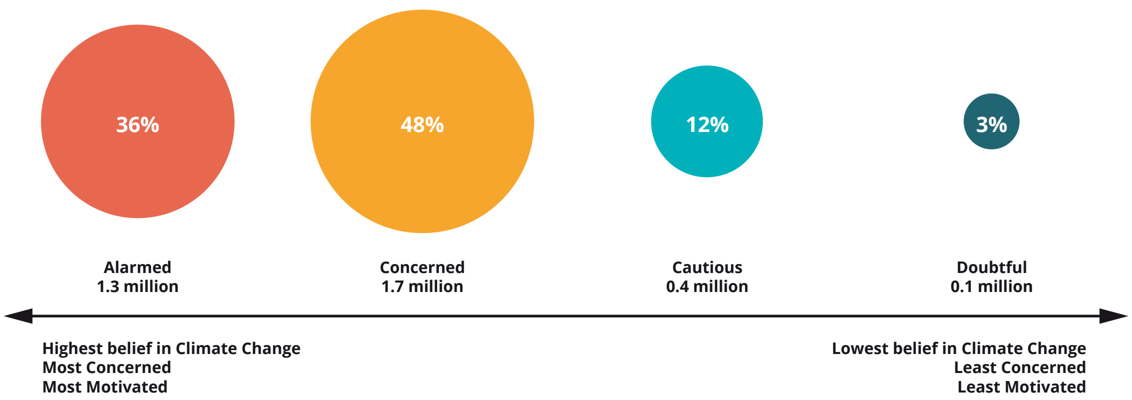
The work demonstrates that the Irish people overwhelmingly recognise the threat of climate change, feel personally affected by it and want to see real change. There was almost complete agreement (95%) that climate change is happening, and the majority of people (92%) think that climate change is caused, 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



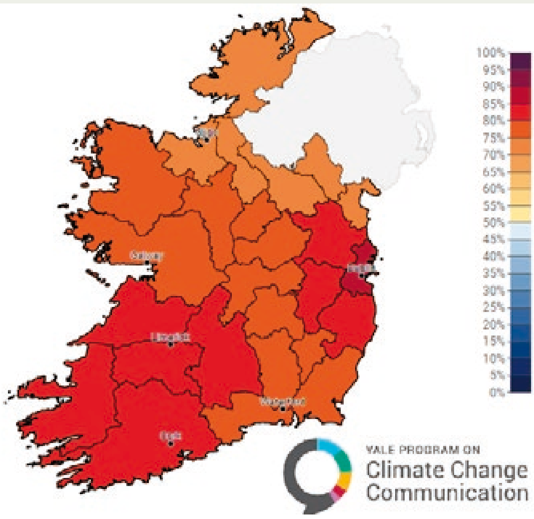
Source: O'Mahony *et al.*, 2024b

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 unequivocable, 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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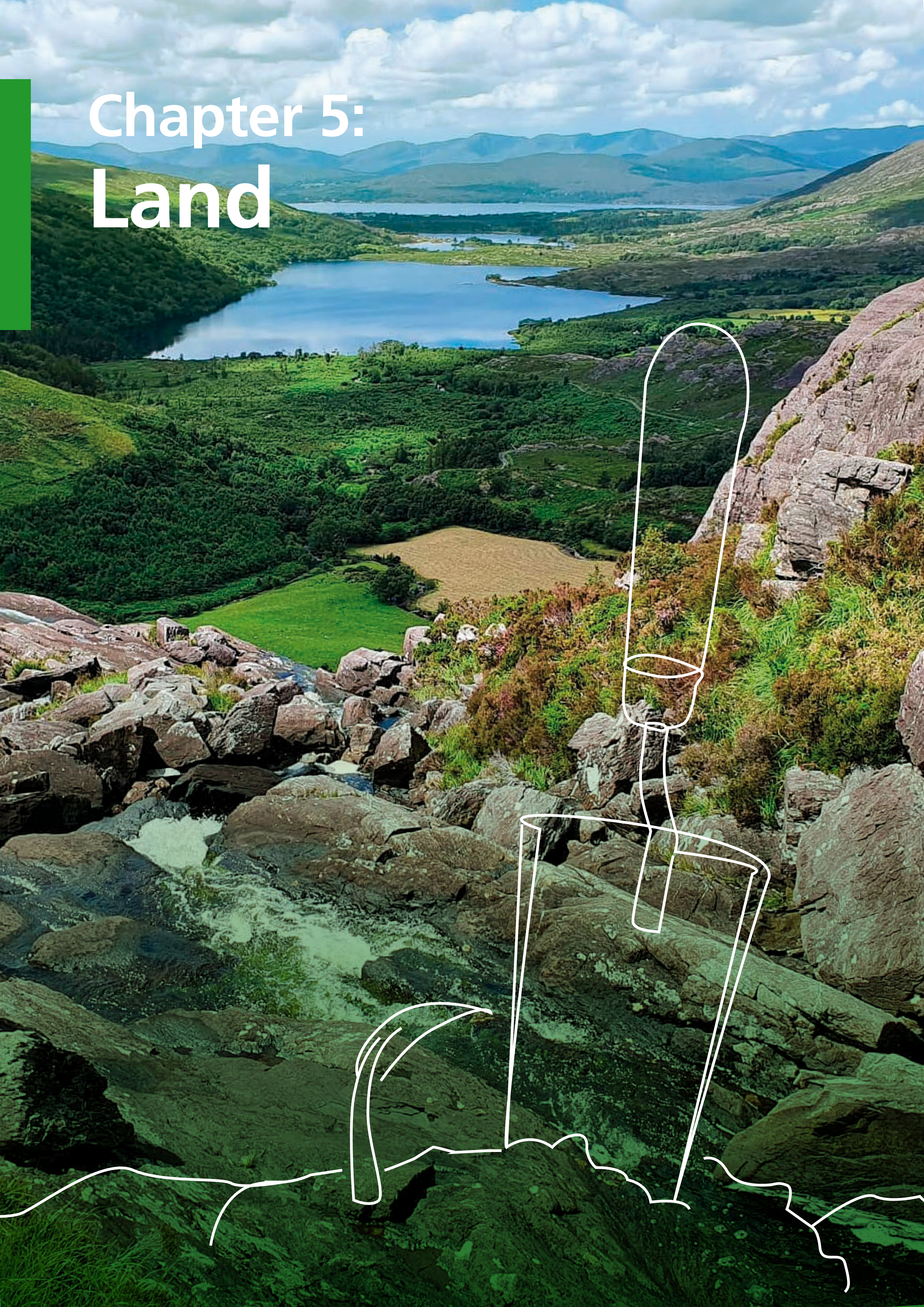
Chapter 5:
Land



Land

1. Introduction

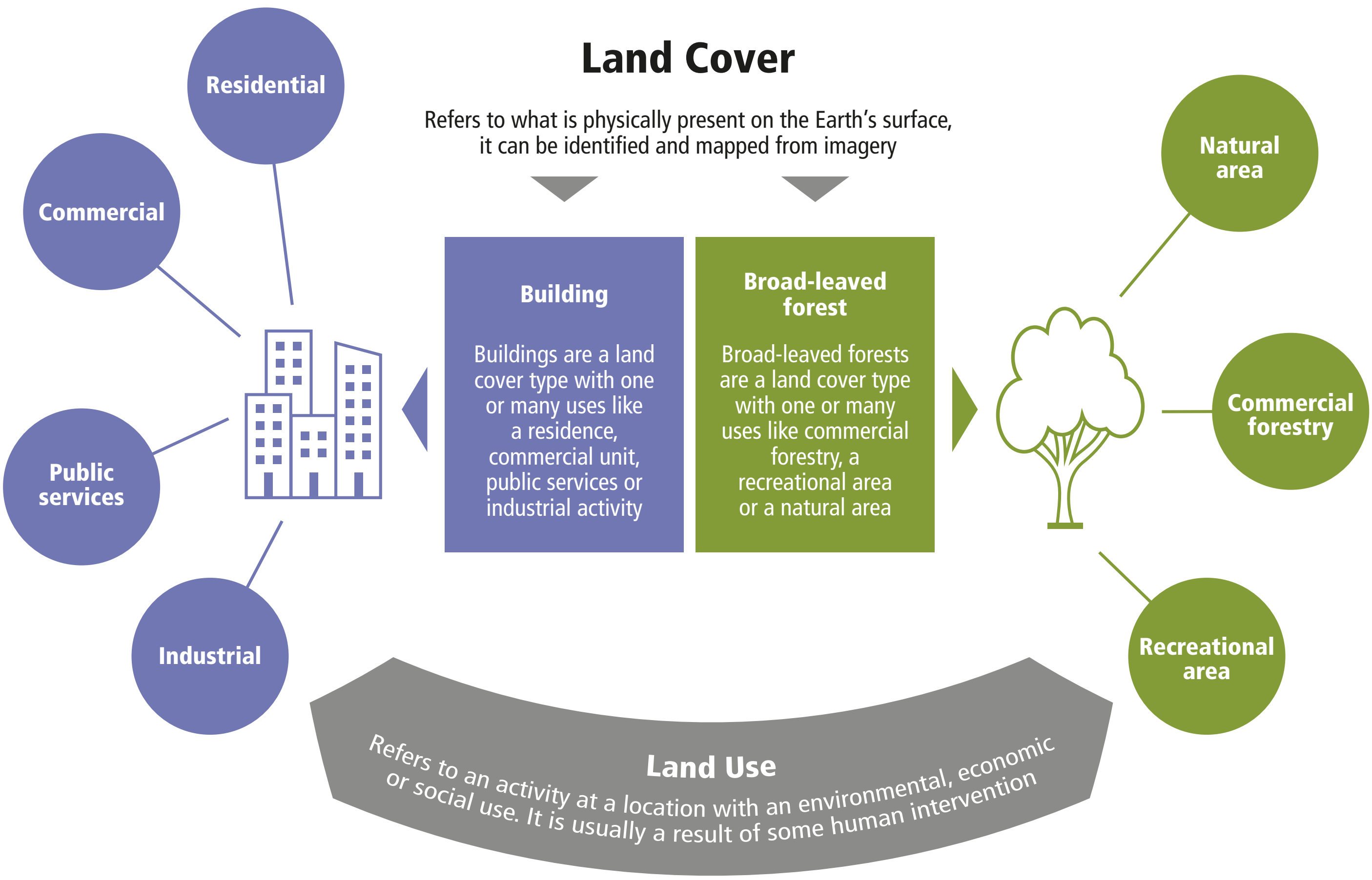
When we see land as a community to which we belong, we may begin to use it with love and respect.

Aldo Leopold

People rely on the land for all aspects of daily life. We use land to grow our food and to supply the materials and space for our homes. Land provides the infrastructure to transport people and materials and the green space that we use for recreation. Land is an inseparable part of the natural cycles that supply clean air and water and it provides habitats for terrestrial species, estimated to make up more than 80% of the Earth's species (Grosberg *et al.*, 2012).

This chapter discusses two aspects of Ireland's land: land cover and land use (Figure 5.1). Land cover refers to that which is physically present on the Earth's surface, e.g. farmland, natural forests, wild areas, inland waterways, built-up areas. Land use describes the human activities that are making use of land, e.g. residences and physical development of various kinds, including agriculture, commercial forestry, peatlands and waterways. A land cover type can have more than one use.

Figure 5.1 Land cover versus land use



2. Land cover

Land cover mapping

The development of the National Land Cover Map of Ireland marks a significant improvement in Irish land evidence. Since 1990, land cover in Ireland has been tracked at 6-yearly intervals by Corine Land Cover, the pan-European land cover map. While Corine Land Cover data are valuable for identifying broad trends in Ireland's land use, they have a coarser resolution than the National Land Cover Map. Corine Land Cover has a minimum mapping unit of 25 ha, while the National Land Cover Map (Topic Box 5.1) has a minimum mapping unit of 0.1 ha.

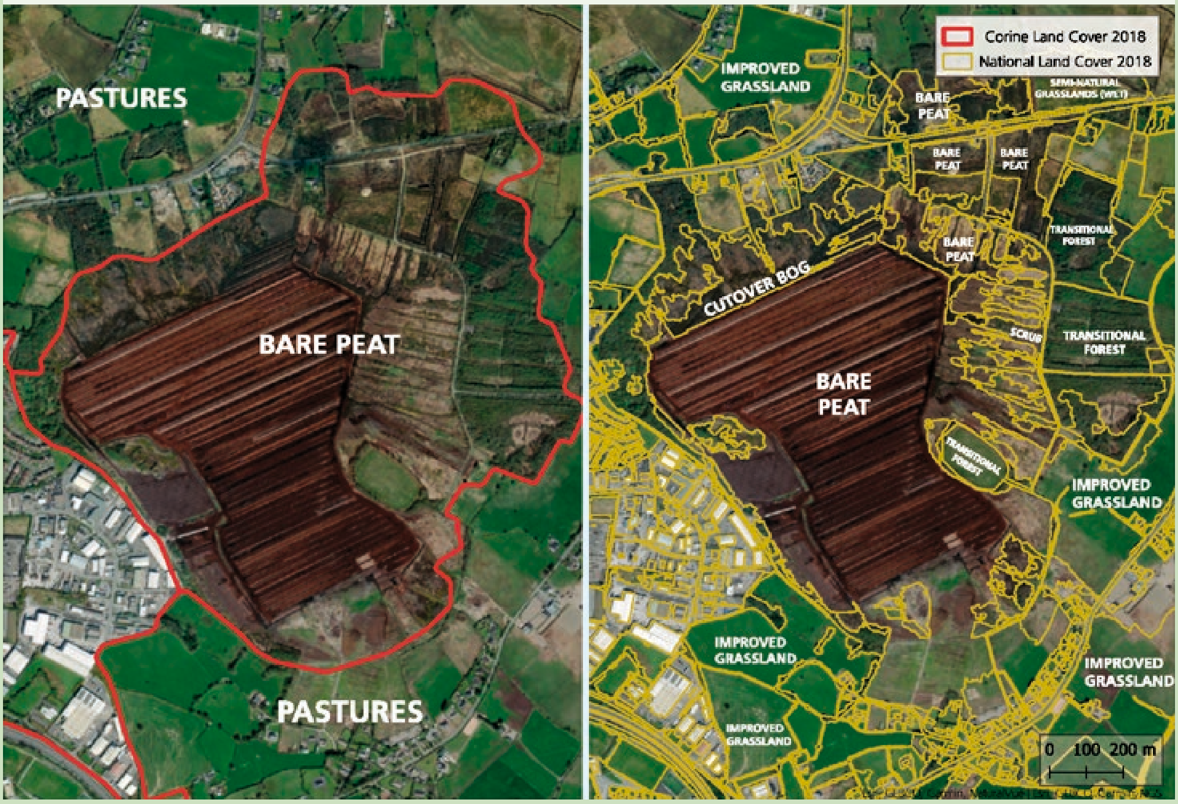
Topic Box 5.1 The new National Land Cover Map

The new National Land Cover Map became available for Ireland in 2023. Produced by Tailte Éireann (formerly Ordnance Survey Ireland) in partnership with the Environmental Protection Agency (EPA), the map provides very detailed data on land cover types in Ireland based on data from 2018. A classification system that includes 36 land cover classes or types was designed in collaboration with national land experts.

Previous State of the Environment Reports used Corine Land Cover data to assess land cover status in Ireland. Corine data are produced under the European Commission's Copernicus Land Monitoring Service.

While Corine provides a useful time series data set, it is best suited to high-level pan-European assessments, as smaller areas (below 25 ha) are not mapped. This means that important land cover types are not identified (e.g. smaller crop areas, hedgerows or buildings). Figure 5.2 illustrates that some land cover types are underestimated in Corine, while others (such as grasslands and peatlands) are overestimated.

Figure 5.2 Comparison of peatland areas using 2018 data from Corine Land Cover (left) and the National Land Cover Map (right)



Note: Corine Land Cover data overestimates the peatland area, as small forest and grass areas are not mapped. Meanwhile, the increased detail in the National Land Cover Map captures these areas

The improved land evidence provided by the new National Land Cover Map has many uses in environmental assessments of water, climate, air, noise and biodiversity. It is important to note that the new map does not provide data on land cover changes when compared with Corine; instead, it is a reassessment of land cover status based on new, more detailed, data. Differences are highlighted in Figure 5.3 and explained in Table 5.1.

Figure 5.3 Comparison of the National Land Cover Map and Corine Land Cover data sets by land cover type, 2018

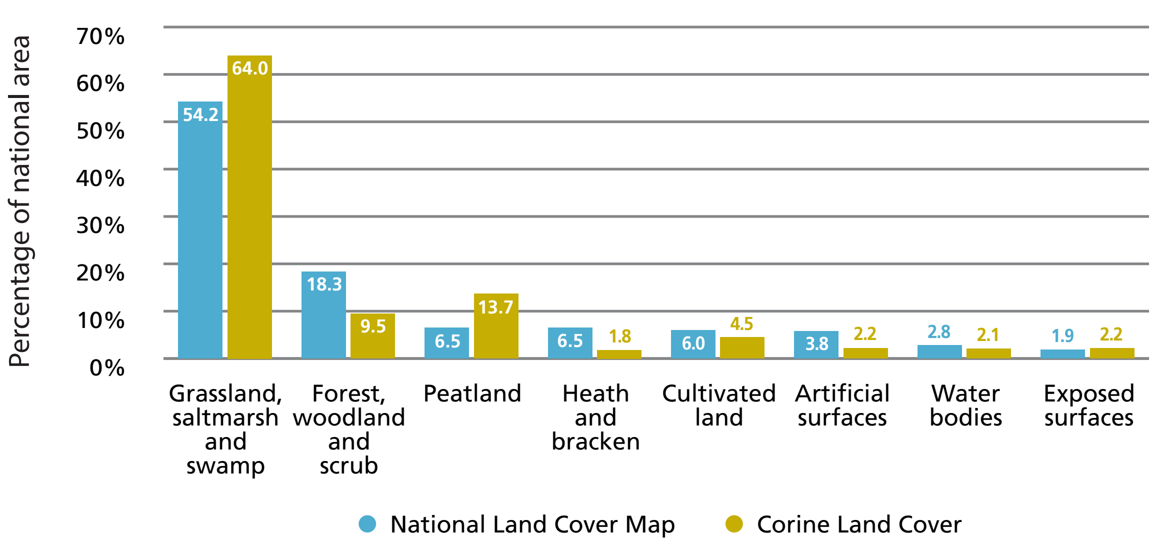


Table 5.1 Primary reasons for the main statistical differences between the National Land Cover Map and the Corine Land Cover data sets

Land cover type	Difference	Primary reason for differences
Grassland, saltmarsh and swamp	–9.8%	Smaller areas of forest, cropland and artificial surfaces previously generalised in CLC are now identified
Forest, woodland and scrub	+8.8%	Small areas of forest, hedgerows, treelines and scrub are now identified, transitioning from mainly CLC grass and peatlands The NLC Map does not measure forestry percentage cover in the same way as the National Forestry Inventory. The forest classes of the NLC Map make up 12.2% of the land cover area. The National Forestry Inventory provides the official statistic for Ireland's forestry cover (11.6%)
Peatland	–7.2%	The CLC mapping process struggles to distinguish heath and bracken from peat. The NLC Map is able to do this, accounting for over 50% of the reduction. Otherwise, smaller areas in CLC peatland are identified as grassland and forest in the NLC Map It is important to note that the NLC Map only maps the land cover at the surface and does not map peat soils

Table 5.1 (continued)

Land cover type	Difference	Primary reason for differences
Heath and bracken	+4.7%	New mapping methods allow heath and bracken to be distinguished from peat, accounting for most of the increase. Some smaller areas in CLC grassland and exposed surfaces were also identified
Artificial surfaces	+1.6%	Buildings, roads and other small artificial areas that were not mapped in CLC have been identified in the NLC Map. These additional areas transitioned primarily from CLC grassland
Cultivated land	+1.5%	Smaller areas of cultivated land, previously generalised into CLC grassland areas, are now identified in the NLC Map

CLC, Corine Land Cover; NLC: National Land Cover

In summary, the National Land Cover Map provides greater detail and evidence on land cover in Ireland by identifying smaller areas of importance that are not visible in the coarser Corine Land Cover. As well as providing a powerful tool for decision-making on land management, the detail of the National Land Cover Map improves our ability to monitor and assess impacts on water, climate, air, noise and biodiversity.

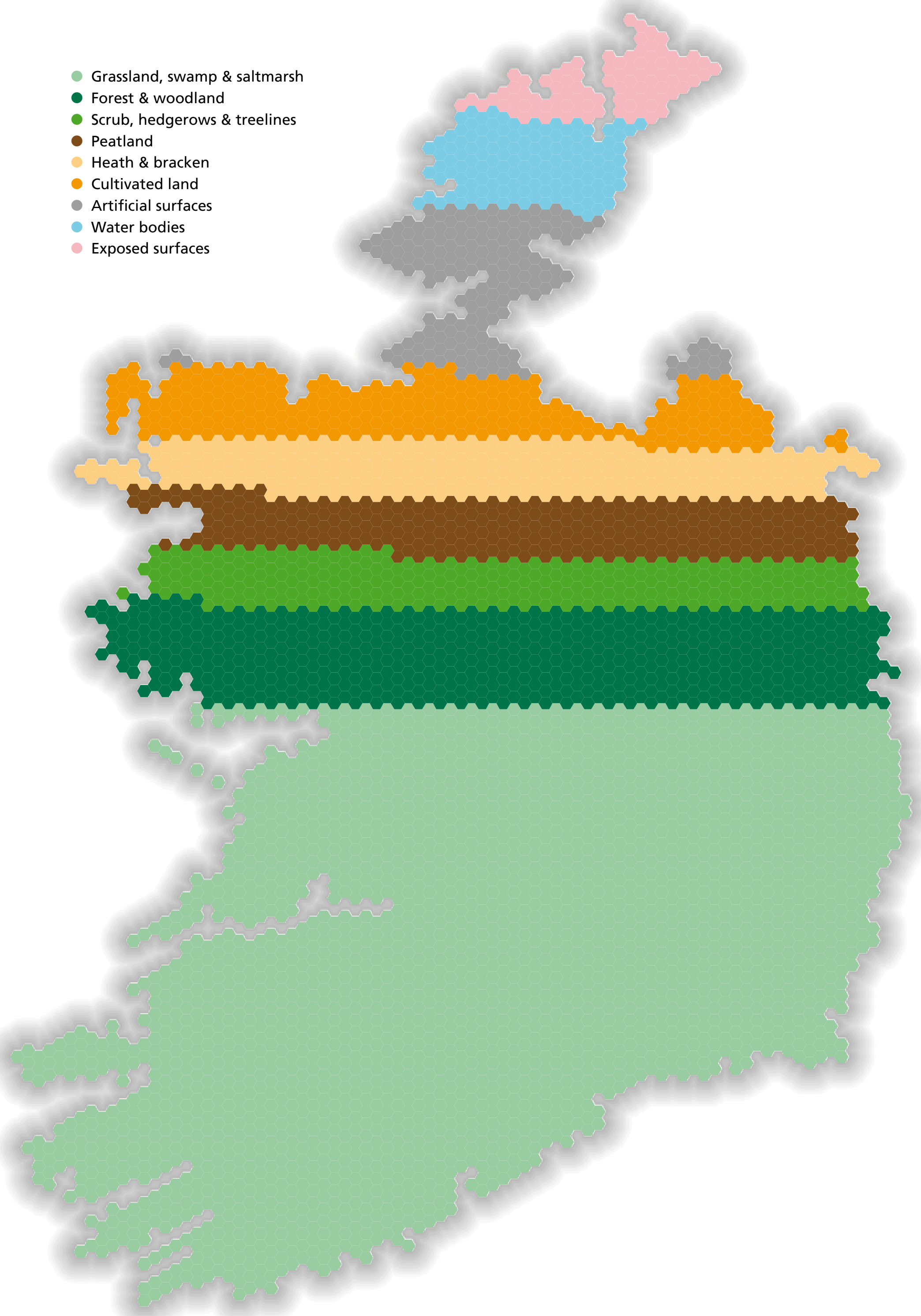
Corine Land Cover data show the following four broad trends since 1990:

1. Ireland's main land cover type is agriculture. This figure has stayed consistently around 67% in Corine Land Cover data since 1990.[1] There have been changes in agricultural land cover: agricultural land has been lost to artificial surfaces through development and road building and gained through other activities, including drainage of wetlands.
2. Artificial surfaces have increased. Although they cover a small area, artificial surfaces have almost doubled since 1990 from 1.45% of Ireland's area in 1990 to 2.4% in 2018, mainly at the expense of agricultural land.
3. Wetland area has decreased, from 18.5% cover in 1990 to 14.8% in 2018 (extensive drainage activity also occurred before 1990).
4. Forest and semi-natural areas have increased, from 10% in 1990 to 13% in 2018.

Changes in Ireland's land cover (both before and after 1990) can be partly attributed to policy formulated for specific national interests that had unforeseen consequences for Ireland's land cover profile. The decrease in wetland areas can be linked to more than one policy decision. For example, one historical policy decision was to produce and market turf and turf products in the 'national interest', outlined in the Turf Development Act (No. 10 of 1946). Other drivers include policies that incentivised the agricultural productivity of land and the planting of more trees. The National Land Cover Map shows that Ireland's residential development pattern is the result of a long-term mix of urban centres and extensive single housing in the open countryside. Ireland's land cover profile according to the National Land Cover Map is shown in Figure 5.4 and Table 5.2.

1 The 2020 Census of Agriculture from the Central Statistics Office estimates that 60% of Ireland's land is used for agriculture. The higher figure in Corine Land Cover data is a result of these data's coarser resolution.

Figure 5.4 Stacked bar chart showing the proportion of Ireland's level 1 land cover types



Source: National Land Cover Map of Ireland

Table 5.2 Ireland's national land cover profile

Land cover type: level 1 (8 classes)	Land cover type: level 1 (km²)	Land cover type: level 1 (% of area)	Land cover type: level 2 (36 classes)	Land cover type: level 2 (km²)	Land cover type: level 2 (% of area)
Grassland, swamp and saltmarsh	38,279.7	54.2	Improved grassland	29,332.3	41.5
			Amenity grassland	1,285.6	1.8
			Dry grassland	795.4	1.1
			Wet grassland	6,685.5	9.5
			Saltmarsh	57.5	0.1
			Sand dunes	102.6	0.1
			Swamp	22.7	0.03
Forest, woodland and scrub	12,907.2	12.2	Coniferous forest	2,564.4	3.6
			Mixed forest	495	0.7
			Transitional forest	3,856.7	5.5
			Broadleaved forest and woodland	1,708.6	2.4
		6.1	Scrub	1,301	1.8
			Hedgerows	2,247.9	3.2
			Treelines	733.9	1
Peatland	4,622	6.5	Raised bog	462.7	0.7
			Blanket bog	2,497.4	3.5
			Cutover bog	1,102.5	1. 6
			Bare peat	529.6	0.7
			Fens	30.7	0.04
Heath and bracken	4,569.1	6.5	Bracken	281.3	0.4
			Dry heath	1,992.6	2.8
			Wet heath	2,295.3	3.2
Cultivated land	4,270.3	6.0	Cultivated land	4,270.3	6
Artificial surfaces	2,681	3.8	Buildings	416.8	0.6
			Ways	1,169.9	1.7
			Other artificial surfaces	1,093.5	1.6
Water bodies	n/a[a]	2.8	Rivers and streams	593.8	0.8
			Lakes and ponds	1,312.6	1.9
			Artificial water bodies	36.5	0.05
			Transitional water bodies	25	0.04
			Marine water	4,029.8	n/a[a]

Land cover type: level 1 (8 classes)	Land cover type: level 1 (km²)	Land cover type: level 1 (% of area)	Land cover type: level 2 (36 classes)	Land cover type: level 2 (km²)	Land cover type: level 2 (% of area)
Exposed surfaces	1,368.7	1.9	Exposed rock and sediments	659.8	0.9
			Coastal sediments	92.4	0.1
			Mudflats	324.4	0.5
			Bare soil and disturbed ground	236.6	0.3
			Burnt areas	19.5	0.03

[a] Marine water bodies are not included in the percentage land area calculation as they are not land features.

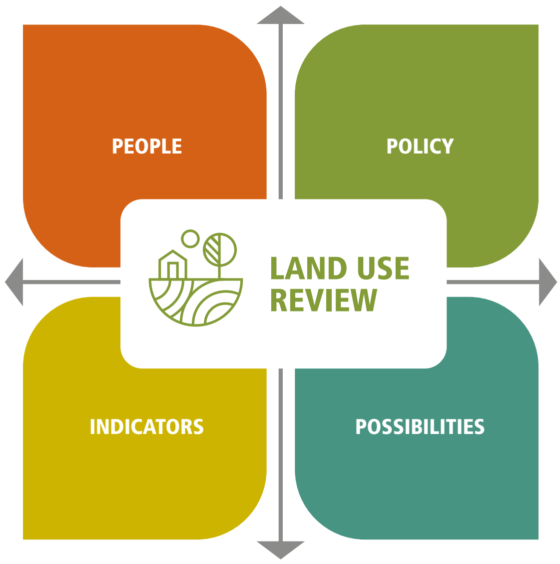
Source: Compiled from National Land Cover Map of Ireland data

3. Land use

Land use describes how humans make use of land and includes activities such as residential use, agriculture, commercial forestry and infrastructural uses such as transport or utilities.

In March 2023, the government published the outputs of phase 1 of the National Land Use Review, which was led by the EPA (DAFM and DECC, 2023a). The purpose of the review was to examine the environmental, socio-economic and ecological characteristics of Ireland's land use. Phase 1 of the review examined four broad areas (Figure 5.5) and made 19 recommendations.

Figure 5.5 The four themes of phase 1 of the Land Use Review



Source: DAFM and DECC, 2023a

Phase 2 of the Land Use Review is being led by three departments: the Department of the Environment, Climate and Communications, the Department of Agriculture, Food and the Marine and the Department of Housing, Local Government and Heritage. Phase 2 will identify the key demands on land (both public and private) to inform policies for land use across key government objectives. The work will note that the remaining years of this decade are critical to address the climate and biodiversity emergencies (declared by Dáil Éireann in 2019), recognising that farmers and farm families play a very significant role as custodians of Ireland's environment. The review will also recognise that any measures made available to farmers will be voluntary and done in partnership with government. This phase of the review will inform the preparation of future climate action plans, in particular actions to achieve reductions in emissions of greenhouse gases (GHGs) for the land use, land use change and forestry (LULUCF) sector.

Phase 2 of the Land Use Review has two working groups:

1. A technical working group to advance the land evidence recommendations from the first phase, to identify land use scenarios to achieve environmental and socio-economic objectives and to set out potential policy options.
2. A citizen engagement working group to communicate, inform, engage and motivate all stakeholders on the agreed national priorities that constitute a shared vision for the necessary transition in land use.

Both working groups report to an oversight group, which in turn reports to the Minister for the Environment, Climate and Communications, the Minister for Agriculture, Food and the Marine, and the Minister of State for Nature, Heritage and Electoral Reform.

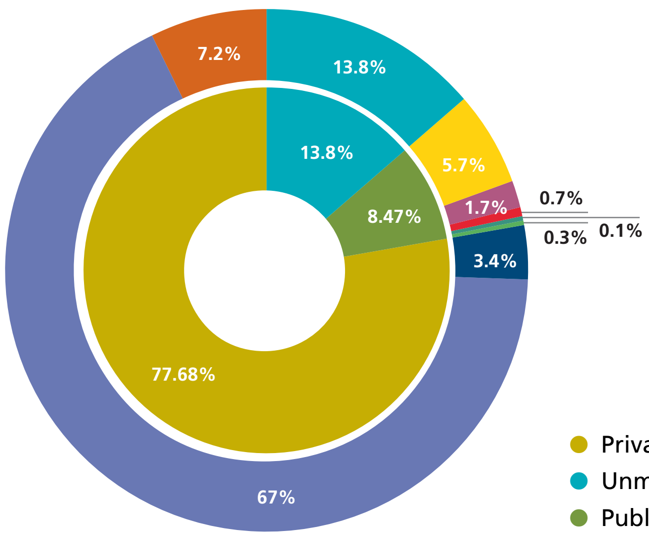
Land use and people

Ireland has a population of 5.3 million (CSO, 2023). The economic activities, residential needs and transport activities of the population influence Ireland's land use profile. As outlined above, at least 60% of Ireland's land cover is agricultural (grassland or cultivated land) reflecting the importance of agriculture to Ireland's economic and social profile. The National Land Cover Map (Table 5.1) shows that artificial surfaces (roads, residential development and commercial development) make up 3.8% of Ireland's land cover. Around 25% of all housing in Ireland tends to be in the form of single houses in the open countryside, developed on agricultural land. This can present challenges for service provision (e.g. delivery of public transport or active travel solutions for rural populations and provision of water and sanitary services).

Under Project Ireland 2040, the National Planning Framework (NPF) projects a population of approximately 5.8 million by 2040 and the Central Statistics Office (CSO) projects a population of up to 6.7 million by 2051. A growing population will influence demands for competing uses of land to support, variously, food production, and the development of new housing, services, infrastructure and amenity uses. Housing is currently in critical demand. More recently, the NPF committed to securing 50% of new housing through developments within the general boundaries of existing built-up areas and through brownfield development.

A high-level land ownership assessment (Figure 5.6) conducted during phase 1 of the Land Use Review identified that 78% of Ireland's land is privately owned (DAFM and DECC, 2023b). This influences how land use decisions are made and what land management practices may be adopted. The ownership profile demonstrates that high-level stakeholder engagement and buy-in are critical to underpin the development and realisation of any vision for overall land use in the longer term.

Figure 5.6 High-level assessment of Ireland's land ownership profile



Private	77.68%
Unmapped	13.8%
Public	8.47%

Farmland (not commonage)	67%
Farmland (commonage)	7.2%
Unmapped	13.8%
Forestry (public)	5.7%
Local government	1.7%
Fuel and energy	0.7%
'Public' combines transport, general public services, education/training, regional/local agency/corporate leisure/tourism, public order and safety, unknown, national corporation	0.1%
Central government/agency	0.3%
Forestry (private)	3.4%

Source of data: DAFM and DECC, 2023b

Land use as an environmental pressure

Environmental indicators are measures that provide evidence about the status of the environment. In phase 1 of the Land Use Review, existing indicators were examined to assess the environmental impacts of land use (DAFM and DECC, 2023c).

Greenhouse gas emissions. Ireland's land is a net source of GHG emissions. It accounted for 9.3% of national total emissions (including LULUCF) in 2023 (EPA, 2023). The main sources of emissions are the drainage of grasslands on organic soils and the exploitation of wetlands for peat extraction (EPA, 2024). Forest land, on the other hand, is a carbon sink. However, this carbon sink is on a declining trend given the age profile of Ireland's forests. Ireland's Climate Change Assessment (Thorne *et al.*, 2023) notes that achieving net zero in this sector will require unprecedented rates of afforestation, rewetting of organic soils, peatland restoration and enhanced carbon sequestration in mineral soils.

Water quality. Current land use practices in Ireland are putting pressure on water quality. The Water Action Plan 2024 (DHLGH, 2024) identifies agricultural land use as the most common and significant pressure on water bodies, impacting over 1000 of Ireland's water bodies. Urban run-off and domestic waste water are also significant pressures on water bodies and are closely related to residential and industrial land use. Forestry and mining land use are also linked to significant pressures on water bodies.

Biodiversity. Current land use practices in Ireland are impacting biodiversity. Agriculture is the most prevalent pressure and threat to protected habitats (NPWS, 2019). Forestry impacts 35% of protected habitats, largely due to non-woodland habitats being converted to commercial forestry, forestry activities impacting water quality and drainage for afforestation. Mining and quarrying affected 32% of protected habitats; this was due to the negative direct effects on habitats of the extraction of minerals and the impacts of peat extraction. Such extraction removes peat bog habitats and has negative consequences for freshwater habitats. Industrial, infrastructure and residential land use all result in soil sealing, which destroys, reduces or fragments areas of natural habitat. Fragmentation is a pressure on all habitats and species because it can limit the area available for foraging for food and it breaks populations down into smaller (and less genetically diverse) communities. National Biodiversity Indicator C.1.i rates fragmentation in Ireland as 'amber' on a red-amber-green scale (NBDC, 2021). European Union (EU) strategies and objectives relating to no net land take are important for preserving intact habitats. The potential impact of urban development on habitats can be mitigated by land recycling and by the densification of urban areas, rather than by using land with higher biodiversity potential.

Soil sealing. Imperviousness (covering soil with an impermeable surface such as concrete) has increased in Ireland since 1990. Sealed soil cannot be used for other important services, including growing food, supporting ecosystems or flood mitigation. Most of the soil sealed in Ireland was originally grassland, unlike in other EU Member States, where mainly cropland has been sealed. Soil sealing arises from covering land with housing, industrial or other built-up areas and with infrastructure.

4. Land use commitments and constraints

Ireland's land use profile is influenced by economic activities, sociological factors, and national and regional policies and strategies. Some of the current range of policies and strategies that are highly relevant for land use are set out later in Table 5.3. Enacting national planning policies and legislation is done through planning legislation at the local level. The government's long-term strategy for physical and spatial development and the built environment, Project Ireland 2040, was published in 2018 and a Draft First Revision to the National Planning Framework (NPF) was published in July 2024.

Under Project Ireland 2040, the NPF guides development and land use investment. It influences the regional spatial and economic strategies of the three regional assemblies of local authorities. It also influences city and county development plans, local area plans and planning schemes in the strategic development zones of the 31 local authorities. The NPF sets high-level goals for managing the growth of Dublin, regional cities and the three regional assembly areas, for promoting sustainable rural regeneration and for promoting more compact urban development within the footprint of existing built-up areas to counteract a business-as-usual trend towards extensive urban expansion and urban sprawl. In tandem with the NPF, the National Development Plan 2021–2030 provides an investment framework (up to €165 billion) built around ten national strategic outcomes shared with the NPF under the overall Project Ireland 2040 initiative. An overview of the Irish planning system is set out in Figure 5.7.

A development plan is the main public statement of planning policies for each county or city. It sets out the land use, amenity and development objectives and the policies of the planning authority for a given 6-year period. The plan consists of a written statement of objectives and includes maps that give a graphical representation of how the city or county will develop over the period. Local area plans provide more detailed planning policies for areas where significant development and change is anticipated. Local area plans must be compatible with national and regional guidance documents and the core strategy and policies of the development plan.

The Office of the Planning Regulator (OPR) was established in 2019 as the independent oversight body for planning. The OPR reviews local authority development plans to ensure that they are consistent with relevant planning policies, including the NPF and the regional spatial and economic strategies, and to ensure compliance with environmental assessment and climate change obligations.

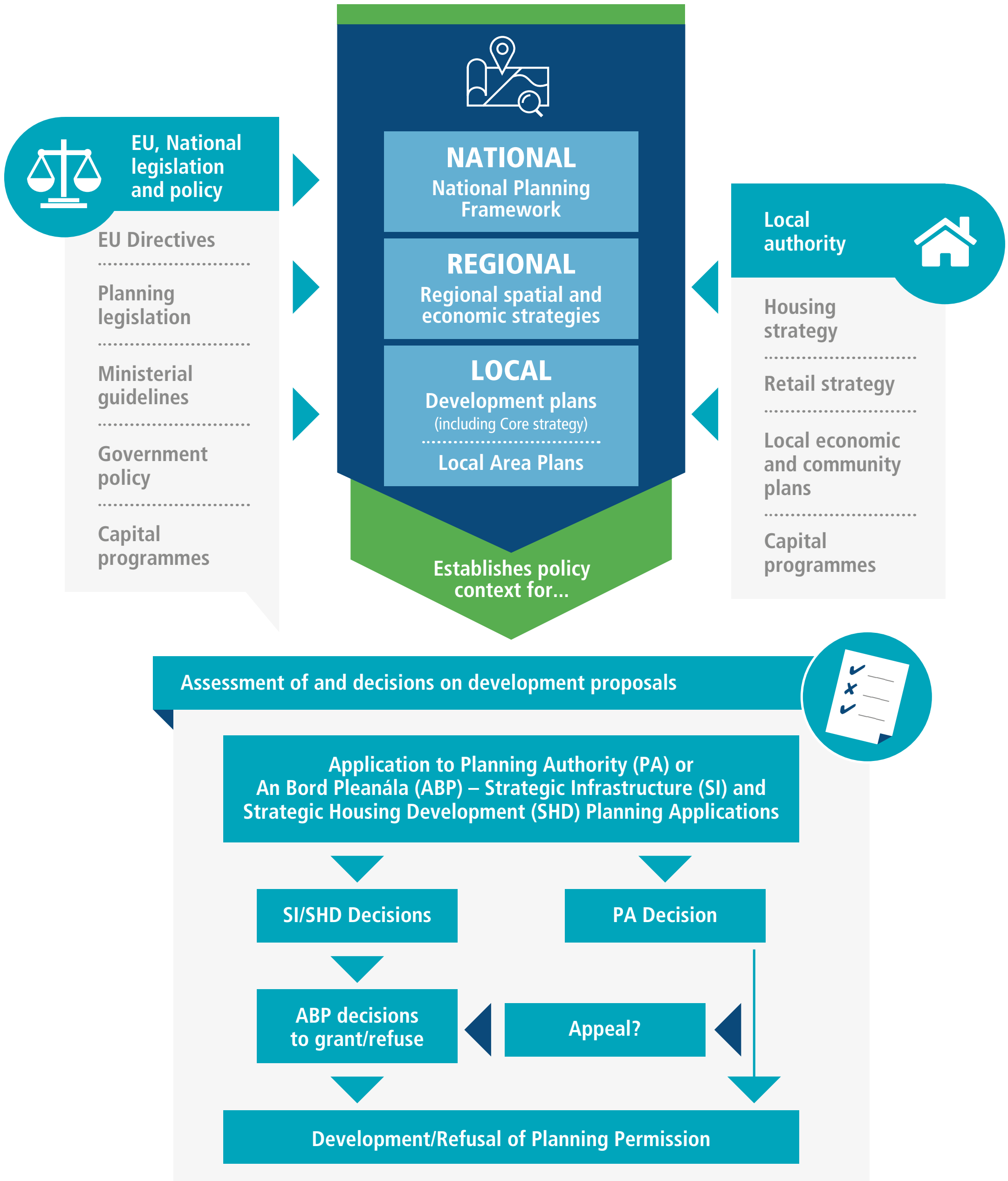
An expert group recommended that the first revision of the NPF should build on the current NPF strategy and strengthen it in three main areas:[2]

1. Compact growth targets should be more ambitious and more clearly defined.
2. The roles of the bodies involved in its implementation should be clarified and strengthened (particularly in relation to metropolitan area strategic plans) and mechanisms should be put in place for more detailed measurement and monitoring of its progress.
3. There should be greater coordination at whole-of-government level across all infrastructure projects (including the National Development Plan) and new efforts should be made to generate broader support for national spatial planning across all of society.

The Climate Change Advisory Council (CCAC) recommendations, included in the Climate Action Plan 2024, also support more ambitious targets for compact growth (denser housing) and a reassessment of how compact growth is measured from a spatial perspective. The Council also calls for more incentivisation of urban brownfield development to limit urban sprawl and urgent investment in accessible public transport (CCAC, 2023).

2 www.npf.ie/expert-group-report-on-the-national-planning-framework-published/ (accessed 2 July 2024).

Figure 5.7 An overview of the Irish planning system



Source: Adapted from Government of Ireland, 2018

The NPF sets out broad goals for how Ireland's land should be used, but there are also other policies and strategies that make commitments on how land should be used or managed. Many demands come from current economic and social contexts that are unlikely to change: we need land for housing and to grow our food, and these needs will continue. Other policies have land use implications (Table 5.3) either to use land for new and different purposes or to manage land in a different way.

The high-level review in Table 5.3 is not exhaustive: it does not catalogue every policy or strategy that has a land use impact. It highlights the main environmental policies and shows that, as pressures on Ireland's land continue, we must find a way to resolve competing demands while managing land in a manner that supports its ability to play its important role in air and water cycles and in supporting healthy ecosystems.

Table 5.3 High-level review of the main policies, strategies and legislation that influence land use

Policy/strategy/ legislation	Explicit conservation target (conserves or limits a land use)	Explicit expansion target (will use more land)	Possible consequential impact (the target is not explicit but could result in a land use change)
ECOSYSTEMS			
EU Biodiversity Strategy for 2030 (May 2020)	Carbon-rich ecosystems should be protected Stop the loss of green urban areas and implement urban greening plans	Set up ecological corridors Increase the quantity, quality and resilience of forests	Increase in protected areas for habitats and species, with an emphasis on high nature value areas
Bord na Móna's Enhanced Decommissioning, Rehabilitation and Restoration Scheme 2021–2026 (November 2020)	Rehabilitate 33,000 ha of post-production peatlands	N/A	N/A
EU Nature Restoration Law (June 2024)	No net loss in the total national area of urban green space and of urban tree canopy cover in urban ecosystem areas compared with 2021. After 2030 the areas must increase, with progress measured every 6 years through a national restoration plan	N/A	EU countries must restore at least 30% of Annex 1 habitat areas in poor condition by 2030, 60% by 2040 and 90% by 2050
EU Common Agricultural Policy Strategic Plan 2023–2027 (January 2023)	Protect wetland and peatland areas National ratio of permanent grassland to agricultural area should not decrease by more than 5% compared with 2018	N/A	Minimum of 4% of agricultural area devoted to space for nature
Food Vision 2030 (August 2021)	N/A	N/A	By 2030, 10% of Ireland's farmed area will be prioritised for biodiversity, spread across all farms throughout the country
Sectoral climate adaptation plans: biodiversity (November 2019)	N/A	N/A	Design corridors to enhance the resilience of protected areas and increase opportunities for dispersal across the landscape
National Biodiversity Action Plan (January 2024)	Tackle Invasive Alien Species and expand protected area network	N/A	Increase in protected areas

Policy/strategy/ legislation	Explicit conservation target (conserves or limits a land use)	Explicit expansion target (will use more land)	Possible consequential impact (the target is not explicit but could result in a land use change)
FORESTRY			
Food Vision 2030, Ag Climatise and LULUCF target	N/A	Increase afforestation from existing levels to at least 8000 ha per year and double the sustainable production of biomass from forests to 2 million tonnes by 2035	N/A
Ag Climatise (December 2020)	N/A	Construct 125 km of new forest roads per year to facilitate the movement of biomass and harvested wood products Through the forestry programme, continue to fund the planting of woodlands of different sizes (from 0.1 ha upwards) to increase connectivity between hedgerows and larger woodlands and provide corridors for wildlife	N/A
Ireland's Forestry Strategy 2023–2030 (September 2023)	N/A	Meet a forest cover target of 18% or more by 2050	N/A
Coillte Strategic Vision (April 2022)	N/A	Coillte to grow 100,000 ha of new forests by 2050	N/A
Ireland's National Energy and Climate Plan 2021–2030 (June 2020)	N/A	Deliver expansion of forestry planting and soil management to ensure that carbon abatement from land use is delivered in 2021–2030 and in the years beyond	Promote the increased use of domestic harvested wood in longer lived products, thus enhancing the storage of carbon in these products and replacing materials with a higher carbon intensity

Policy/strategy/ legislation	Explicit conservation target (conserves or limits a land use)	Explicit expansion target (will use more land)	Possible consequential impact (the target is not explicit but could result in a land use change)
BUILT LAND AND TRANSPORT			
EU Soil Strategy[a] (November 2021)	No net land take[b] by 2050 A no net land take goal requires reducing soil sealing and reusing existing abandoned land for development	N/A	N/A
Housing for All (September 2021)	Introduce a new tax to activate vacant land for residential purposes and to replace the vacant site levy	Increase supply of new housing, up to an average of at least 33,000 per year to 2030 State land bank to provide more land to the Land Development Agency to bring forward up to 15,000 homes and state to fund local authorities for land acquisition	N/A
Ireland's National Energy and Climate Plan 2021–2030 (June 2020)	Make growth less transport intensive through better planning, remote working and modal shift	Expand the network of cycling paths and park and ride facilities	N/A
National Sustainable Mobility Policy 2022–2025 (April 2022)	Support compact growth and transport-orientated development through better integrated land use and transport planning	Deliver improved active travel infrastructure, expansion of regional bus and rail services and local bus networks, and improved connectivity between different transport modes	N/A
National Demand Strategy (2024)	Includes examination of optimal use of space and integrated land use and transport planning	N/A	N/A
5-year local authority climate action plans	Climate Action Plan 2024 encourages local authorities to consider road space reallocation in their 5-year climate action plans	N/A	N/A
National Cycle Network and CycleConnects	N/A	N/A	Roll-out of walking and cycling infrastructure

Policy/strategy/ legislation	Explicit conservation target (conserves or limits a land use)	Explicit expansion target (will use more land)	Possible consequential impact (the target is not explicit but could result in a land use change)
AGRICULTURE			
Ireland's Fifth Nitrates Action Programme 2022–2025 (March 2022)	N/A	N/A	6 m buffer in critical source areas Limits on farm stocking rates
Ireland's National Energy and Climate Plan 2021–2030 (June 2020)	N/A	N/A	Reduced management intensity on at least 40,000 ha per annum of grasslands on drained organic soils Better management of grasslands, tillage land and non-agricultural wetlands (1.4 Mt CO_2 eq cumulative abatement) Specified range of improvements in farming practices in line with recommendations from Teagasc Support diversification in agriculture and land use to develop sustainable and circular value chains and business models for lower carbon intensity farming
Ag Climatise (December 2020)	N/A	Action 10: Increase the area under tillage production above the current area of 300,000 ha by 2030, producing more native-grown grains and legumes for the livestock industry while further enhancing the environmental credentials of the sector	N/A
Common Agricultural Policy (CAP) Strategic Plan 2023–2027 (January 2023)	N/A	N/A	Fund and plant more hedgerows

Policy/strategy/ legislation	Explicit conservation target (conserves or limits a land use)	Explicit expansion target (will use more land)	Possible consequential impact (the target is not explicit but could result in a land use change)
ENERGY			
Ireland's National Energy and Climate Plan 2021–2030 (June 2020)	Phase out coal and peat-fired electricity generation	N/A	Increase the share of electricity generated from renewable sources to 70%, underpinned by the Renewable Electricity Support Scheme Generate at least 3.5 GW of offshore renewable energy of mainly offshore wind, develop up to 1.5 GW of grid-scale solar energy, and increase onshore wind capacity to up to 8.2 GW Introduce a support scheme for micro-generation Increase the renewable biofuel content of motor fuels, underpinned by the biofuels obligation scheme Introduce legislation to ban the sale of new fossil fuel cars from 2030 Support efforts to increase the share of domestic renewable sources in the energy mix, including wind, solar and bioenergy Facilitate infrastructure projects, including private sector commercial projects, that enhance Ireland's security of supply and are in keeping with Ireland's overall climate and energy objectives
Renewable Energy Directive ((EU) 2023/2413) (October 2023)	N/A	N/A	A binding overall EU target to reach a share of at least 32% of energy from renewable sources

[a] See Chapter 6

[b] Land take occurs when soil is sealed for development use, meaning that the soil cannot be used for other important means including supporting ecosystems, flood mitigation or growing food

Mt CO_2 eq, megatonnes of carbon dioxide equivalent

GW, gigawatts

N/A, not applicable

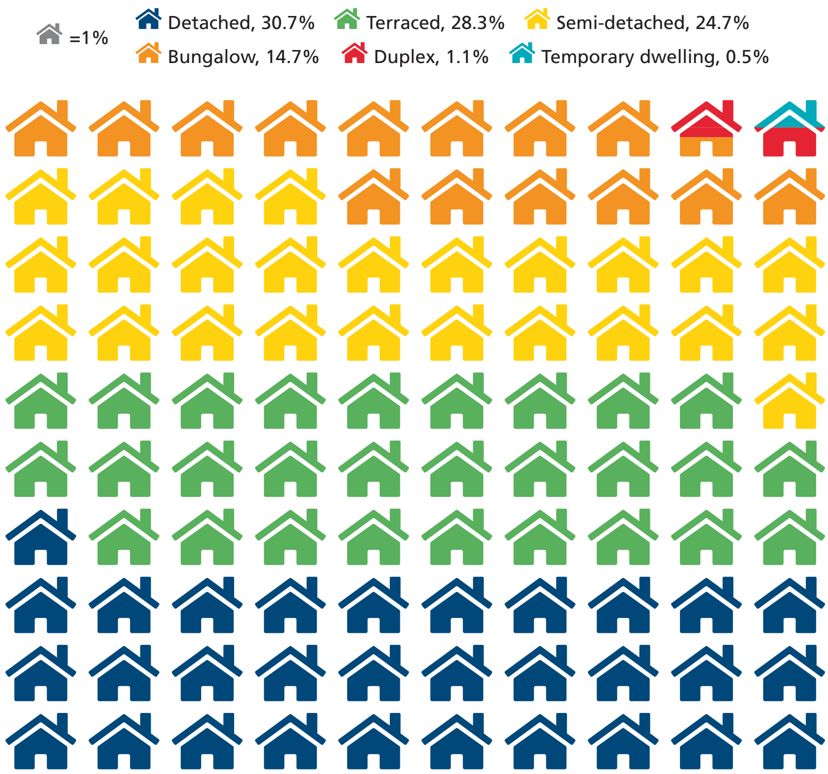
As shown in Table 5.3, explicit conservation targets exist for built land (via the no net land take target under the EU Soil Strategy, see Chapter 6) and for peatlands and permanent grasslands (under the CAP Strategic Plan 2023–2027). In summary, these targets set out that the extent of artificial surfaces (3.8% according to the National Land Cover Map) should not increase, the peatland area (6.5%) should not decline further and the ratio of permanent grassland to the total agricultural area should not decrease by more than 5%.

Current policies and strategies (Table 5.3) include explicit expansion targets for ecosystems, forestry and agriculture and for more built land to provide housing and to service mobility (mostly for the provision of active travel, greenways and increased rail connections). The expansion targets protecting space for nature do not prescribe how land should be used, and this is where land management comes in. The correct land management policy and approach can make it possible for healthy ecosystems to successfully co-exist with land uses such as forestry and agriculture.

Meeting land use targets

Meeting Ireland's housing targets while adhering to the no net land take target in the EU Soil Strategy (see Chapter 6) will require using vacant or derelict properties (for which there are some explicit targets), increasing the density of development and implementing land recycling (reuse of abandoned, vacant or underused land for redevelopment). Census 2022 found that the increase in housing stock from 2016 to 2022 was equivalent to an average 1% rise per year, while the population rose by 1.2% per year during the same period. As illustrated in Figure 5.8, GeoDirectory, the national address database jointly managed by An Post and Tailte Éireann, identifies over 2.1 million residential dwellings in Ireland.[3] The national residential vacancy rate in June 2023 stood at a record low of 3.9% (81,712 units), and 21,134 address points were classified as derelict.

Figure 5.8 Residential dwellings stock



Source: GeoDirectory, 2023

3 assets.ey.com/content/dam/ey-sites/ey-com/en_ie/topics/economics/ey-geodirectory-residential-report-q4-2023.pdf (accessed 25 July 2024).

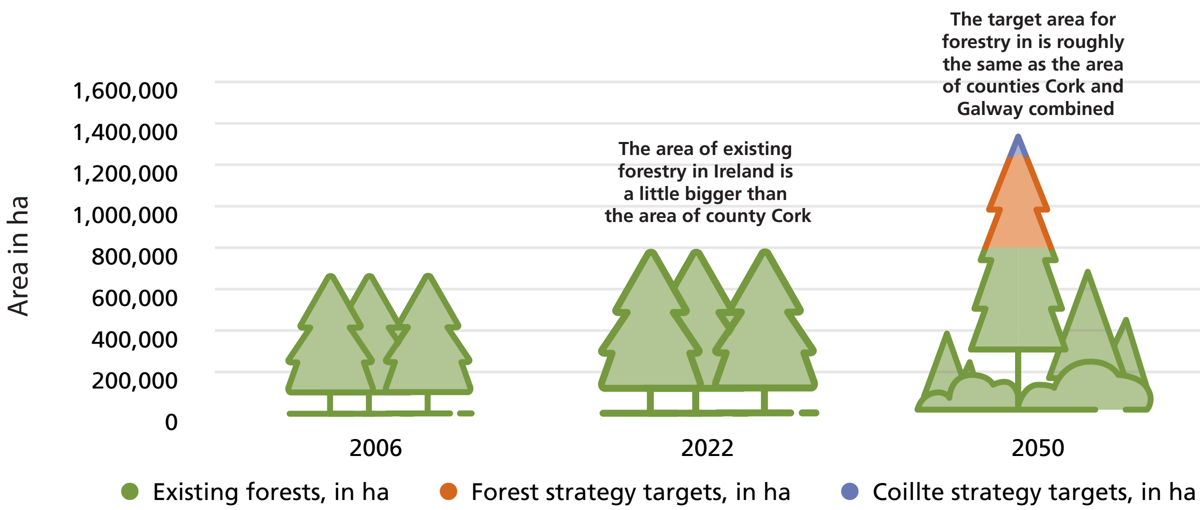
Achieving a no net land take target has implications for how other national policies might be delivered. For example, under a no net land take target, the 33,000 homes sought under the Housing for All policy (Table 5.3) would be supplied each year without a consequent net increase in artificial surface area (according to the National Land Cover Map, artificial surface areas are currently 3.8% of Ireland's land area). The GeoDirectory Residential Buildings Report 2023 identified 22,842 buildings under construction with 17.2% of the new construction activity occurring in Dublin (GeoDirectory, 2023).

Based on the assessment of policies and strategies undertaken (Table 5.3), the most frequently occurring explicit expansion target is to increase the area under forestry. Of the policies assessed, six have targets for forestry expansion. These policies and associated targets have different purposes, such as increasing carbon sequestration, providing raw material for biomass or building and promoting ecosystem connectivity. Given that forestry is currently a pressure on protected habitats and on water quality, any expansion of forestry to meet climate action and sustainable development objectives must be done in a way that has a positive impact on biodiversity and water quality.

The National Forest Inventory for 2022[4] identified that 808,850 ha (11.6%) of Ireland's land area was forest (DAFM, 2023). Forest cover increased from 10% (697,842 ha) in 2006 to 11.6% in 2022.

The Forest Strategy target of 18% by 2050 would mean that 1,256,116 ha of Ireland's land area would be forest (on both public and private land), an increase of 447,266 ha. The Coillte target aims to supply 100,000 ha of new forest by 2050, which is just under one-quarter of the Forest Strategy target. The Food Vision 2030 and Ag Climatise targets of 8000 ha per year would take 43 years to achieve the Forest Strategy target (assuming that the Coillte target is achieved and counted as part of the overall Forest Strategy target). Ireland's Climate Change Assessment (Thorne *et al.*, 2023) noted that for forests to contribute to net zero emissions would require between 25,000 and 30,000 ha of planting per year which is significantly higher than the 8000 ha outlined in the Forest Strategy. Figure 5.9 gives an indication of the forestry targets.

Figure 5.9 Forestry levels in Ireland (2006 and 2022) and 2050 target levels



Source: DAFM, 2023

4 The National Forest Inventory uses a specific method to measure forestry, so its estimate of Ireland's national forest cover is different from that of the National Land Cover Map. The figure provided by the Forest Inventory is considered the official statistic for forest cover in this chapter.

The EU Biodiversity Strategy, the Common Agricultural Policy Strategic Plan (including the €1.5 billion ACRES agri-environment scheme) and Food Vision 2030 all set targets for space for nature within agricultural land. Food Vision 2030 recognises the significant pressure on water quality and biodiversity exerted by agriculture (as the predominant land use). Food Vision 2030 outlines a sustainable food systems approach that recognises how fundamental a healthy environment is to food production. Such an approach requires food producers to also be engaged in sustainability measures (e.g. cutting GHG emissions, managing water resources, storing carbon, protecting soil health and supporting biodiversity). Food Vision 2030 calls for more to be done at EU and national levels to incentivise the delivery of ecosystem services by food producers. Initiatives such as the Farming for Nature programme provide tangible examples of farms that are productive and have a positive impact on biodiversity.

While some policies have a very clear land use implication – they will either conserve or expand particular land uses – other potential consequences are not clear, as they depend on how policies are implemented. For example, whether the Fifth Nitrates Action Plan, and any changes to Ireland's Nitrates Derogation, have an impact on land use demands depends on the response to reduced stocking rates and whether they are achieved by expanding the area of land farmed or by managing the number of livestock.

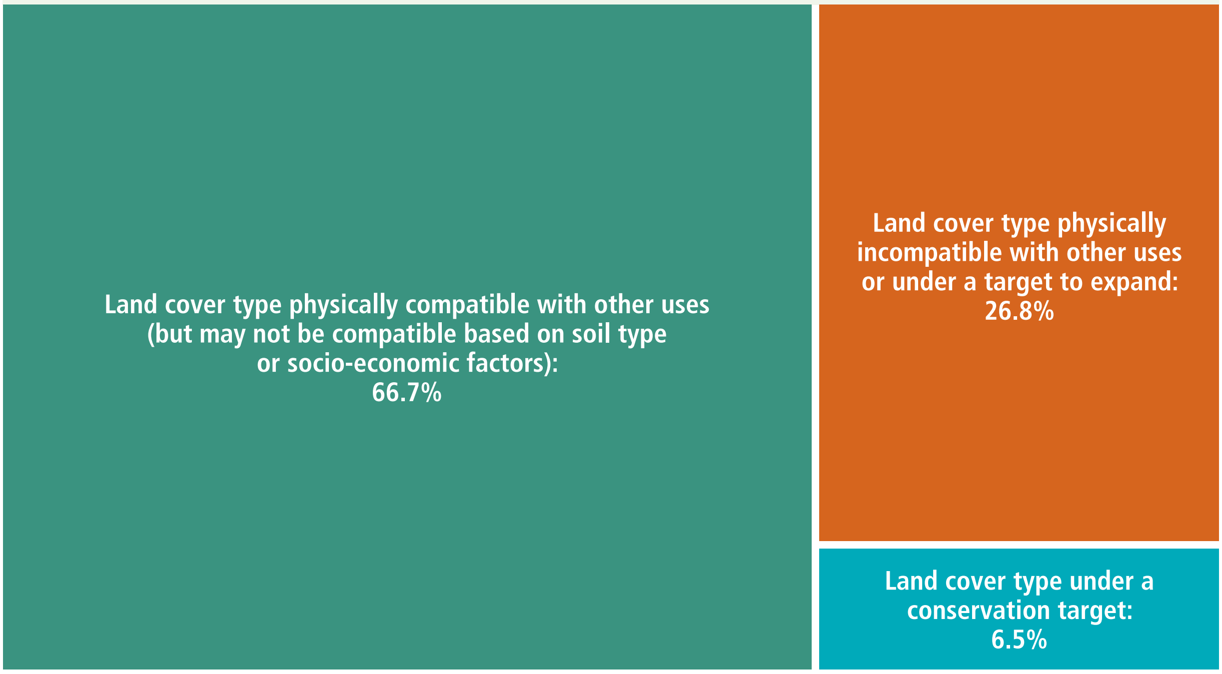
Similarly, renewable energy targets incur demands for onshore wind and solar installations. The impact of this demand on land use depends on the type of land the energy installations occupy and the potential for energy generation to co-exist with other land uses. Solar and wind energy infrastructure can co-exist with other land uses (e.g. agrivoltaics is the dual use of land for agriculture and solar power generation). The revised Renewable Energy Directive ((EU) 2023/2413) entered into force in October 2023. It requires the existing share of renewable energy in the EU to double. In identifying where renewable generation can be accelerated, Member States must map the domestic potential for renewable energy generation and the associated infrastructure required by May 2025. The revised Renewable Energy Directive proposes that the permit-granting procedures may need to be further streamlined to enable the acceleration of renewable energy delivery. Renewable energy generation can be achieved through wind energy, solar energy and bioenergy (Figure 5.10). The specific effects of the acceleration of energy generation on Ireland's land use depends on how these energy sources are implemented.

Figure 5.10 Solar array, Hilltown Solar Farm, Co. Meath

Credit: David Dodd, DECC

National policies and strategies, along with our existing land use practices, are placing demands on Ireland's land. Not all locations and existing land uses can support changes in land use or the addition of different land uses. For example, artificial surfaces are generally not compatible with forestry or agricultural expansion targets, as this would require the removal of built surfaces first. Figure 5.11 shows a limited, high-level assessment of existing land cover types that are potentially physically compatible with a future change in land use. It indicates that up to 66.7% of Ireland's land is potentially physically compatible with a change in land use. However, this assessment does not consider other important contexts, such as soil type or the social or economic aspects of a change in land use. Accordingly, the actual amount of land that is truly compatible with a change in land use – when soil type, social, economic and other factors are considered – is likely to be considerably less. The assessment doesn't account for multiple land uses at the same location which will be an important approach for the future. A much deeper assessment of which land uses are suitable for different locations is required to create a clear picture of land demand in Ireland and to identify whether Ireland can accommodate all current land use demands.

Figure 5.11 Area of land in Ireland that is physically compatible with a change in land use to meet policy targets



Other land use constraints

As well as social and economic factors, other constraints can influence the suitability of land for particular uses. Climate change brings increased climatic hazards. The Climate Ireland portal[5] identifies coastal erosion, inland flooding, coastal flooding and water scarcity as Ireland's key climatic hazards of concern.

Coastal erosion will influence future land use in coastal zones, depending on the strategic approaches adopted locally to respond to coastal erosion (Figure 5.12). Strategies to conserve existing developments or land uses in coastal zones can manage the impact but may require significant investment in hard infrastructure. Retreat allows for coastal erosion but may result in land uses or development projects having to be abandoned or for 'no development' policies to be implemented in coastal zones.

5 www.climateireland.ie (accessed 2 July 2024).

Figure 5.12 Coastal erosion near Kilmore, Co. Wexford

Credit: David Dodd, DECC

Nationally, Ireland has high levels of water availability, but there are constraints on the water supply in more densely populated areas, particularly along the east coast, which might affect residential and commercial development. Uisce Éireann's water supply capacity register[6] shows that, while there is capacity for new connections in the Dublin area, there are limits on the level of service available and that water conservation orders are likely until the development of new supplies. Examination of the 2018 drought identified that, while the drought occurred on a national scale, its impacts varied: eastern regions reported a reduction in harvested biomass, while western uplands and bogs in the midlands produced more biomass (Falzoi *et al*., 2019). Ireland's Climate Change Assessment (Thorne *et al.*, 2023) projects increases in the frequency and severity of droughts which may impact regional agricultural and forestry land use and ecosystems.

The Office of Public Works has modelled the risk for coastal and river flooding. An analysis of the coastal flood risk overlain on the National Land Cover Map shows that the types of land cover most likely to be impacted by coastal flooding include the typical land cover classes that occur in coastal areas (sand dunes, saltmarshes, etc). Table 5.4 shows the areas of land cover types that are at risk from coastal flooding and river flooding under modelled high-probability scenarios.

For coastal flooding, typical coastal land cover types such as saltmarshes and sand dunes are at risk. This assessment provides a high-level summary of the types of land cover that are at risk of flooding, indicating the types of land use constraints that we will have to contend with as Ireland's climate changes. Considering their relative extent in the National Land Cover Map, artificial areas are relatively more at risk from coastal and river flooding than other land cover types. Ireland's Climate Change Assessment (Thorne *et al.*, 2023) noted the importance of developing plans – particularly for the built environment and coastal environments – to develop a climate-resilient Ireland.

6 www.water.ie/connections/developer-services/capacity-registers/water-supply-capacity-register/dublin/ (accessed 2 July 2024).

Table 5.4 Areas of land cover types at risk of coastal or river flooding (in hectares) according to the Office of Public Works' high-probability flood scenarios

Land cover type	Area (ha) at risk under high-probability flooding scenario	
	Coastal flooding	River flooding
Artificial surfaces	2,529	3,269
Exposed surfaces	4,961	2,767
Cultivated land	3,075	4,616
Forest, woodland and scrub	6,404	12,370
Grassland	29,130	50,256
Saltmarsh and swamp	4,419	1,190
Peatland	809	5,963
Heath and bracken	645	232

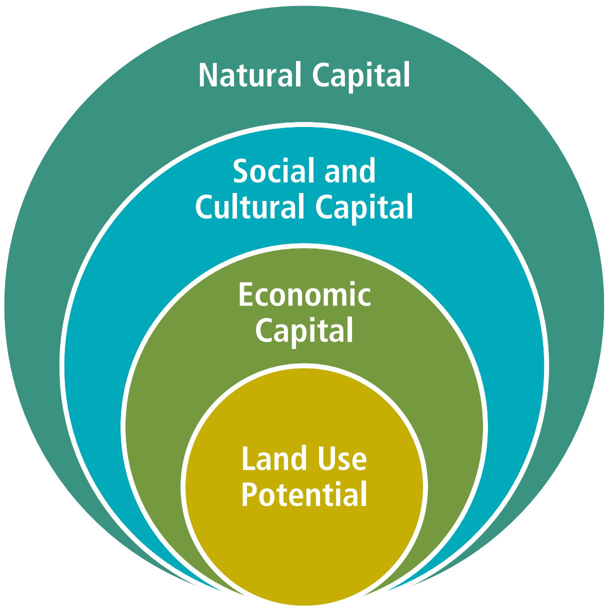
5. Responses to land use pressures and land demands

A range of approaches are being taken to address land use pressures and goals in various countries, including Ireland. A capitals framework concept (DAFM and DECC, 2023d) identifies land as a critical resource underpinning economic, social/cultural and natural capital (Figure 5.13). These three types of capital are interrelated; activities in one can result in positive or negative outcomes in another. Natural capital refers to the direct and indirect value that nature provides to society (Dwyer and Wentworth, 2020). Natural capital includes freshwater, minerals, soil for growing food, and natural services such as pollination. An important conclusion of the capitals framework is that safeguarding natural capital requires a shift from policies that focus on different aspects of land use towards a more integrated approach (Dwyer and Wentworth, 2020). A Royal Society paper (RS, 2023) recommends that land use decision-making should be based on a multifunctional approach that considers natural aspects when making decisions about economic or social uses of land.

Examples of national land use plans

The importance of prioritising land use decisions as the basis for meeting socio-economic, climate change and biodiversity goals is supported by an assessment completed by the Danish Council on Climate Change (DCCC, 2024). The assessment considered how Denmark's land use in 2050 would be able to meet three goals (limiting GHG emissions, achieving good ecological status in water bodies and making room for biodiversity). The assessment identified a synergistic effect: some land uses contribute to several objectives simultaneously if applied in the right locations. The synergistic effect could help to limit the costs of achieving the three objectives. Given that 72% of Denmark's land is agricultural, the regulatory framework proposed in the assessment could be of significant interest to Ireland.

Figure 5.13 A capitals approach to land use



Source: DAFM and DECC, 2023d

The concept of multiple benefits is not new: Scotland implemented a multiple benefits approach in its first land use strategy in 2011 (Scottish Government, 2011).

Scotland has released two further land use strategies since 2011, both of which build on the initial strategy. Like Ireland, Scotland's land is mostly in private ownership. The 2017 Scottish statement of land rights and responsibilities recognised the close relationship between land and people and that 'land use and ownership contribute to the fulfilment of many human rights' (Scottish Government, 2017). Managing land use to meet multiple needs requires a truly collaborative approach to understanding (sometimes competing) stakeholder requirements across different sectors at scales that can be implemented at a local level (Hölting *et al.*, 2020). Meaningful stakeholder engagement from the start is essential for the implementation of land use that provides multiple benefits (Dwyer and Wentworth, 2020). This is especially important in Ireland, given Ireland's land ownership profile and the importance of community buy-in for land use decisions.

Scotland's current (and third) land use strategy recognises that demands on its land are growing and that addressing climate and nature emergencies requires changes in how land is used (Scottish Government, 2021). Scotland's land use strategies illustrates the potential to move away from a siloed view of land use towards a recognition of land use as a system.

Topic Box 5.2 Scotland's land use strategies

Scotland's first land use strategy (Scottish Government, 2011) stated that, while Scotland's land area is fixed, the benefits that land can deliver are not. The strategy noted that not all land benefits (or services) are visible to landowners and, with the right knowledge and support, land capacity could be better exploited in sustainable ways. Land use that delivers multiple benefits describes a land use approach that delivers various positive outcomes, often for more than one stakeholder. One example presented in Scotland's land use strategy is an agroforestry land use approach whereby natural woodland on a farm provides shelter for livestock along with carbon retention and ecosystem benefits.

Scotland second strategy (2016–2021) retained the vision and objectives of the first and sought to clarify how a land use strategy would support cross-sectoral, rather than sector-by-sector, approaches to land use (Scottish Government, 2016). The second strategy was followed by a statement of land rights and responsibilities (Scottish Government, 2017).

Scotland's third land use strategy presents an overarching vision of what sustainable land use in Scotland could look like, moving away from a sector-by-sector approach. The strategy presents seven representative landscapes with a vision for how each landscape would change if competing land uses were sustainably managed.

Phase 1 of Ireland's Land Use Review includes a review of 21 national land use plans (NLUPs) and strategies from other countries to assess their approaches to land use planning. The plans all took different approaches, but the concept of the interconnectedness of land use decisions and environmental (or natural) capacity was a common theme in many. Ecosystem services approaches were taken by Costa Rica, Iceland, Portugal and Switzerland. Portugal's NLUP perceived ecosystem services as a way of differentiating regions and redistributing wealth, noting the importance of integrating ecosystem services into economic value chains. Costa Rica was an early adopter of payments for ecosystem services. To address low forest cover, a 1996 law paid landowners to convert agricultural land and livestock farming into agroforestry and silvopasture (combining trees and livestock).

Payment was provided for mitigating GHG emissions and protecting biodiversity, water and/or scenic beauty. Costa Rica significantly increased its forest cover, and land has become a carbon sink (DAFM and DECC, 2023e).

Another common theme across many of the NLUPs was the use of spatial data and models to help design and track land use decisions and interventions. Access to data through programmes such as the European Copernicus Land Monitoring Service offer great potential to track changes in land use, as they make it feasible to quickly assess the impacts of land use decisions.

Ireland's Land Use Review

The 19 recommendations from phase 1 of Ireland's Land Use Review address the data and evidence that should be developed to support land use plans in Ireland. Phase 1 recommended developing the ability to track and model Ireland's land use as the integrated and interconnected system that it is. Phase 1 delivered a point-in-time assessment of Ireland's land use: bringing together a complete set of integrated indicators would enable a constant or rolling review.

While phase 1 of the Land Use Review gathered evidence, phase 2 is assessing land use policies and measures. As outlined above, land use is driving pressures on the environment, but adopting a more integrated approach with multiple benefits, similar to approaches being taken by other countries, could provide a way forward. The challenge for phase 2 of the review is to identify the measures that are needed to ensure that Ireland's natural capital remains able to sustain social and economic land use needs. The engagement of all stakeholders is key (Dwyer and Wentworth, 2020), and the NLUP approaches of other countries show potential pathways for incentivising the protection of natural capital.

6. Conclusions

Ireland's land cover data tell us that the main land cover is grassland. Since 1990 there have been long-term trends of increasing areas of artificial surfaces, of wetland loss and of growing areas of forestry. Ireland's land cover changes have been driven by different factors, including national policy and economic activity. The new National Land Cover Map provides higher resolution information about domestic land cover than Ireland has ever previously accessed. Phase 1 of the Land Use Review made 19 recommendations about how Ireland's land evidence can be further extended and improved to support land use decisions.

The aim of the ongoing Land Use Review is to identify appropriate policies, measures and actions in the context of the government's wider economic, social and climate objectives. Environmental evidence shows that land is a net source of GHG emissions, and land use is driving pressures on water quality and biodiversity.

There are many demands on Ireland's land. Along with a growing population, there are a range of national policies and strategies that have targets that depend on land. Ireland's land is mostly privately owned, so the active engagement and participation of all land stakeholders is vital to ensure that policies and targets are successfully implemented.

While land-related policies and targets are often set at the national level, their implementation depends on the local scale: different locations are suited to different land use options. While it is challenging to consider local implementation when forming national policy, Ireland's relatively small geographical size makes this more feasible. The new National Land Cover Map, and advances in land mapping data and technology, present opportunities to support local-level decision-making. Considering Ireland's geographical extent and the range of demands on its land, a multiple benefits approach – properly applied – offers a path to meet environmental, social and economic demands. Land use decisions can be complex, but maintaining a rolling review of land use based on the best available data would support land use decision-making.

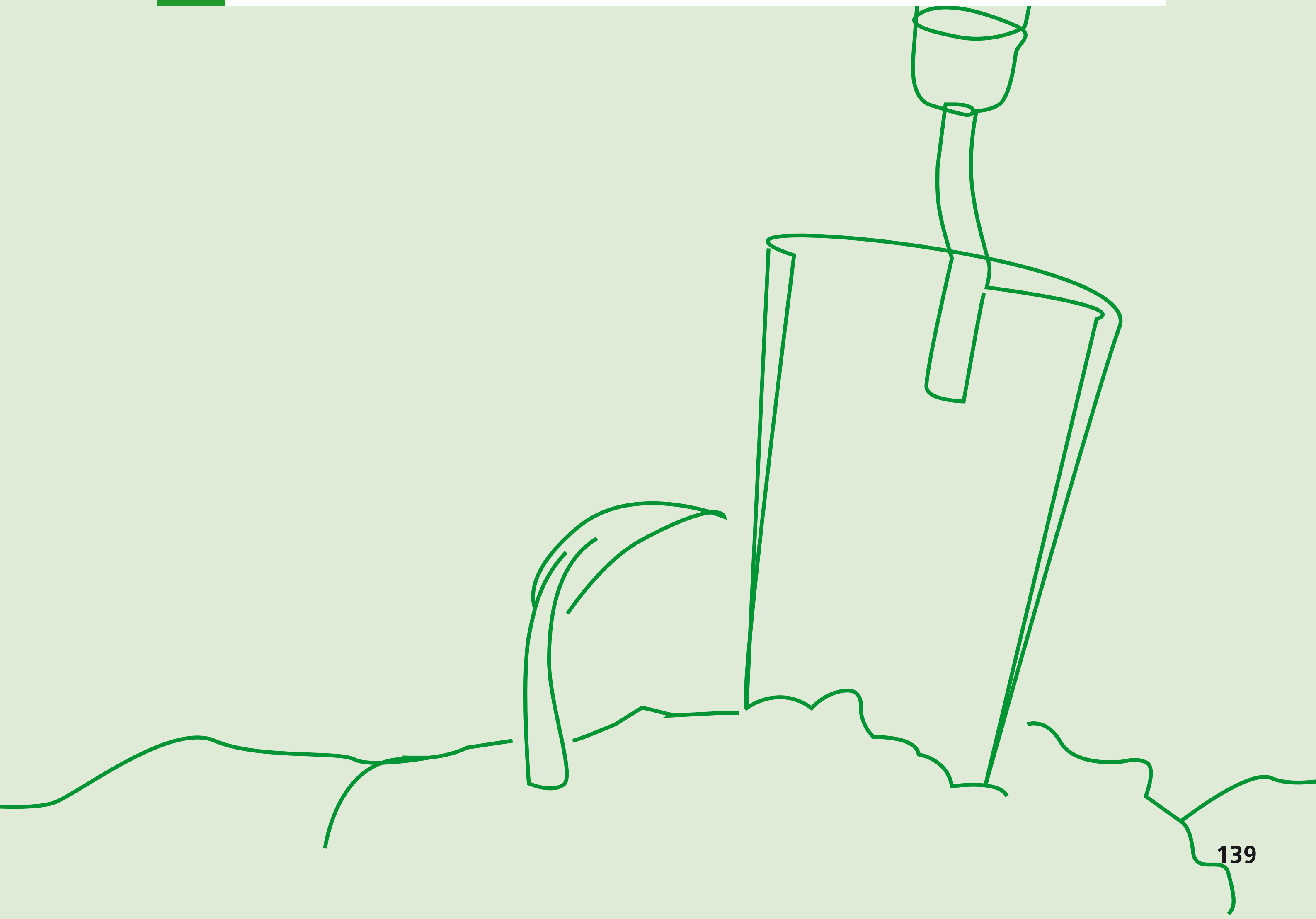
Key chapter messages

1. Ireland’s land is in demand. Our current land use is a source of greenhouse gas emissions. Some of our current land use practices are exerting pressures on water quality and nature that show no immediate signs of abating.

2. We cannot make more land, so must use our land wisely. Part of this challenge is to understand how best to use our land for social and economic benefits in a way that supports, rather than damages, the environment. The national land use review has a vital role to play in identifying land use opportunities and constraints.

3. Land use offers natural, social and economic benefits. We can use our land in ways that support climate action, nature restoration, protection of water quality and a sustainable economy through implementing a multiple benefits approach. To do this we must reframe how we approach national land use decisions. We must take a holistic and integrated view across all the social, economic, and legislative demands we have for Ireland’s land. Emerging evidence shows that we can implement solutions that deliver natural, social and economic capital together.

4. Land use is about using land to benefit people, and stakeholders need to be engaged in decisions that impact them. Evidence shows that to reframe how we use our land will require engaging people in the process and providing positive supports to incentivise change.



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Chapter 6:
Soil

Soil

1. Introduction

While we might not immediately think of soils when we think of nature, soils are the Earth’s largest habitat. They are essential for life: they support terrestrial plant life used as food by humans and animals. Soil health is vital to biodiversity, plant growth and food production, climate control and water quality regulation. The value of soils is not limited to supporting plant growth: they also provide a wide range of essential services (Baer and Birgé, 2018; Smith *et al.*, 2021). Maintaining soil health is essential to enable soils to continue to supply the important services they provide (Figure 6.1).

> “Too few know that the thin layer that lies below our feet holds our future. Soil and the multitude of organisms that live in it provide us with food, biomass and fibres, raw materials, regulate the water, carbon and nutrient cycles and make life on land possible. It takes thousands of years to produce a few centimetres of this magic carpet.”
>
> **EU Soil Strategy for 2030 (EC, 2021a)**

Figure 6.1 Soil services

Climate and air quality regulation

Soils hold the largest terrestrial carbon stocks and are an important carbon sink. Carbon storage as soil organic carbon is important as a carbon sink. Soils can be a source of greenhouse gases (GHGs) such as carbon dioxide, methane and nitrous oxide.

Regulation of water flow and quality

Healthy soil can help regulate the water cycle (Keesstra et al, 2021). "Green" water is the water that is available in soil for plants. “Blue” water is the water available in groundwater and in surface water bodies like rivers and lakes. This water is replenished by infiltration through soils. If plant cover is low, or the soil structure is insufficiently able to cope with rainfall, then water can run off leading to flooding, loss of soil nutrients (which can impact water quality) and soil erosion (Keesstra et al, 2021). Healthy soils can play an important role in regulating floods and droughts (Saco et al, 2021).

Soils & human health

There is evidence that exposure to soil micro-organisms can lessen the prevalence of allergies and atopic health conditions like asthma (Thiele-Bruhn, 2021). Micro-organisms in soil can be used to produce antibiotics (Waksman, 2010).

Support for terrestrial ecosystems

As well as providing a habitat for life below ground, soils impact on habitats above ground by influencing the diversity of plants that grow and the fauna that depend on the plant life. Soil life has a complex interaction with plant life, which in turn drives the formation of soil in the long term (De Deyn Gerlinde and Kooistra, 2021).

Supply of food, fuel and material

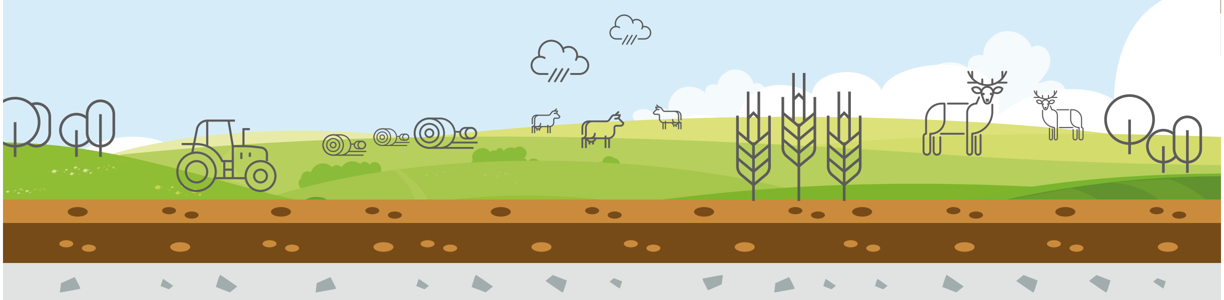
Soil is essential for plant growth, which is essential for food and raw materials (Baer & Birge, 2018).

Nutrient cycling

Nitrogen (N) and Phosphorus (P) are two of the main sources of water pollution in Ireland (EPA, 2023a). Soil biota can remove N from the ecosystem. Levels of P in rivers can be abated by the strategic use of wetlands (Baer & Birge, 2018).

Soil as a habitat

Soils are the largest habitat, being home to the majority of all living species on Earth (Thiele-Bruhn, 2021). Soil contains an abundance of bacteria, fungi, insects, isopods, earthworms, spiders, centipedes, millipedes and other invertebrates. While soil is an ecosystem in its own right, this ecosystem is vital to plant health and agricultural production (Baer & Birge, 2018).



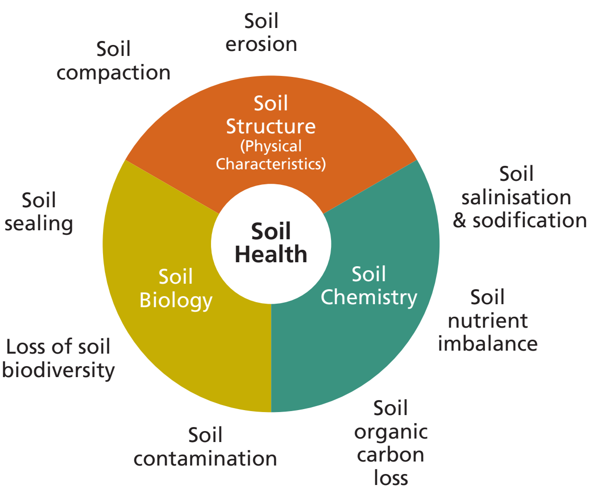
2. Soil health and global threats to soil health

Soil health is defined as the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals and humans (Lehman *et al.*, 2020). A healthy soil has good biological, chemical and physical (structural) properties. Healthy soils are better able to support the functions and services outlined in Figure 6.1. They take many years to form, so protecting their health is of vital importance to ecosystems and food systems. Soil health is protected by ensuring that soil chemistry is in the right balance, maintaining soil structure and integrity, and safeguarding the soil biome.

Healthy soils support climate action. Soil can act as a carbon sink to mitigate climate change, and healthy soils have better water retention capacity for withstanding droughts or helping with flood management during extreme rainfall and flooding events.

Soils are essential for food security: 95% of our food is directly or indirectly produced on soils. Healthy soils are essential for supporting high yields of nutritious food. The European Commission estimates that soil degradation is costing the European Union (EU) tens of billions of euros every year. A United Nations' (UN) assessment identified global threats to soil health (UNCCD, 2017) (Figure 6.2).

Figure 6.2 Soil health and threats to soil health



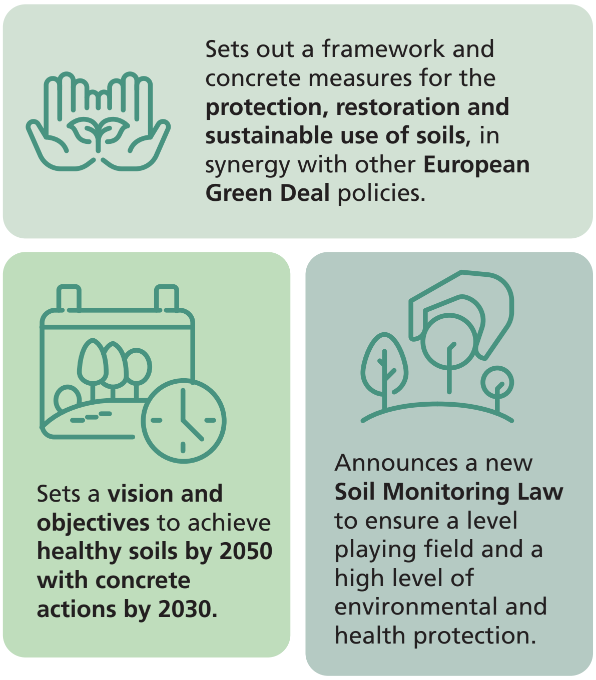
Source: Adapted from UNCCD, 2017

3. EU Soil Strategy

Research on the links between soil health, plant diversity, terrestrial ecosystems and carbon sequestration shows that protecting soil health delivers benefits to the whole ecosystem, to food security and to climate action.

The EU Soil Strategy for 2030 (EC, 2021a) sets out a vision to achieve healthy soils by 2050. The strategy follows a European Environment Agency (EEA) conclusion in 2019 that the lack of a comprehensive policy framework to protect land and soil would limit European environmental and sustainability objectives. A review identified that, while soil-relevant EU policy spans many themes, it does not include specific overarching soil legislation (EI, 2017). Adopted in 2021, the EU Soil Strategy seeks to address the lack of a legal framework for the protection of soils and to provide soils with legal protection similar to that of water, air and the marine environment (Figure 6.3). A pillar of the EU Soil Strategy is to provide a legal framework through the development of a soil monitoring law. A proposal for an EU soil monitoring law was published in 2023 and is being reviewed by the European Parliament in 2024.

Figure 6.3 What the EU Soil Strategy sets out



Source: Adapted from EC, 2021b

Achieving all the goals and objectives of the EU Soil Strategy depends on full implementation of other related EU initiatives, as outlined in Table 6.1.

Table 6.1 EU Soil Strategy objectives

MEDIUM-TERM OBJECTIVES (2030)	RELATED EU INITIATIVE
Restore significant areas of degraded and carbon-rich ecosystems, including soils	EU Biodiversity Strategy for 2030[a]
Make significant progress in the remediation of contaminated sites	EU Biodiversity Strategy for 2030[a]
Achieve an EU net greenhouse gas removal of 310 million tonnes of carbon dioxide equivalent per year for the land use, land use change and forestry (LULUCF) sector	Proposal for a revision of the LULUCF Regulation[b]
Reach good ecological and chemical status in surface waters and good chemical and quantitative status in groundwater by 2027	Water Framework Directive[c]
Reduce nutrient losses by at least 50%, the overall use and risk of chemical pesticides by 50%, and the use of more hazardous pesticides by 50% by 2030	EU Farm to Fork Strategy[d]

LONG-TERM OBJECTIVES (2050)	RELATED EU INITIATIVE
Reach no net land take	Roadmap to a Resource Efficient Europe[e] and the Eighth Environment Action Programme[f]
Soil pollution should be reduced to levels no longer considered harmful to human health and natural ecosystems and should be within the boundaries our planet can cope with, thus creating a non-toxic environment	Pathway to a Healthy Planet for All, EU Action Plan: 'Towards Zero Pollution for Air, Water and Soil'[g]
Achieve a climate-neutral Europe and, as the first step, aim to achieve land-based climate neutrality in the EU by 2035	European Climate Law Regulation[h] and Proposal for a revision of the LULUCF Regulation
Achieve a climate-resilient society for the EU, fully adapted to the unavoidable impacts of climate change by 2050	EU Adaptation Strategy[i]

Source: Adapted from EC, 2021a

[a] EU Biodiversity Strategy for 2030 (COM(2020) 380).

[b] Proposal for a revision of the LULUCF Regulation (COM(2021) 554).

[c] Water Framework Directive (2000/60/EC).

[d] EU Farm to Fork Strategy (COM(2020) 381).

[e] Roadmap to a Resource Efficient Europe (COM(2011) 571).

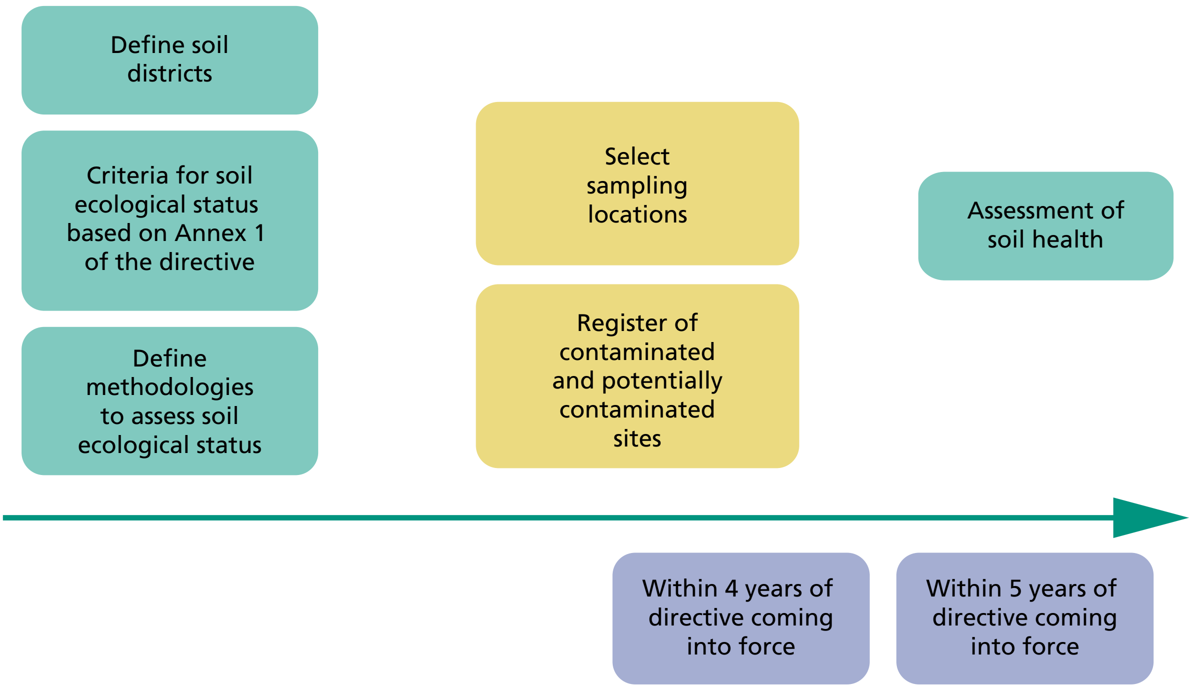
[f] Eighth Environment Action Programme (Decision No 1386/2013/EU).

[g] EU Action Plan: Towards Zero Pollution for Air, Water and Soil (COM(2021) 400).

[h] European Climate Law Regulation ((EU) 2021/1119).

[i] EU Adaptation Strategy (COM(2021) 82).

Figure 6.4 Proposed soil monitoring law



Source: Adapted from EC, 2023a

The current proposal for an EU soil monitoring law (EC, 2023a) is a response to scientific evidence that 60-70% of EU soils are in an unhealthy state and that pressure on land and soil is increasing soil sealing.[1] The proposal will require EU Member States to establish a framework for monitoring soil health (Figure 6.4).

Under the proposed soil monitoring law (EC, 2023b), Member States will be required to identify soil districts and define criteria for soil ecological status and the methodologies to assess them. The annexes of the proposed directive set out the soil health criteria that can be taken into consideration. Member States will be required to assess soil health at selected sampling locations within 5 years of the directive coming into force, and then every 5 years after that. Soil will be considered healthy if it achieves good or high ecological status.

To work towards an aspirational goal of achieving no net land take by 2050, soil sealing and soil destruction are to be managed as the first and most impactful step. A register of contaminated and potentially contaminated sites must be created.

An obligation to include soil restoration in the proposed soil monitoring law was considered but not included. The European Commission will analyse the requirements to restore unhealthy soils by 2050. This assessment will take place 6 years after the proposed law comes into force and will be informed by the information collected by Member States in their implementation of the law.

4. Status of soils in Ireland

Ireland's soil types are variable. They are influenced by Ireland's geology and terrain (slope), rainfall, drainage, vegetation types, land use and climate, which includes the influence of past glaciation. Gley and peat soils are characterised as having poor drainage. Podzols and brown podzolic soils are found where there is moderate drainage and the soil forms distinct horizons (layers) created by minerals and nutrients leaching at different rates. Brown earth soils (Figure 6.5) are relatively young soils formed where dense vegetation has resulted in decaying leaves (humus), which is mixed with soil organisms, giving the soil a brown colour and less distinctive horizons.

1 Soil sealing is the process whereby ground is covered with impermeable materials (such as asphalt and concrete) for residential or commercial buildings or infrastructure such as roads, rail and piers, rendering it impervious to water.

Figure 6.5 Brown earth soil type

Source: Teagasc Irish Soil Information System

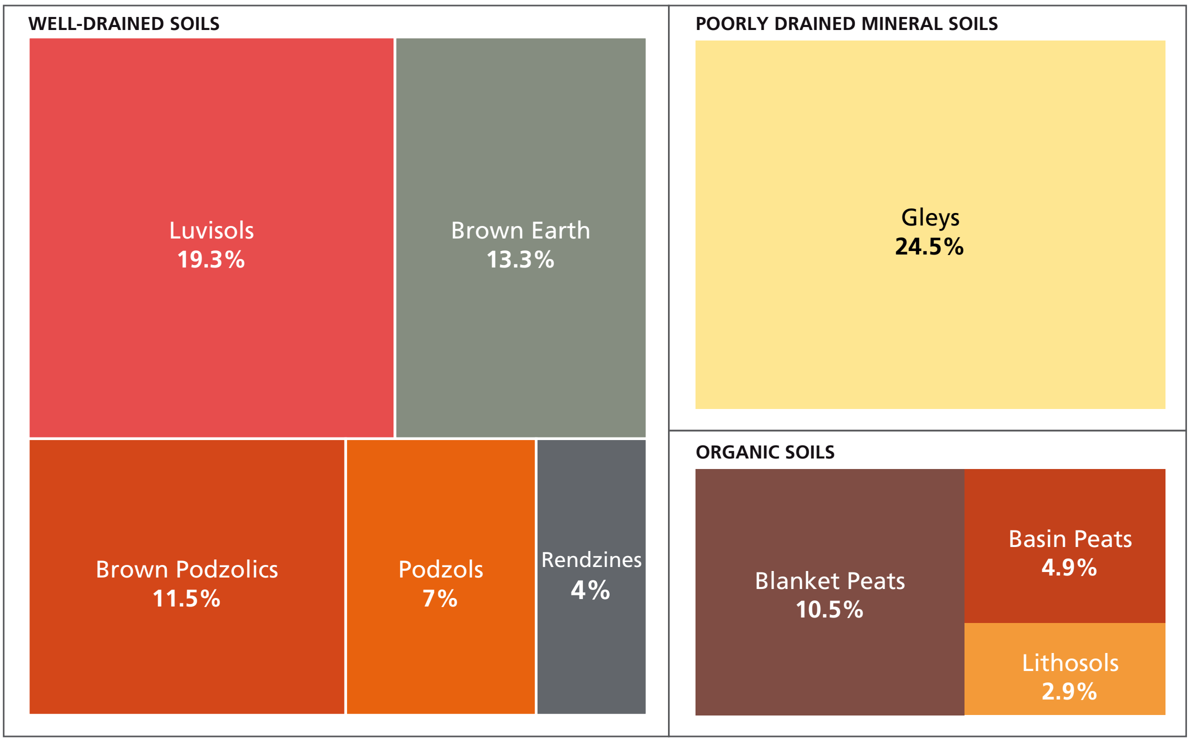
Ireland's Soil Information System classifies soils using a hierarchical grouping. Figure 6.6 shows Ireland's great soil groups. Well- and moderately drained soils (podzolics, brown earths, podzols and rendzinas) make up 55% of Ireland's soils. Poorly drained mineral soils (gleys) make up 24.5% and organic soils (peats and lithosols) make up 18%. Urban areas and water make up the rest of Ireland's soil area but are not included in Figure 6.6.

A review of Irish soil research and data from 2013 to 2021 identified major gaps in our knowledge of Ireland's soils (McNamara *et al.*, 2022). It found that current research was biased towards the collection of data on soil pH and nitrogen content and that agricultural soils were studied more than urban or contaminated soils. It concluded that soil knowledge in Ireland is not well aligned to EU or national priorities.

Irish soils and the proposed EU soil monitoring law

Annex 1 of the proposed EU soil monitoring law (EC, 2023b) sets out soil health descriptors and criteria for healthy soil condition under specified aspects of soil degradation (summarised in Table 6.2).

Figure 6.6 Ireland's soil groups, graphed by total area



Source: Adapted from Teagasc, 2020a

Table 6.2 Soil health descriptors in Annex 1 of the proposed EU soil monitoring law

Part A: Soil descriptors with criteria for healthy soil condition established at the EU level
Salinisation
Soil Erosion
Loss of organic soil carbon
Subsoil compaction
Part B: Soil descriptors with criteria for healthy soil condition established at the Member State level
Excess nutrient content in soil
Soil contamination
Reduction of soil capacity to retain water
Part C: Soil descriptors without criteria
Excess nutrient content in soil (nitrates)
Acidification (soil acidity in pH)
Topsoil compaction
Loss of soil biodiversity
Part D: Land take and soil sealing indicators
Land take and soil sealing
The indicators (in km^2 and as a percentage of the Member State's land surface area) are: ▪ total artificial land ▪ soil sealing ▪ land take, reverse land take and net land take[a] ▪ additional optional indicators such as land fragmentation, land recycling rate, land taken for commercial, logistics and energy use, and the consequences of land take, such as effects on ecosystems or flooding intensity

Source: EC, 2023b

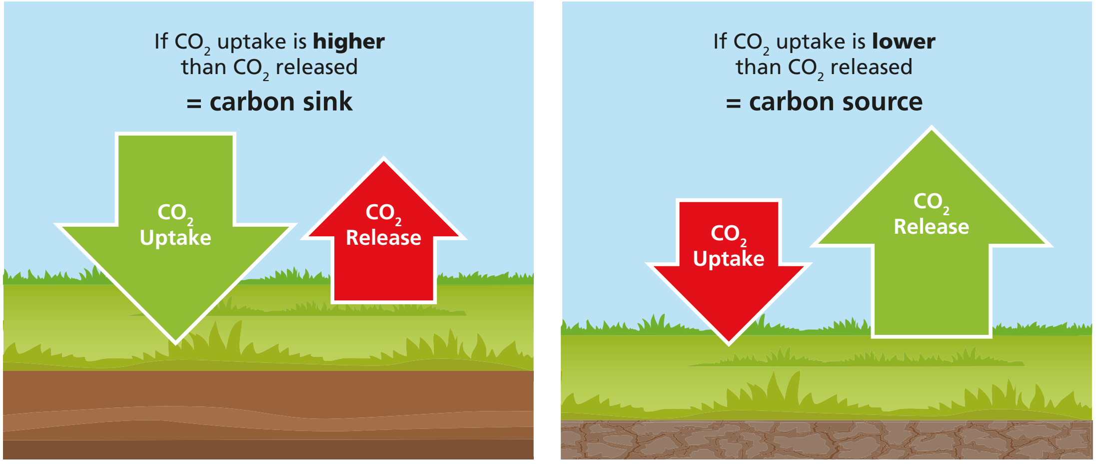
[a] where 'reverse land take' means the conversion of artificial land into natural or semi-natural land and 'net land take' means the result of land take minus reverse land take.

The four parts of Annex 1 are discussed in the following section, based on data from Irish studies or indicative (modelled) data from the EU Soil Observatory (EUSO, 2023). The criteria are presented only for general guidance to indicate whether the soil condition is likely to be of concern. They are not based on detailed, local assessments, which will be a requirement under the proposed soil monitoring law.

Part A indicators: criteria set at EU level

Salinisation. This is the accumulation of soluble salts such as sodium, magnesium and copper at a level that affects soil health. Salinisation is not a prevalent issue in Ireland. It affects southern European soils in the Iberian Peninsula and Mediterranean coastal areas (EC, 2008).

Figure 6.7 Schematic of carbon sources and sinks



Source: Adapted from Teagasc, 2020b

Soil erosion. The EU Soil Observatory identifies four drivers of soil erosion: water, wind, harvest and tillage. Of these four, tillage erosion and water erosion are the two most prevalent in Ireland, based on the EU Soil Observatory model, with wind erosion confined to small coastal areas. Harvest erosion occurs when soil that adheres to crops or rock fragments is removed during harvesting; it is more prevalent during the harvesting of root and tuber crops than other crops. Harvest erosion is lower in Ireland than in other EU Member States, as our land use for crops is relatively low (Ireland's agricultural land use is predominantly grassland).

Tillage erosion occurs in the east, south-east and south where tillage activity is more widespread. The EU Soil Observatory model has identified greater potential for water erosion in areas of higher altitude (including uplands in Wicklow, Cork, Kerry, Galway and Donegal). Soil loss by water erosion in Europe is expected to increase as climatic conditions change. An assessment of different land use and climate change scenarios predicts an increase in soil erosion but at relatively lower rates in northern European countries such as Ireland than in southern Europe (Panagos *et al.*, 2021).

Loss of soil organic carbon. Soil organic carbon improves soil productivity and water retention and acts as an important carbon sink. Teagasc research shows that clay soils have a higher carbon sequestration capacity; however, ploughing can increase carbon loss and, in a dry year, soils can switch from being carbon sinks to sources of carbon emissions (Figure 6.7). Soil organic carbon is affected by soil management regimes, fertilisation and animal stocking rates (Teagasc, 2020).

Grasslands on mineral soil can be a carbon sink and grasslands on drained peat soils are a substantial carbon source (Teagasc, 2020).

Soil organic carbon stocks are influenced by short-term changes between cropland and grassland and by soil disturbances. The Environmental Protection Agency (EPA)-funded Soil Organic Carbon and Land Use Management (SOLUM) project examined methods for accurately measuring soil organic carbon in Ireland (Saunders *et al.*, 2022). The EU Soil Observatory has identified peatlands in Europe that are within a fixed radius of croplands to ascertain the risk of peatland degradation. This model identified 62% of Ireland's peatlands at risk of degradation. Corine (Coordination of Information on the Environment) Land Cover data, while coarser in resolution, offers longer term trend information and indicates that Ireland's peatlands decreased by 22% between 1990 and 2018. This figure does not account for peatlands lost before 1990, or since the establishment of the Bog Commission in the early 1800s. Further research, the RePeat project,[2] is mapping the extent of peatlands using Bog Commission maps and advanced geospatial and Earth observation techniques.

Peatlands are unique ecosystems and can sequester large amounts of carbon dioxide, so they are an important element of Ireland's climate mitigation efforts (Figure 6.8). Peatland degradation is a result of peat extraction for energy and horticultural use and of drainage for agricultural, forestry or settlement use.

2 sites.google.com/view/project-repeat/home

Figure 6.8 Irish peat bog

Credit: Mark McCorry, Bord na Móna

Part B indicators: criteria set at Member State level

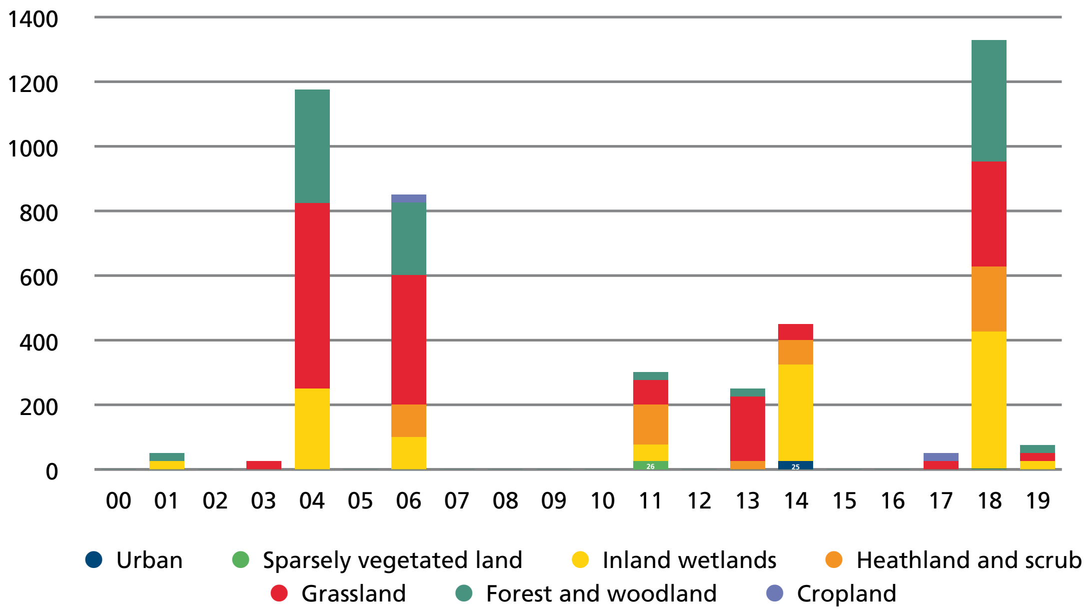
Excess nutrient content in soil. Phosphorus is essential for plant health. Excess phosphorus in soils affects water quality (see Chapter 8) and contributes to biodiversity decline and human health risks. The EU Soil Observatory model maps lands where the phosphorus surplus exceeds the threshold used by many European countries to define phosphorus excess (50 mg/kg). Teagasc sampling programmes have identified that 63% of Ireland's soil is deficient in soil phosphorus (O'Donnell *et al.*, 2021). This results in a high dependency on fertiliser application in Ireland.

Between 12% and 20% of the country's soils have sufficient or excess phosphorus (O'Donnell *et al.*, 2021); this is consistent with the modelled values for phosphorus excess from the EU Soil Observatory. Excess phosphorus is a greater issue in agricultural soils with poor drainage and is detrimental to the ecological health of rivers and lakes (EPA, 2022).

Soil contamination. The proposed soil monitoring law will require Member States to create a register of contaminated and potentially contaminated sites. While there is no register of contaminated soils or sites in Ireland, data sources exist that could be used to inform such a register. For example, historical mine sites were assessed in 2009 by Geological Survey Ireland and the EPA. The EPA also maintains a register of data from local authorities on closed, unregulated landfills (sites that operated in a local authority area without a waste licence between July 1977 and March 1997). The EPA also reports to the European Chemicals Agency on the implementation of the Persistent Organic Pollutants (POPs) Regulation (S.I. No. 146/2020); this includes sites contaminated with POPs.[3] Furthermore, the EU Soil Observatory used data from the Land Use and Coverage Area Frame Survey (LUCAS) to model potential soil pollution from copper, mercury and zinc and has identified areas that are above their proposed safe thresholds for mercury and/or zinc.

3 echa.europa.eu/documents/10162/16596982/report_pops_ie_en.pdf/f31f7f36-fa84-d599-6cd6-7f65b9aaf9cd?t=1667378478475

Figure 6.9 Area of soil moisture deficit by year (km²), per tier 1 land cover in Ireland



Source: EEA, 2021b

Reduction of soil capacity to retain water. The ability of soil to retain adequate water is essential for plant growth. The EEA's Copernicus service tracks soil moisture over time to detect and monitor agricultural droughts (EEA, 2021a). For the 2000-2019 period, Europe had a long-term soil moisture deficit. During that period, Ireland's overall soil moisture profile showed a slight surplus rather than a deficit in soil moisture (Figure 6.9). The data for Ireland indicate the close relationship between drought and soil moisture deficit; the years that Ireland experienced drought conditions (such as 2004, 2006 and 2018) are clearly identifiable in their effects on soil moisture deficit (DAFM and DECC, 2023). Soil water retention is important in lessening the impact of flooding, particularly where it is because of extreme rainfall.

Part C indicators: descriptors without criteria

Excess nutrient content in soil (nitrates). While nitrogen is essential for plant growth, excessive nitrates in soil cause water pollution (see Chapter 8), have negative implications for human health and contribute to greenhouse gas emissions.

The EU Soil Observatory used agricultural data and a European biogeochemical model framework to identify agricultural land areas where nitrogen surplus exceeds 50 kg/ha per year. Ireland has the third highest value in Europe (at 80%) of agricultural land above the 50 kg/ha per year threshold. Nitrates can leach from soil into water; this is a greater issue in free-draining soils in the south-east where it causes a problem for water quality in estuaries along the southern seaboard (EPA, 2022). Soil acidification can be accelerated by the application of ammonium-based fertilisers.

Topsoil compaction. Compaction is a decrease in soil porosity or volume due to stress from machinery or animal traffic, which compromises the capacity of soil to hold air or water. It represents one of main soils threats in Ireland. The Teagasc Soil Quality Assessment Research Project (SQUARE) examined soil health indicators (physical, chemical and biological) for Irish grassland soils (Bondi *et al.*, 2019). Among the array of physical indicators measured, soil structure emerges as a pivotal factor supporting all other soil functions. The deterioration in soil structural quality, leading to soil degradation and compaction, is frequently the outcome of intensive management practices (Bondi *et al.*, 2021). This can result in water's diminished ability to permeate and drain through the soil, hampering water storage and purification in the landscape.

Bondi *et al.* (2019) found that Irish grassland soils were generally healthy but that some soils were better at delivering soil functions than others. Well- and moderately drained soils such as brown earth and podzolic soils could support agricultural production but do not have the same capacity as poorly drained soils to store carbon or contribute to water purification. Poorly drained soils, such as gleys, are not as productive as well-drained soils. While poorly drained soils can store more carbon and support a more active soil microbiome, they are more susceptible to structural degradation in the form of compaction.

For Irish soils, Bondi *et al.* (2021) developed a soil trafficking intensity index that considers the effect of geo-climatic variability or differences in drainage classes on soil compaction risk.[4] In general, poorly drained sites were more vulnerable to machinery trafficking than grazing trafficking pressure, being more prone to damage. At a national scale, this index can be used to identify soils at risk of compaction and to underpin targeted management advice for supporting sustainable grassland production.

Acidification (soil acidity in pH). Chemical indicators yield substantial information on nutrient cycling, primary production and carbon sequestration functions in soils. Notably, soil pH and soil organic matter have been recognised as key elements in regulating nutrient availability in soils and influencing various soil functions, including carbon sequestration and nutrient cycling.

Loss of soil biodiversity. Soil biology is often referred to as the 'engine of the soil', with soil biodiversity and the soil microbiome positioned at the core of soil functioning. Biological indicators provide insights into the impact of past and current management practices on soil health. For instance, the abundance and presence of earthworms serve as practical and easily recognisable soil health indicators (Figure 6.10). Nevertheless, a considerable portion of soil biology necessitates more advanced analysis, which may not always be feasible for routine in-field soil health assessments.

Figure 6.10 Photo of soil biodiversity (earthworm)

Credit: Olaf Schmidt, UCD

The soil biome is an ecosystem and provides essential services to support soil formation, soil structure and plant growth. The EU Soil Observatory modelled a set of 13 factors, such as habitat fragmentation, land use change, soil pollution and soil sealing, that negatively affect soil biological functions. The model differentiates between soils that have a higher than moderate risk of loss of soil biological functions. The assessment identified that 36.73% of the EU's soil area has potential threats to its biological functions that are moderate or worse than moderate. Two-thirds of Ireland's soil area falls within these categories (62.98%). The EU Soil Observatory assessment is based on modelled data. A national assessment to understand the status of Ireland's soil biome would be important to validate this assessment.

Intensive exploitation and soil organic matter decline are the highest potential threats to soil biodiversity in the EU (Orgiazzi *et al.*, 2016). Agricultural practices with high levels of mechanisation and use of pesticides strongly affect soil biodiversity. To counteract such threats, Orgiazzi *et al.* (2016) recommend that agri-environmental schemes include measures to protect and enhance soil biodiversity. The EU Soil Observatory assessment also identifies soil areas under threat within protected area boundaries; Orgiazzi *et al.* (2016) recommend considering soil biodiversity as a criterion for protected area designation and planning.

Further research highlights the links between farming practices, soil biodiversity health and terrestrial ecosystem health. The research suggests a strong link between pesticide and fertiliser use and declines in bird populations across Europe (Rigal *et al.*, 2023). This is attributed in part to the known impact of pesticide use on invertebrates, a crucial food source for many birds.

Such assessment of soil organisms is an important part of measuring soil health, but these data are currently sparse in both the EU (Orgiazzi *et al.*, 2016) and Ireland (Bondi *et al.*, 2019). Given the importance of the soil biome, and the impact of soil biological functions on plant growth and terrestrial ecosystems, measures to collect data and to protect soil biodiversity functions against potential threats should be prioritised (Orgiazzi *et al.*, 2016).

The ability of soils to absorb and sequester carbon has a relationship with plant diversity. Studies of agriculturally degraded and abandoned lands found that the carbon sequestration rate was greatly enhanced when the plant diversity of these lands was restored (Yang *et al.*, 2019).

4 The index can detect changes in direct indicators of soil structural quality, such as bulk density, total porosity, water holding capacity, water conductivity and visual soil appearance, but also indirect indicators, such as soil carbon content, earthworm abundance and microbial biomass.

Part D indicators: land take and soil sealing

Soil sealing is the result of creating impervious surfaces for residential and commercial buildings and for infrastructure such as roads, rail and piers. The new national landcover map of Ireland indicates that 4% of Ireland's soil is sealed. Longer term data from Corine Land Cover, although less detailed, show that soil sealing has doubled since 1990.

In Ireland, the creation of sealed soils has occurred at the expense of agricultural land cover loss. Sealed soil is impervious to water, leading to run-off and a poor ability to help mitigate flooding. Soil sealing removes the ability of the soil biome to function, but it also impacts terrestrial biodiversity through the fragmentation of terrestrial habitats. The creation of hard surfaces, such as roads, can break habitats into smaller, unconnected parts, a process called fragmentation. This has a negative impact on access to food and on the genetic diversity of animal populations. The national biodiversity indicators rate habitat fragmentation in Ireland as 'amber' on a red-amber-green scale (NDBC, 2021).

5. Emerging aspects of soil health

Microplastics in soil have been identified as an emerging threat to the world's soils (FAO, 2021). They come from a variety of sources. Waste water and biosolids from waste water treatment plants are major sources (O'Kelly *et al.*, 2021; Nash *et al.*, 2023). Other sources include agricultural plastics, landfills, beach littering and urban run-off. These plastics can degrade into smaller microplastics that transfer into surface waters where the particles are absorbed by small aquatic animals and fish and their predators (Nash *et al.*, 2023).

Research has examined the impact of microplastics on soil, soil fauna and plant growth. They have been found to affect soil chemistry, as they are carriers of heavy metals (O'Kelly *et al.*, 2021). Microplastics also have an impact on soil structure, which can change water dynamics (de Souza Machado *et al.*, 2018) and the enzyme activities of soil microbes (Yang *et al.*, 2021) and soil invertebrates (Huerta Lwanga *et al.*, 2016). Earthworms exposed to different concentrations of microplastics show lower growth rates and higher mortality rates in higher concentrations of microplastics (Huerta Lwanga *et al.*, 2016). This has implications for soil, as earthworms have a beneficial impact on its structure and aeration. Research into the effects of microplastics on soil ecosystems discovered reduced shoot height, changes in root structure, alterations in leaf composition and other impacts on plant growth, including lower seed germination rates, (Boots *et al.*, 2019; de Souza Machado *et al.*, 2019). The effects on plant growth were due to chemicals in the microplastics and their impact on soil structure and chemistry.

6. Conclusions

Given the many vital services that we depend on our soils to deliver, from supporting food production and water purification to supporting ecosystems and production of raw materials, we have everything to gain from safeguarding the health of Ireland's soils. Soil health is complex: it depends on the physical, chemical and biological attributes of soil.

Unlike air and water, soil does not have specific overarching legislation to protect it. To address this, the EU soil monitoring law, proposed in July 2023, sets out indicators for soil health that Member States can use to assess soils and identify areas of poor soil health.

Ireland's primary source of soil information is the Irish Soil Information System. This identifies Ireland's main soil classes. To implement the proposed soil monitoring law, Ireland will need to undertake an assessment of its soil health, using a soil sampling programme across defined soil districts. Achieving this assessment will fill evidence gaps. The kind of modelling capability illustrated by the EU Soil Observatory shows the opportunities offered by soil mapping and modelling to help us understand soil health. Ireland should take a cross-public sector approach to the advancement of soil mapping and modelling to rapidly improve our knowledge of soil health at a national level. The proposed EU law will also require the creation of a national contaminated sites register, which will be a welcome development in identifying potential hazards to human health.

Addressing the threats to Ireland's soil will have a positive impact on water quality, biodiversity and climate action as well as improving soil health. Different soil types offer different types of service and this diversity is enormously important in addressing different needs. Well-drained soils support agricultural production, whereas less productive soils can often store more carbon or support a more active soil biome. Detailed knowledge of Ireland's soils would enable the appropriate use of different soil types according to the services they are best placed to provide.

Research has improved knowledge of the factors that influence the capacity of soil to store carbon. Knowing which soils can act as carbon stores and how to manage them to maximise their organic carbon is important for climate change mitigation. Peatlands have a very high carbon storage potential, which it is crucially important to protect (Figure 6.11).

Figure 6.11 Peat soil over lake alluvium

Source: Teagasc Irish Soil Information System

Protecting soil's ability to regulate water flow has benefits for both climate change adaptation and water quality. Limiting soil sealing means that soil's natural ability to help regulate flow in times of flood is conserved, which is vitally important in areas subject to flood risk. Ireland's soils have not generally shown a moisture content deficit, but this can change locally in times of extreme drought. Compaction has been identified as a threat to Ireland's soil health and its ability to regulate and purify water; measures to address compaction are important in protecting or restoring soil health.

Soil can help to regulate the nutrients that are available to plants and the amount of nutrients that leach into Ireland's waterways. The levels of nitrates and phosphorus in Ireland's surface waters indicate that there are excess nitrates leaching from soil and some areas where there is excess phosphorus.

The status of Ireland's soil biome is not easy to measure directly, but modelled information from the EU Soil Observatory suggests that Ireland is not unique in Europe in having many factors that threaten soil biodiversity. Given the importance of the soil biome to good soil health and to healthy terrestrial ecosystems, a national assessment to understand Ireland's soil biome is important to confirm the potential extent to which Ireland's soil biome may be under threat.

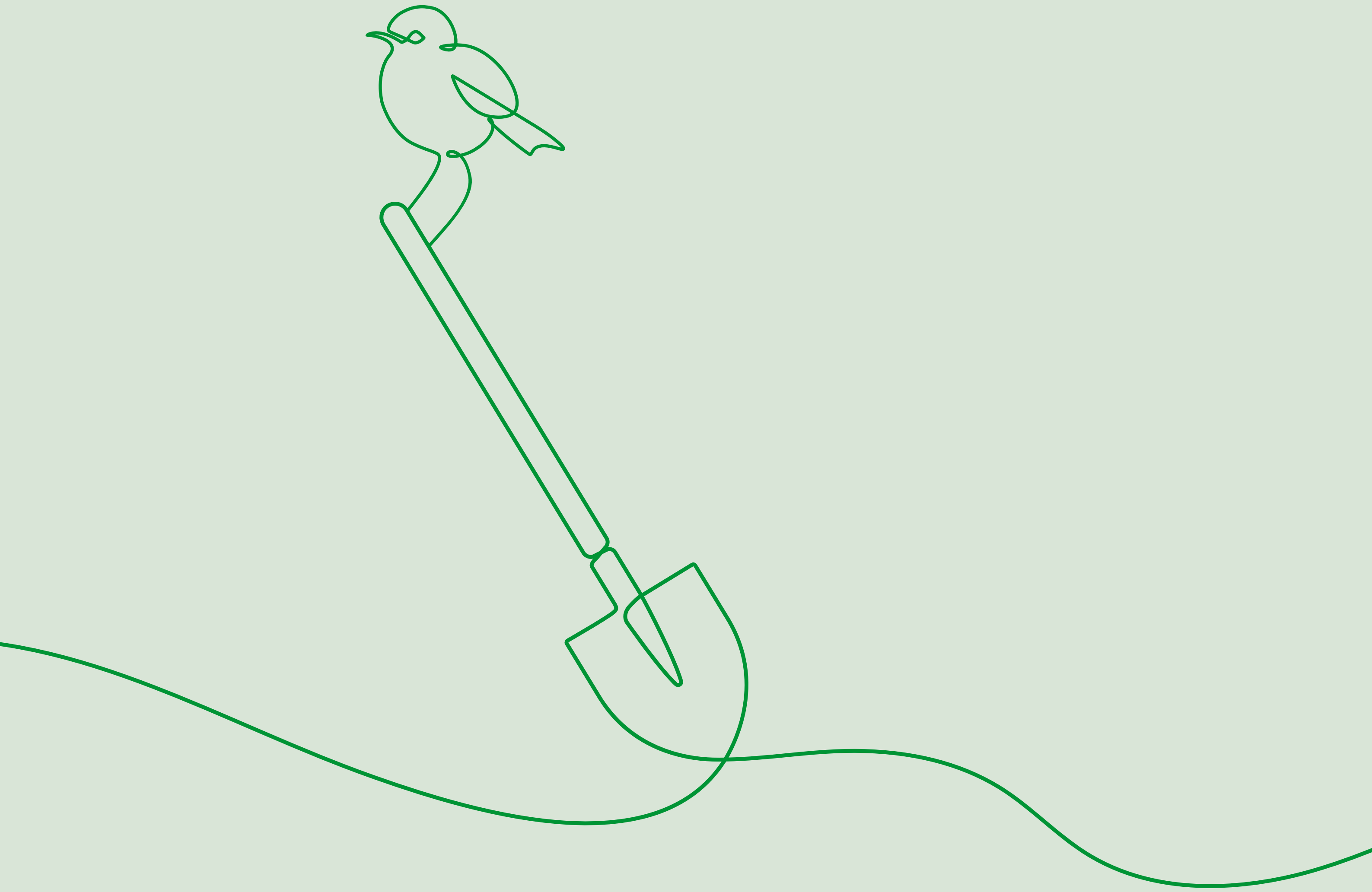
The advent of a proposed soil monitoring law and the existing EU Soil Strategy indicate that the vital importance of soil to human life and a healthy, well-functioning environment is being recognised. However, the proposed law does not include any obligations to restore unhealthy soils to full health. Given the vital impact of soil health on Ireland's agriculture and its important role in climate action, we should be ambitious in going beyond the requirements of the soil monitoring law and enact soil health restoration plans. This is an opportunity for Ireland to show leadership in soil restoration practices for the benefit of food security, ecosystems, climate action and water quality that would underscore our green credentials as a truly sustainable food producer.

Key chapter messages

1. Ireland's soils play important roles in storing carbon, in regulating both water flow and water quality and in growing food and raw materials. Soils are under threat from excess nutrients, compaction, soil sealing and loss of soil biodiversity, in Ireland and across the EU. Soil health must be prioritised to ensure food security, protect the soil biome, and safeguard the important environmental services that soil provides.

2. The protection of soils lacked a legal and policy framework until recently and the publication of the EU Soil Strategy in 2021 and the proposed soil monitoring law in 2023 are significant. Ireland faces challenges in achieving the objectives of the EU Soil Strategy and in implementing the proposed soil monitoring law. However, getting this right would significantly advance the protection of Ireland's soil health.

3. To support the proposed soil monitoring law and soil health assessment, Ireland should advance soil mapping and modelling, through a cross-public sector approach, which would rapidly improve our knowledge of soil health at a national level.



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Chapter 7: Nature

Nature

1. Introduction

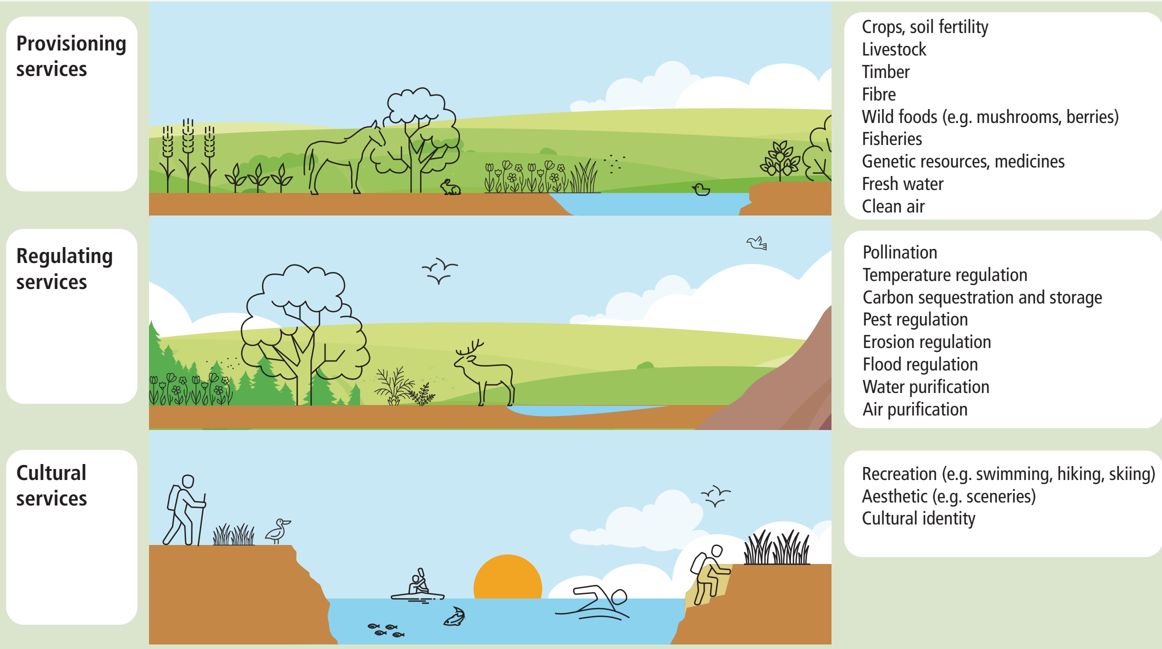
The terms 'nature' and 'biodiversity' are often used interchangeably. Nature is all life on Earth, together with the living systems of which it is a part, for example geology, water and climate. Biodiversity, meaning biological diversity, describes the variety of life forms on Earth. Biodiversity is also multi-layered and includes genetic diversity (the difference between two people), species diversity (the difference between the red squirrel and the grey squirrel) and habitat diversity (the difference between a bog and a calcareous grassland) (NPWS, 2024). Nature and biodiversity are essential to humanity and need to be protected.

Without nature and its diversity of life and habitats, our planet would be unable to function properly or provide clean water, clean air, food and raw materials (Topic Box 7.1). Our ability to respond to and prevent future environmental challenges, such as climate change, natural disasters and pandemics, would also be challenged. Nature is also the foundation of the world's economy. Over half of the global gross domestic product is dependent on materials and services that are delivered by ecosystems. For example, raw materials are needed for industry and construction, and genetic resources are vital for farming and medicine. Spending time in our natural environment and around nature, in our 'green' and 'blue' spaces, promotes wellbeing (Chapter 14).

Topic Box 7.1 Ecosystems

Ecosystems are communities of living organisms interacting with each other and their environment (e.g. air, water, rocks and soils). They provide a series of services and benefits for humans. Examples of these services and benefits for humans include clean air and water, food, raw materials (e.g. timber, medicines), opportunities for recreation, such as angling and sea swimming, and a sense of place. These are referred to as ecosystem services, of which three different types exist: provisioning, regulating and cultural (Figure 7.1). Nature and biodiversity play a key role in the functioning of ecosystems and their ability to provide ecosystem services. The value of nature and benefits from ecosystem services extend far beyond that which can be measured in financial terms.

Figure 7.1 Examples of ecosystem services that support human society



Source: EEA, 2021a

When the variety of habitats, species, genetic resources or communities is reduced we lose nature and biodiversity. It is estimated that up to 1 million animal and plant species are now threatened with extinction, more than ever before in human history (IPBES, 2019). Globally, the loss of nature and biodiversity is higher than at any point in recent history and is continuing at an unprecedented rate, so much so that it could be considered that we are in the midst of a sixth global mass extinction event (IPBES, 2019; Finn *et al.*, 2023). Human activities are the primary driver behind biodiversity loss (IPBES, 2019). Bar-On *et al.* (2018) estimate that humanity has resulted in the loss of 83% of wild animals since civilisation began.

Ireland has significant international and legal obligations to protect nature and biodiversity.[1] The European Union (EU) Habitats and Birds Directives have resulted in the creation of a network of sites for habitat and species protection, the Natura 2000 network. The network consists of Special Protection Areas (SPAs) protected under the Birds Directive and Special Areas of Conservation (SACs) protected under the Habitats Directive. Ireland also has a network of Natural Heritage Areas (NHAs), which are given protection under the Wildlife (Amendment) Act (2000). These are areas considered important for the habitats present or which hold species of plants and animals whose habitat needs protection. To date, 148 peatlands have been designated as NHAs and there are a further 630 proposed NHAs, which are afforded limited protection before formal designation[2]. Ireland has Marine Protected Areas in our marine and coastal areas, which are discussed further in Chapter 8. Despite this, we have seen significant declines in nature and biodiversity and their related social, political and economic consequences (NPWS, 2024), so much so that a biodiversity emergency was declared by Dáil Éireann in 2019 (Topic Box 7.2).

Topic Box 7.2 **National biodiversity emergency and the Citizens' Assembly on Biodiversity Loss**

When Dáil Éireann declared a national biodiversity emergency in May 2019, Ireland was one of the first countries in the world to do so. In response, a national Citizens' Assembly on Biodiversity Loss and a Children and Young People's Assembly on Biodiversity Loss were established.

National Citizens' Assembly on Biodiversity Loss

The Citizens' Assembly on Biodiversity Loss was convened to examine how the State could improve its response to biodiversity loss and to bring forward proposals in that regard. The assembly comprised 100 members: 99 randomly selected members of the public and an independent chairperson appointed by the Taoiseach.

Following deliberation, 159 recommendations were agreed and published in April 2023 (Citizens' Assembly, 2023). These included a call on the Oireachtas to accept the full range of recommendations and implement them without delay to curb the crisis and allow the conservation and restoration of biodiversity for the people of Ireland both present and future. The assembly also indicated overall disappointment with the State's failure to address biodiversity loss, particularly with the lack of implementation and enforcement of national biodiversity legislation (Citizens' Assembly, 2023).

Sector-specific recommendations focused on agriculture, freshwaters, marine and coastal environments, peatlands, forestry, woodlands, hedgerows, protected sites, protected species, invasive species, and urban and built environments. The assembly acknowledged the role of farmers as custodians of the land who possess a rich knowledge and understanding of the environment. It recommended that the agricultural industry be supported in conserving and restoring biodiversity.

Children and Young People's Assembly on Biodiversity Loss

Ireland's first Children and Young People's Assembly on Biodiversity Loss called for biodiversity to be at the centre of decision-making and for children and young people to be included in responding to biodiversity loss.[3]

1 www.npws.ie/legislation/irish-law (accessed 1 April 2024).

2 www.npws.ie/protected-sites/nha (accessed 18 April 2024).

3 cyp-biodiversity.ie/ (accessed 1 April 2024).

The Oireachtas Joint Committee on Environment and Climate Action advised that the calls to action set out by the assembly should be examined and considered for implementation by the relevant government departments.

Oireachtas Joint Committee on Environment and Climate Action

The Oireachtas Joint Committee on Environment and Climate Action examined the recommendations of the Citizens' Assembly report on biodiversity loss and, in turn, published its report in December 2023 (JCECA, 2023). It had engaged extensively with stakeholders to ensure that the biodiversity crisis in Ireland would be addressed in a meaningful way. Among its key recommendations were to change fundamentally the approach to environmental governance and enforcement taken across government departments, to place the fourth iteration of the National Biodiversity Action Plan on a statutory footing and for the state to play a leading and supportive role in the adoption and implementation of the EU Nature Restoration Law (see section 4).

2. The status of protected nature in Ireland

In Ireland, the National Parks and Wildlife Service (NPWS) provides a 6-yearly update on the assessment of the conservation status of habitats and species in Ireland protected under the EU Habitats Directive (92/43/EEC, Article 17), with the most recent being in 2019 (NPWS, 2019a). That report indicated that, of Ireland's 59 habitats listed in the directive, most have an unfavourable status with almost half showing ongoing declines, including marine, peatland (Figure 7.2), grassland and woodland habitats (NPWS, 2019a).

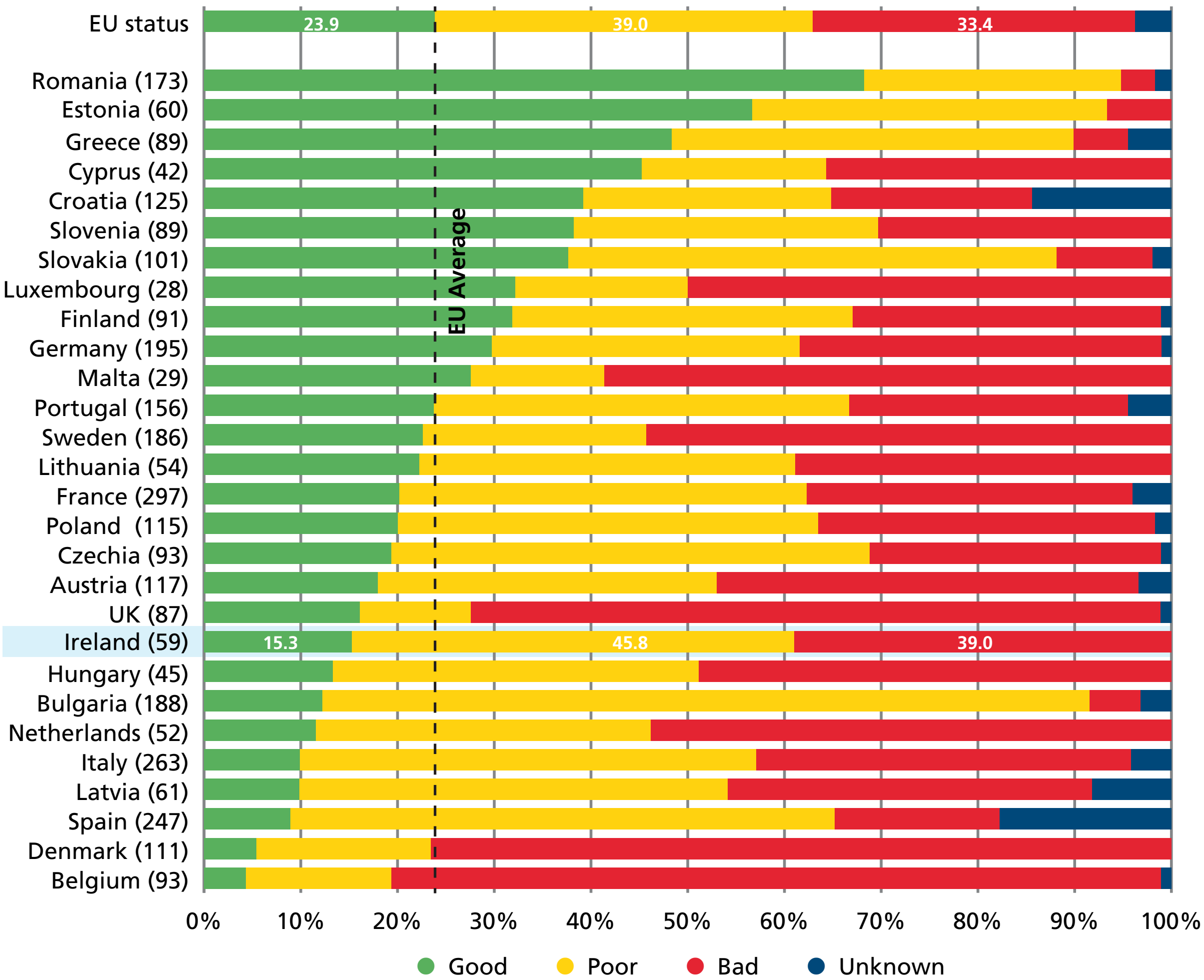
Ireland also falls below the EU average when it comes to the number of habitats reported as being in 'good' conservation status (Figure 7.3). In a European assessment covering the period 2013-2018 (EEA, 2020), Ireland comes 20th out of 28 Member States (including the UK). The European Environment Agency (EEA) assessment also reported on Ireland's 60 species listed in the directive. It highlights that the majority of species (72%) protected under the EU Habitats Directive are stable or increasing. Overall, 57% of Irish species assessed have a good conservation status (Figure 7.4), which is above the EU average (30.4%).[4] The EEA's latest 'State of nature in the EU' report (2020) shows alarming results from the 2013-2018 reporting period (Topic Box 7.3).

Figure 7.2 Intact Irish peatland, Clara bog, Co. Offaly

Credit: ©Tina Claffey

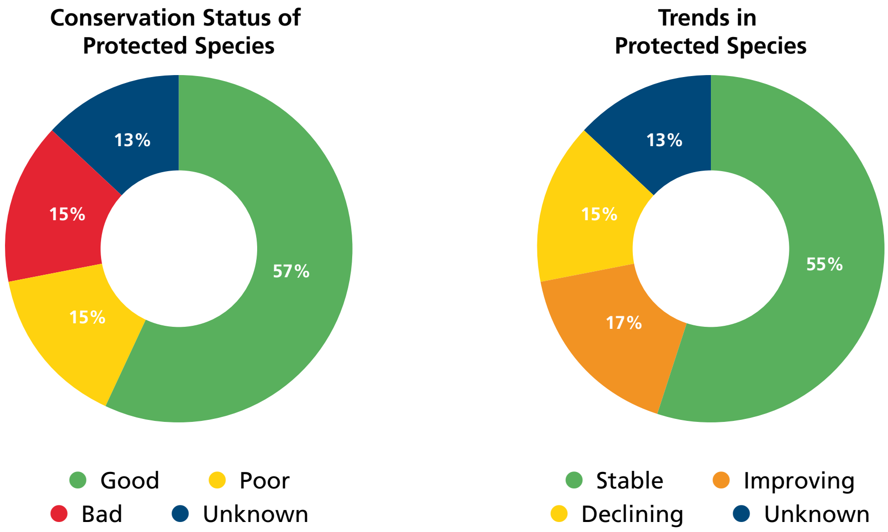
4 Conservation status of species under the EU Habitats Directive (accessed 18 April 2024).

Figure 7.3 Conservation status of protected habitats at EU Member State level, 2013-2018



Source: EEA, 2021b

Figure 7.4 Summary of the assessment results for (left) the status of and (right) trends in species populations protected under the EU Habitats Directive in Ireland



Source: NPWS, 2019a

Species such as the pine marten and otter have shown increases, with the pine marten showing an increase in range (NPWS, 2019a). Some key species, however, are declining. One of the species of greatest concern is the pollution-sensitive freshwater pearl mussel (Figure 7.5). Only a few rivers have populations that include juvenile individuals; populations without young individuals are likely to die out (NPWS, 2019a). The next update on the assessment of the conservation status of protected habitats and species in Ireland is due in 2025.

Figure 7.5 One of Ireland's longest-lived species, the freshwater pearl mussel, *Margaritifera margaritifera*, considered to be in bad status in Irish rivers and lakes

The EU Birds Directive (2009/147/EC, Article 12) reporting for Ireland (NPWS, 2019b), also published every six years, highlighted that approximately 30% of the breeding species assessed are estimated to have remained stable or increased in abundance over the long term. Such birds include the little egret, great spotted woodpecker, golden eagle, white-tailed eagle and red kite. In contrast, almost 20% of breeding bird species in Ireland for which there are available data are in long-term decline. For example, acute declines were recorded up to 2018 for some ground nesting bird species such as red grouse, whinchat, twite, dunlin, golden plover, curlew, corncrake and redshank. Unfortunately, there were still several species that had significant data gaps and were therefore not assessed. The next full update on the assessment of the conservation status of protected birds (Article 12) in Ireland is due in 2025. Meanwhile, recent reporting from the NPWS highlights serious declines (59% since 2000) in the hen harrier (*Circus cyaneus*) population, a medium-sized raptor typically found in upland areas in Ireland (Ruddock *et al.*, 2024). Estimates suggest that this iconic bird of prey could be extinct in Ireland within 25 years (Ruddock *et al.*, 2024).

While the 2019 updates on protected habitats and species (NPWS, 2019a) and protected birds (NPWS, 2019b) are welcome, it must be noted that these represent only protected flora and fauna, which account for a small percentage of our nature and biodiversity. Very little research or data collection has been undertaken on the status of our non-protected habitats and species that make up most of our flora and fauna. This may be obscuring the true scale of biodiversity loss and highlights the need for accurate and up-to-date data on a wider range of biodiversity in Ireland.

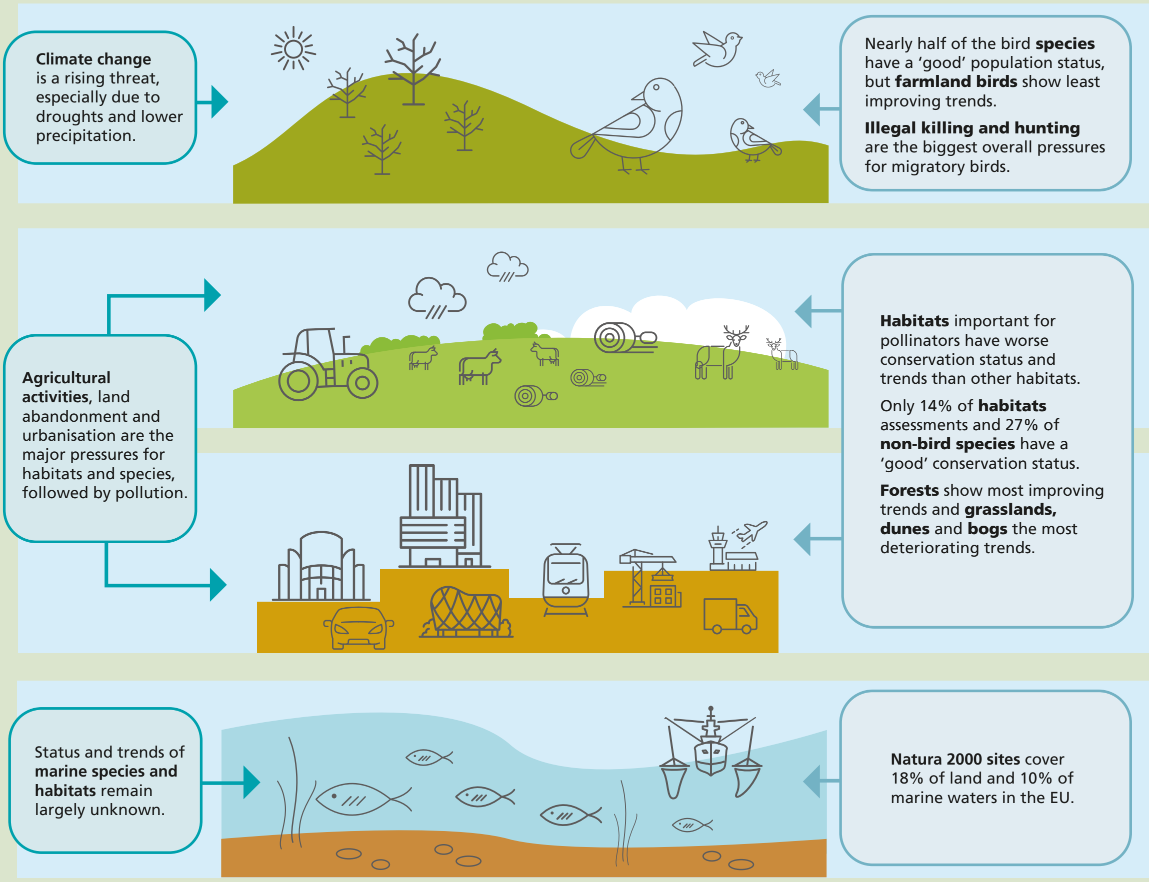
Some statistics from Irish biodiversity research are stark. For example, Fitzpatrick *et al.* (2007) found that more than half of Ireland's bee species had experienced substantial declines in numbers since 1980, with 30% of species considered threatened with extinction. Water quality is continuing to decline too, with almost half of freshwater systems in Ireland in poor or deteriorating condition (Chapter 6). Sixteen freshwater species, comprising ten aquatic insects, five snails and the European eel (*Anguilla anguilla*), are now considered critically endangered in Ireland (Kelly-Quinn *et al.*, 2020). Even more stark is that 11 species (eight water beetles, one stonefly and two snails), or 2.3% of the invertebrate species examined to date, are now considered extinct in Ireland (Kelly-Quinn *et al.*, 2020). Further information on some selected groups of Irish flora and fauna is provided below.

The EEA's latest 'State of nature in the EU' report (2020) shows alarming results from the 2013-2018 reporting period (Topic Box 7.3).

Topic Box 7.3 State of Nature in the EU

The EEA says that many species and habitats in Europe face an uncertain future unless urgent action is taken to reverse the situation (Figure 7.6).

Figure 7.6: Summary of the state of nature in Europe

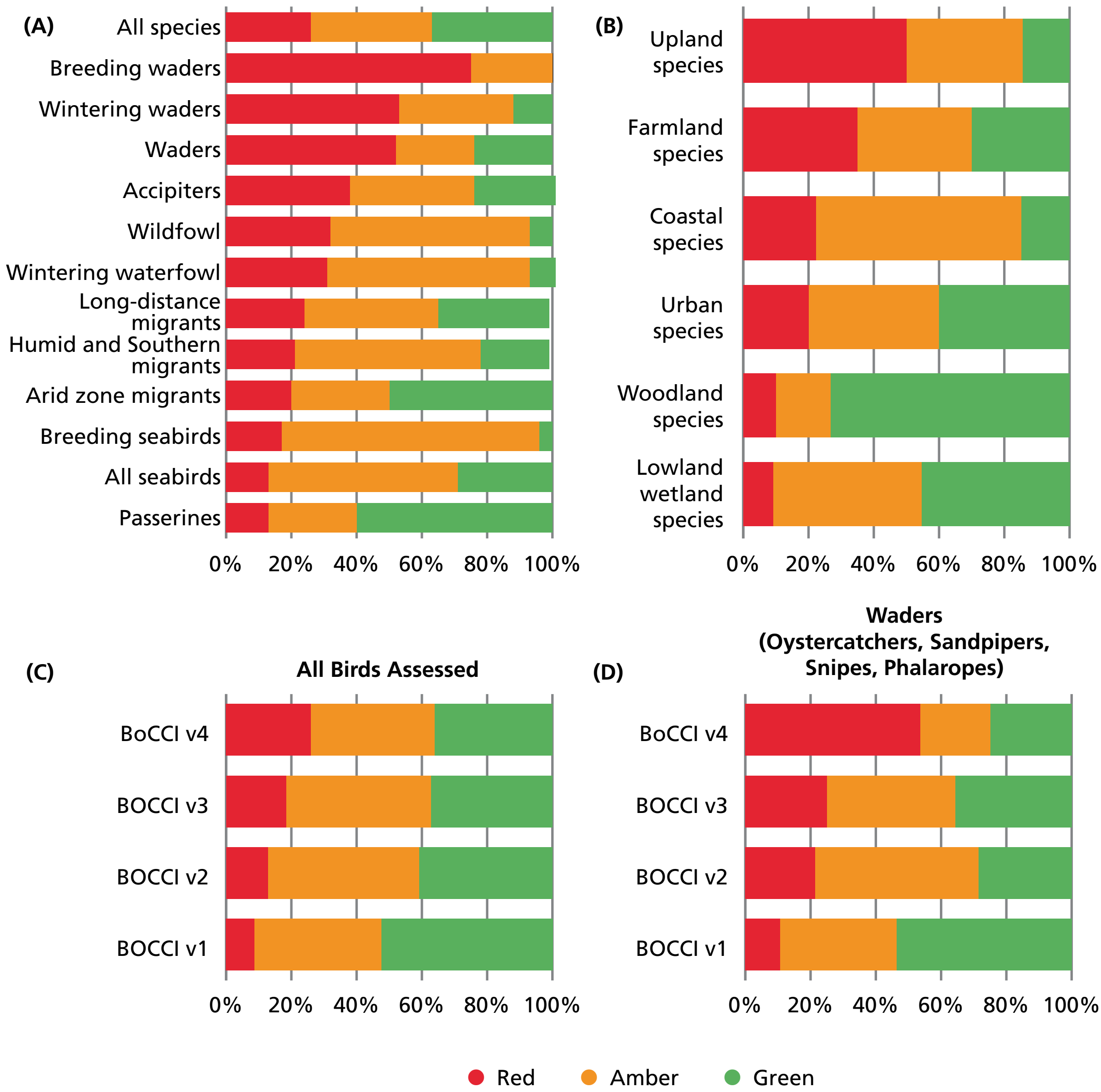


Source: Adapted from EEA, 2020

Birds of Conservation Concern in Ireland

Birdwatch Ireland and the Royal Society for the Protection of Birds Northern Ireland carried out the latest assessment of the conservation status of all regularly occurring birds on the island of Ireland, known as the Birds of Conservation Concern in Ireland (BoCCI) review. This assessment is separate from the EU Birds Directive requirements. The criteria on which the BoCCI review is based do, however, include conservation status at global and European levels and within Ireland. It assesses historical decline, trends in population and range, rarity, localised distribution and international importance. The latest BoCCI report included a range of national and global criteria and placed 26% of the 211 species assessed on the Red List, meaning that they are considered to be of high conservation concern (Gilbert *et al.*, 2021). Particularly affected are breeding waterbirds, and birds that use upland and farmland habitats (Gilbert *et al.*, 2021), but all habitats and bird groups are affected to some degree (Figure 7.7). More alarming is the fact that iconic species, some once common across the Irish landscape, such as the curlew, corncrake and hen harrier, are considered to be on the brink of extinction (for discussion of related conservation projects, see the section below on the Corncrake LIFE project and the Curlew Conservation Programme).

Figure 7.7 The proportion of species categorised as red, amber or green by the BoCCI assessment in 2021 and comparison with previous BoCCI assessments



Source: Reproduced with permission from BirdWatch Ireland and RSPB Northern Ireland

A) The proportion of species per taxonomic group.

B) The proportion of species per breeding habitat.

C) The percentage of species considered red, amber or green in BoCCI version 1 (Newton *et al.*, 1999), BoCCI version 2 (Lynas *et al.*, 2007), BoCCI version 3 (Colhoun and Cummins, 2013) and BoCCI version 4 (Gilbert *et al.*, 2021).

(D) The percentage of wading species considered red, amber or green across BoCCI assessments from 1999 to 2021. Each column is categorised as red, amber or green. All data displayed as percentages.

Botanical Society of Britain and Ireland Plant Atlas for Ireland

In 2023, the Botanical Society of Britain and Ireland (BSBI) published a new Plant Atlas for Ireland (Stroh *et al.*, 2023). Using data collected over 20 years (2000-2020), the atlas highlighted a significant loss of Irish flora, with more than half of Irish native plant species (56%) having declined in range or abundance or both. According to the BSBI, many of the habitats that Irish wild plants depend on have been removed or altered by farming and forestry since the 1950s. Grassland plants have been affected the most. Re-seeding, over-fertilising, nitrogen deposition, herbicides, drainage and changes in grazing pressure have all contributed to the decline of species (Stroh *et al.*, 2023). Mirroring the freshwater faunal declines highlighted by Kelly-Quinn *et al.* (2020), the BSBI report also highlighted how many Irish lakes and wetlands have seen significant declines in both species and populations of native aquatic flora, with many lakes now dominated by invasive non-native aquatic plants, such as Nuttall's pondweed, *Elodea nuttallii*[5] (Figure 7.8).

Other important habitats such as peatlands have been planted with conifers or converted to agriculture, thus excluding the native peatland plants, such as sphagnum moss, heathers and sundew. There is also evidence that climate change may have affected Irish flora by helping some southern species to spread northwards, altering the natural range of species expected in Ireland. Non-native plants such as Himalayan balsam and rhododendron have become invasive. These are having a negative impact on native flora across the country (Stroh *et al.*, 2023).

Figure 7.8 Increase in distribution of the invasive Nuttall's pondweed, *Elodea nuttallii*, 1986-2019. Dots on the maps represent records of the pondweed (at the scale of 10 km × 10 km squares) in each period

Source: Map data available at plantatlas2020.org/atlas/2cd4p9h.xmq

5 A perennial aquatic plant native to North America, Nuttall's pondweed, *Elodea nuttallii*, grows submersed in lakes, rivers and other shallow water bodies. In Ireland it is considered an invasive alien species that is outcompeting and replacing our native aquatic flora, such as charophytes. www.eea.europa.eu/themes/biodiversity/state-of-nature-in-the-eu/article-12-national-summary-dashboards-archived

International Union for Conservation of Nature Red List of threatened species in Ireland

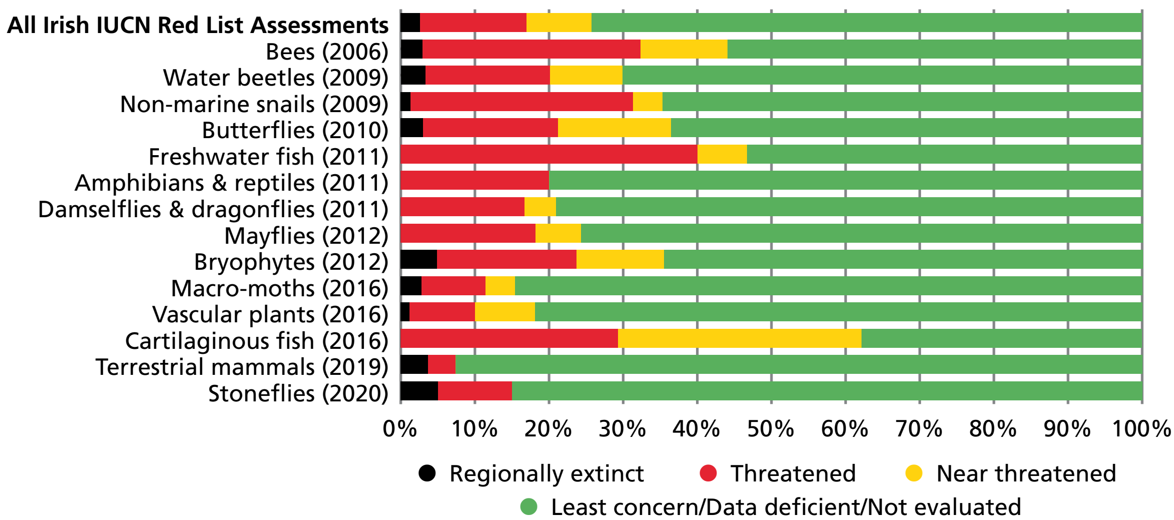
What is often missed in our current understanding of biodiversity in Ireland is the sheer number of species and groups that have not received any assessment to date (see Kelly-Quinn *et al.*, 2020). Most of our assessed species are listed in both the EU Habitats and Birds Directives and are therefore required to be assessed on a 6-year basis. However, these species represent just a small proportion of all the species found in Ireland. It is estimated that our island has at least 31,000 species: only about a tenth of these have had their conservation status assessed. This means that there is a fundamental gap in our knowledge about how biodiversity is changing in Ireland. Even within certain groups such as the insects, for example, data can often be over-reliant on particular groups such as moths and butterflies (Lepidoptera) and do not paint an accurate picture of the status of the wider diversity of insect groups (Duffus and Morimoto, 2022). Such an approach can mask declines or improvements in less well-studied groups.

The International Union for Conservation of Nature (IUCN) was established in 1964. Its Red List of Threatened Species has evolved to become the world's most comprehensive information source on the conservation status of animal, fungi and plant species. It is independent of other reporting mechanisms, such as the EU Habitats and Birds Directives. The IUCN Red List is a critical indicator of the health of the world's biodiversity (ICUN, 2012) and has been used to assess several groups in Ireland.

Unfortunately, of the Red List assessments completed up to 2020, 433 (14%) of 3145 Irish species assessed using the IUCN criteria are considered threatened with extinction, and 9% are near threatened.[6] Some notable examples include the angel shark (*Squatina squatina*), basking shark (*Cetorhinus maximus*), European eel (*Anguilla anguilla*), Arctic char (*Salvelinus alpinus*) and Atlantic salmon (*Salmo salar*). More worryingly, 82 (3%) species assessed have been categorised as extinct in Ireland (Figure 7.9), most notably the grey wolf (*Canis lupus*),[7] once widespread in Ireland but hunted to extinction.

Other extinct species may be less well known but include the orange-striped stonefly (*Perlodes mortoni*), the minutest diving beetle (*Bidessus minutissimus*), the grass-like wetland specialist Buxbaum's sedge (*Carex buxbaumii*) and the moss *Dicranum undulatum*, to name a few. The loss of *Dicranum undulatum*, a species once recorded in raised bogs in the midlands, is almost certainly due to drainage and damage to its habitat by industrial-scale peat extraction (Lockhart *et al.*, 2012).

Figure 7.9 A summary of all IUCN Red List assessments for Irish flora and fauna carried out between 2006 and 2020 highlighting regionally extinct (black), threatened (red) and near threatened (orange) species



Source: Data sourced from published reports at www.npws.ie/publications/red-lists

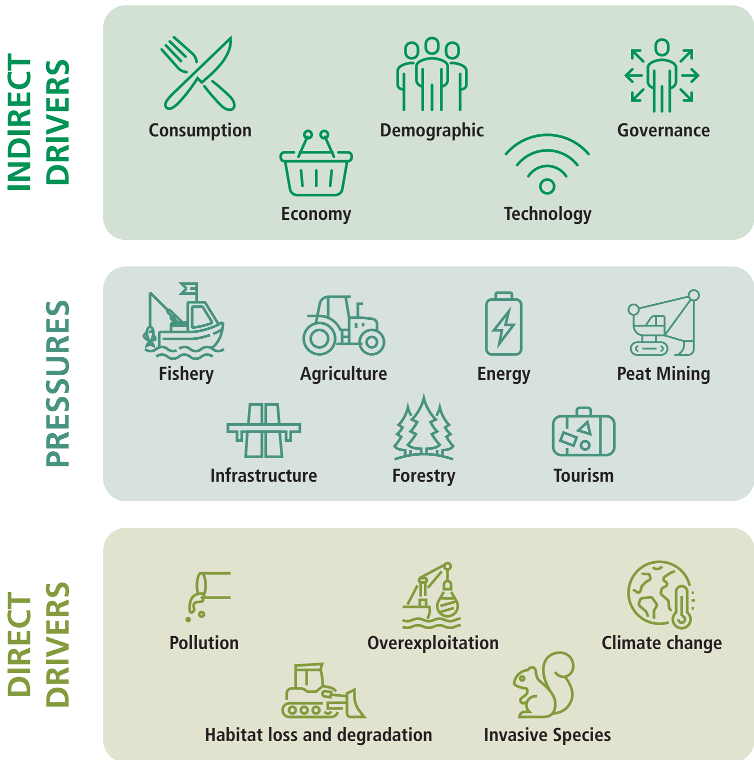
6 Full list of Red Lists reports for Ireland can be found here: www.npws.ie/publications/red-lists (accessed 1 April 2024).

7 The last grey wolf (*Canis lupus*) was reportedly shot in Co. Carlow in 1786 (Fairley, 1984; Hickey, 2016).

3. Threats to nature and biodiversity

How we live in and use our land has significant implications for human life, our economy and our society, and it also has consequences for nature and biodiversity. The most recent global assessment of biodiversity loss by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) lists changes in land and sea use, direct exploitation of organisms, climate change, pollution and invasion of alien species as the main threats to biodiversity (IPBES, 2019). In Ireland, the main reasons for biodiversity loss are wide ranging but generally reflect those highlighted by IPBES (2019). More specifically, and according to the most recent National Biodiversity Action Plan – for the period 2023-2030 (NPWS, 2024) – overgrazing, undergrazing, land abandonment, water and air pollution, alien and problematic species, recreation, development (particularly residential, agricultural and commercial), land drainage, river barriers and the modification of coastal areas, and climate change are all key issues affecting nature in Ireland. However, the ways in which human activities affect nature and biodiversity loss are nuanced and often reflect the policies and strategies adopted by society and government. This results in both direct and indirect drivers of change and demand that magnify pressures on the environment, nature and associated biodiversity (Figure 7.10).

Figure 7.10 Indirect and direct drivers and human pressures that cause biodiversity loss in Ireland



An indirect driver operates by altering the level of or rate of change of one or more direct drivers. Important indirect drivers include changes in population, economic activity, and technology, as well as socio-political and cultural factors.

Pressures from human activities have changed the state of the environment and ecosystem. Important pressures in Ireland include agriculture, commercial forestry, energy, industry, fisheries, peat mining and tourism.

A direct driver influences ecosystem processes and can therefore be identified and measured to differing degrees of accuracy. Important direct drivers include habitat change, climate change, invasive alien species, overexploitation, and pollution.

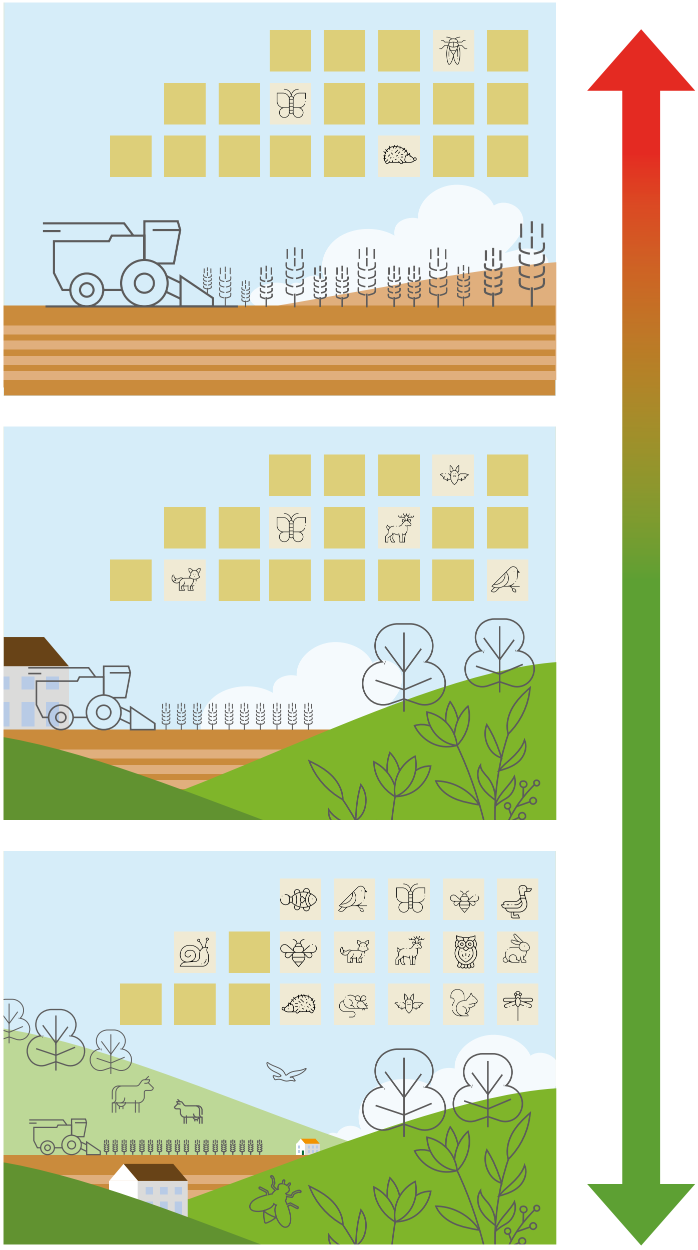
Source: Adapted from OPW, 2022

Land cover and land use

The challenges of managing the modified landscape we have created over generations cannot be overstated. Land cover in Ireland is dominated by grasslands. More than half of our land is used for agriculture-related activities. For more information about land cover and use, see Chapter 5.

This specialisation and intensification of land for agriculture has had a significant impact on biodiversity (Figure 7.11).

Figure 7.11 Value of landscape and land-use diversity for high biodiversity and healthy ecosystem functioning and resilience



Homogenous agricultural landscape

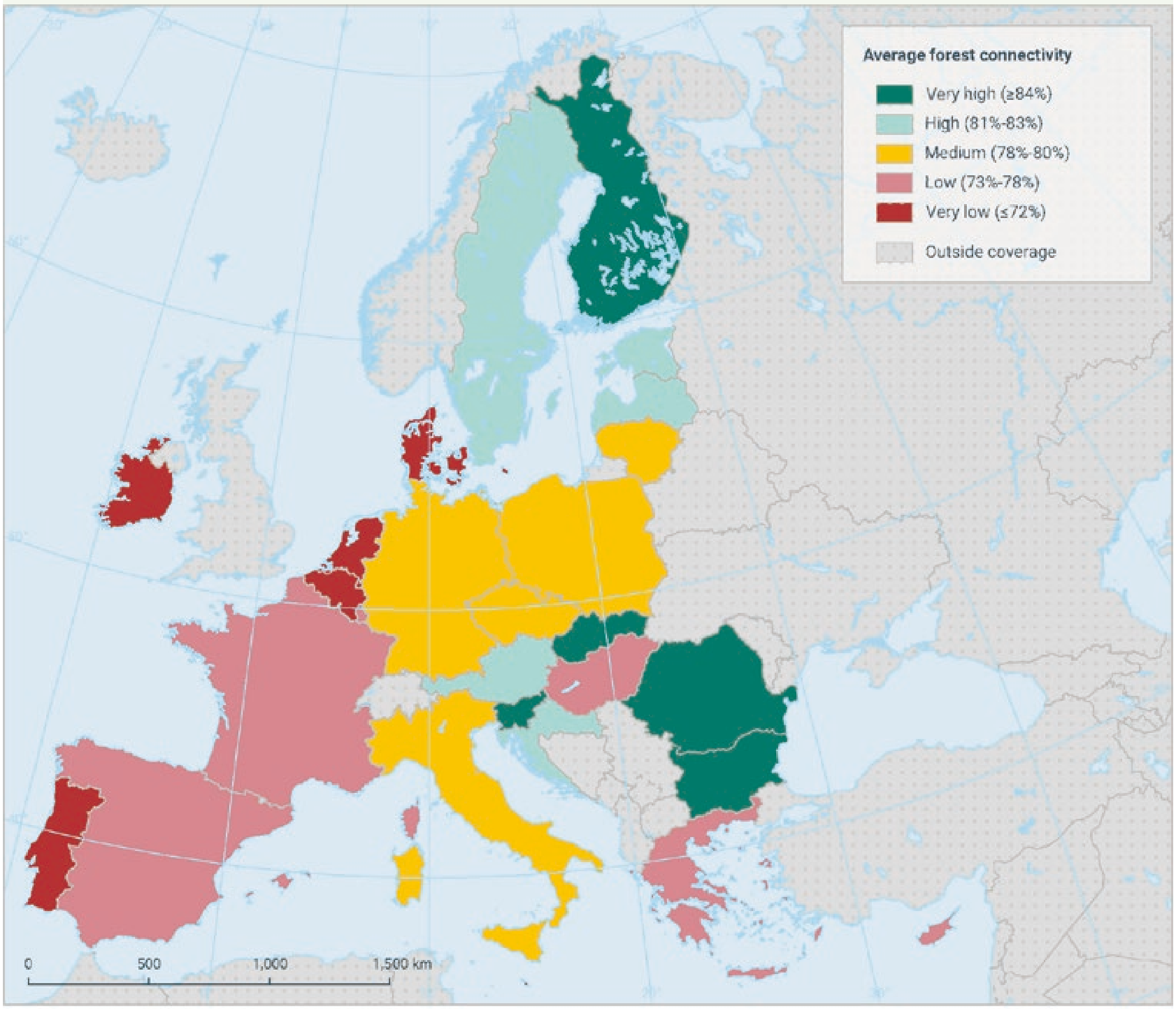
- Low biodiversity -> biological pest control missing, pollination deficit
- Heavy dependence on agrochemicals
- Susceptibility to erosion and nutrient leaching -> increased pollution of groundwater and water bodies
- Lower soil biodiversity -> poorer soil health
- Less carbon stored and sequestered
- Larger vulnerability to extreme weather events
- Unsustainable in long term

Agricultural landscape with diverse landscape elements

- Higher biodiversity -> possibility to count on biological pest control, improved pollination
- Decreased dependence on agrochemicals
- Resistance to erosion, decreased nutrient leaching
- Higher soil biodiversity -> improved soil health
- More carbon stored and sequestered
- Increased resistance to extreme weather events
- Sustainable also in long term

The declines in populations and species diversity of bees, butterflies and other insects, birds and plants are largely the result of monoculture and the drive to achieve ever-increasing levels of productivity (DCHG, 2019). This drive for productivity has been characterised by the loss, removal or neglect of hedgerows, stone walls, rough grass areas, ponds, wetlands and scrub, while practices such as land drainage and fertiliser and pesticide application, although local in extent, reduce space for nature (DCHG, 2019). Similarly, the fragmentation and loss of habitats reduces the space and connectivity needed for viable and sustainable species populations (Guilfoyle *et al.* 2023) and therefore overall survival (e.g. fragmented forest and woodland habitat in Ireland; Figure 7.12).

Figure 7.12 Forest fragmentation in the EU Member States



Source: EEA, 2023

Over-exploitation

Over-exploitation of our natural resources is a major driver of biodiversity loss. Peatlands have been mined for fuel for 400 years in Ireland (Malone and O'Connell, 2009). Ireland's Atlantic climate and diversity of peatland habitats has resulted in a unique biodiversity that is considerably different from that found elsewhere in Europe (excluding Scotland) and across the world.[8] Today, given the conversion of natural peatlands to agricultural pasture and forestry and practices such as drainage and turf cutting, the Irish Peatland Conservation Council[9] estimates that Ireland has witnessed a 77% loss in peatland habitat, the majority of which has occurred over the past 50 years owing to human activities. Similarly, the NPWS estimated that only 10% of the original raised bog resource and 28% of the original blanket peatland resource are considered natural peatlands and suitable for conservation (DAHG, 2015) (Figure 7.13). In a global study, Fluet-Chouinard *et al.* (2023) estimated that Ireland had lost up to 90% of its wetlands (peatlands included) since 1700, owing to human activities associated with land drainage and land use change, primarily for agricultural activities and urbanisation. This loss of peatlands and other wetlands (swamps, ponds, etc.) has been detrimental to our native biodiversity.

8 www.npws.ie/peatlands-and-turf-cutting (accessed 1 April 2024).

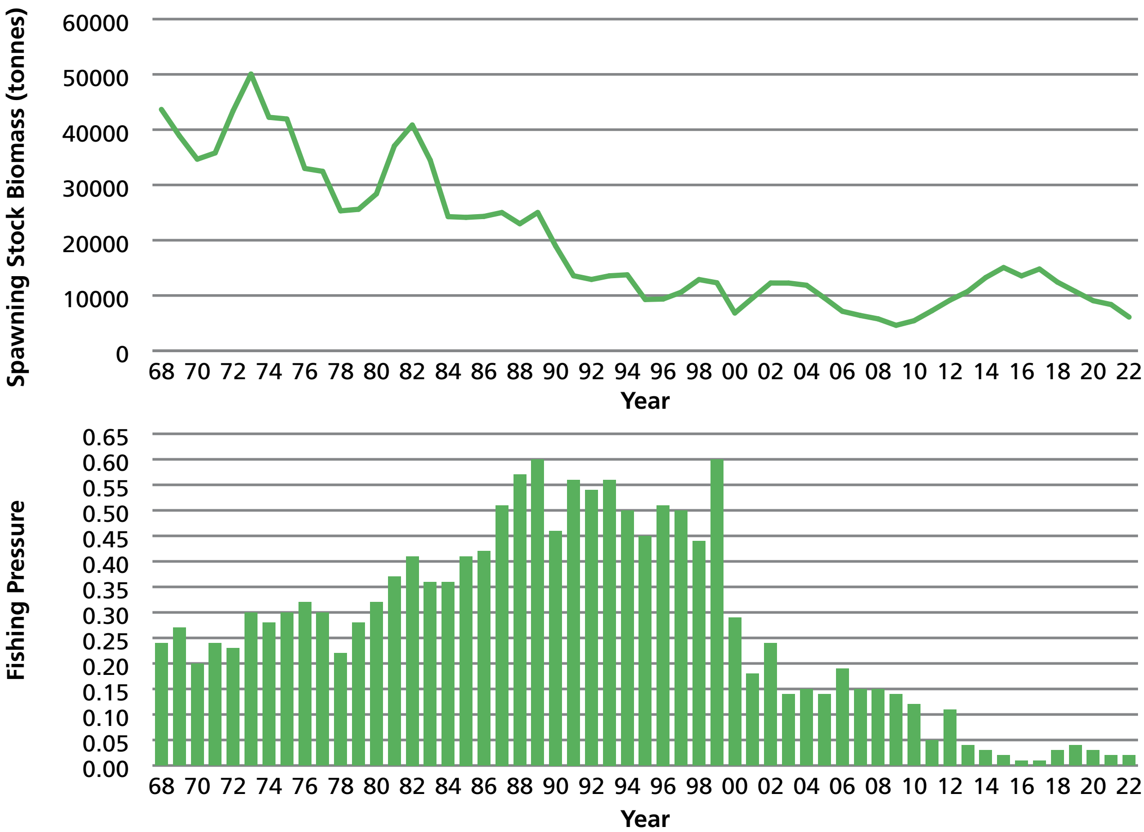
9 www.ipcc.ie (accessed 1 April 2024).

Nevertheless, Ireland still has one of the highest proportions of Europe's remaining intact peatlands and bogs, including a variety of raised and blanket bogs, fens and wet heath. These peatland habitats need to be protected (and where necessary restored) and have potentially immense value for protecting native Irish biodiversity and providing a range of other ecosystem services, such as carbon storage and flood mitigation (DAHG, 2015).

Figure 7.13 Exploited peatland

Over-exploitation of marine fish stocks remains a driver of biodiversity loss in Ireland (Vaughan *et al.*, 2023). Coupled with the effects of climate change, many commercial fish stocks will continue to come under pressure in the future. For example, both herring and cod (Figure 7.14), which are cold-water species and are at the southern limit of their range in Ireland, have seen declines in their spawning stock biomass in recent years, which is directly attributable to over-exploitation in the 1970s, 1980s and 1990s (Vaughan *et al.*, 2023). Over-exploitation can have long-term knock-on effects on both our economy and our livelihoods. Extinction threatens 48 species living in the Irish marine environment, including fish, crustaceans, shellfish and other invertebrates, with over-fishing, alongside accidental by-catch and near-shore pollution, driving many population declines (Fogarty, 2017).

Figure 7.14 The relationship between spawning stock biomass (top) and fishing pressure (bottom) on cod, *Gadus morhua*, in the Irish Sea, 1968-2022. Fishing pressure based on the Vessel Monitoring System



Source: Vaughan *et al.*, 2023

Figure 7.15 Macroalgal bloom in Youghal Bay, Co. Cork, a negative response to high levels of nutrient pollution

Pollution

Clean air is essential for healthy ecosystems. While recent decades have seen significant improvements in air quality in Ireland, air pollution continues to cause damage to both our health and the environment (DECC, 2023). Air pollution in the form of nitrogen deposition continues to affect natural habitats and their plant communities (Aherne *et al.*, 2021), which, in turn, has consequences for associated sensitive species and biodiversity, namely our butterflies, bees, other insects and birds. Air pollution from sulphur deposition, while much reduced, may still contribute to the acidification of soils and water (Chapter 2).

Water pollution in our environment is unfortunately too common, mainly due to nutrient inputs from agriculture and poorly treated waste water (Figure 7.15). For further discussion on this topic, see Chapters 8 and 9. The loss of high-quality unpolluted rivers, lakes and estuaries nationally has consequences for many freshwater species, such as the freshwater pearl mussel, and also for aquatic plants, invertebrates, fish and birds (King *et al.*, 2011, Kelly-Quinn *et al.*, 2020, Stroh *et al.*, 2023). Nutrient pollution in our waters also favours opportunistic invasive species, such as Nuttall's pondweed, allowing them to outcompete and replace our native fauna (see Figure 7.8). Similarly, nutrient pollution, in combination with invasive species, such as the Ponto-Caspian zebra mussel now widespread across Ireland, can result in significant ecological and economic impacts.

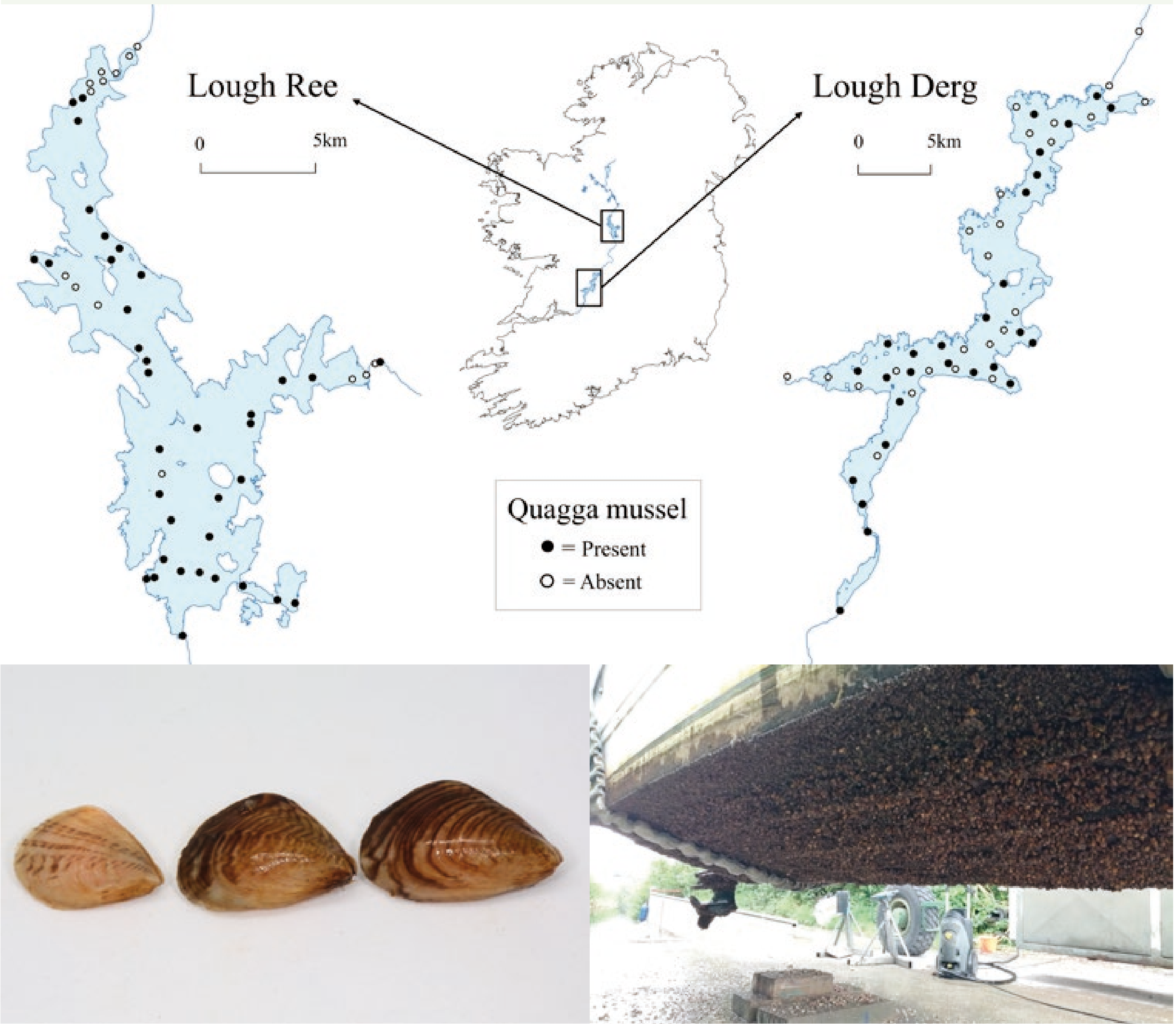
Invasive alien species

Invasive alien species are those that have become problematic after they have been introduced (deliberately or accidentally) to places where they do not occur naturally. Increased trade, human movement, changes in land use and climate change mean that the risk of invasive species arriving, spreading and becoming established in Ireland is high. Non-native species become invasive because they adapt to their new environment easily, outcompeting native species for resources such as food, light or space, and may have little or no predation (e.g. sika deer; Twining *et al.*, 2022).

These invasive species can have a negative impact on the economy, wildlife and habitats and are one of the top five causes of biodiversity loss across the globe (IPBES, 2019). For example, Stroh *et al.* (2023) recently highlighted non-native species as one of the main threats to native plant biodiversity in Ireland. Similarly, invasive species can cause environmental and economic damage – for example, both zebra and quagga mussels[10] can block public and private water abstraction in lakes, increasing operating costs. They attach readily to boats (Figure 7.16) and moorings, causing damage and increasing maintenance costs. Invasive species can also contribute to large ecological disasters; for example, in Lough Neagh in Northern Ireland, the combination of nutrient pollution (from agricultural run-off and sewage), the proliferation of invasive zebra mussel populations across the lake (which filter particles from the water, increasing light penetration) and climate change has resulted in extensive blooms of toxic blue-green algae (The Rivers Trust, 2024). Blue-green algae can release toxins harmful to humans, animals and birds.

10 These species are both originally from the Ponto-Caspian region and are known to cause widespread economic and ecological impacts on affected waters outside the native range.

Figure 7.16 (top) The Shannon River system with Lough Ree and Lough Derg enlarged. Dots show the presence (black) and absence (white) of the invasive quagga mussel (first discovered in Ireland in July 2021) during surveys in 2021 and 2022. The photographs (bottom left) show three quagga mussels and (bottom right) thousands of quagga mussels established on the hull of a boat on the Shannon system – a key dispersal mechanism of this species



Source: Map reproduced from Flynn *et al.*, 2023

Ireland has a long list of invasive non-native species (e.g. zebra mussel, quagga mussel, Asian clam, grey squirrel, Alpine newt, rhododendron, Chinese mitten crab (Figure 7.17) and Pacific oyster), which have all displaced, to varying degrees, naturally occurring species across Ireland, resulting in biodiversity loss and damaged ecosystems.

Figure 7.17 The invasive alien Chinese mitten crab (left) caught in the Barrow estuary. Native white-clawed crayfish (right) from the Slate river, Co. Kildare, a protected species now absent from much of the River Barrow Catchment and whose range in Ireland has declined in recent years because of a lethal contagious fungal-type disease (*Aphanomyces astaci*) originally from North America

Credit: Jan-Robert Baars (UCD)

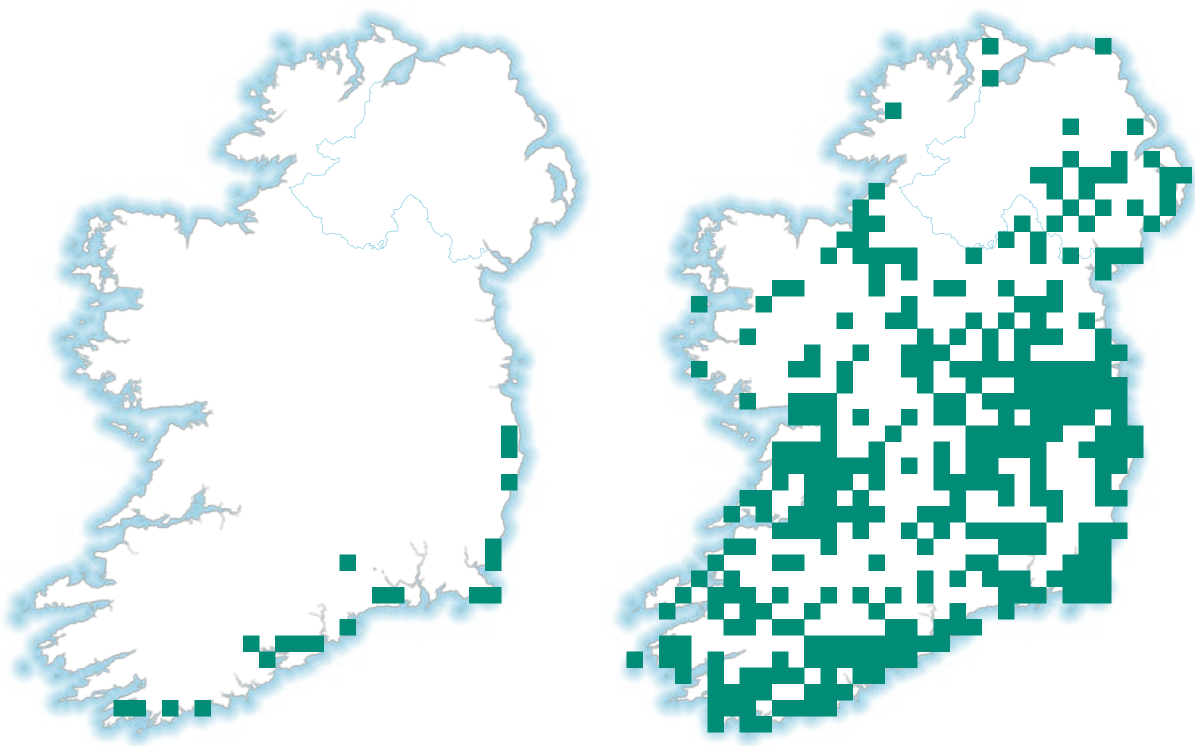
There are also significant economic costs. Kelly *et al.* (2013) estimated that the annual cost of invasive species to Ireland's economy was over €200 million, although this figure has most certainly increased since. IPBES (2023) estimated the annual global cost of invasive species in 2019 as €400 billion. The increased threats of other species becoming established (such as the Asian hornet, coypu and raccoon), and others spreading (like fireblight (*Erwinia amylovora*), a bacterial disease affecting hawthorn) have the potential to further damage Ireland's native species and habitats, resulting in increased economic costs. Despite the EU Regulation on the prevention and management of invasive alien species (Regulation (EU) No 1143/2014), ongoing failures relating to the continued introduction and spread of new invasive species in Ireland (Figure 7.17) highlight issues relating to the lack of enforcement initially and suitable management regimes (i.e. control and/or eradication) thereafter of non-native species and their introductions across the island.

Climate change

The climate and biodiversity emergencies are complicated and interconnected challenges. Biodiversity helps to regulate the climate and protect us from extreme weather and other effects of climate change. However, climate change is recognised as a major driver of change in nature and biodiversity globally (see IPBES, 2019). Changes in climatic conditions (e.g. rainfall patterns, average temperatures, prevalence of storms) in Ireland are likely to drive species change, both positively and negatively, with the geographical range of many of our native species likely to change. Climate change will also further aid the spread of invasive species and the associated negative consequences of native species' decline. It will also increase habitat degradation and fragmentation; increase the intensity, magnitude and frequency of fires, floods, storms and periods of drought; and increase pollution of air, water and soil.

Ireland has already had species (e.g. the winter stonefly, *Capnia atra*) categorised as vulnerable to extinction due to climate change (see Feeley *et al.*, 2020), while other species, such as the emperor dragonfly, have seen significant increases in their distribution across Ireland in recent years (Figure 7.18) as average temperatures rise. Similarly, several studies (see Woodward *et al.*, 2015) have highlighted the significant effect of heavy rainfall, flash flooding and related storm impacts on river biodiversity in Ireland, with the recovery of species often taking years to decades. Globally, the United Nations (UN) estimates that 8-41% of species are at risk of losing half their habitat owing to increasing temperatures, while live coral reefs have nearly halved in the past 150 years and further warming threatens to destroy almost all remaining reefs.[11]

Figure 7.18 The geographical spread of the emperor dragonfly, *Anax imperator*, in Ireland. This species was first recorded here along the south and south-east coast in the period 2000-2003 (left) and has gradually spread north and north-west over the past 20 years (right) due to climate change



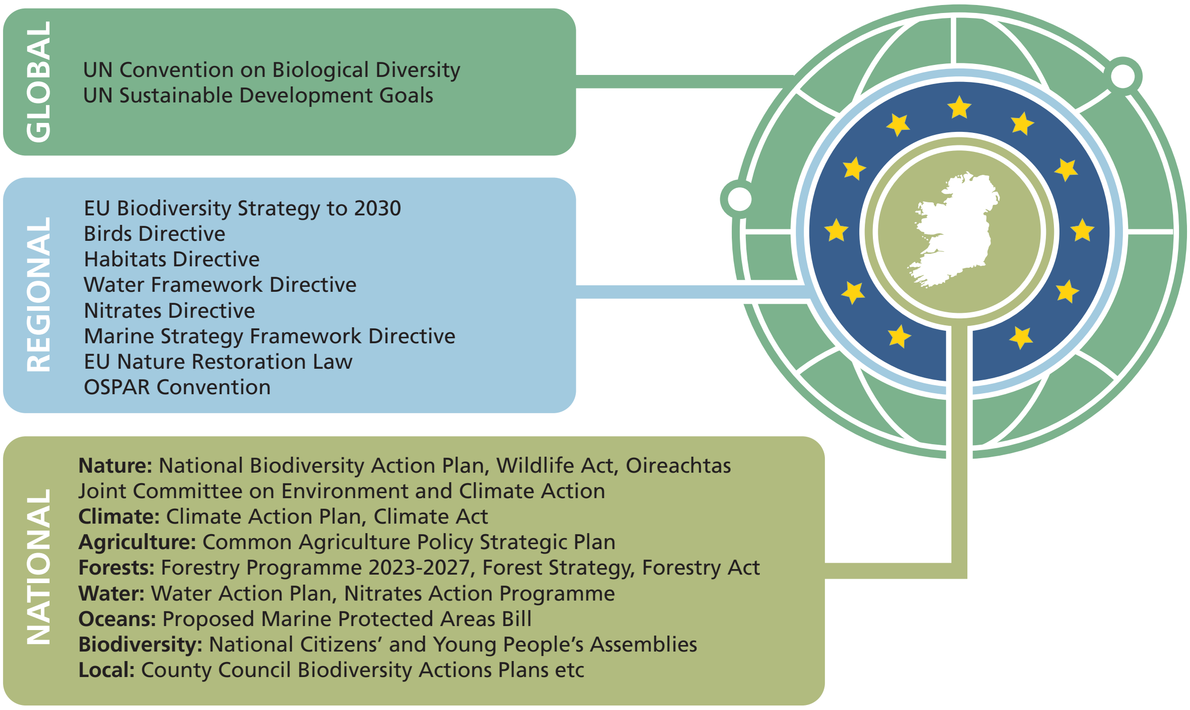
Source: NBDC, 2023; some CEDaR-generated data is included in the maps

11 www.un.org/en/climatechange/science/climate-issues/biodiversity (accessed 2 April 2024).

4. Global and European policies, plans and programmes for nature

Since the Dáil declared a biodiversity emergency in 2019 (Topic Box 7.2), the policy landscape has changed dramatically (Figure 7.19).

Figure 7.19 Environmental policies, plans and programmes that influence biodiversity



Source: Adapted from NPWS, 2024

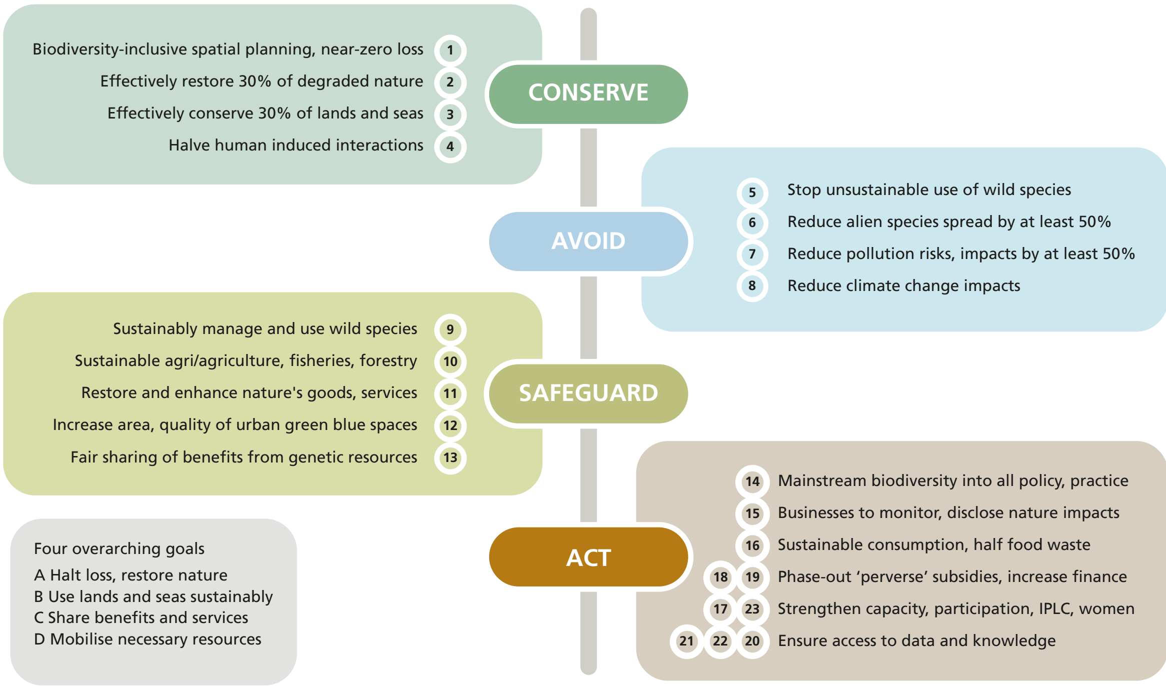
The UN Kunming-Montreal Global Biodiversity Framework

In 2022, the United Nations Biodiversity Conference of the Parties (COP15) to the UN Convention on Biological Diversity (CBD) adopted a landmark agreement to guide global action on nature through to 2030. Known as the Kunming-Montreal Global Biodiversity Framework (GBF), this agreement aims to address biodiversity loss, restore ecosystems and protect indigenous rights. The GBF includes concrete measures to halt and reverse nature loss, including protecting 30% of the planet and restoring 30% of degraded ecosystems by 2030. It also contains proposals to increase finance to developing countries. NPWS (2024) provides more detail on the alignment of government policy and the fourth iteration of the National Biodiversity Action Plan with the GBF targets. The framework contains global goals and targets (Figure 7.20) that aim to protect and restore nature for current and future generations, ensure its sustainable use and encourage investment in a green global economy. Together with the Paris Agreement[12] on climate change and the UN 2030 Agenda for Sustainable Development,[13] the agreement paves the way towards a climate-neutral, nature-positive, resilient world by 2050.

12 unfccc.int/process-and-meetings/the-paris-agreement (accessed 4 April 2024).

13 sdgs.un.org/goals (accessed 4 April 2024).

Figure 7.20 Some of the key global targets of the Kunming-Montreal Global Biodiversity Framework



Source: Adapted from NPWS, 2024

The EU Biodiversity Strategy

The European Green Deal, which aims to make the EU climate neutral by 2050, is supported by policies such as the EU Biodiversity Strategy for 2030 (EC, 2021), the new Common Agricultural Policy Strategic Plan (see Chapter 10) and nationally by the Climate Action Plan, among others (see Chapter 4). The EU Biodiversity Strategy sets out a comprehensive package of commitments and actions to put Europe's biodiversity on the path to recovery by 2030. It addresses the five main drivers of biodiversity loss – changes in land and sea use, over-exploitation, climate change, pollution and invasive alien species – and aims to put in place an enhanced governance framework. As well as taking action to restore and protect biodiversity in Europe it commits to taking EU action to raise the level of ambition for biodiversity worldwide and reduce the impact of trade. In addition, a third river basin management plan cycle and new legislation for marine protected areas (MPAs) are currently in train. These developments are reflected throughout the new (fourth) National Biodiversity Action Plan (NPWS, 2024).

EU Nature Restoration Law

The EU Nature Restoration Law (Regulation (EU) 2024/1991) sets legally binding targets to restore degraded ecosystems, in particular those with the most potential to capture and store carbon, and to prevent and reduce the impact of natural disasters. The law will require all Member States to produce a national restoration plan. This work will be led by the NPWS and will include a public participation process, informed by robust ecological and socio-economic impact assessments (NPWS, 2024).

The proposal contains the following specific targets:

- based on existing legislation (for wetlands, forests, grasslands, rivers and lakes, heath and scrub, rocky habitats and dunes) – improving and re-establishing biodiverse habitats on a large scale and bringing back species populations by improving and enlarging their habitats

- pollinating insects – reversing the decline of pollinator populations by 2030, achieving an increasing trend in pollinator populations, and developing a methodology for regular monitoring of pollinators
- forest ecosystems – achieving increasing trends in the amounts of standing and lying deadwood, the proportion of uneven aged forests, forest connectivity, the abundance of common forest birds and stocks of organic carbon
- urban ecosystems – achieving no net loss of green urban space by 2030 and an increase in the total area covered by green urban space by 2040 and again by 2050
- agricultural ecosystems – increasing populations of grassland butterflies and farmland birds, increasing the stock of organic carbon in cropland mineral soils and the share of agricultural land with high-diversity landscape features, and restoring drained peatlands under agricultural use
- marine ecosystems – restoring marine habitats such as seagrass beds or sediment bottoms that deliver significant benefits, including for climate change mitigation, and restoring the habitats of iconic marine species such as dolphins, porpoises, sharks and seabirds
- river connectivity – identifying and removing barriers that prevent the connectivity of surface waters, so that at least 25,000 km of rivers are restored to a free-flowing state by 2030.

As part of the EU Nature Restoration law, Member States are required to submit National Restoration Plans to the Commission within two years. Ireland's 4th National Biodiversity Action Plan 2024-2030 (NPWS, 2024) commits to the preparation of a National Restoration Plan by 2026 to contribute toward the ambitious EU restoration targets.

Ireland’s National Biodiversity Action Plan

Ireland’s 4th National Biodiversity Action Plan 2024-2030 was published in January 2024 (NPWS, 2024). The plan is an all-of-government document and sets out the national agenda for protecting and restoring biodiversity for the period 2024-2030. It aims to deliver the transformative changes required in how we value and protect nature with a view to proactively tackling the biodiversity emergency. Key objectives in the plan include:

- adopt a whole-of-government, whole-of-society approach to biodiversity
- meet urgent conservation and restoration needs
- secure nature’s contribution to people
- enhance the evidence base for action on biodiversity
- strengthen Ireland’s contribution to international biodiversity initiatives.

The objectives are underpinned by 194 actions supported by indicators (NPWS, 2024). The plan also takes account of EU and international biodiversity strategies and policies and relevant national policies. The plan recognises the critical importance of the compilation of a national restoration plan, which will support the ambition of the EU Biodiversity Strategy for 2030 and the restoration targets of the Global Biodiversity Framework. The fourth iteration of the National Biodiversity Action Plan also includes other actions (see NPWS, 2024) to address the recommendations arising from the Citizens’ Assembly on Biodiversity Loss (Topic Box 7.2), including increased resources, support for local action, engagement with business and putting the action plan on a statutory footing. NPWS will also explore ways in which the rights of nature could be formally recognised, including the potential for constitutional change (NPWS, 2024).

5. Current action on nature

Clearly, the production of biodiversity actions plans, whether by businesses or on a local, regional, national or international governance level, is a positive step for nature restoration and promotes biodiversity protection. However, action plans must have clear targets and tangible ways of measuring success to evaluate the current state, and change in state, of verifiable data that relate to biodiversity (NBDC, 2021a). In other words, it is important that we start and continue to measure and assess the state of biodiversity. This process should involve the measurement of indicators for appropriate data relating to biodiversity. This includes direct metrics, such as the number of endangered species and habitats, and indirect metrics, such as the number of biodiversity-related policies implemented (NBDC, 2021a), and will provide evidence-based results for reporting on biodiversity change and conservation action and informing conservation policy at national and European levels. Evidence of tangible action and associated outcomes in relation to biodiversity is slowly becoming more evident in Ireland.

A review of the third iteration of the National Biodiversity Action Plan for the period 2017-2021 (BWG, 2023) highlighted progress in implementing actions, aiding a shift in public opinion towards a greater appreciation of biodiversity. For example, efforts to mainstream biodiversity into decision-making and improve expert knowledge of biodiversity across government were deemed successful, and several programmes are ongoing. Large sectoral achievements included the restoration or rehabilitation of 25,000 ha of peatland habitat by Bord na Móna (BWG, 2023) and the publication of Ireland's river basin management plans for 2018-2021 and 2022-2027 (DHLGH, 2024).

The establishment and reporting of the Citizens' Assembly on Biodiversity Loss set an international benchmark for embedding biodiversity into the public consciousness and for society-led recommendations. Several additional positive actions are highlighted below.

Expansion of Ireland's national parks

In addition to the Natura 2000 network and network of NHAs (see Introduction) Ireland has eight national parks:[14] the Burren, Co. Clare; Glenveagh, Co. Donegal; Killarney, Co. Kerry; Wicklow Mountains; Connemara, Co. Galway; Wild Nephin, Co. Mayo, the Boyne Valley (Brú na Bóinne[15]), Co. Meath and Páirc Náisiúnta na Mara, Ciarraí[16] (Kerry Seas National Park). Ireland also has 77 registered nature reserves, most of which are owned by the state, except for a few owned by organisations or private landowners.

All-Ireland Pollinator Plans 2015-2020 and 2021-2025

The All-Ireland Pollinator Plan 2015-2020, managed by the National Biodiversity Data Centre (NBDC), was the first action plan to address the decline of pollinating insects such as bees (see Fitzpatrick *et al.*, 2007). It set out to ensure the sustainability of our food production, avoid additional economic impact on the agricultural sector and protect the health of the environment (NDBC, 2020). Its overarching goals were to collectively take steps to reverse the loss of pollinators by restoring populations to healthy levels. The results of the first All-Ireland Pollinator Plan were extremely positive. It changed the perception of biodiversity conservation from being negative to being seen as an endeavour that can be achieved with positive solutions-based approaches. The pollinator plan engaged communities, businesses and local authorities in proactively managing land for pollinators and, by association, other biodiversity.

A new All-Ireland Pollinator Plan for 2021-2025 (NBDC, 2021b) builds on the success of the first plan. It provides a 5-year road map to help bee and other pollinator populations and our wider biodiversity. It engages with more partners to deliver more actions and focuses on encouraging a better way of managing our whole landscape to permanently support our struggling biodiversity.

14 www.nationalparks.ie/ (accessed 4 April 2024).

15 www.discoverboynevalley.ie/new-national-park-boyne-valley (accessed 4 April 2024).

16 www.nationalparks.ie/kerry-seas/ (accessed 24 April 2024).

EU LIFE projects

The EU LIFE programme 2021-2027 funds environmental, climate and energy objectives. The programme seeks to develop, demonstrate and promote innovative techniques, methods and approaches to reach EU environmental and climate goals. Integrated projects support authorities in EU Member States in implementing environmental and climate plans, programmes and strategies developed at a regional, multi-regional or national level. One of four main themes in the LIFE programme is 'Nature and Biodiversity'.

Some of the Irish nature and biodiversity LIFE projects include Waters of LIFE,[17] the Corncrake LIFE project (below), LIFE on Machair[18], the Wild Atlantic Nature LIFE project and the Kerry Life Freshwater Pearl Mussel project (Topic Box 7.4).

Corncrake LIFE project and Curlew Conservation Programme

Ireland's population of endangered corncrakes has risen by more than one-third in recent years, according to the latest figures provided by the NPWS (2024). These show that the number of breeding territories in 2023 surpassed 200 for the first time in a decade. The increase has been brought about following the introduction of a multi-million-euro conservation investment in 2019, funded by the EU LIFE programme.[19]

Similarly, the Curlew Conservation Programme has reported the largest number of young curlew (Figure 7.21) fledged in the wild since the programme began in 2017 (Harrison *et al.*, 2023). The project is supported by the NPWS and the Department of Agriculture, Food and the Marine (DAFM). It reported that 42 chicks reached fledgling stage in 2023, up from 19 in 2022, representing more than double the number of chicks reaching the stage of being able to fly (Harrison *et al.*, 2023).

Figure 7.21 A curlew chick

Credit: Barry O'Donoghue, NPWS

17 www.watersoflife.ie/ (accessed 4 April 2024).

18 www.lifeonmachair.ie/ (accessed 18 April 2024).

19 www.corncrakelife.ie (accessed 4 April 2024).

Topic Box 7.4 Wild Atlantic Nature and Kerry LIFE Freshwater Pearl Mussel projects

The Wild Atlantic Nature LIFE Integrated Project[20] aims to deliver and support the management of high-quality habitats, and to improve the conservation status in the Special Areas of Conservation network of blanket bog, a priority habitat under the Habitats Directive. The primary focus is on 35 Natura 2000 sites in the north-west of Ireland, covering a total area of 262,632 ha (Figure 7.22). Running from 2021 to 2030 and led by the Department of Housing, Local Government and Heritage (DHLGH) with nine other associated beneficiaries, this multidimensional project works with farmers, landowners, local communities, state agencies and others across a broad range of actions spanning sectors including agriculture, forestry, tourism, community development and science.

Figure 7.22 Wild Atlantic Nature LIFE-IP Blanket Bog Special Areas of Conservation within the Northern and Western Regional Assembly

Map adapted from NPWS[21]

The Kerry LIFE Freshwater Pearl Mussel Project[22] team worked closely with farmers and forest owners in the County Kerry river catchments of the Caragh and Blackwater. The project, which ran between 2014 and 2020, initially targeted an area comprising 2500 ha of farmland and 515 ha of forestry (in both public and private ownership) for inclusion. This target was exceeded and covered 5038 ha of farmland and 542 ha of forest. By the project's end, 25 key deliverables and outputs had been achieved. These included an improved river habitat for the protected and endangered freshwater pearl mussel; 5.9 km of river buffer zones created; 76 km of drains re-vegetated; 122 drains blocked; 2.6 km of hedgerow planted; sediment losses reduced; livestock management facilities and livestock drinking facilities enhanced; nutrient inputs on farms across 501 ha reduced; 27 ha of native woodland established; 14.1 ha of existing woodland conserved; and 50.2 ha of conifer plantation converted to long-term native woodland.

20 www.wildatlanticnature.ie (accessed 4 April 2024).

21 LIFE IP Wild Atlantic Nature – Wild Atlantic Nature (accessed 24 April 2024).

22 www.npws.ie/research-projects/kerrylife (accessed 4 April 2024).

European Innovation Partnerships

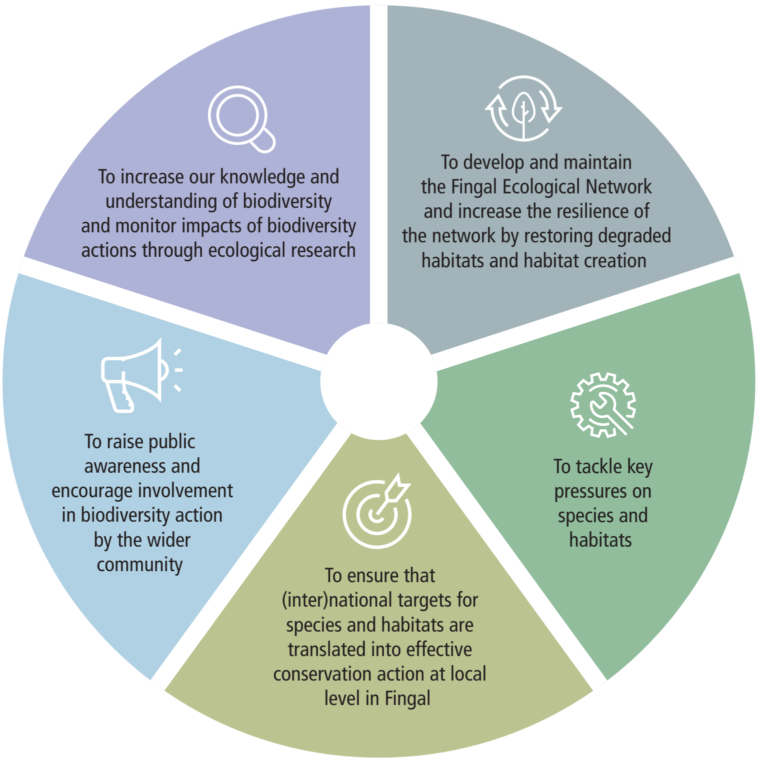
European Innovation Partnerships bring together relevant parties at the EU, national and regional levels to streamline, simplify and better coordinate existing financial instruments and initiatives. Managed by the DAFM in Ireland, European Innovation Partnerships focus on challenges that can benefit society and modernise sectors and markets. They allow farmers, scientists and other experts to collaborate to develop new practices that are environmentally friendly and economically sustainable. Projects focusing on protecting wildlife and biodiversity include:

- BRIDE – Biodiversity Regeneration in a Dairying Environment[23]
- a locally led scheme for the conservation of the hen harrier[24]
- Protecting Farmland Pollinators[25]
- a project on the conservation of breeding curlew in Ireland[26]
- Pearl Mussel Project.[27]

Local authority biodiversity officer programme

Local authority biodiversity officers work at city and county levels collecting data on biodiversity, carrying out conservation projects, developing policies, providing advice and information, and raising awareness. Their role is diverse and is defined by individual local authority preferences, but with a core focus on strategic planning and collaboration on biodiversity and nature. For example, Fingal Council County published 100 actions[28] associated with five broad objectives (Figure 7.23). The programme is being delivered by the Heritage Council and the County and City Management Association, with support from the DHLGH and the NPWS.

Figure 7.23 Objectives of Fingal Biodiversity Action Plan



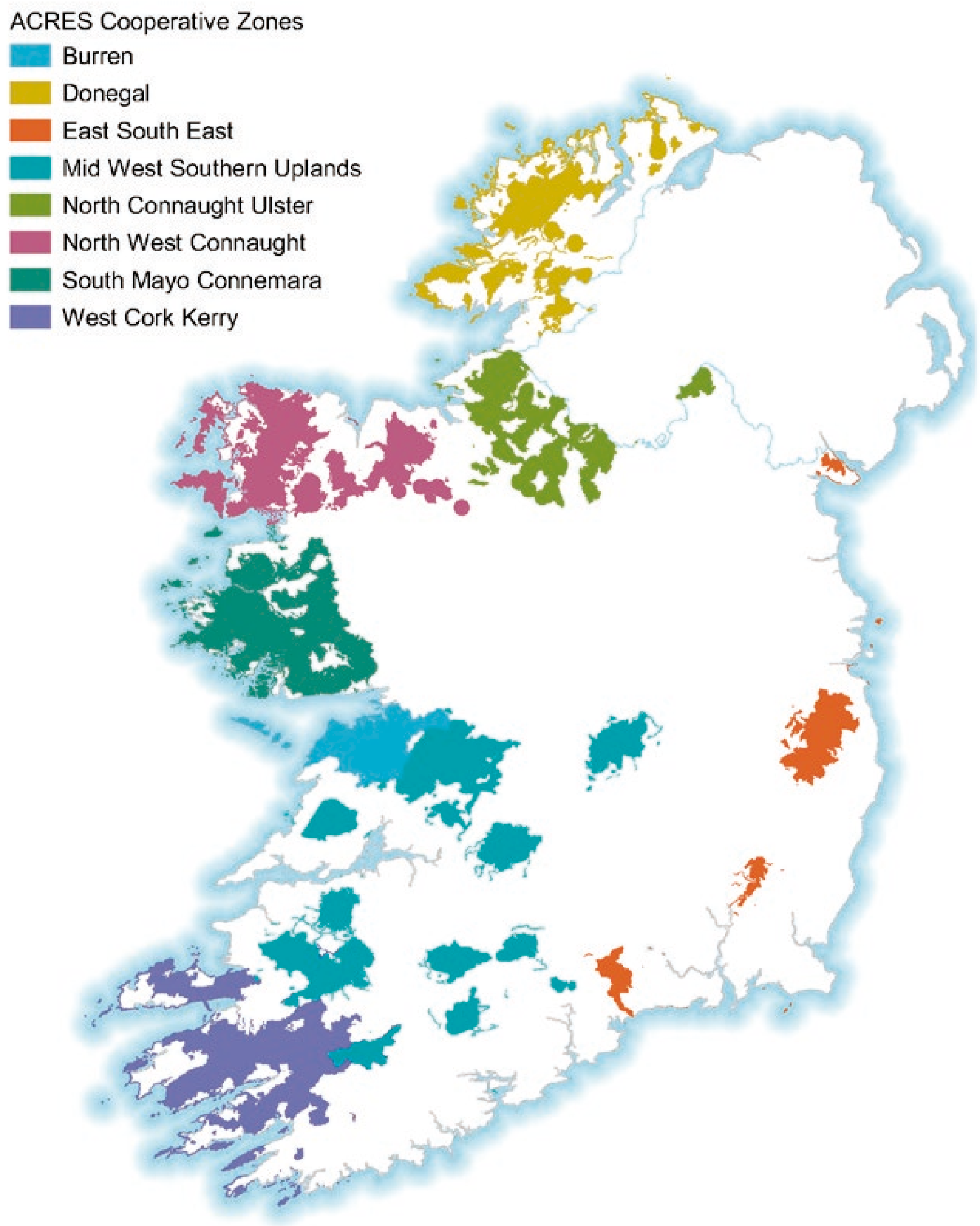
Source: Fingal County Council, 2023

23 www.thebrideproject.ie (accessed 4 April 2024).
24 www.henharrierproject.ie (accessed 4 April 2024).
25 biodiversityireland.ie/projects/protecting-farmland-pollinators (accessed 4 April 2024).
26 birdwatchireland.ie/our-work/species-habitat-conservation/countryside-wetlands/curlew-eip (accessed 4 April 2024).
27 www.pearlmusselproject.ie (accessed 4 April 2024).
28 www.fingal.ie/sites/default/files/2023-12/Fingal%20Biodiversity%20Action%20Plan%202023-2030.pdf (accessed 9 September 2024).

Agri-Climate Rural Environment Scheme

The €1.5 billion Agri-Climate Rural Environment Scheme (ACRES) programme[29] came into effect in January 2023 and is now the flagship agri-environmental scheme in use across Ireland, available to farmers in eight cooperation zones (Figure 7.24).

Figure 7.24 The eight ACRES cooperation zones



Adapted from DAFM[30]

29 www.gov.ie/dafm (accessed 4 April 2024).

30 gov – Agri-Climate Rural Environment Scheme (ACRES) (www.gov.ie) (accessed 24 April 2024).

These zones are targeted specifically at high-nature-value farmland dominated by semi-natural vegetation, Natura 2000 sites and priority water catchments with high water quality. ACRES incorporates landscape and catchment considerations into a results-based agri-environmental approach for these zones. The cooperation project teams are fully funded by the DAFM, ensuring no cost to the farmer and delivering income support for up to 50,000 farm families. The scheme uses results-based incentives through measurable on-farm actions (e.g. planting trees and hedgerows, establishing winter food crops for birds, and creating and enhancing riparian buffer strips along streams and rivers) to address biodiversity decline while also supporting farm families.

Peatlands Climate Action Scheme

The Peatlands Climate Action Scheme[31] (also known as the Enhanced Decommissioning Restoration and Rehabilitation Scheme, or EDRSS) encompasses the restoration and rehabilitation of approximately 33,000 ha of Bord na Móna peatlands that were previously harvested to generate electricity. Through the project, and the associated Peatlands and People LIFE Project[32], Bord na Móna is reassigning employees from harvesting operations into rehabilitation to support the natural environment and biodiversity of the peatlands. To date, approximately 17,000 ha have been rehabilitated across 54 bogs. The scheme is funded by €108 million from the EU National Recovery and Resilience Plan, administered by the Department of the Environment, Climate and Communications, regulated by the NPWS and operated by Bord na Móna.

Business for Biodiversity Ireland

Launched in 2022, the Business for Biodiversity Ireland platform[33] is a not-for-profit organisation established to guide and educate Irish businesses about their impacts on the natural world and enable them to assess their impacts and dependencies on nature by developing meaningful biodiversity strategies. Some of the services offered by the platform include increasing understanding of biodiversity through educational webinars, facilitating networking and collaboration among participating companies, educating member companies about national policy on biodiversity and identifying nature-based solutions to address climate change and biodiversity loss.

National Biodiversity Data Centre

In December 2022, the NBDC[34] was established as a company limited by guarantee by the government, placing it on a more secure footing. The NBDC, first established in 2007, has been at the forefront of many positive initiatives in relation to biodiversity in Ireland for 17 years. The centre has a wide remit, primarily collating and making data publicly available, but also producing informative and educational resources. This enables the NBDC to support national initiatives to maintain and enhance biodiversity, including recording species associated with Ireland's terrestrial, freshwater, marine, river and wetland environments. The NBDC currently manages nearly 6.5 million records of nearly 18,000 different species across 177 different data sets.[35] Citizen science and conservation initiatives coordinated by the NBDC include structured monitoring schemes such as the National Pollinator Monitoring Scheme, the Butterfly and Bumblebee Monitoring Schemes, Dragonfly Ireland 2019-2024, Explore Your Shore! and Rare Plant Monitoring Scheme.

Forestry Programme

Ireland's Shared National Vision for Trees, Woods and Forests until 2050 calls for the right trees in the right places for the right reasons with the right management. Ireland's Forest Strategy to 2030 describes how the 2050 vision will be made a reality, and the Forestry Programme 2023-2027 is the first step in implementing the vision. The Forestry Programme has been designed to make a significant contribution to Ireland's biodiversity objectives. The programme will facilitate the creation of new forest habitats at scale, with generous incentives for farmers and public bodies to plant mixed native woodlands on suitable land, and also 20-year payments for farmers to retain and promote emergent woodland on their land. For existing forest owners, measures under the Forestry Programme such as the Native Woodland Conservation Scheme, the Woodland Improvement Scheme and other sustainable forest management practices will be invaluable in protecting and enhancing biodiversity across our landscape.[36]

31 www.bnmpcas.ie (accessed 4 April 2024).

32 peatlandsandpeople.ie (accessed 17 September 2024).

33 businessforbiodiversity.ie (accessed 4 April 2024).

34 biodiversityireland.ie (accessed 4 April 2024).

35 maps.biodiversityireland.ie/ (accessed 10 April 2024).

36 www.gov.ie/dafm (accessed 4 April 2024).

6. Conclusions

The challenges of protecting the wide diversity of Ireland's habitats and species are now more serious than ever. The quality of natural habitats and the species they support are declining, both globally and nationally. These challenges are serious and, while they are not new, they are unprecedented. Valuing and protecting our natural environment were identified as key challenges in the 2012, 2016 and 2020 State of the Environment reports. Clearly, continuing with a 'business-as-usual approach' will mean that nature and our wild places will continue to fragment, and biodiversity will continue to decline.

The global assessment of biodiversity and ecosystem services undertaken by IPBES (2019) found that human actions are threatening more species with global extinction now than ever before. The report asserted that transformative global changes in human society are needed. Despite the numerous positive initiatives outlined above, trends in nature and biodiversity loss in Ireland are, for the most part, going in the wrong direction. To change the current unsustainable path will require greater consideration of biodiversity at every step of development and in sectoral plans and policies – a whole-of-government, whole-of-society approach to managing and protecting biodiversity. It will require detailed consideration of the national governance structures in place to protect biodiversity. It will also entail assessing the level of government funding required to stop and reverse the loss of biodiversity and habitats and to enhance, protect (via enforcement, where necessary) and adequately manage our natural environment.

Implementing the actions, plans and recommendations outlined in the fourth iteration of the National Biodiversity Action Plan (NPWS, 2024), reports from the Citizens' Assembly on Biodiversity Loss (Citizens' Assembly, 2023), the Joint Committee on Environment and Climate Action (JCECA, 2023), and the EU Nature Restoration Law will be very positive steps. The successful implementation of these actions, plans and recommendations will be critical in reversing the trends in biodiversity loss across Ireland and in driving nature restoration. Implementation will also result in additional positive effects, providing improvements in water quality (see Chapter 8) and the marine environment (see Chapter 9) and in mitigating the impacts of climate change (see Chapter 4). Although some of the actions have come a long way, particularly relating to agricultural policy, business engagement and the expansion of NPWS, previous iterations of the National Biodiversity Action Plan used similar language to the current (fourth) version and set many of the same, or similar, high-level targets. To see tangible and measurable improvements in nature across Ireland, the actions and plans outlined in the action plan must be resourced and implemented and their performance monitored and reported on. Much of the responsibility for the actions set out in the fourth National Biodiversity Action Plan (NPWS, 2024) primarily fall under the remit of the DHLGH, while DAFM has a considerable number of actions; nevertheless, it is essential that the alignment of policy, action and results across government are coordinated or they may be more difficult to achieve. Ultimately, embedding biodiversity and nature at the heart of policies that are aligned across sectors, such as agriculture, water, planning and so forth, will ensure that nature is considered at all levels across society. Significant positive results can be achieved where investment, science and local communities are used to drive positive action on the ground. The success of the Corncrake LIFE project, for example, indicates that nature can recover when aided by appropriate action and conservation measures.

Key chapter messages

1. The Irish landscape is heavily modified by humans. Many of the few remaining natural and semi-natural habitats are in a poor or bad state. Research in Ireland highlights that 85% of our protected habitats and almost one-third of our protected species of flora and fauna are in unfavourable status, over half our native plant species are in decline and more than 50 bird species are of high conservation concern. The leading causes of these declines are changes in agricultural practices, including intensification; pollution; the increasing spread of invasive species; and our changing climate.

2. Our natural habitats and biodiversity have been squeezed to the margins of our landscape and policies, while food production and economic development have been prioritised. However, nature underpins our food production, food security and economic development. We risk our future if we continue to marginalise nature, and its protection, and fail to deliver adequate, achievable, impactful, evidence-based and coordinated action to protect and restore it.

3. Biodiversity loss affects everyone. It is essential that nature protection, enforcement, management and restoration are mainstreamed across government, social and economic sectors and are fully considered at all levels of national, regional and local decision-making.

4. Nature can recover if given the opportunity. For example, Ireland’s corncrake population has risen by more than 35% in recent years, reflecting the outcome of a multi-million euro conservation investment that began in 2019. Positive actions to halt declines and to restore the key elements of our natural world must be implemented.

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Chapter 8: Water

Water

1. Introduction

Water is essential to life. Our rivers, lakes, estuaries, coastal waters and groundwaters sustain our livelihoods, food production and industries, support our tourism and recreational activities, and are an integral part of our culture and heritage. As well as being critically important to humans, water is just as essential for the many species that call Ireland's waters home. From the tiniest river insects to kingfishers and otters, these creatures rely on clean water and healthy aquatic habitats for their survival.

This precious resource is under threat from a range of human activities that cause pollution and damage to our waters and its habitats, and from climate change. The freshwater pearl mussel, Ireland's longest living animal, which depends on clean water, is facing extinction. By safeguarding our waters, we can also protect the delicate ecosystems that rely on them, allowing them to build resilience and adapt to the effects of climate change.

The European Union (EU) Water Framework Directive (WFD; 2000/60/EC) and our national water policy aim to protect clean waters and restore degraded waters. However, despite these efforts, Ireland's water quality is not as good as it should be.

The Environmental Protection Agency's latest water quality reports (EPA, 2022, 2023a, 2024a) show that water quality is not as good as it should be and that any improvements made in recent years are being offset by declines elsewhere. Overall, the proportion of waters in satisfactory condition has decreased since assessments under the WFD began in 2007.

We must protect and maintain the health of our waters. Without clean and healthy waters, we cannot hope to sustain a vibrant society or a thriving aquatic environment with diverse species and habitats.

This chapter sets out the current state of our groundwaters, rivers, lakes, estuaries, lagoons and nearshore coastal waters. It looks at the pressures affecting water quality and quantity. It examines the responses that are in place and planned to address water pollution. Issues that affect the marine environment are reviewed in Chapter 9. Habitat quality and species diversity in surface waters are discussed in Chapter 7, and some key water and health issues (drinking water, bathing water, shellfish waters, waste waters, algal blooms and hazardous chemical substances) are considered in Chapter 14.

2. Current situation

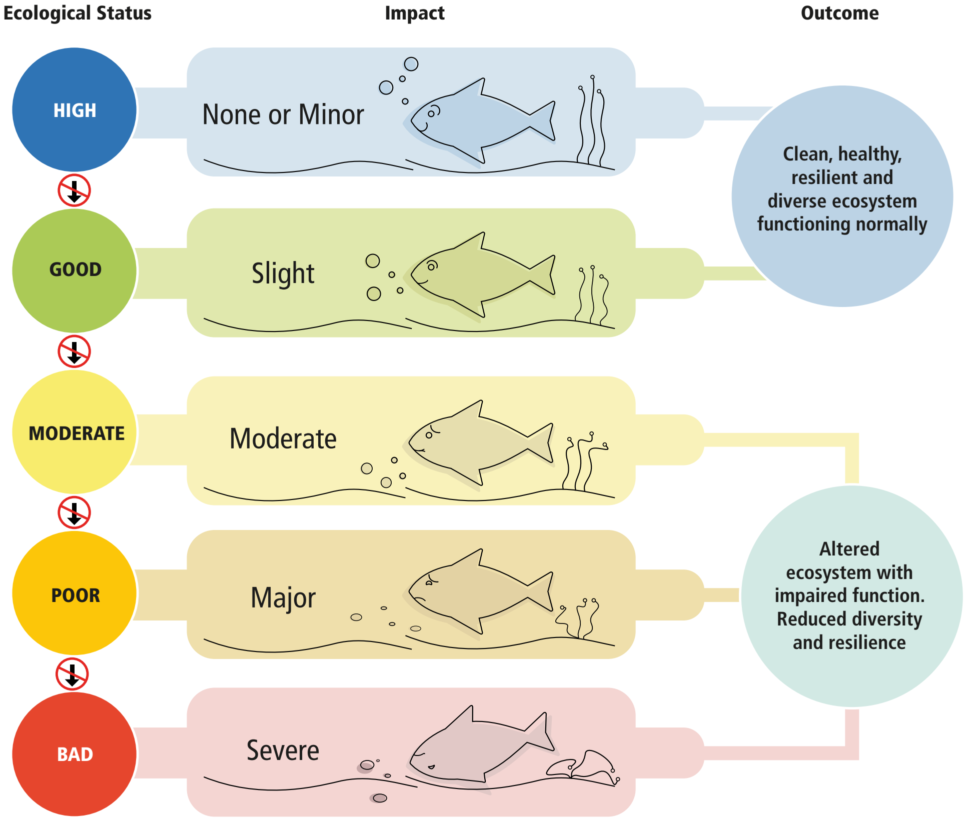
Ireland has an extensive water quality monitoring programme, undertaken by the EPA, local authorities, Inland Fisheries Ireland, Waterways Ireland and the Marine Institute. The EPA classifies and reports on the quality of surface waters (rivers, lakes, estuaries and coastal waters) and groundwaters every 3 years under the approach set out in the WFD (Figure 8.1). Surface waters are classified as being in high, good, moderate, poor or bad ecological status. Groundwaters are classed as good or poor.

The overall aim for water quality, as required by the WFD, is to achieve good or high ecological status and good chemical status in all water bodies. Waters in high and good ecological status show only minor or slight changes from natural conditions and represent healthy and diverse ecosystems. We are required to protect these from deterioration.

Waters in less than good status (moderate, poor or bad) range from moderately to severely damaged by pollution or habitat degradation. We need to restore these.

Finny River, Co. Mayo

Figure 8.1 The five ecological status classes of surface waters and the associated environmental impacts



Source: EPA, 2022

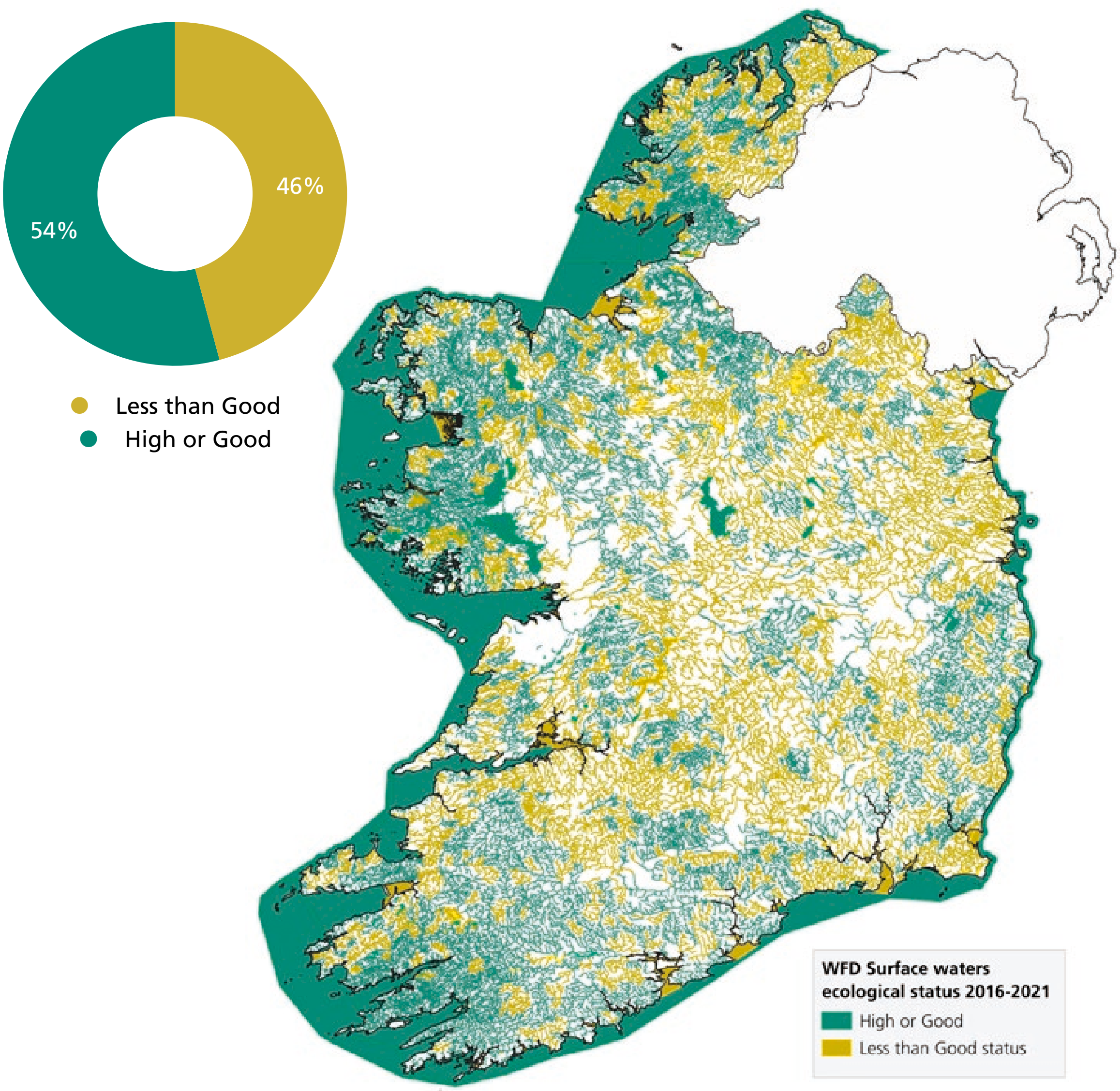
Surface waters

Nearly half (46%) (EPA, 2022) of our surface waters are not ecologically healthy, and this is primarily due to human activities. Agriculture, damage to hydromorphology (see Topic Box 8.1), commercial conifer forestry plantations and poorly treated sewage are the most significant pressures on Ireland's aquatic environment.

The EPA undertakes a full assessment of the overall quality and ecological status of Ireland's waters every 3 years and reports on the indicators of water quality in the intervening years.

The data and evidence in this report are based on the most recent full assessment of the status of Ireland's surface waters (EPA, 2022) (Figure 8.2) and updated indicators data from 2022 (EPA, 2023a) and 2023 (EPA, 2024a).

Figure 8.2 Surface water ecological status, 2016–2021

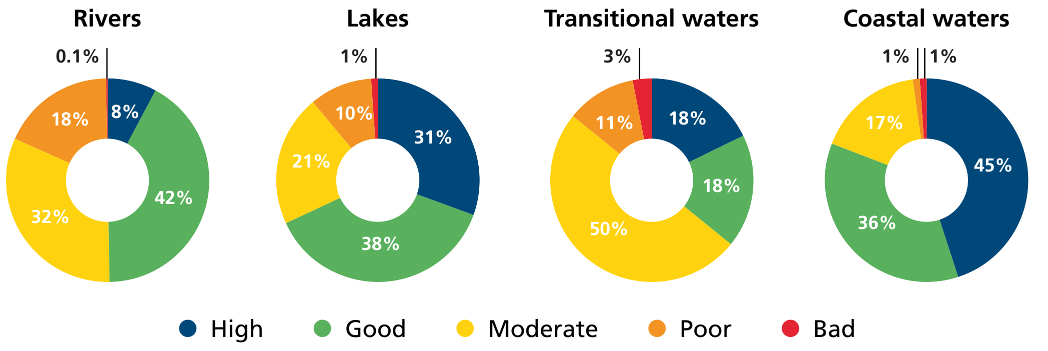


Source: EPA, 2022

Coastal waters have the highest percentage of waters in high or good ecological status (81%) followed by lakes (69%), rivers (50%) and transitional waters (estuaries and lagoons) (36%), which have the poorest water quality (Figure 8.3).

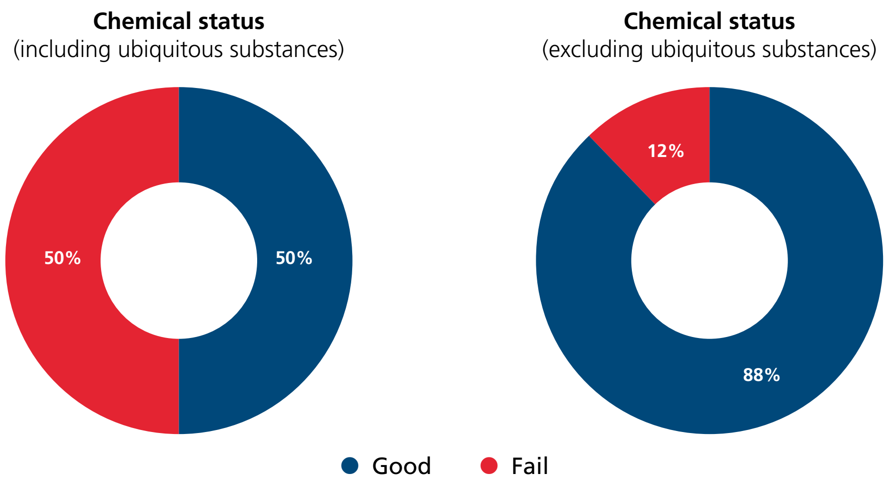
Half of the surface waters monitored in the period 2016–2021 failed to achieve good chemical status due to the exceedance of environment quality thresholds for at least one hazardous chemical substance (Figure 8.4). However, when ubiquitous substances (chemicals widespread in the aquatic environment, such as mercury) are excluded from the assessment, 88% of water bodies are in good chemical status.

Figure 8.3 Percentage of waters in each ecological status by surface water body category, 2016–2021



Source: EPA, 2022

Figure 8.4 Proportion of monitored surface water bodies achieving or failing to achieve good chemical status, 2016–2021



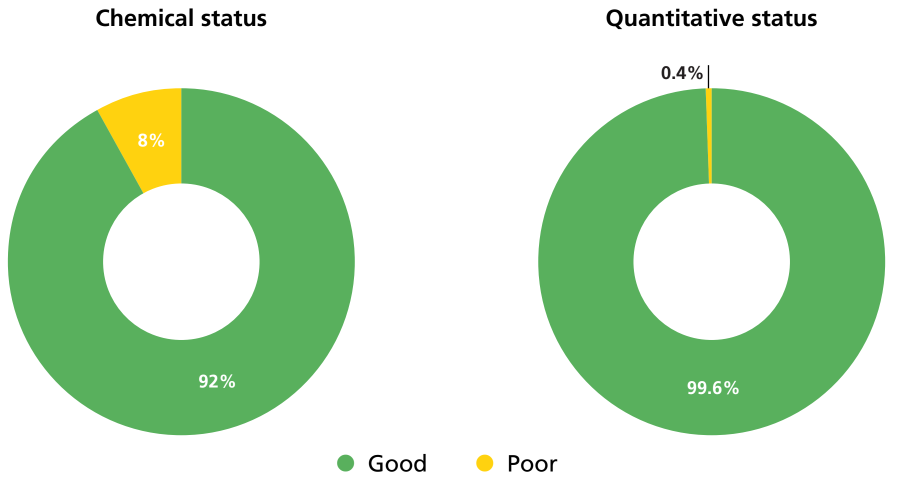
Source: EPA, 2022

High status objective water bodies. Waters that are in high status are our cleanest and healthiest waters. They are significant biodiversity reservoirs and increase the resilience of our ecosystems to environmental damage. In some areas, we depend on these highest quality waters to increase the aquatic biodiversity in the more degraded areas downstream when water quality has improved. The protection and restoration of high status objective water bodies is therefore an important water quality objective.

In Ireland, 334 rivers, 41 lakes and 27 transitional and coastal water bodies have a high status objective, commonly known as Blue Dot waters. Of these 402 high status objective water bodies, only 175 are currently in high status. This represents a failure to protect our most pristine water bodies over the last 20 years. These water bodies need to be protected and, where necessary, restored.

Groundwaters. With a few localised exceptions, the quality and quantity of groundwater in Ireland is generally good (Figure 8.5): 92% of groundwater bodies are in good chemical status and over 99% are in good quantitative status. Overall, 91% of bodies met both objectives, accounting for 97% of the country by area (69,519 km^2).

Figure 8.5 Chemical and quantitative status of groundwaters, 2016-2021



Source: EPA, 2022

Changes and trends in water quality

Water quality has been monitored in Ireland since the 1970s. The WFD came into effect in 2001 and the baseline year for assessment is the 2007–2009 monitoring period. Despite two cycles of river basin management planning, successive EPA reports show that, while progress has been made in reducing the number of the worst-polluted 'bad' sites, the percentage of sites in satisfactory condition (good or high status) has declined since then. The most recent full EPA assessment (EPA, 2022) reported further declines in all water categories, most significantly in the quality of our estuaries (15.7%) and coastal waters (9.5%). The declines were associated with increased nitrogen losses to the marine environment, particularly in the south and south-east of the country (Figure 8.6).

Figure 8.6 Ecological status of monitored surface water bodies (including rivers, lakes, estuaries and coastal waters) in each of the main assessment periods, from the first assessment in 2007–2009 to the most recent assessment period (2016–2021)

Source: EPA, 2022

Point source discharge

3. What is the problem? Significant pressures and issues

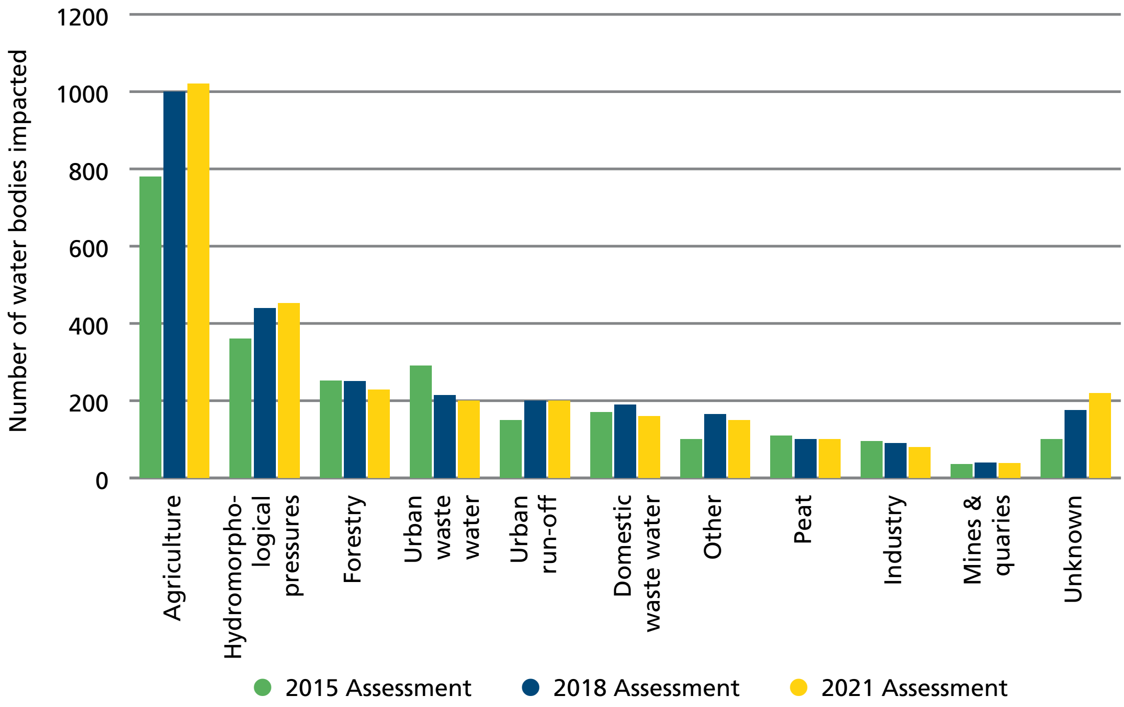
A range of human activities put pressure on water quality. The EPA assesses what the particular issue is and identifies what and where the pressures are that are affecting water quality.[1] Water bodies that are in danger of not meeting their environmental objectives, based on the water monitoring data, are categorised as 'at risk'. In total, 1649 water bodies (34%) are at risk of not meeting their environmental objectives by 2027. The top four significant pressures impacting at-risk water bodies are as follows.

1. ***Agriculture*** (impacting 1023 water bodies). The main issue associated with agriculture is the loss of excess nutrients (primarily nitrogen and phosphorus) from farming activities, both in the yard and across the farm. This is often accompanied by the loss of fine sediment, which is another important issue. Hazardous chemicals such as those found in pesticides and animal health products can also have an impact on water quality.
2. ***Activities that damage hydromorphology*** (impacting 448 water bodies). Changes to flow and physical habitat can damage the ecology and change the natural function and processes of water bodies. Hydromorphological alterations are associated with land and stream drainage (largely for agriculture or forestry), channelisation (largely driven by arterial drainage schemes, flood protection work and navigational dredging) and urban areas. See Topic Box 8.1 for more information.
3. ***Forestry*** (impacting 216 water bodies). Activities such as afforestation, forest road works, thinning, clear-felling and reforestation can cause the release of sediment, nutrients and pesticides to water bodies and can impact habitat conditions. The available evidence shows that water quality decline caused by commercial forestry activities can be substantial, dropping by two or sometimes three status classes. However, water bodies can recover within a few years and can remain in very good condition when the forests are stable between harvesting events. Much of this pressure arises from inappropriate historical afforestation practices, which included the planting of commercial conifers on peat soils, often in sensitive uplands and without water setback distances in place.
4. ***Urban waste water*** (impacting 197 water bodies). The main issues arising from urban waste water are the release of nutrients (nitrogen and phosphorus), organic pollution and the release of pathogens from poorly or untreated sewage that pose a risk to human health.

Figure 8.7 shows the changes in the numbers of water bodies impacted by each pressure based on the three most recent assessments. The biggest change has been in the number of water bodies impacted by agriculture – an increase of over 200. The number of water bodies impacted by waste water is decreasing as investment increases and upgrading treatment plants progresses.

1 www.epa.ie/publications/monitoring--assessment/freshwater--marine/update-on-pressures-impacting-on-water-quality.php (accessed 21 June 2024).

Figure 8.7 Number of at-risk water bodies impacted by pressures affecting their ecological status in 2015, 2018 and 2021



Source: EPA, 2022

Topic Box 8.1 Examples of damage to river hydromorphology

Dredging damages the riverbed and vegetation growing in the channel and on the bankside and can be detrimental to wildlife, such as fish, living in the water.

Poaching by livestock can cause damage to riverbanks and release sediment that can clog up fish spawning beds.

Topic Box 8.1 Examples of damage to river hydromorphology (continued)

Barriers impede the movement of water, sediment and fish, such as salmon, and alter the natural flow of a river.

Hard engineering works on rivers permanently damage the habitat, reduce shade, and can give invasive species an advantage.

Healthy riverine hydromorphology means rich and mature riparian zones, no barriers, a clean riverbed with a natural flow, and a healthy ecology.

Nutrient pollution

The most significant issue affecting water bodies at risk of not meeting their environmental objective is nutrient pollution. When phosphorus or nitrogen[2] enter waterways they can cause excessive growth of plants and algae. This overgrowth can clog up those waterways and lead to oxygen loss from the water, which harms the ecology. Monitoring data show that recovery can occur relatively quickly when the nutrient sources are removed and when there are good water quality areas upstream for restoring the aquatic wildlife.

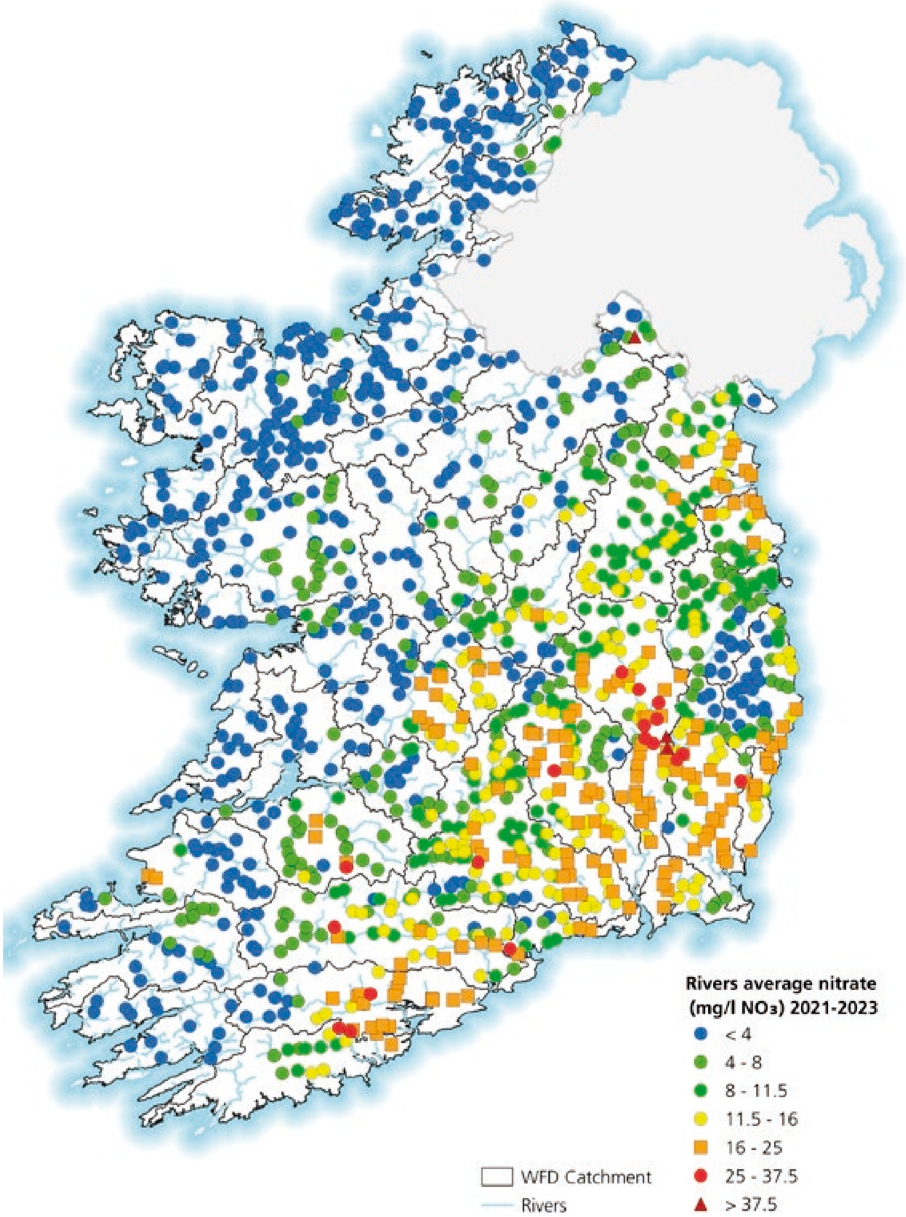
Nitrogen pollution is caused mainly by agricultural activities. Phosphorous pollution comes from both agricultural losses and urban waste water. While increased concentrations of both phosphorus and nitrogen can lead to eutrophication, the presence of excess phosphorus is of particular concern for the ecological health of our rivers and lakes. Elevated levels of nitrogen are more of a concern for our estuaries. High nitrate concentrations in some drinking water supplies can pose a risk to human health.

2 Different terms, such as phosphate and nitrate, can be used for phosphorus and nitrogen depending on analysis and reporting requirements.

As well as through direct discharges, nutrients can find different pathways into our waters depending on the landscape and soil type. Nitrogen tends to move down through freely draining soils until it meets the water table. From there, it makes its way horizontally underground in groundwater until it reaches a watercourse and eventually the downstream estuary. Phosphorus tends to move overland, carried by run-off on wet and heavy soils.

Nitrogen. Nitrate concentrations are too high in 42% of river sites and 17% of estuarine and coastal water bodies (EPA, 2024a). This excess nitrate is damaging the ecological health of many of our estuaries and nearshore coastal waters. In particular, nitrate concentrations are too high in the south-east and southern region of Ireland (Figure 8.8). Annual average nitrate concentrations generally increased in these areas from about 2013 and peaked in 2018/2019, following a combination of excess nitrogen use and a drought year. There have been year-on-year fluctuations since 2020 but no real improvement overall. Concentrations remain too high, especially in the east, south-east and south.

Figure 8.8 Average river nitrate concentrations, 2021–2023

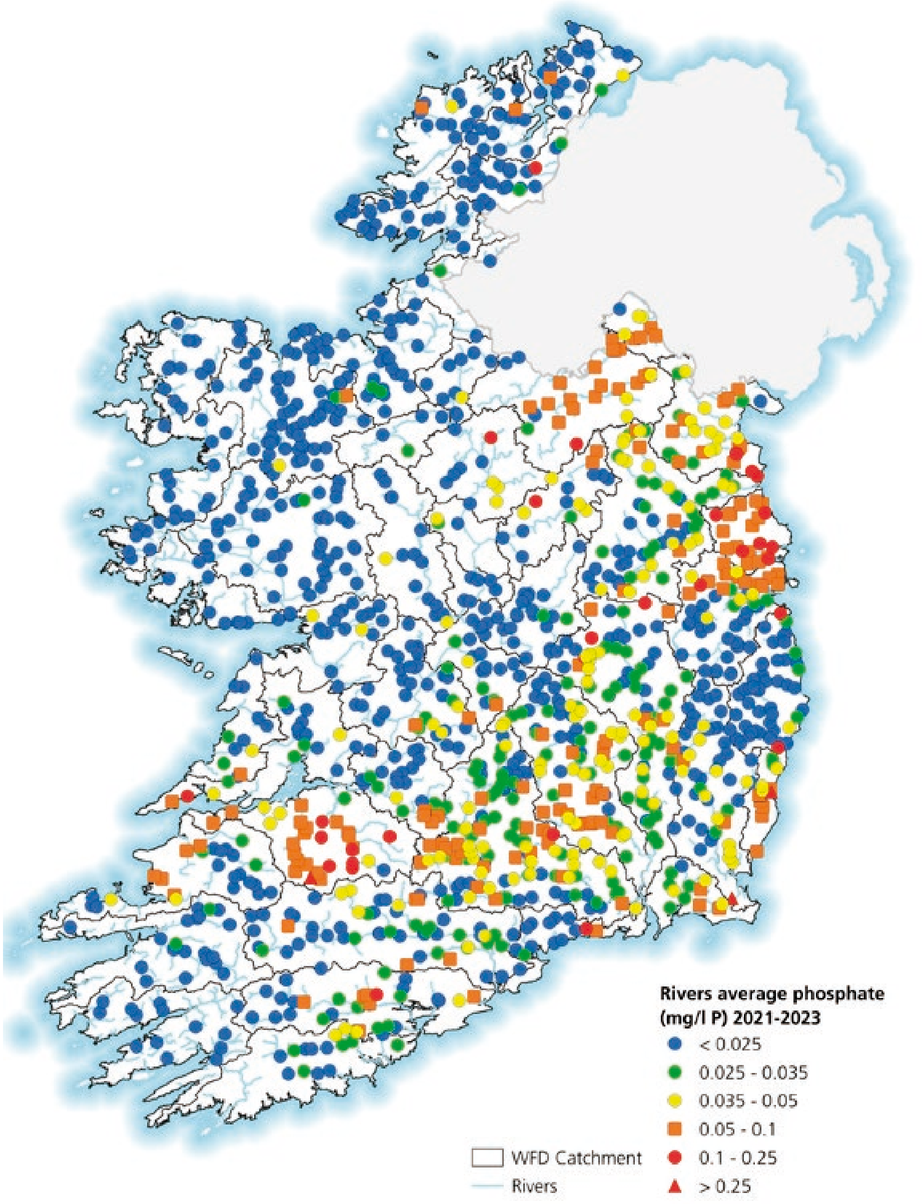


Source: EPA, 2024a

Phosphorus. Phosphorous concentrations are too high in 27% of rivers and 35% of lakes (EPA, 2024a), and this is having an impact on their ecology. Elevated phosphorous concentrations are associated with areas of poorly draining soil, for example in Limerick, Monaghan and Meath (Figure 8.9). Lakes in Cavan and Monaghan have the highest total phosphorous concentrations. Phosphate levels in rivers and lakes fluctuate from year to year but have generally been stable in recent years.

Nutrient loadings to the marine environment. Loads of nitrogen and phosphorus discharged to the marine environment from our rivers have increased since the 2012–2014 period (EPA, 2024a), placing continued pressure on the ecology of our marine water bodies. The EPA reported notable declines in the ecological status of estuaries and coastal waters in 2022 (EPA, 2022), particularly along the southern seaboard. These declines are attributed to increasing nutrient concentrations as a result of agricultural losses.

Figure 8.9 Average river phosphate concentrations, 2021-2023



Source: EPA, 2024a

Hydromorphology

Damage to the hydromorphology of our waters is the second most prevalent of the significant issues affecting water quality in Ireland. A significant proportion of our water bodies is being damaged by activities that impact their physical condition, flow and habitat. These changes, referred to as alterations to the hydromorphology, are most common in our rivers and estuaries.

The most common types of activities causing hydromorphological damage in Ireland include:

- channelisation (straightening river channels), drainage and dredging of the waterway
- land drainage works associated with farming and forestry
- hard engineering works on the banks and beds of rivers, lakes and marine waters
- barriers, impoundments and weirs
- abstraction of water for drinking water, farming and industry
- overgrazing, poaching by livestock and removal of riparian vegetation.

The changes to hydromorphology can impact the entire ecosystem by removing suitable habitat and clogging the spawning beds of fish. Removal of riparian vegetation such as trees can create pathways for pollutants to make their way over land and into watercourses, and reduce shade and food sources for aquatic wildlife. Over-widening of channels can lead to shallower water levels and may result in the overheating of streams and rivers, a risk that is increasing with climate change.

Barriers, impoundments and weirs affect the free passage of water and sediment, and can prevent migratory species, such as salmon, lamprey and eel, from accessing their natural spawning grounds and successfully completing their life cycles.

Significant water abstraction and land drainage can alter natural flow conditions and lake levels. A reduced flow of water and increased sedimentation can negatively impact species, such as the mayfly and freshwater pearl mussel, that need clean, flowing, oxygen-rich water.

Hazardous chemical substances

Certain hazardous chemicals that are widespread in the aquatic environment can cause harm to aquatic organisms and pose a risk to drinking water supplies (see also Chapter 14). These substances are monitored and assessed against environmental quality standards, which have been set at levels to protect the most sensitive aquatic organisms and public health.

Of the 349 rivers, lakes and estuaries monitored by the EPA between 2016 and 2021, half had concentrations of one or more chemical substances higher than the relevant environmental quality standard (EPA 2022). Three substances, mercury, polycyclic aromatic hydrocarbons (PAHs) and polybrominated diphenyl ethers (PBDEs), accounted for 83% of the exceedances. Mercury is naturally occurring and is emitted globally from volcanoes and the burning of coal. PAHs are produced from the burning of fossil fuels. Both mercury and PAHs find their way into water bodies via atmospheric deposition (rainfall). PBDEs are a group of substances used as flame retardants in the manufacture of household goods and clothing. PBDEs enter water bodies via industrial and municipal waste waters. All three of these substances are bioaccumulative (they can build up in animals or fish), persistent (stable for a long time) and toxic to aquatic and human health.

In recent years, other substances of emerging concern have been detected in Irish waters. Per- and polyfluoroalkyl substances (PFASs) are widely used in the manufacture of stain-resistant clothes and household products and in industrial processes and firefighting foams. They enter water bodies via waste waters and leakage from contaminated sites. PFASs have been detected in rivers and estuaries (EPA, 2022), and PFAS contamination has been identified at sites associated with the use of firefighting foams.[3]

Pesticides found in our aquatic environment are suspected of having toxic impacts. Concentrations of the agricultural insecticide cypermethrin (a component of sheep dip) were found to exceed the relevant environmental quality standard in some Donegal rivers and transitional waters in the south-east (EPA, 2022).

The herbicide MCPA (2-methyl-4-chlorophenoxyacetic acid), used for controlling rushes in grassland areas, is regularly detected in surface waters. In 2023, the pesticide limit was exceeded in 23 public drinking water supplies (EPA, 2024b), mostly because of the presence of MCPA.

3 www.epa.ie/publications/monitoring--assessment/waste/monitoring-for-per--and-poly-fluoroalkyl-substances-pfas-and-brominated-flame-.php (accessed 25 June 2024).

4. Responses

The WFD and other associated national and EU environmental, public health and planning legislation set the framework used to protect and restore water quality in Ireland. This legislation is implemented by a range of public bodies and by local authorities. The WFD requires that river basin management plans (RBMPs) establishing programmes of measures to achieve water quality objectives are implemented in 6-year cycles.

River basin management plans

The first two cycles of RBMPs, covering the period 2009–2021, established comprehensive monitoring and reporting programmes, developed new governance structures, and implemented an integrated catchment management approach to the protection of waters. Over that time, however, the plans did not achieve the water quality protection and restoration objectives required under the WFD. The Water Action Plan 2024, A River Basin Management Plan for Ireland, which covers the third cycle, was published in September 2024 (DHLGH, 2024). While some of the new measures, such as the Farming for Water European Innovation Partnership (EIP)[4] and National Barriers Programme,[5] have commenced, the delay in finalising and adopting the overall plan delayed progress in improving governance, implementing measures and enacting legislation required to restore and protect water quality. A summary of the key measures is set out in Table 8.1.

Table 8.1 Summary of measures to deal with the main significant pressures on water quality from the third iteration of the National River Basin Management Plan (Water Action Plan 2024) 2022–2027

Sector/pressure	Measure
All pressures	■ Expansion of the Areas for Action programme, which builds further on the Priority Areas for Action programme managed by the Local Authority Waters Programme
Agriculture	■ Strengthening of the Nitrates Action Programme and associated Good Agricultural Practice Regulations (S.I. No. 113/2022) to reduce nutrient pollution ■ Strengthening of measures in the CAP Strategic Plan to improve water quality, including conditionality, ecoschemes and the results-based Agri-Climate Rural Environment Scheme ■ Implementation of a national agricultural inspection plan overseen by the EPA and supported by new inspectors in local authorities ■ Commitment of €60 m to a Farming for Water EIP to support the implementation of targeted measures on farms to protect water quality
Hydro-morphology	■ Introduction of a new legislative regime to manage the impacts of pressures on the physical condition of waters ■ Investment in the National Barriers Programme led by Inland Fisheries Ireland. ■ Improving fish migration in the Lower River Shannon (at the Parteen and Ardnacrusha dams)
Forestry	■ Introduction of new support measures in the Forestry Programme 2023–2027 to protect water quality ■ Increase in the area of forest with appropriate water setbacks ■ Introduction of incentives to create new native forests to provide water services
Urban waste water	■ Continued investment by Uisce Éireann in improvements to waste water infrastructure, prioritising waters where urban waste water is a significant pressure ■ Investment in new waste water infrastructure in villages not served by public waste water collection systems

CAP, Common Agricultural Policy

Source: DHLGH, 2024

4 www.gov.ie/en/press-release/468aa-ministers-mcconalogue-hackett-and-noonan-launch-60-million-farming-for-water-eip/ (accessed 25 June 2024).

5 www.fisheriesireland.ie/what-we-do/research/national-barriers-programme (accessed 25 June 2024).

Agricultural measures

Agriculture is the most widespread of the pressures that impact water bodies. The number of water bodies impacted by agricultural activities increased between 2015 and 2021, coinciding with a period of significant intensification driven by the removal of the dairy quota and strategies such as FoodVision 2025. The need to address the impact of agriculture on water quality is now receiving significant attention as a result of the risk to the nitrates derogation (See Topic Box 8.2).

Actions to address the impacts of agriculture on water quality consist of both regulatory and voluntary measures. The primary regulatory tool is the Good Agricultural Practice Regulations. Voluntary measures are implemented through the Agricultural Sustainability Support and Advisory Programme (ASSAP), agri-environmental schemes, such as the Agri-Climate Rural Environment Scheme (ACRES), and other results-based payment schemes under EIP and LIFE projects. Details of the key measures are included in Chapter 10.

The review undertaken to develop the Fifth Nitrates Action Programme highlighted a significant level of non-compliance with the Good Agricultural Practice Regulations. In addition, the Commission's Implementing Decision ((EU) 2022/696) on the nitrates derogation required Ireland to take additional measures to improve compliance. To address this, the EPA was tasked with overseeing and monitoring the implementation of a new national agricultural inspection programme carried out by local authorities. This programme is now in place and additional resources have been assigned to the EPA and local authorities. A key element will be an increase in farm inspections and improved data on the extent and nature of non-compliance and the resolution of issues.

Topic Box 8.2 Ireland's nitrates derogation

The aim of the Nitrates Directive (91/676/EEC) is to protect water quality from nutrient pollution arising from agricultural sources. Every 4 years, Member States may seek a derogation to increase the level of organic nitrogen loading from 170 kg/N/ha to a maximum of 250 kg/N/ha, provided that the derogation does not impact water quality. Derogation farms are subject to additional, more stringent, measures than other farms and an increased inspection regime.

Ireland was initially granted a nitrates derogation in 2007 and is currently one of three remaining EU countries that hold one. The Netherlands' derogation is being phased out by 2025, and Denmark will not seek another after July 2024, when its derogation expires, so it is likely that Ireland will be the only country negotiating a further derogation for 2026 onwards.

A condition of Ireland's current derogation required an interim assessment of water quality to be carried out in 2023 in accordance with specific criteria set by the European Commission (2022/696/EU). The outcome of the assessment was a reduction in the maximum permitted organic nitrogen load from 250 kg/N/ha to 220 kg/N/ha on derogation farms over much of the country.

The derogation reduction has generated considerable public interest in water quality and the actions that need to be taken on farm to reduce nutrient pollution. Actions to prevent phosphorous losses to water are relatively straightforward and involve breaking the pathway between the source and the water body at the farm level. Actions to reduce nitrogen losses can be more challenging, as it is the cumulative amount of nitrate lost from the catchment area to waters that counts, so all farms have a role to play. The level of nitrogen loss varies depending on farm practices, soil type and weather, but the key action needed is reducing the source load in areas where the risk of loss is highest.

Three types of action need to be progressed to reduce the impacts from agriculture and improve water quality.

1. Ensure that all farms comply with the Good Agricultural Practice Regulations. Significant new resources have recently been committed to local authorities to increase inspections and to the EPA to develop a national agricultural inspections programme and oversee its implementation.
2. Continue to improve nitrogen use efficiency on farm, so that as much as possible of the nitrogen used is taken out in food or crops and not leached into the environment. The average nitrogen use efficiency on Irish farms is 24% (Teagasc, 2023), but Teagasc aims to increase that to 35% on grassland farms through a range of measures, including improving soil fertility and nutrient management planning.
3. Step up efforts to reduce cumulative nitrogen loading in catchments where required. In some catchments, improving compliance and efficiency may be enough to achieve the required reductions in nitrate leaching.

Actions to protect and improve water quality are needed across all farming types, not just derogation farms. It remains to be seen whether the current increased focus on the need to improve water quality and additional measures, such as the enhanced agricultural inspection programme and Farming for Water EIP, will be delivered at the scale and pace needed.

A challenge for agriculture is that many of the measures to address water quality are voluntary schemes. In addition, incentives are not always sufficient to get measures where they are needed, or measures are not sufficiently targeted to address the specific issues in the locations where they are needed. While ASSAP has a high farmer engagement rate, a review of the programme identified the lack of funding for voluntary measures as a barrier to progress.[6] A key response to this is a new Farming for Water EIP, which was launched in March 2024. This will provide funding to farmers for implementing specific, targeted measures to protect and restore water quality.

Hydromorphological measures

Impacts on hydromorphology arising from multiple sectors are the second most prevalent pressure on our waters, affecting 448 water bodies. Current measures to address hydromorphology include control of agricultural land drainage (via the Environmental Impact Assessment Regulations (S.I. No. 296/2018)), best practice guidelines for drainage works[7] and a barriers assessment programme;[8] however, it is acknowledged in the Water Action Plan 2024 that controls on pressures that impact the physical condition of waters need to be strengthened.

One such control is the introduction of a regulatory regime to address the impact of abstractions on water quality. The Abstractions (and Associated Impoundments) Act (No. 48 of 2022) was published in 2022 and regulations to give effect to the Act were published in August 2024.

Another key measure in the Water Action Plan is the introduction of a regulatory regime to control activities that involve works on, or in, water bodies that may impact their hydromorphology. The control of such activities is a requirement of the WFD, and Ireland's failure to have adequate controls in place is the subject of a European Commission infringement case.

Irish rivers are heavily fragmented by barriers such as weirs, culverts and bridges, which block the movement of fish and impact the overall habitat and biodiversity of rivers. The new National Barriers Programme, established by Inland Fisheries Ireland, will develop the evidence base to identify, risk assess and develop suitable restoration programmes to mitigate the impacts of barriers. This work will support the objectives of the EU Nature Restoration Law (Regulation (EU) 2024/1991) to deliver free-flowing rivers.

The implementation of measures to address and regulate activities that impact hydromorphology has received little attention, limiting the state's ability to manage this pressure. The actions set out in the Water Action Plan need to be prioritised and resourced to make progress in this area.

Forestry measures

Forestry is the third most significant pressure impacting water quality, and there has been little change in the relative scale of its impacts between the assessment periods. Water quality declines caused by forestry operations, such as afforestation, harvesting and thinning, can often be substantial; however, there is evidence that water bodies can recover following these events and remain in good condition when the forests are stable. Forest creation can also be used as a mitigation measure for other pressures; for example, to intercept overland loss of phosphorus or sediment from agricultural activities from entering water.

In 2023, the Shared National Vision for Trees, Woods and Forests in Ireland by 2050[9] was published, calling for:

> The right trees in the right places for the right reasons with the right management – supporting a sustainable and thriving economy and society and a healthy environment.

6 www.teagasc.ie/media/website/crops/ASSAP-Expert-Review-Final-Report---pdf--22-Nov-2021.pdf (accessed 24 June 2024).

7 www.floodinfo.ie/frs/media/filer_public/b0/5a/b05a1126-7de1-4921-bdb2-1c2579470171/environmental_guidance_-_drainage_maintenance_and_construction_2019_web_part-1.pdf (accessed 24 June 2024).

8 www.fisheriesireland.ie/what-we-do/research/national-barriers-programme (accessed 24 June 2024).

9 www.gov.ie/en/publication/forestry-policy-and-strategy/#shared-national-vision-for-trees-and-forests (accessed 24 June 2024).

This vision informed Ireland's Forestry Strategy 2022–2030,[10] with the associated Forestry Programme 2023–2027. The Forestry Programme includes a number of measures relating to the protection of water during all forestry activities, including the Forests for Water scheme; grant aid for conversion to continuous cover forestry or native woodlands; a forestry environmental enhancement scheme to establish setbacks in legacy forests; and grant aid for various works to reduce forestry activity or mitigate its effects.

The main risk to water quality occurs when forestry activities are occurring, so the implementation of mitigation measures and their effective oversight is essential. Forestry measures and impacts are further discussed in chapters 5 and 10.

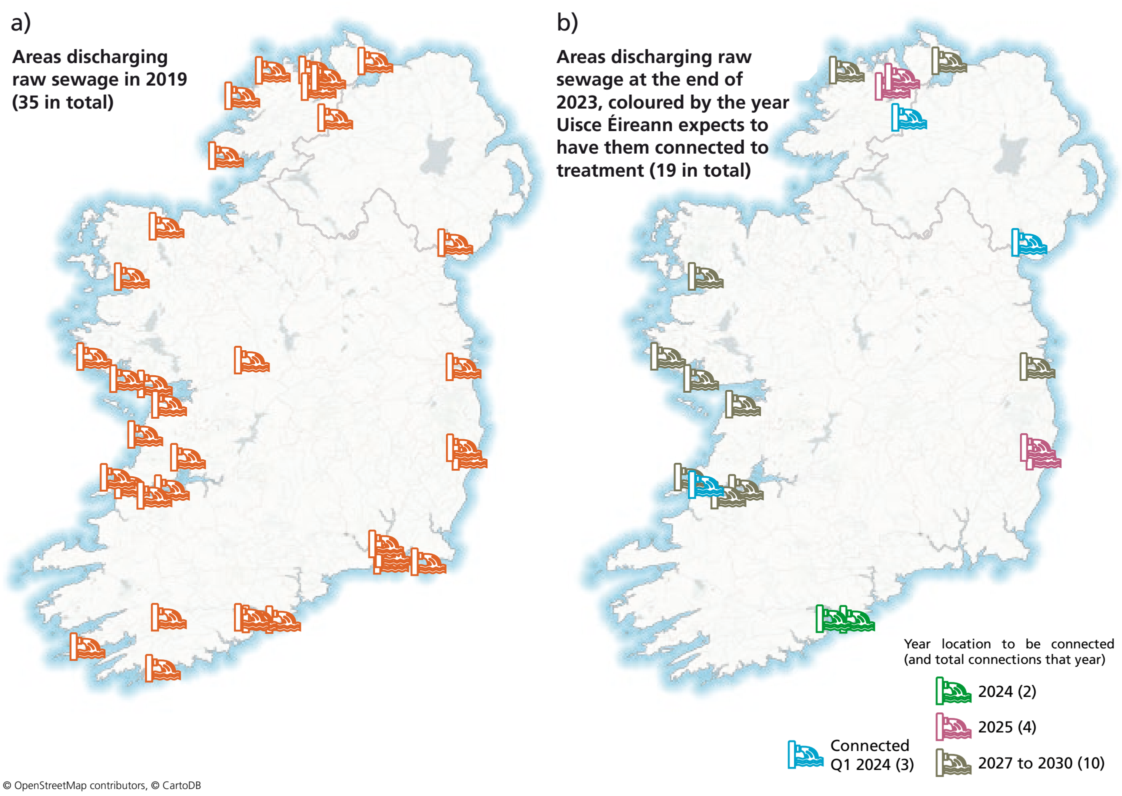
Urban waste water measures

Urban waste water discharges, from treatment plants and overflows, are the fourth most significant pressure impacting our waters; almost 200 water bodies are affected by discharges, either alone or in combination with other pressures.

The EPA has identified priority areas where Uisce Éireann should direct resources to protect the environment from the harmful effects of waste water discharges. There were 80 priority areas at the end of 2023, down from 148 in 2017. However, Uisce Éireann has still not clearly identified the interventions needed at one-third of the priority areas where waste water is adversely impacting inland and coastal waters (EPA, 2023b).

At the end of 2023, 19 towns and villages were still discharging raw sewage every day. Uisce Éireann is implementing plans to provide treatment for nine of these areas by the end of 2025, and the remaining areas are expected to receive treatment between 2027 and 2030 (Figure 8.10).

Figure 8.10 Towns and villages still discharging raw sewage in a) 2019 and b) 2023



10 www.gov.ie/en/publication/forestry-policy-and-strategy/#irelands-forest-strategy-2023-2030 (accessed 24 June 2024).

Ireland's waste water collecting systems include an estimated 2447 storm water overflow outlets; however, Uisce Éireann does not have sufficient information on discharges from these storm water overflows (EPA, 2023b). To address this information gap, Uisce Éireann is assessing all storm water overflows against national standards and is installing equipment to monitor overflow events. The information gathered from this work will provide greater clarity on storm water overflows and their impact and support prioritisation of action to mitigate their discharge risk.

At the end of the period 2020–2024, Uisce Éireann will have invested €5.35 billion in improving the water services infrastructure, with 42% of this spending on collection and treatment of waste water.[11] The number of water bodies impacted by urban waste water is reducing and the investment is delivering improvements in water quality; however, treatment in many areas is still not as good as it needs to be. It will take multi-billion euro investment and at least two decades to bring all waste water collection and treatment systems up to standard (EPA, 2023b).

Measures to address other pressures

A range of other pressures impact water quality, including domestic waste water treatment systems, urban run-off and industry. All of them need to be addressed in order to achieve our water quality objectives. Further information on all the measures to address these pressures is set out in the Water Action Plan.

Management of hazardous substances

A wide range of legislation is in place to reduce the effects of chemicals on the environment and human health. Measures to improve the management of the life cycle of chemicals will reduce the effects of chemicals in use now and will seek to ensure that chemicals produced in the future do not have negative effects on human health or the environment (see Chapter 14).

Phasing out the burning of fossil fuels and developing safer manufacturing processes will halt emissions of mercury, PAHs and PDBEs over time. In Ireland, tighter controls on the use of cypermethrin and MCPA, replacement of hazardous PFASs and the remediation of PFAS-contaminated sites will reduce the risks from these substances. Remedial measures have been successful in preventing the exceedance of MCPA thresholds in water supplies by bringing relevant stakeholders and local catchment groups together to promote responsible pesticide use and resolve the issues at source.

Increased monitoring of these substances by the EPA in recent years has improved our knowledge of the sources and prevalence of hazardous chemicals in the aquatic environment. Continued vigilance, regular risk assessments and appropriate mitigation measures will be required to protect Irish waters from hazardous chemical substances.

Improved governance

A three-tiered structure was created during the second cycle of the RBMP to improve governance and implementation. While the structure has significantly improved collaboration between stakeholders and implementing bodies, particularly at the local and regional levels, there were still issues with overall ownership of the plan, the accountability of implementing bodies, and the tracking of the progress of measures and of the overall plan.

The management of water quality is by its nature the responsibility of a range of different agencies and bodies. Good governance arrangements are essential to deliver on the commitments made in the Water Action Plan and to ensure accountability for delivering water quality objectives. EPA-funded research by the Institute of Public Administration, *Water Governance in Ireland: Towards the Third-Cycle River Basin Management Plan, 2022–2027* (IPA, 2021), included recommendations for building on and improving the governance arrangements in areas such as the functioning of the three tiers, clarity of institutional roles and capacity building. The research also highlighted the need for improved data gathering on measures being implemented so that their effectiveness and overall progress in delivering water quality objectives can be assessed. It is essential that these recommendations are implemented and, in particular, that tracking the progress of the overall plan and the implementation of measures is improved and the information is made publicly available.

11 www.water.ie/sites/default/files/projects/strategic-plans/capital-investment-plan/Capital-Investment-Plan-2020-2024-Explanatory-Booklet.pdf (accessed 3 July 2024).

A measure in the Water Action Plan will be the establishment of a programme delivery office in the Department of Housing, Local Government and Heritage to oversee and coordinate governance and implementation. This has the potential to significantly improve oversight.

Infringement cases

Of the 14 active environmental infringement cases against Ireland, five relate to water.[12]

These are a failure to correctly transpose the WFD (open since 2007); a breach of the Urban Waste Water Treatment Directive (91/271/EEC) (two cases dating from 2013 and 2023); a failure to address trihalomethanes in drinking water (open since 2017); and a failure to finalise plans for the management of river basins.

The number of infringement cases, failure to fully resolve them in a timely manner and the significant delays in publishing both the second and third cycles of the RBMP point to a lack of priority given to water policy and management by consecutive governments over decades.

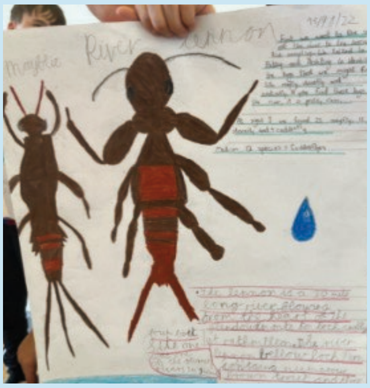
The recast Drinking Water Directive ((EU) 2020/2184) and revised Urban Waste Water Treatment Directive[13] are bringing new and more stringent requirements for water services. It is essential that these directives are fully implemented within the time frames required to protect water quality and health, and that all the outstanding requirements of the WFD are implemented.

Community and stakeholder engagement

There has been a strong emphasis in recent years on improving public participation and community involvement in the protection of waterways. The water community officers at the Local Authority Waters Programme (LAWPRO) have established themselves as contact points for local communities across the country. A growing number of groups are getting involved in caring for their local water environment, ranging from angling and sports clubs and Tidy Towns and community development associations to local catchment groups and river trusts (Topic Box 8.3).

Topic Box 8.3 Community projects

Examples of community projects include the Blue Dot Explorer project and (overleaf) the East Corrib Alliance project.



12 ec.europa.eu/atwork/applying-eu-law/infringements-proceedings/infringement_decisions/ (accessed 24 June 2024).

13 www.consilium.europa.eu/en/press/press-releases/2024/01/29/urban-wastewater-council-and-parliament-reach-a-deal-on-new-rules-for-more-efficient-treatment-and-monitoring/ (accessed 3 July 2024).

Topic Box 8.3 Community projects (continued)

Blue Dot Explorer. This project engages with schools in northern Donegal on the value of high-status rivers. It is led by the An Taisce Donegal Local Association in conjunction with Nature Northwest and LAWPRO.

East Corrib Alliance. The group was formed by angling clubs associated with Lough Corrib and the rivers and streams on the eastern side of the lough. It delivers projects on restoration and maintenance of spawning habitat, conservation and protection of wild brown trout and salmon, and monitoring of water quality throughout the area. The funding supports the provision of fencing (below left), animal drinking troughs (including solar-powered troughs; below right) and tree planting.

The Community Water Development Fund[14] has provided funding for these groups in amounts ranging from hundreds of euros to a maximum of €25,000. Since 2018, €2.7 million has been invested in supporting 886 local community groups to carry out a range of activities aimed at protecting water quality and increasing local awareness. A further €500,000 under the new LAWPRO Catchment Support Fund will help non-governmental organisations working on water quality to develop and strengthen the skills, processes and resources they need to grow.

The establishment of An Fóram Uisce[15] as a statutory stakeholder group was another key measure to improve stakeholder participation in protecting water quality. The forum has 26 members representing 13 sectors with an interest in water quality. It provides a national platform for drawing on members' various perspectives and expertise to seek consensus and develop policy advice on the preparation and implementation of RBMPs.

The development of local catchment management plans and sectoral action plans, which will be delivered during the third cycle of the RBMP, will be a further step in improving public information and increasing public participation in protecting water quality.

14 lawaters.ie/funding (accessed 24 June 2024).

15 thewaterforum.ie (accessed 24 June 2024).

Climate adaptation and water resilience

The effects of climate change on Ireland's water resources will be wide-ranging and will create both acute and chronic challenges. The coastal waters around Ireland are projected to continue warming, and ocean acidity is expected to increase. Increased water temperatures will lead to additional in-channel vegetation growth, reduced oxygen availability, reduced aquatic habitat diversity and thermal stress to aquatic species.

Changes in precipitation are expected to contribute to an increase in the frequency of flooding and drought events. This will affect water availability, as well as increasing run-off of pollutants from land and surface and sewer flooding, leading to pollution.

The effects of climate change are already being felt in Ireland. Monitoring records show increases in intense precipitation events, average river flows and sea level rise, highlighting the need to plan for and adapt to climate change. Achieving our water quality objectives is a key measure to ensure the resilience of our water bodies and protect them against climate change impacts.

The Water Quality and Water Services Infrastructure Sectoral Adaptation Plan (Water SAP) (DHPLG, 2019) is the primary adaptation tool for the water sector. A separate SAP was published for flood risk management. The Water SAP outlines the risks to the water sector and the potential adaptive measures needed to address these risks. A key measure highlighted in the Water SAP is the integrated catchment management approach that has been adopted in Ireland to manage water resources and address water quality issues. Progress on the implementation of adaptation policy and increasing resilience under the Water SAP was given an overall rating of 'moderate' by the Climate Change Advisory Council (CCAC, 2023). Its report found limited evidence of mainstreaming adaptation across departments, local authorities and agencies.

Uisce Éireann has developed a National Water Resources Plan,[16] which is a strategic approach aimed at future-proofing public water supply over the next 25 years to address climate change impacts and other challenges, such as population growth and emerging contaminants.

A second iteration of the Water SAP is due to be completed in 2025, and it is essential that a more effective assessment of the risks and adaptation measures needed is undertaken and implemented and that national plans such as the Ireland's Water Action Plan and Uisce Éireann's National Water Resources Plan are fully aligned with the Water SAP.

Further detail on climate change risks and on national mitigation and adaptation approaches is available in Chapter 4.

Water research and innovation

Since the launch of its 10-year research framework (EPA, 2021), the EPA has committed over €4.3 million to projects under the research hub 'Protecting and Restoring our Natural Environment' (EPA, 2023c).

Examples of ongoing projects funded by EPA Research to address these thematic areas include:

- HymoGuide – developing guidance for regulatory standards for hydromorphology
- HydroGen – integrating DNA-based assessment tools into water quality and biodiversity monitoring
- GRADS & SMARTS – sustainable management of groundwater resources
- AquaCop – using remote sensing products for monitoring transitional and coastal waters
- WFDFutureS – supporting a long-term project to research future climate and demographic scenarios and management tools for the WFD.

Several project teams co-funded by the Irish government and the EU are working with local stakeholders to improve water quality in their catchments, including on a number of EU co-funded EIP projects.

16 www.water.ie/projects/strategic-plans/national-water-resources/# (accessed 24 June 2024).

The Waters of LIFE is an EU LIFE integrated project with a €20 million budget that aims to help reverse the deterioration of Ireland's most pristine waters[17] (see also Chapter 7). Waters of LIFE will support the implementation of measures to protect and enhance high status objective water bodies and thus will support the work of the Blue Dot Catchments Programme run by LAWPRO, which has the same objective.

5. Outlook

The EPA conducted an assessment of the measures contained in the Water Action Plan 2024 with a view to forecasting their efficacy in achieving Ireland's water quality objectives (EPA, 2024c). The analysis focused on the 1649 (34%) water bodies currently at risk of not meeting their 2027 environmental objectives. It assessed whether there were specific targeted measures in place to address the pressures on them and, if so, the likelihood of their being effective. The assessment shows that there will be a significant shortfall in reaching our 2027 targets even if all the measures are fully implemented (Figure 8.11).

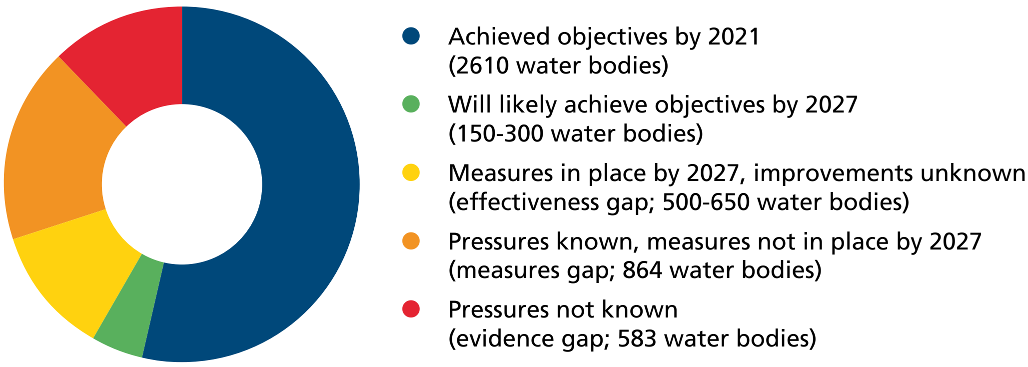
Specifically, the analysis found that:

- Between 150 and 300 of the water bodies assessed are forecast to meet their water quality targets by 2027.
- A further 500–650 at-risk water bodies may see some water quality improvements, even if not to the level required to meet the status objectives.
- Approximately 864 of the 1649 water bodies do not have specific, targeted measures planned and are therefore unlikely to achieve their status objectives by 2027.

These forecasts do not take account of any future deteriorations in water quality, which, based on the evidence to date, are essentially offsetting any improvements being made.

There remains therefore a significant challenge ahead to meet our water quality objectives, ensure we have safe and resilient water services and meet the new, more stringent requirements of the recast Drinking Water Directive and Urban Waste Water Treatment Directive.

Figure 8.11 Likelihood of water bodies achieving Water Framework Directive objectives by 2027



Source: EPA, 2024c

17 www.watersoflife.ie/about/#:~:text=The%20Waters%20of%20LIFE%20is%20an%20EU%20LIFE,protracted%20and%20persistent%20water%20quality%20trend%20in%20Ireland (accessed 24 June 2024).

6. Conclusions

Almost half of our surface waters, rivers, lakes, estuaries and coastal waters and their associated ecosystems are degraded and are not achieving their water quality objectives.

While significant investment and additional resources have been committed to address water quality issues in recent years, based on current and planned measures we will not achieve our legally binding water quality objectives by 2027.

There are a number of key gaps that need to be addressed to prevent further decline and to start to see a significant scale of improvement in water quality. In addition, climate change is impacting, and will continue to impact, water resources and water quality management.

The main factor impacting water quality is excessive concentrations of nitrogen and phosphorus.

Nitrate concentrations are too high in 40% of river sites and in 20% of estuarine and coastal water bodies nationally. The agricultural sector is responsible for more than 85% of the total nitrogen losses to water in certain catchments in the south and south-east. Phosphate concentrations are too high in 28% of rivers and 36% of lakes.

Water quality is a local issue. Unless measures are targeted to the specific problem and area where the measure is needed they will not deliver improvements. This is a key gap, particularly among agricultural measures, which are often at the national scale, voluntary or delivered through specific projects and not sustained.

We will not achieve our water quality outcomes without effective implementation of and compliance with environmental legislation.

With the exception of hydromorphology, there is a wide range of legislative instruments in place to mitigate the impacts of various pressures on water quality. However, there is a significant gap in implementation in terms of achieving compliance. Agricultural inspections are identifying significant levels of non-compliance with the Good Agricultural Practice Regulations, and the EPA has highlighted the need for improvements in local authority performance with respect to agricultural inspections.

Measures to address hydromorphology are limited. The abstraction regime is not yet in place and there is no effective control of activities that can impact hydromorphology, including from land drainage works at the farm level to large arterial drainage and flood mitigation schemes.

A range of other pressures, such as septic tanks, regulated discharges to water and impacts from forestry and illegal peat extraction and drainage, could be addressed through effective implementation and enforcement of existing legislation.

There is an urgent need to improve the overall governance and accountability of water management in Ireland.

A new three-tier structure to significantly improve the governance of water management in Ireland was introduced in the second cycle of the RBMP. While this resulted in some improvements, particularly in engagement and coordination among key stakeholders and implementing bodies, the tiers themselves were not operating as they should, and there were gaps in overall accountability and the tracking and reporting of measures and progress. The Water Action Plan was published in September 2024. While some of the high-level measures in the plan have already commenced, the delay in finalising and adopting the overall plan created a national water policy vacuum that limited progress to date in the restoration and protection of water quality.

Climate change is impacting, and will continue to impact, water quality and water services.

The effects of climate change are already being felt in Ireland. The management of water resources, historically not a major issue in Ireland, will become increasingly important to meet our population growth, industry and food production needs. Ensuring good water quality is a key measure to ensure resilience in conditions of low flow and higher temperatures. Climate change adaptation to protect water quality and water services is not as well progressed and integrated as it needs to be.

Key chapter messages

1. There needs to be immediate, substantial and sustained reductions in nitrogen pollution, especially in catchments of concern in the south and south-east, to prevent any further deterioration in the quality of our estuaries and coastal waters. Targeted measures to reduce phosphate run-off could deliver significant improvements in inland waters and offer multiple benefits for climate and biodiversity.

2. We need to see full implementation of existing environmental legislation and high compliance rates across all regulated activities. A regulatory regime to address activities that impact hydromorphology is also required. All measures must be sufficiently targeted to the water quality issue and location to ensure that they deliver improvements.

3. Water governance structures need to be reviewed to ensure that they operate effectively. Detailed tracking and reporting of measures in Ireland's Water Action Plan 2024 is required to improve accountability among implementing bodies, public access to information and, ultimately, Ireland's water quality.

4. It is essential to build climate resilience into water quality management and into water services. Plans - such as the Water Action Plan, the Water Quality and Water Services Climate Adaptation Plan, and Uisce Éireann's National Water Resources Plan - are key to identifying risks and adaptation measures.

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Chapter 9:
The Marine Environment

The Marine Environment

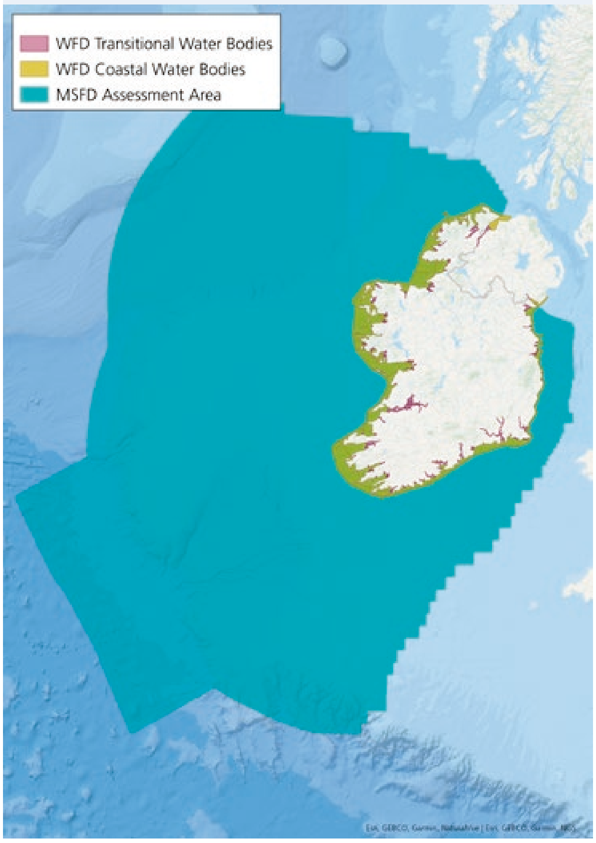
1. Introduction

The estuaries, coastal and marine waters of Ireland combine to extend to over 880,000 km^2. The area covered by water is more than ten times the land mass of Ireland. In recent years, there has been increased attention given to our marine areas, their constituent habitats and biodiversity, their natural resources and their energy generation potential. Marine areas can be damaged by human-induced pressures and pollution, whether of global origin (e.g. climate change, marine litter or fisheries) or of local origin (e.g. agriculture, industry or urban waste water). Although Ireland's offshore waters have generally been considered relatively clean and healthy, our nearshore coastal systems are under increasing pressure.

As our saline waters are very diverse and cover such a large area, they are assessed and managed in different ways. Estuaries and coastal waters are close to shore. Estuaries represent the interface between the freshwater environment (see Chapter 8) and ocean waters. These areas are very dynamic and highly variable in their salinity levels, tidal forces, freshwater inputs and exposure to the wider ocean environment. Water quality in estuaries is primarily managed under the Water Framework Directive (WFD; Directive 2000/60/EC); within the WFD, estuaries are referred to as transitional waters. These connect to coastal waters, which cover larger areas of greater salinity and extend to around 1 nautical mile offshore. The WFD sets out the management measures and assessment techniques required to assess these water bodies.

In the wider marine area, the Marine Strategy Framework Directive (MSFD; Directive 2008/56/EC) is the main legislation used to ensure that our seas are clean, healthy, biologically diverse and sustainably used. Figure 9.1 shows the WFD and MSFD areas. The MSFD requires the application of an ecosystem-based approach to managing human activities, enabling the sustainable use of marine resources, goods and services and the assessment of whether marine waters are achieving good environmental status (GES).

Figure 9.1 Water Framework Directive coastal and transitional water bodies and the Marine Strategy Framework Directive assessment area



Source: https://atlas.marine.ie/

In Ireland, the Department of Housing, Local Government and Heritage (DHLGH) is the lead body responsible for the implementation of the MSFD. The DHLGH is supported by several other government departments and state agencies. The Environmental Protection Agency (EPA), Marine Institute and National Parks and Wildlife Service (NPWS), among others, provide data and monitoring and support Ireland's delivery of the MSFD.

Implementation of the MSFD is through both national contributions and work undertaken regionally, in cooperation with other countries bordering the North-East Atlantic under the auspices of the OSPAR Convention (Topic Box 9.1).

The DHLGH also leads on the implementation of the WFD. The DHLGH is responsible for publishing and overseeing the River Basin Management Plans to ensure that all our surface water and groundwater achieve at least good status with no deterioration. The third River Basin Management Plan, Ireland's Water Action Plan (DHLGH, 2024a), was published in September 2024 and covers the period 2022-2027.

Aligned with the MSFD, the Maritime Spatial Planning Directive (2014/89/EU) also requires that an ecosystem approach be taken to marine planning in Ireland as part of the holistic management of activities in Ireland's waters. The directive is transposed through the Maritime Area Planning Act (2021) and Ireland's marine plan. The National Marine Planning Framework has also been in place since 2021. The Maritime Area Planning Act ensures the ongoing development of strong governance and licensing structures that mirror land planning. Table 9.1 outlines some of the key legislation governing the marine environment, although the full legislative system is very complex.

Topic Box 9.1 OSPAR Quality Status Report 2023

OSPAR
QUALITY STATUS REPORT 2023

The OSPAR Commission is an international organisation working to protect the marine environment of the North-East Atlantic. OSPAR brings together 15 countries and the European Union to address environmental issues affecting the North-East Atlantic Ocean.

OSPAR is committed to safeguarding the marine environment for present and future generations. Its work highlights the interconnectedness of the ocean with climate change, human wellbeing and the overall health of our planet.

The OSPAR Commission's comprehensive *Quality Status Report 2023* (OSPAR, 2023a) assesses the environmental health and status of the North-East Atlantic Ocean and the effects of human activities on it.

The report is made up of more than 120 assessments (OSPAR, 2023a,b) and covers many aspects, including biodiversity, habitats and human activities that impact the marine environment. It examines the presence of contaminants and pollutants in the water, such as chemicals and microplastics, and assesses their potential effects on marine life and ecosystems.

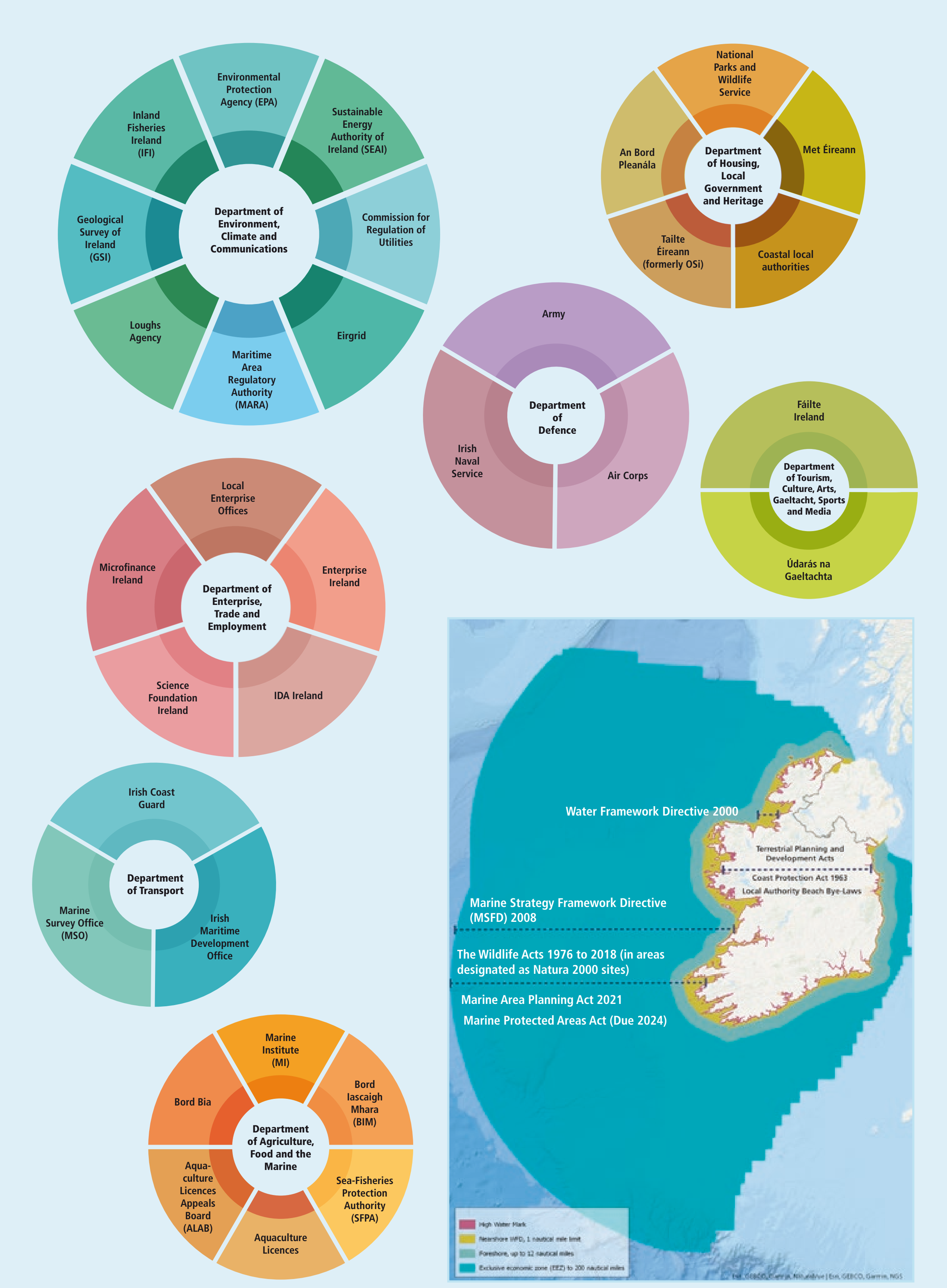
Table 9.1 Key legislation governing the management and protection of the marine environment

Legislation	International/ EU/Ireland	Purpose
OSPAR Convention 1992	Int	Guides international cooperation on the protection of the marine environment of the North East Atlantic
Water Framework Directive (WFD) (2000/60/EC)	EU	Water quality in estuaries (transitional waters) and coastal water up to ~1 nautical mile from shore are primarily managed under the WFD
Marine Strategy Framework Directive (MSFD) (2008/56/EC)	EU	A European Union directive aimed at achieving or maintaining GES in European Seas. Represents the environmental pillar of the EU's Integrated Maritime Policy
Maritime Spatial Planning Directive (2014/89/EU)	EU	Promotes the sustainable growth of maritime economies, the sustainable development of marine areas and the sustainable use of marine resources. Requires that an ecosystem approach be taken to marine planning in Ireland as part of the holistic management of activities in Ireland's waters. Transposed through the Maritime Area Planning Act (2021)
Marine Planning Policy Statement (2019)	IE	Outlines a vision for the future development of our marine planning system
National Marine Planning Framework (2021)	IE	Outlines Ireland's vision, objectives and marine planning policies for each marine activity. Aligns with the principles of the OSPAR Convention
Maritime Area Planning Act (2021)	IE	An act to regulate the maritime area. Sets out functions of the Maritime Area Regulatory Authority

Overall, management of the maritime areas is divided across multiple government departments and agencies, with no one organisation having overall responsibility. This can lead to a lack of clarity on roles and responsibilities in the marine area (Figure 9.2) (O'Hagan *et al.*, 2020; Farrell *et al.*, 2023). Key organisations involved include the following: DHLGH, Department of the Environment, Climate and Communications, Department of Agriculture, Food and the Marine; Maritime Area Regulatory Authority (MARA), NPWS, EPA, Sea Fisheries Protection Authority, Inland Fisheries Ireland, Irish Maritime Development Office, Office of Public Works, Department of Transport, Department of Foreign Affairs. Increasingly, more responsibilities are now being delegated to other coastal local authorities.

In this chapter we present information on the status of Ireland's marine systems and discuss the primary human activities that exert pressure that may damage the environmental status of these waters. The main responses to these challenges are also discussed.

Figure 9.2 Government departments and public bodies with a remit in coastal and marine waters



Source: Adapted from Farrell *et al.*, 2023

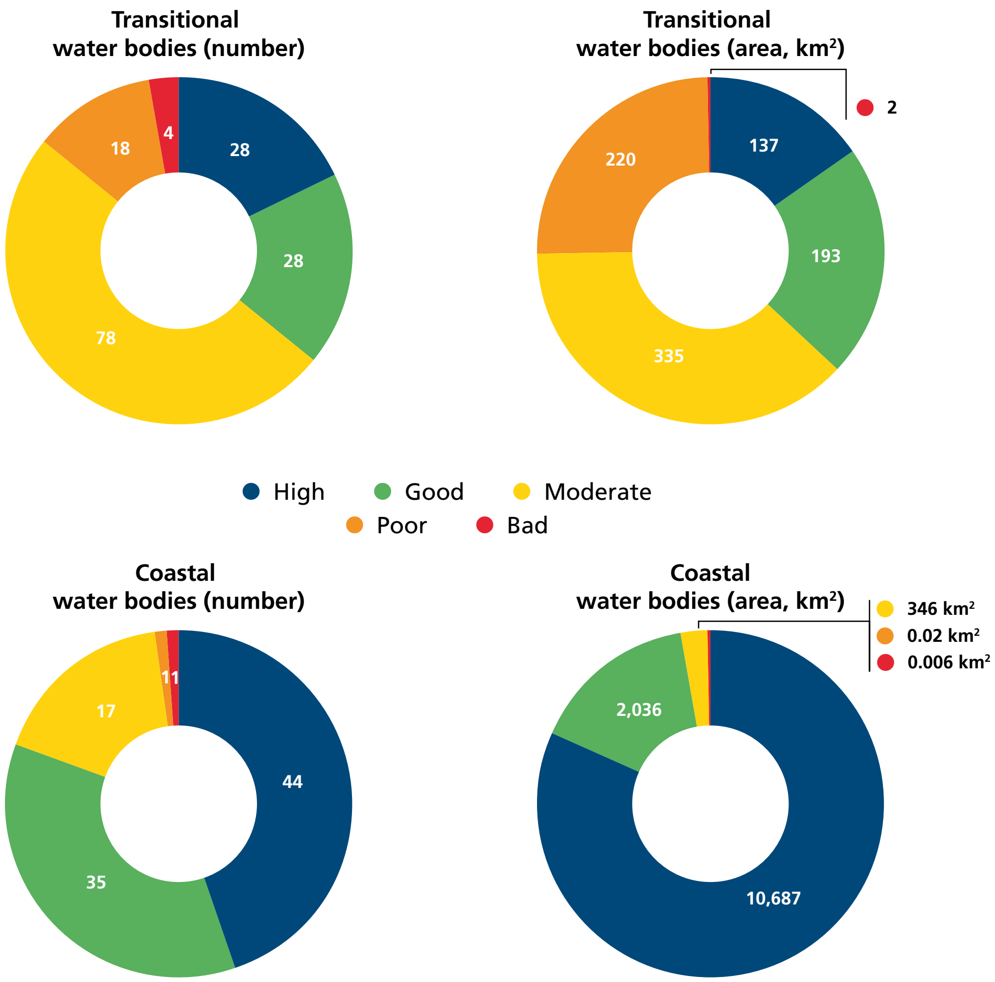
2. Current health of Irish marine waters

In 2022, the EPA published Ireland's updated WFD status in *Water Quality in Ireland 2016-2021* (EPA, 2022). The report set out the latest assessment of the health of Ireland's rivers, lakes, canals, groundwaters, and transitional (estuaries) and coastal waters. The assessment showed that over half (54%) of our surface waters are in satisfactory ecological health, being at either good or better ecological status. Coastal waters had the highest percentage of waters at high or good ecological status (81%), while estuarine waters had the worst water quality (36%).

Figure 9.3 shows that only 56 (36%) estuarine water bodies are at high or good ecological status and 100 (64%) are at moderate or worse ecological status and that 79 coastal water bodies (81%) are at high or good ecological status, with 19 (19%) at moderate or worse status. The majority (95%) of the surface area of coastal waters are at high or good ecological status.

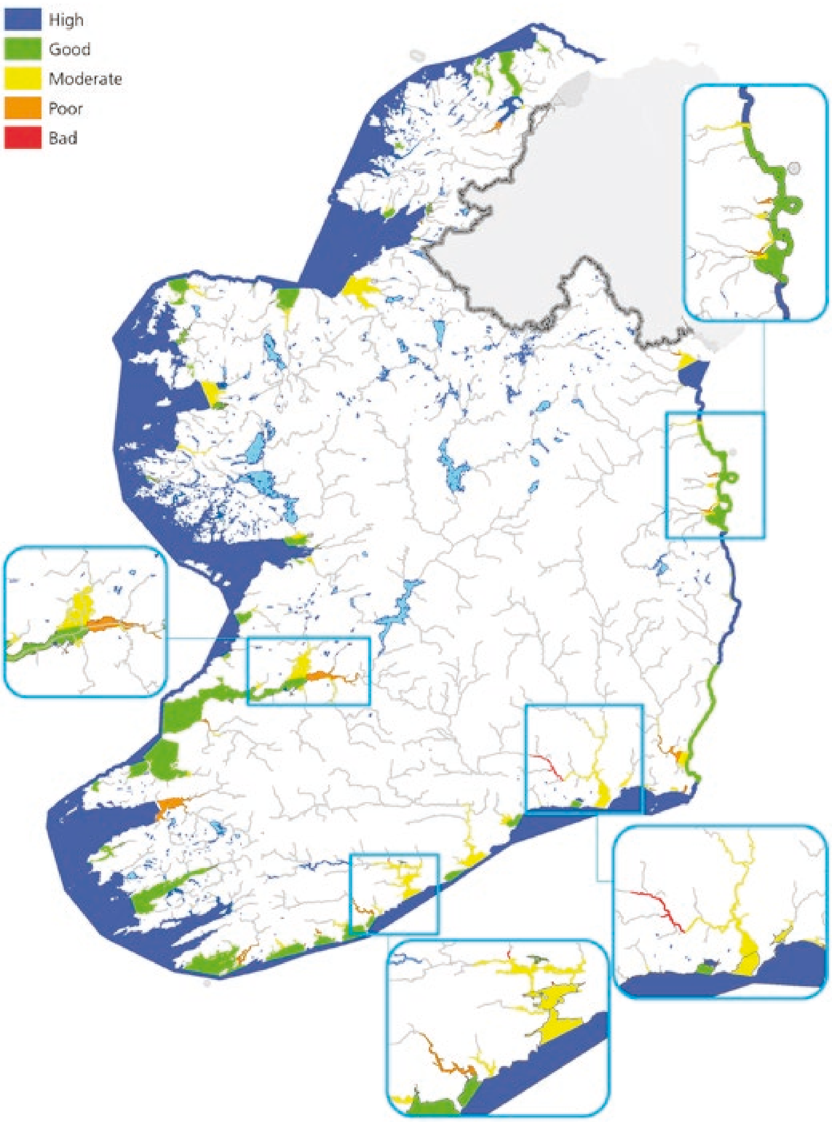
Figure 9.4 provides a geographical representation of the status of our transitional and coastal waters. Transitional waters achieving less than good status are located primarily in the south and south-east of the country and include the estuarine reaches of the Bandon, Lee, Barrow, Nore, Suir and Slaney rivers.

Figure 9.3 WFD status of transitional and coastal water bodies, 2016-2021, by number and by area



Source: EPA, 2022

Figure 9.4 Ecological status of transitional and coastal water bodies during 2016-2021



Source: EPA, 2022

Assessments under the MSFD are updated every 6 years. The latest draft assessment was published for public consultation in 2024 (DHLGH, 2024b). The draft assessment provides information on Ireland's assessment methodology for the required 11 environmental descriptors, their environmental targets and current status (Table 9.2).

The previous assessment, published in 2020, showed that Ireland's marine waters had achieved GES for five descriptors. Some but not all of the criteria for five further descriptors were of GES. There was not enough information to provide a complete assessment for descriptor 11 (EPA, 2020).

The results of the 2024 draft assessment are largely the same. They suggest that five descriptors have met GES, three have achieved GES for some elements but some information is still lacking and one descriptor (food webs) has insufficient information to assess its environmental status. There is now a better understanding of the status for descriptors 8 and 10 (contaminants and marine litter) due to the availability of more data and newly agreed assessment targets. (Table 9.2).

Table 9.2 Draft good environmental status (GES) assessment for the 11 MSFD descriptors (Source: DHLGH, draft publication)

Descriptor	Draft 2024 MSFD assessment
1. Biological Diversity	Achieved GES for some elements of biological diversity, but the status of many species groups is unknown. Numerous species, in particular a significant proportion of fish species, are not at GES
2. Non-indigenous species	Achieved GES
3. Population of commercial fish/ shellfish	GES has been achieved for 29 stocks of commercially exploited fish and shellfish. GES has not been achieved for 46 stocks, and the status of 99 stocks remains unknown
4. Elements of marine food webs	Environmental status for this descriptor remains unclear
5. Eutrophication	Achieved GES
6. Sea floor integrity	GES has been achieved for 75% of the MSFD areas; however, the status of 15% of the area remains unknown and approximately 11% has not achieved GES. Disturbance due to bottom trawling is widespread, with 40% of the MSFD assessment area affected to varying degrees
7. Alteration of hydrographical conditions	Achieved GES
8. Concentrations of contaminants	GES has been largely achieved for concentrations of most contaminants in seawater, sediments and biota in Irish coastal and marine waters. Concentrations of most parameters assessed are at levels that ensure the protection of the marine environment
9. Contaminants in fish/seafood for human consumption	Achieved GES
10. Marine litter	GES has not been achieved for marine litter
11. Introduction of energy including underwater noise	GES has been achieved for continuous and impulsive noise

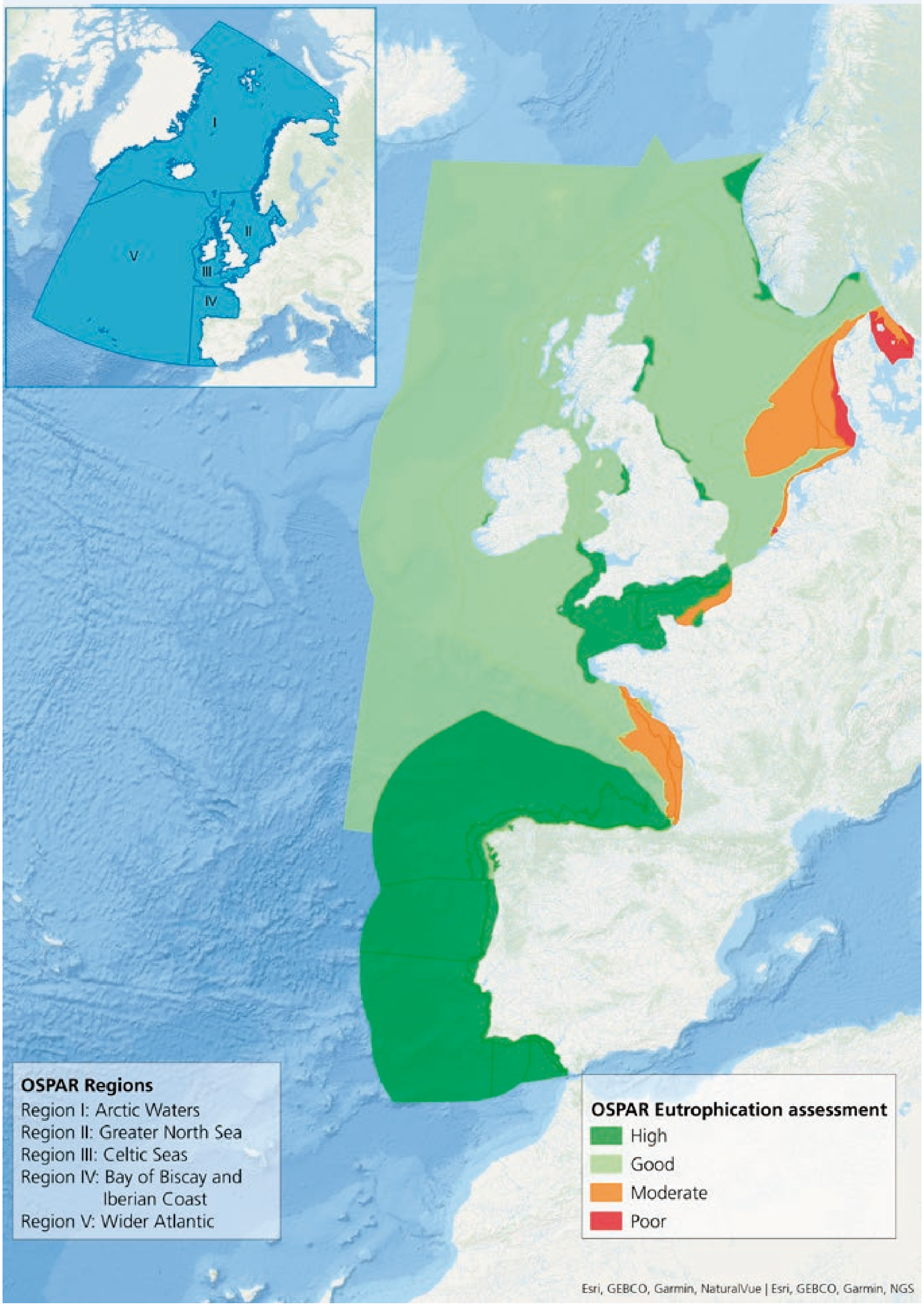
Eutrophication status of marine offshore areas

The OSPAR Convention was established to identify threats to the marine environment and develop programmes and measures to ensure effective national action to combat them. OSPAR's strategic objectives were updated in 2021 (OSPAR, 2021a) with the North-East Atlantic Environment Strategy 2030 (OSPAR, 2021b). Eutrophication in our marine water is assessed using methods developed under the OSPAR Convention, which covers the entire North-East Atlantic Ocean from Greenland to Portugal (Figure 9.5).

Eutrophication is the result of excessive enrichment of water with nutrients, which may accelerate the growth of algae in the water column. This may result in a range of undesirable disturbances in the marine ecosystem, including a shift in the composition of the flora and fauna (which in turn affects habitats and biodiversity), depletion of oxygen levels, changes in water clarity, and behavioural changes or even death of fish and other species.

The latest OSPAR assessment of eutrophication (OSPAR, 2023b), which covers regions II, III and IV, indicates that there are problem areas along the continental coasts and in the river plumes and coastal areas of the Bay of Biscay and in the greater North Sea (Figure 9.5). Eutrophication problems indicate that riverine nutrient inputs remain the major source. For Ireland, no eutrophic areas were observed in our marine waters, although significant problems remain in our transitional waters and some coastal waters (see Chapter 8).

Figure 9.5 Location of the five OSPAR regions comprising the OSPAR Maritime Area (inset) and the eutrophication status of marine areas in regions II, III and IV (main)



Source: Adapted from OSPAR, 2023b

Carrownisky Strand, Co. Mayo

Pollution status of marine offshore areas

OSPAR also assesses the levels and impacts of hazardous substances such as metals, pesticides and organic compounds in the marine environment.[1] Concentrations of many of the most serious hazardous substances, such as polychlorinated biphenyls and polyaromatic hydrocarbons (commonly known as PCBs and PAHs, respectively) and organochlorine insecticides, have decreased substantially compared with concentrations in the 1980s and 1990s. Concentrations of these substances in Ireland's marine environment generally do not exceed the thresholds used to assess environmental status, indicating GES. However, the concentrations of some legacy contaminants, specifically mercury and the antifoulant tributyltin (commonly known as TBT), do exceed the low thresholds applied in OSPAR assessments. The results of the draft 2024 MSFD assessment indicate some changes from the previous assessments where certain elements are above the assessment criteria, but this reflects the incorporation of additional parameters and revised thresholds rather than an actual deterioration in Ireland's marine quality.

A wide range of substances are monitored in coastal and transitional waters under the WFD to assess chemical status. Concentrations in water typically comply with environmental quality standards, indicating that harmful effects on aquatic life would not be expected (EPA, 2022).

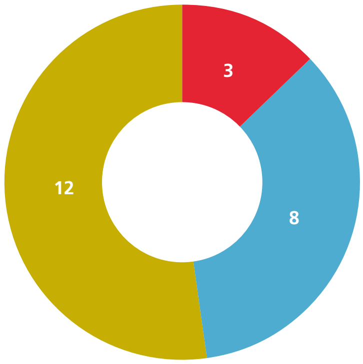
Biodiversity

Since the most recent State of the Environment Report in 2020 (EPA, 2020), NPWS has published the fourth iteration of the National Biodiversity Action Plan (2024). The plan sets the national biodiversity agenda for the period 2023-2030 and aims to deliver the transformative changes required in the ways in which we value and protect nature.

Of the 23 coastal and marine habitat types designated under the Habitats Directive (Council Directive 92/43/EEC), eight were found to be in favourable status nationally (Figure 9.6), according to Ireland's most recent Article 17 report (NPWS, 2019) on the condition of our habitats and species. The remaining 15 types were at either unfavourable-inadequate (12) or unfavourable-bad (3) status. In particular, lagoons, large shallow inlets and bays, halophilous scrub and fixed dunes were at unfavourable-bad status and declining. The next update on the status of these habitats is due in 2025.

1 OHAT – OSPAR Hazardous Substances Assessment Tool: dome.ices.dk/ohat/ (accessed 2 May 2024).

Figure 9.6 Status of Ireland's marine habitats



Source: NPWS, 2019

The draft 2024 MSFD update represents a much more comprehensive and internationally integrated assessment than earlier assessments, with many more species assessed under this descriptor. GES is being achieved for a few species in our marine waters, but the status remains unknown for many vertebrate species, including reptiles. For fish biodiversity, GES is also not being achieved in the Irish maritime area for any of the four species groups included in the assessment (coastal fish, deep-sea fish, demersal fish and pelagic fish). Regional assessments have now been carried out for ten mammal species (up from two small-toothed cetacean and two seal species assessed nationally in 2020). Among the mammals, GES continues to be achieved for one species (i.e. grey seal), but GES is not being achieved for two small cetacean species (i.e. harbour porpoise and common dolphin), both of which are subject to incidental by-catch, which is assessed through a coordinated regional approach.

In September 2023, Ireland signed the United Nations Biodiversity Beyond National Jurisdiction Agreement (UN, 2023), also known as the High Seas Treaty, to promote the conservation and sustainable use of marine biological diversity in areas beyond national jurisdictions.

Further information on wider biodiversity issues and the policy and legislation covering this area is found in Chapter 7.

Marine protected areas

The use of spatial conservation measures to protect the marine environment and its natural integrity and ecosystems is a key measure called for in the MSFD and the Nature Directives (Habitats Directive and Birds Directive) and under the UN Convention on Biological Diversity. In this regard, delivering Ireland's ambition for its marine protected areas (MPAs) is a key action to help meet our commitment to protect 30% of our marine areas by 2030 (DHLGH, 2023a). While the proportion of our waters currently designated as protected marine sites has increased from 2.3% to over 9%, this is still a long way from meeting that commitment.

It is important that marine developments do not occur at the expense of the wider marine environment, and the delayed MPAs legislation is essential in this regard. As part of a process to identify, designate and manage Ireland's network of MPAs, the government approved the General Scheme of the Marine Protected Areas Bill in December 2022. The legislation is now being drafted. It is anticipated that the Bill will be brought to government for approval to publish in 2024. The forthcoming legislation includes provision for an Ocean Environment Policy Statement to be adopted by government and revised at least every 6 years. This will set out the national vision for the protection of the marine environment and for priorities for the designation of MPAs.

The area of marine waters and seabed protected by means of designations under the EU Nature Directives has increased from 2%, as reported in the 2020 State of the Environment Report (EPA, 2020), to almost 10%. Ireland designated two new special areas of conservation (SACs) for the protection of reef habitats[2] in 2022. The Porcupine Shelf SAC has an area of 14,795 km^2 and the Southern Canyons SAC covers 14,434 km^2. Of the 27,000 Natura sites across the EU, the new SACs are the fourth and fifth largest.

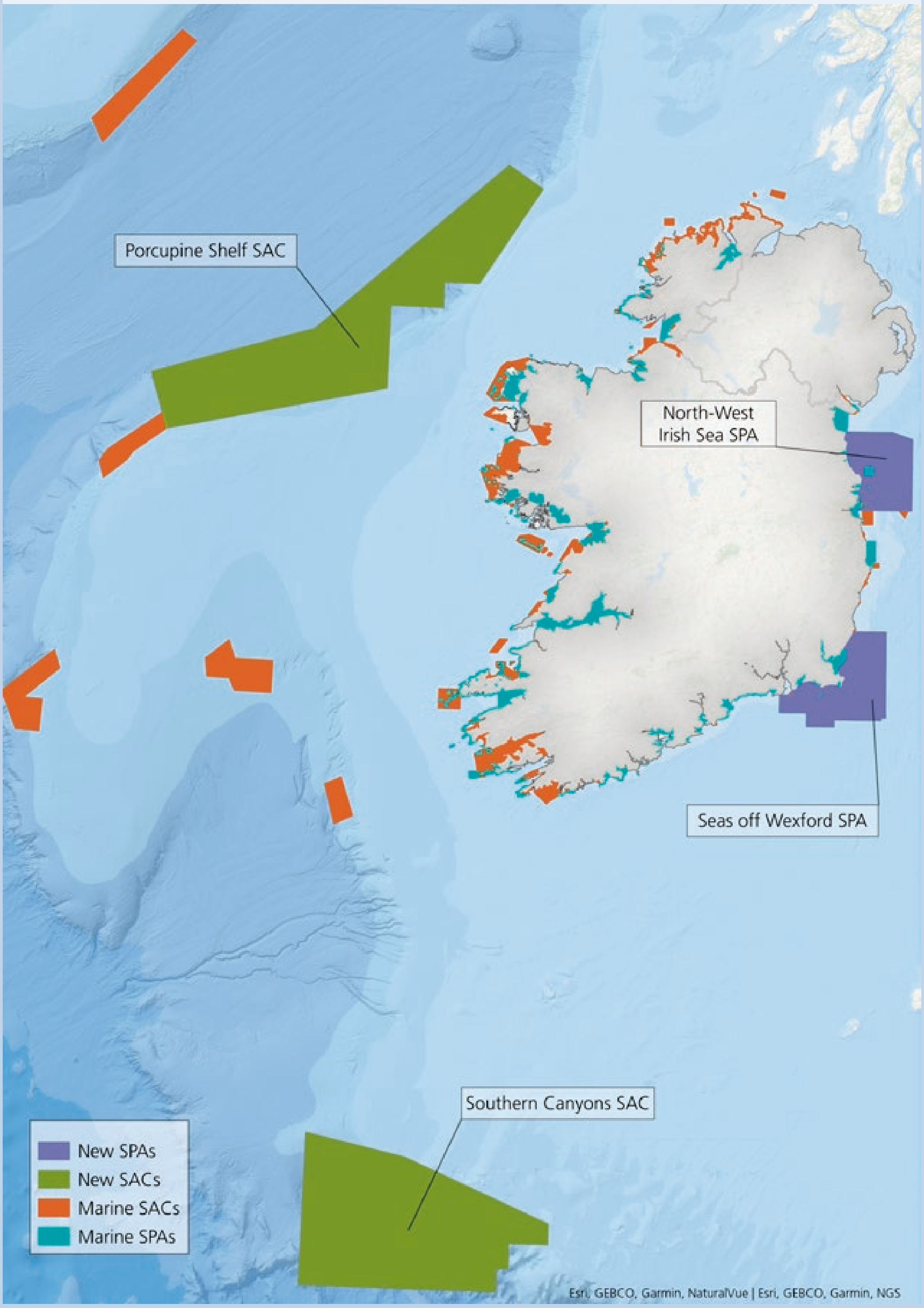
Two further Special Protection Areas (SPAs) were also recently designated. (Topic Box 9.2). The level of protection is unclear, as the management measures are yet to be put in place for all areas. The EU Biodiversity Strategy for 2030 calls for at least 10% of each Member State's marine environment to be strictly protected; however, this commitment has yet to be included in any EU or national legislation.

2 www.gov.ie/en/publication/e5057-notice-of-intention-to-designate-porcupine-shelf-002267-and-southern-canyons-002278-as-special-areas-of-conservation (accessed 10 June 2024).

Topic Box 9.2 New special protection designations

The North-West Irish Sea Special Protection Area (SPA) was designated under the EU Birds Directive (2009/147/EC) in late 2023. It will cover more than 2300 km^2 of important marine waters for a range of bird species throughout the year. The Seas off Wexford SPA, designated in January 2024, is over 3000 km^2 in size and is the largest SPA in Ireland. The designation increases the percentage of Ireland's protected marine waters. Figure 9.7 maps Ireland's marine SPAs and SACs.

Figure 9.7 The boundaries of the new North-West Irish Sea and Seas off Wexford SPAs and the new Porcupine Shelf and Southern Canyons SACs



Bathing water

The Bathing Water Quality in Ireland Report for 2023 (EPA, 2024a) shows that the water quality at most of Ireland's bathing waters met or exceeded the appropriate standards: 77% of bathing sites had 'excellent' water quality, while 97% met the minimum standard. This represents an improvement since the EPA's 2020 State of the Environment Report period, when 95% of waters met the criteria. It is also higher than the current EU average of 96% (EEA, 2024). The number of designated bathing areas has slightly increased also, from 147 in 2019 to 148 in 2023; the public can suggest new bathing waters to local authorities for designation each year.

3. Drivers, pressures and impacts

Marine fisheries

Ireland's marine area is an extensive resource for seafood production. The value of fish and shellfish landed in Ireland was €507 million in 2022 (BIM, 2023a). However, fishing continues to be the primary threat to ecosystem health despite a decrease in fishing pressure since the 1990s (ICES, 2022b). The health of fish and shellfish populations is assessed under the MSFD. These assessments indicated that GES was achieved for 29 stocks (17%) of fish and shellfish assessed but not for 46 stocks (26%), with the environmental status of 99 stocks (57%) currently unknown (DHPLG, 2020). Slightly fewer stocks are achieving GES now than in 2020, while the number of unknown stocks remains the same.

Apart from the effects of the removal of targeted stocks, fishing practices can have an impact on the marine environment through the disturbance of seabed habitats and incidental by-catch (OSPAR, 2021c; ICES 2022a). The use or location of nursery and feeding habitats is still poorly understood, and many benthic (i.e. seabed) habitats, including reefs, are thought to have been severely damaged by bottom-contacting fishing gear. The MSFD status assessment of seabed disturbance shows that the extent and distribution of physical disturbance pressures on the seabed are significant (DHLGH, 2024b). Analysis of bottom mobile fishing data from 2010 to 2015 showed physical disturbance to be widespread, occurring to some degree in 64,865 km^2 (OSPAR Region III of Ireland's Marine Reporting Unit); some 13% of Ireland's reporting area. By-catch of mammals (in particular harbour porpoise, common dolphin and grey seals), seabirds and vulnerable species of fish including elasmobranchs (sharks, rays and skates) remains a significant pressure (ICES, 2022c; Taylor *et al.*, 2022).

All sectors, including fisheries, are required to contribute to Ireland achieving its targets to reduce greenhouse gas emissions. Emissions arising from fuel use by the Irish fishing fleet, reported as an average of 1.03 tonnes carbon dioxide (CO_2) equivalent per tonne of fish landed, are low compared with the global average emissions of the seafood sector (1.7 t CO_2 eq/t) and those of other food-producing sectors (BIM, 2023b).

Ocean warming, sea level rise and ocean acidification

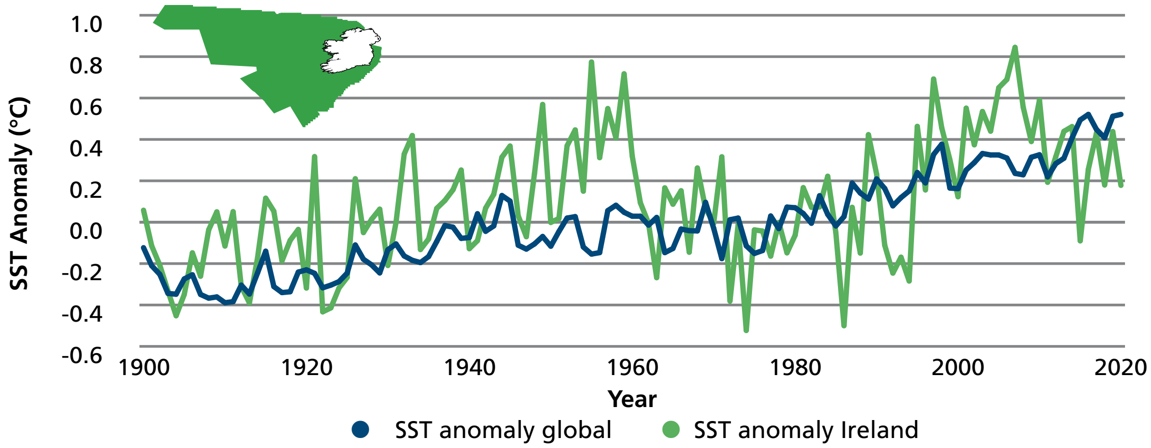
The ocean has absorbed more than 90% of the additional heat due to greenhouse gas emissions from human activities over the last five decades. It also absorbs about a quarter of annual anthropogenic carbon dioxide emissions to the atmosphere (von Schuckmann *et al.*, 2020; Friedlingstein *et al.*, 2022). This has mitigated the severity of climate change effects but has caused changes to the physical conditions and chemistry of the oceans that now threaten marine ecosystems and the services they provide (Wåhlström *et al.*, 2022).

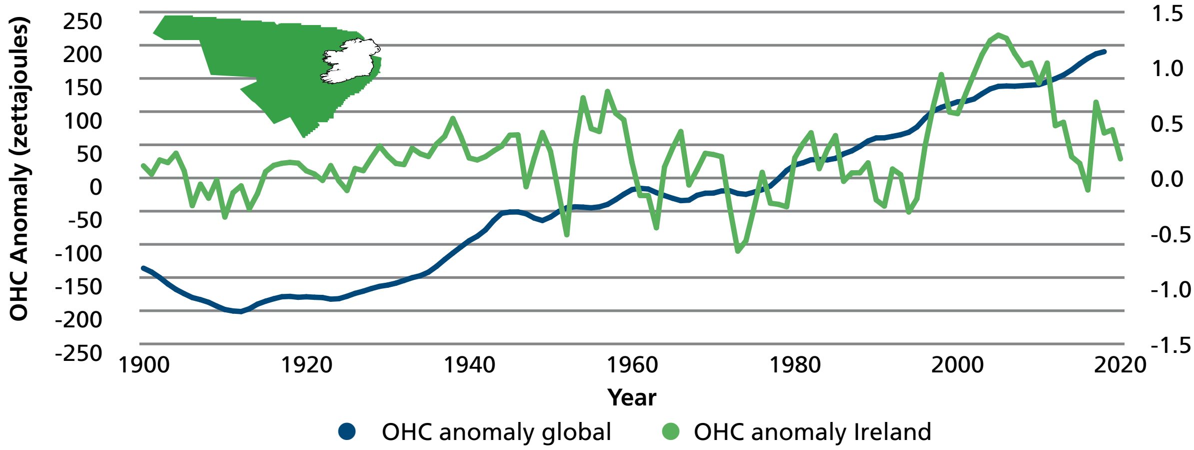
Sea level rise has been accelerating, with a global mean sea level rise of more than 9 cm since 1993, primarily attributed to melting ice and thermal expansion of the oceans. Since the 1990s, satellites have shown increased rates of sea level rise with rates around Ireland of 2-3 mm per year, in line with global trends (Cámaro García and Dwyer, 2021; McCarthy *et al.* 2023). Ireland also has a high-energy wind and wave climate. The coastal infrastructure and communities are under increasing threat from extreme sea levels, including storm surges, due to sea level rise and increased storminess (McCarthy *et al.*, 2023).

Global sea surface temperature increased at a rate of approximately 0.016°C per year from 1993 to 2020 (Figure 9.8), equating to an increase of approximately 0.43°C worldwide (von Schuckmann and La Traon, 2022). Ocean heat content[3] continues to increase, and marine heatwaves are becoming more intense and frequent (Cheng *et al.*, 2022; IPCC, 2023; Nolan *et al.*, 2023). The mild Irish climate is dominated by the Atlantic Meridional Overturning Circulation or Gulf Stream system. A weakening of the Atlantic Meridional Overturning Circulation is considered very likely this century and is a large source of uncertainty in climate models (McCarthy *et al.*, 2023).

3 Ocean Heat Content (OHC) – the sum of the heat energy stored in the ocean.

Figure 9.8 Global (blue) and Irish waters (green) sea surface temperature (SST) anomaly (top). Global (blue) and Irish waters (green) ocean heat content (OHC) anomaly (bottom). Anomalies are calculated relative to the period 1960-1990. Inset highlights in green the 'Real Map of Ireland' – the limits of Irish waters used here





Source: Nolan *et al.*, 2023

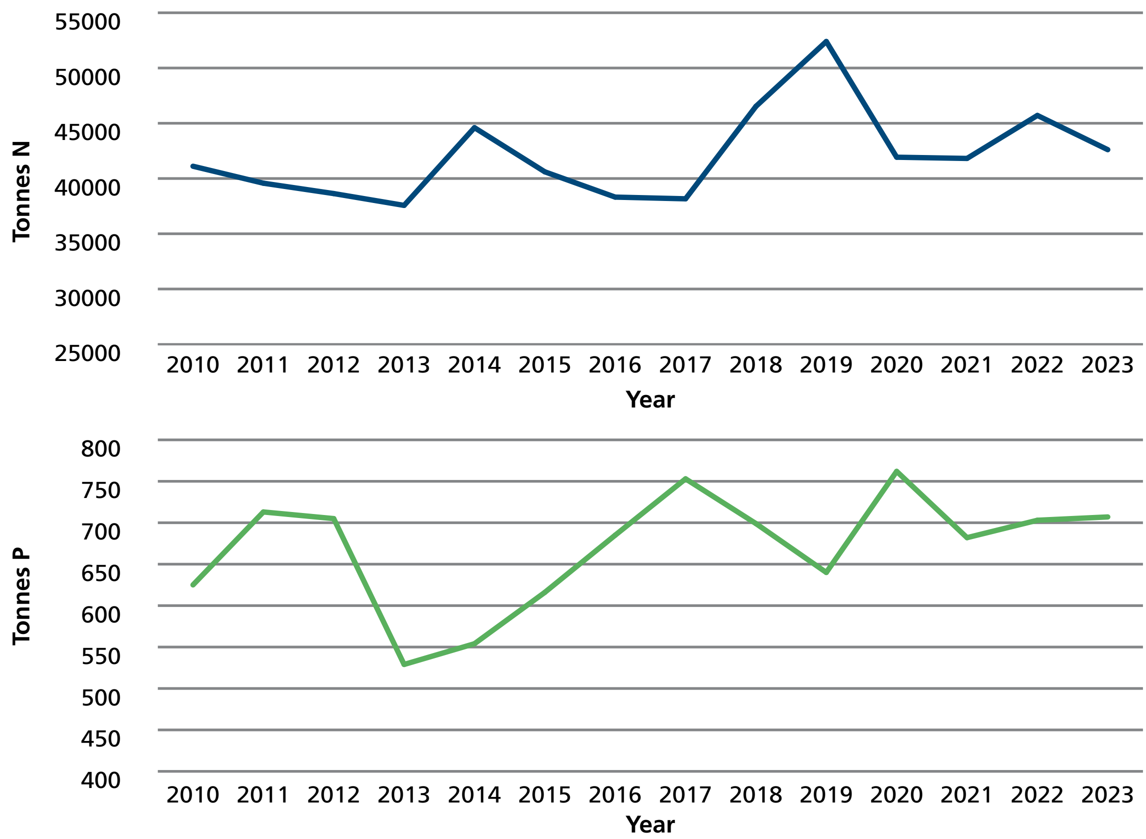
The uptake by the oceans of anthropogenic carbon dioxide emissions also leads to acidification. The pH (the scale used to specify the acidity or basicity of an aqueous solution) of Irish waters has been declining over the last four decades (McGovern *et al.*, 2023). Ocean acidification will continue and even accelerate under the higher carbon dioxide emission scenarios. Certain marine organisms that build calcium shells or skeletons, such as shellfish and cold-water coral (*Desmophyllum pertusum*) reefs, will be vulnerable to ocean acidification.

There have been changes in marine ecosystems, such as in the seasonality and abundance of many species including phytoplankton and zooplankton at the base of the food web. Globally, climate change is leading to a poleward expansion of many species. There is evidence of an increase in the presence of warm-water species to the south of Ireland. However, for fish and seabirds, disentangling climate effects from other pressures on populations, including fishing, remains a challenge (Nolan *et al.*, 2023; Vaughan *et al.*, 2023).

Nutrient enrichment

The assessment of nutrient enrichment in marine waters shows that eutrophication is not an issue in our offshore waters. However, in the seas closer to shore this is not always the case. Assessment under the WFD has shown that 64% of our estuaries are at moderate status. In particular, no estuaries on the south coast are at a status higher than moderate (EPA, 2021). The primary driver of environmental status is nutrient enrichment. The OSPAR Inputs of Nutrients to the OSPAR Maritime Area programme has been tracking the loads of different parameters from land-based activities reaching the marine environment since the 1990s (Axe, 2022). For Ireland, large decreases in nitrogen and phosphorous inputs were observed, and these continued to decline until around 2013 (EPA, 2024). Since then, the inputs of nutrients have increased (Figure 9.9), and these are largest in the rivers entering the sea along the south and south-east coasts of Ireland.

Figure 9.9 Trends in Ireland's total oxidised nitrogen (N) loads (top) and phosphate (P) loads (bottom) entering the marine environment (Source: EPA, 2024b)



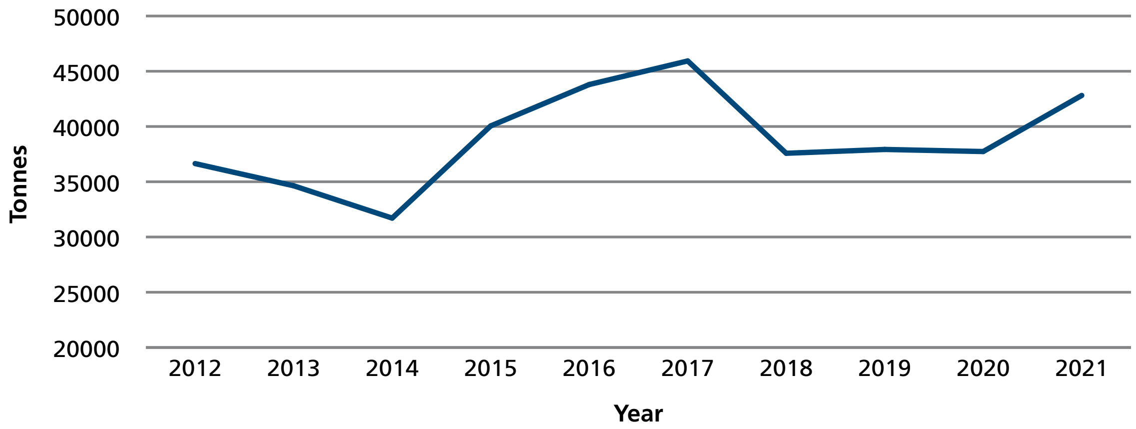
Increases in nutrients as a result of human activities, such as agriculture and waste water production (domestic and urban), are the primary driver of the decline in the status of our estuaries. Nutrient enrichment has serious impacts in these areas, including large accumulations of seaweed, phytoplankton blooms and declines in oxygen conditions (Figure 9.10). Recent assessments (EPA, 2021, 2022,2023, 2024b) indicate that these impacts are also being observed in coastal waters, suggesting that the persistence of these nutrient inputs may cause wider issues in the marine environment.

Figure 9.10 Impact of nutrient enrichment on Clonakilty Bay

Aquaculture

The Irish aquaculture sector's output in 2022 was worth €196 million and mainly consisted of oysters, mussels and salmon production (BIM, 2023a) (Figure 9.11).

Figure 9.11 National total tonnage of Irish aquaculture output, 2012-2021



Source: BIM, 2023a

Aquaculture operations can potentially affect the marine environment, such as through escaped farmed salmon, the spread of pathogens and parasites to native populations, and the potential disturbance to and displacement of fish, shellfish, birds and other wildlife populations. The accidental introduction of non-native species, together with water pollution, aquaculture and other activities, is considered a pressure for a number of protected habitats (NPWS, 2019; OSPAR, 2021d; ICES, 2022a).

Aquaculture is also at risk of environmental pressures. Ireland has 64 designated shellfish growing areas, which have specified water quality requirements to support shellfish production. The risks from pollution risks to shellfish production and environmental health are discussed in Chapter 14.

Dredging and dumping at sea

The removal of seabed material for maintenance and navigational purposes is a common occurrence in ports and harbours around Ireland. The disposal of this dredged material at sea can only occur under a Dumping at Sea Permit granted by the EPA. Such permits are also required for the removal and dumping of dredged material to facilitate infrastructural expansion (capital projects). Permit returns show that, in 2023, approximately 1.3 million tonnes (wet weight) of material, arising mainly from maintenance projects, were dredged and deposited at eight licensed disposal sites around the Irish coast. In Dublin Port, capital works commenced as part of the MP2 Project[4] which is being carried out under Dublin Port's Masterplan 2040 to increase the port capacity. The permitting process ensures that dumping is a localised pressure and contaminated sediments are not dumped at sea. Assessments under the MSFD indicate that dumping is not having widespread or long-term effects on the wider ecosystem.

Underwater noise

Sound is a by-product of human activities in the marine environment (e.g. shipping or construction) or is produced intentionally for the purposes of surveying the seabed or water column. Sound is referred to as 'noise' only when it has the potential to cause negative impacts on marine life.

Anthropogenic sound sources are categorised as impulsive or continuous. A recent OSPAR assessment looked at impulsive sound sources in the North Sea area, which include percussive pile driving for inshore and offshore construction, seismic surveys to map subsea oil and gas deposits, explosions and some sonar sources (OSPAR, 2023c). This has shown that impulsive sound sources have caused temporary displacement of small cetaceans (e.g. harbour porpoise), increased physiological stress in some fish species (e.g. European seabass) and caused developmental abnormalities in invertebrate larvae. In some cases, they may also be capable of causing more severe effects such as permanent auditory damage or blast injuries.

4 www.dublinport.ie/masterplan/mp2/ (accessed 2 May 2024).

The status of underwater noise in Ireland's marine environment is based on an analysis of the spatial and temporal patterns of sound sources, a modelling approach for impulsive noise and a risk-based approach for continuous noise.

In 2022, threshold values for the spatial and temporal extent of underwater noise were agreed at an EU level (Borsani *et al.*, 2023). This has allowed Ireland to perform an assessment of the impacts of underwater noise. Vessel traffic is the main source of human-made continuous noise in the Irish marine environment. Impulsive noise includes sources such as percussive pile driving, seismic surveys, explosions and some sonar sources. Analysis of underwater noise using information from the OSPAR Impulsive Noise Registry indicates that Irish marine areas fall below agreed thresholds in the years assessed.

Offshore energy

Ireland has committed to achieving a target of at least 5 GW of installed offshore wind capacity in its maritime area by 2030 within the Climate Action Plan 2024 (DECC, 2023). The plan also sets out a further commitment that up to 80% of Ireland's electricity will be from renewable sources by 2030.

Offshore renewable energy will play a significant role in advancing Ireland's environmental commitments towards achieving climate neutrality by 2050. The process for developing this is included in the draft Offshore Renewable Energy Development Plan II, which was published for public consultation in April 2023 (DECC, 2023). It is important that the plan is closely aligned with the National Marine Planning Framework and the Maritime Area Planning Act 2021, so that, in delivering energy, other relevant sectors operating in the maritime area and impacts on the marine environment will be considered. The government is also currently consulting on the development of planning guidance for offshore wind energy. These guidelines will help clarify the requirements and organisational roles under the Maritime Area Planning Act, as they relate to offshore wind energy for different public bodies, as well as the environmental factors that need to be considered.

Developments must fully account for the relevant requirements of the WFD and MSFD. Where the potential for significant effects on water quality and biodiversity remains uncertain, even after mitigation measures have been applied, further environmental monitoring and research may be required. While not currently included in the draft Offshore Renewable Energy Development Plan II, the cumulative impacts from associated infrastructural and connection works must be fully considered. Where conflicts remain difficult to resolve, the overall benefit of the developments must be considered.

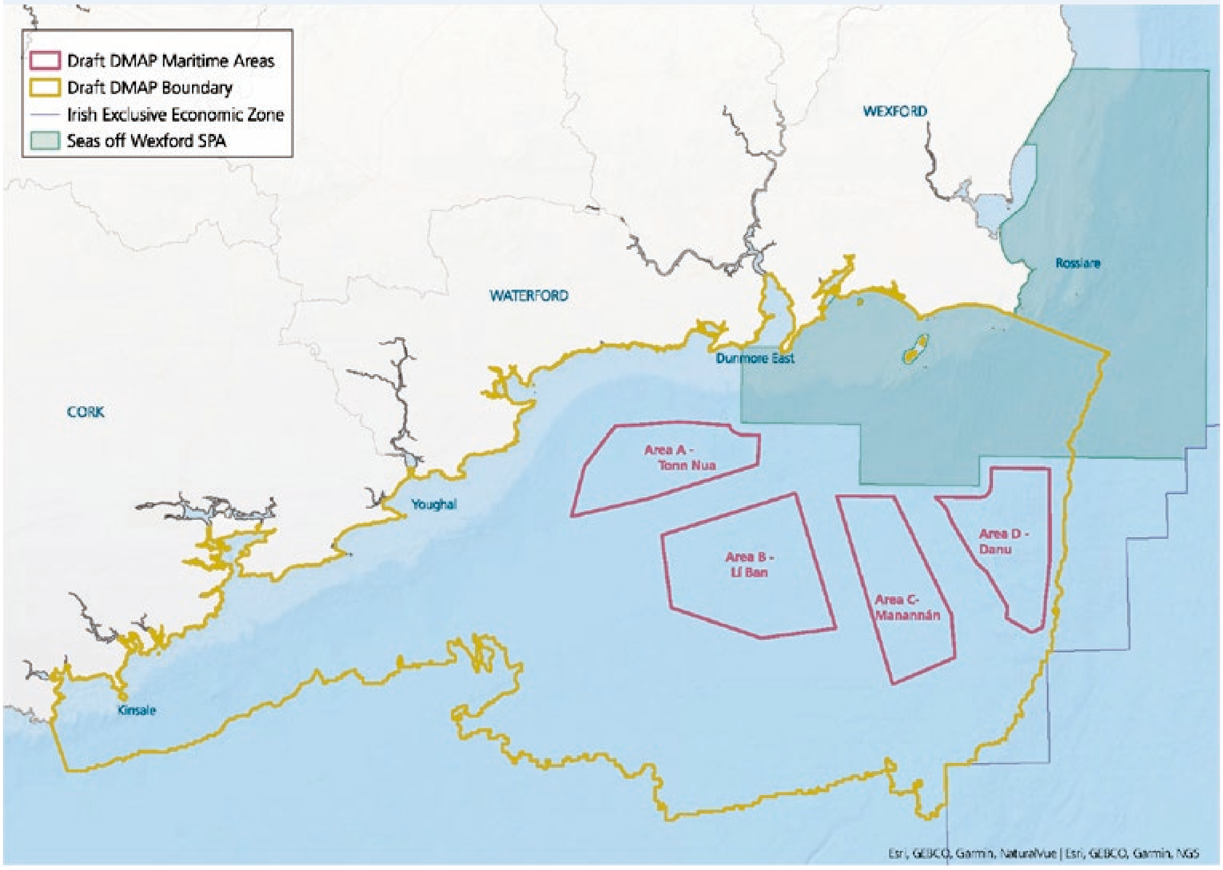
The state is working to identify appropriate locations for offshore wind development in consultation with local communities and with consideration for other maritime activities, including fishing and seafood production, and sensitive or protected habitats. In 2023 an ecological sensitivity analysis of the western Irish Sea was undertaken as part of a screening for species and habitats that may need protection under forthcoming MPA legislation. It identified areas of comparatively higher and lower ecological sensitivity based on the best available scientific evidence while concurrently providing information that could inform planning decisions that need to be taken about the potential siting of offshore renewables infrastructure.[5]

The views of the public are being sought through public consultation processes, for example on the South Coast Designated Maritime Area Plan (DMAP) proposal, published in May 2024.[6] This proposal represents the first time the DMAP forward planning process, set out in the Maritime Planning Act (2021), has been applied in Ireland and is focused on identifying the geographical areas for future offshore renewable energy development (Figure 9.12). A further ecological sensitivity analysis is being completed for the Celtic Sea in 2024 to align with the proposed South Coast Offshore Renewable Energy DMAP. This will ensure that protection of the marine environment is considered concurrently with the development of offshore renewables.

5 www.gov.ie/en/publication/e00ec-marine-protected-areas/ (accessed 2 May 2024).

6 gov – Public Consultation on the Draft South Coast Designated Maritime Area Plan for Offshore Renewable Energy (SC-DMAP) (www.gov.ie) (accessed 16 May 2024).

Figure 9.12 Geographical area of the proposed South Coast Designated Maritime Area Plan (DMAP)



Source: DECC, 2024

4. Responses

Ireland's MSFD Programme of Measures, led by the DHLGH, sets out Ireland's plan to maintain or achieve GES for our marine waters up to 2028. The Programme of Measures considered the assessment of Ireland's environmental status and the environmental targets outlined in Ireland's Marine Strategy Part 1 (DHLGH, 2020).

Among the actions set out in the programme are those to:

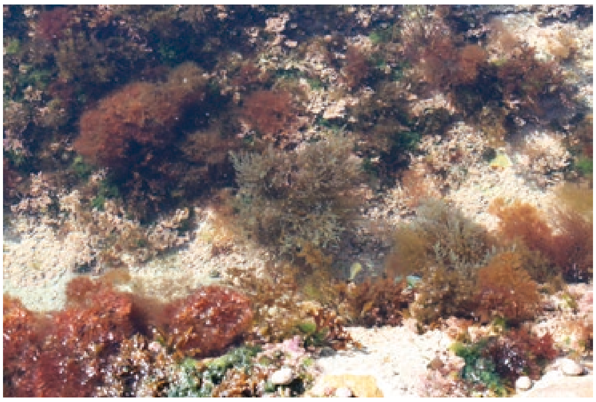
- develop and expand Ireland's MPAs to cover 30% of our marine area by 2030 (including planned enactment of the Marine Protected Areas Bill in 2024)
- develop nature-based solutions in coastal and marine systems to protect biodiversity, improve resilience to climate change and reduce the impact of pollution
- provide environmental guidance for offshore renewable energy
- develop an all-Ireland management strategy for non-indigenous species and invasive species in coastal and marine areas
- update guidance on reducing underwater noise pollution to protect marine mammals
- fully implement the Single Use Plastics Directive and Circular Economy Act as part of a wide range of actions aimed at reducing litter and plastics in our seas.

While the WFD Water Action Plan mentions the need for better integration of actions to protect shellfish waters and aquaculture, there are few clear measures specifically targeting marine waters. There is, however, an increase in the number of priority action areas that include transitional and coastal water bodies. Feedback from the public consultation process highlighted the failure of the draft plan to adequately address coastal pressures and the scarcity of measures to address coastal and transitional issues.

Measures implemented through the Water Action Plan will be the primary response to addressing the increasing nutrient enrichment issues in our estuarine waters. In particular, the agricultural measures (see Chapters 8 and 10) will help to reduce the inputs of nutrients into the marine environment. In addition, the catchment-based approach to managing water resources and dealing with water quality issues is well established in Ireland and should assist in addressing nutrient issues (DHLGH, 2024a).

The EU Nature Restoration Law (Regulation (EU) 2024/1991) will set legally binding targets to restore degraded ecosystems and prevent and reduce the impact of natural disasters. The law entered into force in August 2024 and will require all Member States to produce a national restoration plan within 2 years of adoption (NPWS, 2024).

In 2023, Ireland brought in the Sea Pollution (Ballast Water Management Convention) Regulations (S.I. No. 188/2023) to give effect to the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention). Under the regulations, all ships are now required to manage their ballast water and sediments to agreed standards. The regulations apply to all Irish ships and to foreign-flagged ships under port state control.



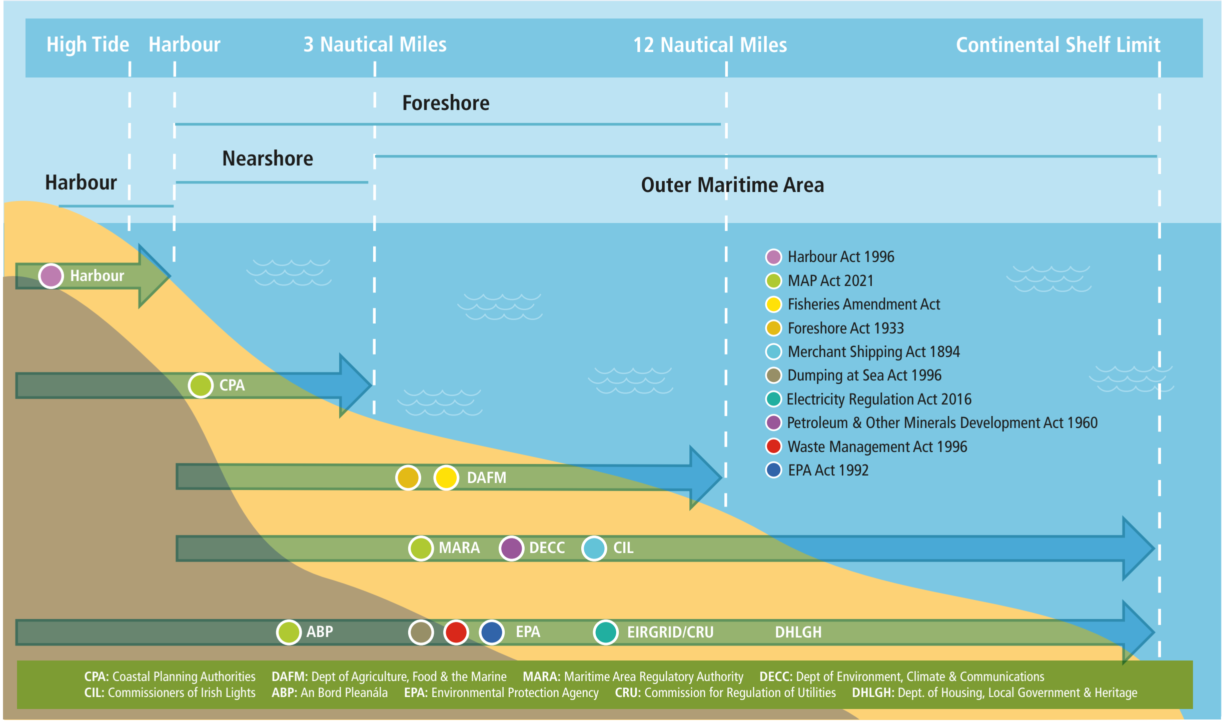
Rockpool containing *Cystoseria*

While the development of nature-based solutions has been tested to a limited degree in Ireland (e.g. Devaney and Perrin, 2015; Cott *et al.*, 2021; Farrell *et al.*, 2023), there is still much to be understood to ensure that the potential co-benefits in terms of increased biodiversity, reduced eutrophication and climate change mitigation are maximised. Work is ongoing at the OSPAR level to collate best practice examples from across the North-East Atlantic and see how different countries can work together to achieve the best outcomes (OSPAR, 2021b).

Spatial planning

The new Maritime Area Planning Act (S.I. No. 50/2021) established a planning system for Ireland's maritime area (Figure 9.13). This is underpinned by a statutory Marine Planning Policy Statement and guided by the National Marine Planning Framework to balance the sustainable use of marine space with the protection of marine ecosystems. Specific designations for activities under this, such as offshore wind energy, will then be guided by Designated Maritime Area Plans (DMAPs).

Figure 9.13 Marine planning system



The Maritime Area Regulatory Authority

MARA was established in July 2023 (DHLGH, 2023b). The establishment of MARA is part of the biggest reform of marine governance in Ireland in almost a century. It marked the transition to a new maritime consenting regime and established a development management regime from the high water mark to the outer limit of the state's continental shelf, administered by An Bord Pleanála, the coastal local authorities and MARA. This new distribution of powers will require building capacity in those organisations with less experience in coastal planning.

MARA is an independent regulatory body responsible for managing and regulating development and activity in Ireland's maritime area. MARA has responsibility for assessing applications for Maritime Area Consents (MACs), which will be required before projects in the maritime area, such as offshore wind, can apply for development consent. MACs confer a right to occupy the maritime area subject to any necessary development consent. MARA is also responsible for granting maritime usage licences for certain activities in the maritime area (e.g. site investigations, dredging, installation of non-permanent pontoons). The MAC regime does not apply to some developments, including those involving navigation, fishing, aquaculture and petroleum exploration.

MARA's functions are set out in the Maritime Area Planning Act 2021 as follows:

- assessing MAC applications for the maritime area
- assessing maritime usage licence applications for specified non-permanent activities
- checking compliance with and enforcement of MACs, licences and offshore development consents granted by An Bord Pleanála
- investigations and prosecutions
- administration of the existing foreshore consent portfolio
- fostering and promoting cooperation between regulators of the maritime area.

As one of the largest potential new uses of the maritime area, the development of offshore wind needs to be carefully considered across all organisations to clearly define how protection and development are to be managed and what appropriate development is, particularly in relation to protected areas.

Marine fisheries

The Common Fisheries Policy governs the fishing sector in Ireland. Irish fisheries data are combined with those from other countries through the International Council for the Exploration of the Sea to provide scientific assessments and advice establishing total allowable catches for fish stocks. A number of historical and recent measures have been developed under this policy to ensure that fishing and aquaculture are environmentally, economically and socially sustainable. Since 2014, the reform of the Common Fisheries Policy has led to the phased introduction of landing obligations for species subject to catch limits. Measures in place for Irish fisheries include a range of area closures, restrictions and technical measures to conserve stocks and the prohibition of bottom trawling in designated coral protection areas and in deep waters (BIM, 2023c).[7] Common Fisheries Policy, national and other measures are included in Ireland's MSFD Programmes of Measures (DHLGH 2022).

In 2023, as part of a 'fisheries and ocean' package, the European Commission published an EU action plan to protect and restore marine ecosystems for sustainable and resilient fisheries (EC, 2023). This aimed to ensure sustainable fishing practices so that fish stocks are fished at a sustainable level and the impacts of fishing on the seabed and on sensitive species are reduced. Actions include phasing out mobile bottom fishing gear in MPAs by 2030, increasing gear selectivity, supporting a just transition for fishers whose livelihoods are impacted by the measures, and strengthening knowledge, research, enforcement, governance and stakeholder involvement.

Aquaculture

The European Commission (EC, 2021) set out its strategy to develop the potential of aquaculture as a source of food in a sustainable manner in line with the European Green Deal. The National Strategic Plan for Sustainable Aquaculture Development 2030 was issued in October 2023 (DAFM, 2023). This aims to sustainably grow the aquaculture sector while ensuring the environmental protection of marine ecosystems and minimising the sector's carbon footprint. The growth of the aquaculture sector must be considered in relation to its impact on marine environmental status under the WFD and MSFD and also on the qualifying interests of protected sites under the Nature Directives.

Climate mitigation and adaptation

The national Climate Action Plan 2024 (DECC, 2023) highlights ambitious marine-relevant climate change mitigation and adaptation targets. The Maritime Area Planning Act 2021 provides for a new national approach to marine planning. Measures developed under these policies need to be considered in the wider ecological context to ensure that maximum co-benefits can be achieved. For example, nature-based solutions can play a role in mitigation and adaptation planning, with the added co-benefits of protecting and restoring degraded ecosystems. Under the MSFD Programme of Measures, nature-based solutions have been identified as key to achieving MSFD targets. The role of coastal Irish ecosystems as a carbon sink, in particular seagrass beds and saltmarshes, is an area of active research[8,9] to better understand how conservation, management and restoration of these ecosystems could protect carbon stores and contribute to mitigation and adaptation measures. But they also need to be considered for their potential to mitigate nutrient enrichment and to enhance biodiversity. The development of a network of MPAs in Ireland's marine areas will include provisions for the protection of ecosystem services such as those provided by 'blue carbon' habitats and climate-resilient features both in coastal areas and offshore.

7 Below 400 m in other vulnerable marine ecosystem areas and below 800 m in deeper waters.

8 Examples of three blue carbon projects led by University College Dublin: Blue Carbon Group (www.ucd.ie/bluecarbon/home/), BlueC (www.bluec.ie) and QUEST (Research Climate Data Table Dev | Environmental Protection Agency (epa.ie)).

9 cordis.europa.eu/project/id/101093865 (accessed 2 May 2024).

Projected increases in sea level and storm surges will result in an increased frequency of coastal flooding and erosion, with significant impacts on coastal settlements, communities and infrastructure. Coastal adaptation responses can include protection (e.g. hard engineering or nature-based solutions), accommodation (adapting to the risks) or managed retreat (Farrell *et al.,* 2023; EPA, 2023b). The Climate Change Sectoral Adaptation Plan for Flood Risk Management 2019-2024 (OPW, 2019), prepared under the National Adaptation Framework, sets out actions to ensure that the potential impacts of climate change on flooding and flood risk are effectively managed.

The establishment by government of an interdepartmental group to consider the scoping of a National Coastal Change Management Strategy recognised that there are current and urgent coastal change issues to be addressed in parallel to the implementation of a medium- to long-term framework. This group was tasked with scoping out an approach for the development of an integrated, whole-of-government strategy for managing our changing coast. Its report included 15 recommendations for enhancing governance and capacity building, growing the evidence base and developing management options (DHLGH and OPW, 2023).

The Biodiversity Climate Change Sectoral Adaptation Plan (DCHG, 2019) and the National Biodiversity Action Plan (NPWS, 2024) also include actions relevant to the effects of climate change on the marine environment. Protection of designated areas and species is a key adaptation measure that addresses biodiversity loss and facilitates building ecosystem resilience to climate change and ocean acidification.

Good data and scientific information are critical to adaptation and planning. Sustained observations of oceanographic, biogeochemical and biological essential ocean variables (Nolan *et al.*, 2021), in line with international best practice for climate monitoring, are essential to support policy development and are included in the Climate Action Plan. The deployment of new infrastructure and participation in international networks and programmes (such as GO-SHIP, Argo and ICOS) have enhanced national observing capabilities (Cámaro García and Dwyer, 2021; Nolan *et al.*, 2021, 2023).

In recognition of its importance, the OSPAR Commission features climate change and ocean acidification as one of four themes in its North-East Atlantic Environment Strategy 2030 (OSPAR, 2021a), with agreed strategic objectives for monitoring and assessment, awareness, mitigation and adaptation.

Marine litter and plastics

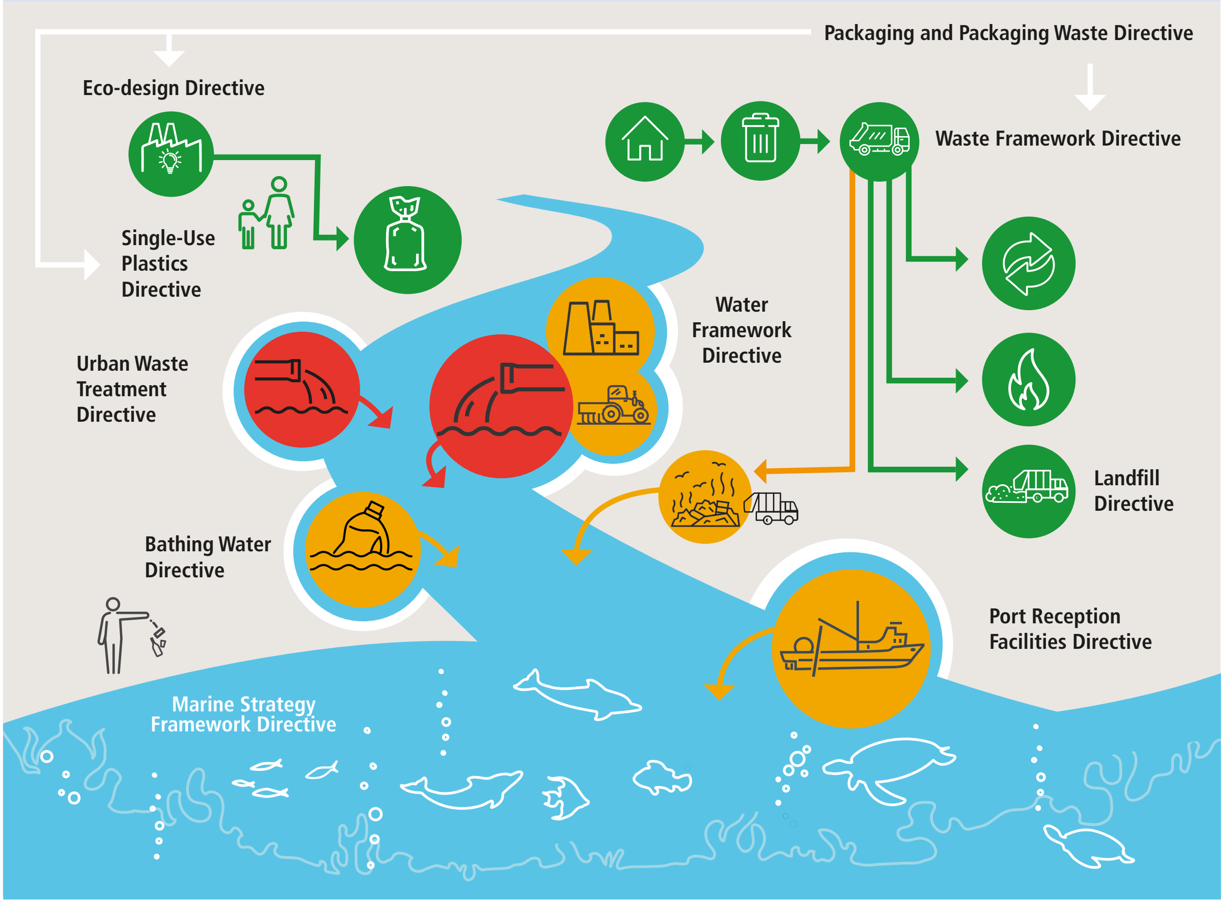
Litter remains abundant across Atlantic beaches (ETC/ICM, 2023; Lacroix *et al.*, 2022). Beach litter is defined as any persistent, manufactured or processed solid material discarded, disposed of, or abandoned in the marine and coastal environment and encountered on beaches.

Single-use plastics and maritime-related plastic litter, such as those from fishing and aquaculture activities, are the most common components of beach litter. Four beaches around the coast of Ireland were monitored over the same transect four times a year using the common OSPAR methodology. The median value was below the threshold value of 20 items per 100 m at two of the four beaches surveyed over the period 2016-2021. The beaches at Silver Strand, Co. Mayo and Carnsore, Co. Wexford fell below the threshold value at 16 and 19 items per 100 m, respectively. Long Strand, Co. Cork and Clogherhead, Co. Louth exceeded the threshold value with 182 items and 90 items per 100 m, respectively.

For comparison, the median total count in the OSPAR North-East Atlantic Area over the period 2018-2020 was 252 items per 100 m, so levels of beach litter in Ireland are below those in other countries in northern Europe (Lacroix *et al.*, 2022).

To strive towards achieving low litter levels on all beaches, multiple legislative measures are in place to control litter entering the marine environment (ETC/ICM, 2023) (Figure 9.14). In Ireland, legislative changes include a ban on microbeads, introduced at the end of 2019, and the launch of a deposit return scheme focusing on single-use plastics and other drinks containers in 2024. Bord Iascaigh Mhara operates the Fishing for Litter[10] initiative to encourage fishers to take ashore the litter they encounter at sea while fishing. However, more action is needed to further reduce the prevalence of marine litter along Irish coasts.

Figure 9.14 European directives relevant to marine litter and domains they target across the life cycle of plastics and waste



Source: Adapted from Deltares graphic in ETC/ICM, 2023

10 fishingforlitter.org/ireland (accessed 2 May 2024).

Research

A range of government departments and agencies have a role in the promotion and funding of marine research in Ireland, including Science Foundation Ireland, the Irish Research Council,[11] the EPA and the Geological Survey of Ireland. The Marine Research Funders' Forum[12] was established in 2018 under the National Marine Research and Innovation Strategy 2017-2021. The forum brings together state funding organisations with the aim of enhancing coordination in marine-related research funding. More than 600 marine research projects were funded nationally between 2017 and 2022.

EPA research programme projects include the following.

- the carbon sequestration potential of the marine environment (e.g. Investigating Ireland's Blue Carbon Potential through a Scientific, Socio-economic and Legislative Approach (BlueC) – quantification, characterisation, source and fate of past and present carbon storage in coastal offshore sediments for effective marine management)
- developments in remote sensing (Artificial Intelligence-powered Forecast for Harmful Algal Blooms – an exploitation of remote sensing CMEMS products for monitoring of transitional and coastal waters).

5. Conclusions

Overall, while our wider offshore marine areas are generally healthy and productive, there are some clear issues and increasing pressures at play. The draft MSFD assessment has highlighted that biodiversity is a key concern in the wider marine environment. Climate change impacts are already being seen in our marine waters, with changes in sea levels and temperatures and ocean acidification already evident. These impacts can act in combination with other pressures to increase the potential for further degradation of delicate ecological communities.

Fishing remains a significant pressure in our oceans, with less than 20% of the fish stocks assessed being sustainably fished. This can have knock-on effects on our wider food webs and may contribute to Ireland not meeting its obligations under the MSFD.

Our nearshore and estuarine waters are showing clear signs of nutrient enrichment, with 64% of our estuaries at moderate or worse status. While this has not yet affected our wider coastal and marine areas, the continued pressure is likely to cause effects in these areas in time if measures identified under the WFD and MSFD are not fully implemented to address it.

The coherence between these policies needs to be better aligned to ensure that the sustainable use of Ireland's maritime area occurs without adverse impacts on the environment. Recent policy measures such as those related to the development of offshore renewable energy and a target to protect 30% of our marine waters need to be properly and quickly aligned. While developments in spatial planning are progressing, the introduction of MPA legislation has been repeatedly delayed.

11 The Research and Innovation Act, signed into law in June 2024, provides for the establishment of Taighde Éireann and the amalgamation of Science Foundation Ireland and the Irish Research Council: www.oireachtas.ie/en/bills/bill/2024/1/ (accessed 2 May 2024).

12 www.marine.ie/site-area/research-funding/national-marine-research-strategy/marine-research-funders'-forum (accessed 2 May 2024).

Key chapter messages

1. Our wider marine environment is generally clean and healthy, but legislation to maintain this needs to be enforced more rigorously and new priorities addressed more quickly. For example, the delayed marine protected areas legislation is an essential part of the marine spatial planning approach that will ensure that marine developments do not occur at the expense of the wider marine environment.

2. Key pressures are still causing impacts on the biodiversity and productivity of marine ecosystems. Fishing at unsustainable levels is impacting both habitats and the food chain. Nearshore nutrient enrichment has the potential to affect coastal amenity. Measures to combat these issues need to be implemented and enforced, as current trends are indicating that environmental status is not moving in the right direction.

3. There have been many recent changes in marine policy. Policy coherence and coordination needs to be improved to avoid damaging our marine environment and to maximise the benefits of protecting it.

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Chapter 10: Environment and Agriculture

Environment and Agriculture

1. Overview

The agri-food sector is an integral part of Ireland's society and economy, especially in our rural and coastal communities. Farming has shaped Ireland's environment for centuries – it is a vital human activity that can deeply impact nature and the environment, but it also relies heavily on a healthy environment to thrive. There is unequivocal evidence from reports by the Environmental Protection Agency (EPA) that the agri-food sector in Ireland is a significant contributor to pollution and impacts our environment. Significant growth in parts of the sector in the last decade has brought significant environmental challenges. There is also evidence, conversely, that when agricultural practices are well managed, and are matched to the capacity of the land in a particular area, they can contribute to maintaining and enhancing environmental outcomes for biodiversity, soil health, climate, water quality and flood protection. It is clear from global assessments that tackling the climate and biodiversity emergencies will require transformative change across land and food systems, with huge implications for the products and services that will be required from farmers in the future.

The latest agri-food sector strategy, Food Vision 2030 (DAFM, 2021a), has brought into sharper focus the importance of achieving environmental sustainability alongside economic growth, and many changes in farm practices to support a healthier environment are now being made on farms across the country. But it is clear from the EPA's published assessments that a deeper level of systemic change is required in practice in the sector to ensure its environmental, social and economic sustainability in a changing world. Substantial progress can be made through the full and effective implementation of existing policies and regulations, for example through achieving full compliance with the Good Agricultural Practice for the Protection of Waters Regulations (S.I. No. 113/2022) and by implementing all the climate measures mapped out in the Teagasc marginal abatement cost curve (MACC), and these steps are urgently required. But navigating the agriculture sector towards a secure and sustainable long-term future will require more substantial fundamental changes in how we use land. Hitherto, much emphasis has been placed on continuous improvement in the product-level carbon efficiency of Irish milk and beef production, and the sector has delivered this with considerable success. Yet the latest scientific evidence increasingly focuses on absolute ecological thresholds to determine environmental sustainability at local, national and global scales. Delivering a truly sustainable and resilient agriculture sector in the long term will require a paradigm shift beyond continuous improvement and relative efficiency towards a goal-oriented approach informed by a vision of a climate-neutral and biodiverse agriculture and land sector. Strategic planning for the risks and opportunities arising from future market and policy responses to a rapidly changing world will be as important for the future economic and social viability of the sector as it will be for achieving environmental objectives. Connecting this foresight approach to current realities to identify possible 'just transitions' for farmers is a huge challenge that can be solved only through broad and constructive engagement across all stakeholders.

Key sustainability challenges

There have been increasing calls for countries to adopt a more holistic 'food systems approach' (Topic Box 10.1) in policymaking, so that all the elements of the system evolve and adapt together in a joined-up way. In practice, this means policymakers for agriculture, fisheries, land use, public health, the economy, trade and the environment working together, developing a holistic view and a shared vision of what the system should look like as a whole in the future. Food systems are complex, and the necessary trade-offs and synergies become apparent, and can be optimised in the public's best interest, only when all the elements of the system are considered together (OECD, 2021). Food systems must work for people and for the planet.

Topic Box 10.1 Food systems approach

Food systems can be described as the complex web of activities surrounding the ways in which we grow, produce, process, trade, transport, consume and waste food, or, put simply, how we get our food from farm to fork. Food systems are central to our health and wellbeing, our livelihoods and economies, and our cultural and social values. Globally, food systems are major drivers of climate change, changes in land use, depletion of freshwater resources, and pollution of aquatic and terrestrial ecosystems (OECD, 2021). At the same time, our food systems are expected to supply a growing global population with safe, secure and nutritious food – global food demand in 2050 is expected to be 56% greater than it was in 2010 (van Dijk *et al*., 2021). Consequently, global food system greenhouse gas emissions could exceed the entire global greenhouse gas budget for climate stabilisation by 2050 (Clark *et al*., 2020). However, up to one-third of food produced is wasted and never consumed, while excessive and unbalanced food intake is a major cause of disease in industrialised countries. Meanwhile, 2.4 billion people were moderately to severely food insecure in 2022 (FAO, 2023).

It is increasingly recognised that global food systems need urgent and profound transformation to become sustainable. While there is good progress being made in some areas, the rate of change is slow and needs to be accelerated (EEA, 2022). Global assessments clearly indicate that realising a sustainable food system will require integration of demand-side measures such as diet change, waste reduction and a reconfiguration of value chains to deliver the right types of food to where they are most needed (IPCC, 2019; Willett *et al*., 2019; Fanzo *et al*., 2021). Diet change could reduce global greenhouse gas emissions by up to 8 Gt CO_2 eq/year, while reducing food and agricultural waste could lower emissions by a further 4.5 Gt CO_2 eq/year (IPCC, 2019). Taking Irish dietary intake as an example, dairy and meat products represent around 30% of energy intake and around 70% of dietary climate impact (Williams *et al*., 2020). Globally, there is increasing recognition of the dual health and environmental benefits that could be realised by reducing the consumption of animal-derived foods across the industrialised countries that produce most of these foods. Recent Teagasc research has shown that a 25% reduction in the emissions associated with the current Irish diet could be achieved if healthy eating guidelines were observed. This would require reducing treat consumption by half, adding three extra portions of fruit and vegetables per day, and reducing the consumption of meat by one portion per day (Conway and McCarthy, 2023).

As climate, biodiversity and health crises intensify, market and policy responses will be amplified but also constrained by biophysical realities such as available land areas and climate change impacts. Profound consequences for food systems and farmers are likely, yet they cannot be extrapolated from past trends. Reactive policymaking could leave the agri-food sector heavily exposed to big risks that undermine the social licence and green marketing on which it depends and simultaneously unprepared to exploit emerging opportunities. Forecasting the future has inherent uncertainties, but strategic foresight analyses can point to the major threats and opportunities associated with specific food system trajectories. For example, the increasing future costs of healthcare for an ageing population are likely to mean that widespread diet and lifestyle changes will become an economic imperative. Diet change in Ireland may not have a significant impact on animal production nationally, which is driven by exports, but a shift towards consuming more diverse, value-added national produce could support national farm diversification – maximising the social, environmental and health benefits. Similarly, reducing food waste could be driven by economic factors if the true costs of food production were borne by consumers. Foresight analyses of future food systems require constructive and open-minded engagement across a broad range of relevant stakeholders with contrasting perspectives. There is an urgent need for critical and constructive discussions on what ‘sustainability’ and ‘resilience’ will mean for Ireland’s agri-food sector in a changing global food system.

Management of land systems is also critical to sustainability. Farmers own and/or manage about 67% of land in Ireland (DAFM and DECC, 2023). Agriculture, and in particular farmers’ actions, will be a key part of the solution to addressing the climate and biodiversity crises. Although there is a lot of uncertainty about precisely how an agriculture and land sector that is compatible with national objectives on climate neutrality, water quality and biodiversity will look, it is clear that the sector will need to change, and the direction of travel is sufficiently clear to inform initial action. Against this backdrop, an array of good programmes and initiatives in Ireland, e.g. Farming for Nature and BASE (Biodiversity, Agriculture, Soil, Environment) Ireland, have made some progress, and there are many positive environmental actions already being carried out on farms, but they have not yet delivered the scale and pace of change needed.

Realising dynamic, sustainable and resilient agri-food and land systems in Ireland will require the development of integrated, cross-departmental policies that recognise the interdependencies of a healthy environment, healthy people, healthy food and healthy planet. Driving the transition to a more climate-resilient and environmentally friendly agriculture sector will require vision and leadership. Urgent implementation must be a priority, and farmers and other landowners must be supported in making the changes that are needed. Some of the most important challenges affecting both the sector itself and broader society are summarised below. See Chapters 4, 5, 6, 7, 8 and 15 for further detail.

- ***Environmental impact.*** The intensification of livestock farming, in particular the dairy sector, in response to ambitious growth policies has contributed to increased environmental degradation in Ireland. Over the last decade there has been an increase in greenhouse gas emissions, air pollution, water pollution from agricultural run-off and leaching, and habitat destruction. While there has been some stabilisation in recent years, and improvements in some areas, addressing these environmental impacts is crucial, not least for producing nutritious sustainable food and maintaining Ireland's green economic trading credentials. The current agri-environmental policies, and/or their rates of implementation, are not yet achieving the desired environmental outcomes.
- ***Climate change and emissions.*** The agriculture sector contributes 38% of Ireland's national greenhouse gas emissions. The key drivers are the size of the national cattle herd and the application rates of nitrogen fertilisers. While both have increased over the last decade, there has been some stabilisation in animal numbers in recent years and significant reductions in chemical fertiliser use. Full implementation of the measures outlined in the Teagasc MACC 2023, which will require additional policy measures to support implementation, will be required to reach the 25% emission reduction target by 2030. The agriculture sector is also a significant contributor to emissions attributed to the land use, land use change and forestry (LULUCF) sector, which is a net source of emissions in Ireland. Key measures include substantial afforestation of Ireland's grassland-dominated landscape, and water table management and restoration are both actions that need to be undertaken in peat soils.
- ***Climate change adaptation.*** Ireland's agriculture sector is vulnerable to the impacts of climate change, including changes in rainfall patterns, extreme weather events and rising temperatures. These factors can affect crop yields, fodder reserves, livestock and plant health, increase disease risk, and reduce overall farm productivity, which in turn could increase economic pressures and have negative impacts on farmers' health and wellbeing. Adaptation strategies are necessary to make agriculture more resilient and reduce its contribution to climate change. Such strategies could include diversification, planting drought-tolerant species, flood prevention/management, management of new pests and diseases, and nature-based catchment management solutions. Different adaptation strategies may be needed in different parts of the country depending on how they are affected by the weather.
- ***Land use and biodiversity loss.*** Agricultural practices such as land intensification and drainage have resulted in habitat loss and reduced biodiversity levels. Land abandonment can also be an issue in some areas, as can commercial afforestation with non-native species in sensitive upland areas. Native species, both flora and fauna, have suffered as a consequence. Maintaining and restoring biodiversity in agricultural landscapes is essential for ecosystem resilience and long-term sustainability.
- ***Water quality.*** Agricultural activities, particularly animal manure management and fertiliser use, contribute to water pollution in Ireland. Excess nutrient run-off, i.e. nitrogen and phosphorus, can lead to eutrophication, which negatively affects water quality and aquatic ecosystems. Pesticides and other chemicals reaching watercourses are a problem in some areas, as are activities that impact on the physical aquatic habitat conditions. Better farm management practices that work in tandem with nature and climatic conditions, in ways that build resilience into the system, are needed to minimise impacts to water quality.
- ***Farm viability and rural communities.*** Many farmers in Ireland face economic challenges, including low farm incomes, fluctuating commodity prices, and high and fluctuating production costs. Farmers are price takers, and small-scale farmers in particular struggle to remain financially viable, which in turn threatens the social structures underpinning our food system. Generational renewal is becoming increasingly challenging. Ensuring fair economic returns for farmers that reflect the true cost of food production and deliver a standard of living that is comparable with other sectors, while providing support for rural development, is important for sustaining agriculture and rural livelihoods. It is also becoming increasingly important to recognise and support the growing number of non-farming landholders to maximise the ecosystem services from their land.

- ***Dependency on farm payments.*** The agriculture sector in Ireland relies heavily on income support through farm payments and schemes under the EU Common Agricultural Policy (CAP). The potential for future reductions in CAP funding poses a significant concern for farmers and the sector's future stability and viability. Developing alternative models of support and diversifying income sources can help reduce the dependency on subsidies and create more resilient farming systems. Consumers are not currently paying the true costs of food production. Meanwhile, development of a circular bioeconomy could open up alternative revenue streams based on less impactful land uses.
- ***Technology and innovation adoption.*** The uptake of technological advances and innovation in Irish agriculture, and indeed globally, has been mixed. It is widely known that there is a diverse range of factors that influence the adoption of new technologies at farm scale, including farm and farmer characteristics and socio-psychological issues such as attitudes and social pressure (Daxini *et al*., 2019). These factors can hinder productivity improvements, efficiency gains and the adoption of sustainable practices. Encouraging research and development, providing training opportunities and promoting knowledge exchange, such as through the Teagasc Signpost Programme, can accelerate the adoption of innovative technologies in the sector. A whole-of-government and industry approach is also needed to provide appropriate regulations and incentives.
- ***Food waste.*** Growing, processing and transporting food all use significant resources such as land, water and energy. Food loss and food waste is generated at each stage along the food chain: primary production, manufacturing and processing, distribution and retail, restaurants and food services, and households. In Ireland, households are one of the biggest sources of food waste. Prevention is the best way to address food waste – the National Food Waste Prevention Roadmap (DECC, 2022) was developed in 2022 with the aim of halving Ireland's food waste by 2030.
- ***Challenges with scale.*** There are challenges with scale in developing and implementing policy in space and time. Policies and regulations are set nationally for application at farm scale, but environmental problems are not 'one size fits all' and often need to be tackled at local community, catchment and landscape scales in different ways. Context-specific priority actions for individual farmers and other landholders should align with strategic land use priorities for the relevant habitat type or landscape setting. There are also time lags between policy design, implementation and the environmental outcome, which means that far-sighted action that extends beyond the typical policy time frame is needed.

Agriculture and the economy

Over the last decade, triggered by the economic recession in the 2000s and the opportunities presented by the lifting of the dairy quotas in 2015, Ireland has pursued an ambitious strategy for growth in the agriculture sector. Three successive agriculture sector strategies have been developed and implemented: Food Harvest 2020 (DAFM, 2021b) and Food Wise 2025 (DAFM, 2015) were both focused on driving growth and economic output, while Food Vision 2030 (DAFM, 2021a) adopted a more integrated food systems approach that recognised the links between policies for food, climate, the environment and health. While these initiatives have brought significant economic benefits to the sector and the economy as a whole, the evidence shows that this growth has been associated with environmental impact. There are also significant hidden environmental, social and health costs in the agri-food system (Topic Box 10.2). There is a growing recognition in the sector, however, that this is unsustainable in the long term and needs to change.

Topic Box 10.2 The hidden costs of agri-food systems

The Food and Agriculture Organization of the United Nations (FAO), in its recent flagship report *The State of Food and Agriculture* (FAO, 2023), states that there are two sides to our agri-food systems: on the one hand they provide benefits to society through food, culture and jobs, but on the other hand they contribute to climate change and degradation of our natural resources, and they fail to provide healthy diets for all. The report attempts to uncover the hidden environmental, health and social costs that are embedded in our food systems, many of which are not reflected in market prices and are therefore unaccounted for. These hidden costs affect the wellbeing of current and future generations.

Understanding the hidden costs could bring to light the breadth of our sustainability challenges and inform policymakers about what changes are needed to transform how food travels from farm to table. FAO carried out a preliminary assessment using a true cost accounting approach and has used it to estimate these hidden environmental, social and health costs globally, and specifically for 154 countries worldwide including Ireland (FAO, 2023). The hidden environmental costs accounted for by the FAO included the impacts of nitrogen emissions to waters and ammonia emissions to air, the contribution of greenhouse gas emissions to climate change, and the costs of land use change and water use. The hidden social costs were associated with poverty and undernourishment, which can be significant in low-income countries but are usually less so in upper-middle and high-income countries such as Ireland. The hidden health costs came from unhealthy dietary patterns leading to obesity and non-communicable diseases and productivity losses, which negatively impact the economy.

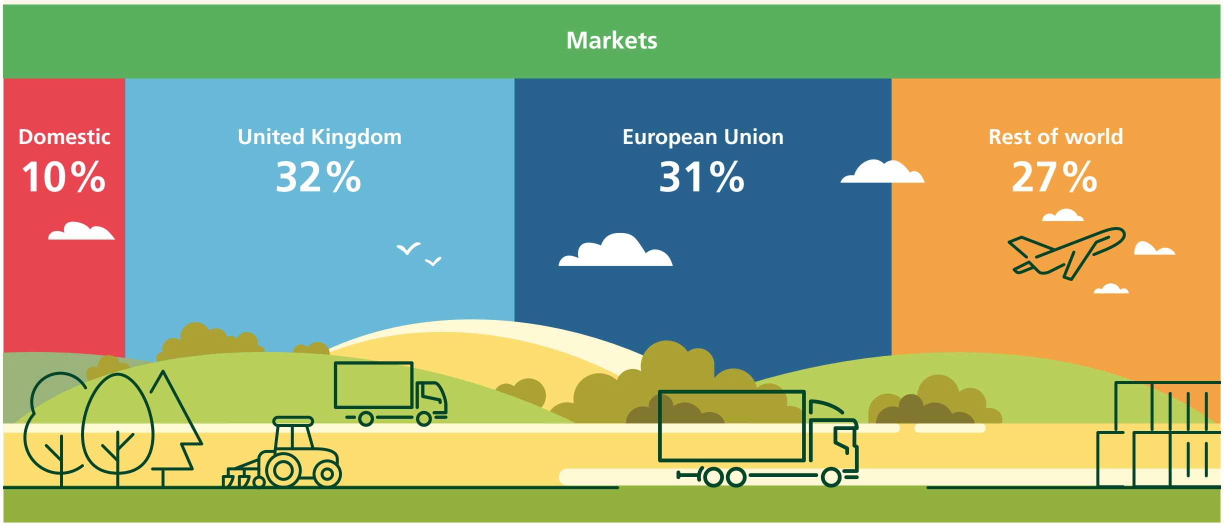
Globally, the report highlighted that hidden costs from agri-food systems reached US$12.7 trillion in 2020, which is equivalent to 10% of global gross domestic product (GDP). Even after taking uncertainty into account, the hidden costs were estimated to exceed US$10 trillion with a 95% probability. The hidden costs in Ireland's agri-food system were estimated at US$23 billion per year, or approximately 5% of GDP, just over half of which was attributed to the environmental costs, with the majority of the remainder associated with health costs. The report notes, however, that this was a phase 1 preliminary modelling exercise, using readily available data that did not include many other hidden costs and benefits and incorporated a high level of uncertainty (FAO, 2023). More detailed phase 2 analyses carried out at the national scale could take into account the specifics of each country. It was nevertheless a useful exercise to raise awareness of the magnitude of the challenges.

Addressing hidden environmental and health costs need not necessarily result in higher food prices according to FAO. For certain highly processed foods or foods with substantial environmental hidden costs, prices may indeed go up. However, prices of nutritious and whole foods without substantial processing are likely to become more competitive, and thus may be favoured by consumers. Such foods are also likely to contribute to a reduction in hidden health costs. Better policies and investment in more sustainable agri-food systems can reduce hidden costs by addressing their root causes.

Some 90% of the food produced by Ireland's farmers, fishers and agri-food companies is exported to over 180 countries worldwide, divided almost equally among the UK, EU and international markets (Figure 10.1). In 2022, agri-food exports were worth €16.7 billion (€18.8 billion including non-edible items), an increase of €3 billion (22%) on 2021 (Bord Bia, 2023). The food and drink sector accounted for 38% of all exports from Irish-owned firms in 2020. The agri-food sector sustains 170,400 jobs (7% of total employment). Beyond direct employment, the estimated output multipliers are around 2.5 for beef production and 2.0 for dairy production and food processing, demonstrating the importance of the sector in the wider rural and local economy (DAFM, 2022a).

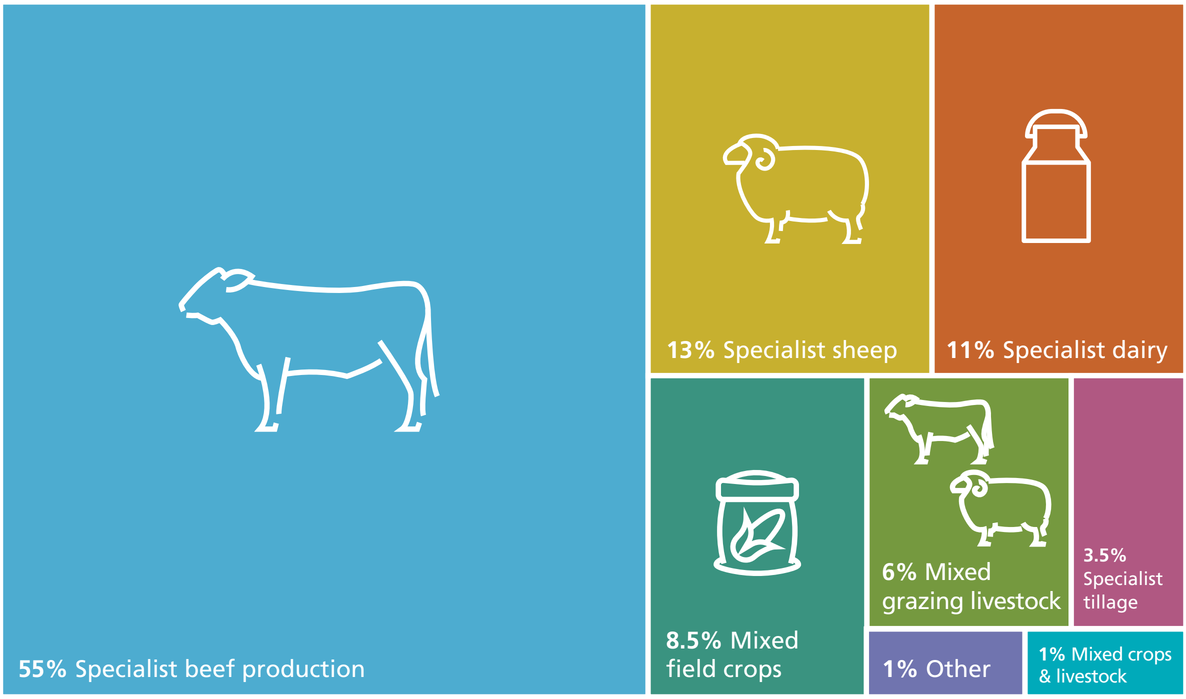
The latest agricultural census data for 2020 (CSO, 2021) show that there are 135,000 farms in Ireland, encompassing 4.5 million hectares (ha) of agricultural area, the vast majority of which is grassland (4.15 million ha). Just over half the farms are classified as specialist beef (55%), while specialist dairy accounts for 11% of farms, specialist sheep 13% and specialist tillage a little under 4% (Figure 10.2), with the remainder being mixed farming. The average farm size nationally is 33 ha (about 80 acres), although farms in the south-east of the country are larger (44 ha). Dairy farms are the largest of all farm types (with an average size of 65 ha).

Figure 10.1 Proportion of Irish food produced for the domestic and export markets, 2022



Source: Adapted from DAFM, 2022a

Figure 10.2 Farms classified by farm system type, 2020

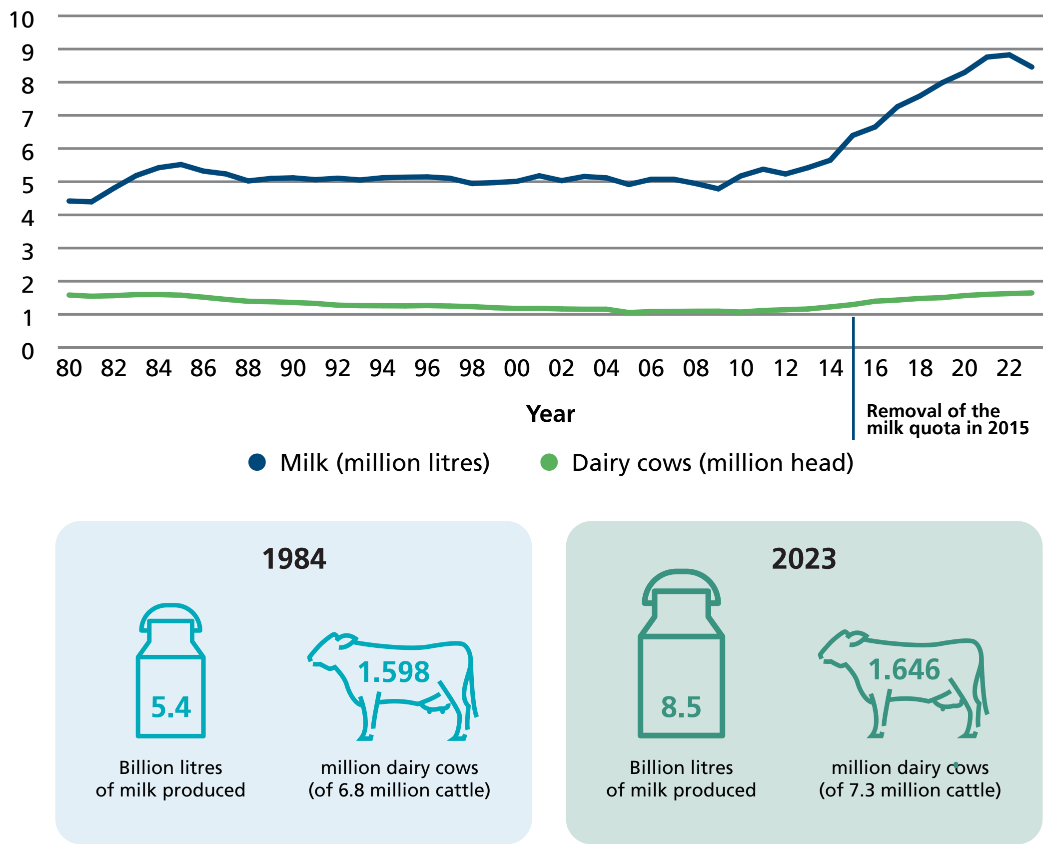


Source: Adapted from CSO, 2021

There were 7.3 million cattle in Ireland in 2023, of which 1.6 million were dairy cows. In the 10 years from 2013 to 2023, dairy cow numbers increased by 41% with a corresponding increase in milk production of 56%. This reflects the removal of the milk quota in 2015 and the national ambition to expand milk production under Food Harvest 2020 and Food Wise 2025, following 30 years of the industry being constrained at 1984 production levels.

While the number of dairy cows in 1998 (1.598 million) was similar to that in 2014, the output per cow in 2014 was 48% more than it was in 1984 (CSO, 2021). Figure 10.3 compares dairy cow numbers and milk production in 1984 and 2023. Between 1984 and 2014, the output per hectare increased by 54% to 10,500 litres (Donnellan *et al.*, 2015).

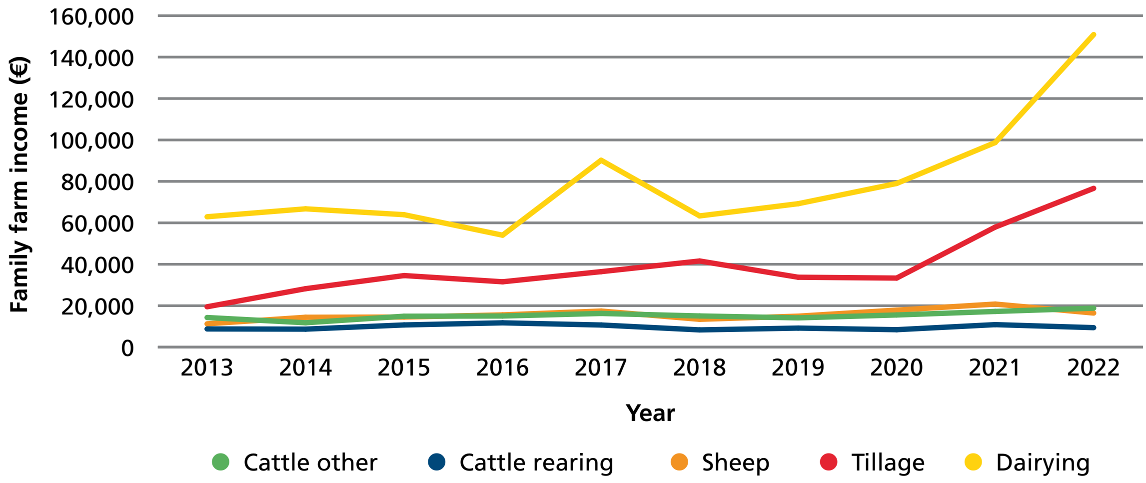
Figure 10.3 Dairy cow numbers and milk production, 1984-2023



Source: Adapted from CSO, 2021

The National Farm Survey, which is carried out annually by Teagasc, provides an overview of the economics of farming at the farm scale. Family farm incomes vary considerably by farm system. Dairy and tillage systems are the most profitable and are financially viable, with increasing trends in income in recent years (Figure 10.4); however, they represent only 11% and 4%, respectively, of Irish farms. In stark contrast, however, incomes on beef cattle and sheep farms, which are the dominant farming systems in Ireland, remain low and relatively unchanged. Small increases in output value are being offset by rising input costs. Direct payments and other payment supports from agri-environmental and other schemes continue to play a critically important role in supporting family farm incomes, in particular on cattle rearing and sheep farms (Teagasc, 2023b).

Figure 10.4 Trends in annual family farm income by farm system, 2012–2022



Note: Preliminary estimates indicate significant reductions in family farm incomes in 2023 on dairy and tillage farms, back to an annual average of €59,000 and €30,000, respectively (Buckley *et al.*, 2023).

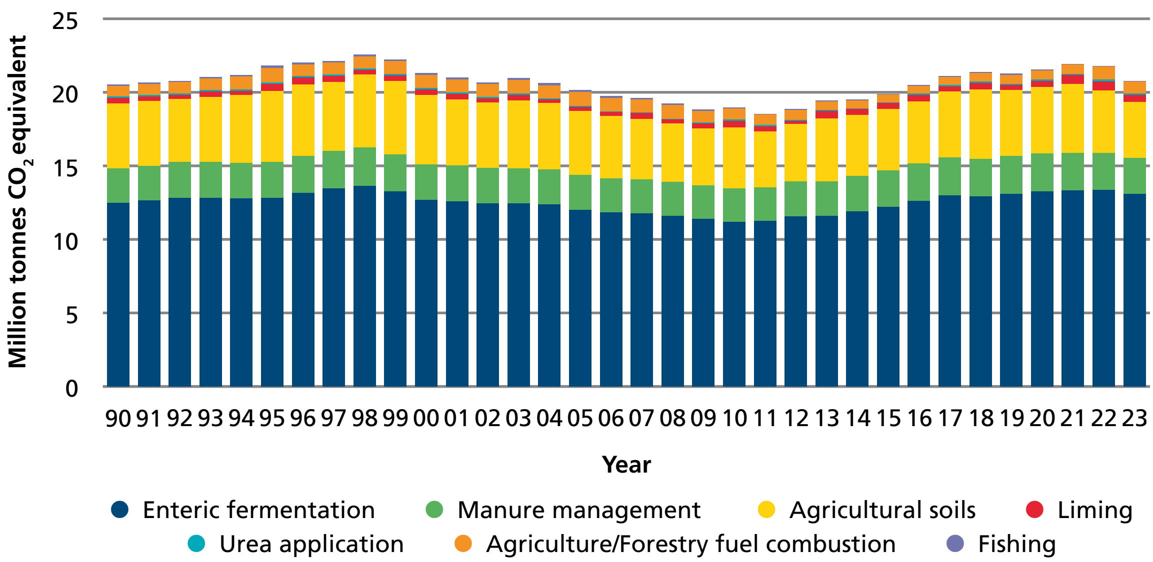
Source: Teagasc, 2023a

2. The impacts of agriculture on the environment

Greenhouse gas emissions

The agriculture sector accounted for 38% of Ireland's national greenhouse gas emissions in 2023 (EPA, 2024a). Trends are largely determined by the size of the national cattle herd and the application rates of nitrogen fertilisers and have been increasing over the last decade as the sector has grown (Figure 10.5). While dairy cattle numbers increased by 2.2% annually on average over the period 2018–2023, the increases have been partially offset by the numbers in other cattle categories that have decreased by 0.6% annually on average over the same period. From 2018 to 2023, an annual average decrease of 3.9% in fertiliser sales was achieved which is positive, however, these lower levels of fertiliser nitrogen use must be maintained.

Figure 10.5 Greenhouse gas emissions from agriculture, 1990–2023



Source: EPA, 2024a

Over the last three decades, emissions were at their lowest in 2011 at 18.5 Mt CO_2 eq (megatonnes of carbon dioxide equivalent), associated with a decrease in the national cattle herd to 6.43 million animals and a decrease in nitrogen fertiliser application to just under 300,000 tonnes. Over the following decade to 2021, emissions increased with the removal of milk quotas and the growth in the sector under Food Harvest 2020 and Food Wise 2025, but since then total emissions have started to decrease. In 2023, the national cattle herd comprised 7.25 million animals, and under 281,000 tonnes of nitrogen fertiliser were applied; in 2023 the national greenhouse gas emissions from the sector were 20.8 Mt CO_2 eq.

Emissions from agriculture include carbon dioxide, nitrous oxide and methane. Of these, methane is the most potent at trapping heat in the atmosphere, and it is the most prevalent in Ireland due to the scale of our livestock sector (Table 10.1).

Table 10.1 Emissions from agriculture and changes over time

Greenhouse gas	Agricultural activity	Contribution to agricultural emissions in 2023 and trend since 1990
Carbon dioxide	Emissions from liming, the application of urea fertiliser and fuel combustion	6.6% of agricultural emissions Increase of 14.3%
Nitrous oxide	Emissions from manure management and agricultural soils	21.3% of agricultural emissions Decrease of 11.9%
Methane	Emissions from enteric fermentation and manure management	72.1% of agricultural emissions Increase of 4.8%

Source: EPA, 2024a

Under the national Climate Action Plan 2024 (DECC, 2023), the agriculture sector must achieve a 25% reduction in greenhouse gas emissions by 2030. The total emissions from the sector are projected to decrease by between 1% and 18% over the period 2022–2030, depending on the measures that are implemented. Savings are projected from a variety of measures, including limiting usage and switching to different chemical fertilisers, methane reduction measures, and water table management (EPA, 2024b). Significant reductions in chemical nitrogen fertiliser use have already been achieved, from 408,000 tonnes in 2018 to less than 281,000 tonnes in 2023. However, it is projected as part of the modelling carried out to support the Teagasc MACC 2023 that, under the current policy framework, dairy cow numbers are likely to increase between 2022 and 2030 (Lanigan *et al*., 2023), which will add additional emissions. These will be offset to some degree by further projected declines in beef cow numbers and an overall slight decline in the national herd.

The latest EPA projections suggest that, based on best available knowledge, there is scope to reduce emissions by 18% by 2030 (compared with 2018), through the full implementation of the measures set out in the Climate Action Plan 2024 and the Ag Climatise roadmap[1] produced by the Department of Agriculture, Food and the Marine (DAFM). This means the sector is not on track to meet the 25% emission reduction target by 2030. Further measures still need to be identified and implemented to achieve this goal. Diversification measures are included in the Teagasc MACC 2023, which could save a further 1.5 Mt CO_2 eq by 2030 according to Teagasc; however, policy levers need to be put in place so that the savings proposed can be realised and maintained.

1 www.gov.ie/en/publication/07fbe-ag-climatise-a-roadmap-towards-climate-neutrality/ (accessed 2 September 2024)

The agriculture sector is also a significant contributor to emissions attributed to the Land Use, Land Use Change and Forestry (LULUCF) sector. The LULUCF sector is a net source of emissions in Ireland, in contrast to many EU Member States, where the LULUCF sector is a net remover of CO_2 from the atmosphere. This is as a result of the drainage of grasslands on organic/peaty soils and the exploitation of peat for energy and horticultural uses. Approximately 8% of the Irish grassland area is underlain by organic/peaty soils and is therefore a source of greenhouse gas emissions. Recent research by Teagasc (Tuohy *et al*., 2023) suggests that not all of these grassland soils are effectively drained in practice, which has led to a revision of emission estimates in the most recent national emission inventory estimates. Further research being conducted by the National Agricultural Soil Carbon Observatory[2] will lead to further refinements to emission estimates in future agriculture sector emission inventories. Land and soil are discussed in more detail in Chapters 5 and 6.

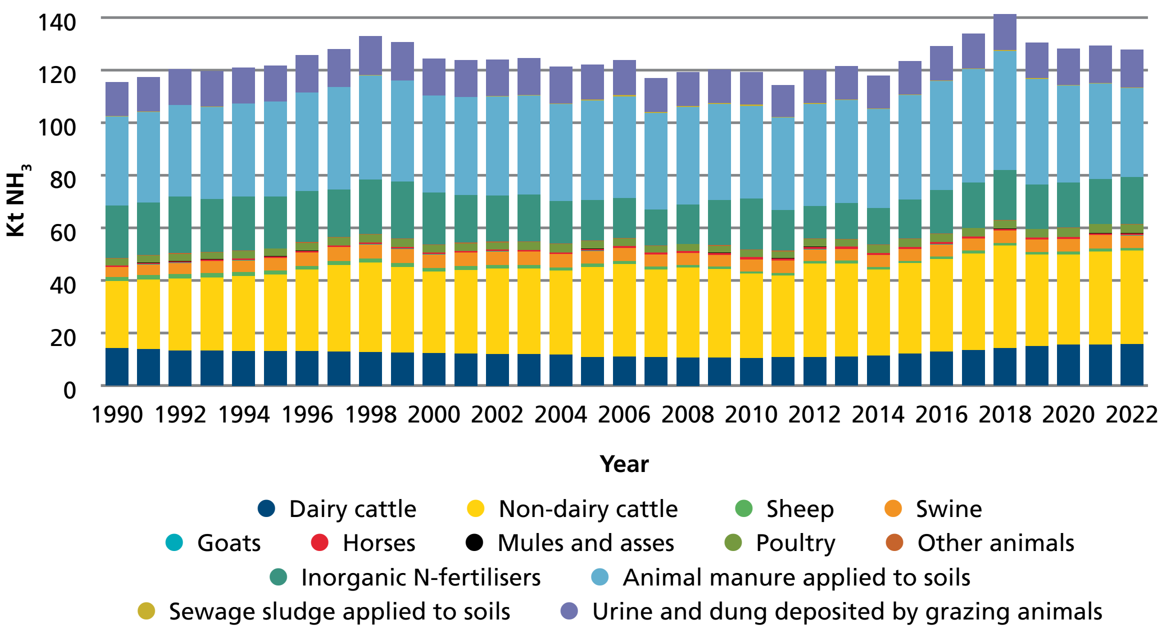
The LULUCF Regulation ((EU) 2018/841) was revised in 2023 and has set land-based net carbon removal targets for the EU that must be implemented via national reduction targets.

Meanwhile, meeting Ireland's 2050 climate neutrality ambition will necessitate the land sector becoming a strong net remover of CO_2 from the atmosphere (Haughey *et al*., 2023). The implied land transformation and farm diversification, including substantial afforestation within Ireland's grassland-dominated landscape, water table management and restoration of peat soils, will require consistent and sustained action through time, guided by a strategic vision for the agriculture and land use sector.

Ammonia and other air pollutants

The agriculture sector is the largest source of ammonia in Ireland (Figure 10.6), accounting for 99% of the national total in 2022 (EPA, 2024c). Total national emissions in 2022 were 128.6 kilo tonnes[3], which is above the current national emission reduction commitment. The trends in ammonia emissions are similar to those of other gaseous emissions from the sector, as they are largely determined by the size of the national cattle herd and the amounts and type of nitrogen fertiliser applied.

Figure 10.6 Trends in ammonia emissions from agriculture, 1990–2022



Source: EPA, 2024c

2 www.teagasc.ie/environment/climate-change--air-quality/soil-carbon/national-agricultural-soil-carbon-observatory (accessed 2 September 2024).

3 One kilo tonne (kt) is 1,000 tonnes.

Ireland's national emission reduction commitment for ammonia for 2020-2029 under the National Emission Reduction Commitments (NEC) Directive (EU 2016/2284) was a 1% reduction compared with a 2005 baseline level. As emissions in 2020, 2021 and 2022 were 3.2%, 4.2% and 3.0% higher, respectively, than the baseline level, Ireland is non-compliant with the emission reduction commitment for 2020-2029. Ireland has not met international emissions commitments for the majority of years over the last decade. In 2023, the European Commission consequently served Ireland with an infringement notice for non-compliance with the directive.[4] Projections of ammonia emissions suggest that achieving the 2030 emission reduction commitment is possible if all measures are adopted, which will require significant policy levers (EPA 2024d). These measures include reductions in chemical fertiliser use, increased use of protected urea, and increased use of low-emission slurry systems.

Agriculture is also a source of a number of other transboundary air pollutants, including nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOCs) and particulate matter, which have local, regional and transboundary effects. While the contribution of agriculture is smaller than other sources, for example power generation, transport and residential fuel combustion, the sector nevertheless has a role to play in reducing these pollutants.

NO_x and NMVOCs are associated with synthetic fertiliser application, urine and dung deposited by grazing animals, and the application of manures to soils. Agriculture is the second largest source of NO_x emissions in Ireland (after transport), contributing 36.4% of the total in 2022, and the largest source of NMVOC emissions, accounting for 39.1% of the national total in 2022. There are national emission reduction targets in place for each of these pollutants. Ireland was compliant with the 2020 emission reduction commitment for NO_x and, after adjustment with flexibility mechanisms, for NMVOCs (EPA, 2024d).

Grazing in the Burren.

4 ec.europa.eu/commission/presscorner/detail/EN/inf_23_142 (accessed 31 May 2024).

The agriculture sector's contributions to emissions of particulate matter arise from manure management, fertiliser application to soils, and both on-farm and off-farm handling and transport of bulk agricultural products. Agriculture contributes 8.6% of total suspended particulate emissions, which includes 7.9% of total national emissions of fine particulate matter <2.5 µm in diameter ($PM_{2.5}$). National emission reduction targets are in place for $PM_{2.5}$ for 2020 and 2030 under the National Emission Reduction Commitments (NEC) Directive. Ireland currently projects compliance with the targets if the adoption of all measures is achieved. Air pollution is further discussed in Chapter 2.

Biodiversity

Biodiversity in the food system provides critical ecosystem services such as creating and maintaining healthy soils, pollinating plants, controlling pests and providing habitat for wildlife, plants, fish and domesticated species that are vital to food production and sustaining agricultural livelihoods. Biodiversity makes food production systems more resilient to external shocks and stresses, such as droughts, flooding and temperature extremes, which will all become more frequent with climate change. Diverse production systems, for example using multi-species swards and different crop and animal species and breeds, and integrating the use of crop, livestock, forestry and aquatic biodiversity in landscape systems, help to promote resilience, improve livelihoods and support nutritious, secure food production (FAO, 2019). A large part of our landscape and our biodiversity has been shaped over millennia by agricultural activities, and agricultural practices play an important role in managing and protecting them. For further discussion on nature and biodiversity, see Chapter 7.

The pressures on biodiversity from farming include land use change such as land drainage and reclamation of wetland and key habitats, such as species-rich and semi-natural grasslands, and other habitats such as scrub; air and water pollution; overuse of external inputs such as fertilisers and chemicals; and intensification of farming systems that lead to a loss of biodiversity. Ireland's most recent formal report on the condition of our protected habitats and species outlined that 85% of our protected habitats were at unfavourable conservation status (NPWS, 2019), almost half of which show ongoing declines, including marine, peatland, grassland and woodland habitats. When it comes to protected species, 57% were deemed to be currently at favourable conservation status, with 72% stable or improving. Of our bird species, 63% were found to be declining, particularly breeding waders and upland and farmland birds (Gilbert *et al.*, 2021).

Three key biodiversity indicators associated with agriculture in Ireland illustrate the challenges (NBDC, 2023):

1. One in every three bee species is threatened with extinction.
2. Thirty-seven species of bird are of high conservation concern, including species such as curlew, hen harrier, twite and yellowhammer. There has been a 59% decline in the hen harrier population since 2000, with just 85 breeding pairs recorded in the most recent national survey (Ruddock *et al.*, 2024), and a 98% decline in the curlew population since the 1980s, with 104 breeding pairs recorded in the most recent national breeding survey (Colhoun *et al.*, 2022). The corn bunting became extinct around 2000, and the once widespread corncrake is largely restricted to the western extremities of counties Donegal and Mayo.
3. Two of our iconic freshwater fish, the Atlantic salmon and the European eel, have suffered catastrophic population declines, and the freshwater pearl mussel, Ireland's longest-living animal, is facing extinction.

A yellowhammer, one of 37 bird species of high conservation concern

In 2023, the Court of Justice of the European Union ruled that Ireland has failed to fulfil its obligations under EU biodiversity conservation laws (CJEU, 2023). While the case was based on the situation in Ireland in January 2019 and progress has been made since then, with, for example, the renewal of the National Parks and Wildlife Service, the ruling highlighted that there is significant work to do to improve biodiversity outcomes.

A prioritised action framework for the period 2021–2027 has been published (NPWS, 2021), which sets out and prioritises the measures that are needed, with links to funding mechanisms, to 'maintain and restore, at a favourable conservation status, natural habitats and species of EU importance, while taking account of economic, social and cultural requirements and regional and local characteristics'. The total cost of the measures that are required is estimated to be €1.14 billion over the period 2021–2027 (NPWS, 2021).

In 2023, the Citizens' Assembly on Biodiversity Loss (see Chapter 7) agreed on 159 recommendations centred on the need to 'take prompt, decisive, and urgent action to address biodiversity loss and restoration and to provide leadership in protecting Ireland's biodiversity for future generations' (Citizens' Assembly, 2023). In relation to agriculture, the group agreed 17 specific recommendations, recognising that biodiversity is currently undervalued in our agriculture production system and policy framework and that, as the custodian of the land, the agriculture industry can make the most impact on conserving and restoring biodiversity. The agriculture recommendations focused on key themes such as the need for improved, more ambitious, joined-up policies that are grounded in a community-led, results-based ethos; greater emphasis on managing soil health, growing the organic sector and farming more in tune with nature; and the need for education, awareness and deeper engagement with consumers.

Water quality

Slightly over half (54%) of Ireland's surface waters have the good or better ecological status that is needed to support healthy aquatic ecosystems. Under the Water Framework Directive (2000/60/EC), all Member States are expected to have achieved at least good ecological status to support healthy waters in all water bodies by 2027 at the latest. Agriculture is the most widespread pressure causing the impacts – the latest assessment to 2021 found that just over 1000 water bodies were affected by agricultural activities, representing little change since the previous assessment.

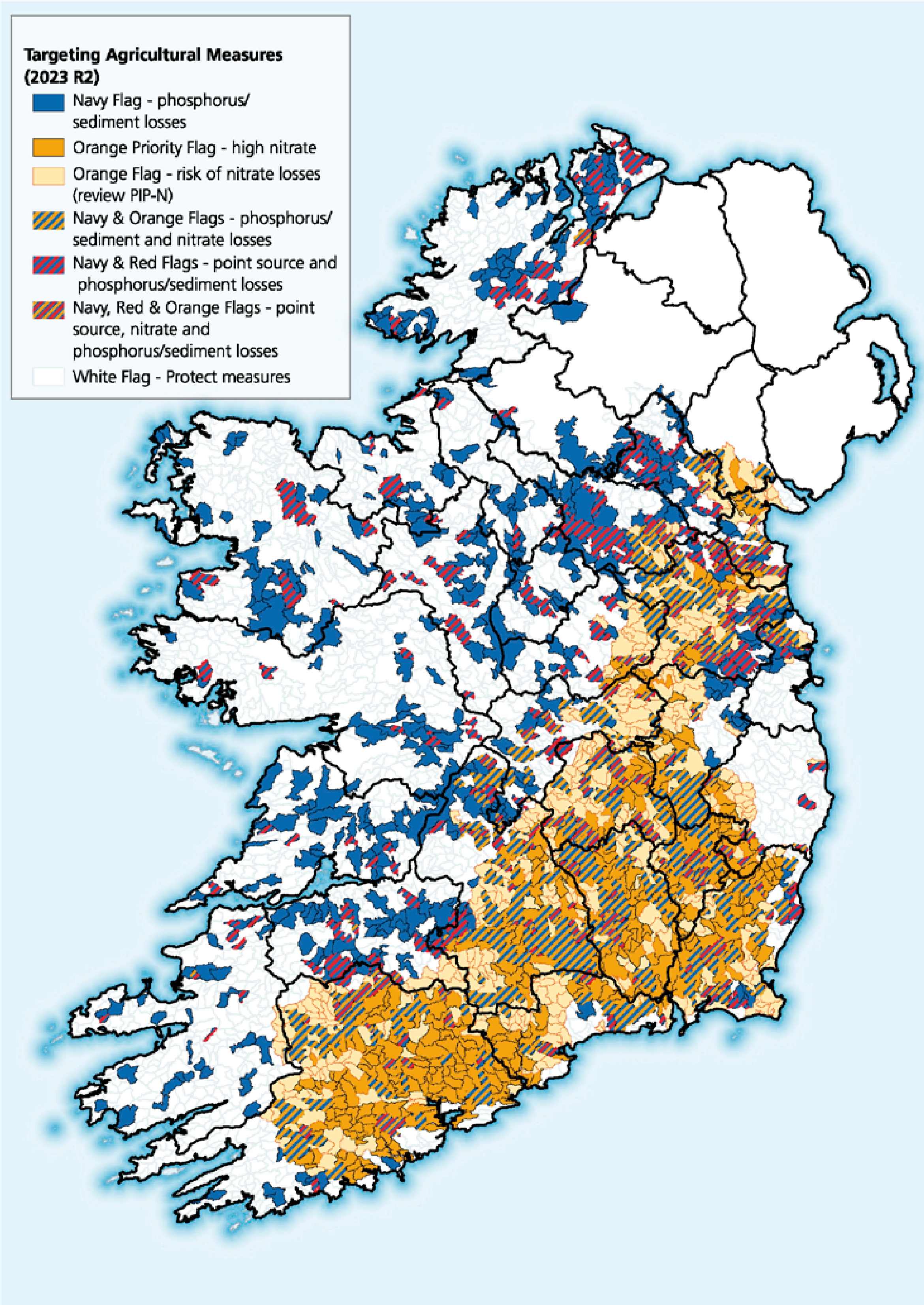
The key water quality issue arising from farming is the loss of excess nutrients (nitrogen and phosphorus) from artificial and organic fertilisers to waters. This leads to eutrophication or the excess growth of plants and algae, especially in our estuaries. Nitrate concentrations are too high to protect aquatic ecosystem health in 42% of river sites and in 17% of estuarine and coastal water bodies nationally, particularly in a number of key catchments of concern in the south and south-east (EPA, 2024e). The ecologies of estuaries and coastal waters are particularly sensitive to nitrogen, and the scale of the declines in the quality of these waters since the early 2010s, when nitrogen concentrations were at their lowest in the last three decades, is a significant concern.

Elevated nitrogen concentrations in drinking water can also cause a public health issue, although the nitrate standard to protect drinking water quality is less stringent than it is for protecting aquatic ecosystem health. In 2023, 12 public water supplies had exceedances of the nitrate standards (EPA, 2024f).

The main source of nitrogen in our waters is leaching from mineral and organic fertilisers and manures from agricultural activities. Substantial reductions in nitrate leaching will be required in some catchments in the south-east to bring nitrogen concentrations back to where they need to be to support healthy aquatic ecosystems (EPA, 2021). The key types of measures involve reducing the nitrogen surplus, i.e. excess nitrogen lost to the environment, either by increasing the efficiency of nitrogen use so that less is available to leach and/or by reducing the overall nitrogen loading on farm. Measures need to be targeted in the freely draining soils in the catchment areas of water bodies where nitrogen is a pollutant of concern. The EPA has produced a national map to help target agricultural measures to protect and restore water quality (Figure 10.7). The EPA has also developed nitrogen pollution impact potential maps[5], which are freely available and are being used by the Local Authority Waters Programme (LAWPRO) and the Agricultural Sustainability Support and Advice Programme (ASSAP) to identify the critical source areas, or hotspots, for targeting measures locally within key areas.

5 www.catchments.ie/next-generation-pollution-impact-potential-maps-launched/ (accessed 31 May 2024).

Figure 10.7 Targeting agricultural measures to protect and restore water quality



Glencar Waterfall, Co. Leitrim

Phosphorus concentrations are too high in 28% of rivers and 36% of lakes, which in turn have an impact on the ecological health of our freshwaters. Phosphorus levels and the biological quality of our rivers and lakes have generally been stable in recent years; water quality is improving in places, but this is being offset by declines elsewhere. The sources of phosphorus on farm include mineral and organic fertilisers and manures, which run off when it rains, often in association with excess fine sediment. The key measures are eliminating the point source losses from farmyards and intercepting diffuse run-off pathways from fields that deliver the pollutants to waters. The EPA has produced phosphorus pollution impact potential maps[6] that show where the risky areas are for phosphorus losses from agriculture; these are currently being used to target measures.

The agriculture sector also has an important role to play in keeping the physical condition of aquatic habitats in the beds and banks of water bodies stable and healthy. Excess fine sediment arising from run-off, bank erosion and in-stream channel maintenance can reduce the light availability and create poor habitat conditions for some species, as well as causing difficulties for drinking water treatment processes. Physical habitat conditions are also altered with drainage, channel and vegetation maintenance. Good management practice includes keeping bankside or riparian vegetation and stream channels intact to provide shade, food sources and habitat diversity. The Farming for Nature initiative has published a best practice guideline for watercourse management[7] for farmers, and an increasing number of projects and results-based payment schemes are now supporting farmers to implement best practice.

The careful management of chemicals, including herbicides, pesticides and veterinary medicines (e.g. sheep dip), is also critical. They are toxic to aquatic life, and a tiny amount can affect drinking water quality. Teagasc has produced guidance on pesticide use for farmers,[8] which highlights that a single drop of pesticide lost to a typical small stream can be enough to breach the legal limit for pesticides in drinking water along 30 km of its length. The number of public water supplies with pesticides detected increased from 17 in 2022 to 23 in 2023. Further work is needed to engage with pesticide users in water catchments to ensure that these substances are used safely and in accordance with the manufacturers' recommendations. The herbicide MCPA (2-methyl-4-chlorophenoxyacetic acid), which is often used to control rushes, ragwort and thistles, continues to cause the biggest problems (EPA, 2024f). The new Drinking Water Regulations,[9] which came into effect in Ireland in 2023, include a requirement to conduct risk assessments and implement measures in these water catchments to protect drinking water quality at source, before it reaches the abstraction point. Innovative schemes such as the 'Let it Bee'[10] campaign by the National Federation of Group Water Schemes is helping to raise awareness in drinking water catchment areas.

6 www.catchments.ie/next-generation-pollution-impact-potential-maps-launched/ (accessed 31 May 2024).

7 www.farmingfornature.ie/your-farm/resources/best-practice-guides/watercourse-management/ (accessed 31 May 2024).

8 www.teagasc.ie/media/website/crops/crops/2015_08_FarmersProfessionalUsers_LowResWeb.pdf (accessed 31 May 2024).

9 S.I. No. 99/2023.

10 nfgws.ie/let-it-bee-project/ (accessed 31 May 2024).

3. Key strategies, plans and programmes

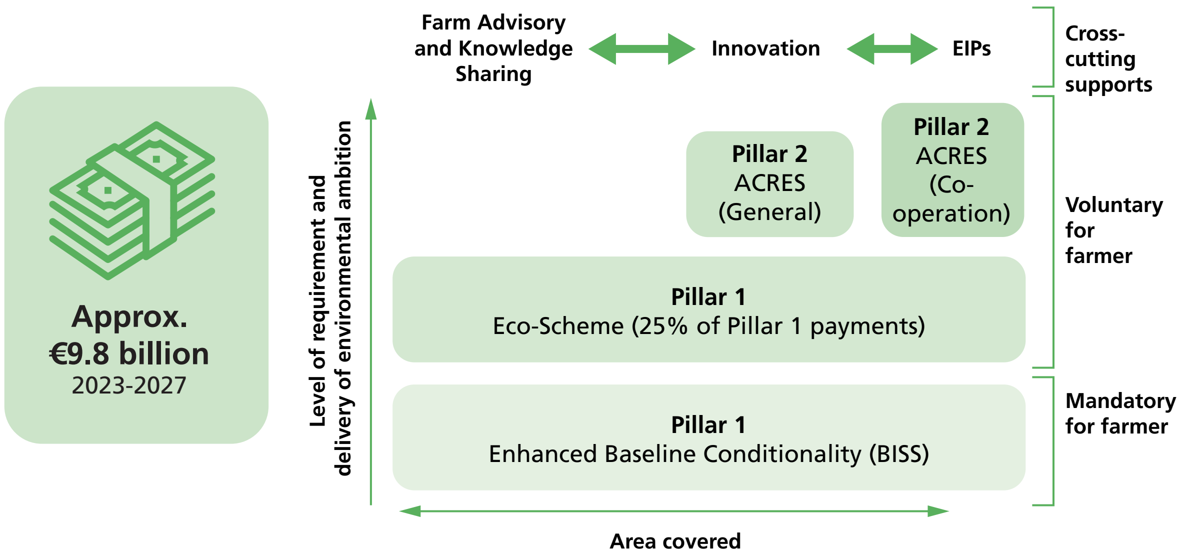
The European Green Deal

The European Green Deal is a set of policy initiatives by the European Commission that aims to make the EU climate neutral by 2050. It has had a significant influence on recent policies underpinning the agri-food sector in Europe and in Ireland, including the CAP, and various other strategies and policies designed to improve environmental outcomes.

The most significant of these initiatives for agriculture is the Farm to Fork Strategy (EC, 2020), which has been in place since 2020 and aims to reduce the environmental and climate impact of primary production while ensuring fair economic returns for farmers. Several other plans and strategies that are in place, in development or under consideration, such as the Zero Pollution Action Plan, the EU Biodiversity Strategy for 2030, the EU Nature Restoration Law, the EU Soil Health Strategy for 2030 and the Integrated Nutrient Management Action Plan, are related plans that share the underlying objective of achieving improved environmental conditions across Europe. Three of the key objectives across these international plans and strategies, which have followed through into Irish plans and strategies, are to reduce both nutrient and chemical pollution from agricultural practices and to increase biodiversity on farms.

Many of these plans and strategies will be very challenging to implement, and there are significant concerns across the EU agriculture sector about how they will impact farming. Some ambitious proposed plans and policies, for example the plan to reduce the use of chemical pesticides in the EU by 50% by 2030 and the Nature Restoration Law, have faced significant pushback and/or amendments at the final approval stages. It is important that farmers are properly supported in adjusting to these challenges and that there is a just transition to a healthy EU environment in the long term.

Figure 10.8 The green architecture of the Common Agricultural Policy 2022–2027 as applied in Ireland



EIP, European Innovation Partnership

Source: James Moran, Atlantic Technical University, 2024

The Common Agricultural Policy

The CAP is a system of subsidies and support programmes for agriculture funded from EU and national budgets. It was originally developed in 1962 as a partnership between agriculture and society, and between what was then European Economic Community and its Member States' farmers. The main aims of the policy at that time were primarily to support farmers financially to deliver security of food supply for European citizens. Since 1992, the CAP has increased the focus on the use of these public funds to deliver environmental outcomes as well as food security. Current subsidies are conditional on achieving good agricultural and environmental conditions on a farm – three of the conditions explicitly relate to climate, biodiversity and general environmental policy objectives.

Ireland's current CAP Strategic Plan 2023–2027 (DAFM, 2022b) includes the provision to support environmental protection and climate change action through the new green architecture (or structure of the funding support streams), with an emphasis on payments for results and performance (Figure 10.8). The total CAP budget allocation is €9.8 billion over 5 years, which includes significant national funding support of €2.3 billion to support rural development measures, including agri-environmental measures. The plan aims to achieve a higher level of climate and environment ambition through the new Agri-Climate Rural Environment Scheme (ACRES), a new eco-scheme, and significant growth in the organic farming sector. Measures to support the development of the arable sector, to protect wetlands and peatlands, and to further develop the Agricultural Knowledge and Innovation System will also be implemented.

While the new green architecture of the CAP offers significant opportunities to raise the overall environmental performance of the agriculture sector, it is essential that measures introduced under the new CAP can show quantifiable and verifiable environmental gains. Agri-environmental measures need to be adapted and adequately targeted to a range of farm intensities and physical settings across the country to ensure their attractiveness and effectiveness for achieving the required outcomes. However, the new CAP alone will not provide all of the solutions to the growing pressures from agriculture on water, climate, air pollution and biodiversity. A whole-of-sector approach is required in which the whole industry (from livestock and land management to the food industry, agricultural education and government) is closely involved in establishing effective and accountable programmes and initiatives that will deliver on environmental targets and sustainability but also underpin on-farm efficiencies and market access. This challenge cannot be underestimated and will need collaboration right across the industry.

Food Vision 2030

In 2021, DAFM published a new 10-year strategy for the agri-food industry called Food Vision 2030 (DAFM, 2021a). The strategy aims to adopt an integrated food systems approach to establish Ireland as a world leader in sustainable food systems by 2030. The four pillars of the strategy consider climate, resilience, food safety and innovation (Figure 10.9). The strategy has the objective of achieving a climate-neutral food system by 2050, with verifiable progress achieved by 2030, encompassing emissions, biodiversity and water quality, as well as a range of other targets for forestry, fisheries, organic farming and food waste.

The monitoring and implementation process of Food Vision 2030 is key to ensuring delivery of the strategy and is a key part of implementing measures to improve water quality, greenhouse gas emissions, ammonia emissions and biodiversity. Tracking and frequent reporting on progress will be critical for building confidence and for enabling adaptive management approaches should adequate progress not be made.

Figure 10.9 Food Vision 2030: Four missions

Source: DAFM, 2021a

The National Biodiversity Action Plan

The fourth National Biodiversity Action Plan was published in 2024 and is a whole-of-government, whole-of-society plan to conserve and restore biodiversity. The plan recognises that, through the ecosystem services it provides, biodiversity underpins the sustainability and productivity of the agricultural, forestry and fisheries sectors, as well as the many businesses and industries that depend on the natural environment or on natural raw materials. The plan includes a number of targets relevant to agriculture, with associated actions to deliver the outcomes, and indicators for monitoring progress. Some examples of the relevant actions and their targets include:

- Incentivising habitat creation and maintenance on farm through the CAP Strategic Plan 2022–2027 and the associated rural development plan. Relevant schemes include the results-based payment agri-environmental scheme (ACRES) and associated farm sustainability plans; Farming for Nature initiatives; and initiatives in Northern Ireland through the Shared Island Fund. The targets include optimising opportunities under agriculture and rural development, forestry and other relevant policies to benefit biodiversity by 2027 and having at least 4% of agricultural land with biodiversity-rich landscape features by 2030.
- Supporting farmers' transition to organic farming, with the aim of increasing the land area under organic farming to 10% by 2030.
- Implementing existing and new measures to reduce chemical pesticide use, with the aim of reducing the use and risk of pesticides by 50% by 2030.
- Having multiple institutions working together to develop measures and support tools to maintain and enhance biodiversity and the ecosystem services associated with agro-ecology systems, including high nature value farming and farmland, by 2027.

Water Action Plan 2024

Ireland's Water Action Plan 2024, which was developed and updated in accordance with the criteria set out in the Water Framework Directive, draws together the programme of measures for agriculture and all the other sectors that are having an impact on water quality. In summary, the key measures for agriculture are:

- implementing the Nitrates Action Programme
- developing and implementing an enhanced local authority agricultural inspections programme with oversight from the EPA
- continuing the LAWPRO and ASSAP approaches to addressing specific water quality issues in an increased number of priority areas for action
- providing a new funding mechanism for farmers for on-farm measures to protect and restore water quality (the Farming for Water project)
- implementing the ACRES agri-environmental schemes and the eco-schemes as required under the CAP Strategic Plan
- Teagasc developing an online web-based tool to deliver farm sustainability plans.

It is critical that all these measures are implemented in full. With the significant water quality challenges that remain across a range of pressures, it is very unlikely that the targets for achieving at least good ecological status in all water bodies by 2027 will be met.

The Nitrates Action Programme

The Nitrates Action Programme, incorporating the Good Agricultural Practice for Protection of Waters Regulations (S.I. 113/2022), is the primary instrument in Ireland for managing the impacts of agriculture on water quality. Nationally, the water quality evidence shows that four successive Nitrates Action Programmes have not delivered the desired water quality outcomes. The Teagasc Agricultural Catchments Programme was established in 2009 to assess the effectiveness of the Nitrates Action Programme measures in six demonstration catchments that have intensive monitoring, research and farm advisory programmes in place. With water quality remaining unsatisfactory in four of the six catchments (Mellander *et al*., 2022), it is clear that there are still gaps that need to be addressed. Measures have been further strengthened in the fifth Nitrates Action Programme for the period 2022–2025 (DHLGH, 2022).

A commitment was made in the fifth Nitrates Action Programme to conduct an interim review of water quality in 2023 and to apply additional measures if specific water quality criteria set out by the Commission (Decision (EU) 2022/696) were not met. The outcome of the assessment was that additional measures are required over much of the country (DAFM, 2023a; EPA, 2023). The additional measures must include a reduction in the maximum allowable loading of organic manure from 250 kg/ha to 220 kg/ha on farms that have a derogation to farm more intensively than advised in the EU Nitrates Directive (91/676/EEC). The derogation reduction has been in place since 1 January 2024 and further measures are under consideration as part of the interim review.

Under the fifth Nitrates Action Programme, the EPA has been given strengthened responsibilities in the oversight of the local authority agriculture inspections regime. A national agricultural inspections programme is being developed and implemented in a phased approach that sets out inspection priorities and expectations with regard to numbers of farms inspected. Inspections will be risk based and targeted and there will be a stronger focus on enforcement and follow-up. A training programme is also being developed.

The Teagasc marginal abatement cost curves

Teagasc has published, and is continuing to update, MACCs, which quantify, using the best available research, the economic costs and the environmental benefits of a range of mitigation measures for ammonia (Buckley *et al*., 2020) and greenhouse gas (Lanigan *et al*., 2023) emissions. For ammonia, the key findings are that 80% of the mitigation potential can be achieved by the full implementation of low-emission slurry spreading techniques and by switching to using protected urea. For greenhouse gas emissions, improvements in carbon sequestration through land use management and land use change, changing fertiliser type, improving the genetic breeding of the dairy herd and the use of feed additives are the key actions. Full implementation of these measures will be required to meet the overall targets.

4. Supporting farmers to make changes

There are many projects, schemes and other mechanisms in place that are working to support farmers to make the necessary changes. Many positive actions are being carried out on farm, but it is as yet unclear whether collectively they will be adequate to achieve the level of environmental improvement that is required.

The Agricultural Sustainability Support and Advice Programme (ASSAP)

ASSAP is a free, confidential and voluntary advisory programme established to work with farmers to improve water quality. It was established under the River Basin Management Plan 2018–2021, and it is co-funded by the government and industry. There are currently well over 40 advisers operating under the programme, including 20 from Teagasc and the remainder from Dairy Industry Ireland. The ASSAP advisers work closely with the Local Authority Waters Programme (LAWPRO) catchment science team, which carries out local scientific investigations in priority water bodies where water quality is unsatisfactory. Armed with the evidence of specifically what and where the agricultural water quality issues are from the LAWPRO team, the ASSAP advisers then engage with the relevant farmers to agree farm actions to improve water quality. The LAWPRO team also engages with other relevant bodies where non-agricultural sources of pollution are identified, for example local authorities, the DAFM Forestry Division, Coillte and Uisce Éireann. This approach ensures that an integrated catchment-specific approach is taken to address the issues.

ASSAP reports that the rate of engagement of farmers in the programme is very high, with 96% of farmers approached agreeing to take part. Farmers receive advice on land management, nutrient management and farmyard management, with issues categorised according to their risk of having an impact on water quality. The key issues requiring action are the management of nutrients, especially diffuse losses of phosphorus and sediment in surface run-off, and the management of farmyards, including manure storage and reducing nitrogen leaching. Action plans are drawn up with each farmer to mitigate the issues (Teagasc, 2021a).

The Tirlán Farming for Water: River Slaney Project is building on the ASSAP approach to provide additional support to farmers in the Slaney catchment, which has been identified in EPA water quality reports as a catchment of concern. The project is a collaborative approach in which Tirlán advisers are working with suppliers in key areas to create individual tailored plans to reduce nutrient losses. Farm sustainability payments are also available for undertaking specific actions on farm.

Further work is needed to collect sufficient information on the measures that have been implemented to provide direct evidence linking farmers' actions to water quality outcomes to demonstrate the effectiveness of these programmes.

Agri-environmental schemes

The flagship agri-environmental scheme as part of the current CAP Strategic Plan is known as ACRES.[11] The scheme came into effect in 2023 and replaced the previous scheme known as the Green, Low carbon, Agri-environmental Scheme or GLAS. The ACRES scheme is backed by €1.5 billion of public funding over 5 years and is targeted at improving the delivery of ecological services on farm through two separate streams: ACRES General and ACRES Cooperation. ACRES General is accessible to all farmers and offers a range of actions for individual farmers, both targeted and general. ACRES Cooperation is available to farmers in defined high-priority geographical areas, and involves results-based payments and bespoke farm and landscape actions. ACRES Cooperation farmers are supported by a project team. Both approaches require the preparation of a farm sustainability plan that is completed and submitted by an accredited ACRES farm adviser. A total of 46,000 farmers were approved to participate under the first tranche of ACRES, and a further 9000 farmers in tranche 2, greatly surpassing the original target of 30,000 farmers in total. In addition, there are some other smaller schemes and projects in place that are targeted specifically at improving biodiversity and other environmental assets on farm, for example the National Parks and Wildlife Service Farm Plan Scheme.

11 www.gov.ie/en/service/f5a48-agri-climate-rural-environment-scheme-acres/ (accessed 31 May 2024).

The European Innovation Partnership, LIFE and other locally led environmental projects

The European Innovation Partnership Scheme funds projects that allow farmers, scientists and other experts to collaborate to develop new practices that are environmentally friendly and economically sustainable.[12] The aim of these innovation partnerships is to road-test new ideas and practices that can then be used more widely by farmers and others to improve productivity and enhance resource efficiency. Many of the projects have been designed to be locally led and results based, so that farmers are rewarded for actions undertaken in addition to positive environmental outcomes on their farms. Some key examples include the BRIDE Project[13] in Cork, the SUAS Project[14] in Wicklow, the Mulkear Project[15] in Limerick, and the larger scale Hen Harrier Project[16] and Freshwater Pearl Mussel Project.[17] The findings from these projects have informed the design and implementation of the ACRES agri-environmental scheme, which is a significant advance on earlier agri-environmental schemes that were based on payment for action models. Two new large-scale projects that will provide funding for farmers were also awarded in 2024: the €25 million Breeding Wader European Innovation Partnership[18] project, which aims to secure existing wader populations at key sites and support population recovery via wider landscape management and policy development; and the €60 million Farming for Water[19] European Innovation Partnership project, which will support the LAWPRO and ASSAP teams to ensure that measures to improve water quality are implemented. Ireland has also been awarded significant EU funding under the LIFE Programme for a number of relevant projects that are also results-based payment schemes to support farmers to implement measures to protect the environment. Two of the more significant ones are the Wild Atlantic Nature Project[20] and Waters of LIFE[21] project.

The Teagasc Signpost Programme

In 2021, Teagasc launched the Signpost Programme to point the way towards a climate-smart farming future. The programme is a partnership of over 30 companies and organisations from across the Irish agriculture sector, with the common goal of working with Irish farmers to reduce greenhouse gas emissions, reduce ammonia emissions, reduce nutrient losses, enhance biodiversity, reduce farmers' costs and improve the efficiency of food production (Teagasc, 2021b). At the core of the programme is a network of Signpost farms that are serving as demonstration farms to showcase the latest science-based technologies to reduce emissions, act as a national network of farms for examining carbon sequestration and act as hubs for climate-friendly advisory support (Figure 10.10). Significant resources[22] are now available and the programme is being demonstrated in practice on the Signpost farms to help farmers learn about and embrace climate-friendly best practice.

The Teagasc Signpost Advisory Programme builds on the network of Signpost demonstration farms by providing enhanced advisory and training support to farmers to commit to, select and implement climate and sustainability actions that will be appropriate and impactful on their farms. An online sustainability digital platform, AgNav, has been developed that calculates the greenhouse gas emissions for a farm and allows farmers to see and understand their carbon emissions and sequestration profile as a baseline from which to act.

12 www.gov.ie/en/service/18a855-european-innovation-partnership-scheme/ (accessed 31 May 2024).

13 www.thebrideproject.ie (accessed 31 May 2024).

14 wicklowuplands.ie/suasproject/ (accessed 31 May 2024).

15 www.mulkeareip.com/ (accessed 6 September 2024).

16 www.gov.ie/en/service/82e360-hen-harrier-programme/ (accessed 31 May 2024).

17 www.pearlmusselproject.ie (accessed 31 May 2024).

18 www.gov.ie/en/press-release/3b3b7-hackett-and-noonan-announce-25-million-nationwide-project-on-breeding-waders-under-the-european-innovation-partnership-programme/ (accessed 31 May 2024).

19 www.gov.ie/en/press-release/468aa-ministers-mcconalogue-hackett-and-noonan-launch-60-million-farming-for-water-eip/ (accessed 31 May 2024).

20 www.wildatlanticnature.ie (accessed 31 May 2024).

21 www.watersoflife.ie (accessed 31 May 2024).

22 www.teagasc.ie/environment/climate-change--air-quality/signpost-programme/publications-/ (accessed 31 May 2024).

Figure 10.10 Engagement channels mobilised in the Signpost Programme advisory campaign

Source: Teagasc, 2021b

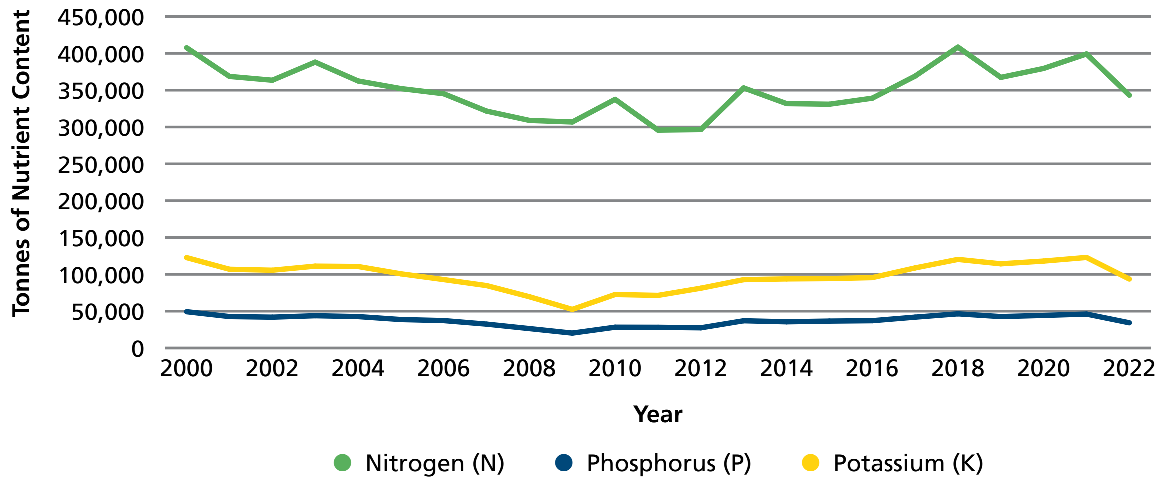
Positive actions being taken on farm

Reducing artificial fertiliser use. Our food systems have grown and developed over the last century with a dependency on the use of artificial fertilisers. At a global level, research has shown that the use of artificial nitrogen and phosphorus has exceeded the limits of the safe operating space of the Earth system's planetary boundaries for humanity and the natural world (Raworth, 2017; Richardson *et al*., 2023; Rockström *et al*., 2023). While nitrogen is relatively readily available, the supply of rock phosphate, which is required to produce phosphorus, is finite (Cordell and White, 2014).

The Farm to Fork strategy (EC, 2020) has set a target to reduce synthetic fertiliser use by at least 20% and to reduce nutrient losses by at least 50% by 2030, while ensuring no deterioration in soil fertility. These nutrient reduction targets have also been embedded in the national Food Vision 2030 strategy. Separately, there is a target in the national Climate Action Plan to cut nitrogen fertiliser use to a maximum of 300,000 tonnes annually by 2030, while the fifth Nitrates Action Programme for 2022–2025 has also set a target to reduce the maximum allowance of chemical fertiliser use by 10%, followed by a possible further 5% pending the interim review.

While it is unclear how these various targets interact, and whether they will achieve the required environmental outcomes, they nevertheless send a clear message that the use of chemical nitrogen in particular needs to be reduced. For Irish farmers operating in a largely grass-based system, reducing the use (and losses) of chemical fertiliser is a key action that can reduce greenhouse gas emissions, achieve air quality targets, and improve water quality and biodiversity. There are also clear economic benefits. However, achieving water quality benefits is dependent on achieving genuine reductions in overall nitrogen surpluses on farm; if chemical nitrogen reductions are simply replaced by increases in nitrogen imports in concentrate feed and/or nitrogen fixation from clover, there will be little change in the overall nitrogen load on farm, and therefore little change in nitrogen losses, unless there are significant improvements in the efficiency of nitrogen use at the same time.

Figure 10.11 Fertiliser sales by nutrient, 2000-2022



Source: CSO, 2023a

The use of synthetic fertiliser nationally has reduced substantially since 2018 (Figure 10.11). In 2022, the nitrogen content of fertilisers sold was 14% lower than in 2021 at just under 345,000 tonnes; phosphorus content fell by 26% to almost 35,000 tonnes (CSO, 2023a). DAFM reported further reductions in chemical nitrogen fertiliser use in 2023 to 281,000 tonnes. The war in Ukraine and the subsequent significant increase in fertiliser prices, plus increased awareness and uptake of the use of nitrogen-fixing clover in grass swards, have been key driving factors in this progress.

At the same time, lime sales increased by 4% to 1.4 million tonnes, the highest it has been during the period 2000–2022 (CSO, 2023a), which reflects a growing awareness of the need to optimise soil pH as part of good nutrient management. Lime application rates fell as low as less than 0.6 million tonnes per annum in the 2000s and early 2010s, which was well below the rates needed. The Teagasc MACC has set a target of 2.5 million tonnes of lime applied per annum to build and maintain optimum soil pH levels.

The reduction in nitrogen fertiliser use will contribute to a reduction in greenhouse gas emissions, and the increase in the use of lime should lead to improvements in soil fertility. However, potential benefits for water quality will not be achieved unless the reductions are targeted at key catchments where water quality is affected by excess nitrate (EPA, 2021).

Reducing the use of pesticides. The Sustainable Use of Pesticides Directive (2009/128/EC) governs the use of pesticides and aims to reduce the risks and impacts of pesticide use on human health and the environment. Herbicides, followed by fungicides and plant growth regulators, are the most common plant protection products sold in Ireland (CSO, 2023b).

The Farm to Fork Strategy (EC, 2020) set two targets in relation to pesticides: one to reduce overall pesticide use by 50% by 2030 compared with the baseline of 2015–2017, and a second to reduce hazardous pesticide use by 50% by 2030. While the 2030 reduction in overall use target was withdrawn from the strategy in 2024, it is nevertheless included in the Irish Biodiversity Action Plan 2024. Ireland is one of only three countries in the EU that has already met the overall use target,[23] and some progress has also been made in reducing the use of hazardous pesticides. Successes such as these could be better linked to environmental outcomes for biodiversity and water quality if adequate spatial data on pesticide use were collected. This would help encourage further uptake of the measures.

Use of clover and multi-species swards. Teagasc research over the last two decades has demonstrated the clear environmental, agronomic, economic, productivity and animal welfare benefits of adding clover to monoculture perennial ryegrass swards and/or replacing them with multi-species mixes (Humphreys *et al*., 2007; Phelan *et al*., 2015; Cummins *et al*., 2021; Moloney *et al*., 2021; Baker *et al*., 2023). The deeper rooting species in the mixes are also beneficial in drought

23 food.ec.europa.eu/plants/pesticides/sustainable-use-pesticides/farm-fork-targets-progress/member-states-trends_en#Ireland (accessed 31 May 2024).

conditions and may be important in the years ahead as a climate change adaptation measure. Recent Teagasc plot trials have demonstrated that nitrogen application can be substantially reduced without affecting grass growth or productivity where clover and mixed-species swards are sown. Further research is under way to develop a blueprint for low, or zero, nitrogen fertiliser use for low-emission pasture-based dairy farming (Teagasc, 2022), and further research is needed to improve the medium and longer term persistence of some of the species in the multi-species swards. New research has been initiated investigating the nitrogen leaching and agronomic aspects of plantain, for example, and the role of red clover is growing in conservation-based systems. All farms under a nitrates derogation are required to include 5 kg of white clover per hectare when reseeding swards, and a new expanded multi-species sward measure and a red clover silage measure were rolled out in 2023 to encourage farmer uptake of multi-species and clover swards (DAFM, 2023b).

Use of low-emission slurry spreading and protected urea. The use of low-emission slurry spreading techniques and protected urea are key measures to mitigate the impacts of ammonia and greenhouse gas emissions. The Teagasc Farm Sustainability Report for 2022 (Buckley and Donnellan, 2023) reported that an average of 14% of total chemical nitrogen fertiliser use on dairy farms, which are the biggest users, was in the form of protected urea, while the figure for cattle farms was substantially lower at 4.3%. In 2023, over half of straight chemical nitrogen used was in the form of urea, 34,000 tonnes (22%) of which was protected urea. In 2022, almost 75% of slurry on dairy farms and less than 34% of slurry on cattle farms was spread using low-emission slurry spreading. These figures all represent an improvement since the previous year but nevertheless demonstrate the challenges ahead if full implementation is to be achieved.

Sustainable farming initiatives. There has been an increased focus in Ireland in recent years on environmentally sensitive farming practices. A number of networks, projects and farming strategies have been established that seek to educate, encourage and promote good practice in farming with nature. Some of these include the Farming for Nature[24] initiative, BASE Ireland[25] and Regenerative Farming Ireland.[26] There are also ambitious policy targets in place to grow the organic farming sector from 2.32% of utilisable agricultural area in 2022 to 7.5% of land being farmed by 2027, through the Organic Farming Scheme[27] (DAFM, 2023c). Carbon farming may bring potential future opportunities for Irish farmers, but it will be important that a data management and verification framework, and independent auditing, is established (Teagasc, 2023b).

Farm sustainability action, incentive and bonus payments are increasingly being offered by the dairy cooperatives to encourage their suppliers to carry out a range of environmental actions on farm. The cooperatives also support the ASSAP team with a number of dairy industry advisers who focus on water quality issues on their suppliers' farms. Origin Green,[28] the food and drink sustainability programme run by Bord Bia, operates at a national level and includes farmers and primary producers, processors and retailers. Many producers are also certified members of the Bord Bia quality assurance programmes. While these quality assurance schemes are welcome and have the potential to raise environmental standards, the emergence of some Origin Green-certified food and drink facilities on the EPA's list of national priority sites for enforcement action, due to their poor compliance and environmental performance records, is not sustainable and needs to be addressed.

Challenges relating actions to outcomes. Despite all the positive actions being taken on farm in recent years, it is unclear what has been achieved in terms of environmental outcomes. While the National Farm Survey and Bord Bia audits do provide some evidence on the implementation and adoption of measures, particularly in relation to climate change, there is a lack of sufficient, spatially explicit evidence on where measures are being implemented on farms, and on how farm practice has changed, that can be directly and geographically related back to the resulting environmental improvements that may have occurred. To determine whether measures are working in terms of environmental improvements, there needs to be data and evidence available on the actions and their progress in terms of implementation and an assessment of their effectiveness. The lack of evidence of measures being implemented to support biodiversity was an important element of the recent Court of Justice of the European Union case against Ireland for failing to fulfil its obligations under EU biodiversity conservation law (CJEU, 2023). Similarly, a recent European Court of Auditors report on the environmental outcomes of the EU's expenditure on climate action through the CAP showed that it has delivered little reduction in agricultural emissions since 2010 (European Court of Auditors, 2021).

24 www.farmingfornature.ie (accessed 31 May 2024).

25 www.baseireland.ie (accessed 31 May 2024).

26 www.regenerativefarmingireland.com (accessed 31 May 2024).

27 www.gov.ie/en/service/d46aec-organic-farming-scheme/ (accessed 31 May 2024).

28 www.bordbia.ie/farmers-growers/origin-green/ (accessed 31 May 2024).

Slurry spreading setback, Cullaun Lake, Co. Clare

Capturing the evidence on measures being implemented, and relating it back to key environmental indicators that the measures have been designed to support, must be a key action in all agri-food sector plans going forward, so that their contribution to positive environmental outcomes can be demonstrated.

It is also largely unknown whether all these actions will collectively deliver the scale of environmental outcomes that is needed. Policy integration and coherence must be improved to ensure that the multitude of plans and programmes are joined up and that there is no pollution swapping or perverse outcomes arising in which a measure that is considered positive for one plan is detrimental for another. Crucially, most mitigation actions to date have focused on technical abatement and efficiency improvements, which are important but may simply lead to more production. A narrow focus on efficiency without considering the associated levels of production compatible with sustainable levels of pollution loading (e.g. nutrient loading at catchment scale or greenhouse gas emissions at national scale) will fail to deliver desired outcomes. Key to this will be the development of a shared, long-term vision, out to 2050, of how Ireland wants to shape its landscape and its food system to deliver all the ecosystem services that society needs. The vision will need to focus on building resilience for a changing climate and incorporate strategies for adaptation. A robust ongoing monitoring and reporting framework will be essential.

5. Farming for the future

Ireland's farmers are facing increasing economic, social and environmental challenges, which are likely to intensify under future climate change conditions. A stronger focus on adapting farming practices to build resilience to the climate and weather challenges ahead will be important. Challenging environmental targets have been set nationally to reduce greenhouse gas and ammonia emissions, improve water quality and reverse the trend in farmland biodiversity, all of which will be expected in an era of increasing global food demand and increasingly uncertain climate change influences. There is a risk that, while these targets may move the food system more closely towards where it needs to be, they will not be adequate to deliver a healthy environment.

There are many competing demands for the use of land, and there is a need to balance the production of food with the need to achieve environmental objectives important for current and future generations (Topic Box 10.3). Phase 1 of the Land Use Review was published in 2023 and aimed to determine the environmental, ecological and economic characteristics of land types across Ireland (Chapter 5). Phase 2 is currently under way and will consider the policies, measures and actions that will need to be taken in the context of the government's wider economic, social and climate objectives.

Topic Box 10.3 Envisioning a climate-neutral agriculture and land sector

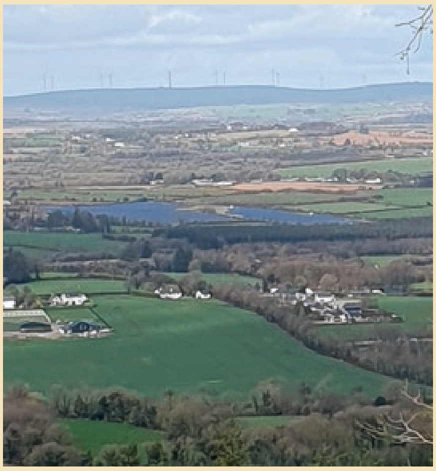
The Climate Action and Low Carbon Development (Amendment) Act 2021[29] commits Ireland to reaching a legally binding target of climate neutrality no later than 2050. This will necessarily involve very large reductions in emissions from agriculture and land use, alongside 'carbon dioxide removal' to offset the inevitable residual emissions (especially from biological systems producing food, for which limited technical abatement options are available). Carbon dioxide removal could include various technologies such as bioenergy with carbon capture and storage, direct air capture, afforestation, artificial weathering of rock and enhanced sequestration of carbon in soils. Many of these options require significant areas of land, and the most suitable proven and scalable option for Ireland – a country with already carbon-rich soils and low forest cover – is afforestation. It is increasingly recognised that bioenergy with carbon capture and storage is also likely to be needed to achieve climate neutrality, once it can be commercially scaled up (DECC, 2023). Ireland has a land area of 70,273 km². This cannot be increased. Therefore, carbon dioxide removal will increasingly compete with other land uses, including producing food, renewable energy and bioeconomy feedstocks and providing habitats for enhanced biodiversity (IPCC, 2019). In fact, given the limited potential to abate emissions from animal and soil processes, maintaining high levels of milk and/or beef production for export into the future will necessitate large areas of land being dedicated to carbon dioxide removal (preferably alongside the delivery of other ecosystem services in a manner that optimises a multifunctional land use approach). This requires urgent planning if it is to be deployed in a timely and efficient manner.

The EPA and DAFM co-funded a research project SeQUEsTER, led by the University of Galway, University of Limerick and Teagasc sought to explore what levels of future agricultural production could be supported within the constraints imposed by achieving climate neutrality and the land areas available for organic soil rewetting/ water table management and afforestation (Styles *et al*., 2024).

The analysis remains highly uncertain owing to ongoing developments in inventory estimates for land sector emissions and potential alternative approaches to defining 'climate neutrality' (Bishop *et al*., 2024). Nonetheless, indicative 'climate-neutral' scenarios that maintain high levels of milk output clearly demonstrate the magnitude of land use transformation that will be required to achieve climate neutrality. Grassland used for animal production would need to decline from 58% of national land cover to 26%, while forest cover would need to increase from 11% to 32%, under internationally agreed 'GWP100' (100 year global warming potential) accounting. Even if methane is set a separate non-zero target in future to represent its short residence time in the atmosphere compared with other greenhouse gases, achieving climate neutrality would require huge changes in agriculture and land use (e.g. a doubling of forest area, and farmed grassland area reducing from 56% to 32% of land cover). For more information about land cover and use, see Chapter 5.

29 www.irishstatutebook.ie/eli/2021/act/32/section/15 (accessed 5 June 2024).

Topic Box 10.3 Envisioning a climate-neutral agriculture and land sector (continued)



Based on the latest analysis, it is clear that a focus on efficiency and emissions abatement in the agriculture sector, while important, will be inadequate to deliver climate neutrality (in the agriculture and land use sector) and would need to be accompanied by all of the following: (1) at least moderate diversification away from milk and/or beef production; (2) restoring degraded peatlands; (3) water table management across tens of thousands to hundreds of thousands of hectares of organic soils under grassland; and (4) planting at least 500,000 ha of new forest (Styles *et al.*, 2024). Maintaining climate neutrality post 2050 will require measures including extended storage of carbon in biochar, wood products and geological storage via bioenergy with carbon capture and storage (Forster *et al.*, 2021). Biogenic carbon could become a highly valued resource in a (nearly) fossil fuel-free world, not least because it offers a unique pathway towards negative emissions.

To date, there has been a lack of integrated, holistic and spatially explicit evidence gathered on areas of overlap and conflict across competing demands on land, including food production, climate action, biodiversity and catchment management for water quality. For example, replacing cattle with anaerobic digestors for bioenergy generation could play an important role in reducing greenhouse gas emissions from both the agriculture and energy sectors but may bring challenges for biodiversity and water quality owing to the need for high grass growth rates and potentially high ammonia emissions from digestate application to soils. It is likely that complementarities can be prioritised, and trade-offs minimised, if actions can be targeted to the most appropriate geographical contexts.

As climate change manifests itself, existing food and land systems may become stressed and new systems may become viable in particular regions (IPCC, 2019). Given the long time lag involved in environmental equilibration to land use changes, it is important to incorporate both climate change adaptation and climate change mitigation into land use strategies. Empowering farmers and other landowners to be positive agents for change requires clear policy signalling based on the big picture and the long view.

We need transformational change in the food system. Key objectives include:

- Develop a long-term, integrated, cross-departmental shared vision and leadership for a future thriving, resilient, productive and verifiably sustainable food system out to 2050.
- Set clear trajectories explicitly linked to the required outcomes that reflect the pace and scale of change that is required, while acknowledging the levels of uncertainty, the need to make progress and the importance of supporting farmers to make the necessary changes.
- Farm in harmony with nature and within the safe limits of healthy functioning ecosystems.
- Adapt, diversify, innovate and build resilience into our farm systems to cope with future climate and environmental challenges.
- Take advantage of the opportunities and multiple benefits of the circular bioeconomy; for example, forestry can contribute to climate action in the LULUCF sector by acting as a carbon sink, and it can also be a bioeconomy feedstock.
- Recognise that, while optimisation and efficiency gains play important roles in the food system to reduce the environmental footprint of the food being produced, they must be complemented by reductions in absolute emissions to achieve environmental outcomes.
- Significantly reduce food waste, optimise the use of land, resources and nutrients, and maximise nutrition and health.
- Collate the evidence, track progress, and actively and adaptively manage the transition to a truly sustainable food system. Adequately support farmers and other landowners to make the necessary changes in practice, while delivering fair economic returns as part of a just transition.

Many of Ireland's farms already display a high degree of vulnerability and may be particularly vulnerable to climate change directly and to the policy and market responses that will accompany it. Just over 25% of beef and sheep farms are economically viable; livestock rearing is often loss-making and dependent on direct payments (Buckley and Donnellan, 2023). This is in stark contrast to the 93% of dairy farms and 79% of tillage farms that are viable economically. For many beef and sheep farmers, forestry can generate higher returns per hectare than livestock rearing, while many extensive farmers already deliver an array of ecosystem services valued by society, yet they are not directly rewarded for doing so. There is an economic imperative to explore diversification options, safeguarding more efficient food production while ensuring that viable farms are handed down to the next generation. There are new opportunities emerging in the circular bioeconomy for the sector to use renewable biological resources to grow valuable materials, crops for bioenergy and food (see Chapter 15). There are ambitious plans, for example to produce biomethane from aerobic digestion, which will require feedstocks from the agriculture sector. Nutrient-rich digestate will then be produced that can be reused on farm (see Chapter 12).

A recent paper by the National Economic and Social Council recommended four key areas of action to support an effective, fair and inclusive transition in the agriculture and land use system. These include the need for (1) socially inclusive dialogue and participation, including with farmers, as the foundation for ensuring a fair process of transition; (2) a transition that is opportunity led, underpinned by a robust means of valuing and accounting for ecosystem services and natural capital; (3) fair, equitable and sustainable distribution of effort and cost sharing; and (4) coordinated action to govern the transition so that it can deliver real change in a balanced, inclusive and just manner (NESC, 2023).

Research supporting the transition to a more environmentally friendly agri-food sector

Significant research is under way nationally to provide the evidence base to support the changes in policy and action that are needed to deliver a sustainable agri-food sector.

In recent years, the EPA has funded more than 40 projects of relevance to agriculture, with a total value of more than €10 million. These have included several peatland-related projects on rewetting, water table management, carbon sequestration and methane emissions in organic agricultural soils (e.g. WET-PEAT, CO2PEAT and PEATCH4); a number of projects on soils and soil health (e.g. MUCKISOILS, AMRSOIL, TellSoilBio and MMeSH); several projects supporting the development of agricultural emissions inventories with Ireland-specific data and emissions factors and impacts on air quality, (such as AIRN2K, ENCORE and IMAGE); and projects looking to agriculture and land use under future climate scenarios (e.g. WaterFutureS, SeQUEsTER and LandingZoNES).

In addition, the EPA has funded significant research to support policy and action from the agriculture sector to improve water quality, including tools and models that are subsequently used in house for EPA assessments.

DAFM awarded close to €25 million of funding for research projects on a range of topics under the banner of sustainable management of natural resources over the period 2010–2021. A further €24 million in research grants was announced at the end of 2023 to support 20 projects across the agri-food, forestry and bioeconomy sectors. Some key examples of relevant projects in recent years include the development of the greenhouse gas and ammonia MACCs and supporting projects; PASTURE-NUE and FaSTEN, which are aiming to improve nitrogen use on farms; and a project on multi-species swards (Multi4More).

The Teagasc Agricultural Catchments Programme, which was established in 2008 to assess the water quality outcomes of the Nitrates Action Programme, is now in its fifth phase. The organisation’s research programme has expanded to reflect the increasing need to improve water quality and reduce greenhouse gas and ammonia emissions while increasing soil carbon sequestration. The Teagasc agri-environmental research programme is ongoing but was given a renewed focus in 2023 with the establishment of a virtual National Climate Centre. The objective of the centre is to coordinate climate research and innovation and to lead the agri-food sector to climate neutrality in 2050. There will be a focus on bringing in new technologies to support that objective to deployment stage.

6. Conclusions

Agriculture is an integral part of the fabric of Irish society, but our food systems are not currently meeting our sustainability targets and need urgent transformational change. Over the last decade, two successive ambitious agricultural growth policies have delivered economic benefits, but challenges remain with associated environmental impacts that need to be addressed:

- The latest EPA projections indicate that greenhouse gases from agriculture are likely to reduce by up to 18% (compared with 2018 levels) depending on the measures that are implemented. Pathways to implementing all the measures identified in Teagasc MACC 2023 must be identified to meet the 2030 targets of a reduction in emissions of 25%. Ireland's commitment to the Paris Agreement will require transformational change across agriculture and the wider land sector by 2050.
- The application of artificial fertilisers and the management of manures are key contributors to air pollution in Ireland. National targets to reduce ammonia emissions are not being achieved. Continued implementation of on-farm abatement measures, such as reduced use of chemical fertilisers, increased use of protected urea and increased use of low-emission slurry systems, and research on new measures, is needed to bring Ireland back into compliance with the current 2020-2029 national emission reduction commitment and to meet the 2030 emission reduction commitment targets.
- Almost half of our surface waters have unsatisfactory water quality, and agriculture is the most widespread significant pressure causing the impacts. Successive Nitrates Action Programmes have not achieved the desired water quality outcomes to date. There needs to be full implementation of the Nitrates Action Programme through compliance promotion and targeted agricultural inspections with follow-up action and enforcement. High rates of engagement and uptake of voluntary measures through ASSAP, the Farming for Water European Innovation Partnership project, the Waters of LIFE project, and various other projects and agri-environmental schemes, will be essential for targeting the right measure in the right place.
- Our farming landscape is currently having a significant impact on biodiversity. The majority of our protected habitats, and many protected species, are at unfavourable conservation status and in significant decline. There is a need to further develop agro-ecological approaches to farming to enhance biodiversity on farms.
- Farm viability and the social fabric of rural communities are under pressure. Many farmers face economic challenges and generational renewal is becoming increasingly challenging. Ensuring fair economic returns for farmers that reflect the true cost of food production and deliver a standard of living that is comparable with other sectors, while providing support for rural development, is important for sustaining agriculture and rural livelihoods.

There are many EU and national policies and strategies to improve the food system under the broad umbrella of the European Green Deal. Key challenges include policy integration and coherence, a robust ongoing monitoring and reporting framework, and the development of a shared vision setting out what Ireland should look like beyond the horizon of Food Vision 2030.

There is a welcome progression in the agri-food sector towards more sustainable farming practices, and there are many positive actions being taken on farm; while improvements are being made in places, they are not at the scale and pace that is needed. There are opportunities for gains to be made throughout the food system that will benefit the environment, farmers and the rural economy, for example by using fewer inputs, adopting carbon farming and embracing the circular economy. However, where these actions are not sufficiently targeted and joined up as a coherent package, there is a risk that they will not deliver the required environmental outcomes. It is vital that the evidence is collected to assess and demonstrate the environmental outcomes of the actions being taken. Ireland has declared a climate and biodiversity crisis, and in that reality we must implement adaptive management programmes, supported by well-designed monitoring programmes that can feed into timely review and revision.

Driving the transition to a more climate-resilient and environmentally friendly agriculture sector that is fit for purpose in 2050 will require vision and leadership. The scale of land transformation necessary requires sustained and consistent action, but, given the time lags involved, implementation must begin urgently. Our farmers are the custodians of the land, and a thriving agriculture sector is key to delivering a climate-neutral, biodiverse economy. The agriculture sector can play a key role as part of the solution to addressing our climate, biodiversity and wider environmental challenges. Farmers must be supported to make the changes that are needed.

Key chapter messages

1. Agriculture is an integral part of the fabric of Irish society. It has a key role in delivering, and depends on, a healthy environment. However, our food systems are not currently meeting our sustainability targets and need urgent transformational change.

2. There are many plans and programmes in place, with positive actions being implemented at farm scale, but there is no clear evidence that the current measures will collectively achieve the scale of environmental outcomes that are needed.

3. A shared vision for 2050 for land use and the food system is urgently required. A clear pathway for the agriculture and land use sector, and adequate supports to achieve it, must be put in place. Implementation and an evidence base for assessing progress must be a priority.

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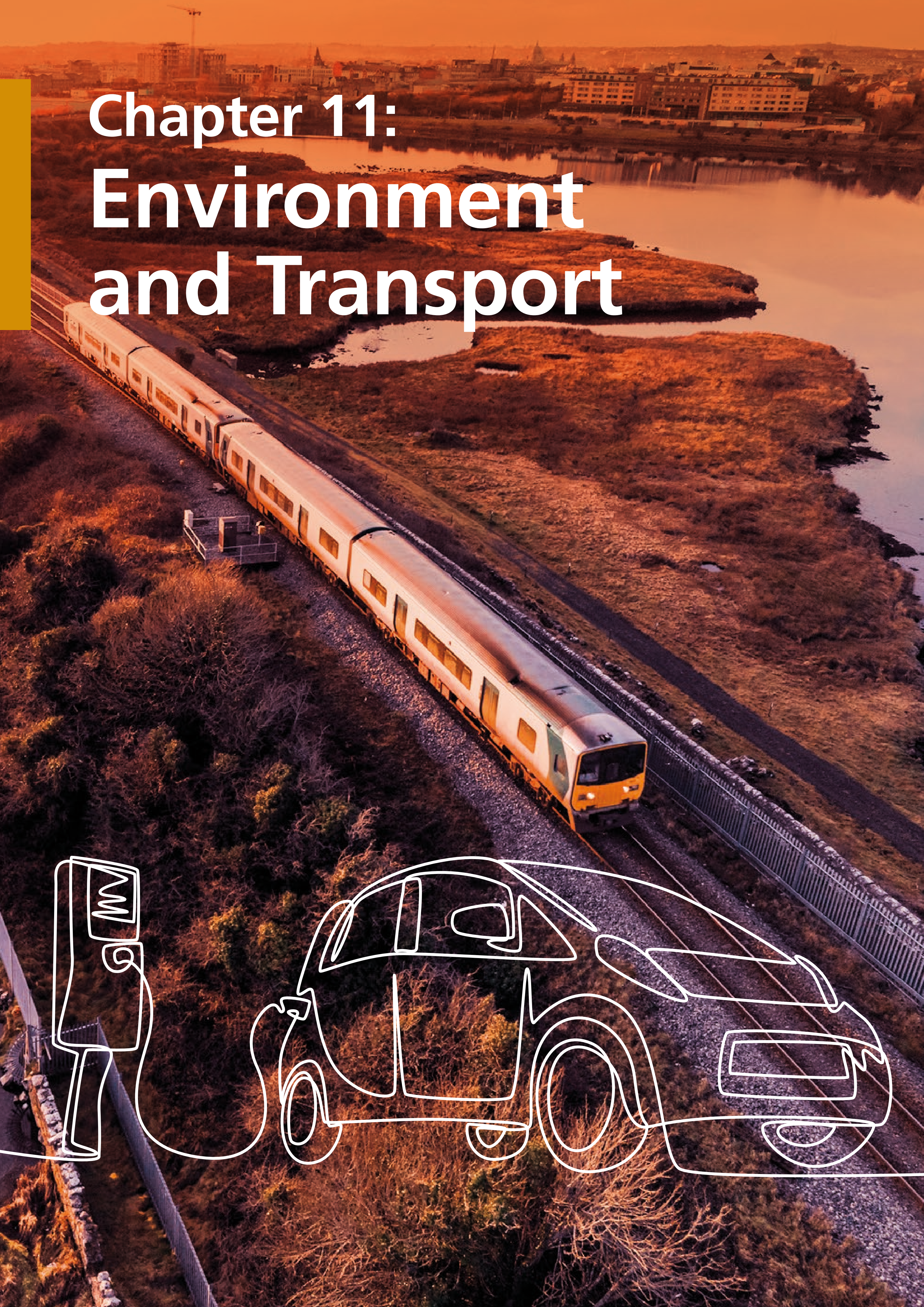
Chapter 11:
Environment and Transport



Environment and Transport

1. Introduction

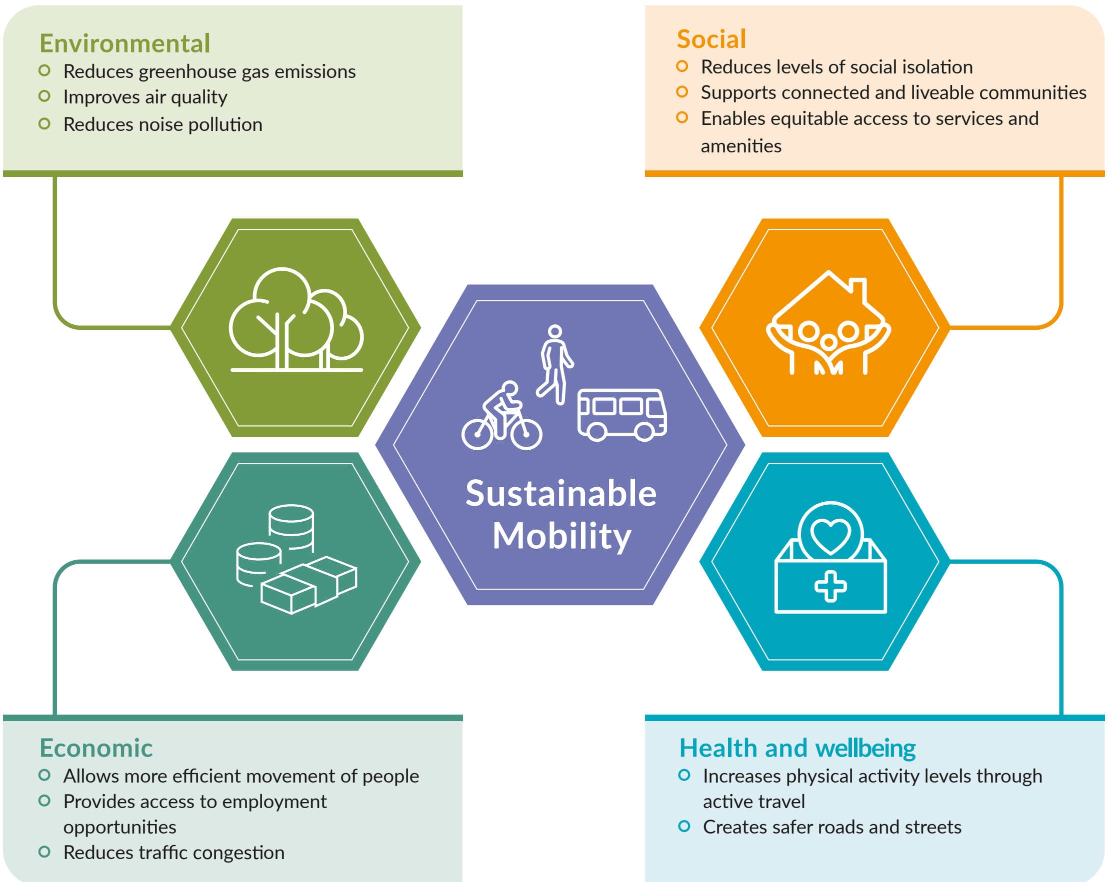
Our transport networks connect us to activities such as employment, recreation, retail and education. A sustainable, accessible and efficient transport system is not only important for wellbeing but also has a key function in trade and the economy.

The transport sector is a major consumer of energy and material resources and a source of environmental pollution, particularly of greenhouse gases, other air pollutants and noise. A sustainable transport network (Figure 11.1) is a vital attribute of any country and is characterised by low environmental pressures and by win–win outcomes for human health and wellbeing and for cleaner, quieter towns and city centres.

In 2022, the Organisation for Economic Co-operation and Development (OECD) conducted one of the most comprehensive evaluations of the Irish transport system ever undertaken (OECD, 2022). The report indicated that, in order to achieve Ireland's climate goals in the transport sector, systemic change would be required; a similar recommendation was made in an earlier iteration of this report, albeit at a more general level (EPA, 2020). The type of systemic change outlined in the OECD report is a rebalancing of urban space to favour active and public modes of transport and to reduce the reliance on electric cars to decarbonise the sector.

This chapter describes how the demand for transport is linked to urbanisation and economic development, discusses the impact of the sector on the environment and explores the policies needed to ensure a sustainable transport sector.

Figure 11.1 Benefits of sustainable mobility



Source: DOT, 2022

2. Demand for mobility

Internationally, cities that have a well-functioning, frequent and reliable transport system tend to be densely populated with mass transport options serving large numbers of people. Ireland has a population density of 72 people per square kilometre, which is 2.5 times less than the European Union (EU) average (World Bank, 2023). The greatest concentration of population is in Dublin city and its suburbs, with almost 25% of the country's population in that area (CSO, 2023a). Our regional cities (Cork, Limerick, Galway and Waterford) account for just over 9% of the population, whereas 29.5% of the total population lives in rural areas (CSO, 2023a). In Dublin, the high population density leads to a greater demand for public transport and more services being provided than in other areas (CSO, 2023a). This, in turn, increases the share of public transport in total trips taken in Dublin. For example, buses were used for 7.8% of all journeys in Dublin, compared with only 2.7% in areas outside Dublin (CSO, 2022). The OECD assessment of Ireland's transport systems (OECD, 2022) is outlined in Topic Box 11.1.

Topic Box 11.1 OECD assessment of Ireland's transport system

In 2022, the OECD published a comprehensive assessment of Ireland's transport system and its current trajectory (OECD, 2022). One specific objective was to determine if Ireland was on course to reach its goals to reduce the carbon footprint of the transport sector. The report identified that Ireland's transport system currently encourages car use and is unfit to enable the country's move to meet its climate goals. The OECD concluded that aiming to decarbonise the transport system via reducing emissions from private vehicles is unlikely to lead to substantially different patterns of behaviour or to achieve the rapid emission reductions needed for climate change mitigation. Three elements were suggested as the source of car dependency and high emissions: induced demand, urban sprawl and the erosion of active and shared transport modes.

Policies with high potential include road space reallocation. The report noted that on-demand shared services and communication campaigns to address car-centric mindsets are only being implemented on a small scale in Ireland. Policies to reallocate road space include street redesign and improved management of public space; spatial planning focused on creating proximity; and mainstreaming shared mobility. The study suggested that Ireland is already paving the way for this process by proposing policies to reallocate road space and mainstream on-demand sharing services while increasing awareness of the need to address car-centric mindsets. It recommended better enforcement of planning regulations to ensure that all developments promote settlements with easy access to transport links and include a network of safe walking and cycling routes.

Overall demand

One of the difficulties in reducing emissions from transport is that the demand for transport is constantly increasing. The country has returned to normality after the COVID-19 pandemic (Topic Box 11.2), and recent figures show that the demand for public transport and the volume of traffic on our roads is increasing to record levels.

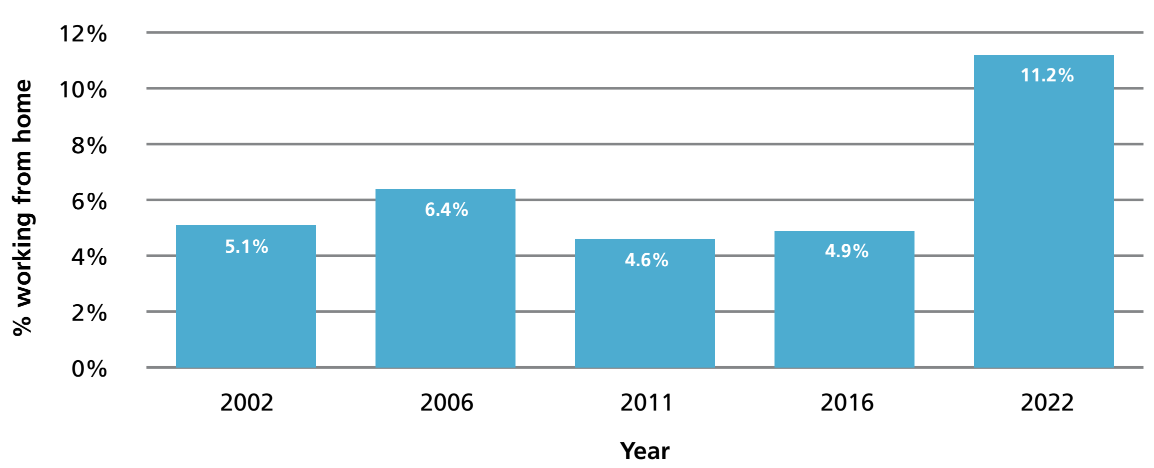
Topic Box 11.2 COVID-19 impacts on mobility demand

The transport sector, and transport movement patterns, were directly affected by the COVID-19 pandemic. Decreases in car traffic volumes of around 30% between 2019 and 2020 were due to lockdowns and reduced travel. A partial recovery was observed in 2021 and the traffic volume increased further in 2022, almost reaching pre-pandemic levels.

Provisional road transport emissions figures for 2023 were 0.3% higher than in 2022, which may suggest a stabilisation of emissions, despite the vehicle fleet increasing by 3%. Road transport emissions in 2023 were approximately 4% below pre-COVID emissions in 2019 (EPA, 2024a). With regard to freight transport, starting from June 2020, volumes of heavy goods vehicle (HGV) traffic generally surpassed those of 2019 (CSO, 2023b). Since then, the volumes of HGV traffic have grown steadily each year by a few per cent.

The COVID-19 pandemic is having several long-lasting impacts on the sector. Those who were able to work from home between 2002 and 2016 accounted for about 5% of the workforce whereas the 2022 Census showed that over 11% of employees were working from home five days a week (CSO, 2023c) (Figure 11.2). Recent research suggests that home working is an option that the public wish to continue, and this will result in changes in commuting patterns and a reduction in transport-derived air pollutant emissions (Stefaniec *et al.*, 2024).

Figure 11.2 Percentage of people working from home, 2002–2022



Source: Compiled from data in CSO, 2023c

Another element of remote working that received a boost during the COVID-19 pandemic was an increase in remote working hubs. Research has demonstrated that those using a remote working hub could avoid 1.126 tonnes of carbon dioxide (CO_2) emissions by using one of these hubs for three days a week for a year (Caulfield and Charly, 2022).

How we move. Recent data show that almost three-quarters (74%) of those who participated in the *National Household Travel Survey 2022* (NTA, 2023a) reported living within a 15-minute walk of a shop. The majority of those surveyed live within a 15-minute walk of a pub or restaurant (67%), a bus stop (67%), a chemist/pharmacy (60%) or a post office (55%). Half reported living within a 15-minute walk of a doctor's surgery (50%). The results presented in Table 11.1 demonstrate that the majority of the population is within a 15-minute walk of many major amenities. However, the results highlight that, in rural parts of Ireland, where approximately one-quarter of the population lives, the majority of people are not within a 15 minute walk of any of these amenities.

Table 11.1 Proportion (%) of people living within a 15-minute walk of amenities, nationally and by region

AMENITY	NATIONAL	RURAL AREAS	DUBLIN CITY AND SUBURBS	GREATER DUBLIN AREA	CORK, GALWAY, WATERFORD AND LIMERICK	LARGE URBAN TOWNS	OTHER URBAN DISTRICTS
Shop	74	38	97	88	97	92	91
Pub or restaurant	67	37	91	79	82	72	85
Bus stop	67	28	98	87	95	82	77
Chemist or pharmacy	60	16	93	80	90	74	79
Post office	55	23	80	70	75	58	78
Doctor's surgery	50	14	78	66	74	58	67

Data from the National Household Travel Survey 2022 (NTA, 2023a) in Table 11.2 show the change in transport mode share nationally over the past decade. The results demonstrate that the car is the predominant mode of transport and continues to be used for most trips.

Credit: Failte Ireland

Table 11.2 National transport mode share (%) in 2012, 2017 and 2022

Transport mode	2012	2017	2022
Car	70	71	69
Walking	20	18	19
Bus/coach	4	5	4
Truck/van	2	1	4
Train/DART/Luas	1	1	1
Cycling	2	3	2
Other	1	1	1

Source: NTA, 2023a

DART, Dublin Area Rapid Transit system; Luas, Dublin tram system

Table 11.3 Transport mode share (%), nationally and by region, 2022

Transport mode	National	Rural areas	Dublin city and suburbs	Greater Dublin Area	Cork, Galway, Waterford and Limerick	Large urban towns	Other urban districts
Car	69	79	53	61	57	71	73
Walking	19	8	31	25	31	19	19
Bus/coach	4	4	7	5	5	3	3
Truck/van	4	7	1	2	2	3	3
Train/DART/Luas	1	–	2	2	–	1	–
Cycling	2	–	5	3	3	1	1
Other	1	2	1	2	2	1	1

Source: NTA, 2023a

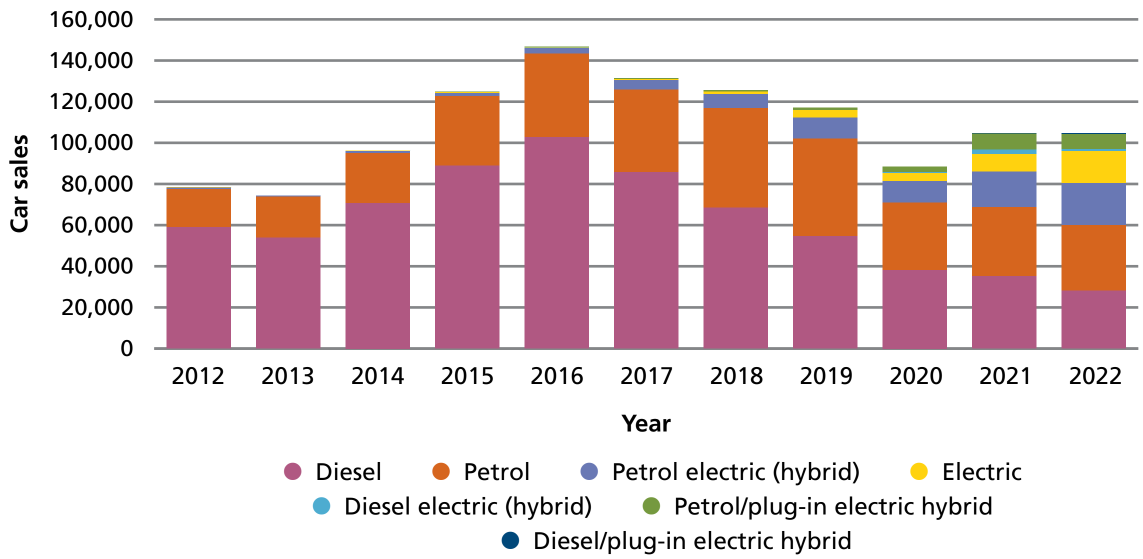
–, not applicable; DART, Dublin Area Rapid Transit system; Luas, Dublin tram system

The data in Table 11.3 demonstrate that in rural Ireland almost 80% of all trips are made by car (NTA, 2023a). The results from the cities demonstrate that car trips account for a lower share of journeys than in rural areas and that walking has a large part to play in cities, accounting for almost one-third of all trips.

Our vehicle stock. On average, 108,585 cars were sold each year between 2012 and 2022 (Figure 11.3) in Ireland. Car ownership levels in Ireland are 458 cars per 1000 people, which is 16% lower than the EU average of 532 cars per 1000 people (Eurostat, 2023a). Public transport use in Ireland is aligned with the EU average (Eurostat, 2023b) and reflects a stable reliance on buses and trains, particularly among third-level students, among whom the bus is the most common mode of travel to college (25%). These trends may suggest a slow and gradual shift away from car dependency and an increasing preference for sustainable transport options among the younger population.

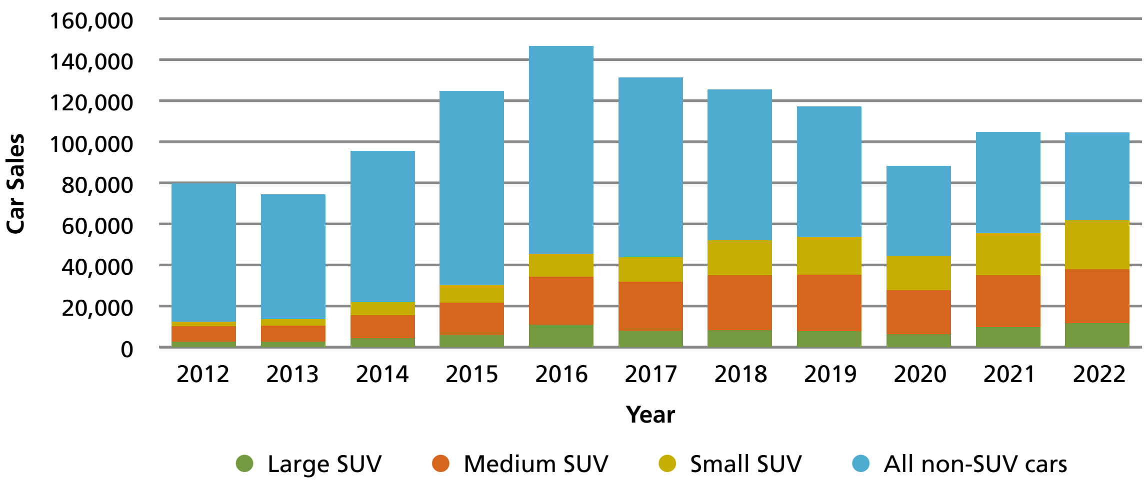
Two notable changes in the car fleet in the decade 2012–2022 was the increase in sales of electric and hybrid cars (Figure 11.3), while at the same time there has been an increase in sales of sport utility vehicles (SUVs) (Figure 11.4). While the volume of 'large SUVs' sold is still small compared with the total volume of cars sold in Ireland, between 2012 and 2022 this category increased by 367%, which may be a cause for concern.

Figure 11.3 Car sales by fuel type, 2012–2022



Source: Compiled from Society of Irish Motor Industry 2023 data

Figure 11.4 Share of SUVs in new car sales, 2012–2022



Source: Compiled from Society of Irish Motor Industry 2023 data

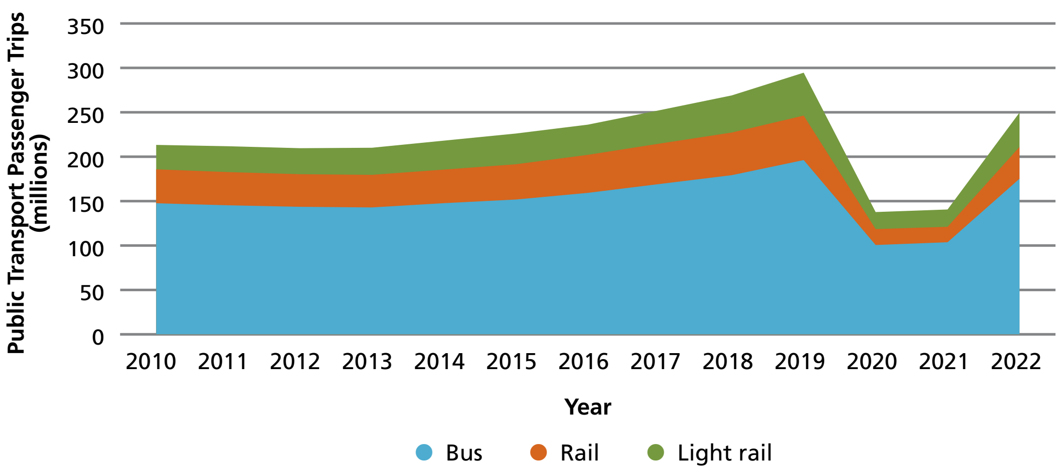
SUVs are characterised by higher fuel consumption because their weight is usually greater than that of standard cars. In 2012, these vehicles made up 16% of new private vehicle sales, and that figure grew to 59% in 2022. In 2022, 15% of all new car sales were fully battery electric (Figure 11.3).

In 2022, there were approximately 72,000 battery electric vehicles (BEVs) and plug-in hybrid electric cars, which was approximately 37% of the Climate Action Plan target for 2025. By the end of 2023, this number had increased to over 121,000 electric vehicles (EVs), accounting for 62% of the Climate Action Plan target for 2025.

Public transport

Figure 11.5 illustrates public transport passenger trips from 2010 to 2022. The preliminary figures for 2023 show that more than 308 million passenger journeys were made by public transport, marking a 24% rise in passenger numbers compared with the year before, and a 5% increase beyond the record previously set in 2019 (NTA, 2024). Bus services consistently account for the largest share of journeys each year, with rail and Luas representing smaller shares.

Figure 11.5 Number of passenger journeys by public transport, 2010-2022



Source of data: NTA, 2023b[1]

1 Estimates for 2023 based on preliminary figures from NTA.

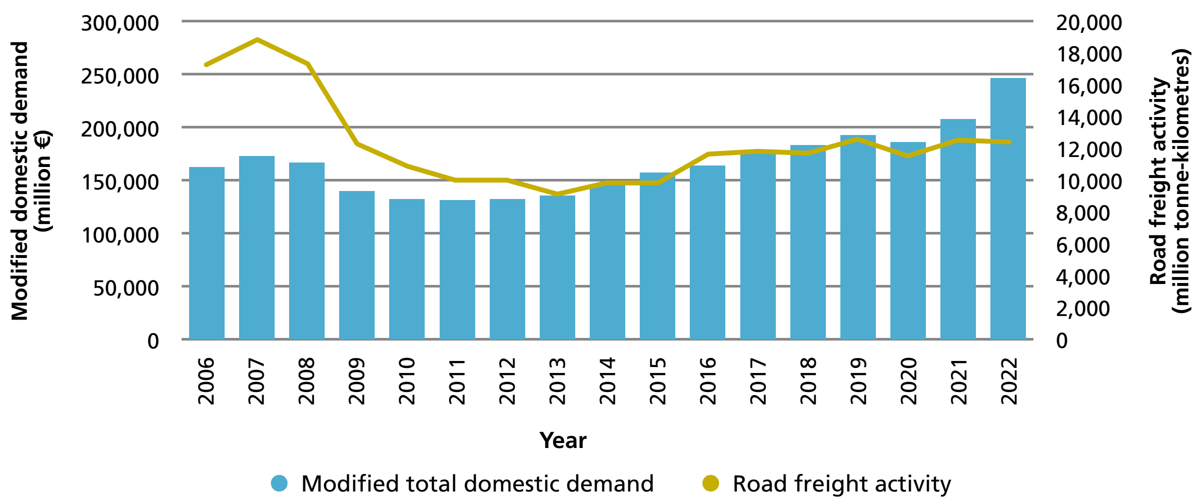
Much of this increase can be ascribed to the introduction and improvement of services under the Connecting Ireland Rural Mobility Plan[2] and the BusConnects Network Redesign.[3] Another factor contributing to this increase is the ongoing improvements in fare and ticketing design, aimed at facilitating easier and more equitable access to services through simplified multimodal and multi-period ticketing, along with fare adjustments made under the National Fares Strategy (NTA and Systra, 2023). Over the last 4–5 years, investment has ramped up significantly, with an unprecedented number of rail projects in planning phases including DART+ West and South West, the Dublin–Navan line (new line), Luas Finglas and MetroLink. Since 2022, there has been a significant increase in rail services provided nationwide on existing rail lines. However, the last new major rail infrastructure project delivered in Dublin was Luas Cross City in 2017, and no new rail network is currently under construction in Dublin.

There have been improvements to the rail network in Cork. The frequency of rail services in the Cork Metropolitan Area was doubled in July 2022, providing a train every 30 minutes to and from Cork and Cobh and Cork and Midleton and every 15 minutes to and from Cork and Glounthaune. Investment is also being made in the Cork Area Commuter Rail programme, which represents the largest investment in the rail network in Cork in the history of the state.[4]

Freight transport

Economic activity is an important factor driving freight demand, as it is directly correlated with increased consumption and production, subsequently raising the demand for transport of goods. In Ireland, the demand (expressed in terms of the modified domestic demand) and road freight activity (in tonne-kilometres) both experienced disruptions in 2020, probably influenced by the pandemic (Figure 11.6). However, both indicators showed a notable recovery in subsequent years.

Figure 11.6 Trends in road freight activity and domestic economic activity, 2006–2022



Sources: Compiled from data in CSO, 2023d; CSO, 2023e

2 www.nationaltransport.ie/connecting-ireland/ (accessed 11 April 2024).

3 www.dublinbus.ie/bus-connects-hub (accessed 11 April 2024).

4 www.irishrail.ie/en-ie/about-us/iarnrod-eireann-projects-and-investments/cork-area-commuter-rail#:~:text=Cork%20Area%20Commuter%20Rail%20Programme%20The%20Cork%20Area,rail%20improvement%20programme%20for%20the%20Cork%20Rail%20Network (accessed 30 July 2024).

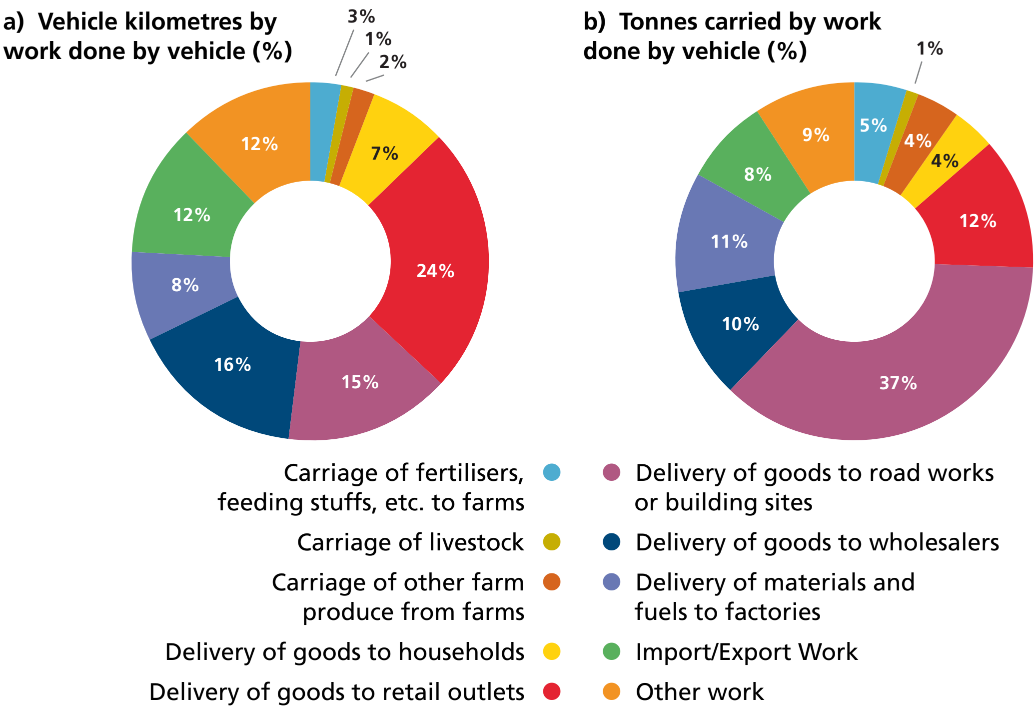
In 2022, the tonnage of goods transported by road saw 6% growth compared with 2021. This represents 3% growth relative to 2019 figures (CSO, 2023d). There was, however, a slight decrease in the distance driven by HGVs (CSO, 2023d). This indicates that, despite higher demand leading to more goods being transported, the distance covered by road vehicles was less.

Compared with other EU countries, Ireland's road freight transport activity in 2022 is at the lower end of the spectrum at 12.36 billion tonne-kilometres (tkm) (Eurostat, 2023b). The amount of goods handled by rail (76 million tkm) in Ireland is the lowest among European countries with an operational rail network (Eurostat, 2023c).

In 2021, vehicles dedicated to transporting goods to roadworks or building sites handled 37% of the total road freight tonnage (41% in 2022; (CSO, 2023d)), while 40% of the vehicle-kilometres driven were associated with deliveries to retail outlets and wholesalers (Figure 11.7).

Topic Box 11.3 later in this chapter proposes an optimal strategy for freight transport.

Figure 11.7 Shares of work done by delivery vehicles



Source: CSO, 2023d

3. Environmental pressures of and impacts from transport

Energy consumption

The 2020 State of the Environment Report highlighted that continued growth in energy consumption for transport was a major concern (EPA, 2020). There has been very little decarbonisation of the transport fuel mix to date, with transport CO_2 emissions remaining tightly coupled to energy use. In 2022, the total transport energy demand had rebounded to 95% of pre-COVID (2019) levels (see Topic Box 11.2), with 94.2% of road transport energy demand met by fossil fuels. The years 2022 and 2023 saw record levels of biofuel blended into our petrol and diesel. Using provisional data from 2023, demand for petrol increased by 6.6% but reduced by 1.2% for diesel. In addition, there were significant increases in the volume of biofuel used: bioethanol increased by 41% and biodiesel by 29.5% (EPA, 2024a).

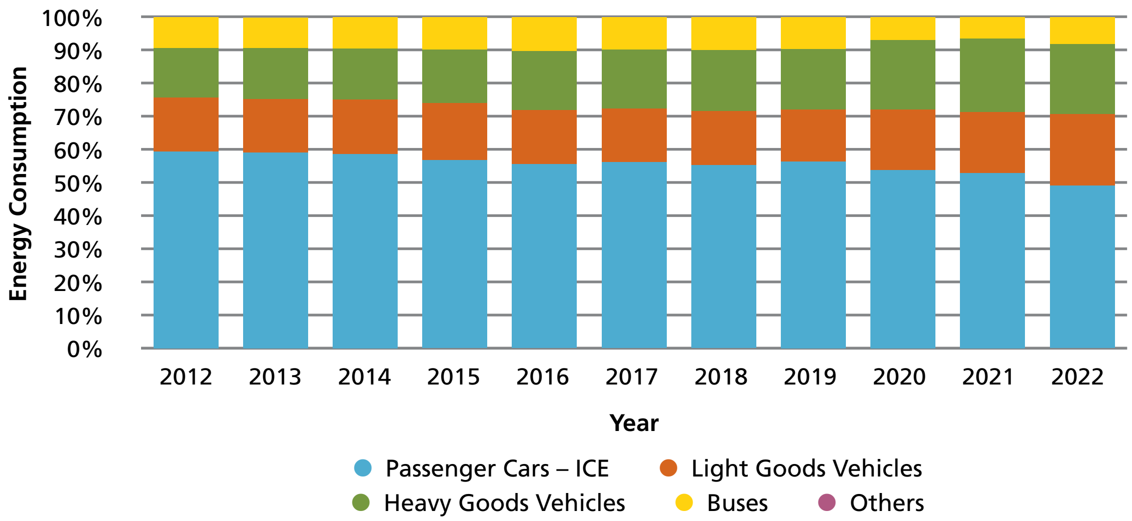
Internal combustion engine passenger cars, despite their share of total demand decreasing from 59.4% in 2012 to 49.1% in 2022, continue to account for just under half of the energy consumption by road transport (Figure 11.8). Light-duty vehicles exhibit minimal fluctuations in their share of energy consumption. Figure 11.8 shows a decreasing trend in the share of energy consumption for buses, from 9.4% in 2012 to 8.1% by 2022. This could suggest improvements in the efficiency of buses, a reduction in bus use or a shift to other modes of transport.

The increase in the proportion of energy consumption attributed to HGVs, from 14.9% in 2012 to 21.2% in 2022, suggests an increase in the volume of goods transported or a change in the usage patterns of these vehicles. It could be because of significant improvements in the fuel efficiency of other vehicle categories, especially passenger cars. As passenger cars have become more fuel efficient and their relative share of energy consumption has decreased, the share accounted for by HGVs appears larger by comparison, not necessarily because these vehicles have become less efficient or more numerous but because other categories are using less energy relative to HGVs.

Greenhouse gas emissions

In 2023, the transport sector was responsible for 21.4% of Ireland's greenhouse gas (GHG) emissions, highlighting the sector's considerable contribution to the country's overall emissions profile. Road transport accounted for 94.8% of these emissions (Figure 11.9).

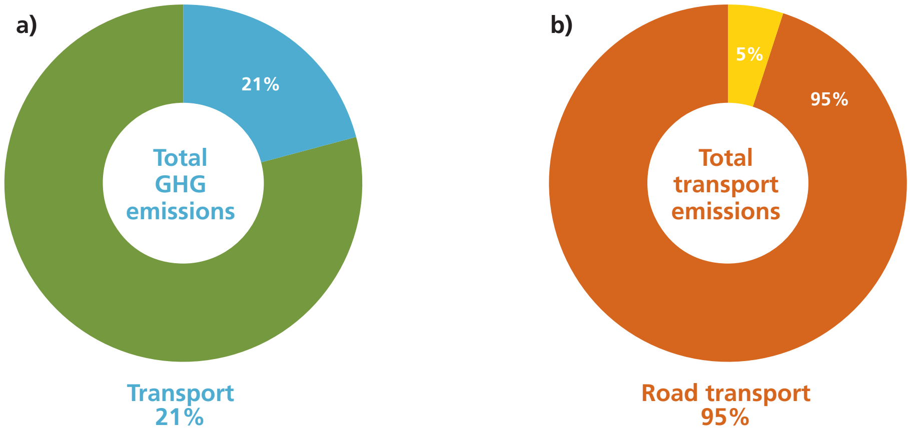
Figure 11.8 Breakdown of energy consumption by each mode of road transport, 2012–2022



Source: EPA, 2024a

Note: Other modes of road transport accounted for 0.1% each year, 2012-2022

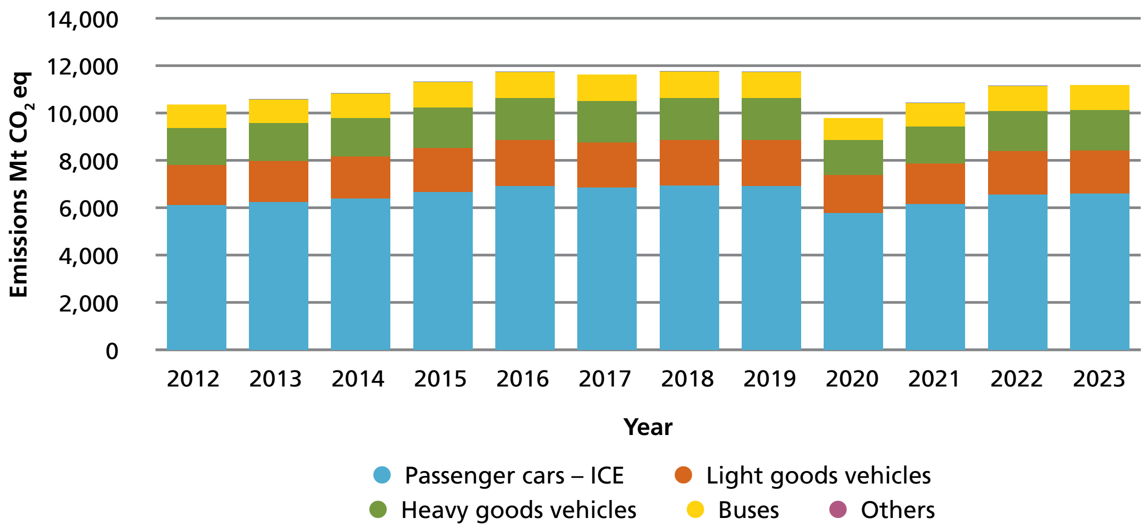
Figure 11.9 Proportion of Ireland's total greenhouse gas emissions from a) the transport sector and b) the proportion of these from road transport, 2023



Source: Adapted from Climate Action Plan (DECC, 2024)

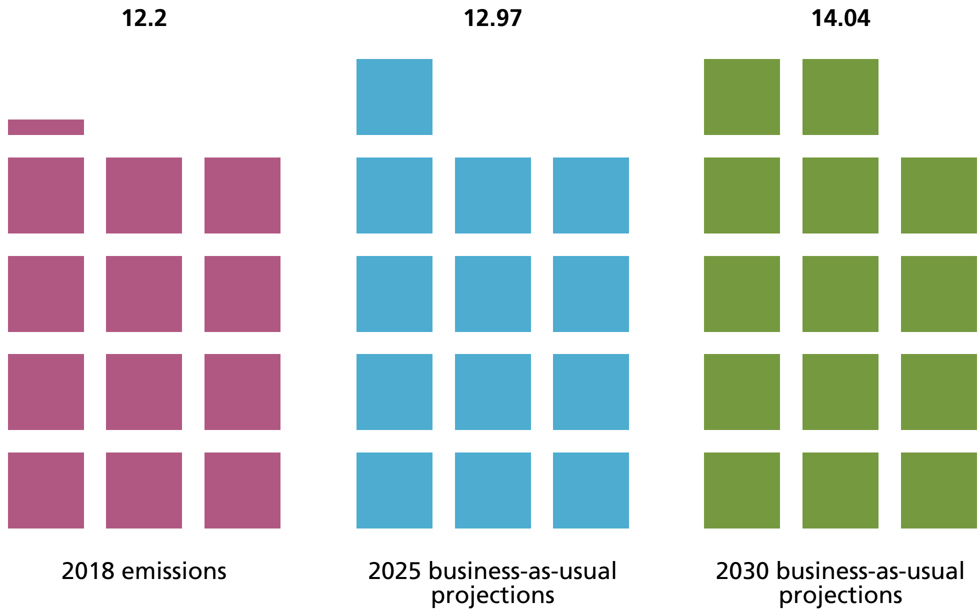
GHG emissions from road transport decreased as a consequence of the pandemic but have been on the rise since 2021, reaching 11.19 Mt CO_2 eq (megatonnes of CO_2 equivalent) in 2023 (EPA, 2024a) (Figure 11.10), as transport and economic activity recovered in the post-pandemic period. Passenger cars accounted for 49% of emissions, with their share of total emissions gradually declining over the last decade from 59% in 2012. Emissions from freight road transport constituted 40% in 2022 (Figure 11.10).

Figure 11.10 Breakdown of emissions by mode of road transport, 2012–2023



Between 1990 and 2023, the transport sector had the greatest overall sectoral increase in GHG emissions at 129.2%, from 5.1 Mt CO_2 eq (megatonnes CO_2 equivalent) in 1990 to 11.79 Mt CO_2 eq in 2023, with road transport emissions increasing by 133.6%. Fuel combustion emissions from transport accounted for 9.2% and 21.4% of total national GHG emissions in 1990 and 2023, respectively. Emissions from road transport were relatively stable during the period 2015–2019, at an average of 11.6 Mt CO_2 eq but reduced to 9.8 Mt CO_2 eq in 2020 due to COVID-19 travel restrictions. However, with the easing and ending of travel restrictions in 2021 and 2022, road transport emissions rebounded to 10.4 Mt CO_2 eq and 11.1 Mt CO_2 eq, respectively.

Figure 11.11 Estimated transport sector greenhouse gas emissions under a business-as-usual scenario. Units expressed as Mt CO_2 eq



In 2023, transport sector GHG emissions increased slightly by 0.3% compared with 2022, although they remained below pre-COVID levels at 11.2 Mt CO_2 eq. This small rise in emissions is in the context of a 6% increase in both 2021 and 2022 as transport sector emissions rebounded following the ending of COVID-19 travel restrictions. Despite this rebound, transport emissions in 2023 were still 4.3% below pre-COVID levels (EPA, 2024a).

It is projected that emissions from HGVs and light goods vehicles will account for 52% of total transport emissions by 2030 and 87% by 2050 as a result of growth in goods services and a reduction in emissions from passenger transport (EPA, 2024b).

Emissions from freight transport via maritime shipping, rail and inland waterways are significantly lower than those from freight carried by HGVs (EEA, 2021). In 2023, Ireland's international marine navigation emissions totalled 0.4 Mt CO_2 eq, a 1.4% decrease from 2022 (EPA, 2024a). These emissions are not included in Ireland's total emissions figure.

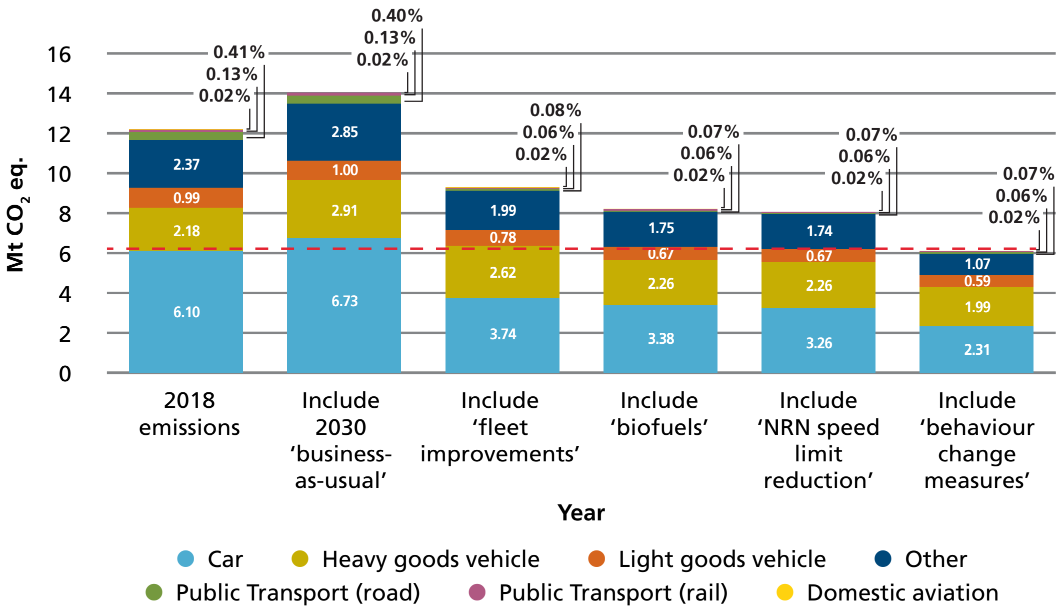
In the case of international aviation, total emissions in 2023 were 3.43 Mt CO_2 eq with only a small fraction of those attributed to transport of cargo (EPA, 2024a).

The National Transport Authority (NTA) has estimated that transport emissions would grow from 12 Mt CO_2 eq in 2018 to 14 Mt CO_2 eq by 2030 if no action was taken to curb them (Figure 11.11)

Ireland has identified measures aimed at reducing transport emissions by 50% by 2030 (as against 2018) in its Climate Action Plan. Staying within carbon budgets and sectoral emissions ceilings is required by law and is Ireland's contribution to curbing climate change. While practices such as enhanced levels of hybrid and remote working that were established during the pandemic may have disrupted some linkages between transport and economic activity, the strong rebound in transport demand and associated 6% growth in transport emissions witnessed in 2022 reflects the rapid return to economic growth, full employment and continued population growth in Ireland.

About two-thirds (64.1%) of the first sectoral carbon budget was expended in the period 2021–2023. While this level could be consistent with the sector complying with its carbon budget to 2025, it would require a consistent decrease in emissions from the level in 2023 in both 2024 and 2025. Over the period to 2025, the capacity to deliver large-scale mitigation measures by providing major new public transport (PT) infrastructure and services, or by significantly shifting the composition of the vehicle fleet to zero-emission alternatives, is limited. Environmental Protection Agency (EPA) projections show a potential cumulative 5-year overshoot of approximately 1 Mt CO_2 eq of the sector's first carbon budget by 2025 if further corrective action is not taken. Furthermore, EPA projections for the second carbon budget period suggest that this level of overshoot continues over the 2026–2030 period, leading to a cumulative projected deficit of approximately 5 Mt CO_2 eq relative to the sector's 37 Mt CO_2 eq carbon budget for the 2026–2030 period. The NTA has modelled the potential effectiveness of various measures in attaining a 50% reduction in transport sector emissions by 2030 to examine the potential impacts for the climate action plans (Figure 11.12). Overall, the modelling identified that fleet improvements (e.g. a move to BEVs) along with enhanced use of biofuels could yield substantial benefits. It was, however, clear from the modelling that a reduction in emissions of over 2 Mt CO_2 eq will need to come from behaviour changes.

Figure 11.12 Predicted reduction in carbon dioxide emissions, 2018–2030 (pathway to a 50% reduction by 2030)



Source NTA, 2023c

Emissions of air pollutants from transport sources

The transport sector has substantial negative impacts on the environment and human health. The majority of the emissions to air from transport in Ireland arise from diesel and petrol consumed by private cars and HGVs.

Transport is one of the key sectors covered under the National Emission Reduction Committments Directive ((EU) 2016/2284), which aims to reduce emissions of certain atmospheric pollutants (for more detail, see Chapter 2).

In Ireland, transport (and mainly road transport) is the second biggest source of nitrogen oxides (NO_x), contributing approximately 34.8% of the total in 2022 and is a smaller contributor of particulate matter (12.5%) (EPA, 2024c). As many transport emissions occur close to people in our towns and cities, they are of particular concern from a human health perspective. This issue is covered in more detail in Chapters 2 and 14.

Transport emissions accounted for 2.6% of total national emissions of non-methane volatile organic compounds, mainly from exhaust and fugitive releases from petrol vehicles.

Road transport saw a decline in NO_x emissions of 25.6 kt, or 44.2%, between 2008 and 2022 due to the economic recession initially and improvements in vehicle technology in later years. The COVID-19 restrictions had a significant impact in 2020 and 2021 (EPA, 2024c).

Ireland's emission reduction commitment for 2030 is set as a percentage reduction on 2005 emission levels; for NO_x the reduction was set at 69% by 2030 under the NEC Directive. Projections of NO_x emissions for all years to 2030 suggest that Ireland will comply with these emission reduction commitments (EPA, 2024c).

In addition to the five key air pollutants to which NEC Directive emission reduction commitments apply, the EPA's air pollutant emissions report also highlights the trends in emissions of other pollutants such as carbon monoxide, lead, dioxins and polycyclic aromatic hydrocarbons (EPA, 2024c).

Emissions of most of these pollutants have greatly decreased since 1990 because of measures such as banning leaded fuel, the introduction of catalytic converters and the move away from solid fuel for residential heating. The general trend in emissions of these pollutants is downwards, and the EPA reported that the changes in the age structure of the national vehicle fleet have had a positive impact.

Impacts of air pollutants on the quality of the air we breathe

The European Environment Agency estimates that there are in excess of 1600 premature deaths in Ireland every year (EEA, 2023) due to poor air quality from causes including cardiovascular disease and respiratory illnesses. Diesel vehicles are implicated in causing roughly 70 of these deaths and a loss of 3.8 years of healthy life across the affected population (Gallagher *et al.*, 2021). Further research suggests that prohibiting older diesel vehicles and ceasing their sales from 2025 could halve NO_x and $PM_{2.5}$ emissions by 2030 (relative to 2015 figures), thereby preserving 300 years of healthy living and generating savings of €43.8 million (Dey *et al.*, 2018). Figure 11.13 highlights the historical trends in NOx emissions.

In 2019, there was an exceedance of the annual permissible limit value for nitrogen dioxide at one monitoring station (St John's Road West) in Dublin. There were no other exceedances recorded elsewhere for nitrogen dioxide or any other air pollutant during 2019. The breach obliged the relevant local authorities to prepare an air quality plan to identify the root causes and formulate measures to address the exceedance by the end of 2021. The resulting plan set out 14 measures to address the issue. One key measure set out in the plan was the integration of a '15-minute neighbourhood' concept in city and county development plans developed for Dublin local authorities in their 2022–2028 development plans.[5]

Transport is not causing any ongoing breaches of current air quality standards, and there were no exceedances of air quality standards recorded at any monitoring station in the national ambient air quality monitoring network in 2020, 2021 or 2022. As outlined in Chapter 2, achieving Ireland's ambition, set out in the Clean Air Strategy, to move to tighter air quality guidelines will be extremely challenging but will have a significant positive impact on health.

Environmental noise

Environmental noise in our towns and cities is increasing, and excessive noise from transport sources is a health risk, with effects on sleep and cardiovascular and metabolic function, in addition to the nuisance caused. Exposure to noise from road traffic, railways, aircraft and industry is estimated to cause 10,600 premature deaths each year in Europe (EEA, 2022). It is estimated that 18.4 million people experience chronically high

5 www.dublincity.ie/sites/default/files/2021-12/dublin-region-air-quality-plan-2021.pdf (accessed 30 July 2024).

levels of annoyance due to noise pollution from transport. At the same time, 5.5 million people are estimated to experience chronically high levels of sleep disturbance (EEA, 2022). The EU Zero Pollution Plan sets a target of reducing the share of people chronically disturbed by transport noise by 30% by 2030 compared with 2017, the reference year (EC, 2021).

Chapter 4 describes in greater detail that just over 1 million people in Ireland are estimated to be exposed to noise levels from road traffic above the reporting thresholds set in the Environmental Noise Directive (2002/49/EC). For major rail infrastructure and the major airport, the number of people exposed to noise levels above the reporting thresholds were 85,100 and 12,600, respectively.

Technical measures to reduce noise exposure, such as the use of low-noise road surfaces or low-noise-generating tyres, have their limitations. Reducing demand and encouraging a major modal shift to walking, cycling and using public transport is a long-term goal as we move to more integrated spatial and transport planning. In this context, mobility planning will need to take account of designated quiet areas that will be defined in the noise action plans currently being prepared by local authorities. These plans are due to be completed in 2024.

Impacts on ecosystems and biodiversity

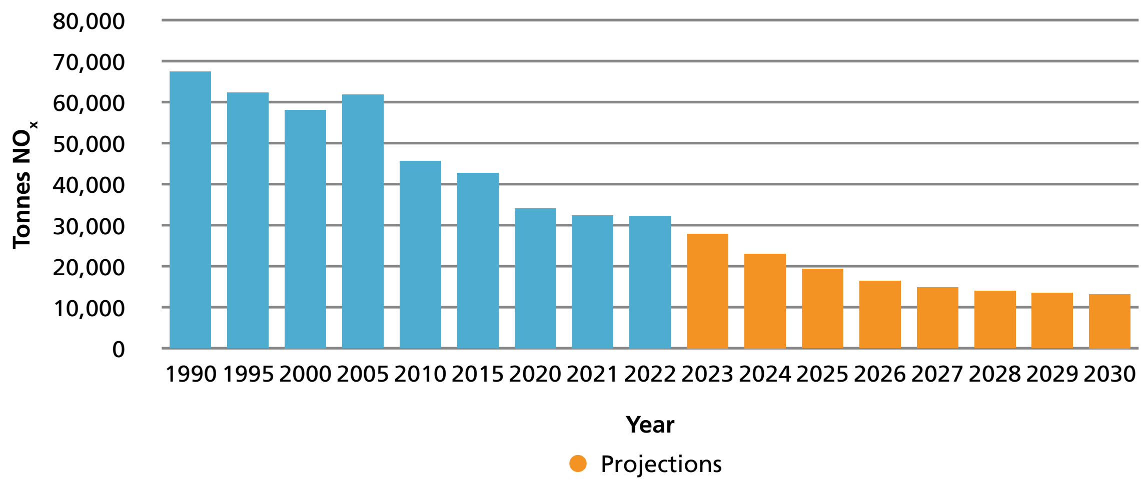
Transport can have significant negative impacts on ecosystems and biodiversity in different ways, including altering the quality and connectivity of habitats and creating physical barriers to the movement of animals between habitat areas or to the growth of plants.

NO_x deposited on land can drive the loss of sensitive species and in water bodies contribute to eutrophication.

Terrestrial noise has an impact on wildlife, as animals are stressed by noisy environments. A literature survey by Shannon *et al.* (2016) found that terrestrial wildlife start to react to noise at levels of about 40 decibels. An EU modelling study indicates that the level of underwater noise from shipping increased between 2014 and 2019, with the largest contribution from container ships, followed by tankers and general cargo ships.

The built environment, which includes all artificial surfaces such as buildings, roads and pavements, is an outcome of urbanisation and impacts the natural environment. The increase in artificial surfaces has been detrimental to the environment because of the loss of biodiversity caused by changes in land use, pressure from infrastructure, including roads, and air and noise pollution.

Figure 11.13 Trends in nitrogen oxide emissions for transport sector, 1990-2022, and projections to 2030



Source: EPA, 2024c

4. Responses

As outlined above, transport has an impact on the environment via air pollution, noise and GHG emissions (see Chapters 2, 3, 4 and 14).

Responses to transport issues to date have centred on reducing emissions of GHGs to mitigate ongoing climate change. These responses will have co-benefits in reducing air pollution and environmental noise but will not fully address these environmental issues. The remainder of this section will consider those responses at EU and national levels.

Policy responses

Table 11.4 provides a summary of the most relevant policy documents related to transport in Ireland. The annual Climate Action Plan acts as the key policy document in the area related to decarbonisation. Its annual review of the sector provides direction in terms of policy and progress in reducing emissions.

Table 11.4 Summary of current transport policy

POLICY	YEAR	OVERVIEW
Climate Action Plan (Department of the Environment, Climate and Communications)	Annual plan	The plan sets out pathways to reduce emissions in the transport sector by 50% by 2030. The plan uses the avoid–shift–improve framework to realise these emission reductions.
Dublin, Cork, Galway, Limerick and Waterford Metropolitan Area Transport Strategies (National Transport Authority)	Multiple years	Each of the five cities and their surrounding regions all produce transport strategies. These strategies outline the steps required to provide sustainable mobility.
Moving Together: A Strategic Approach to the Improved Efficiency of the Transport System in Ireland (Department of Transport)	2024	This draft strategy provides a range of demand management options for reducing emissions, including air pollutants, and noise exposure. The draft makes 35 key recommendations to enable a more efficient transport system in Ireland.
National Electric Vehicle Charging Infrastructure Strategy 2022–2025	2023	This strategy presents the pathway and practical steps for the delivery of a national electric vehicle charging network.
National Road EV Charging Network Plan	2023	This plan is the first part of the National EV Charging Plan and focuses on and provides a roadmap for the development of en-route EV charging.
Universal Design Guidelines for EV Charging Infrastructure	2023	The guidelines provide clear direction to all those involved in the manufacturing, procurement, installation and operation of the electric vehicle charging infrastructure.
Ireland's Road Haulage Strategy 2022–2031	2023	The first-ever government strategy dedicated to the haulage and road freight sector focuses on measures to help the sector move to a low-carbon future.
Renewable Transport Fuel Policy 2023–2025	2023	This sets out Ireland's policy pathway for achieving a renewable transport fuel supply that meets national Climate Action Plan biofuel targets and EU renewable energy obligations.

POLICY	YEAR	OVERVIEW
National Sustainable Mobility Policy (Department of Transport)	2022	The policy establishes a strategic framework for active travel (walking and cycling) and public transport to 2030 to assist Ireland in meeting its climate commitments.
Five Cities Demand Management Study (Department of Transport)	2022	This study focuses on the five cities in Ireland and how travel demand management measures could be incorporated to reduce emissions and congestion and improve air quality. It was a key input to the draft strategy Moving Together (see above).
National Investment Framework for Transport in Ireland (NIFTI)	2021	A strategic framework to guide future investment in Ireland's land transport network. It aligns with the broader goals of Project Ireland 2040 and aims to support sustainable development and decarbonisation.

Avoid–shift–improve in an Irish context

Technology-orientated efficiency improvements alone will not be sufficient to achieve the very substantial and urgent reductions in environmental pressures that are required. Instead, there is a need to complement incremental improvements to established systems with other measures addressing the scale or patterns of consumption. The following section describes some of the key 'avoid–shift–improve' actions that have potential in the Irish context.

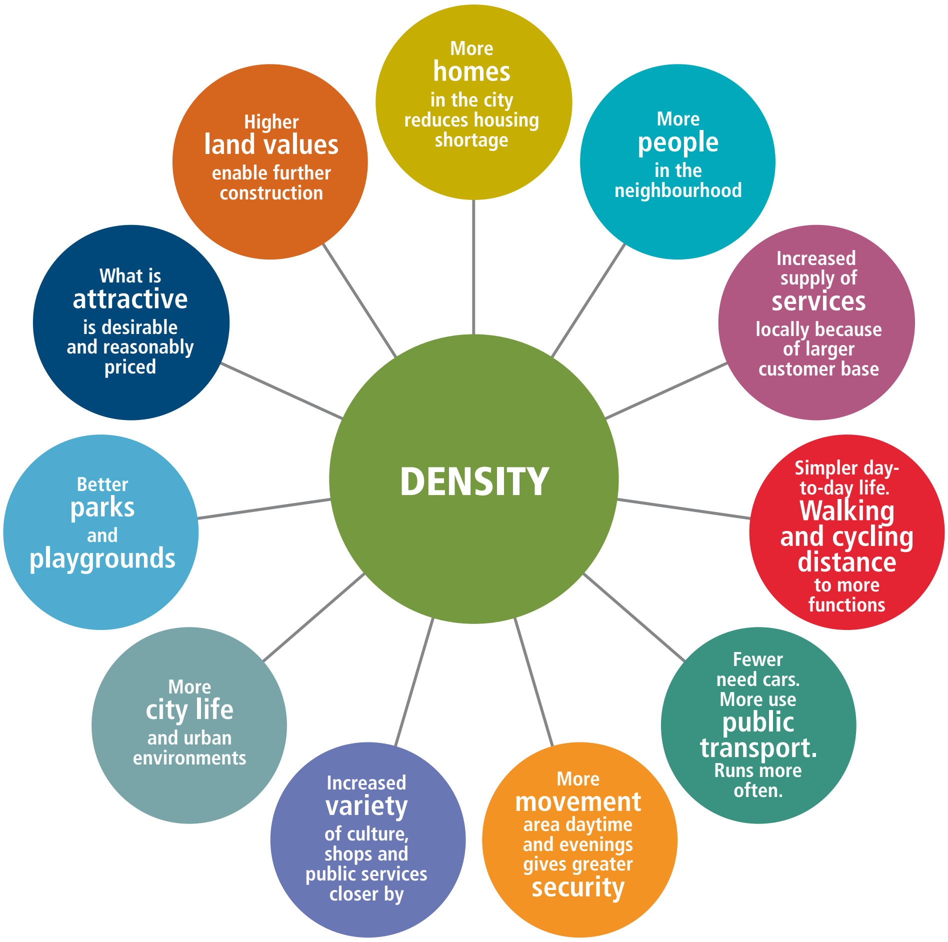
Avoidance actions

Spatial planning. Compact development principles advocate higher population densities, mixed land use combining residential, commercial, recreational and other spaces, street connectivity, access to destinations by public transport, walking and cycling, and having public transport nodes within optimal distance of trip origins and destinations (Moriarty *et al.*, 2023). Some of the principles of compact living that overlap with proximity planning were tested in Irish urban areas, and several interventions are proposed in the work of Andersen (2021). By concentrating development, compactness helps preserve open spaces, agricultural land and natural habitats while also reducing infrastructure costs and the environmental impacts associated with urban expansion (Figure 11.14). The draft update to the National Planning Framework has set a target of at least 40% of all new housing to be built within existing built-up areas of cities, towns and villages (Government of Ireland, 2024). Increasing the attractiveness of brownfield over greenfield sites is important to meet the targets outlined in the National Planning Framework. This can be achieved by introducing green spaces and maintaining public spaces well rather than other interventions, such as a vacancy tax, which has been only partially effective (OECD, 2022). Land use is further discussed in Chapter 5.

A transport-orientated development (TOD) working group was established in December 2021 under the Government's Housing for All plan to consider opportunities for TOD in major urban centres to support compact growth, achieving climate action objectives and housing delivery. The working group published a report on TOD opportunities in Dublin[6] in June 2023.

6 www.gov.ie/en/publication/0b532-opportunities-for-transport-orientated-development-tod-in-major-urban-centres-dublin-study/ (accessed 31 July 2024).

Figure 11.14 Multiple benefits of compact development



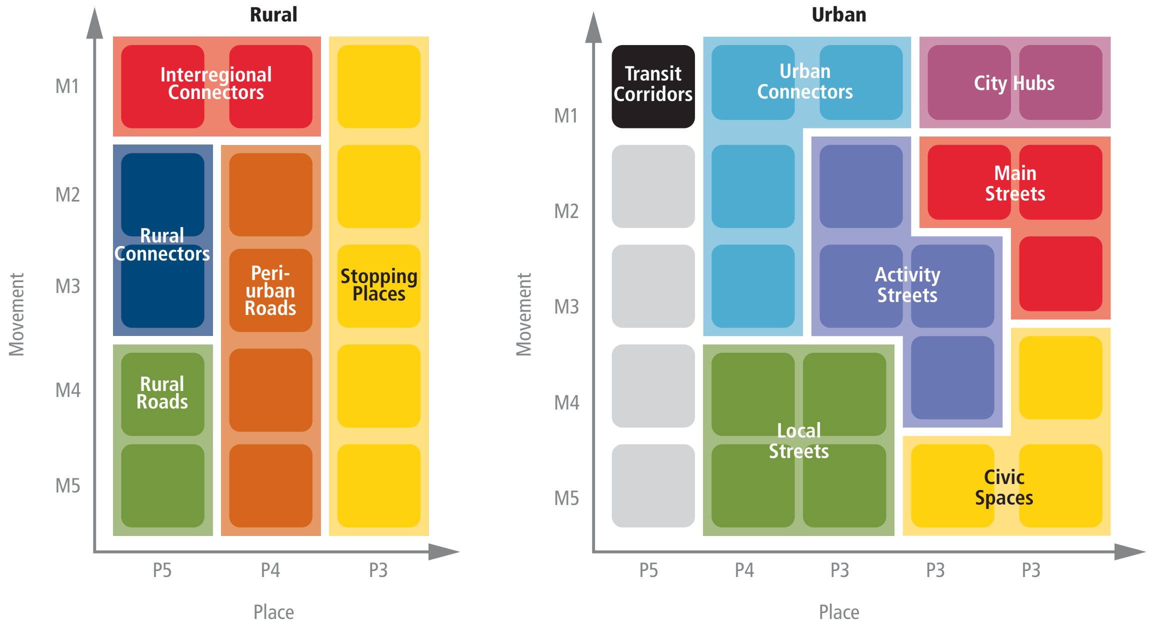
Source: Bibri *et al.*, 2020; reproduced under the terms of the Creative Commons CC BY 4.0 licence (creativecommons.org/licenses/by/4.0)

Reallocation of street space. The reallocation of road space is critical in supporting sustainable modes of transport, especially walking and cycling, and has been found to contribute positively to achieving equity, wellbeing, a thriving local economy and climate action targets (Douglas *et al.*, 2023). However, interventions for reallocating urban space in Ireland are rather fragmented and being introduced incrementally rather than transformatively, as the car-dominant mental model prevents the radical implementation of road reallocation (Egan and Caulfield, 2024).

Pedestrian plans are established for the five cities, with more to follow for regional centres throughout 2024 (DoT, 2024a). The Active Travel Investment Programme has delivered 600 kilometres of walking and cycling paths nationwide, with over 1200 projects progressed or delivered, including the Salmon Weir Bridge in Galway, the Bilberry Greenway in Waterford, and the Mahon Greenway in Cork (DoT, 2024a).

Road space is contested space and thus holistic planning and balancing stakeholder needs is necessary. For instance, the framework proposed by Creutzig *et al.* (2020) balances three perspectives: streets for transport, streets for climate action and sustainability, and streets as places. In another example, using the movement and place framework, the New Zealand government has introduced the One Network Framework, which methodically categorises streets and roads to facilitate targeted actions (Figure 11.15). This allows the redesign of areas to prioritise movement on essential inter-regional roads and enhance place functions that promote walking and cycling on local streets (Waka Kotahi NZ Transport Agency, 2023).

Figure 11.15 One Network Framework classification of streets and roads in New Zealand



Source: Waka Kotahi NZ Transport Agency, 2023; reproduced under the terms of the Creative Commons CC BY-NC 4.0 licence (creativecommons.org/licenses/by-nc/4.0/).

The direct relationship between reallocating road space to people and the improvement of air quality is evident in a number of studies (Hulkkonen *et al.*, 2020; Glazener *et al.*, 2022). The travel restrictions implemented in 2020 to curb the spread of COVID-19 have underscored the clear connection between traffic and nitrogen dioxide levels in ambient air (EPA, 2021). This connection between restricting car traffic and improved air quality is increasingly recognised by Irish policymakers. For example, the Living Streets scheme in Dún Laoghaire is designed to both reduce noise and improve air quality while also encouraging safer travel within its designated areas (DLRCC, 2023). Local evidence from redesigning Blackrock village shows that it increased public space by 25%, reduced car trips by 40% and improved business revenue, air quality and street safety (TU Dublin and DLRCC, 2021).

Demand management. The Department of Transport published the *Five Cities Demand Management Study* in November 2021 (DOT, 2021). The study set out to develop an understanding of the drivers of transport demand and how a shift to more sustainable travel in Dublin, Cork, Waterford, Limerick and Galway could be promoted. The study assessed a wide range of measures in terms of their impact in reducing GHG emissions, tackling congestion and improving air quality. This included measures such as reallocating road space from private cars to prioritise walking, cycling and public transport; providing safer walking and cycling options; and reducing the number of parking spaces. It also included the concept of 15-minute neighbourhoods, where the population can reach the amenities it needs daily by a short walk, cycle or public transport journey. The study, which provided a series of evidence-based demand management recommendations for each of the cities along with a national roadmap for delivery, was a key input to the development of a new national demand management strategy (DOT, 2024b).

The new draft strategy aims to make the transport system more efficient and to alleviate the impacts of car dependency and congestion on the economy, the environment and the health of our society. The strategy, and associated Implementation plan, includes recommendations on developing demand management schemes and updating national guidelines and standards to support road space reallocation measures in particular.

Shift actions

Active travel. There are various determinants of the choice between walking and cycling, but trip characteristics and the built environment can be directly or indirectly influenced by policy. For instance, adapting the infrastructure in such a way that saves travel time (e.g. more pedestrian crossings) and creating a mixed land use environment, where residential and other functional areas are combined, can significantly reduce distances, thereby encouraging active travel (Ton *et al.*, 2019).

Connecting Ireland Rural Mobility Plan. The NTA's Connecting Ireland Rural Mobility Plan is delivering new rural bus services in towns and villages at a rate of approximately one new service every week, with over 110,000 vehicle-kilometres a week added to the public transport network in 2022 through new services, more frequent services and route extensions. As a result, over 50 settlements were newly connected to the public transport network, facilitating crucial access to health services, education and employment opportunities and reducing reliance on private transport. The key commitments made in Connecting Ireland are as follows:

- 70% of people in rural Ireland to have access to public transport services that provide at least three return trips to the closest large town
- over 100 rural villages to benefit from frequent public transport services for the first time
- over 100 rural areas to benefit from a regular service to their county town for the first time
- over 60 new connections to regional cities from surrounding areas
- an innovative approach to improving mobility for people in remote areas.

Micromobility. Encompassing small, lightweight vehicles such as e-scooters, e-bikes and bicycles, micromobility presents a promising solution for sustainable transport in Ireland. These vehicles are designed for short distances of up to 15 kilometres and have the lowest GHG emissions per vehicle-kilometre of any form of urban transport (ITF, 2020). Micromobility has the potential to increase the affordability and sustainability of transport (Kathiresh *et al.*, 2022).

Micromobility can be a good alternative to private cars for trips of 2–5 kilometres and is attractive during congested periods (Liao and Correia, 2022). The results of the National Travel Survey suggest that these modes were used for approximately 2–4%[7] of all trips in 2021 (CSO, 2022a). Among electric micro-vehicles, e-bikes, e-scooters and e-cargo bikes are the most popular (Liao and Correia, 2022). e-Bikes are sometimes seen as an option for the first or last mile of trips made by public transport.

With the right policies and frameworks, micromobility can play a significant role in creating a sustainable, efficient and inclusive transport network in Ireland. Ireland's Road Traffic and Roads Act 2023 sets out the regulations for legal categories of light EVs. For instance, the new legislation regulating e-scooter use (and also e-bikes and e-mopeds) is expected to improve the safety of both e-scooter riders and other road users[8].

Improvement actions. A number of actions are seeking to make the transport system more efficient by reducing the emissions per unit of distance travelled. These include moving to EVs, improved fuel efficiency or blending fossil fuels with biofuels.

Electric vehicles. As part of the Climate Action Plan 2024, electric cars (and the associated national EV charging infrastructure strategy[9]) play an important role in achieving climate targets in the transport sector. Fleet electrification targets assume 845,000 private EVs in the fleet by 2030, with a requirement for 30% of BEVs in the total passenger fleet. At the end of 2023, battery electric cars accounted for 4.5% of the passenger car fleet.

New registrations of EVs have grown steadily over time. However, there is uncertainty around achieving the targets, as sales over the last two years show slower growth, and the trends show a preference for SUVs, which consume more energy.

Athlone became the first town in Ireland to have a fully electric bus fleet in 2023. A fleet of 11 electric Bus Éireann buses is expected to carry 10,000 passengers per week and reduce CO_2 emissions by 400 tonnes a year.[10] The introduction of the first 100 double-decker battery electric buses to Dublin city services is almost complete, with 85 of these buses now in service and completion anticipated by the end of 2024. In 2024, the bus network in Limerick is expected to be fully electrified with 34 new electric buses; depot electrification plans are also being progressed in Cork, Galway and Sligo.

Shared mobility. The average private car is in active use only 3–4% of the time, and for the remaining time it occupies space parked at home or elsewhere (Government of Ireland, 2021). Simulations for Dublin show that shared mobility services have the potential to replace 20% of private car trips, which translates into a reduction in emissions of more than 20% (ITF, 2018).

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7 Electric micro-vehicles are included in either 'cycle' (alongside bicycles) or 'other' modes of travel, making it challenging to determine the exact share of trips.

8 www.gov.ie/en/campaigns/5e95b-e-bikes-e-mopeds-and-e-scooters/

9 The EU Alternative Fuels Infrastructure Regulation ((EU) 2023/1804) mandates minimum infrastructure requirements on the European transport network.

10 www.nationaltransport.ie/news/minister-ryan-launches-irelands-first-all-electric-town-bus-service-in-athlone/ (accessed 31 July 2024).

The simulation does not assume that vehicles are electric; thus, supplying electric shared mobility options could cut emissions even further (ITF, 2018). Another study shows that the introduction of shared cars in Dublin, assuming a certain level of uptake and that all vehicles would be electric, could save emissions of 84 kt CO_2 eq annually (Rabbitt and Ghosh, 2016). The Yuko scheme in Dublin was found to decrease emissions and reduce car ownership (Caulfield and Kehoe, 2021). Over recent years the number of shared bike schemes across the country has grown substantially. Each of the five cities in Ireland now has a shared bike scheme, and many of the larger towns across the country are introducing similar schemes.

In addition to systems already available, such as docked or dockless e-bikes and e-scooters, new solutions such as e-mobility hubs are being tested. The hubs centralise the availability of various forms of micromobility and electric cars, often interconnected through a unified digital platform. Such solutions are currently being tested in Ireland in projects including eHUBS (Interreg NWE, 2023), TRACT (SEAI, 2023a) and ROBUST (SEAI, 2023b).

Freight transport. A particularly difficult challenge for decarbonising the transport sector has been encountered in the haulage and heavy goods road freight sector, which, together with emissions from the light commercial vehicle fleet, accounts for 43% of total transport emissions. Collectively, the commercial goods fleet comprises over 385,000 commercial vehicles (as at end December 2021), of which approximately 40,000 are HGVs, which are heavily reliant on diesel fuel for their operation (Topic Box 11.3).

Topic Box 11.3 Freight transport

Integrating road, rail and maritime freight transport

The optimal strategy for freight transport is to integrate road freight, rail and maritime transport and to shift economic incentives to favour rail freight (OECD, 2021). The *All-Island Strategic Rail Review* (DoT and DfI, 2024) and earlier Rail Freight 2040 Strategy (Irish Rail, 2021) propose to integrate rail in more pronounced ways into existing freight corridors. The rail review (DoT and DfI, 2023) aims to increase rail freight's share of total freight transport to 10%, from a current historical low of below 1% of total tonne-kilometres. The proposed recommendations include creating a sustainable first mile–last mile access system for Dublin Port, lowering track access charges for freight services, enhancing rail connections to major ports, and establishing a network of inland terminals near major cities on the rail network. The estimated reduction in emissions resulting from these changes is not known. Nevertheless, Irish Rail estimates show that rail freight produces 76% less emissions per tonne-kilometre than road transport even if not electrified (Irish Rail, 2021), and thus the savings are likely to be substantial. This is a long-term plan and it will be important to monitor and evaluate progress to ensure effective and timely delivery.

New last-mile delivery options

For the last mile of delivery, e-cargo bikes, which are designed for transporting heavy loads, are equipped with an electric battery to reduce the physical strain on the rider. Given that a substantial amount of the transport of goods by HGVs occurs within urban areas, identifying an alternative such as e-cargo bikes is crucial for reducing traffic congestion. These bikes are versatile and suitable for various urban freight needs, including postal deliveries (Topic Box 11.4), food and drink deliveries, and essential service maintenance (Blazejewski *et al.*, 2020).

Internationally, e-cargo and cargo bikes are commonly used for last-mile deliveries, moving goods from city hubs, micro-hubs or directly from local businesses to customers (Büttgen *et al.*, 2021; Katsela *et al.*, 2022). A recent simulation for Padua suggests that using e-cargo bikes for last-mile deliveries could reduce costs by 27–45% and emissions by 71–79% and also shorten delivery times in the case of e-cargo bikes (Ceccato and Gastaldi, 2023). Research indicates that infrastructure improvements, such as segregated cycling lanes that can make deliveries by e-cargo bikes more efficient than vans and trucks, are expected to increase uptake. Other infrastructure improvements include better parking facilities and improved access for cargo bikes (Sherriff *et al.*, 2023).

Topic Box 11.4 Transitioning to sustainable transport

An Post, as the operators of one of the largest fleets in the country, has a responsibility to ensure that it is reducing the carbon footprint of its vehicles. With a presence in every community, An Post is able to help create a cleaner, greener society by spreading awareness and leading by example.

In 2018, An Post began transitioning its fleet to EVs and committed to replace its last-mile vehicles with EVs wherever possible. There are now over 1100 EVs in the fleet, including the first 7.5-tonne e-truck in Ireland as well as over 160 e-trikes for shorter routes.

An Post's journey to a sustainable transport model extends beyond vehicle acquisition to include:

- the development of Ireland's largest private charging network of over 1300 chargers, including two public-access fast chargers for customers at the Carlow and Wexford delivery service units
- the use of hydro-treated vegetable oil for its HGVs as an interim solution.

An Post is committed to investing further in sustainable transport, expanding and adapting its last-mile EV fleet as it shifts from being a letter-focused to a parcel-focused business. It remains on track to meet its target of transitioning 50% of the fleet to alternative fuel sources by 2025.

An Post is an active member of a number of leading national and European networks, including the Alliance for Logistics Innovation in Europe,[11] Climate Group[12] and Hydrogen Ireland.[13]

Source: An Post

Integrated response

Volume 4 of the recently published Ireland's Climate Change Assessment (Moriarty *et al.*, 2023) supports the call for systemic change in the transport sector. The necessary change must occur within the structure of the transport system, rather than only targeting symptoms such as traffic congestion. This entails shifting the focus of the transport system's goals from mobility to accessibility. The need to integrate spatial, urban and transport planning provides leverage for redesigning the current system and the avoid–shift–improve framework can help prioritise actions so that proximity redesign ('avoid') is placed at the forefront, followed by supporting the shift to sustainable transport modes ('shift').

11 www.etp-logistics.eu (accessed 31 July 2024).

12 www.theclimategroup.org/ev100-members (accessed 31 July 2024).

13 hydrogenireland.org/?sfw=pass1727261097 (accessed 31 July 2024).

5. Areas for focus

Increasing demand for transport

In 2023, we saw increasing numbers of vehicles on our roads, a record demand for public transport and an increase in the demand for freight. Together with our increasing population, these factors will all make reaching our emission reduction targets in the transport sector very difficult to achieve.

Capacity constraints

Extensive plans exist for developing new public transport infrastructure, including MetroLink, DART+ programme, Luas extension in Dublin, light rail for Cork, BusConnects for Dublin, Cork, Galway, Waterford and Limerick, and active travel infrastructure right across the country. Achieving the volume of construction required to deliver this infrastructure by the end of the decade will be a monumental task. Many large transport projects have faced planning delays, and their timeline for construction and delivery in the late 2020s to mid 2030s means that they are unlikely to deliver substantial decarbonisation of the sector over the rest of this decade.

Emissions rising

In 2023, we saw GHG emissions stabilise in comparison to 2022, and it appears that the benefits and savings from existing policies and measures are just keeping pace with the drivers pushing emission levels upwards.

A growing private transport fleet

The make-up of car fleets in Ireland is following the international trend towards larger and heavier vehicles. Almost 80% of the vehicles sold in 2023 were reliant on fossil fuels,[14] with sales of new cars up 16% on 2022. These vehicles will be in Ireland's car fleet for at least another decade, locking in their emissions and making it increasing difficult to decarbonise this sector.

Grid capacity to facilitate heavy goods vehicle charging

A key concern is getting charge into depots to allow low-cost overnight HGV charging. EV trucks are commercially available and the cost is supported by a state grant – but private and public uptake is likely to remain low until a charging infrastructure is in place.

Long-term ability to adapt

The current trajectory in the uptake of electric cars could see us reach our Climate Action Plan targets for 2025. However, the targets for 2030 are very ambitious, and obstacles such as the supply of electric cars, the availability of charging infrastructure and a potential plateau in sales may put this target in jeopardy. Equally, there are concerns about the supply of feedstock required to produce the amount of biofuel required in our targets.

14 www.simi.ie/en/news/121-850-new-car-registrations-in-2023-electric-cars-up-45

6. Conclusions

The transport sector is a major consumer of energy and material resources, and it is a source of environmental pollution, particularly GHGs, air pollutants and noise. A sustainable transport network is a vital attribute of any country, as it reduces pressure on the environment and results in cleaner, quieter towns and city centres.

The OECD has noted that aiming to decarbonise the transport system in Ireland via improvements in private vehicles is unlikely to lead to substantially different patterns of behaviour or achieve the rapid emission reductions needed for climate change mitigation. To achieve Ireland's climate goals in the transport sector requires systemic change. Such change requires deep integration of spatial, transport and transition planning to implement measures that deliver compact development and to expand the active and public transport infrastructure to achieve the modal shift needed to overcome the dominance of the private car.

An internationally accepted policy approach for changing transport systems is the hierarchy of the avoid–shift–improve framework. This includes implementing measures to reduce the frequency and distance of trips (avoid); moving towards more environmentally friendly modes of transport, such as walking, cycling or using public transport (shift); and promoting efficient fuel and vehicle technologies, including EVs (improve). For Ireland, while elements of the framework are in place, there is a need to accelerate this approach if we are to decarbonise the transport sector and meet our challenging environment and climate targets.

Key chapter messages

1. The transport sector is a major consumer of energy and material resources and is a source of environmental pollution, particularly greenhouse gases, air pollutants and noise.

2. A sustainable, accessible and efficient transport system is not only important for the environment and wellbeing but is also a key enabler for the economy.

3. High-level integration between land use planning and transport planning is needed to achieve more compact development, incentivise a move away from private cars, and move trips to rail, bus, cycling and walking. Shifting to these modes is an essential part of a sustainable and climate-neutral transition for the transport sector.

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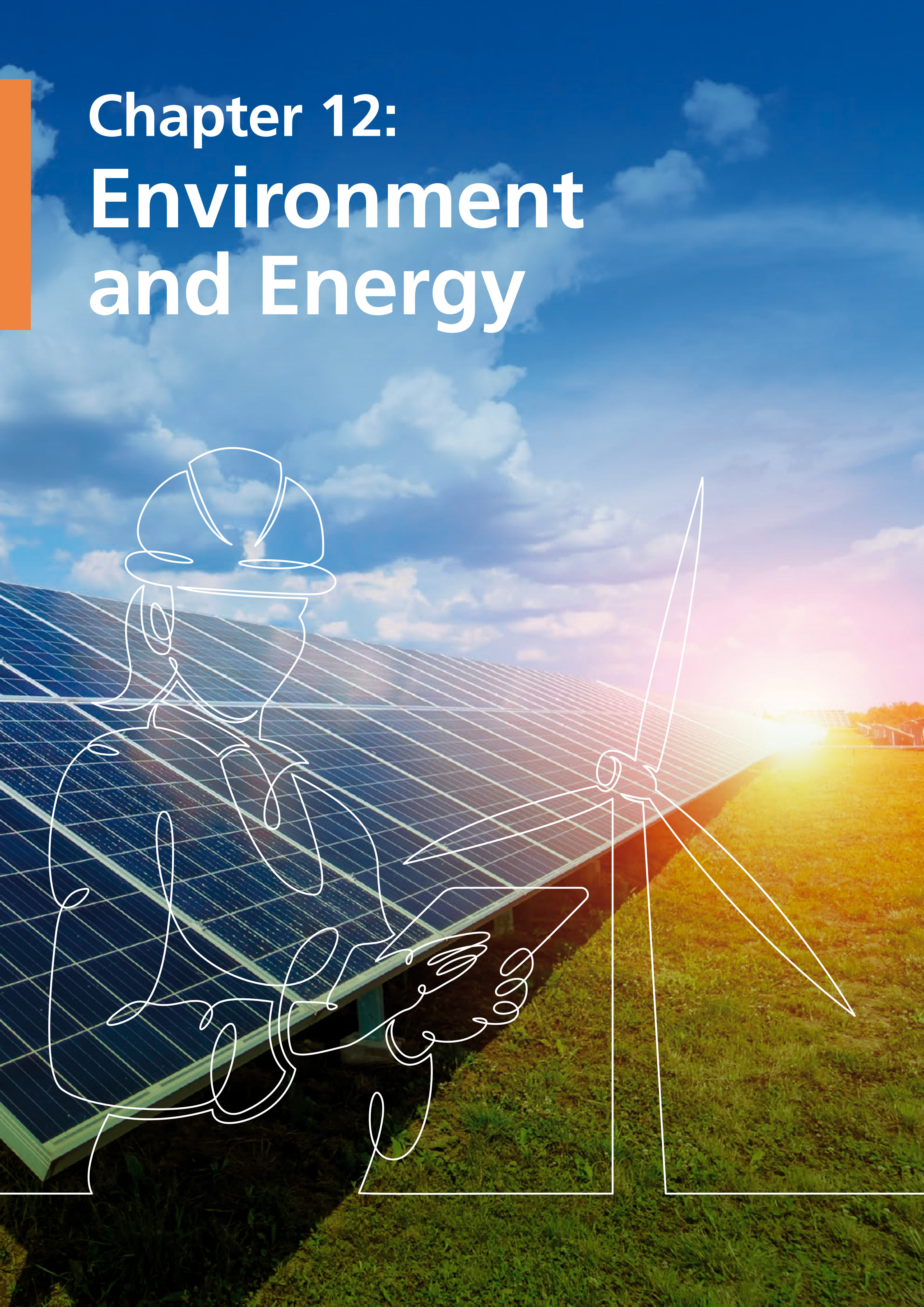
Chapter 12: Environment and Energy



Environment and Energy

1. Introduction

Our health, environment and climate are significantly affected by how we source, manage and use energy in Ireland to meet our growing demands for heating, mobility and electricity. Access to reliable energy supplies and energy-powered technologies has improved our quality of life and has been a key enabler of economic and social development in Ireland. A century has passed since legislation was introduced that drove the construction of Ireland's first large-scale hydro power plant at Ardnacrusha, which in turn led to the development of our electricity grid system, enabling widespread access to electricity and the multiple benefits this brought.

Population growth, economic growth and rising standards of living over the past 50 years have all contributed to increasing Ireland's demands for heating, transport and electricity. We have primarily met these growing demands by using more coal and peat initially, then oil (petrol, diesel and kerosene), followed by natural gas and more recently wind power.

As a consequence of meeting these growing demands primarily with oil, natural gas, coal and peat, our energy system is highly dependent on fossil fuels. Ireland has made some progress in transforming the electricity system through the deployment of wind farms, with renewable energy currently providing more than 40% of electricity used. However, electricity represents only one-fifth of Ireland's energy use, and our transport and heating systems remain heavily reliant on fossil fuel systems, with lock-ins that need to be addressed.

In addition to growing electricity from wind and solar sources, some progress has been made in Ireland's heating and transport energy systems due to policy changes relating to new buildings through building regulations, upgrading existing buildings through retrofitting, biofuel blending in transport and increased sales of electric vehicles.

Ireland's energy supply and demand is currently undergoing accelerated changes driven by increased climate policy ambitions and by economic and geopolitical trends. The policy responses that followed Russia's invasion of Ukraine and the resulting increases in energy prices highlighted our dependency on imported fossil fuels and the need to improve our energy security. This further emphasised the urgency of accelerating the transition away from fossil fuels in Ireland and towards using cleaner and more renewable energy sources to support decarbonisation, protect against volatile energy prices and secure Ireland's future energy supply.

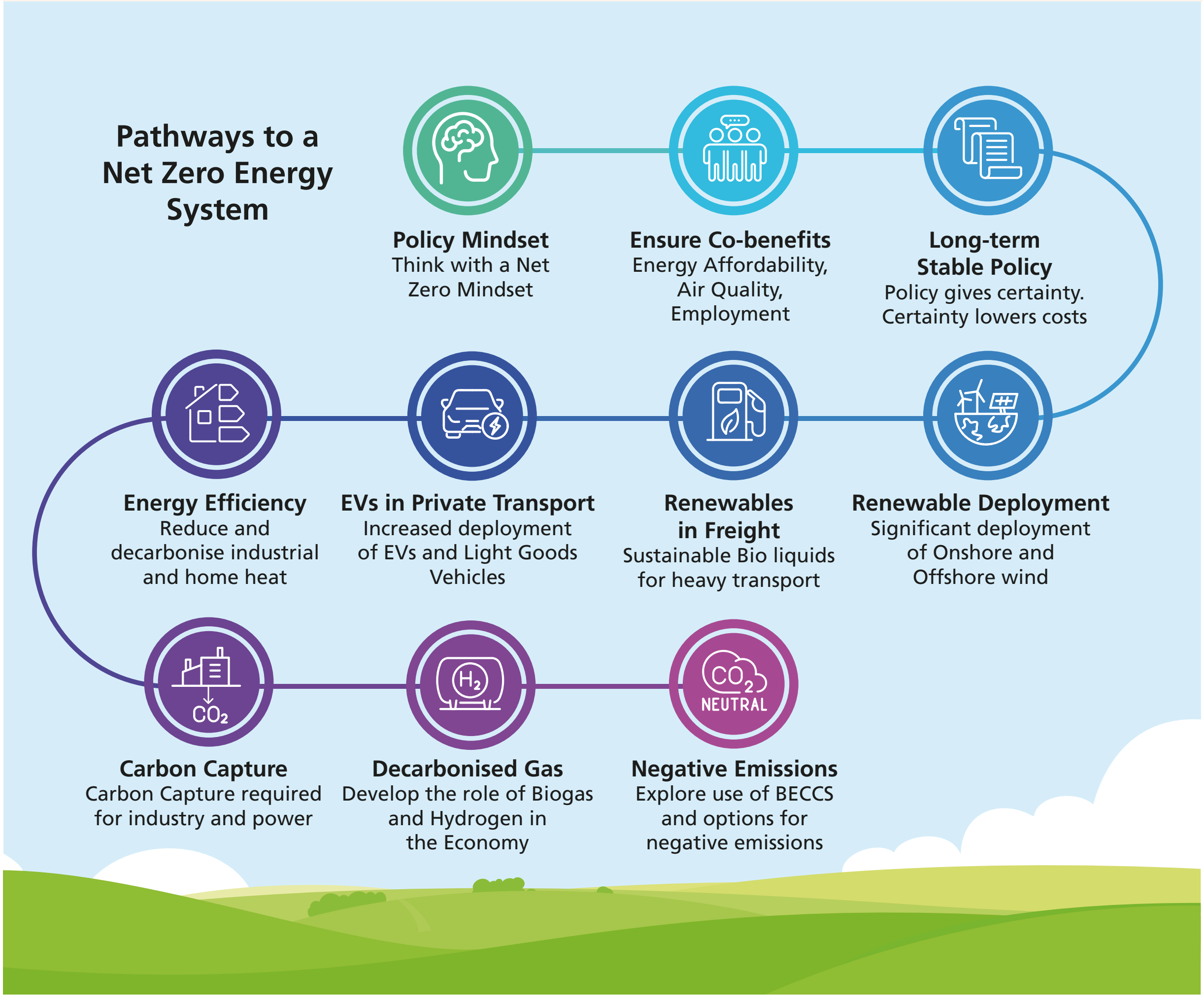
Demands for energy are also changing, and Ireland is experiencing strong growth in electricity demand, in particular through the development of the digital economy. Therefore the transition requires not only technological changes but also systemic changes across society and the economy – changes that challenge approaches to growth and consumption. This transformation of our energy systems also needs to enable a just transition for all members of society.

Looking ahead, the changes that are needed in Ireland's energy system are becoming increasingly clear. Volume 2 of Ireland's Climate Change Assessment (ICCA), *Achieving Climate Neutrality by 2050* (McGookin *et al.*, 2023), highlights that well-established 'no-regret options' can significantly move Ireland's energy decarbonisation forward and need to be implemented now. These include demand reduction (e.g. through energy efficiency and reduced consumption), electrification (e.g. electric vehicles and heat pumps), deployment of market-ready renewables (e.g. wind and solar power) and low-carbon heating options (e.g. district heating).

According to the ICCA report, however, there remains uncertainty regarding the full scale and mix of specific future technologies to help bring the sector to net zero emissions. Alternatives such as bioenergy, other renewables and hydrogen will be needed in sectors not currently suited to electrification, such as heavy transport and industry, and to balance a grid based on variable renewable electricity technologies. These require further investigation.

The ICCA report also highlights that renewables open up opportunities in the green economy, including for coastal communities and farmers, and that distributed energy enables homeowners to be producers of energy, lowering energy bills. The energy transition requires consideration of issues beyond technical aspects, including environmental, societal, economic and governance dimensions. The ICCA report identifies the need for an enhanced regulatory and planning framework to accelerate the deployment of renewables, realise co-benefits and manage trade-offs, competition and impacts on other land uses, including biodiversity, food production and carbon sequestration. In summary, the pathways to achieving a net zero energy system involve many elements (Figure 12.1)

Figure 12.1 Pathways to a net zero energy system



BECCS, bioenergy with carbon capture and storage

Source: Adapted from McGookin *et al.*, 2023

2. Energy, health and the environment

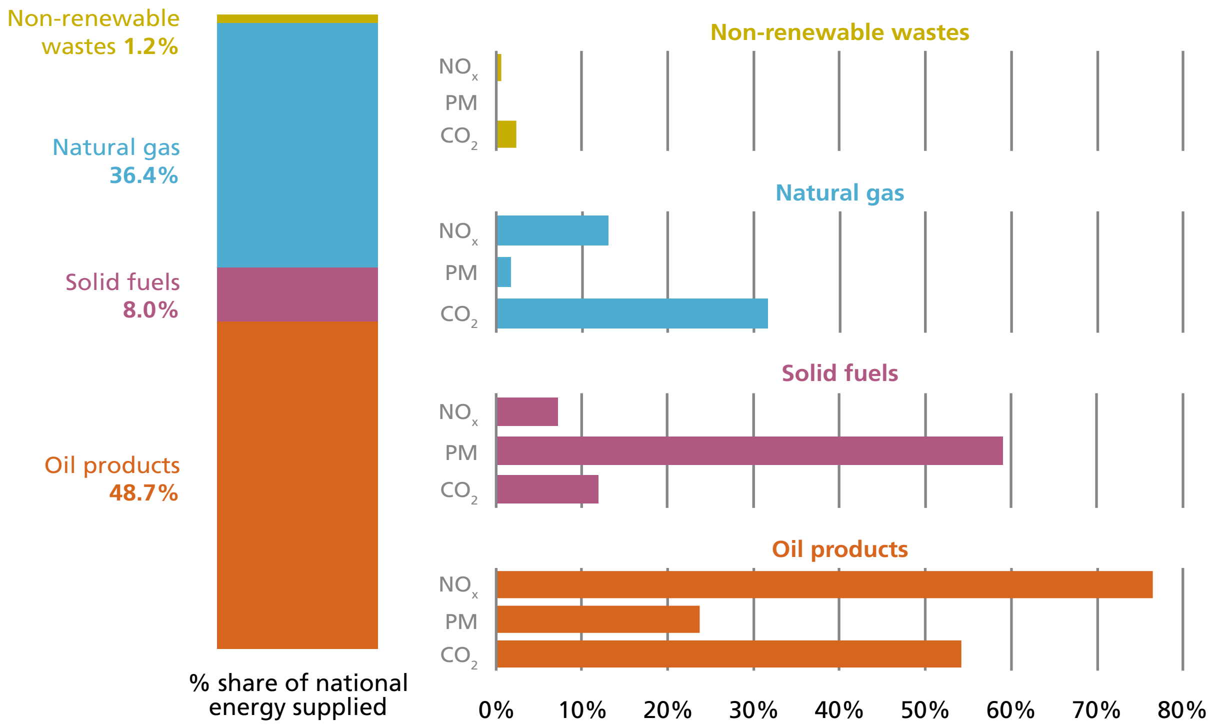
The generation of useful energy for mobility, heating and electricity through the combustion of coal, oil products, natural gas and peat (i.e. fossil fuels) releases polluting by-products that have significant adverse impacts on human health, the climate and our environment.

Fossil fuel use is a significant source of key air pollutants and greenhouse gases (GHGs). The main impacts of combustion of fossil fuels include:

- the emission of GHGs
- the direct production of reactive gases such as nitrogen oxides, sulphur dioxide and particulates, including black carbon
- the production of secondary pollutant gases and particulates such as ozone, ammonium nitrate and ammonium sulphate, and condensed compounds such as organic carbons
- the release of heavy metals such as mercury and the formation of persistent organic pollutants such as polycyclic aromatic hydrocarbons, which build up in ecosystems and food chains.

The relative impact on air quality and climate change depends on the fossil fuel used and its quality. The combustion of solid fuels such as coal and peat has the largest impacts, and gas combustion has the lowest impacts, with the combustion of liquid fuels typically having intermediate impacts (Figure 12.2). The combustion of biofuels can also result in significant air pollutant emissions that vary with fuel type and combustion systems used. Sustainably produced fuels such as wood, biogas and ethanol have less of an impact on the climate system but may have an impact on air quality.

Figure 12.2 Energy use in 2022 and relative emissions of carbon dioxide, particulate matter and nitrogen oxides



Sources: EPA, 2024a,b

Addressing the range of impacts caused by energy use while maintaining and enhancing our health and wellbeing is a central element in a series of United Nations conventions and global policies as well as key European Union (EU) and national policies (EC, 2020; DECC, 2024a). The approach taken can be summarised as follows:

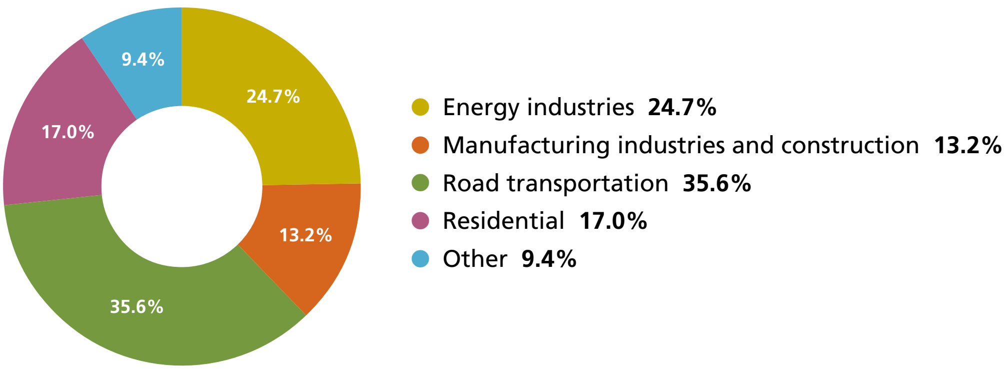
- Reduce energy use and loss through increased energy efficiency and demand reduction.
- Reduce emissions through mitigation technologies such as removing certain contaminants, such as sulphur, and carbon capture and storage.
- Switch to clean and sustainable energy solutions from non-combustion sources such as hydropower, wind or solar energy and the use of green hydrogen. These do not give rise to combustion-related impacts, but there is a need to be cognisant of their social and environmental impacts, as they do impact land use.

These issues are explored in more detail later in this chapter and in Chapter 2, Air; Chapter 4, Climate; Chapter 5, Land; Chapter 11, Transport; and Chapter 13, Industry.

3. Sources of and trends in Ireland's key energy-related greenhouse gas emissions

Ireland's national energy-related GHG emissions accounted for 50% of Ireland's total GHG emissions (including from land use, land use change and forestry) in 2023. Emissions in 2023 were 6.8% lower than in 2022, driven by reduced emissions from electricity generation and residential sources; however, faster annual reductions will be needed to stay within carbon budgets and sectoral ceilings (EPA, 2024). Ireland's energy-related GHG emissions in 2023 were 15% lower than 2018 levels. Emissions from electricity generation in Ireland decreased by 22.1% in 2023 due to the increased importation of electricity from the UK through electricity interconnectors, together with an increase in the share of renewable electricity generation to 40.7%. Transport sector emissions (excluding international aviation and navigation) grew by 0.3% in 2023 having previously increased by 6% in both 2022 and 2021. Emissions from residential buildings decreased by 7% in 2023, hitting a historical low for the second consecutive year. Carbon dioxide emissions from the manufacturing combustion sector decreased by 4.6%, from commercial services by 2.5%, and from public services by 2.7% in 2023, associated with reductions in fossil fuel use within these sectors (Figure 12.3).

Figure 12.3 Profile of Ireland's energy-related greenhouse gas emissions by sector



Source: EPA, 2024c

4. Key energy demand drivers

Focusing on trends over time, the drivers of energy demand vary across the energy consuming sectors, but economic growth and population growth are key pressures that are difficult to decouple fully from energy demand growth. Energy prices and weather also have a key impact on our demands for energy. Given our current high dependency on imported fossil fuels, we are very exposed to fuel price variations, which in turn are influenced by geopolitical events, as has been very evident in the past few years.

Ireland's climate mitigation policy has a strong supply-side focus on increasing the deployment of renewable electricity together with a focus on electrifying as much energy end use as possible. The most prominent example of the latter is the roll-out of electric vehicles and heat pumps, with the goal of switching transport and heating away from fossil fuel combustion technologies towards renewable electricity-powered technologies.

However, it is essential to have a complementary focus on energy demand reduction and energy efficiency measures, which can bring additional emission reductions and also cost savings and improved energy affordability. Understanding the demand drivers for electricity, transport fuels and home heating fuels is essential to inform policy choices. These drivers are briefly explored here and also in Chapter 11.

Electricity demand

Ireland's electricity demand doubled over the period 1990-2020. EirGrid projects that this demand will further increase substantially by 2030, based on an increasing demand for electricity from high-demand users, including pharmaceutical plants, high-tech manufacturing and data centres, and the increasing use of electricity for transport and heating (EirGrid, 2024).

Data published by the Central Statistics Office (CSO) on metered electricity consumption indicate that there was a 2.5% increase in electricity demand in 2023 relative to 2022, largely driven by a 20% growth in electricity consumption by data centres. Data centres accounted for 21% of metered electricity consumption in 2023, which exceeded the electricity use of urban households (18%) and rural households (10%).

Residential heating fuel demand

The GHG emissions inventory limits residential emissions to those associated with domestic heating and cooking using solid, liquid or gaseous fossil fuels. The upstream emissions associated with residential electricity usage are recorded in the energy industries sector.

The key drivers of residential emissions are therefore the number of households, which is related to both population growth and economic growth, the emissions performance of the energy systems in these households, weather and energy prices.

It is particularly notable that, despite the almost doubling of the number of households (from 1 million in 1990 to 1.9 million in 2023), emissions from the sector in 2023 are slightly below 1990 levels. This was achieved by improved insulation and energy efficiency, coupled with switching from carbon-intensive solid fuels to liquid and gaseous fuels over the period.

Changes over time to building regulations mean that newer homes have a much-improved energy performance and are heated using electricity and heat pumps. The continued growth in the number of households is therefore not anticipated to result in increased residential emissions in the future.

Transport fuel demand

Transport GHG emissions have seen the greatest growth in energy-related emissions, having increased by 134% from 1990 to 2023 (EPA, 2024c). This growth can be directly linked to the increased number of passenger car and freight transport activity over that time frame, which is coupled to economic growth.

Increasing the share of electric vehicles in the car fleet and growing the use of biofuels have a key role in decoupling transport demand growth from emissions growth in the future. There is also a need to pursue complementary measures that address an overdependence on private car usage for congestion, environmental, health and wellbeing reasons. These include increasing public transport use and more trips undertaken by walking and cycling, i.e. active travel. This is explored in greater detail in Chapter 11.

5. EU and national energy policy

There are significant policy and legislative drivers at EU and national levels that are accelerating Ireland's energy transition. These will both enhance energy security and help deliver on climate commitments.

EU energy policy

The European Green Deal and associated European Climate Law (Regulation (EU) 2021/1119) are key overarching elements of EU policy that are driving changes in energy policy in Ireland and across the EU. The European Climate Law provides a legislative framework for Member States to achieve an overall reduction in GHG emissions of at least 55% by 2030, compared with 1990 levels. This ambition builds on progress to date in reducing emissions whereby, according to Eurostat, net GHG emissions reduced by 31% in the EU between 1990 and 2022.

There are many elements of the European Climate Law that impact directly on Ireland's energy sector. The EU targets for GHG emission reduction are allocated separately to sectors that participate in the EU Emissions Trading System (ETS) (electricity generation, large industry and intra-EU aviation) and sectors outside the scheme, i.e. the non-ETS sectors (heat, transport and agriculture).

Directive (EU) 2023/959 targets a 62% EU-wide reduction in ETS emissions by 2030 relative to 2005 levels. The ETS establishes a 'cap-and-trade' market that results in a carbon price for emissions associated with fossil fuel-generated electricity and for heavy users of fossil fuels.

Regulation (EU) 2023/857 sets binding annual non-ETS GHG emission reductions for each Member State from 2021 to 2030 that collectively will deliver a 40% reduction in EU-wide non-ETS GHG emissions by 2030 relative to 2005 levels. Ireland's target under this EU Effort Sharing Regulation is to achieve a 42% reduction in non-ETS GHG emissions by 2030.

At EU level, the Governance of the Energy Union and Climate Action Regulation ((EU) 2018/1999) also requires Ireland to prepare a National Energy and Climate Plan (NECP) and a Long-term Strategy on Greenhouse Gas Emissions Reductions. The NECP[1] describes the actions Ireland needs to take to decarbonise its energy sector in line with EU targets to 2030. Ireland's NECP draws on the Climate Action Plan 2024 (CAP24), which is Ireland's policy to reduce sectoral emissions and achieve its 2030 climate targets (DECC, 2024a). Ireland's Long-term Strategy on Greenhouse Gas Emissions Reductions[2] sets out Ireland's 2050 climate action targets and describes sector-specific pathways to reaching those targets. In addition to meeting the specifications of Article 15 of the EU Regulation on the Governance of the Energy Union and Climate Action, this long-term strategy is also in line with Article 4 of the Paris Agreement.

In addition to climate mitigation policies, there is a large set of energy sector-specific policies and measures encompassing renewable energy, energy efficiency, energy security and energy markets. The EU's ambition for renewable energy has grown in recent years, driven by the leadership position taken by the EU globally on climate action. In addition, the EU's dependence on imported fossil fuels came into sharp focus during the energy crisis following Russia's invasion of Ukraine. This prompted a specific EU policy response (REPowerEU plan[3]) that refocused attention on maritime transport accelerating renewable energy deployment.

The EU Renewable Energy Directive (2023/2413) establishes an overall EU target for the renewable energy share of overall energy use of at least 42.5% by 2030. The EU achieved its 20% renewable energy target in 2020 agreed under the original EU Renewable Energy Directive (2009/28/EC) (EC, 2024). Ireland's 2020 target under this directive was to achieve a renewables share of 16% of gross final energy consumption by 2020. In 2020, Ireland achieved a 13.5% renewable share of energy use and purchased 'statistical transfers' costing €50 million to address the shortfall of 3500 GWh of renewable energy. Ireland's target for 2030 is 43%, as set out in the National Energy and Climate Plan 2021-2030. It is important to note that this target is 43% of gross final energy consumption, that is, including heating and transport in addition to electricity.

1 www.gov.ie/en/publication/a856a-national-energy-and-climate-plan-necp-2021-2030/#:~:text=The%20NECP%20will%20act%20to,of%20Climate%20Action%20Plan%202024. (accessed 9 September 2024).

2 www.gov.ie/en/publication/e4e81-long-term-strategy-on-greenhouse-gas-emissions-reductions/ (accessed 9 September 2024).

3 eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2022%3A230%3AFIN&qid=1653033742483 (accessed 9 September 2024).

This target is expected to increase, given that the EU 2030 target has increased from 32% to 42.5%. In addition, Ireland must retain the baseline (of 16%, i.e. the 2020 target) and meet interim trajectory points in 2022, 2025 and 2027 (20.9%, 27.6% and 33.6%, respectively). In 2023, Ireland achieved a 14% renewable share, falling significantly short of the agreed targets (SEAI, 2024a).

The EU Energy Efficiency Directive (2023/1791) compels Member States to collectively ensure a 11.7% reduction in energy consumption by 2030, compared with the projections of the EU reference scenario 2020 (EC, 2021a,b). This establishes an effective cap on EU energy use of 8874 TWh by 2030. The indicative target for Ireland is a 2030 final energy demand of 115 TWh. This is approximately 18% below Ireland's energy demand in 2022. This is very challenging in the context of Ireland's projected economic and population growth in the period to 2030. Based on Sustainable Energy Authority of Ireland (SEAI) projections of energy demand, Ireland's energy use is projected to exceed the indicative cap by between 19% and 31% in 2030.

National policy

In addition to meeting targets agreed at EU level, Ireland has established a strong legislative and policy framework in recent years that is impacting energy supply and demand trends. The Climate Action and Low Carbon Development (Amendment) Act 2021 provides for an ambitious 51% reduction in GHG emissions by 2030, compared with 2018 levels. To achieve this aim, legally binding carbon budgets and sectoral emissions ceilings have been put in place across all sectors, including the key energy sectors of electricity, transport, industry and buildings. These issues are explored in more detail in Chapter 4.

The electricity sector has made significant achievements in terms of emission reductions over the past 20 years relative to other sectors and was allocated an ambitious sectoral emissions ceiling of 40 megatonnes of carbon dioxide equivalent (Mt CO_2 eq) in the period 2021-2025. By 2023, electricity had expended 68% of the sectoral ceiling, a higher share than any other sector. There was a significant 21.6% reduction in emissions in 2023, however. As a result, emissions will need to reduce by 10% per annum in 2024 and 2025 to stay within the ceiling.

The greatest progress towards sectoral emissions ceilings for energy-related emissions has been observed in energy in buildings – both residential and commercial and public buildings. Emissions released in the period 2021-2023 accounted for 62% of the 29 Mt CO_2 eq sectoral emissions ceiling for the residential sector and 61% of the 7 Mt CO_2 eq for the commercial and public buildings sector. Residential sector emissions could increase slightly in the period 2024-2025 and still remain within the sectoral emissions ceiling.

In addition to improving energy efficiency by switching to lower carbon fuels, electrification will play a key role in the decarbonisation of transport and heating (in both buildings and industry). Electrification transfers emissions from transport and heating to electricity, increasing the challenge in meeting the electricity sectoral emissions ceiling. This points to the need for unprecedented deployment rates of renewable energy and grid infrastructure, requiring urgent action by all relevant stakeholders. Environmental Protection Agency (EPA) GHG emission projections indicate that current planned measures will fall short of achieving the sectoral emissions ceiling goals (EPA, 2024d).

CAP24 outlines goals for heating, transport and renewable energy, focusing on solar and onshore and offshore wind generation. It also identifies further areas for development in the second half of the decade, including the role of hydrogen, in line with the National Hydrogen Strategy 'the role of interconnector capacity in increasing low-carbon power supply through deeper integration of cross-border electricity markets; building out low-carbon flexibility opportunities such as long-duration energy storage; and deploying sustainable biofuels, in line with EU regulations, in hard-to-abate transport sectors such as domestic aviation and maritime.

6. Ireland's energy supply

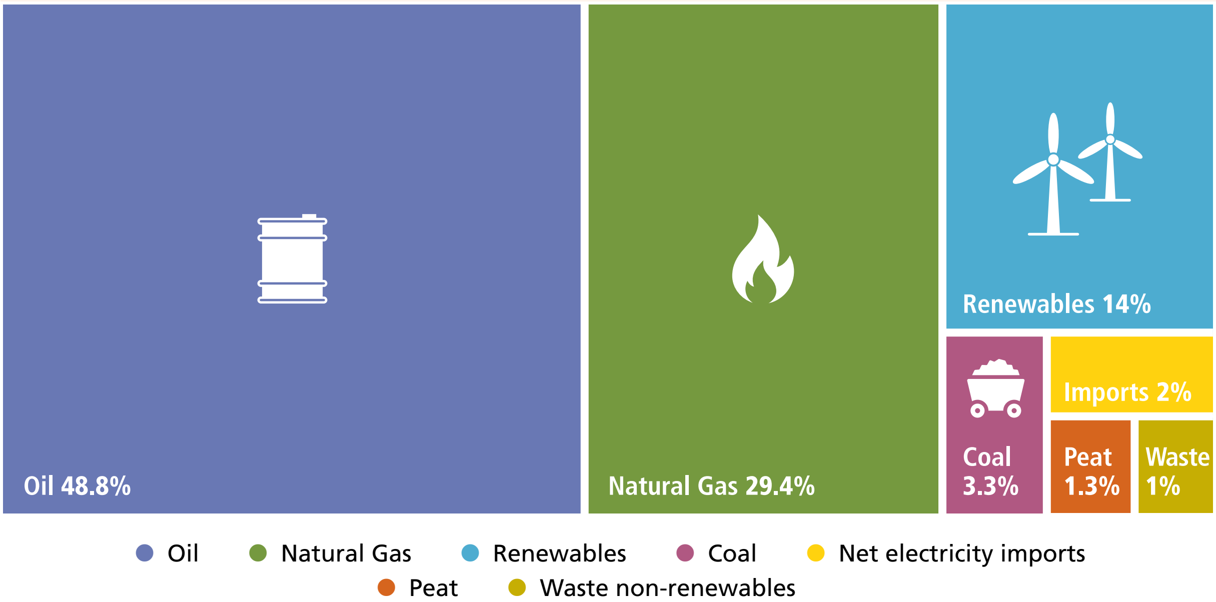
Ireland's energy supply, generally referred to as total primary energy requirement (TPER), is the amount of energy used in Ireland each year. This includes the energy requirements for the conversion of primary energy sources into energy used by the final consumer, for example electricity generation, oil refining and peat briquetting.

In 2023, Ireland's TPER fell 1.7% to 164 TWh of energy compared with 2022, with 82.8% of energy supply coming from fossil fuels (SEAI, 2024b). This is the lowest level of TPER in over 20 years, with the exception of 2020, when COVID-19-related travel restrictions significantly reduced demand for petrol, diesel and jet kerosene. The year 2023 also saw record use of renewable energy in Ireland at 14% of TPER. The fuel breakdown of TPER for 2023 is presented in Figure 12.4.

Over three-quarters of Ireland's energy came from oil and gas in 2023, with 48.8% of energy from oil used for heating and transport, with small amounts also used for electricity generation. Ireland used 35.5% less coal, 19.2% less peat and 7.2% less natural gas than in 2022, while there was an increase of 9.5% (+2.0 TWh) in energy from renewables and of 11.6% (+0.2 TWh) in energy from non-renewable waste. In addition, there was a substantial and unprecedented 1200% (+3.0 TWh) increase in net imports of electricity (SEAI, 2024c).

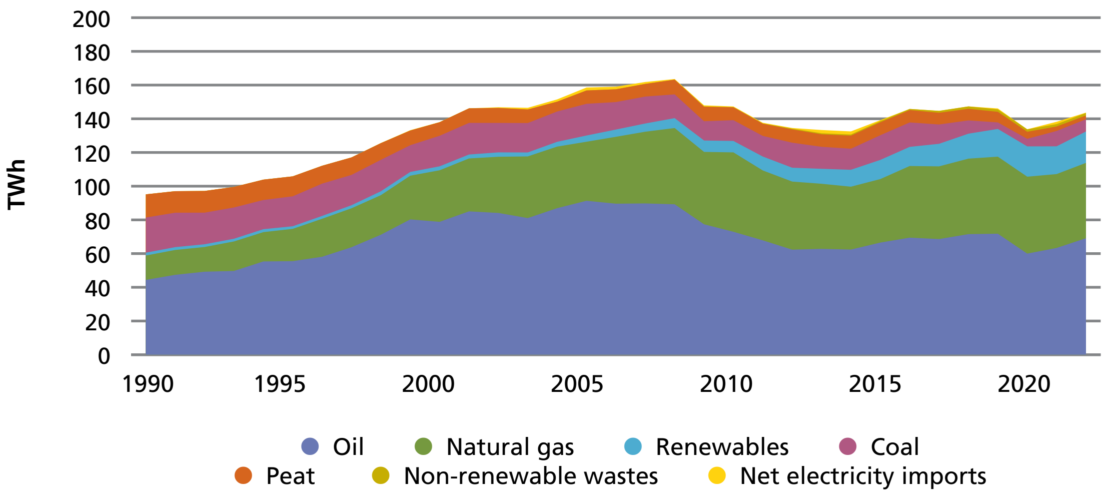
The trends in TPER in Ireland over the period 1990-2023 are presented in Figure 12.5. (SEAI, 2024a). The continued dominance of oil in Ireland's energy supply mix is evident, as is the growth in dependence on natural gas in particular over the past 25 years. The reduction in the use of solid fuels (coal and peat) is also apparent in Figure 12.5, along with the steady growth in renewable energy.

Figure 12.4 Breakdown by fuel of Ireland's total primary energy requirement in 2023



Source: Adapted from SEAI (2024b)

Figure 12.5 Total primary energy requirement in Ireland, 1990-2023



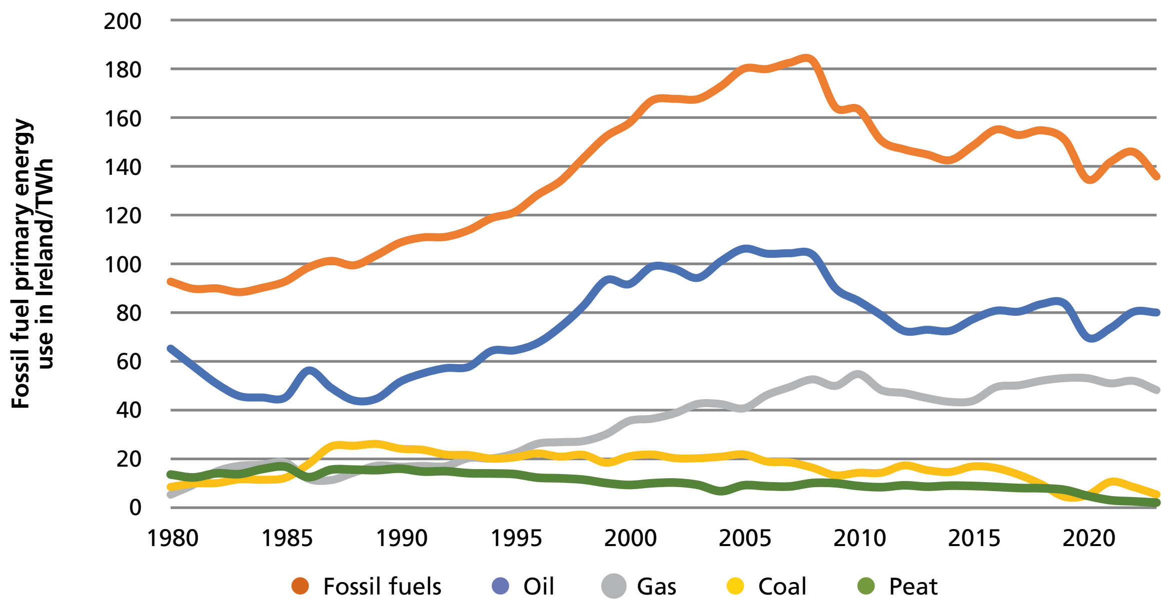
Source: SEAI, 2024a

According to the International Energy Agency all fossil fuel usage is anticipated to peak globally before 2030 (IEA, 2023). This marks a significant development, signalling the beginning of the end of the fossil fuel era. The data for Ireland on fossil fuel usage indicate that the peak in overall fossil fuel usage (at 183 TWh) took place in 2008, as shown in Figure 12.6.

Ireland's strong economic growth in recent decades, in particular in the late 1990s and early 2000s, prompted an increased demand for energy, which was met primarily by growth in oil and gas usage, driving fossil fuel usage to its peak in 2008. This growth sometimes masked the underlying fuel switching and energy efficiency gains that were introduced in the period from 2000, along with the growth in renewable energy in the past 15 years in particular. The economic downturn between 2007 and 2013 saw overall energy supply reducing and, as Ireland's economy recovered, fuel switching, energy efficiency and renewables have combined to dampen fossil fuel growth since then, as is evident in Figure 12.6.

Focusing on individual fuels, coal and peat both reached their peak contribution to Ireland's energy supply during the 1980s, first peat in 1985 and then coal in 1989. Since then both fuels have been in decline, more rapidly as a fuel for home heating and more recently as a fuel for electricity generation. Oil has accounted for more than half of Ireland's total fossil fuel usage since 1992. Oil demand was highest in 2005 at 106 TWh and then plateaued before dropping after 2008 during the economic recession. Natural gas usage grew steadily over the 20-year period between 1990 and 2010 and appears to have peaked in 2010. Natural gas use may increase in the short term until more renewables are brought on to the grid in the remainder of the 2020s and the next decade. The report *Energy Security in Ireland to 2030* sets out that natural gas will play a greater role in electricity generation during the transition to a renewables-led system, particularly to support the grid in times of low renewable output (DECC, 2023a).

Figure 12.6 Fossil fuel use in Ireland, 1980-2023



Source: Based on data from the Economic and Social Research Institute and SEAI

From 2013 to 2022, oil and natural gas use increased by 6.6% and 10.8%, respectively, due to the demands from transport (oil) and electricity generation (gas), while the use of more carbon-intensive fuels, coal and peat, declined by 44% and 27%, respectively (SEAI, 2024d).

Ireland continues to source most of its energy from fossil fuels, however. In addition, most of Ireland's energy is imported: in 2023, Ireland's energy import dependency was 78.4%, importing 77.5% of its natural gas and 100% of its oil and coal requirements.

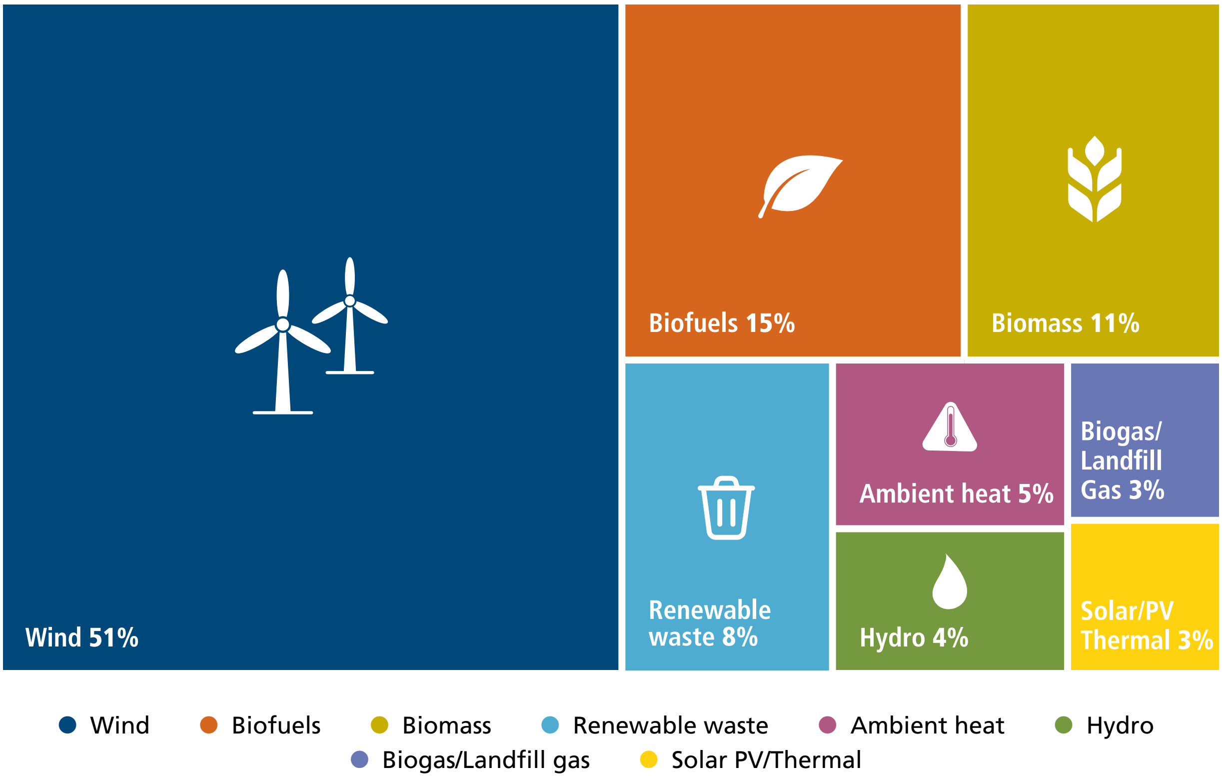
Natural gas from the Kinsale gas field contributed significantly to Ireland's indigenous energy supply in the 1990s. After a lull in indigenous natural gas supply during the early 2000s, production at the Corrib gas field has helped to reduce Ireland's energy import dependency to below 70% since 2015. As this gas field has depleted, Ireland's energy import dependency has grown again.

The use of peat as a fuel for electricity generation ended in 2023, when planning permission expired for the last remaining plant, and coal-fired generation at the Moneypoint power plant is due to end in 2025. To ensure security of electricity supply, while new generation capacity is constructed the Moneypoint power plant will transition from coal- to oil-fired electricity generation.

The contribution of renewable energy to Ireland's energy supply increased over tenfold from 2 TWh in 1990 to 23.0 TWh in 2023, providing 14% of total energy supply and more than half of all indigenous energy in Ireland (SEAI, 2024d). Wind accounted for just over half (50.8%) of Ireland's renewable energy, followed by biodiesel , biomass and renewable wastes. In 2023, heat pumps installed in homes and businesses across the country harnessed renewable ambient heat in the air that, in energy terms, exceeded the renewable energy produced from hydroelectricity.

Figure 12.7 illustrates Ireland's renewable energy contribution to TPER in 2023 and emphasises the dominance of wind and bioenergy in Ireland's renewable energy mix.

Figure 12.7 Contribution of renewables to Ireland's total primary energy requirement, 2023



Source: SEAI, 2024b

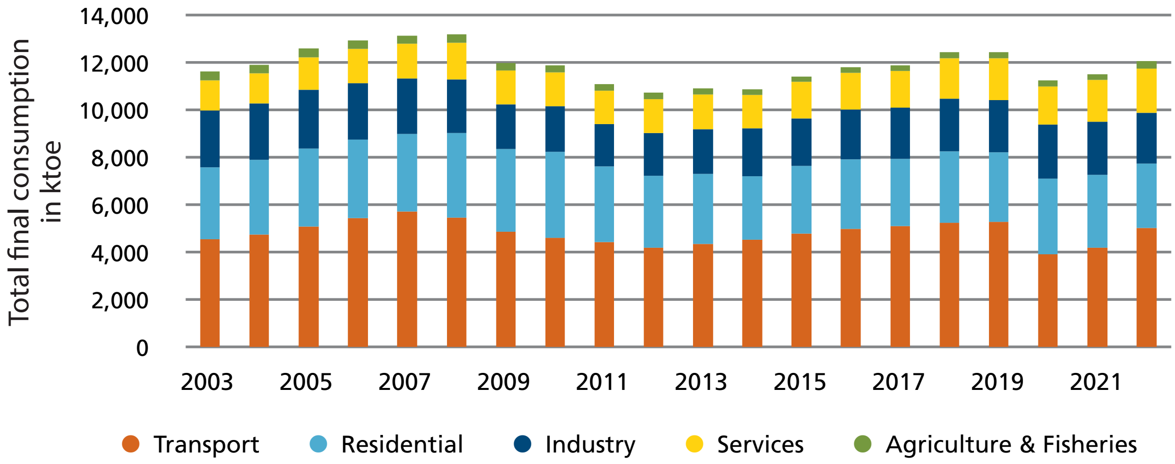
7. Total final energy consumption

Some of Ireland's primary energy is transformed into different forms of useful energy using a range of processes (e.g. electricity generation and oil refining) before being used by final energy users. Much of the energy (46% in 2022) used to generate electricity is 'lost' as waste heat in thermal power plants during generation and as distribution losses in the electricity grid.

For this reason, the 164 TWh of total primary energy in 2023 became 141 TWh of total final consumption (TFC) of energy, which represents the total energy delivered to final users. TFC in Ireland grew by 1%, despite TPER reducing by 1.7%, pointing to an efficiency increase in the overall energy system.

Over the past 20 years, Ireland's TFC peaked in 2008, as shown in Figure 12.8. Energy demand subsequently reduced during the economic recession and then increased in all sectors but remains below 2008 levels.

Figure 12.8 Total final energy consumption in Ireland by sector, 2003-2022



Source: SEAI, 2023

The transport sector dominates TFC in Ireland, accounting for a 41.3% share in 2022. Heating is also significant, accounting for 36.5% of TFC, comprising space and water heating in homes and in commercial and public buildings, in addition to thermal energy for manufacturing in industry. According to SEAI's national heat study (SEAI, 2022), heat demand is expected to rise over the next 20 years, and the deployment of energy efficiency measures in all sectors is not projected to sufficiently offset the impact of economic and population growth. New buildings also drive the growth in heat demand in the services sector. In the industry sector, heat demand grows in line with projections of increased economic activity.

8. Electricity generation

Ireland has seen significant changes in electricity generation over the past 20 years, and significant changes are expected over the next 20 years. This expectation is due in part to our significant wind and solar energy resources and also to the potential role of electrification in decarbonising heating and transport, which currently remain locked into fossil fuel systems.

Ireland's electricity demand was almost 34,000 GWh in 2022, accounting for 22% of TFC, while combustion of oil and gas accounted for 70% of TFC. The share of electricity in TFC is projected to increase with the increase in the number of electric vehicles and heat pumps, displacing the use of oil and gas for transport and heating.

Electricity demand is also growing in response to economic and population growth. Electricity use in the information and communication technologies sector has increased in particular in recent years, due to the increase in the number of data centres in Ireland. Electricity demand overall increased by 3% per annum on average over the 5-year period to 2022. Of this increase in demand, 23% per annum is due to the ICT sector, which currently accounts for over 20% of total demand.

There have been significant changes in Ireland's electricity fuel mix over the period from 2015 to 2023. Electricity demand increased in this 8-year period by 22%, but the fossil fuels combusted to generate this electricity reduced by 23%, demonstrating the higher efficiency of low-carbon electricity generation. There has been a reduction in solid fuel usage (coal and peat) for electricity generation and an increase in electricity generation from renewables and efficient natural gas plants.

In 2023, 40.7% of Ireland's gross electricity supply (which is the sum of indigenous generation and net imports) was renewable (SEAI, 2024b). The year 2023 saw new records for wind generation in Ireland, which was 4.1% higher than in 2022, setting a new annual record of 11.7 TWh. It was also the first year that Ireland produced more energy from wind than it extracted from its natural gas reserves (10.9 TWh) (SEAI, 2024b).

The impact of these changes on Ireland's electricity generation mix is also demonstrated over a longer period by the substantial reduction in the CO_2 intensity of electricity in Ireland, down from 896 g CO_2/kWh in 1990 to 255 g CO_2/kWh in 2023 (SEAI, 2023; EPA, 2024c).

9. Looking ahead

Decarbonisation of electricity generation has been a key measure in successive climate action plans, with the end of peat's use as a fuel for electricity generation in 2023 and the use of coal at Moneypoint to be phased out at the end of 2025. Significant growth in renewable energy is required to meet Ireland's future demands for electricity, requiring a transformation of power system operation to achieve the flexibility required to incorporate the growth in renewables while maintaining power system security. Table 12.1 summarises some of Ireland's renewable generation and system flexibility ambitions over the next ten years.

Wind energy

Ireland currently has 4.6 GW of installed wind generation capacity (over 99% of which is onshore) (SEAI, 2023). Ireland's CAP24 targets a 50% renewable energy share of electricity generation by 2025 and an 80% share by 2030 (DECC, 2024a). This will require increasing onshore wind capacity to 6 GW in 2025 and to 9 GW in 2030 and an offshore wind capacity of 5 GW by 2030.

Table 12.1 Some key metrics to deliver reduced emissions from electricity generation

THEME	ACCELERATE RENEWABLE ENERGY GENERATION	ACCELERATE FLEXIBILITY
2025 KPIs	▪ 50% renewable electricity share of demand ▪ 6 GW onshore wind capacity ▪ Up to 5 GW solar photovoltaic capacity	▪ Maximum level of renewables at any one time on the grid: 85% ▪ Minimise surplus generation ▪ Required long-term storage (4 hours plus) in place
2030 KPIs	▪ 80% renewable electricity share of demand ▪ 9 GW onshore wind capacity and at least 5 GW offshore wind capacity ▪ 8 GW solar photovoltaic capacity	▪ Maximum level of renewables at any one time on the grid: 95-100% ▪ Minimise surplus generation ▪ Required long-term storage (4 hours plus) in place ▪ At least 2 GW of new flexible gas-fired generation ▪ Zero emission gas-fired generation from biomethane and hydrogen commencing by 2030
2031-2035 measures	▪ Decarbonisation roadmap for net zero power system ▪ Green hydrogen production via 2 GW offshore wind	▪ Required additional duration storage technologies in place ▪ Increased zero emission gas-fired generation to enable a net zero power system

KPI, key performance indicator

Source: DECC, 2023b

The development of offshore renewable energy is hence a critical element of meeting climate action plan targets. CAP24 sets the objective of developing 5 GW of installed offshore renewable energy by 2030, with a further 2 GW of non-grid connected capacity to be in development by 2030, rising to 37 GW by 2050, with floating technology playing a role. The first Offshore Renewable Electricity Support Scheme auction (ORESS-1) was held in June 2023. There were four successful applicants with an average support price of €86/MWh for approximately 20 years, with three projects planned for the east coast and one for the west coast of Ireland. The successful projects ranged in size from 0.45 GW to 1.3 GW, with a combined installed capacity of just over 3 GW. ORESS-2 is due to launch in 2024, aiming to address the shortfall in offshore wind capacity and delivering the targeted 5 GW of grid-connected offshore wind by 2030 and the further 2 GW of non-grid wind power for green hydrogen production.

Ireland's Offshore Wind Industrial Strategy ('Powering Prosperity') is focused on action in 2024 and 2025. It sets out how it will build on the 2030 targets and includes an interim target for 2040 of 20 GW capacity (DETE, 2024). It sets out that achieving the 2050 target of 37 GW of generation capacity would enable the production of green hydrogen and other fuels, the development of a hydrogen industry, the decarbonisation of industrial heat and the export of electricity, and ensure energy security through interconnection.

The National Marine Planning Framework was adopted by the government in May 2021. This framework applies to Ireland's maritime area, outlining objectives and marine planning policies for each marine activity. A key objective of the framework is to ensure that future developments in Ireland's maritime area take place in a sustainable and strategic way, with consideration of environmental protection. The framework commits the government to using sub-national forward spatial planning through the establishment of designated maritime area plans (DMAPs). The Minister for the Environment, Climate and Communications has been designated as the competent authority to prepare DMAPs for the development of offshore renewable energy. Ireland's first offshore renewable energy designated maritime area will be situated off the south coast (See Chapter 9).

Solar energy

CAP24 sets a solar capacity target of 5 GW in 2025 and 8 GW in 2030. Ireland's solar photovoltaic electricity generation capacity reached close to 1 GW by the end of 2023, and solar energy accounted for 1.9% of gross electricity supply (SEAI, 2024b). Utility-scale grid-connected solar farms accounted for 64% of solar photovoltaic generation, with 36% coming from rooftop solar panels. Generation from solar farms increased 24-fold compared with the previous year, due to multiple sites being connected to the national grid in 2023. In parallel, electricity generation from rooftop solar panels increased by 74% in 2023.

Energy storage

Electricity storage systems aim to ensure security of supply in the electricity network by storing excess renewable generation and managing peak demand. The government's Electricity Storage Policy Framework for Ireland 2024 sets out the role of electricity storage in meeting Ireland's 2030 climate goals and addresses the deployment of storage up to 2040 (DECC, 2024b). The policy framework refers in the main to electricity storage systems developed to provide grid-supporting services. According to the policy framework, electricity storage systems with a capacity of over 1 GW are in place, and this capacity is expected to grow substantially in the coming years.

Biomass

Biomass accounted for 56% (i.e. 125 million tonnes of oil equivalent or 1453 TWh) of gross final renewable energy consumption in the EU in 2021 (this share was 63% in 2005) (EEA, 2023). This is much greater than in Ireland, as outlined in Figure 12.7, where biomass accounts for 33% of Ireland's renewable energy. Biomass here includes bioenergy in the form of solid biomass, liquid biofuels and renewable wastes.

Biomass used for energy generation is considered to be carbon neutral because plants and trees can regrow and sequester CO_2 from the atmosphere. However, the process of regrowth can take several decades, and the use of biomass in energy via combustion releases significant amounts of CO_2 and other pollutants into the atmosphere over the short term. The production, harvesting and transport of biomass for combustion can impact biodiversity, the condition of ecosystems and their capacity to sequester CO_2 from the atmosphere. Therefore, the use of biomass needs to be balanced with other ecosystem conservation needs.

Energy efficiency and electrification of buildings

In addition to significant ambitions for renewable energy supply, Ireland has many policies and measures in place to upgrade the energy performance of buildings and to switch their energy supply from fossil fuel boilers to electric heat pumps.

Houses currently built in Ireland tend to have a high standard of energy performance and are mostly heated by heat pumps following changes to building regulations in 2005. Almost half (48%) of Ireland's existing dwellings, however, have a relatively low building energy rating of 'D' or lower on a scale of A-G, indicating significant ongoing energy costs for these households. CAP24 has a target of upgrading 120,000 dwellings to a rating of 'B2' by 2025 and the installation of 45,000 heat pumps. The targets for 2030 are to retrofit 500,000 dwellings and install 400,000 heat pumps. The National Retrofit Plan sets out how the government intends to deliver on the climate action plan targets (DECC, 2022).

There is progress, according to SEAI, including 47,953 home upgrades delivered in the year 2023 – 17,600 to a B2 level (SEAI, 2024e). To achieve the desired delivery trajectory and meet the 2030 target, SEAI has projected that 185,000 home energy upgrades should be delivered between 2019 and 2025. Of these, over 83,000 should be upgrades to a B2/cost-optimal level. According to SEAI, when the carbon savings from the non-B2 upgrades are included, this will be equivalent to the CAP24 target of 120,000 B2 upgrades over the period. To deliver on the National Retrofit Plan objective, SEAI said it would need to deliver on average 75,000 B2-equivalent home upgrades per year from 2026 to 2030 to achieve the overall target of 500,000 by 2030 (SEAI, 2024e).

Heat pumps are gaining in popularity as the default heating system for new builds, and 3750 heat pump installations were supported by SEAI in 2023. While the number of heat pumps supported in 2023 was up 65% on the 2022 figure, SEAI stated that this number will need to dramatically increase in the coming years to achieve the 45,000 target by 2025 (SEAI, 2024e).

The 2022 Heat Study by SEAI noted that capital costs are a barrier to installing heat pumps in the residential sector, and additional policy support is needed to drive uptake (SEAI, 2022). The SEAI report also highlighted that the biggest challenges in achieving the 2025 and 2030 targets is the availability of sufficient skilled workers and construction sector inflation (SEAI, 2024e). In addition to retrofitting and heat pumps, the SEAI Heat Study also highlights the untapped potential in Ireland of district heating, which has the distinct advantage of being able to use renewable energy supplies to meet heating requirements (Topic Box 12.1).

In the context of the rising energy prices, driven by international geopolitics, that have significantly affected oil, gas and electricity prices over the past 3 years, researchers at the Economic and Social Research Institute estimated that 29% of Irish households were in energy poverty (Barrett *et al.*, 2022). Retrofitting the homes of those experiencing energy poverty is crucial for a just transition.

Topic Box 12.1 District heating

District heating has the potential to play an important role in improving energy efficiency and reducing emissions in Ireland. District heating networks can use various renewable technologies to help decarbonise the heat sector. Currently, district heating accounts for a very small share of the Irish heating sector, estimated to be significantly less than 1%, representing one of the lowest shares in Europe (SEAI, 2022). The large-scale deployment of heat networks (district heating) and the use of bioenergy can make significant contributions to reducing CO_2 emissions. Heat extracted from purpose-built combined heat and power generation and waste heat are the cheapest energy sources for heat networks. Heat pumps and biomass are also widely used to meet heat supply needs in the modelling where combined heat and power is not available. SEAI recommends that opportunities for extracting heat from power stations, recovering waste heat from industrial sites, and feeding heat from geothermal sources and low-grade heat from data centres into district heating schemes should also be encouraged. This would need policy, planning and regulatory support to be provided.

The revised EU Renewable Energy Directive strengthens the promotion of district heating in EU Member States. This will be transposed into Irish law by 11 October 2025.

Electricity interconnection

Increased interconnection and storage help balance electricity supply and demand between countries and provides a valuable back-up power supply for when electricity systems have reduced capacity. Electricity interconnection is playing an increasing role in Ireland's energy system as the system becomes decarbonised and fossil fuel generation is replaced by large-scale variable-supply renewables. Interconnectors act as energy highways and allow energy import and export. As we increase our share of renewable electricity generation, interconnectors will allow us not only to import electricity when we have insufficient indigenous generation available but also to export electricity when we generate more than we require to meet our domestic energy demands.

Ireland's net import of electricity across interconnectors increased 12-fold up to 3.3 TWh in 2023 and set a new annual record. This step change in interconnector behaviour is set to increase into the near future. Ireland's interconnection capacity currently stands at 500 MW in a single connection to the UK. Facilitated by the National Policy Statement on Interconnection 2018,[4] capacity is set to more than treble by 2026 to 1700 MW, including a return of direct interconnection between Ireland and the EU via the Celtic Interconnector (DECC, 2023c).

Energy efficiency and electrification of transport

The current dependence of transport systems in Ireland on liquid fossil fuels is unsustainable and is completely misaligned with the goal of transitioning to a climate-neutral economy. A range of zero- and low-emission transport technologies now exists, primarily electrification but also liquid and gaseous biofuels and the emerging prospects of electrofuels (hydrogen, green methanol, etc.), in particular for harder to electrify transport modes such as aviation and maritime shipping.

Technology end-of-pipe solutions alone do not address systemic and structural issues, however. An integrated approach to mobility and settlement planning that embraces the avoid-shift-improve approach and encourages opportunities for active modes of travel and public transport can have multiple gains, including for overall energy use in transport and for health and the environment.

For a detailed discussion of the energy use and environmental impact of the transport sector in Ireland, along with future plans for the sector, please refer to Chapter 11.

Renewable fuels

While electrification is expected to meet many energy needs in the future, some hard-to-decarbonise sectors will require access to fuels or stored energy that can meet their demands, including for some industrial and transport applications. Progress is being made with developing these low- and zero-carbon energy supplies.

Liquid biofuels. Ireland set new records for biofuel blending in road petrol and road diesel in 2023. The annualised average biofuel blend in road diesel was 8.4% in 2023, up from 6.5% in 2022, and the average biofuel blend in road petrol was 4.2% in 2023, up from 3.2% in 2022. The increased blending of biofuel into road diesel reduced the energy demand of fossil petrochemical diesel by 2.0% in 2023 (SEAI, 2024a).

Ireland's energy requirements for biodiesel, bioethanol and biomass are satisfied through a combination of indigenous production and international imports. In 2023, Ireland's import dependencies on biodiesel and bioethanol were 68.4% and 78.8%, respectively, while its import dependency on biomass was 16.1% (SEAI, 2024b).

In 2023, biofuels saved 0.81 million tonnes of CO_2 emissions from transport. Since 2005, there have been cumulative biofuel emissions savings of 6.4 million tonnes of CO_2, making biofuels one of the more important mitigation measures to date for reducing transport-related emissions (EPA, 2024c).

Biomethane. Biogas is produced as the main product of the anaerobic digestion of biological feedstocks, including food waste, sewage sludge and agricultural feedstocks. Biogas typically comprises 60% methane and 40% carbon dioxide. When biogas is upgraded to greater than 97% purity methane, it is termed biomethane.

CAP24 has ambitious targets of producing 1 TWh of biomethane by 2025 and 5.7 TWh by 2030 from anaerobic digestion of agricultural feedstocks to replace the fossil methane in the natural gas network. This target is a little over 10% of the current use of fossil fuels; however, it is expected to rise to over 50% of Irish usage by the mid-2030s as Ireland shifts the economy away from gas in favour of electrification. Achieving the biomethane targets will require very significant investment and scaling up from the current biomethane production level. A recent Gas Networks Ireland report identified the potential for 14.8 TWh of biomethane from over 170 prospective producers (Gas Networks Ireland, 2023).

4 www.gov.ie/en/publication/3e988-national-policy-statement-on-electricity-interconnection/ (accessed 9 September 2024).

A National Biomethane Strategy was published in June 2024 setting out a vision for an agri-led biomethane industry that promotes the use of the gas in Ireland's future energy system. According to the strategy, the increase in biomethane production needed to achieve the CAP24 targets will be facilitated by increasing the number of anaerobic digestion plants in Ireland to 200 by 2030. In Ireland there are currently two operational biomethane facilities that can inject methane into the national grid and 43 facilities that produce biogas. These new anaerobic digestion plants will require authorisation from the EPA when using waste feedstocks.

To be classified as a zero-carbon-rated fuel, biomethane must satisfy the Renewable Energy Directive's life cycle sustainability criteria. A national biomethane charter is planned, which will include all of the issues covered by the Renewable Energy Directive, as well as land use, water quality, biodiversity, fertiliser use and carbon sequestration to the extent that they are not addressed under the Renewable Energy Directive.

It is estimated that, to meet the biomethane production targets, over 20% of all winter cattle slurry produced in Ireland would be required to facilitate a balanced feedstock for the anaerobic digestion plants. The National Biomethane Strategy assumes an equal mix of grass foliage and slurry in the feedstock and estimates that, at national level, a total land area of 120,000 hectares would be needed to produce the silage to feed the anaerobic digester biomethane plants required to reach the 5.7 TWh target. The strategy will seek to avoid potential competition with other critical uses of land, including food production and biodiversity protection, and ensure that the industry contributes to nature and water quality recovery. The strategy highlights that anaerobic digestate can be used to replace chemical fertilisers, reducing the need for these in agriculture.

Hydrogen. The National Hydrogen Strategy was published by the Department of the Environment, Climate and Communications in 2023. The strategy sets out the strategic vision for the role that hydrogen will play in Ireland's energy system and the short-term actions that need to be delivered to enable the development of the hydrogen sector in Ireland. The rationale for the strategy is to develop a solution for hard-to-decarbonise sectors with an indigenous zero-carbon renewable fuel that enhances our energy security while also presenting some potential export opportunities.

The strategy envisages hydrogen supporting dispatchable flexible electricity as a long-duration store of renewable energy in decarbonising industrial processes and as a transport fuel in sectors such as heavy goods transport, maritime transport and aviation. Prior to 2030, it is envisaged that hydrogen will be produced from grid-connected electrolysis from surplus renewables. A 2 GW target for the production of renewable hydrogen from offshore wind has been set for 2030.

10. Subsidies and taxes

Taxation, operating in conjunction with other measures, provides the government with an important climate action policy lever. Fiscal measures such as price signalling and the gradual removal of fossil fuel subsidies support the move away from heavily polluting fossil fuels and towards more sustainably fuelled transport, heat and industry. A range of policies, including demand management, is needed to meet the necessary reductions and underpin the transition to a low-emission and ultimately net zero economy.

Fossil fuel subsidies

The International Energy Agency's World Energy Outlook 2022 (International Energy Agency, 2022) highlights that recent direct fossil fuel subsidies and below-market energy prices reduce or remove incentives for energy efficiency and disproportionally benefit wealthier households and businesses, and are a burden on public finances.

The EU and its Member States have a long-standing commitment to phasing out potentially environmentally harmful subsidies, including fossil fuel subsidies. Such subsidies include tax exemptions/reductions for specific goods or groups. The CSO provides an analysis of fossil fuel subsidies in Ireland (CSO, 2023), including direct and indirect subsidies. These direct subsidies include those provided for fossil fuel exploration, production and consumption, with a significant focus on lower income households and groups (Table 12.2). The CSO estimates direct fossil fuel subsidies at €300 million per annum for 2017-2021, on average. Additional direct subsidies were introduced following Russia's invasion of Ukraine in February 2022, as fossil fuel prices soared, including direct electricity payments to households, reduced VAT on electricity and natural gas, and decreases in excise rates on road petrol and diesel. Higher fossil fuel prices have the hardest impact on poor people. These recent subsidies were not targeted to any income group and apply to all householders and fuel users. It is important to ensure that climate policies and fuel taxation measures are targeted to the most vulnerable, helping to achieve a just transition.

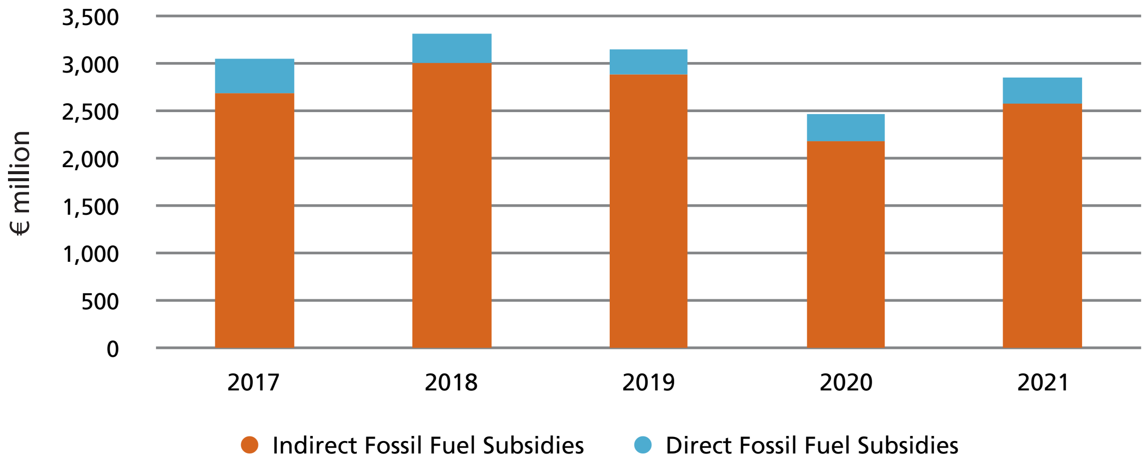
Table 12.2 Direct fossil fuel subsidies, 2017-2021

DIRECT FOSSIL FUEL SUBSIDIES	2017	2018	2019	2020	2021
Total	**357.8**	**309.6**	**268.7**	**290.6**	**284.8**
Fossil Fuel Production					
Petroleum exploration and production promotion and support scheme	2.1	1.2	1.4	2.1	0.9
Science Foundation Ireland fossil fuel R&D funding	1.3	1.3	0.8	0.2	0.0
Fossil Fuel Consumption					
PSO levy: electricity generation from peat	117.8	65.5	25.5	31.4	7.7
PSO levy: security of supply	–	–	–	–	–
Electricity allowance	110.2	108.6	105.7	104.9	115.7
Gas allowance	20.6	19.3	21.2	20.9	22.1
Fuel allowance	90.5	96.1	96.0	116.2	126.3
Other supplements (including heating)	5.8	7.7	7.7	4.9	4.1
Fuel grant for disabled drivers /passengers	9.5	10.0	10.5	10.0	8.1

– Scheme not in operation or no relevant payments made

Source: CSO, 2023

Figure 12.9 Direct and indirect fossil fuel subsidies, 2017-2021



Source: CSO, 2023

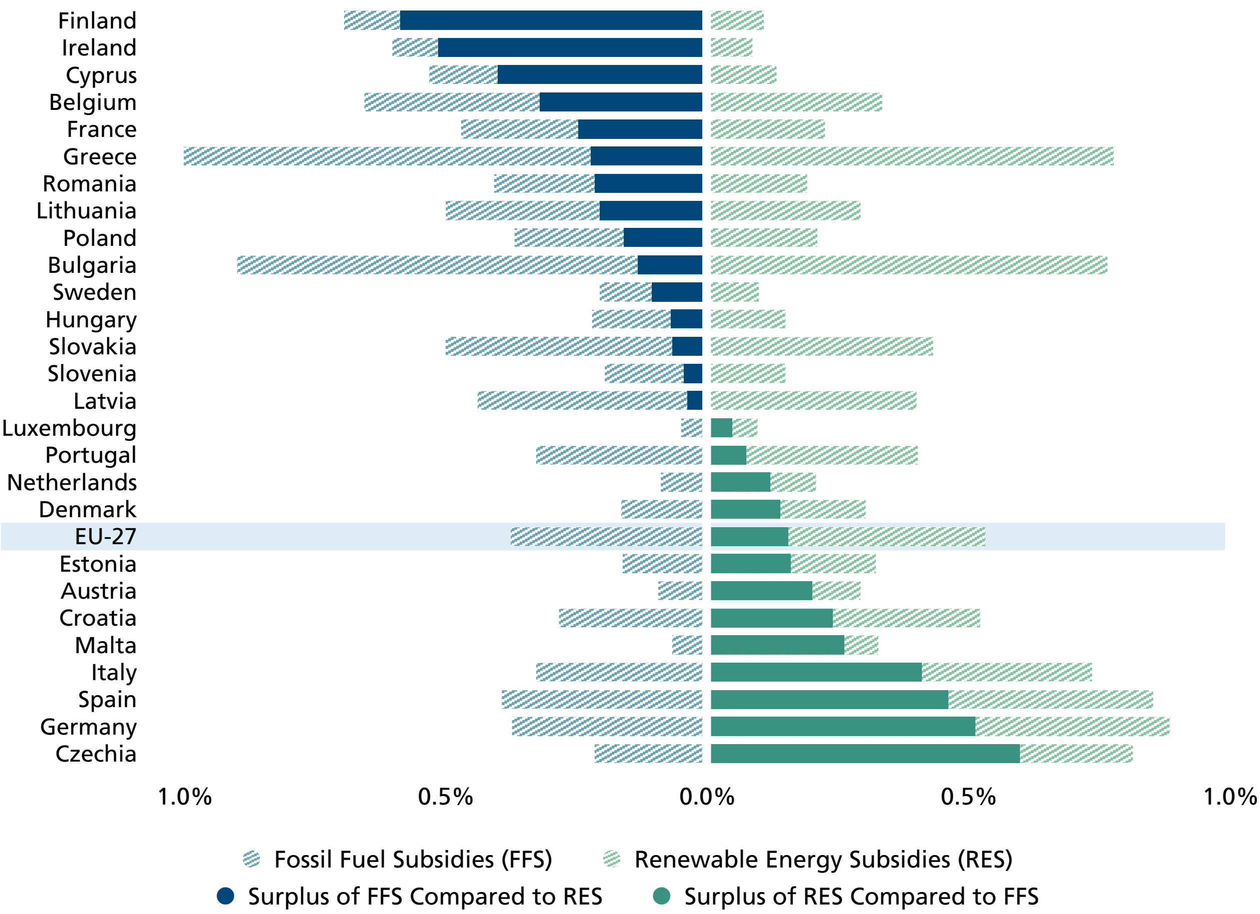
The CSO also estimates indirect fossil fuel subsidies amount, on average, to €2.5 billion per annum, including exemptions on excise and VAT for aviation fuels, tax differentials on marked gas oil and road diesel, VAT rebates for road diesel and lower VAT on energy products. The total indirect and direct fossil fuel subsidies for 2017-2021 are presented in Figure 12.9, which shows COVID-19 impacts resulting in lower subsidies in 2020.

Renewable energy subsidies

A recent European Court of Auditors report assessed how energy taxes, carbon pricing and energy subsidies fit with EU climate objectives (European Court of Auditors, 2022). Energy taxation can support climate efforts, but current tax levels do not reflect the extent to which different energy sources pollute. Renewable energy subsidies almost quadrupled over the period 2008-2019, while fossil fuels subsidies remained stable.

Fossil fuel subsidies represent an obstacle to reaching climate goals because they hinder the green energy transition. Overall, across the EU, renewable energy subsidies are higher than fossil fuel subsidies, but Ireland is among 15 Member States that allocate more fossil fuel subsidies than renewable energy ones (Figure 12.10) (European Court of Auditors, 2022).

Figure 12.10 Level of fossil fuel subsidies compared with renewable energy subsidies



Source: European Court of Auditors, 2022; reproduced under the terms of the Creative Commons CC BY 4.0 licence (creativecommons.org/licenses/by/4.0/)

Energy taxes and carbon pricing

The importance of carbon pricing in reducing GHG emissions has been recognised across the world, with both taxation and 'cap-and-trade' pricing schemes in operation in many countries and regions, including in the EU and Ireland. Evidence of the impact of taxing energy use on reducing energy consumption has been widely published over many years (Labandeira *et al.*, 2017). While direct energy taxation (e.g. taxes on transport or heating fuels) has been in place in Ireland for many years, a carbon tax was introduced in December 2009 directly related to CO_2 emissions, and has remained in place since then, growing steadily over time.

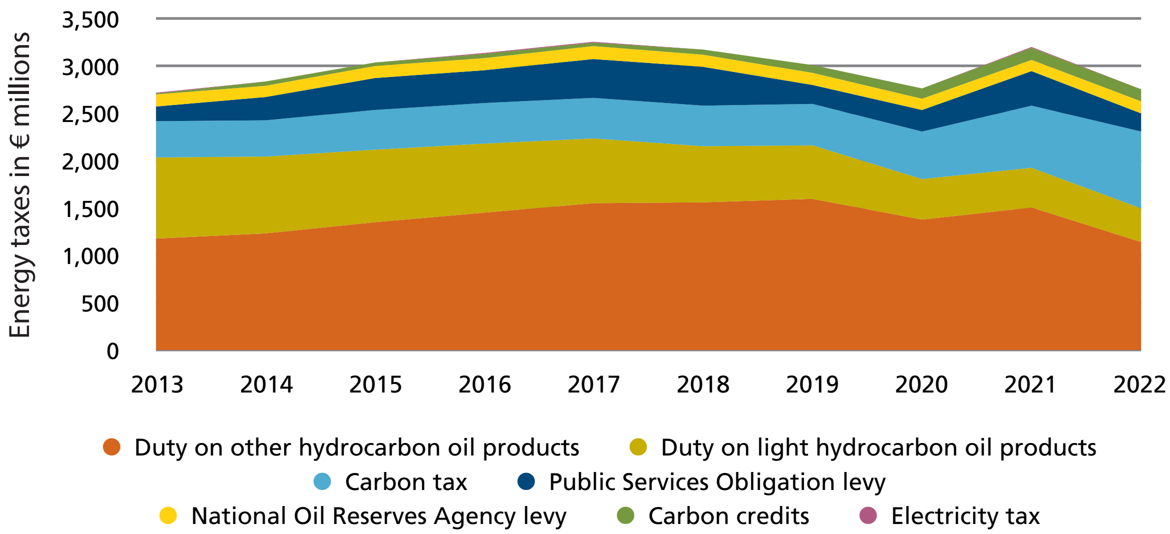
Since 2010, an excise duty, in the form of the Natural Gas Carbon Tax, has been applied to supplies of natural gas. Mineral Oil Tax (MOT) is an excise duty that applies to liquid fuels released for consumption in Ireland for motor or heating purposes.[5] The MOT rates were amended in 2010 to introduce a carbon component in addition to the pre-existing non-carbon component. A carbon tax was introduced for solid fuels in 2013 in the form of the Solid Fuel Carbon Tax, which is applied to coal, peat briquettes, milled peat and other peat supplied in Ireland.

The rates applied to the Natural Gas Carbon Tax, Solid Fuel Carbon Tax and the MOT carbon component are proportionate to the amount of CO_2 emitted when the fuel is combusted and are based on charging an amount per tonne of CO_2 emissions.

5 www.revenue.ie/en/companies-and-charities/excise-and-licences/excise-duty-rates/mineral-oil-tax.aspx (accessed 9 September 2024).

Legislation was introduced in 2020 setting a 10-year trajectory of carbon tax increases to bring the charge per tonne of CO_2 emissions to €100 by 2030. While carbon tax has continued to increase, reaching €807 million in 2022, energy taxes have reduced overall since 2017, with reductions in duty on light hydrocarbon products and other hydrocarbon products (Figure 12.11). A phased reversal of these cuts has taken place in 2023 and 2024.

Figure 12.11 Energy taxes, 2013-2022



Source: CSO, 2023

11. Conclusions

Meeting Ireland's statutory obligations to remain within carbon budgets to 2030 and achieve climate neutrality by 2050 requires significant and unprecedented changes to the energy system.

Large-scale and immediate GHG emission reductions are needed across the whole energy system (electricity, heat and transport). The ICCA report highlights that well-established 'no-regret options' can move Ireland's energy decarbonisation significantly forward and must be implemented now. These include demand reduction, electrification, deployment of market-ready renewables and low-carbon heating options (e.g. district heating).

Ireland's heating and transport systems remain heavily dependent on fossil fuels, and rapid transformational change is needed in how we heat our homes, deliver our goods and services and transport people and goods.

Localised environmental issues relating to air quality are integrally linked with the combustion of fossil fuels for home heating and transport. Progressing heating and transport systems towards using zero-carbon fuels will have a significant beneficial impact on air quality.

Retrofitting homes and other buildings is key to reducing emissions and brings multiple other benefits relating to air quality and health. Electrification of home heating through the replacement of solid and liquid fuels with heat pumps is also key to reducing building energy-related emissions. Retrofitting the homes of those experiencing energy poverty should be a priority, as it is crucial for a just transition.

Renewable electricity generation is projected to reach up to 80% of electricity generation at the end of the decade as a result of a projected rapid expansion in wind energy and solar power. Continuing this substantial progress is a critical element in Ireland achieving net zero.

Renewable fuels such as solid, liquid and gaseous forms of bioenergy and hydrogen will be needed in sectors not currently suited to electrification, such as heavy goods transport and some sectors of industry and to balance an electricity grid based on variable renewable electricity technologies.

A net zero energy system can bring multiple benefits, including improved energy security and significantly reduced import of fossil fuels into Ireland to meet our energy needs, from over 80% today (SEAI, 2024d) to less than 5% in the future, and societal co-benefits, including improved human health and air quality.

To ensure grid stability and security of supply, the system will also require other options, such as increased interconnection, demand flexibility, storage and zero-emission back-up generation.

The ICCA report highlights that renewable energy not only reduces emissions but also opens up opportunities in the green economy, including for coastal communities and farmers, and distributed energy enables homeowners to be producers of energy, lowering energy bills.

The energy transition requires consideration of issues beyond technical aspects, including environmental, societal, economic and governance dimensions. In this context, the ICCA report identifies the need for an enhanced regulatory and planning framework to accelerate the deployment of renewables, realise co-benefits and manage trade-offs, competition and impacts on other land uses, including biodiversity, food production and carbon sequestration.

Effective frameworks for investment in Ireland's energy transition are needed, and significant redirection of fossil fuel subsidies can contribute to this process.

SEAI has highlighted the challenge of establishing a sufficient supply of competent providers to meet the needs of the National Retrofit Plan. Similar challenges have also been highlighted in the renewables industry. Addressing these gaps in national capability will be critical to achieving the transformational changes needed to progress to net zero.

Key chapter messages

1. Established technologies, such as wind energy, solar photovoltaics and bioenergy, will be key in meeting short-term emission reduction targets (i.e. 2030), whereas significant growth in offshore wind infrastructure is expected to be the key essential element of future energy systems. Enhanced regulatory and planning frameworks, and support schemes, are required to accelerate the deployment of renewables, realise co-benefits and manage trade-offs.

2. Growing demand for electricity is an anticipated by-product of the expected electrification of the heat and transport sectors. However, additional and rapidly increasing electricity demand growth from large energy users is putting pressure on energy systems.

3. World class infrastructure takes significant time and investment from conception to implementation. The time horizon for achieving national and EU commitments is getting ever shorter. Planning in the broadest sense needs to be fast tracked to achieve the ambitious national renewable energy targets.

4. Substantial challenges remain for high-intensity hard-to-decarbonise sectors, e.g. high temperature users, and the development of low or zero carbon fuels to meet these applications are needed. Negative emissions technologies and solutions will also be required to deliver a climate-neutral Ireland.

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Chapter 13:
Environment and Industry

Environment and Industry

1. Introduction

Industry is an important part of Ireland's economy, providing jobs and vital goods for modern society. Over 18% of the workforce in Ireland, 2.3 million people in 2022, was employed in industry (CSO, 2023), with the industrial sector third behind the healthcare and retail sectors in terms of workforce size. The total value of products manufactured in Ireland in 2022 was €132 billion. The three largest industry sectors accounted for two-thirds (or almost €90 billion) of total net selling value – pharmaceutical products (32%), food products (18%) and chemicals and chemical products (17%) (CSO, 2023). Ireland is the world's third largest exporter of pharmaceuticals; there are now more than 84,000 highly skilled people directly and indirectly employed in the wider chemical and pharmaceutical manufacturing sector. Bord Bia (2024) reported an increase in Irish food and drink exports of 22% in 2022, worth €16.7 billion. This decreased by 4% in 2023 but remains 24% higher than it was in 2019.

While these sectors provide significant benefits to the Irish economy, they also present potential risks to the environment that require appropriate management and regulation. Industrial activities are a source of pressure on the environment, mainly in the form of waste generation, resource consumption and emissions to the atmosphere, soil and water ecosystems.

Studies have shown that air pollution from industrial facilities across Europe has significant costs associated with its impacts on human health, ecosystems, infrastructure and climate. Across Europe, more than 100 industrial facilities (none from Ireland) are responsible for 50% of the damage caused by air pollution, mostly emitted by energy suppliers within Germany, Poland, Italy, France and Spain (EEA, 2024).

Some industrial sites cause local issues with water and air quality and can create noise and odour problems which impact a community's ability to enjoy its local environment.

2. European policy context

European Green Deal

The European Green Deal is Europe's strategy to ensure a climate-neutral, clean and circular economy by 2050, optimising resource management and minimising pollution while recognising the need for deeply transformative policies (EC, 2019). It provides a roadmap for industries to transition towards more sustainable practices, while also fostering innovation and competitiveness. It aims to reach zero pollution for a toxic-free environment under the Zero Pollution Action Plan (EC, 2021). One of the pillars of the Green Deal is 'a predictable and simplified regulatory environment'.

Strategic Agenda 2024-2029

Adopted by the European Council in 2024, the Strategic Agenda 2024-2029[1] sets priorities for the European Union (EU) for the next 5 years in line with the EU's ambition to become the first climate-neutral continent, focusing on green and digital industries and technologies. Agreed priorities include more support for the scale-up of Europe's manufacturing capacity for net-zero technologies and products, the development of a more circular and resource-efficient economy and an ambition to simplify business permitting. There is a continued commitment in the Strategic Agenda to protect nature, reverse the degradation of ecosystems and strengthen water resilience. See Chapter 15 for more on the circular economy and Chapters 7 and 8 for further discussion of nature and water protection.

Industrial Emissions Directive

The revised Industrial Emissions Directive (IED) (2024/1785/EU)[2] is the main piece of EU legislation for preventing and reducing pollution from large industries (Topic Box 13.1). The amount of air pollutants emitted by these industries is seven times less than it was 20 years ago (EC, 2021). Table 13.1 maps the IED to selected European Green Deal policies.

1 www.consilium.europa.eu/media/4aldqfl2/2024_557_new-strategic-agenda.pdf (accessed 15 July 2024).

2 Amending IED Directive (2010/75/EU) and Landfill Directive (1999/31/EC).

Topic Box 13.1 Industrial Emissions Directive

The IED (2024/1785/EU) which amended IED (2010/75/EU) is the primary instrument in place to control and mitigate environmental and health impacts arising from industrial emissions in Ireland and across the EU. The Environmental Protection Agency (EPA) is the competent authority in Ireland for the IED.

In the revised directive, additional intensive agriculture and large-scale battery production activities will be brought into scope. The revision will require a greater focus on energy, water and material efficiency and reuse, in addition to promoting the use of safer, less toxic or non-toxic chemicals in industrial processes. Licences issued under the revised IED will include tighter controls on air and water emissions, additional monitoring where a derogation has been granted and enhanced public access to information. There is also a requirement to have greater synergies with the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) Regulation[3] and with authorities, particularly in relation to chemical management systems at installations and in developing sector-specific good practice for chemical manufacture.

The revised directive will offer better protection to human health and the environment by reducing harmful emissions from industrial installations while promoting energy efficiency, a circular economy and decarbonisation.[4]

There are approximately 50,000 installations in Europe operating in accordance with IED licences across 65 industrial activity types such as cement, chemical and power plants (Figure 13.1).

Table 13.1 Mapping of Industrial Emissions Directive to selected European Green Deal policies[a]

POLICY AREA	EXAMPLES OF IED CONTRIBUTION AND RELEVANCE
Zero Pollution Action Plan	▪ Prevents and reduces emissions of pollutants to air, water and soil ▪ Seeks to ensure that emissions do not lead to exceedances of environmental quality standards defined in air and water legislation ▪ Regulates transfers of industrial pollutants to urban waste water treatment plants
Climate change and energy policies	▪ Takes GHG emissions of pollutant reduction techniques into account ▪ Regulates emission of GHGs not covered by the ETS (e.g. methane) ▪ Identifies energy efficiency techniques and established energy performance levels for specific processes ▪ Requires transformation plans (under the revised IED)
Sustainable chemicals	▪ Reduces the presence of harmful chemicals in the environment ▪ Will require chemical management systems at installations and the development of sector-specific good practice for chemical manufacture (under the revised IED)
Circular economy/ waste	▪ Promotes the efficient use of materials, water and energy and encourages waste prevention/recycling and the use of secondary raw materials ▪ Reduces emissions of pollutants from waste management installations
Nature and biodiversity	▪ Contributes to protecting biodiversity, by curbing pollutant emissions, one of the drivers of biodiversity loss

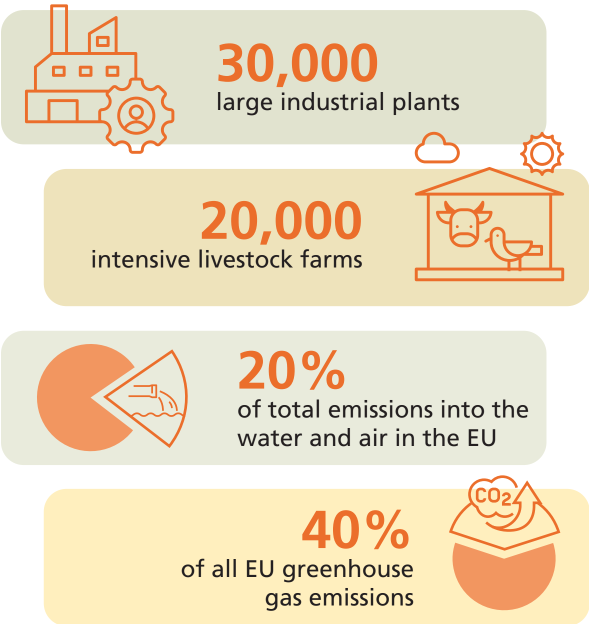
a eur-lex.europa.eu/resource.html?uri=cellar:8695b069-b5a9-11ec-b6f4-01aa75ed71a1.0001.02/DOC_1&format=PDF

ETS, Emissions Trading System; GHG, greenhouse gas.

3 eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:02006R1907-20221217 (accessed 15 July 2024).

4 www.consilium.europa.eu/en/press/press-releases/2024/04/12/industrial-emissions-council-signs-off-on-updated-rules-to-better-protect-the-environment/ (accessed 15 July 2015).

Figure 13.1 IED regulation across Europe



Source: Adapted from the European Council[5]

The objective of the IED licensing system is to provide an integrated management approach that concurrently considers environmental pressures on air and water quality and in terms of waste generation. IED licence conditions must be based on the use of best available techniques (BATs),[6] which are the most environmentally effective of the economically viable techniques available. Within Europe there is a legal requirement that industry must report on emissions via the Industrial Emissions Portal,[7] and these data are then made available to the public.

Installations covered by the IED currently account for 20% of total emissions to water and air in the EU. The IED applies to large combustion plants with a rated thermal input capacity over 50 MWth (megawatts thermal), including standby plants, which emit large quantities of pollutants to air. The Medium Combustion Plant Directive ((EU) 2015/2193) applies to all combustion plants with a rated thermal input capacity of between 1 and 50 MWth. These directives control emissions to air of sulphur dioxide (SO_2), nitrogen oxides (NO_x) and particulate matter. The introduction of the Medium Combustion Plant Regulation (S.I. No. 595/2017) will bring a reduction in emission limit standards for all new and existing plants in Ireland by 2025.

Across the EU, IED installations account for 40% of all EU greenhouse gas emissions. These emissions are mainly regulated under the EU Emissions Trading System (ETS) (see Chapters 4 and 12), which the EPA is responsible for administering in Ireland. The scheme includes 112 installations nationally. Since 2005, Ireland's emissions within the scope of the ETS have decreased by 35%, with electricity generators and cement plants responsible for most of the decrease (see Chapter 4). Light industry (non-energy intensive), such as some dairy processing plants, are covered by the Effort Sharing Regulation (ESR) ((EU) 2018/842).[8] Under the ESR, Ireland is required to reduce its emissions from these sectors by 42% by 2030, relative to 2005 levels.

Industrial sites licensed under the IED are located in all 26 counties. Ireland has a lower proportion of what is considered traditional heavy industry than its European counterparts (e.g. metal processing or mineral extraction) and a higher proportion than EU Member States of licensable industry in three specific sectors (Figure 13.2):

1. intensive agriculture – 45% of the total licensed industries in Ireland; 6% above the EU average (39%)
2. slaughtering, food and drink – 15% of Ireland's industrial installations; more than twice the EU average (7%)
3. chemicals – 11% of the total of licensed sites in Ireland; 2% above the EU average (9%).

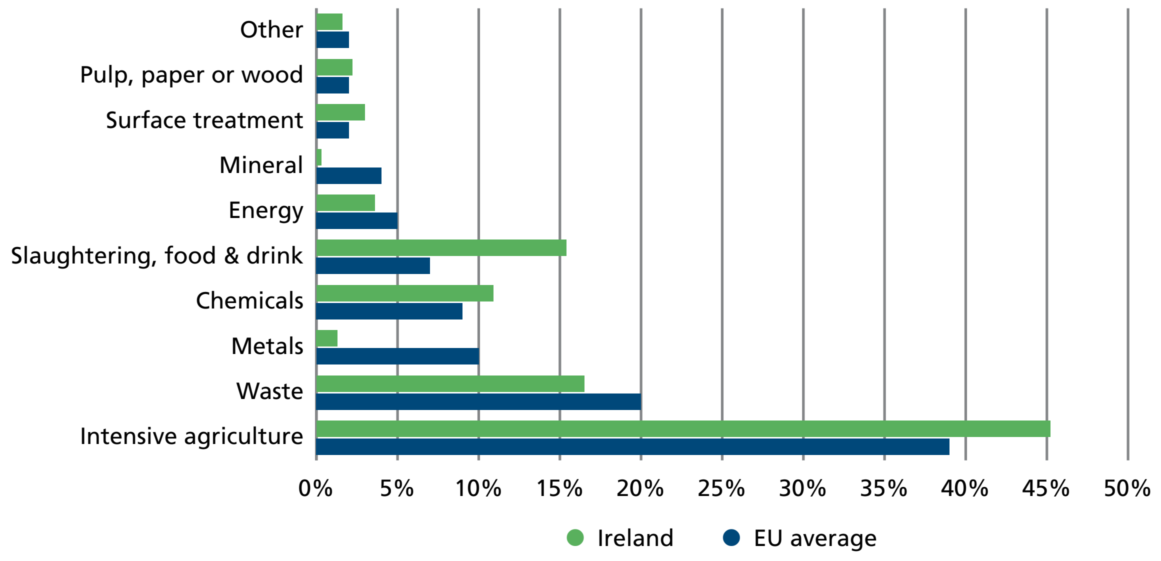
5 www.consilium.europa.eu/en/infographics/industrial-emissions-directive-key-figures/ (accessed 15 July 2024).

6 For further information on BATs, the BAT Reference Document and BAT Conclusions, visit www.epa.ie/our-services/licensing/industrial/industrial-emissions-licensing-ied/industrial-emissions-licensing-process-explained-/bat--bref--cid/ (accessed 15 July 2024).

7 industry.eea.europa.eu/#/home (accessed 15 July 2024). The information contained in the portal is reported annually and requested under the IED via the EU Registry on Industrial Sites (EU Registry) and the European Pollutant Release and Transfer Register. The European Industrial Emissions Portal replaced the European Pollutant Release and Transfer Register website in 2021.

8 National binding targets (for the period 2021-2030) are covered by the ESR. This includes emissions from agriculture, transport, buildings and light industry.

Figure 13.2 Composition of Industrial Emission Directive licensed industry (% of total licensed sites) in Ireland compared with EU Member States



Source: Compiled from European Council data[9]

Corporate Sustainability Reporting

The Corporate Sustainability Reporting (CSR) Directive ((EU) 2022/2464), arising from the European Green Deal's climate change action objectives, requires that companies disclose climate and environmental data (Topic Box 13.2).

Topic Box 13.2 Corporate Sustainability Reporting Directive

The CSR Directive requires companies that fall within its scope to disclose information on what they see as the risks and opportunities arising from social and environmental issues and on the impact of their activities on people and the environment. This information informs and assists investors, consumers and other stakeholders evaluating the sustainability performance of companies. The requirement of this directive is being implemented in Ireland and in other EU Member States in 2024 (for companies with more than 500 employees), with a phased implementation planned over the coming years until full implementation is in place in 2028.

The directive ultimately aims to increase transparency and ensure stakeholder access to reliable and comparable information about companies across a wide range of environmental and social issues.

Transformation plans and reporting as envisaged under the IED revision will complement the CSR requirements, providing a means for the concrete implementation of these requirements at the installation level.

9 www.consilium.europa.eu/en/infographics/industrial-emissions-directive-key-figures/ (accessed 15 July 2024).

3. Environmental regulation in Ireland

The EPA is the environmental regulator for large industrial and waste installations in Ireland (Figure 13.2). Licensing, permitting, inspections and the enforcement of permits form the core of the EPA's regulatory work. Further details of the EPA's work in this area are outlined later in this chapter.

Local authorities regulate industries that are not required to have a licence from the EPA, through single media permits (air, water), licences or waste permits. Other enforcement bodies, including Inland Fisheries Ireland, the Loughs Agency, the National Parks and Wildlife Service and Waterways Ireland, may investigate cases of unauthorised discharges to water or assess the impact of emissions to water from an industrial site.

Some industrial activities may cause or increase the risk of a major accident with potentially harmful consequences for the environment and/or human health. These plants are covered by the Seveso Directive (2012/18/EU), which is transposed nationally under the Chemicals Act Regulations 2015.[10] These regulations place specific emphasis on prevention measures, public information and the management of accidents. There are currently over 100 such installations in Ireland, and the lead regulator for these regulations is the Health and Safety Authority. Many of these installations are also licensed by the EPA under the IED.

Furthermore, the Commission for Regulation of Utilities is responsible for the regulation of some large-scale petroleum and natural gas installations, power generation plants and waste-to-energy plants. In some circumstances, the enforcement of environmental regulations may also have a cross over with planning authorities. The Maritime Area Regulatory Authority has a role in the licensing and enforcement of offshore development consents (see Chapter 9).

Enforcement networks play a crucial role in enhancing cooperation and coordination among the agencies responsible for preventing and combating illegal activities (Topic Box 13.3).

The EPA is Ireland's competent authority for issuing and enforcing industrial emissions (IE) licences in Ireland. There are over 650 IE licensed installations in Ireland regulated by the EPA (Figure 13.3).

Topic Box 13.3 Enforcement networks

There are several national and European enforcement networks where regulators can meet and share information. These networks ensure that environmental regulations are consistently enforced. The two most prominent networks are the European Union Network for the Implementation and Enforcement of Environmental Law (IMPEL) and the Network for Ireland's Environmental Compliance and Enforcement (NIECE).[11]

IMPEL

IMPEL is an international association of environmental authorities of the EU Member States, the UK, acceding and candidate countries of the EU, European Economic Area and European Free Trade Association countries and potential candidates that wish to join the European Community. IMPEL's mission is to ensure the effective implementation and enforcement of environmental law in Europe.

NIECE

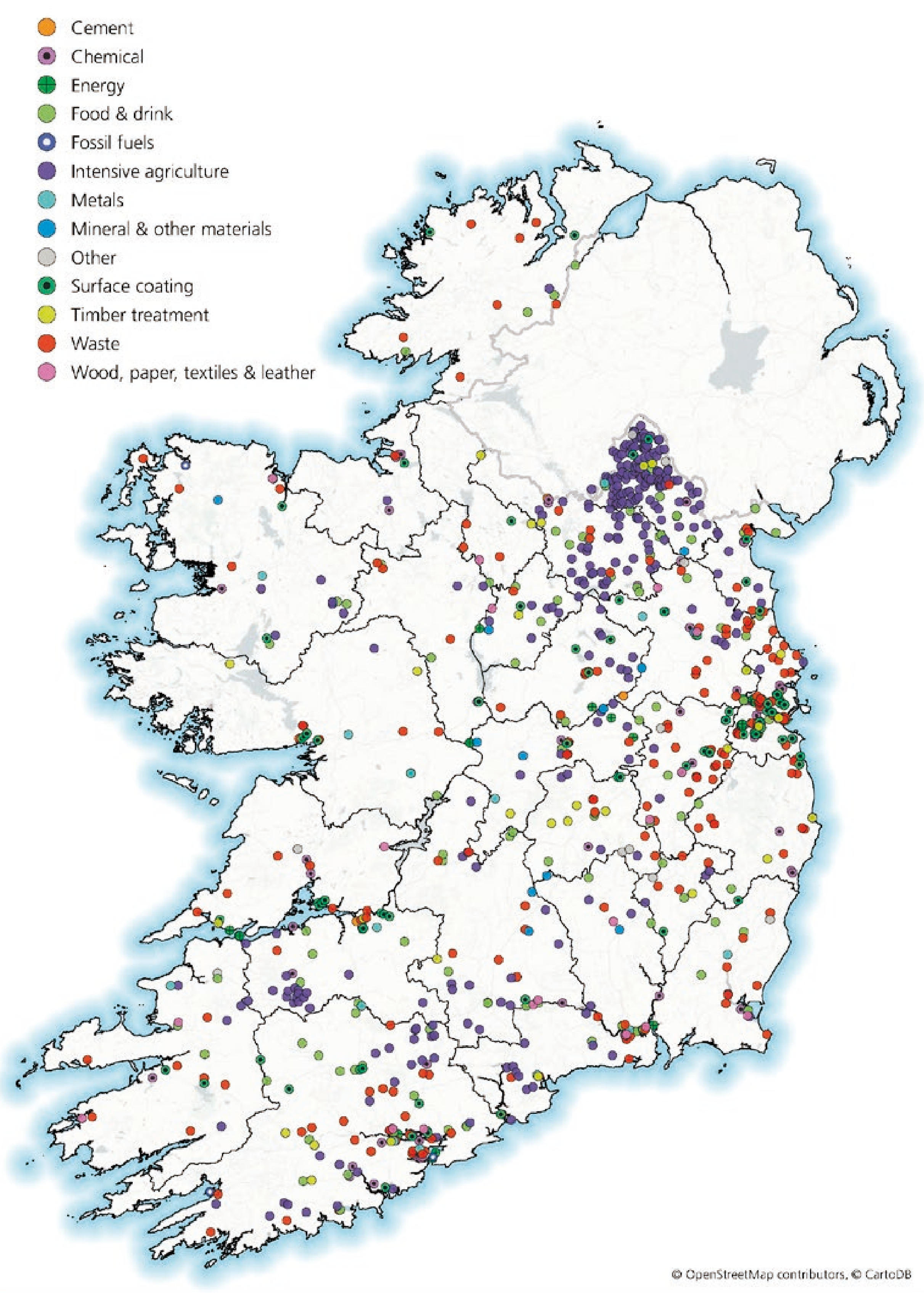
NIECE is structured around key priority areas for environmental enforcement in Ireland, such as waste, water and air/climate. Members include representatives of local authorities, state agencies and government departments. The network provides a forum that encourages individuals and organisations to work together to deliver improvements in these priority areas.

The continued development of enforcement networks is essential to ensure both an effective and harmonised approach to environmental enforcement in Ireland and proactive communications with the public.

10 Chemicals Act (Control of Major Accident Hazards Involving Dangerous Substances) Regulations 2015 (S.I. No. 209/2015). The Seveso Directive was named after an accident that occurred in 1976 in a chemical plant near Seveso, Italy, resulting in emissions of air pollutants (dioxins) affecting residents and the environment.

11 www.impel.eu/en (accessed 15 July 2024); www.epa.ie/our-services/compliance--enforcement/support-and-supervision-of-local-councils/niece-network/ (accessed 15 July 2024).

Figure 13.3 EPA-licensed industrial sites in Ireland, by sector



Once the EPA has issued a licence to a facility, it monitors compliance to ensure that installations do not have significant impacts on human health or the environment and that they are carrying out their activities in accordance with their licences. The EPA's annual inspection plan provides a baseline for site visits based on requirements set out in the IED (EPA, 2022). The EPA assesses performance reports, records and information that are sent by operators as part of their licence requirements. The agency also carries out inspections to make sure that operators are complying with their licences. Where non-compliances are noted, appropriate and proportionate enforcement actions are taken.

The EPA published its revised compliance and enforcement policy in 2019, following extensive consultation with various stakeholders such as licensees, industry representative bodies and the public (Topic Box 13.4).

The EPA's strategic outcome to deliver a protected and healthy environment by 2026 states that,

"any regulated operators polluting the environment or impacting public health will be held to account".

Topic Box 13.4 EPA Legal activity

The EPA's enforcement approach[12] is underpinned by the principles of:

- proportionality in applying environmental law and securing compliance
- consistency of approach
- transparency in how the EPA operates
- targeting enforcement action where it is needed
- implementing the polluter pays principle.

Prosecutions are a key tool used by the EPA as part of its wide-ranging enforcement powers. While most of the cases taken are summary prosecutions in the District Court, more serious prosecutions are taken on indictment, through the Office of the Director of Public Prosecutions.

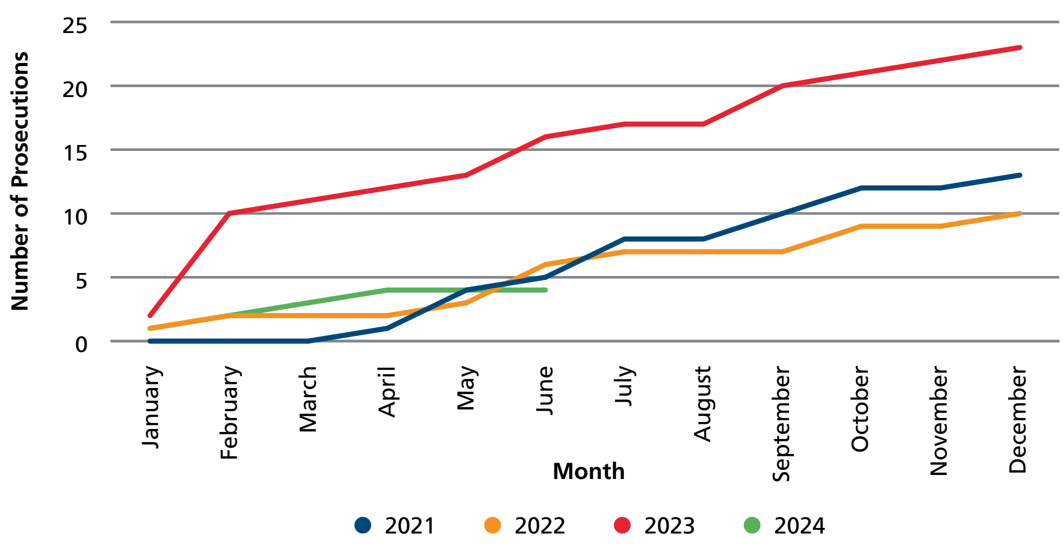
Tralee Courthouse

Between January 2021 and June 2024, the EPA took District, Circuit and High Court action. Figure 13.4 shows the number of legal cases brought by the EPA: 48 criminal legal cases which concluded in relevant District Courts and two in the Circuit Court. The majority of these were prosecutions taken against companies in the industrial and waste sectors, and Uisce Éireann (formerly Irish Water). Of the two Circuit Court cases finalised in the period, one incurred fines for the company involved of €34,000, plus costs, the other the sentencing of a waste company director to 3 years imprisonment, with 12 months suspended.

The EPA also initiated District Court prosecutions and a High Court injunction regarding the unauthorised extraction of peat.

12 Compliance and Enforcement Policy: www.epa.ie/our-services/compliance--enforcement/whats-happening/compliance-and-enforcement-policy/ (accessed 15 July 2024).

Figure 13.4 District and Circuit Court prosecutions concluded in the period January 2021-June 2024



The EPA received 13 challenges to decisions issued by judicial review in the High Court in the January 2021-June 2024 period. In addition, the EPA was a notice party in two High Court challenges against planning decisions. Most cases related to decisions on industrial emission licences. The number of decided cases in the High Court or the Court of Appeal was four, with the outcome finding in favour of the EPA in all cases. Two challenges were dismissed as being premature and four judgments were challenged in the Court of Appeal, with a successful outcome in two and judgement awaited in two.

EPA legal cases are expected to increase with a move to the Commercial Court and subsequently the Planning and Environmental Court, bringing additional resource requirements due to a strictly enforced and compressed timeline.

Since its establishment in 1993, the EPA has been committed to conducting its regulatory work in an open and transparent manner and to providing public access to regulatory correspondence related both to the licensing of major industrial, waste management and comparable activities and to the enforcement and monitoring of the environmental performance of licensed operators. This policy is in line with the Aarhus Convention (UN, 1998) and associated EU and national law.[13] With the introduction of the Licensing and Enforcement Access Portal (LEAP Online) in 2023, the public can access enforcement and compliance records on the EPA website (Topic Box 13.5).

EPA inspection

13 Principally the Access to Information on the Environment Regulations 2014 as amended (S.I. No. 615/2014), which enacted the Aarhus Convention in Irish law and the Access to Information on the Environment Regulations 2014.

Topic Box 13.5 LEAP Online

leap
Licence & Enforcement Access Portal

LEAP Online[14] provides enhanced online public access to regulatory records issued or received by the EPA, subject to certain exceptions provided for in law, including the General Data Protection Regulation, the Freedom of Information Act and Access to Information on the Environment Regulations. These records are the formal compliance and enforcement correspondence exchanged between the EPA and holders of EPA licences and permits. The regulatory records that can now be viewed online include EPA site inspection reports (and licensee responses), air, water and noise monitoring returns and annual environmental reports.

LEAP Online has greatly improved the public's ability to learn about licensed activities in Ireland, and it provides operators with an effective way of communicating with their neighbours and the wider community. The portal's development complies with Article 5.3 of the Aarhus Convention to:

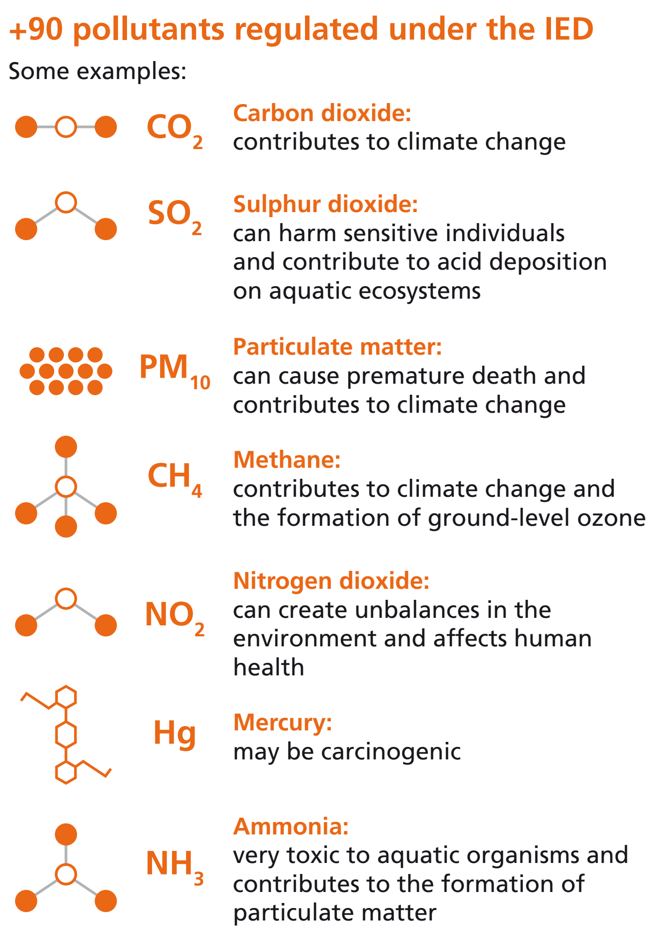
> "ensure that environmental information progressively becomes available in electronic databases which are easily accessible to the public through public telecommunications networks."

LEAP Online provides access to regulatory records for the current and prior 7 calendar years. It covers integrated pollution control (IPC), IED, waste, waste water, dumping at sea and radiological licences/permits. The upload of regulatory records to LEAP Online is deferred for a period of 30 calendar days following their acceptance or issue by the EPA. LEAP Online is hosted on the 'Our Services' tab on the EPA website (www.epa.ie).

4. Emissions from industry

The IED currently regulates more than 50,000 industrial installations across Europe, including 650 in Ireland. Since 2020, the majority of IED permits issued in Ireland have been in the energy and intensive agriculture sectors. Approximately 75% of permits issued since 2020 in the energy sector are for data centres while 84% in the intensive agriculture sector are for poultry rearing facilities. Examples of the pollutants regulated under the IED are set out in Figure 13.5.

Figure 13.5 Examples of over 90 pollutants for which the Industrial Emissions Directive sets annual emission thresholds across Europe



Source: Adapted from the European Council[15]

14 leap.epa.ie/confirm?returnUrl=https%3A%2F%2Fleap.epa.ie%2F (accessed 15 July 2024).

15 www.consilium.europa.eu/en/infographics/industrial-emissions-directive-key-figures/ (accessed 15 July 2024).

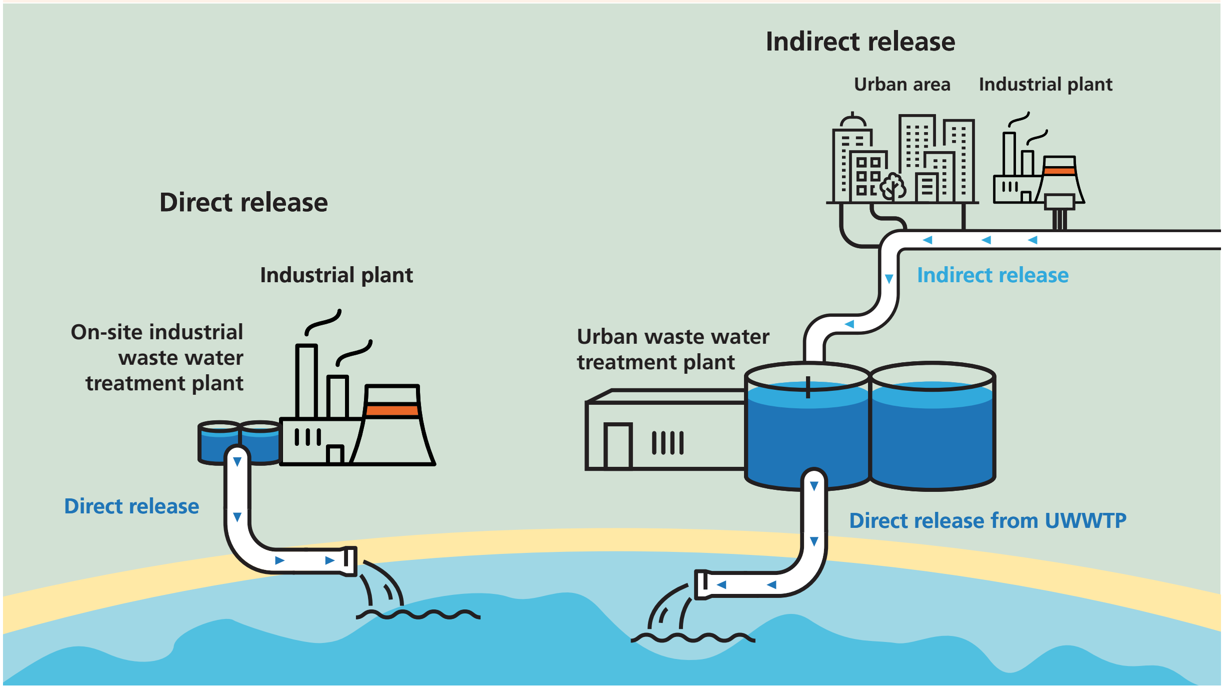
Emissions to water

Industrial pollutant emissions can impact both surface water and groundwater. Emissions from industry to surface water can be direct – from an on-site waste water treatment system or stormwater drainage network – or indirect, via sewers, subject to consent from Uisce Éireann, for discharge into its sewer and subsequent treatment in an EPA-regulated municipal waste water treatment plant. The impact that emissions from industry can have on water depends greatly on the nature of the water into which the pollutant is discharged. The effect that pollutants may have on surface water can be measured by examining physical, chemical and biological impacts.

Surface water. In Ireland, industrial emissions to surface water are not a main pressure on water quality when compared with the emissions of other sectors. As discussed in Chapters 8 and 9, emissions from industry rank ninth out of 11 significant pressures on water quality. Industry's impact on water quality is far less than that of other sectors, as industrial facilities that discharge to surface water have emission limit values with which they must comply. Where they have failed to comply with their emissions limit values, installations may have negatively impacted surface water quality by depleting oxygen levels and/or having toxic effects on aquatic life in receiving waters.

Industrial pollutant releases to surface water include compounds that contain nutrients such as nitrogen (referred to as total nitrogen) and phosphorus (total phosphorus) which can cause eutrophication in surface waters. Releases are also described in terms of their total organic carbon content. High levels of organic content in a natural water body will undermine an ecosystem's operation by, for example, affecting oxygen levels in the water. The IED permits issued by the EPA to operators set out limits for emissions to water that ensure that industrial activities do not have detrimental effects on the receiving environment. Emissions to water from industry can be direct or indirect via sewer and urban waste water treatment plants, as illustrated in Figure 13.6.

Figure 13.6 Direct and indirect releases of treated waste water to water from industrial sites



UWWTP, urban waste water treatment plant.

Other relevant pollutants are heavy metals such as arsenic, copper, nickel and zinc, which can also have detrimental impacts on human and environmental health. Emerging and trace pollutants such as persistent pharmaceutical and cosmetic products, microplastics, trace organics and residues present a potentially serious threat from industry to human health and ecosystems. A review of the Water Framework Directive (2000/60/EC) in 2022 identified 25 new priority substances in waters, such as per- and polyfluoroalkyl substances (discussed in Chapter 14), bisphenol A and various veterinary pharmaceuticals. The revised IED will ensure that permit requirements related to these substances (and other emerging pollutants) are better controlled and more integrated. The implementation of the revised IED is projected to result in a 10-30% reduction in some of these substances from IED installations.[16]

With the exception of emissions of some metals, direct releases from industry are minor compared with discharges from urban waste water treatment plants (EPA, 2020). There has been a significant decrease in emissions of metals to water (Figure 13.7) from industry in the past 15 years, which reflects the more stringent requirements resulting from reviews of licence conditions and emission limit values undertaken by the EPA. These requirements arose from the EPA-initiated licence reviews of 87 industrial licences, which reduced limits to ensure compliance with standards by 2015. Large improvements from the mining sector accounted for most of the significant decreases.

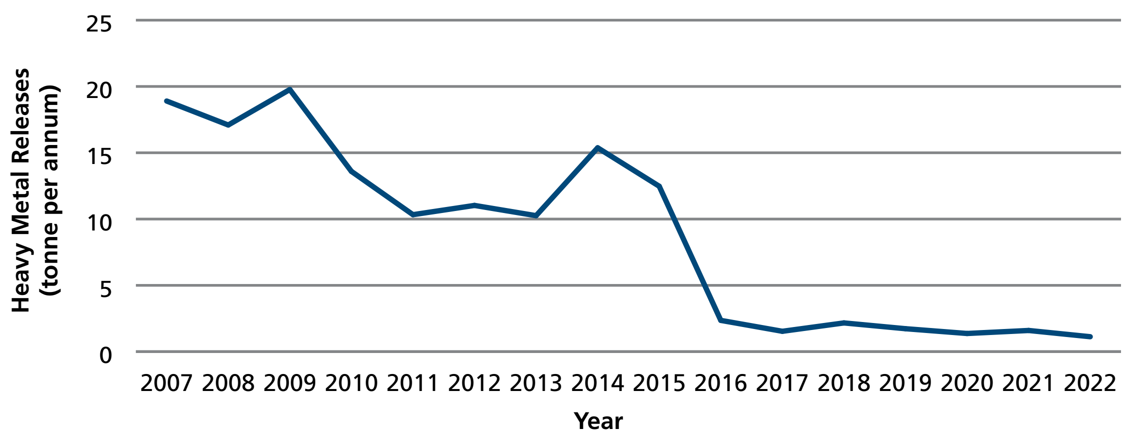
Groundwater. Direct emissions to groundwater are prohibited under the European Communities Environmental Objectives (Groundwater) Regulations 2010 (S.I. No. 9/2010) and 2022 (S.I. No. 287/2022), and no industry in Ireland is licensed to have direct discharges to groundwater.

Many industrial facilities are required to monitor and report on the quality of groundwater beneath their installations. Although industry is not a significant source of surface water or groundwater pollution in Ireland, there have been historical and accidental industry releases to groundwater that have caused groundwater quality issues that continue to be assessed and remediated.

Regarding groundwater contamination from industry, the parameters of concern tend to be associated with historical unlined landfills, hydrocarbons from the spillage of fuel and other oils, and industrial chemicals such as halocarbons. Compared with surface water pollution, groundwater pollution is often harder to detect, and it is also more difficult to fully understand the extent and nature of contamination. Many of the groundwater pollution issues associated with industry can persist for many years and intervention may be required to return groundwater quality to a satisfactory status.

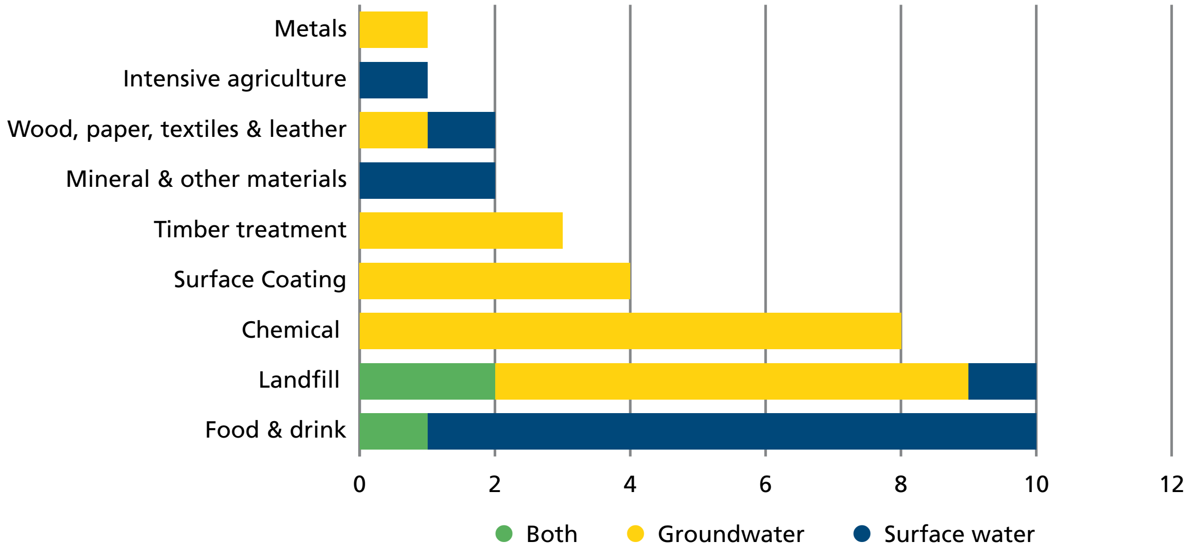
The Water Framework Directive requires all Member States to protect and improve water quality in all waters (see Chapter 8). The impact of emissions from industry from nine different sectors (Figure 13.8) are recorded as ‘significant pressures’ in water catchment assessments.

Figure 13.7 Heavy metal releases to water from industry, 2007-2022



16 environment.ec.europa.eu/document/download/a5e95ed4-88d6-4222-a3fa-8e2f17f0b2e1_en?filename=Staff%20Working%20Document%20-%20Impact%20Assessment%20Report%20accompanying%20the%20Proposal_0.pdf (accessed 15 July 2024).

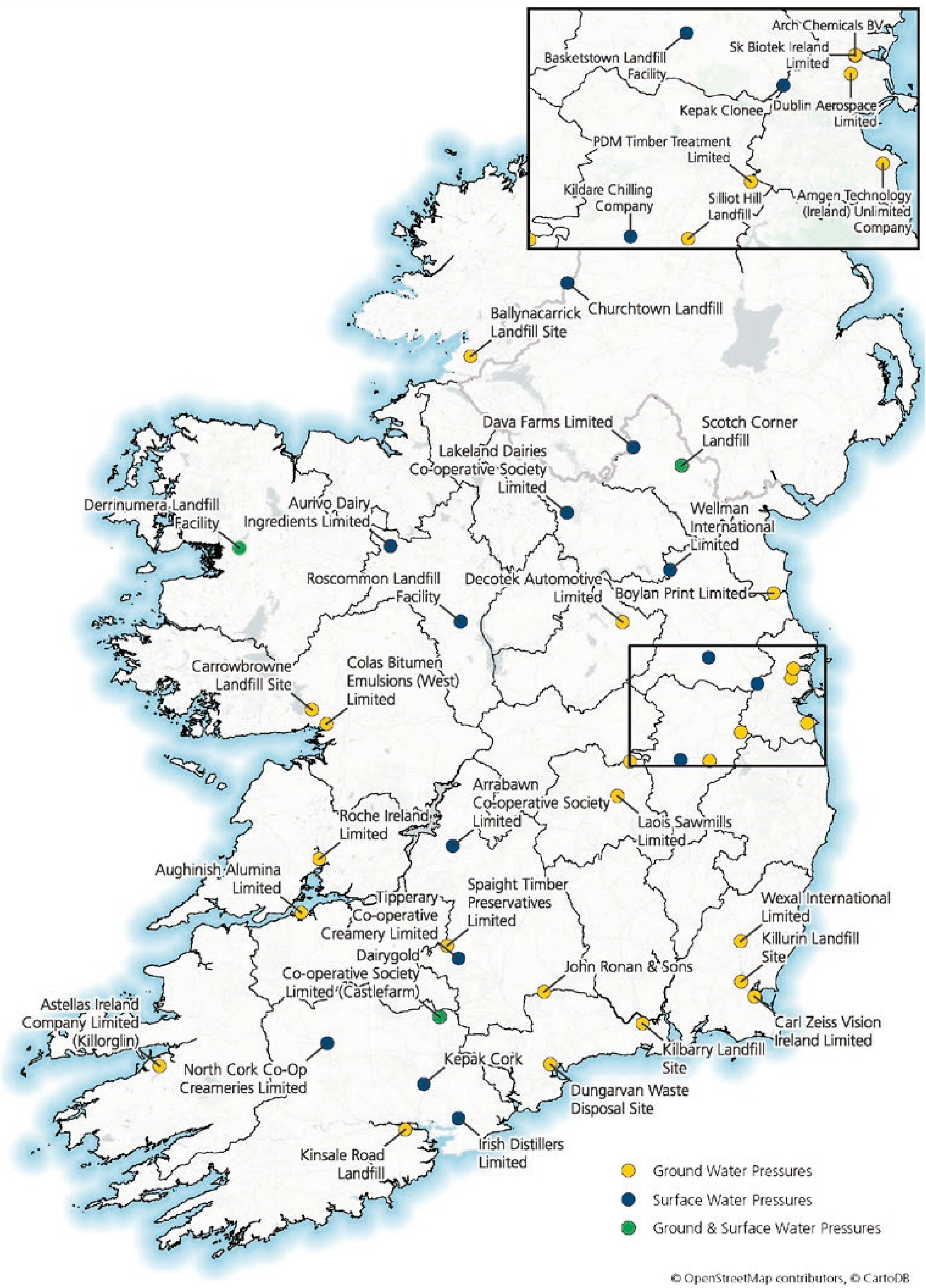
Figure 13.8 Number of sites within EPA-licensed sectors (April 2024) identified as placing significant pressures on groundwater or surface water under the Water Framework Directive



In 2022, 41 industrial sites were identified as placing significant pressures on water quality, representing less than 5% of all EPA-licensed industry in Ireland (Figure 13.9). Of these, 14 were placing significant pressures on surface water quality, 24 on groundwater quality and three on both surface water and groundwater quality. The EPA has developed a series of site-specific enforcement plans for these sites, which are spread across 20 different counties. The requirements for each site vary depending on the source and cause of the pressure and can include replacing on-site drainage networks, enhancing waste water treatment capacity and removing historical contamination.

EPA inspection at an intensive agriculture site

Figure 13.9 Industrial sites placing significant pressures on surface water or groundwater under the Water Framework Directive

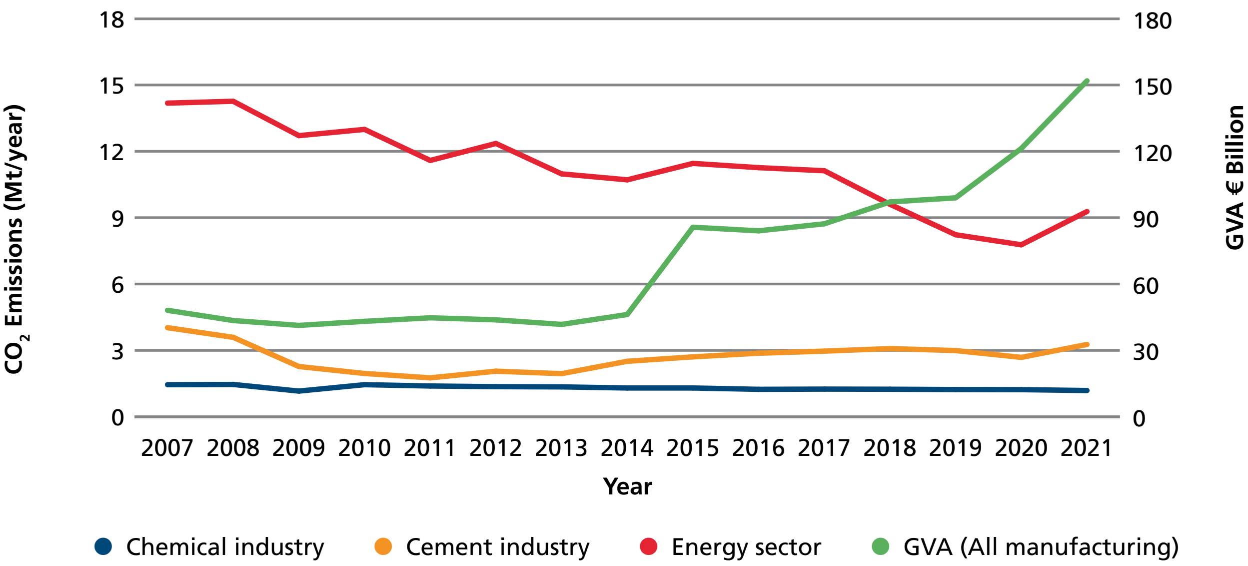


Emissions to air

Significant air pollutants from industrial sources include acidifying pollutants e.g. sulphur oxides (SO_x) and other pollutants that damage human health and the environment, such as NO_x, particulate matter, non-methane volatile organic compounds and ammonia. Overall, across Ireland and Europe, emissions of some significant pollutants have decreased from industrial sources over the past 20 years. The overall downward trend in levels of these pollutants illustrates the tighter emission limits, improved abatement technologies and the move to cleaner fuel sources. Emissions to air from industrial sites represent a significant proportion of Ireland's emissions to air: 37% of SO_2, 17% of NO_x and 16% of fine particulate matter (EPA, 2024a). Over 80% of these emissions come from two sectors – the energy sector and the mineral sector (cement).[17]

Figure 13.10 illustrates the decline in carbon dioxide (CO_2) emissions, the most significant greenhouse gas, for key industrial sectors compared with gross value added (GVA)[18] for all manufacturing sectors in Ireland from 2007 to 2022.

Figure 13.10 Air releases: carbon dioxide emissions by industry sector in Ireland compared with gross value added (constant prices) for all manufacturing sectors in Ireland, 2007-2021



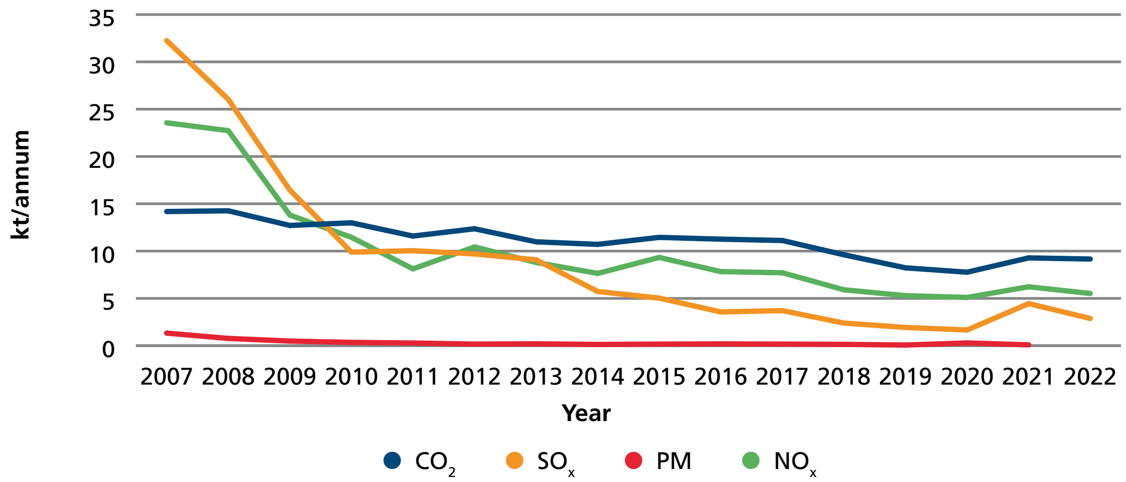
Source: Compiled from European Environment Agency and Central Statistics Office data

17 industry.eea.europa.eu/analyse/air (accessed 15 July 2024).

18 GVA figures for Ireland, particularly after 2015, have been distorted by the introduction of an accounts system applied by Eurostat (Regulation (EU) 549/2013). Modified gross national income gives a truer measure of how the Irish economy is growing. Even when emissions intensity is mapped against modified gross national income there is still a significant decoupling between emissions and economic growth.

Figure 13.11 shows a steady decline in some of the main emissions to air over the past 15 years from the licensed energy sector in Ireland.

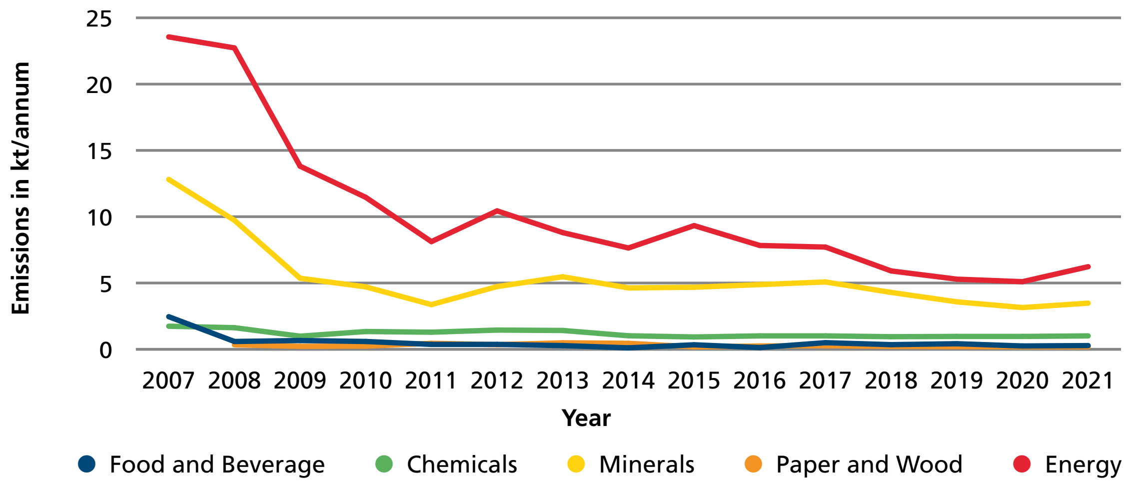
Figure 13.11 Emission trends in main pollutants from the energy sector in Ireland, 2007-2022



PM, particulate matter.

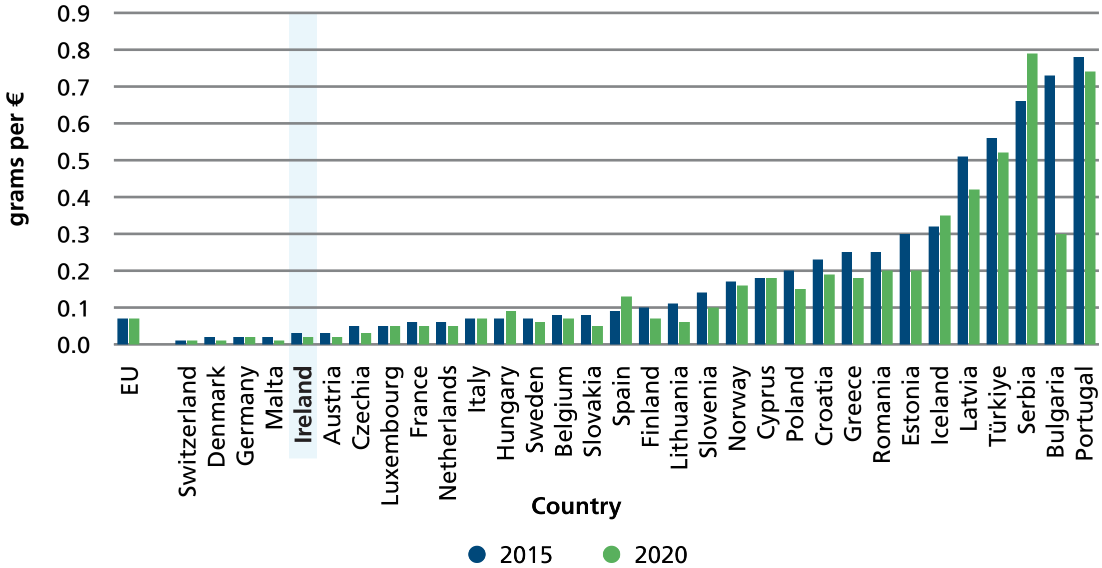
Figure 13.12 shows NO_x emission levels released from various industrial sectors nationwide.

Figure 13.12 Air releases: nitrogen oxide emissions by sector in Ireland, 2007-2021



Source: Air releases (europa.eu)

Figure 13.13 Air emissions intensity of industry by country for 2015 and 2020 (based on particulate matter emissions)



Source: Eurostat

As outlined in the section on surface water above, Ireland has a low proportion of heavy industry compared with its European counterparts. One of the United Nations Sustainable Development Goals (SDG 9.7)[19] compares air emissions intensity[20] with industrial economic output. Figure 13.13 shows that Ireland is ranked among the EU Member States with the lowest air emissions intensity of industry.

5. Cumulative impacts

An important element when addressing the impact of an industry is to assess the expected impact of two or more nearby installations on the environment. The cumulative impact of pollutants caused by intensification of industry in a relatively small geographical area has the potential to cause localised exceedances of environmental quality standards or critical levels/loads (Topic Box 13.6).

Impacts on amenity

When not appropriately controlled, emissions from industry may directly reduce the amenity of the environment and of the local communities nearby. Indications of this impact are the levels and types of complaints that arise from members of the local community. The number of EPA-licensed industrial sites that are frequently complained about is small, with just 17 sites receiving ten or more complaints in 2023. Most complaints relate to odour and noise issues. Nuisance issues tend to have an impact on people's amenity and private dwellings, and such issues often become emotive. The number and types of complaints received by the EPA between 2018 and 2023, in relation to EPA-licensed industry, are shown in Figure 13.14: 88% of all complaints related to nuisance odour and noise. Seven of the ten most complained about industrial facilities are situated in urban areas or within 500 m of residential areas.

19 ec.europa.eu/eurostat/statistics-explained/index.php?title=SDG_9_-_Industry,_innovation_and_infrastructure&oldid=563873#Air_emissions_intensity_of_industry (accessed 15 July 2024).

20 Emissions intensity is calculated by dividing the sector's particulate matter emissions by its GVA, which is defined as output (at basic prices) minus intermediate consumption (at purchaser prices).

Topic Box 13.6 Potential cumulative impact of pollutants

Impact of ammonia emissions to air from intensive agriculture on Natura 2000 Sites. Natura 2000 is a European network of important ecological sites (as outlined in Chapter 7). The potential impacts in Natura 2000 sites from intensive pig and poultry installations are ammonia emissions to air and resultant nitrogen deposition. When above critical levels, ammonia adversely impacts biodiversity through eutrophication, acidification or direct toxic effect. Nitrogen deposition has been identified as one of the leading causes of global biodiversity decline, alongside changing land use practices and climate change. Associated with this, Ireland has been served with an infringement notice by the European Commission because of non-compliance with ammonia reduction commitments. In Ireland there is a significant concentration of licensed intensive agriculture sites in Counties Cavan and Monaghan (see Figure 13.3). Over 70% of all EPA-licensed poultry farms are in County Monaghan. Owing to the density of intensive agriculture and the presence of Natura 2000 sites in the same region, the planning, development and permitting of intensive agriculture sites in this area needs to be carefully examined and managed to ensure that the sensitive Natura 2000 sites are protected.

EPA-funded research assessed the impact of ammonia emissions from intensive agriculture installations on special areas of conservation and special protection areas (Kelleghan *et al.*, 2020). The EPA has since issued guidance for prospective licence applicants on conducting assessments of the potential impact of emissions on Natura 2000 sites (EPA, 2023). The cumulative impact of air emissions from the existing intensive agriculture sector in a relatively small region has resulted in a restriction on the potential expansion of the sector in that area. The EPA is reviewing over 200 licensed intensive agriculture sites to ensure that licences are brought into line with the most recent BAT to control emissions from these facilities, including emissions of ammonia to air. The revised licences for this sector will require new technologies and practices to be implemented that will reduce ammonia emissions to air.

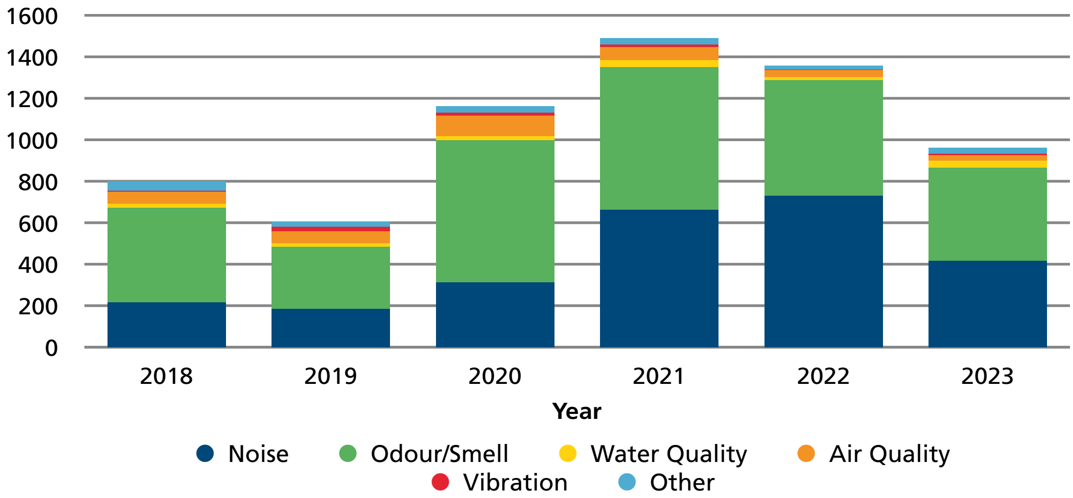
Data centres. The continued growth and evolution of the technology sector in Ireland is an important component of the national economy. The number of data centres, an associated aspect of this industry, has increased significantly in Ireland in recent years. Data centres provide storage and processing capacity for digital data and are an essential component of our digital economy.

Data centres require a continuous supply of electricity to operate, which is often provided by a connection to the national grid. However, outside normal operating conditions, for example in the case of a loss of the national grid as a power source, data centres typically rely on both on-site battery storage (uninterruptable power supplies) and on-site power generators. Typically, the generators will be brought online in the event of grid power supply issues, if critical power system maintenance work is being undertaken or if there is a request from the grid operator to reduce grid electricity load.

The use of on-site power generation has brought data centres into the EPA's licensing regime under the IED. The IED applies to installations with generating capacity of 50 MWth and above, including standby plants. There are over 20 licensed IED installations in Ireland, mostly in north County Dublin and County Meath.

The primary emissions of concern from these data centres are emissions to air from the on-site power generation units, in particular NO_x. There is now a high concentration of these types of installations in a relatively small geographical area around Dublin.

Figure 13.14 Number of complaints received by the EPA about industry, by issue, 2018-2023



The sectors about which most complaints are received are the food and drink (56%) and waste (20%) sectors. Odour complaints peaked in April 2020. This peak may reflect people's increased presence in their communities during the COVID-19 pandemic. Many of the industrial sites experiencing high levels of complaints have residential areas right up to the site boundary. The closer proximity of housing to industrial sites does require operators to enhance their environmental performance to ensure that facility emissions do not give rise to nuisance issues. Local authorities, in exercising their zoning and planning functions, need to be cognisant of such issues when considering siting residential areas alongside industrial sites.

6. Unauthorised industrial activities

All industrial activities that are included in the Environmental Protection Agency Act 1992 (EPA Act 1992) require a licence from the EPA to operate. To ensure consistency and conformity with statutory requirements, the EPA actively pursues operators of industrial activities that either have not applied for or do not hold a current licence for their activities.

Commercial peat extraction

Peat extraction on a commercial level in Ireland involves the harvesting of peat from large areas of peatland for subsequent processing and use (Figure 13.15). Commercial peat extraction in Ireland is governed by a complex set of regulations, an outline of which is presented in Figure 13.16. The EPA regulates the larger activities (greater than 50 hectares) while local authorities have key roles in regulating all commercial peat extraction, specifically regarding planning permission and requirements to undertake Environmental Impact Assessment and Appropriate Assessment.

Figure 13.15 Commercial extraction of peat

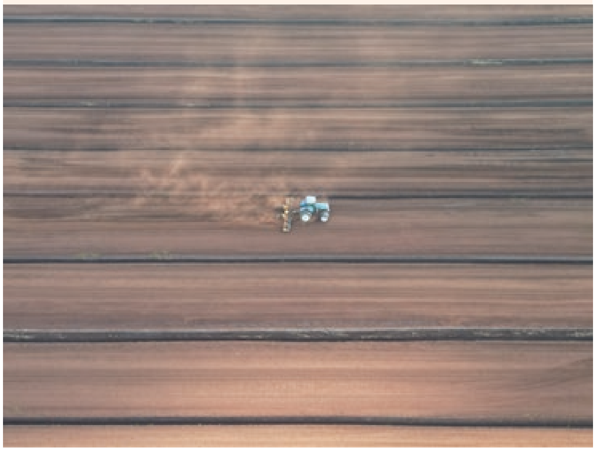


Figure 13.16 Regulation of commercial peat extraction

More than **50** hectares	EPA License Planning permission Environmental Impact Assessment Appropriate Assessment
30-50 hectares	Planning permission Environmental Impact Assessment Appropriate Assessment
Less than **30** hectares[a]	Planning permission Environmental Impact Assessment Appropriate Assessment

a Planning permission is required for the extraction of peat from an area exceeding 30 hectares or from an area less than this where it is likely to have a significant effect on the environment.

The EPA issued nine IPC licences to Bord na Móna (Class 1.3 of the EPA Act 1992) for the commercial extraction of peat. However, since extraction has ceased at these peatlands in recent years, rehabilitation works are progressing.

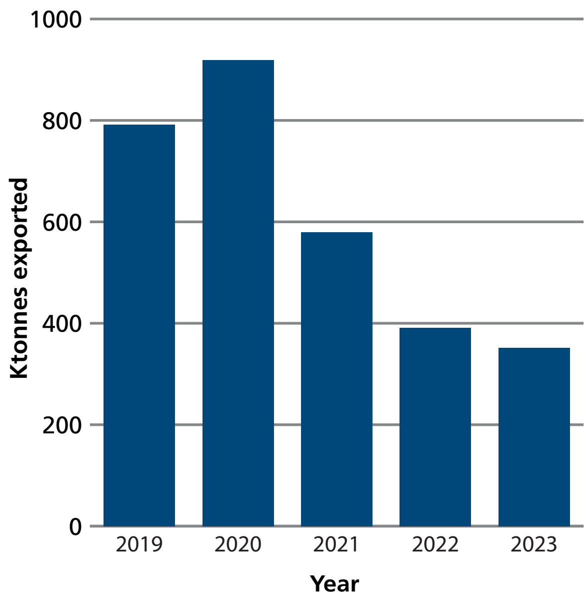
Currently, several other commercial peat extraction activities continue to operate despite the absence of any authorisation from either the EPA or relevant local authorities. These operations are primarily based in the midland counties (Longford, Westmeath, Kildare, Offaly, Tipperary and Roscommon). The EPA has had significant concerns about the lack of local regulation of the commercial peat sector for a number of years. All of these activities continue to operate in the absence of any planning permission, and, with the exception of the nine IPC licensed peatlands, environmental regulation is largely absent. To protect Ireland's peatlands, planning policy must proactively address the issue of unauthorised peat extraction operations.

The EPA has deployed significant resources to control the unregulated commercial peat sector and will continue to target its enforcement interventions at these operations. The EPA has successfully taken legal proceedings against illegal operators in the District Court and High Court, which has resulted in the cessation of illegal peat extraction on a number of peatlands.

The EPA has also a specific role, under Section 63 of the EPA Act, to supervise local authorities' performance of their statutory duties to protect the environment. The EPA is exercising its powers under this legislation to ensure that local authorities take the appropriate regulatory and enforcement actions against unauthorised commercial peat extraction.

Traditionally, a significant amount of the extracted peat was used for the generation of electricity in Ireland, however this practice ceased in recent years. In addition, the global exportation of Irish peat has been declining. While Ireland exported 919,000 tonnes of peat in 2020, this figure decreased to 351,000 in 2023 (Figure 13.17).

Figure 13.17 Annual tonnage of peat exported from Ireland, 2019-2023



Source: CSO, 2024

Impacts on water quality and river habitats arising from illegal peat extraction and drainage include the release of ammonium and fine-grained suspended sediments and the physical alteration of aquatic habitats. The installation of extensive drainage networks can result in the lowering of water tables, disrupting the ecosystem balance and thereby providing flow pathways for sediment and dissolved organic carbon to reach water bodies.

7. Resource use in industry

Operators of industrial installations are required to use resources such as energy and water more efficiently and to minimise waste as a condition of their EPA-issued industrial emissions licences.

Energy management

The industrial sector accounted for approximately 18% of final energy consumption in Ireland in 2022.[21] Efforts to improve energy efficiency and transition to more sustainable energy sources are crucial to reduce environmental impacts. Many licensed installations have implemented the requirements of their industrial emissions licence in terms of energy auditing and plans to reduce emissions but have then exceeded the minimum emissions criteria by installing renewable energy systems and infrastructure. In recent years, many industrial facilities have moved away from oil- and gas-fuelled electrical power generation and steam generation. The installation of solar-powered systems is one area where there has been significant investment. The provision of ground-mounted solar farms adjacent to industrial facilities is increasing (Topic Box 13.7), and several planning applications for such developments are under consideration by the planning authorities.

Water use

Many industries in Ireland use significant amounts of water, mainly in the following processes.

- **Water as a product ingredient.** Water is used in the brewing and distilling sector and in other aspects of drinks manufacturing, where large volumes of water are blended with other ingredients to make a final product.

Topic Box 13.7 Going beyond compliance

Case study: Eli Lilly, Cork

During 2021, Eli Lilly installed the single largest solar farm in Ireland at the time of installation (Figure 13.18). The capacity of phase 1 of the project was 5.6 MW (megawatt) maximum output. Phase 2 added an additional 3.4 MW capacity, bringing the total maximum output capacity to approximately 9.0 MW. The 6.5-hectare farm will power a significant proportion of the company's Cork site.

Figure 13.18 Eli Lilly solar farm adjacent to its plant in County Cork

21 www.seai.ie/data-and-insights/seai-statistics/key-statistics/energy-use-overview/ (accessed 15 July 2024).

- **Cooling water.** Many industrial sectors abstract water for the purposes of cooling parts of their processes. Power generation, data centres and dairy processing facilities all require large volumes of water to operate. Usually, this water can be discharged back to the environment after it has been used.
- **Wash water.** Many industries use large volumes of water for cleaning production areas and equipment. Much of this water requires further treatment prior to discharge to the environment.

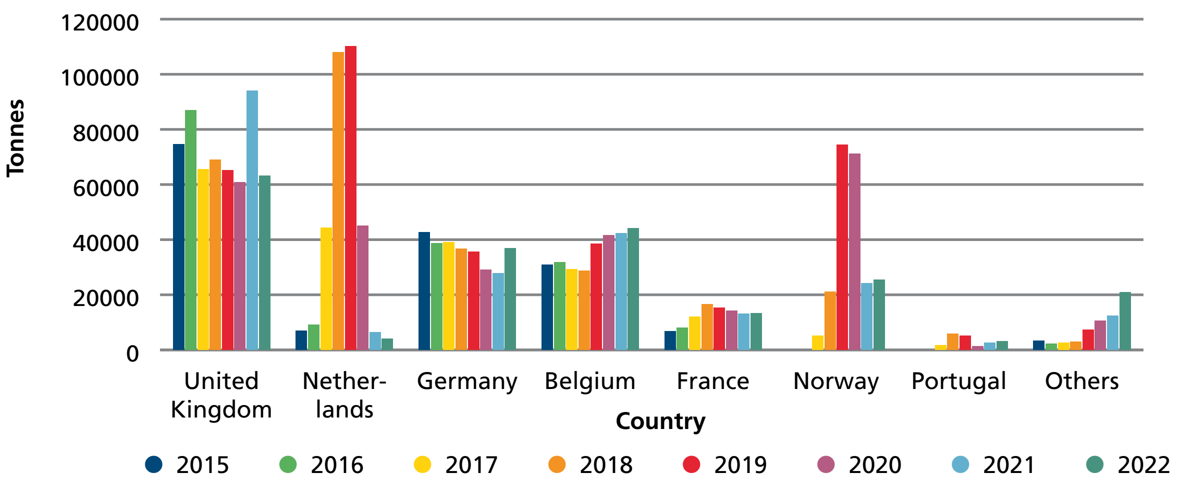
The Water Framework Directive, along with the associated statutory instruments, identifies that the removal of a water resource can pose as great a risk to the quality of the environment as any physio-chemical or biological impact. Currently, any enterprise abstracting more than 25,000 litres of water per day is required to register its abstraction with the EPA. Of the 1800 entities registered with the EPA, just 171 are abstracting water for use at industrial installations. The industrial sectors with the highest numbers of sites registered for water abstraction are intensive agriculture, energy generation, chemicals, and food and drink.

Waste arisings and the circular economy

Together with wider society, industry needs to move away from a linear economy and towards a more circular economy (see Chapter 15). The industrial licensing regime has longstanding requirements to reduce waste arisings and to recover or recycle as much waste as possible. The current waste policy,[22] the National Hazardous Waste Management Plan[23] and the National Waste Management Plan for a Circular Economy[24] set out how to implement circular economy principles across a range of areas.

Industrial facilities remain the largest source of hazardous waste in Ireland, followed by the construction and demolition sector and municipal sources, which produce small amounts of hazardous waste in comparison. The types of industrial hazardous waste generated include waste treatment by-products, industrial solvents, sludges, oils, waste electrical and electronic equipment, batteries and infectious healthcare waste. Ireland does not have the facilities required to treat the full range of hazardous waste that it generates, and much of it is exported for treatment (Figure 13.19). In 2021, for the first time, a higher percentage of hazardous waste was treated in Ireland (52%) than was exported (48%). This is dealt with in greater detail in Chapter 15.

Figure 13.19 Destination of hazardous waste exported from Ireland, 2015-2022



Source: EPA

22 A Waste Action Plan for a Circular Economy Ireland's National Waste Policy 2020-2025, Department of Communications, Climate Action and Environment. gov – Waste Action Plan for a Circular Economy (www.gov.ie) (accessed 25 July 2024).

23 National Hazardous Waste Management Plan 2021-2027, EPA. National Hazardous Waste Management Plan 2021-2027 | Environmental Protection Agency (epa.ie) (accessed 25 July 2024).

24 National Waste Management Plan For a Circular Economy 2024-2030, Local Government Ireland, Regional Waste Management Planning Offices. National Waste Management Plan for a Circular Economy 2024-2030 – MyWaste (accessed 25 July 2024).

8. Responses to environmental challenges

It is critical that industry has a stable and consistent compliance base from which to work. While overall there is a good level of compliance across many industrial sectors in Ireland, there are several specific issues that are being addressed. These include operators that have not yet complied with their obligations to seek an environmental licence or permit and those whose operations are negatively impacting the environment.

On the other end of the spectrum are facilities that are going beyond complying with the requirements of their licences to achieve high levels of environmental performance in their resource management.

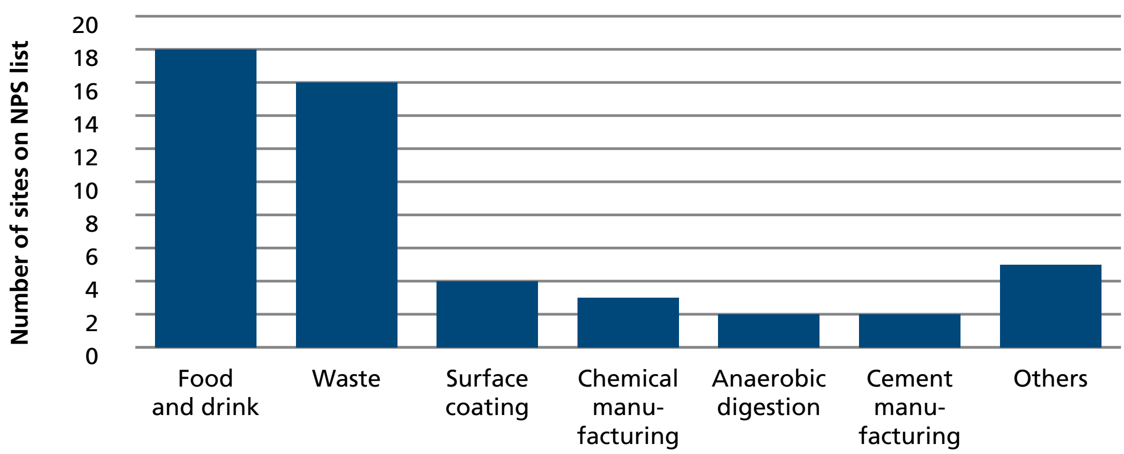
Addressing environmental performance

Inspection and monitoring. The EPA's Office of Environmental Enforcement (OEE) continually assesses the levels of compliance and the environmental performances of facilities licensed under the IED. Since 2020, the OEE has carried out over 5000 individual inspections at these facilities to assess compliance. Over the same period, the OEE opened over 200 investigations where significant issues were identified that required corrective actions or where an environmental risk was detected that required preventative measures to be implemented.

National priority sites. The EPA uses a national priority sites (NPS) system to identify and publish the names of licensed sites that are deemed an enforcement priority. Since the NPS system began in 2017, 50 licensed facilities have been listed. Issues that result in facilities being listed include emissions to water and air, nuisance complaints (odour and noise) and poor waste management. The food and drink sector and the waste sector have appeared on the NPS list more than any other sector (Figure 13.20).

Dairy processing and animal slaughtering plants have appeared more often than any other licensed industry type, constituting almost one-third of all sites on the NPS system (see Topic Box 13.8). Issues with poor waste water management and odour emissions are common at the dairy processing sites on the NPS list. As with the dairy sector, many of the issues at animal slaughtering plant sites relate to waste water and odour emissions because of delayed investment in and provision of suitable environmental control infrastructure such as noise and odour abatement technology.

Figure 13.20 National priority sites list, by sector, 2017-2023



Topic Box 13.8 Dairy processing in Ireland and dairy processors on the national priority sites list

The amount of milk entering Irish milk processing plants has risen by over 50% since the abolition of milk quotas in 2015, with volumes peaking at 8824 million litres in 2022 compared with 5648 million litres in 2014. The volume of milk processed decreased slightly during 2023, to 8459 million litres.[25]

In recent years, while some parts of the dairy processing sector have invested significantly to ensure compliance with environmental standards (Figure 13.21), many plants have failed to maintain compliance with their environmental obligations during this expansion period. The inclusion of nine dairy sites on the EPA NPS list, representing 30% of all EPA-licensed dairy processing plants in Ireland, highlights a significant issue that the sector needs to address. The provision of environmental controls and the associated infrastructure in the sector has often lagged behind other sectors.

Figure 13.21 Waste water treatment at a dairy processing plant in Ireland

Processing milk into various products (powder, butter, cheese, etc.) results in significant volumes of waste water that require treatment prior to being discharged to the environment. It is the poor management of this waste water treatment process that has given rise to issues in the industry.

Nuisance odour from dairy sites is usually associated with waste water treatment processes. The presence of dairy fats in certain conditions, such as warm weather, can lead to the generation of offensive odours. An analysis of odour complaints from the food and drink sector over the past five years indicates an overall increase in odour complaints between March and September. This coincides with the main milk processing season.

While the dairy processing sector has taken the commercial opportunity to increase production levels, it has not matched this with investment in environmental controls at a number of processing sites. With sufficient investment and infrastructure, treatment of waste water from the dairy sector can readily comply with statutory requirements.

The waste industry in Ireland has evolved over the past 20 years, with the closure of many landfills, the development of waste-to-energy plants and the expansion of waste transfer and processing facilities. Transfer stations handling non-hazardous waste were the main waste facility type to be placed on the NPS list, mainly because of a lack of adequate capacity and suitable infrastructure. Non-hazardous waste transfer stations handle all domestic waste and the majority of commercial and industrial waste generated in Ireland. Handling waste without creating nuisance impacts, such as those caused by odour, noise and flies, must be a priority for site operators, who need to take a proactive approach to addressing these issues. Four of the five landfill site issues that appeared on the NPS list related to poor post-closure management of landfill gas and leachate. While the closures of many of the older local authority-operated landfills were accelerated as a result of the requirements of the Landfill Directive (1999/31/EC), thus resolving many operational issues such as odour, litter and pests (e.g. flies, birds, vermin), there remain legacy issues that have not been appropriately managed. The continued management of closed landfills is a challenge that needs to be prioritised by local authorities.

Maturity of environmental management and compliance. The enforcement function of the EPA continues to be a keystone driving good environmental industry performance in Ireland. The overall context has evolved since the EPA first licensed industry in 1994. Industry has moved from a period of early regulation into the current period of advanced environmental management, where most industry now provides adequate financial and human resources to achieve and maintain compliance, including going beyond compliance in many instances.

A progression in compliance can often be seen across regulated communities through the implementation of management systems that drive continuous improvement. The EPA's licensing process requires all licensed installations to prepare and implement an environmental management system. This has resulted in a steady shift from 'reactive' to 'optimised and resilient' compliance (Figure 13.22).

25 Data Milk Statistics September 2023 – Central Statistics Office (accessed 25 July 2024).

Figure 13.22 Evolution and maturing of environmental compliance

The effective implementation of an environmental management system at a regulated installation creates a platform for operators to consider how they can go beyond the basic requirements of their licence.

Beyond compliance

'Going beyond compliance' refers to organisations willingly and deliberately searching for ways to exceed their regulatory requirements (Keely *et al.*, 2020). This can be done by fostering an innovative and communicative culture, analysing working processes and instigating and cultivating new management systems. Within the industrial community, the EPA has noted a movement towards going beyond compliance in recent years, with most sectors reporting examples to the Agency in their respective annual environmental reports. Going beyond compliance demonstrates a maturity in environmental performance and occurs when key drivers and favourable conditions are in place and when a consistent level of compliance with environmental requirements is maintained (Table 13.2).

Table 13.2 Internal and external drivers and barriers to environmental performance

	DRIVERS	BARRIERS
Internal	■ Financial benefit to the organisation ■ Organisational culture ■ Leadership commitment ■ Individual employee ethics and attitudes ■ Operational risks from a large environmental footprint	■ Lack of available funding ■ Organisational culture (norms, structure, learning and communication) ■ Pressure on staffing and financial resources ■ Lack of knowledge and information ■ Lack of leadership commitment ■ Lack of employee acceptance and participation
External	■ National government and EU legislation ■ Risk to organisational reputation ■ Media, NGOs, community groups and wider society ■ Competitors ■ Shareholders, investors and customers ■ Supply chain partners ■ Financial institutions, including insurance providers	■ Intransigent regulations ■ Market demands ■ Consumer behaviour ■ Lack of available funding ■ Lack of shareholder acceptance

NGO, non-governmental organisation.

Source: Keely *et al.*, 2020.

Many industries in Ireland are working together to improve the overall quality of water. An example of this is Water Stewardship Ireland,[26] a voluntary, industry-led network of companies that enables businesses to access peer-to-peer expertise, water stewardship innovations and programmes, international certification and research insights. Working in partnership with Irish and European agencies (regulatory and developmental), key national stakeholders and industry, Water Stewardship Ireland consists of 300 of the largest production and service facilities across Ireland, all working to deliver improved water quality and make efficient use of water in their operations.

Many of the recent examples of going beyond compliance in Ireland overlap with other national policies. For example, the drive to decarbonise industry and reduce emissions, in keeping with the national Climate Action Plan, has been a common goal of such projects, where companies have adopted the use of solar technologies.

While enhancing environmental management systems and actively working towards going beyond compliance is welcome, it is important that industry first establishes a stable and consistent compliance base from which to work. Some industry sectors have moved into optimised systems with ease, while others have not maintained basic-level compliance.

9. Industry and climate action

The European Green Deal commits to delivering net-zero greenhouse gas emissions at the EU level by 2050, with Ireland committed to achieving a 51% reduction in emissions from 2021 to 2030. Ireland's commitments are set out in the Climate Action and Low Carbon Development (Amendment) Act 2021. Together, the ETS and ESR (described in Section 2 above) will facilitate the achievement of the EU-wide target of at least a 55% greenhouse gas emissions reduction by 2030 (DECC, 2024). Emissions from industry have broadly aligned with economic activity; however, there are some positive signs of a decrease in manufacturing combustion emissions from economic growth, with emissions having decreased by 7.1% in 2022 relative to 2021 and, overall, by 9.1% relative to 2018.

The Climate Action Plan outlines the actions required to be taken, including implementing carbon budgets and emission reduction targets and ceilings on a sectoral basis (DECC, 2024). The sectoral emissions ceiling for industry in the 2021-2025 carbon budget period is set at 30 Mt CO_2 eq (megatonnes of carbon dioxide equivalent) and proposed to be reduced to 24 Mt CO_2 eq for the 2026-2030 budget period. Current projections show that industrial sector emissions are currently not aligned to Ireland's reduction targets. The EPA's 2023 National Inventory Report shows that 66.7% of the budget has been used in the first 3 years. To meet the sectoral emissions ceiling in the first budgetary period, the industry sector will now need to achieve average reductions of 14% in 2024-2025 (EPA, 2024b).

The Climate Action Plan 2024 sets out key performance indicators to be realised by industry to achieve the requisite carbon abatement in each budget period. These include:

- reduce fossil fuel use in the industry sector from 64% of final consumption (2018) to 45% by 2025. Reduce to 30% of final consumption by 2030
- achieve a 50-55% share of carbon-neutral heating in total fuel demand by 2025, increasing to a 70-75% share by 2030
- reduce industry fossil fuel demand by 7% by 2025 and 10% by 2030 by adopting energy-efficient measures in manufacturing processes
- achieve at least 1 TWh (terawatt hour) consumption of zero-emissions gas for industrial heating by 2025, increasing to 2.1 TWh consumption by 2030.

Manufacturing combustion emissions are projected to reduce by between 6% and 22% from 2021 to 2030 with the implementation of efficiency measures and renewable heat generation. However, industrial process emissions are projected to increase by 5% from 2021 to 2030 due to an anticipated increase in cement production (EPA, 2024c).

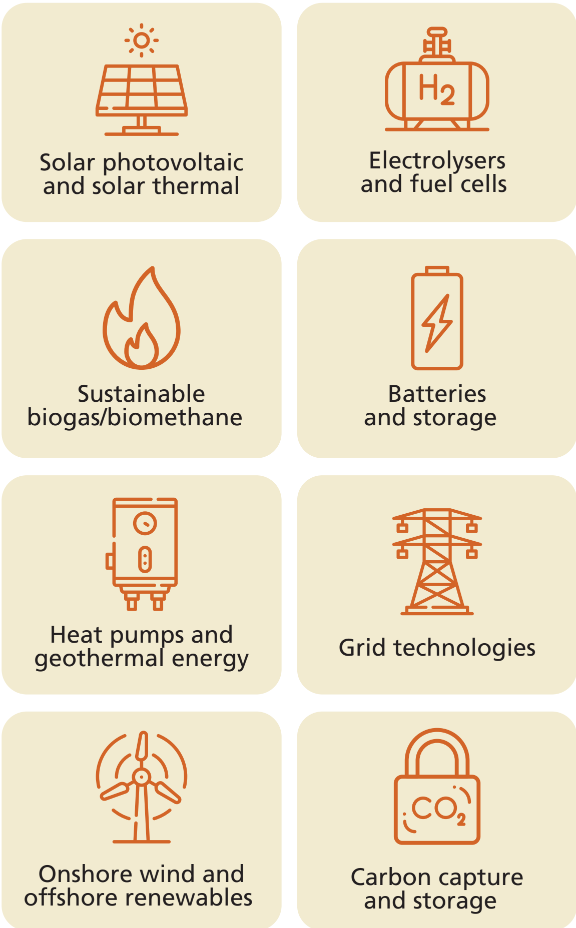
At present, the policy approach is to transition industry to clean energy using voluntary and incentive-based instruments. The specific areas where industry needs to take action include carbon-neutral heating, carbon capture, use and storage (CCUS), use of zero-emissions gas and improved energy efficiency. Enterprise Ireland and IDA Ireland are working with industry to decarbonise the sector's operations, and many incentive schemes are being made available to industry to bring about this change. Over €55 million has been made available through the Emissions Reduction Investment Fund (€30 million) and the Climate Planning Fund for Business (€25 million).

26 www.waterstewardshipireland.com (accessed 15 July 2024).

There are signs of progress in some areas. The move from carbon-intensive fuel oil to cleaner gas fuel is a likely cause. Further movement from combustion-sourced heating to electrification in industry will see this decoupling of emissions from economic growth continue.

One clear change arising from the climate emergency and wider energy crisis is to rapidly progress the provision of net-zero technologies (see Figure 13.23) and energy efficiencies within industry.[27] These are considered in Chapter 12.

Figure 13.23 Key net-zero technologies that are commercially available and have potential for a rapid scale-up



Source: European Commission[28]

Research on industry and the environment

The government has put in place a number of research programmes to support companies in the industry sector in their green transition. Some of the more notable include various Enterprise Ireland programmes,[29] including the Irish Manufacturing Research Centre, which is dedicated to assisting manufacturers and their supply chains to switch from linear to circular business models, and the Nimbus Research Centre, which looks at the potential for innovative water reuse within industry. Significant funding is also made available under the Science Foundation Ireland research centres,[30] linking scientists in partnerships across academia and industry to tackle key environmental challenges. These include:

- BiOrbic – converting food waste residues to higher value products
- VistaMilk – sustainable agri-tech
- MaREI – researchers working with 50 companies on energy transition and climate action approaches.

Since 2019, the EPA has funded nearly 30 new research projects relevant to the environment and industry area, a commitment of €3.12 million. Funding comes from the EPA Research Programme (2021-2030) and the EPA Green Enterprise Scheme.

Research is vital for providing integrated solutions for many of the complex challenges facing the industrial sectors in Ireland. A team at University College Cork demonstrated the effective treatment of dairy waste water while generating products that can strengthen the local economy and create new relationships between farmers, dairy processors and innovative rural industries (Walsh *et al.*, 2022).

Following a successful EPA-funded pilot project with major industrial water users in Ireland (Stockil *et al.*, 2016), a research team based in Limerick is part of a significant Horizon Europe funding programme (€20 million) that is developing novel digital technologies aimed at maximising water and energy recovery and modernising industrial waste water management practices.

27 Energy Efficiency Directive (EU/2023/1791)

28 commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/green-deal-industrial-plan/net-zero-industry-act_en (accessed 25 July 2024).

29 e.g. Climate Enterprise Action Fund; Enterprise Ireland/IDA Ireland technology centres and Enterprise Ireland technology gateways.

30 www.sfi.ie/sfi-research-centres/ (accessed 15 July 2024).

Another project identified key climate change risks and opportunities facing Ireland's business sectors, including chemicals, electronics and food manufacturing (Deignan *et al*., 2022). By translating climate impacts into business and financial risk, opportunity and commercial imperatives, it is hoped that businesses will be encouraged to take appropriate action to ensure that they remain resilient (Deignan *et al*., 2022).

Research from the Economic and Social Research Institute has found that smaller Irish enterprises are less prepared for the climate transition – for instance, 83% of micro firms have no climate plan in place (ESRI, 2023). A key factor that appears to strongly motivate climate action is the proportion of company expenditure that is allocated to energy.

10. Conclusions

For the past 30 years there has been a decrease in the main pollutants arising from industry in Ireland, such as emissions of SO_x and NO_x to air. At the same time, production and employment in the sector has increased overall. This decoupling of emissions from growth of the industry sector is the result of investment and technological progress, overseen by strong, integrated environmental regulation.

The planned transition to more renewable energy sources, and away from combustion-sourced heating systems to electrification, is a shift that could see greenhouse gas emissions from industry significantly decrease. Decoupling greenhouse gas emissions from the growth of industry is essential to ensure that Ireland delivers on its environmental and economic goals. Achieving the targets and staying withing the ceilings for industry set out in Ireland's Climate Action Plan will be a significant challenge but are necessary to fulfil our commitments to reduce greenhouse gas emissions.

There are some sectors within Irish industry that must further improve their environmental performance.

- The dairy processing sector needs to ensure that it prioritises environmental performance and improves compliance with limits on odour and water emissions.
- Waste transfer site operators need to take a proactive approach in handling waste without creating nuisance impacts while legacy issues remain at closed landfill sites in the waste sector. The continued management of such sites is a challenge that needs to be prioritised by local authorities.
- There is an urgent need for significant uptake of abatement techniques to control and reduce ammonia emissions to air from the intensive agriculture sector to ensure the protection of sensitive habitats in some parts of Ireland.

Nationally, industry must operate within the statutory framework long established and implemented in Ireland. The continued operation of unauthorised commercial peat extraction at the expense of Ireland's natural habitats is not acceptable and should cease.

It has been 30 years since the EPA issued the first licence to industry, and there has been a significant shift in industry's compliance and environmental performance in those 30 years. The presence of an established, structured environmental regulation system in Ireland, led by the EPA and other regulatory authorities, provides a stable and predictable setting for industry to operate in. Overall, Irish industry maintains a good level of compliance with environmental requirements. As envisaged in the European Green Deal, the implementation of the revised IED will drive further improvements in the environmental performance of industry.

While improvements in compliance culture, reductions in emissions and environmental controls are welcome, the challenges of further reducing greenhouse gas emissions and resource use are significant.

Key chapter messages

1. Industrial pollution in Ireland is decreasing, thanks to a blend of regulation, developments in manufacturing, control technology and environmental initiatives. However, despite these improvements, some sectors of industry are still responsible for a significant burden on our environment. Continued investment and change are needed to ensure compliance with tighter environmental standards and to achieve the targets and reductions that are required under industry's climate commitments.

2. Compliance with environmental regulation across industry in Ireland is high overall. Many sectors have advanced environmental systems in place that demonstrate a maturity in their approach to environmental compliance. However, a disproportionate number of sites in the food and drink sector, in particular dairy processing sites, and in the waste sector are not performing optimally and are regularly cited on the EPA's list of national priority sites for not complying with their licence conditions.

3. The unauthorised harvesting and extraction of peat on an industrial scale is causing destruction of Ireland's natural habitats and compromising the vital role of peatlands in helping society mitigate the impacts of and adapt to climate change. It is essential that planning policy clearly prioritises the regulation and control of these operations. The EPA will continue to exercise its authority over operators and other regulators to ensure the cessation of such unauthorised activities

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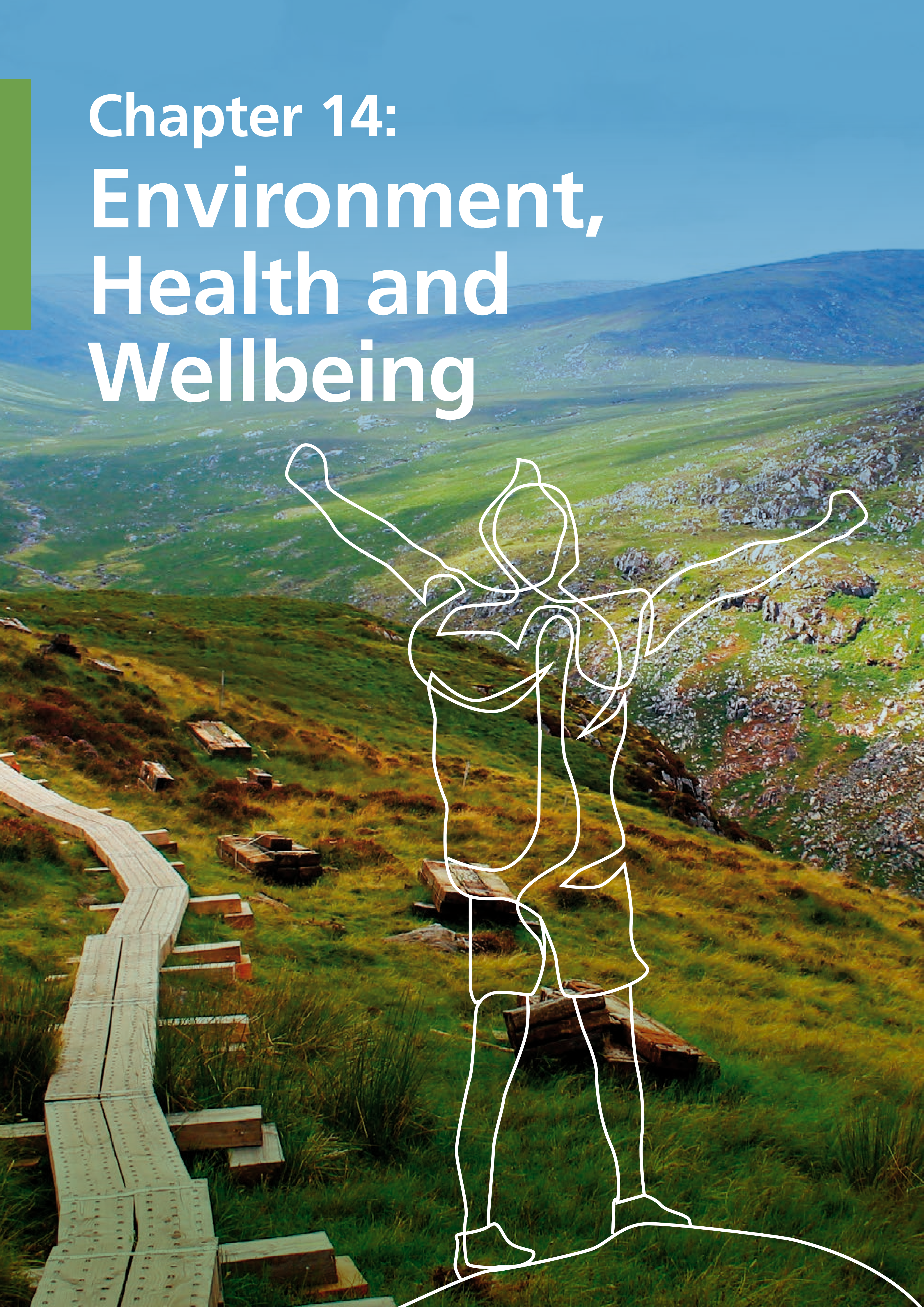
Chapter 14:
Environment, Health and Wellbeing



Environment, Health and Wellbeing

1. Introduction

Our health is affected by our surrounding environment in many and complex ways. Our most basic needs are clean air, clean water and food, and safe shelter. The quality of each one of these needs is directly influenced by the quality of our environment. It follows that preventing damage and pollution to the environment helps to protect our health and wellbeing, allowing us to live longer and healthier lives.

We have made some notable strides both in Ireland and elsewhere in addressing environmental and health issues, which are resulting in improved health and wellbeing among our population. The positive impact resulting from the introduction of the 'smoky coal ban' in Dublin in 1990 is a good example of the tangible impact that regulation of solid fuels and subsequent reductions in pollution levels can have on people's health. Research has shown that the introduction of the ban has resulted in approximately 350 fewer deaths per year, reducing cardiovascular, cerebrovascular and respiratory mortality in the general population (Clancy *et al*., 2002). Since its introduction in Dublin, the ban was subsequently extended to other cities and towns in Ireland, with a nationwide restriction on the sale of smoky fuels in Ireland introduced in 2022. An analysis of the effect of the phased extension of smoky coal bans to towns in Ireland found that there are now fewer diagnoses of respiratory disease among older people than there were before the bans were implemented (Lyons *et al*., 2023).

Every day we are subject to various environmental exposures – those that can help us and those that can harm us. Engagement with our green and blue spaces and exposure to our natural environment can generally have a protective effect on our health – improving mental health, reducing stress, improving physical activity and reducing premature mortality. Harmful environmental exposures include air pollution from burning solid fuels and from traffic, excessive noise from transport, exposure to the radioactive gas radon, consumption of poor-quality drinking water, and exposure to hazardous chemicals from various sources. The impact that these environmental risks, both individually and in combination, have on our health is substantial, with one in ten premature deaths in Europe linked to environmental pollution (EEA, 2023a). Data have shown that over 18% of premature cardiovascular deaths are caused by certain environmental risks (EEA, 2023b) with over 10% of premature cancer deaths attributable to certain environmental carcinogens (EEA, 2022).

Further compounding this, the risks and impacts associated with harmful environmental exposure are also unequally distributed across society, giving rise to unequal and unjust health outcomes for different population groups such as vulnerable members of society (children, older people) and those with more disadvantaged socioeconomic status (EEA, 2019a) (Topic Box 4.1).

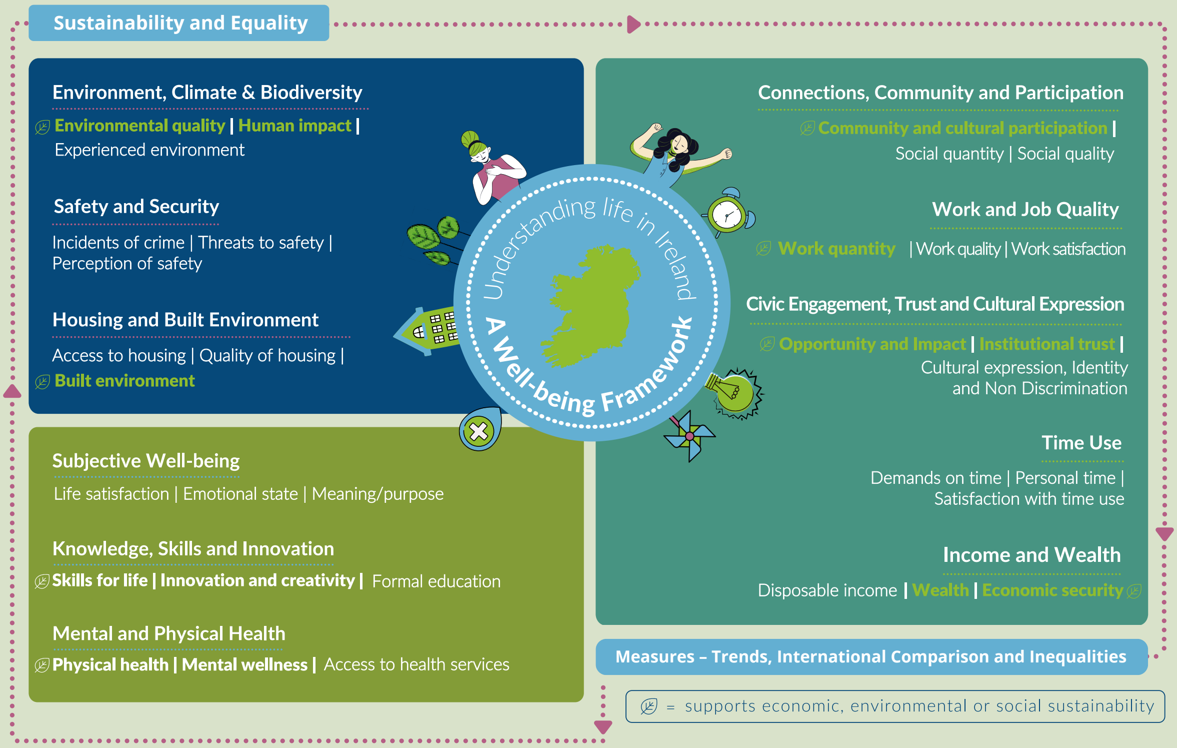
The positive news is that we can do something about it. The harmful environmental exposures causing health impacts and premature deaths are modifiable and within our power to change. By tackling issues such as air and water pollution, radon, chemical exposure and greenhouse gas (GHG) emissions, we can take tangible steps to improve and protect our health. Primary prevention is the greatest tool we have in protecting the health of our population and that of the environment. Proactive prevention measures, through regulation and policy as well as through individual action by all members of society making changes to how they live, can help to deliver a safer, healthier place to live now and in the future. Indeed, one of the six priority objectives of the Eighth Environment Action Programme to 2030 (Decision (EU) 2022/591) is to pursue zero pollution to protect the health and wellbeing of humans, animals and ecosystems from environment-related risks, exposures and negative impacts.

This chapter discusses current evidence and policy in relation to the various types of environmental exposure positively or negatively impacting our health and identifies measures that must be taken to protect our environment and improve the health and wellbeing of all people living in Ireland.

Topic Box 14.1 The Wellbeing Framework for Ireland

It is increasingly recognised that traditional macro-economic indicators, such as gross domestic product, fail to provide a comprehensive picture of the diverse experiences and wellbeing of people and households. A cross-government initiative called the Wellbeing Framework (WBF) for Ireland has been developed, which aims to capture a more complete and holistic view of how our society is faring and how Ireland is doing as a country. The WBF for Ireland focuses on quality of life, with a particular emphasis on sustainability and equality (Figure 14.1).

Figure 14.1 Well-being Framework for Ireland



Source: Department of the Taoiseach, 2023a

In the government's most recent annual analysis, the environment, climate and biodiversity dimension (one of 11 dimensions analysed) was the only one that showed negative overall performance, with poor performance in all four dimension indicators (pollution/grime, water body quality, GHG emissions, waste generated) (Department of the Taoiseach, 2023a). When compared with other European Union (EU) countries, Ireland had the highest emissions in tonnes per capita and was below the EU average in water body quality and waste generated per capita.

While the WBF for Ireland is still in the early stages of implementation, assessments carried out through the framework can help to bring new information more clearly into the policymaking space. Significant opportunity exists for the framework to capture data of greater breadth and depth on environmental issues, which can then be better linked with wellbeing objectives. There should also be greater focus around environmental justice issues to help in identifying inequalities and make them more visible, which has been called for by the National Economic and Social Council and others (O'Neill S. *et al.*, 2022; NESC, 2023). Environmental inequalities are not well addressed by current policy and are likely to endure, and potentially expand, into the future (EEA, 2019b). Identifying and increasing the visibility of inequalities under frameworks such as the WBF would make these issues more evident, allowing a greater focus and targeted and measurable action across policy areas.

2. Positive environmental exposures – enhancing our health and wellbeing

Engagement and contact with our natural environment is associated with measurable improvements in the health and wellbeing of the population – getting outdoors and using our green and blue spaces can have a multitude of benefits for our health, both physically and mentally. A growing body of evidence has pointed to the beneficial health effects of living near and engaging with natural environments, with links to improved mental health and wellbeing, physical activity levels and social interactions and reduced stress levels. Our natural environment is also capable of reducing many hazards such as noise and air pollution. A meta-analysis of cohort studies examining green spaces and mortality identified a protective effect from exposure to greenness (Rojas-Rueda *et al*., 2019), and a meta-analysis of blue spaces demonstrated positive health impacts at a population level (Smith *et al*., 2021).

The COVID-19 pandemic transformed how people use their surrounding natural environment and gave us a renewed and increased appreciation of the nature in and environment of our local areas. With this revitalised appreciation for our local environment and societal desire for healthier living, coupled with increasing challenges associated with rising population numbers and levels of urbanisation and the need for compact growth, the drive to make our urban areas more resilient, sustainable and rich in nature-based infrastructure has never been more urgent. Spatial planning is one of the most significant ways of achieving this, in the context of both health protection and health promotion. Health-centred planning, design and management can help protect us from many of the environmental hazards we are exposed to in urban settings, such as air pollution, noise from busy roads, flooding and increased temperatures due to the urban heat island effect. Well-designed, connected and accessible spaces can help citizens to make more sustainable choices and live healthier lives by promoting active travel and physical activity and by offering a sense of community.

Urban greening has become a well-established priority in international frameworks and European policy as a key contributor to sustainability. The EU Biodiversity Strategy for 2030 calls on all cities with more than 20,000 inhabitants to develop urban greening plans incorporating measures from parks and gardens to green roofs and urban farms to help towns and cities grow greener in the future and provide vital benefits for physical and mental health and wellbeing (EC, 2021).

The **3–30–300** rule (Figure 14.2) is an emerging concept developed by Prof Cecil Konijnendijk of the Nature Based Solutions Institute (Konijnendijk, 2023), which introduces objective benchmarks for urban areas to promote equitable nature access. It stipulates that:

3 – Everyone should be able to see at least three mature trees from their home, place of work or study.

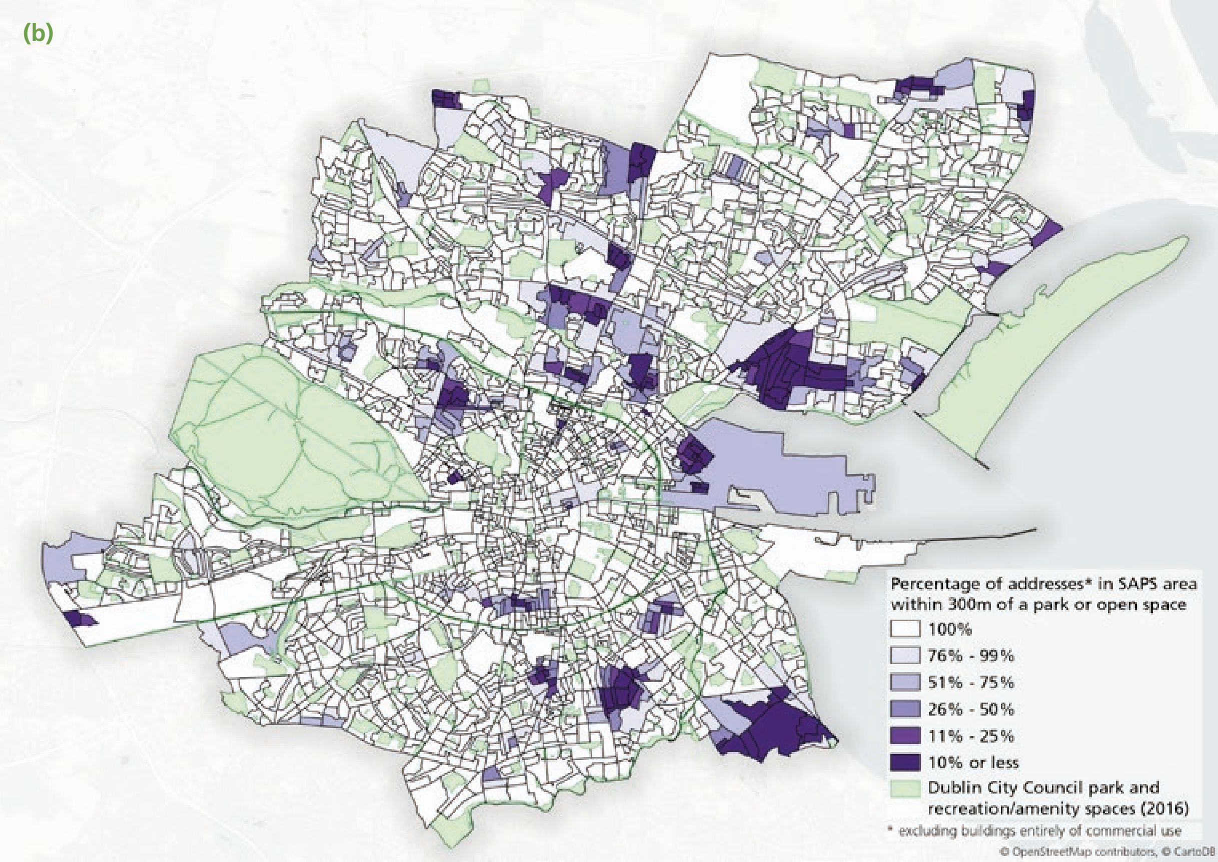
30 – Every neighbourhood should have at least 30% tree canopy cover.

300 – In line with recommendations from the World Health Organization (WHO) Regional Office for Europe, everyone should be a maximum distance of 300 m from their nearest high-quality public green space.

Figure 14.2 (a) Visualisation of the 3–30–300 rule (b) Percentage of addresses (from Geodirectory) in small area population statistic (SAPS) areas of which are within 300m of a Dublin City Council park or open spaces as outlined within the Dublin City Council Parks and open Spaces 2016 dataset[1]

(a)

(b)



Source: (A) UNECE, 2021.

1 data.gov.ie/dataset/parks-gardens-and-public-spaces-dcc#:~:text=This%20dataset (18 September 2024).

While availability of green space is important, spaces must be of high quality in various respects, including safety, accessibility, cleanliness and wider service provision, to be perceived as being adequate by the local community (Scott *et al*., 2020; Barlow *et al*., 2021). By enhancing the provision and design of new and existing green spaces by incorporating specific attributes valued by the local community, green spaces can be maximised as health-promoting environments.

Ireland's National Planning Framework 2040 (DHLGH, 2018) recognises the key national environmental challenges we face, in terms of climate change, air quality, health risks to drinking water, urban waste water and protecting our natural environment, and indicates that the planning system will be 'responsive' to these challenges. Our urban areas are at the front line in terms of vulnerability to the progressively worsening impacts of climate change – they are significant sources of GHG emissions while also housing a significant proportion of our population.

Nature-based solutions

Nature-based solutions (NbSs) are a key tool in helping to address climate change, biodiversity loss and environmental pollution while simultaneously benefiting human health, societal wellbeing and urban prosperity. NbSs have gained much momentum and focus in recent years (Faivre *et al*., 2017) as multifunctional solutions for addressing socio-environmental challenges and benefiting both human wellbeing and biodiversity. Solutions can encompass a broad range of approaches including green and blue infrastructure and natural water retention measures, as well as ecosystem-based adaptation and disaster risk reduction measures (EEA, 2021a). The International Union for Conservation of Nature estimates that one-third of climate mitigation measures needed to meet the goals of the Paris Agreement can be provided by NbSs.

We currently have much knowledge around NbSs, including evidence of their benefits and good examples of NbSs in practice. We also have national guidance to assist local authorities and planning professionals with NbSs for the management of rainwater and surface water run-off in urban areas (DHLGH, 2021), as well as regional guidance around NbSs and blue–green infrastructure (Southern Regional Assembly, n.d.). Mainstreaming and upscaling the implementation of appropriate localised NbSs should be prioritised as a means of addressing many environmental challenges while co-benefiting health and wellbeing.

The design and implementation of NbSs should be inclusive and collaborative from the outset, allowing communities to participate in the design of their own spaces, thereby mobilising local knowledge into local solutions. This is of particular importance, as national-level research has demonstrated the success of this approach as a means of providing guidance and insights into innovative approaches that could be explored (Scott *et al*., 2020; Clavin *et al*., 2021). Monitoring and evaluating the performance and impact of NbS interventions across various societal challenge areas (including climate resilience, water management, air quality and biodiversity, as well as health and wellbeing) is essential if we are to fully understand the success of NbSs, and also provides evidence to inform policy and further action for appropriate land use planning and management (Dumitru *et al*., 2021).

3. Key environmental and health issues

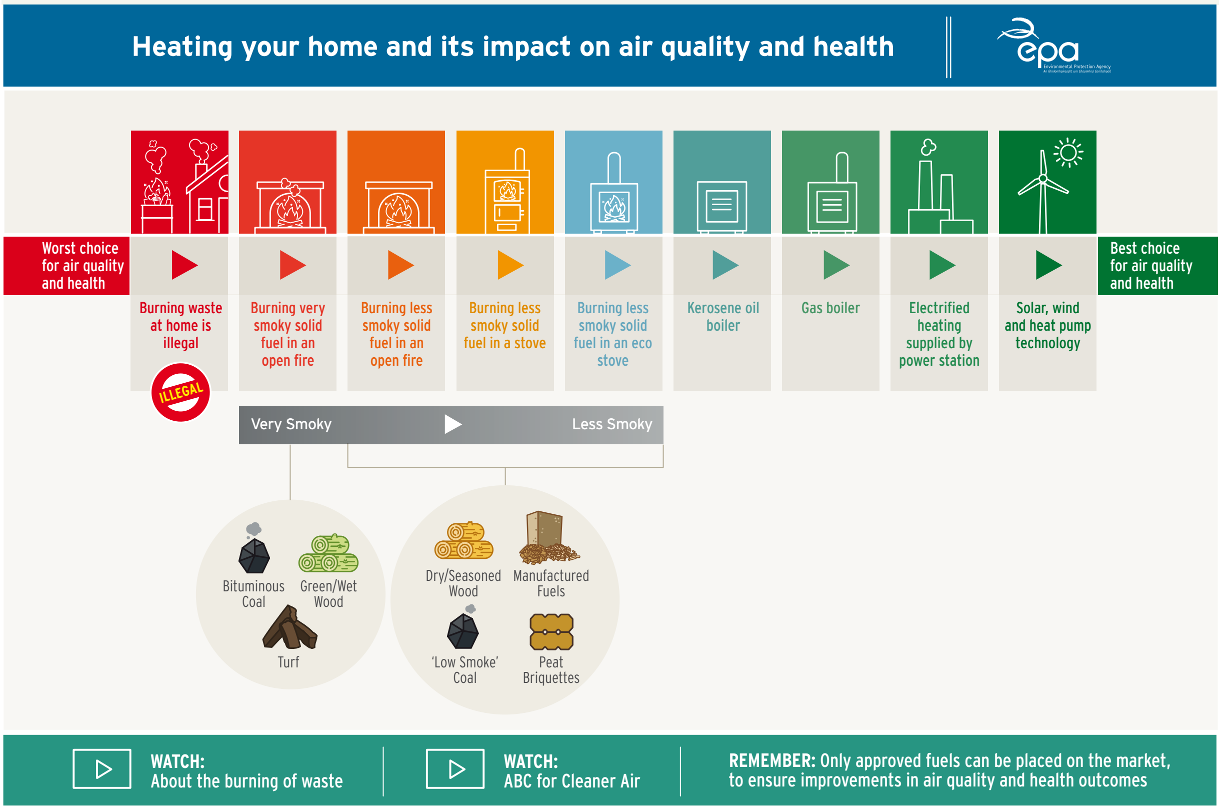
Air pollution

Air pollution is the single greatest environmental threat to our health, causing an estimated 1600 premature deaths annually from conditions such as cardiovascular disease and respiratory illnesses (EEA, 2023c). The air pollutants of concern for health in Ireland are fine particulate matter (with a diameter of less that 2.5 µm ($PM_{2.5}$)) and nitrogen dioxide (NO_2) (EPA, 2023a).

Higher levels of $PM_{2.5}$, the most impactful pollutant on health, are associated with burning solid fuels in our towns and villages, affecting localised air pollution levels. High levels of NO_2 in large cities and urban areas are associated with road traffic (EPA, 2023a).

In 2021, WHO published revised air quality guidelines that substantially lower the guidelines for both NO_2 and $PM_{2.5}$. At EU level a revision of the Cleaner Air for Europe Directive (2008/50/EC) has been progressed, while at national level Ireland's first Clean Air Strategy sets the country an ambition of progressively moving towards achieving the WHO guideline limits by 2040. Meeting the WHO guideline limits will be a major challenge for Ireland, but it is one that is essential if we are to safeguard the health of our citizens (see Chapter 2 for more details).

Figure 14.3 Better ways to heat your home



Source: EPA, 2024a

Solid fuel use. When we heat our homes by burning solid fuels such as coal, peat and wood in stoves or open fires, harmful air pollutants, including $PM_{2.5}$, are released. As well as having an impact on the outdoor air quality in our locality, burning of solid fuel has an impact on our indoor air quality by exposing occupants to considerable levels of air pollutants. The choices we make in how we heat our homes can have a large bearing on our health and the health of our family and the community in which we live (Topic Box 14.2).

New Solid Fuel Regulations came into effect in October 2022 restricting the sale of smoky fuels in Ireland (S.I No. 529/2022; see also Chapter 2 for more details). The primary objective of the regulations is to improve air quality and people's health by ensuring that the most polluting fuels are no longer available on the Irish market. A range of policy measures are needed to encourage the transition away from the use of peat and other solid fuels, towards more sustainable alternatives (Figure 14.3). An examination of the implementation of policy measures in other countries suggests that measures to tackle solid fuel use are most effective when implemented as a suite of supportive interventions (Eakins *et al*., 2022). Targeted education and awareness of the negative effects of using solid fuels, better burning practices, the costs and benefits of using cleaner heating systems such as heat pumps, and the benefits of retrofitting homes are needed, particularly in localities where significant air pollution will continue. Coupled with this, more targeted support schemes offering incentives for retrofitting homes are needed for highly polluting homes. The Climate Change Advisory Council's *Annual Review 2023* (CCAC, 2023) recommends that the number of retrofits needs to increase each year and that homes using peat or coal as their main heating fuel should be prioritised.

Transport-related air pollution. Road traffic and vehicle emissions are the main outdoor source of the harmful air pollutant NO_2. As our towns and cities tend to have greater volumes of traffic, higher concentrations of NO_2 are seen on busy roads, representing a risk to health in these often densely populated urban areas. Almost 70% of journeys are by private car (CSO, 2021), signalling that there is much more to do in enabling and encouraging the transition to more active modes of travel (see Chapter 11 for more details).

Noise pollution

Environmental noise can originate from a wide range of sources, but noise from transport sources (road, rail and aircraft) results in the largest population exposure to excessive noise levels. Over 1 million people are estimated to be exposed to transport noise levels above the mandatory noise level reporting thresholds given in the Environmental Noise Directive (2002/49/EC). Moreover, nearly 1.5 million people are exposed to road traffic noise above the stricter WHO Environmental Noise Guidelines for the European Region (WHO, 2018). The EU Zero Pollution Action Plan aims to reduce the number of people chronically disturbed by transport noise by 30% by 2030 compared with 2017.

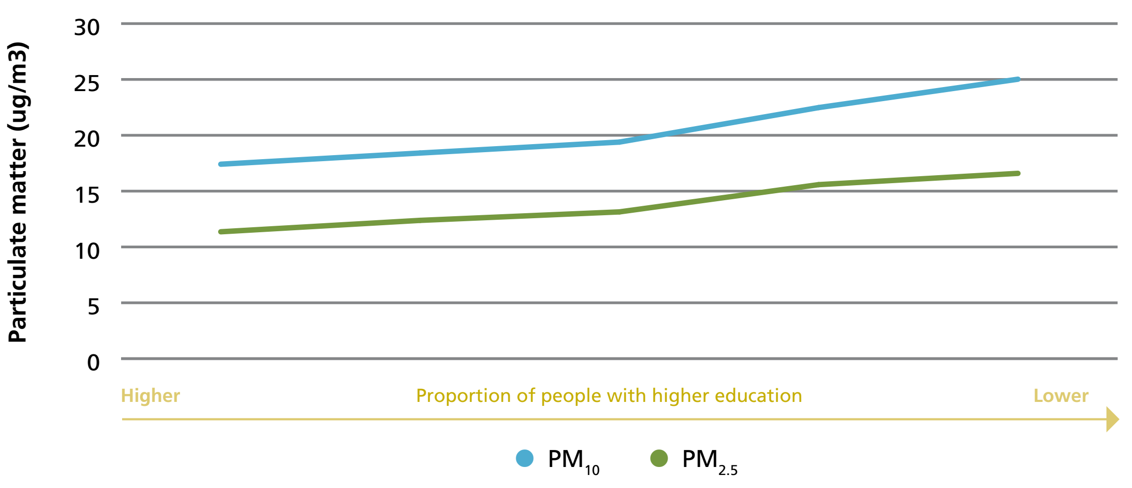
There is a clear link between transport policy and reducing environmental noise from transport. While some work has been ongoing to tackle noise in Ireland, such as the use of lower noise road surfaces, traffic calming measures to reduce speed and noise monitoring at residential locations, the actions so far are not sufficient to meet the targets in the EU Action Plan. New noise action plans are in development at local authority level, and national sustainable mobility policies should provide some benefits. There is also a need to focus on the identification and protection of quiet areas as outlined in the Environmental Noise Directive. Such areas may also provide a multitude of additional co-benefits that can improve health and wellbeing and reduce harmful environmental exposures.

Topic Box 14.2 Unequal exposure and impacts

There are marked differences in the vulnerability of certain cohorts of society to environmental hazards – individuals who are already in poor health, as well as young and elderly people, are vulnerable cohorts of society that tend to be more adversely impacted than the general population. Research using data from the Irish Longitudinal Study on Ageing has demonstrated that long-term low-level exposure to $PM_{2.5}$ is associated with poorer mental health in older people in Ireland (Lyons *et al*., 2024).

Groups disadvantaged in terms of socio-economic status, such as those on lower incomes or who are unemployed, are also disproportionally more affected by environmental hazards because of factors such as poorer housing conditions or living in areas with high volumes of road traffic. An analysis of the differences in exposure to certain air pollutants (ETC/ACM, 2018; EEA, 2019a) found that regions characterised by lower socio-economic status (e.g. lower levels of education) tended to have higher levels of $PM_{2.5}$ and PM_{10} (particulate matter with a diameter of less than 10 micrometres) air pollution (Figure 14.4).

Figure 14.4 Difference in exposure to particulate matter ($PM_{2.5}$ and PM_{10} mean pollution) in European regions, classified according to the proportion of people without higher education in the population (2013–2014)



Source: Adapted from ETC/ACM, 2018

Children are particularly vulnerable to air pollution. Their higher breathing rate and lower physical height means that they can be more directly susceptible to air pollution from traffic exhausts. Moreover, their bodies, organs and immune systems are still developing (see Chapter 2 for more details). It is estimated that air pollution causes over 1200 deaths in those under the age of 18 every year in European Environment Agency (EEA) member and collaborating countries (EEA, 2023d). Recent research funded by the Environmental Protection Agency (EPA) demonstrated a strong positive association between $PM_{2.5}$ levels and prescribing rates of drugs used to treat asthma and chronic obstructive airway disease, particularly in young children (aged 0–4 years) (Ó Domhnaill *et al*., 2023).

The implementation of policy measures may not benefit all members of society evenly. There is a need to assess and understand inequalities in exposure levels, as well as inequalities in impact, at a more granular scale so we can focus measures appropriately and, importantly, track changes over time.

Safe and clean water and sanitation

Drinking water. Drinking water can pose a risk to health if it is contaminated by pathogens or certain chemicals. The recast Drinking Water Directive[2] ((EU) 2020/2184) brings significant new requirements for water suppliers and regulators. These include implementing a risk-based approach (drinking water safety plans) across the whole drinking water supply chain and an updated list of more stringent existing (e.g. lead) and new standards (e.g. per- and polyfluoroalkyl substances (PFAS)). Nationally, water comes from a public water supply operated by Uisce Éireann (82% of population), a private household supply such as a well (12% of population) or a private group water scheme (6% of the population).

Compliance with the microbiological and chemical standards for public drinking water supplies remains high at greater than 99.7%, and this compares well with the EU-wide historical compliance rate of more than 99.5% for a range of chemical parameters.[3] Drinking water treatment in many supplies is still, however, not robust enough to ensure that all supplies will be resilient and safe into the future, with 57 public supplies identified by the EPA as requiring remedial action in its most recent update (EPA, 2024b).

The quality of water from private supplies (including group schemes) is consistently lower than that from public supplies, with little indication that this disparity is improving. About 1 in 20 private supplies tested fail to meet *Escherichia coli* standards, compared with only 1 in 200 public water supplies. Concerningly, each year on average over one-quarter of small private supplies are not subject to any monitoring. Private wells are not regulated so information on their quality is not available. Ireland has one of the highest notification rates in Europe for certain notifiable pathogens, including Shiga toxin-producing *E. coli* (STEC) (also referred to as verocytotoxin-producing *E. coli* (VTEC)) (Topic Box 14.3).

In addition to issues with microbial contamination, there are a number of issues related to chemical contamination. There has been an increase in the number of supplies listed on the EPA's action list because they contain trihalomethanes (THMs). In January 2024, the European Court of Justice ruled that Ireland had failed to fully implement the Drinking Water Directive in relation to breaches of the limit for THMs in 30 drinking water supplies, 21 of which were Uisce Éireann public supplies (see Chapter 16 for further information). There are also issues with lead, with limited action taken to replace lead pipework under the National Lead Strategy. This is particularly urgent and requires leadership at a national level given the cumulative risk to health posed by exposure to lead in drinking water supplies. The recast Drinking Water Directive includes requirements to halve the level of lead that is permitted in drinking water (from 10 µg/l to 5 µg/l) by January 2036. Compliance with this limit will most likely not be achieved without the replacement of all lead connections. The Lead Remediation Grant Scheme[4] provides 100% of costs up to €5,000 for householders to replace lead drinking water pipes within the boundaries of their property.

2 Implemented by the European Union Drinking Water Regulations 2023 (S.I. No. 99/2023).

3 www.eea.europa.eu/publications/zero-pollution/health/water-pollution (accessed 16 July 2024).

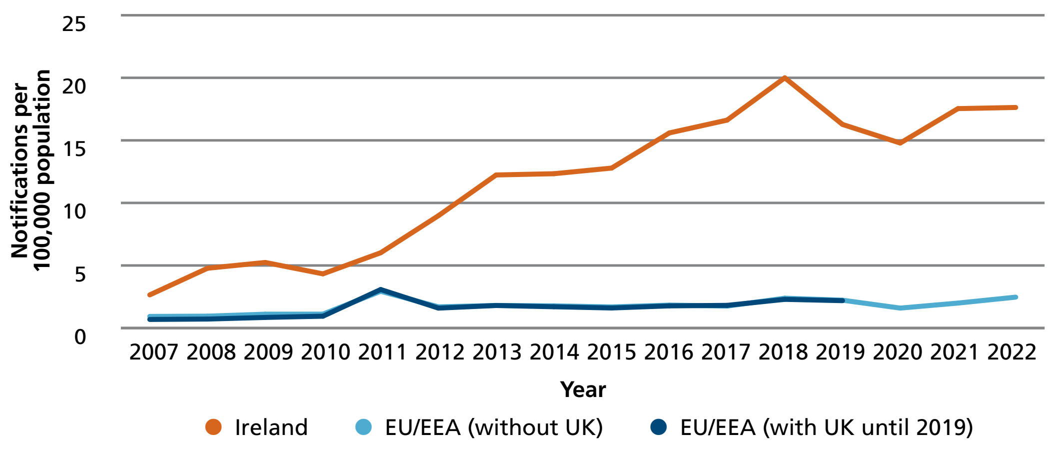
4 gov – Domestic Lead Remediation Grant Scheme – Customer Leaflet (www.gov.ie/en/publication/7fe5d-domestic-lead-remediation-grant-scheme-customer-leaflet/) (accessed 20 September 2024).

Topic Box 14.3 STEC/VTEC infections in Ireland: a persistent threat to public health and wellbeing

STEC/VTEC infections are a significant concern for public health in Ireland. Ireland consistently reports the highest rates of STEC/VTEC infections in the EU, with an increasing trend since 2010 (Figure 14.5). Ruminants, mainly cattle, are the primary reservoir of this zoonotic pathogen, which they shed in their faeces. A low infectious dose, with ingestion of just ten STEC/VTEC bacteria from contaminated food or water, is enough to cause symptomatic disease (FSAI, 2010). Children under the age of 5 and the older population are particularly vulnerable to severe illness caused by STEC/VTEC infection and a complication called haemolytic uraemic syndrome, which can be life threatening.

More recent data from the Health Protection Surveillance Centre (HPSC) and the European Centre for Disease Prevention and Control (ECDC) highlight that Irish STEC/VTEC notification rates were one of the highest in Europe in 2022. Many factors combine to favour human exposure to this zoonotic pathogen in Ireland:[5] high levels of rainfall, the high density of ruminant animals at pasture and the high proportion of rural dwellers who rely on private sources of untreated water all contribute to our increased risk. Exposure to private well water was the most commonly reported risk factor among STEC/VTEC cases in 2022 (HPSC, 2024). Meteorological events, including persistent and heavy rainfall, have also been shown to concur with STEC/VTEC outbreaks (O'Dwyer *et al*., 2016), suggesting that a changing climate is likely to influence the pattern and frequency of outbreaks of this disease in the future.

Figure 14.5 Trends in STEC/VTEC in the EU and Ireland, 2007–2022



Source: Adapted from ECDC, Surveillance Atlas of Infectious Diseases[6]

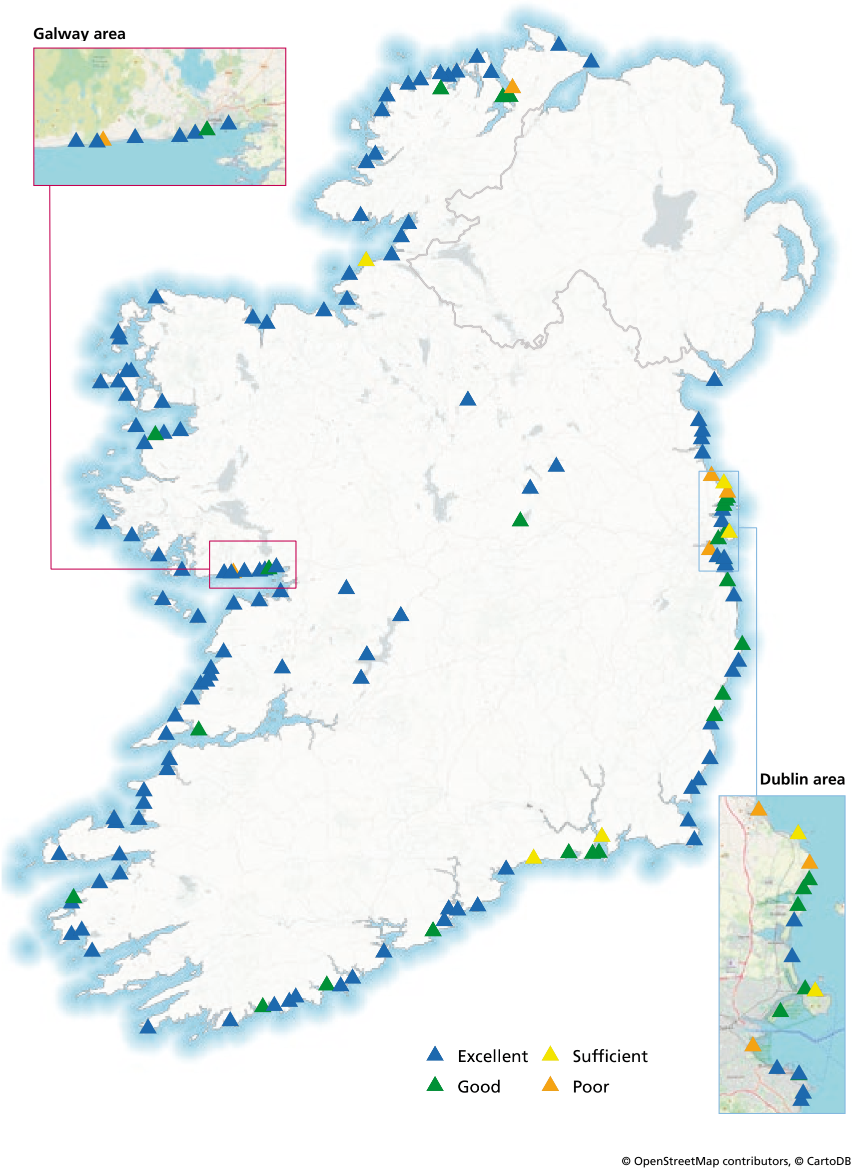
Quantifying the relative contribution of potential environmental sources, pathways and temporal dynamics of STEC/VTEC contamination is a priority area, particularly in light of climate change impacts. Improvements in private water supplies are essential if we are to protect human health. This includes ensuring that private wells are properly constructed such that the well head is adequately protected and contamination by surface run-off is prevented and that water is treated by ultraviolet radiation or ultrafiltration. While funding is available through the Department of Housing, Local Government and Heritage (DHLGH) for improvement works for private supplies and group water schemes, during the 2019–2021 funding cycle of the Multi-annual Rural Water Programme, over 60% (€36 million) of the funding available for infrastructural improvements went unused by water suppliers.

5 Zoonotic pathogens are infectious diseases that can be transmitted from animals to humans.

6 https://atlas.ecdc.europa.eu/public/index.aspx – examining notification rate of confirmed cases of STEC/VTEC infection.

Bathing water. The use of our local environment is changing, with swimming now increasingly becoming a year-round activity. The overall quality of Ireland's bathing water is high with 97% (143 of 148) of sites meeting or exceeding the minimum standard in 2023 (EPA, 2024c) (Figure 14.6). Localised issues remain from impacts from urban waste water discharge incidents, agricultural run-off and dog fouling. Ireland is below the European average in terms of the percentage of bathing water sites rated as excellent (79.1% vs 85.7%) (EEA, 2023e). Increasing the use of 'prior warning' notices (228 issued in 2023) to warn bathers of potential problems, along with a conservative approach to closing beaches in response to potential water quality impacts, is serving to protect bathers' health. However, given the increasing recreational use of our bathing waters, further health protection would be served by local authorities officially designating more bathing sites and providing better information for those who wish to swim all year round. The public can suggest new bathing water locations to their local authority in order to have additional bathing water sites designated. It is essential that there is timely provision of information to swimmers and other recreational water users to help them make informed choices to protect their health.

Figure 14.6 Map showing bathing water sites and the bathing water quality status of each



Source: EPA, 2024c

Domestic waste water treatment systems. There are nearly half a million domestic waste water treatment systems, mostly septic tanks, in Ireland. Faulty septic tanks systems can contaminate household drinking water wells with harmful bacteria and viruses and can pollute water bodies. Of all septic tanks inspected by local authorities in 2023, 45% failed inspection, with a significant number identified as a risk to human health and the environment (EPA, 2024d). When septic tanks are not functioning properly, it is critical that householders fix the problem to prevent unnecessary risk to their family's health. Local authorities require householders to fix systems that fail inspection. The most recent report on domestic waste water treatment system inspections found that the number of advisory notices open for more than 2 years (576) has continued to increase and remains a concern (EPA, 2024d). More consistent enforcement is needed by local authorities when advisory notices are not addressed. The septic tank grant scheme[7] operated by DHLGH was amended in 2024, increasing the available grant from €5,000 to €12,000. This presents a significant opportunity for householders to repair, upgrade or replace their septic tanks, thereby preventing needless risks to human health and the environment.

Urban waste water. Untreated and poorly treated waste water can contain harmful bacteria and viruses that pose a risk to people's health. The treatment of waste water is therefore essential to protect our environment and public health. Once treated, the effluent is discharged into rivers, estuaries, lakes and coastal waters. More than 1 billion litres of waste water are collected each day in Ireland's sewers and treated at over 1000 Uisce Éireann treatment plants. In Ireland, urban waste water treatment is still not as good as it needs to be, and this is putting our environment and public health at risk. Waste water treatment failed to meet EU standards in 15 large towns and cities in 2022 (EPA, 2023). These included the Greater Dublin Area, served by an overloaded plant at Ringsend that treats over 40% of Ireland's urban waste water. Infrastructure upgrades to increase the capacity of the Ringsend plant and bring it up to the required standard are well advanced. The works are due to be completed in 2025 but the upgraded infrastructure in place since the start of 2024 has the capability to meet EU standards, provided it is operated and managed effectively.

At the end of 2023, raw sewage from 19 towns and villages was being discharged into the environment every day, which poses an unacceptable risk to the environment and public health. The EPA has repeatedly highlighted that these areas must be connected to waste water treatment plants as a matter of urgency.

A legacy of underinvestment means that multi-billion euro spending is required to bring all infrastructure up to standard – it is likely to take at least two decades to bring all infrastructure up to standard. While progress has been made in several areas over the last few years, the EPA has highlighted that the pace at which Uisce Éireann must deliver improvements needs to accelerate (EPA, 2023). Uisce Éireann's next investment plan for 2025–2029 must prioritise resources to tackle priority areas highlighted by the EPA.

Topic Box 14.4 describes the establishment of the National Wastewater Surveillance Programme, a valuable tool that public health officials use to monitor infectious diseases through waste water across the country.

7 gov – Domestic waste water treatment systems (septic tanks) (www.gov.ie) (29 July 2024).

Topic Box 14.4 Our waste water as a powerful public health monitoring tool – establishment of Ireland's National Wastewater Surveillance Programme

The pandemic saw the implementation of waste water monitoring across Europe as a tool to track COVID-19 and its variants in the community. People infected with the SARS-CoV-2 virus can shed virus in their faeces and urine, which can then be detected in untreated waste water. Analysis of the waste water can be used to inform public health teams providing estimates of the frequency of infection and of variants of the virus that are circulating. The analysis acts as an additional, complementary tool providing community-level information to other public health surveillance systems monitoring the number of people testing positive or seen in healthcare facilities.

Ireland's National SARS-CoV-2 (COVID-19) Wastewater Surveillance Programme was established in 2020 by the Health Service Executive (HSE), Uisce Éireann, the National Virus Reference Laboratory and University College Dublin, and involved the sampling of 68 waste water catchment areas across Ireland on a weekly basis (Ringsend sampled twice per week). The catchment area analysed covered 80% of the population connected to the public waste water treatment facilities across a broad geographical area. The results of analysis of samples continue to be reported on a weekly basis by the HPSC.[8] Since January 2023, the number of catchment areas covered by the COVID-19 surveillance programme has been reduced to 30; however, the programme still covers approximately 70% of the population connected to the public waste water system. Beyond COVID-19, the establishment and operation of the surveillance programme now represents a national surveillance infrastructure that could be readily applied to micropollutants (biological and chemical contaminants in water in trace quantities). Waste water surveillance could be a powerful public health tool acting as an early warning system for environmental or human health threats, or allowing longitudinal surveillance for contaminants or pathogens of concern. For example, indirect environmental surveillance for antimicrobial resistance (AMR) consistently lags behind direct surveillance for AMR in human or animal populations; however, systematic waste water surveillance now offers a timely and powerful opportunity to gain insights and to provide a more integrated view of AMR dynamics in our populations and ecosystems.

There is also opportunity to combine the waste water monitoring systems in operation across various countries into an integrated global network for disease surveillance (Keshaviah *et al*., 2023). Ireland is currently collaborating with other countries across Europe to develop the use of waste water surveillance and to integrate this with other public health surveillance tools.

Antimicrobial resistance. Antibiotics revolutionised the treatment of bacterial infections and made many modern medical procedures possible. However, the overuse and misuse of antimicrobials such as antibiotics, for human or animal health, has resulted in a rapid increase in AMR, which jeopardises the effectiveness of these medicines and modern healthcare systems. AMR is considered responsible for more than 35,000 deaths each year in the EU and European Economic Area countries (ECDC, 2020). An analysis of the economic burden of AMR in Ireland in 2019 found that over 4700 resistant infections occurred across 50 public hospitals, resulting in 215 deaths and approximately 5000 years of healthy life lost. In addition, these patients' lengthier hospital stays were estimated to cost at least an additional €12 million in that year (HIQA, 2021). AMR has been identified as one of the top three health threats for priority action by the European Commission and EU Member States (HERA, 2022), and it is consistently listed as one of the strategic risks facing Ireland under the government's annual national risk assessment (Department of the Taoiseach, 2023b).

8 www.hpsc.ie/a-z/nationalwastewatersurveillanceprogramme/ (accessed 16 July 2024).

AMR is a quintessential One Health issue: One Health recognises that the health of humans, animals and the environment are closely linked and interdependent. Ireland's second One Health National Action Plan on AMR 2021-2025 (iNAP2) is the successor plan to Ireland's first National Action Plan on AMR 2017-2020 (iNAP1) and outlines over 150 actions, both One Health-focused as well as sector-specific, to tackle the issue of AMR in Ireland (DAFM & DOH, 2021). Compared with public health and the health of food-producing animals, the health of the environment has, to date, received little attention with regard to AMR. However, the environment is a complex reservoir of antimicrobial-resistant organisms and genes that can drive AMR, and is a critical, but often overlooked, dimension of this One Health issue (see section 5).

A recent research project revealed the presence of antimicrobial-resistant organisms and AMR genes of clinical concern in our aquatic environment, including those that are resistant to last-resort antimicrobials such as carbapenemase-producing Enterobacterales (Hooban *et al*., 2021, 2022; Cahill *et al*., 2023; Morris *et al*., 2024). Discharged waste water, particularly that emanating from healthcare facilities, was found to play a significant role in dissemination of AMR in the natural aquatic environment. This persistence of resistant microbes and AMR genetic elements in our environment is an important signal of a wider problem around the use of antimicrobials, which is continuing to drive AMR.

iNAP2

OBAIR LE CHÉILE CHUN ÁBHAIR FHRITHMHIOCRÓBACHA A CHOSAINT DON TODHCHAÍ

WORKING TOGETHER TO PROTECT ANTIMICROBIALS FOR THE FUTURE

Ireland, like many other countries, does not currently have a systematic surveillance system to monitor levels of AMR in our environment. Several antimicrobial compounds are included in the Water Framework Directive (2000/60/EC) watchlist for monitoring; however, the number of substances monitored and the frequency and density of monitoring are very limited. Proposed revisions to various pieces of EU legislation, including the Urban Waste Water Treatment Directive (91/271/EEC), the Water Framework Directive, the Groundwater Directive (2006/118/EC) and the Environmental Quality Standards Directive (2008/105/EC), intend to include monitoring for AMR genes. A recent European Council recommendation (2023/C 220/01) under the 2023 Commission revision of pharmaceuticals legislation highlights that environmental monitoring of antimicrobial-resistant organisms and AMR genes in our waters, waste water and agricultural soils is 'essential' to understand the level of environmental contamination and the risk posed to human health (European Council, 2023). Indeed, provisional political agreement was reached in March 2024 on proposals to review the EU Urban Waste Water Treatment Directive's higher standards of treatment and monitoring activities for micropollutants and AMR. Therefore, it seems likely that it will eventually become a legislative requirement to monitor AMR in our environment. Ireland has already made a substantial investment in research in recent years on the environmental dimension of AMR – this provides us with a wealth of evidence on which we should build. If we are to gain the requisite evidence to have a more holistic understanding of AMR and the risks it poses to human and animal health, we must step up our surveillance, not only of residues of antimicrobial compounds but also of resistant microorganisms and microbial genes coding for AMR.

Algal blooms. Harmful algal blooms occurred at a number of freshwater lakes across the island of Ireland in 2023, affecting recreational bathing sites and drinking water sources and posing serious risks to aquatic life, as well as ecological, animal and human health. Toxic blue–green algae blooms are caused by cyanobacteria, which are natural inhabitants of freshwater and marine waters. These bacteria and the toxins they produce during a bloom can potentially kill livestock, wild animals and pets if ingested and can also cause harm to people who come into contact with, or swallow, the affected water. Human activities can influence the extent to which cyanobacteria can proliferate, with excess nutrients arising from agriculture and waste water systems within catchments areas, combined with climate change and weather conditions, driving the occurrence of blooms. Local authorities have responsibility for monitoring, risk assessing and analysing waters for suspect blooms. The HSE Bathing Water Working Group has developed guidance for responding to incidents of microbiological pollution in bathing waters. Restricting bathing and other water-contact activities and posting on-site warning signs are some of the recommended actions for safe practice in managing contact with blooms. Health warnings and swimming restrictions were placed across many lakes on the island of Ireland in 2023 due to harmful algal blooms. It is likely that we will continue to see changing patterns and incidences of algal blooms as a result of continued anthropogenic pressures and climate change impacts. It is essential that local authorities remain vigilant in promptly identifying harmful algal blooms and notifying the public to help safeguard public health.

Shellfish waters. Waters used for the farming or harvesting of shellfish (e.g. oysters, mussels and clams) are protected. If waste water is discharged into the catchments of these waters without adequate treatment (e.g. disinfection of treated waste water using ultraviolet lamps) it has the potential to contaminate shellfish with bacteria and viruses. This can put public health at risk, as people may get sick by eating contaminated shellfish. The EPA has highlighted that Uisce Éireann is taking too long to complete assessments of shellfish waters and to carry out necessary improvements: 23 assessments were overdue in 2022 (EPA, 2023b). The EPA requires Uisce Éireann to implement improvements to protect shellfish waters without delay and expedite the remaining assessments. It is vital that adequate funding for these works is allocated by Uisce Éireann so that the assessments and infrastructure works can be completed.

Radiation

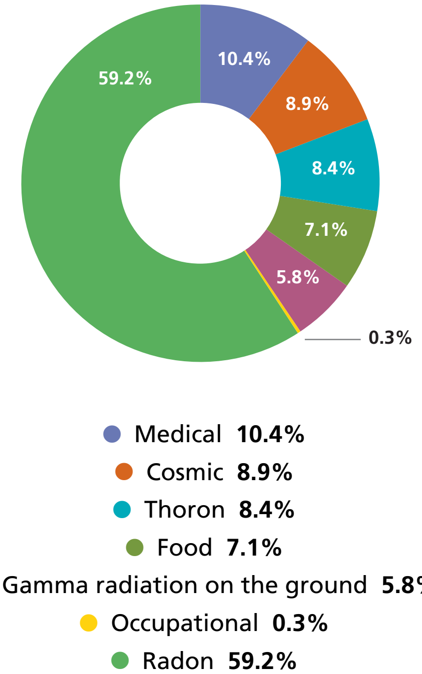
Radiation can be of benefit to our health, for example in medical imaging or in medical treatments, but radiation also has the potential to cause negative health impacts. The estimations of radiation doses received from various pathways were updated in 2024, and while no major changes were found in the overall doses, there was some additional exposure from increased air travel and a reduction in the average estimated dose from medical imaging.

The average annual radiation dose for a person in Ireland from all sources is 4.172 mSv (EPA, 2024e) (Figure 14.7). This exposure comes predominantly from natural sources, which, together with medical exposures, account for 99% of the total average exposure.

Our greatest radiation exposure comes from radon (59% of total), which is linked to approximately 350 new cases of lung cancer each year in Ireland (Figure 14.8) (Murphy *et al*., 2021). Radon is a natural radioactive gas that is emitted from the ground into our buildings, where the levels build up.

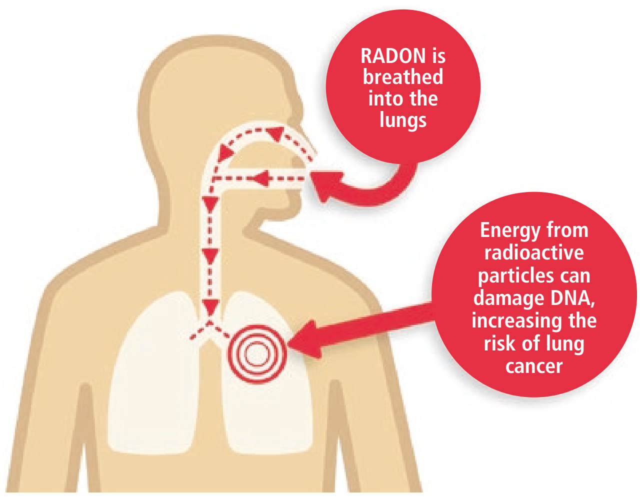
Ireland has a more significant radon problem than many European countries because of its geology. The EPA published new radon risk maps in 2022 (Figure 14.9) using approximately 30,000 radon measurements combined with detailed geological information. According to the new maps, one-third of the country is now designated as a high radon area (areas where one in five homes are likely to have a high radon level), and 170,000 homes nationally could have radon levels above the national reference level of 200 Bq/m^3. This is an increase of 45,000 homes from the previous estimate in 2002. Householders can search by their Eircode to see the radon risk in their area (www.epa.ie/radon).

Figure 14.7 Sources of average radiation dose in Ireland



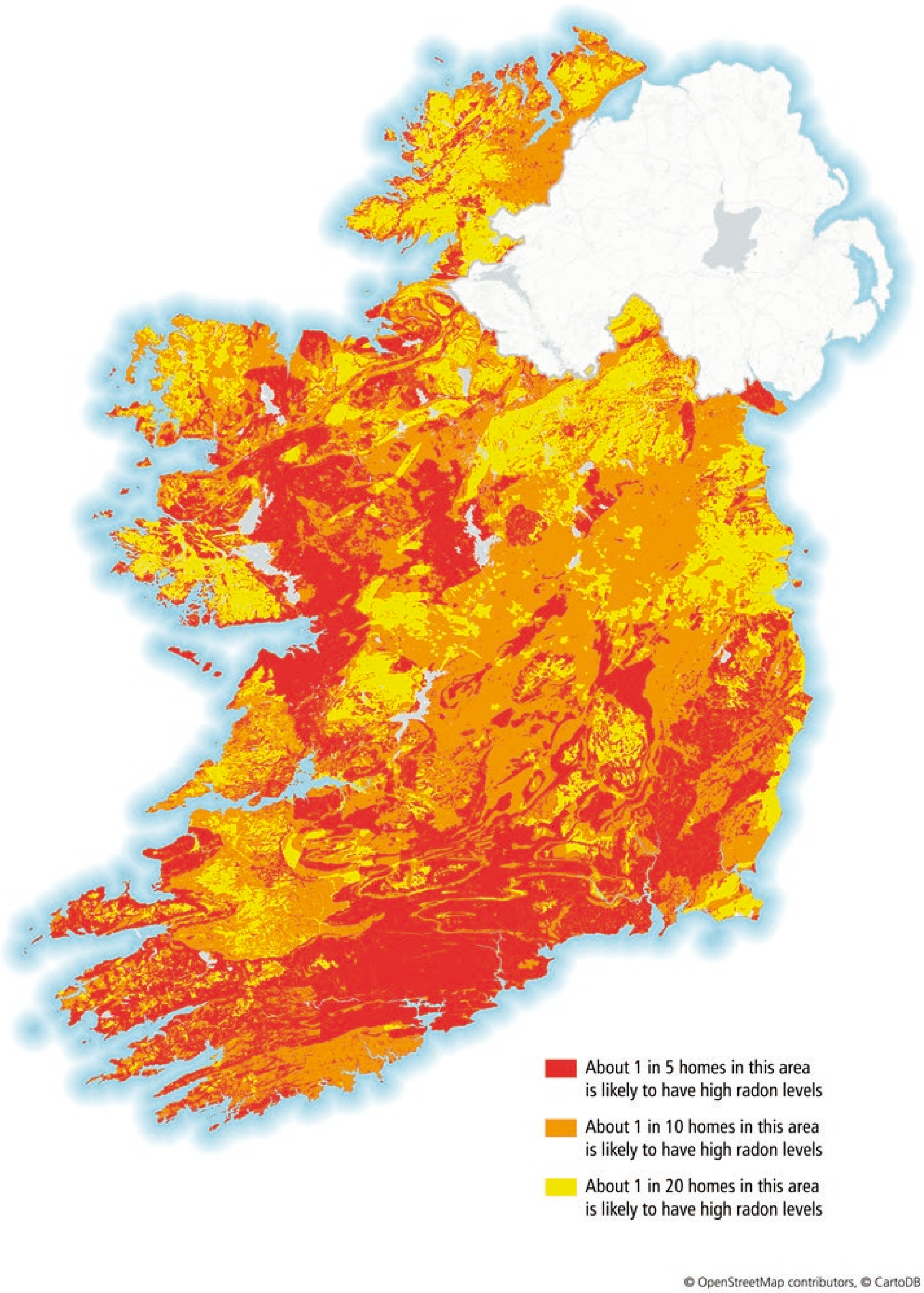
Source: EPA, 2024e

Figure 14.8 Radon damages the lungs, increasing the risk of lung cancer



Source: EPA, n.d.

Figure 14.9 Radon risk map of Ireland



Source: EPA, n.d.

Digital radon gas detector.

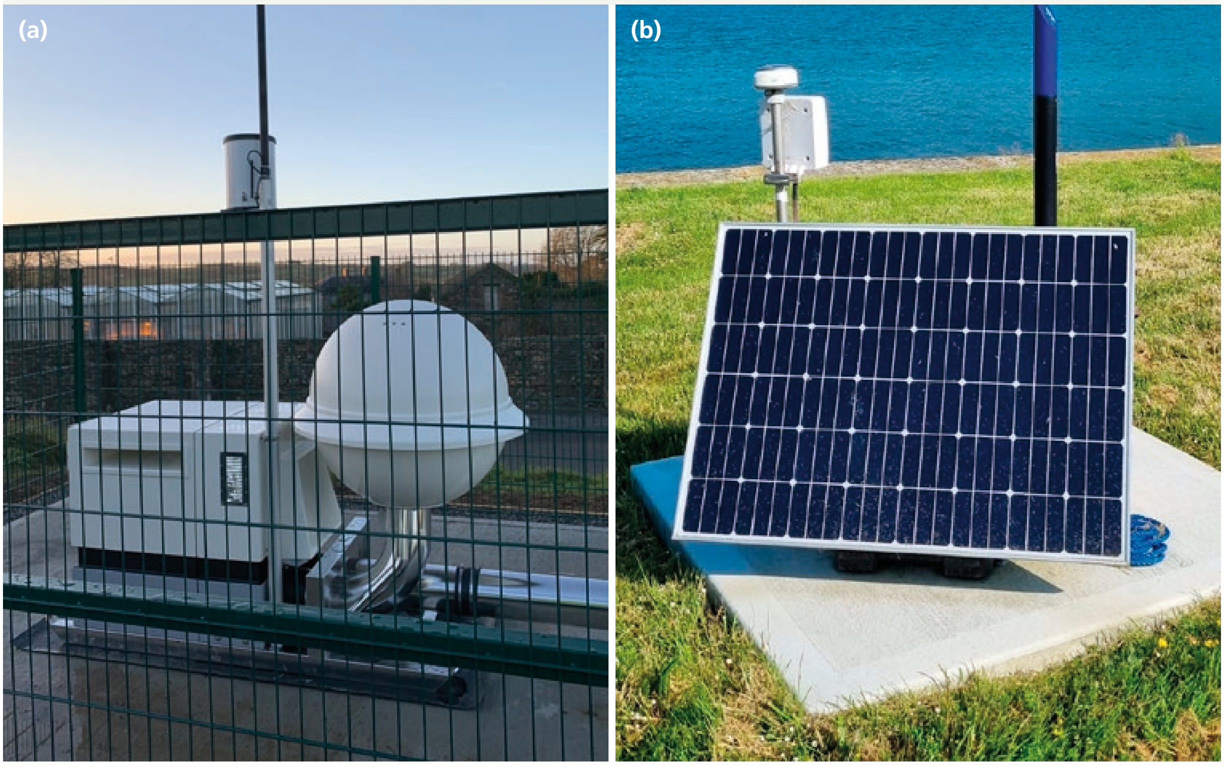
Strengthening of passive prevention measures for radon in new builds is a priority focus of the government's National Radon Control Strategy (2019–2024).[9] Updated building guidance from the DHLGH published in 2023 references the new radon risk map and restates the requirements for all new buildings to be fitted with a standby radon sump and for all new buildings in areas with high radon levels to have a radon membrane installed (Technical Guidance Document C). All employers with workplaces in areas with high radon levels are required to test them for radon and must remediate where necessary. Recognising that primary prevention in new builds is the most effective way of protecting the population against radon, strengthening radon prevention measures in new builds nationwide irrespective of radon risk must be a critical element of national action to protect citizens from this modifiable cancer risk.

Protection against radon in older buildings and homes is an area requiring specific focus. The Programme for Government set an ambitious target of retrofitting 500,000 homes by 2030. While the target of 500,000 retrofits moves Ireland in the right direction in its ambitions to become a sustainable, low-carbon and energy-efficient economy, research has highlighted the potential for radon levels to increase or decrease following a home retrofit, depending on the ventilation strategy employed during the retrofit, with increases linked to insufficient ventilation post retrofit (McGrath *et al*., 2021).

It is critical that ambitions under the national retrofit programme are used as an opportunity to reduce the levels of radon in our existing building stock and that sufficient measures, such as a post-retrofit radon measurement, are used to ensure that levels of radon are below the national reference level. The EPA strongly recommends that all existing households test their homes for radon and take action if the levels are high.

9 www.epa.ie/publications/monitoring--assessment/radon/The-National-Radon-Control-Strategy-Phase-2.pdf (access 26 September 2024).

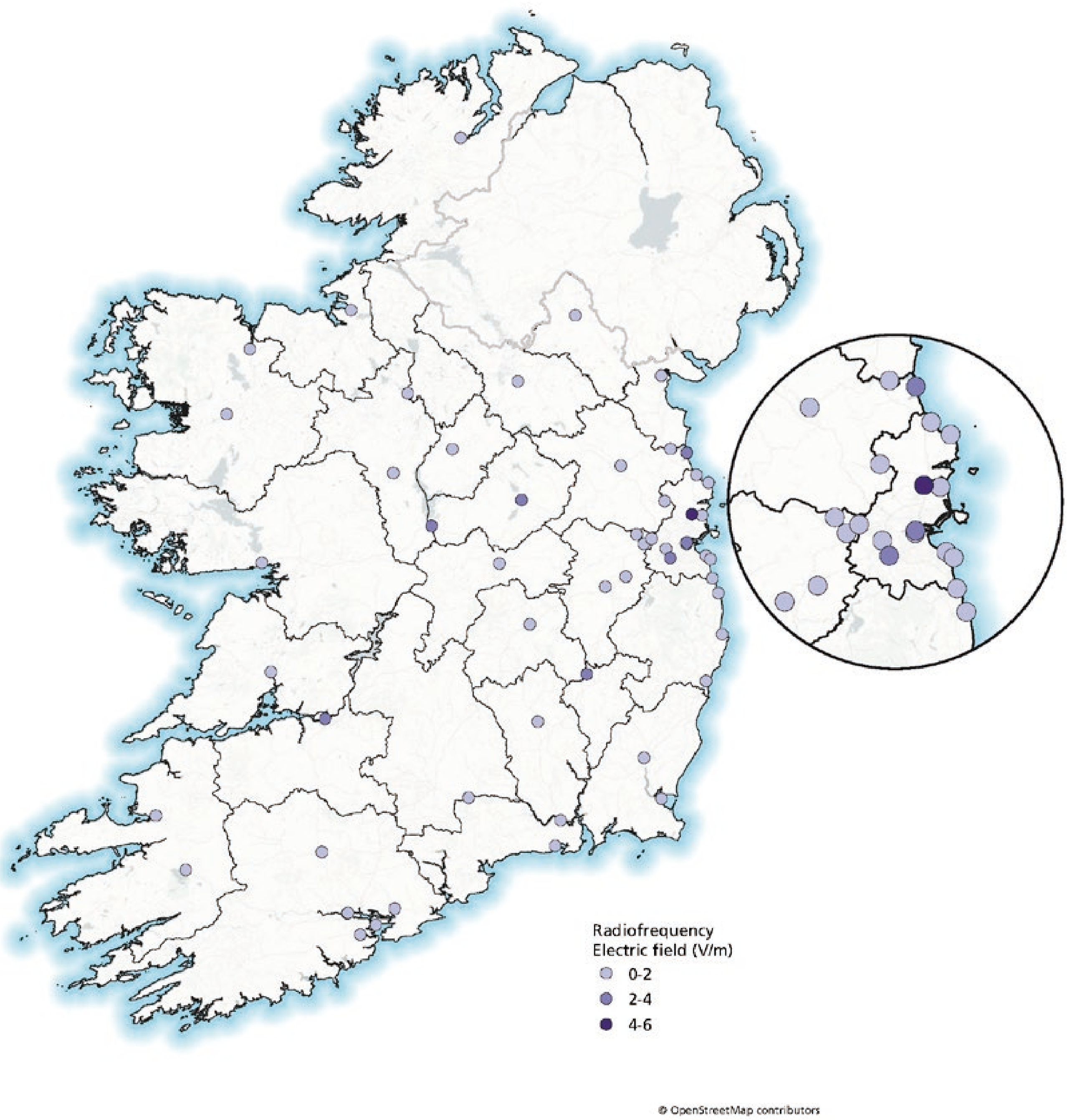
Figure 14.10 (a) A high-volume air sampler in the National Radiation Monitoring Network, and (b) a gamma spectroscopic measuring system in the upgraded National Radiation Monitoring Network



The EPA's National Radiation Monitoring Network constantly monitors radiation levels in air across Ireland. Between 2019 and 2023 the network was upgraded to bring the number of monitoring stations up to 26 (Figure 14.10). In the event of a nuclear emergency, data from the network will support decision-making on whether there is a need to implement public protective actions. Routine monitoring of levels of artificial radioactivity in air shows that the levels of artificial radionuclides are low and do not pose a significant risk to the health of the Irish population. The EPA also monitors samples of seawater, seaweed, sediment, fish and shellfish from fixed locations around the coast, in the Irish Sea and from fishing ports for radioactivity. While levels of artificial radioactivity in the Irish marine environment remain detectable, the environmental concentrations are lower than historical levels and do not have an impact on humans or the marine environment. The OSPAR Commission's Fifth Periodic Evaluation (OSPAR, 2023) concluded that Contracting Parties have made significant progress towards fulfilling the aim of ensuring that concentrations in the environment are near background values for naturally occurring radioactive substances and close to zero for artificial radioactive substances.

Electromagnetic fields. Electromagnetic fields (EMFs) are generated by many services that are expected in a modern society. EMFs are generated whenever electricity is produced, distributed or used and are used to transmit information via mobile phones, media broadcasts and Wi-Fi. The EPA monitored radio frequency EMFs from mobile phones, media broadcasts and Wi-Fi at street level in 55 urban sites during 2021 and 2022 (Figure 14.11) (EPA, 2023c). The typical level found was 1 V/m, which is substantially below the lowest reference level (28 V/m) recommended by the International Commission on Non-Ionizing Radiation Protection. According to WHO, no health effects have been identified for EMF exposure at levels below these guidelines set for members of the public. Further monitoring of EMF exposure from other technologies commenced in 2024.

Figure 14.11 Results from radio frequency electromagnetic field measurement in Ireland



Source: EPA, 2023c

Chemicals

Chemicals play a vital part in our daily lives. We are in contact with them all the time at home and at work. They are used to clean the water we drink, used in the production of the food we eat, form the clothing we wear and the electronics we use, and cure us from many illnesses, to name just a few vital uses. There has been a 50-fold increase in the production of chemicals since 1950, and the number is anticipated to triple again by 2050 (EEA, 2018). In 2021 over 90 million tonnes of chemicals posing risks to human health were produced and consumed in the EU.[10] Humanity is now deemed to have exceeded its safe operating space – or to be outside its planetary boundary – for novel chemical entities and pollution (Persson *et al.*, 2022).

Some chemicals or products containing them may harm us when in use (e.g. through ingestion, inhalation or absorption through the skin), while others, if not managed properly, may be released into the environment and cause pollution. Some of these chemicals move freely in the environment (e.g. from air to water), travelling long distances from where they were first released, while others can accumulate in soils and potentially enter the food chain. Substances harmful to us or to our environment can be classified by the threats they pose; for example, some groups may cause cancer while others may be highly toxic to humans and other animals or plants. Chemical pollution can also have long-term and large-scale impacts on our environment, including degrading ecosystems, reducing biodiversity by causing declines in animal populations or diversity, and compromising the ecosystem services humans require for clean drinking water and food production. The transition towards safer and more sustainable chemicals and the control and phasing out of the most harmful chemicals is therefore critical for human and ecosystem health.

Persistent organic pollutants. Certain chemicals that are highly persistent in the environment, can bioaccumulate and are toxic to humans and wildlife have been classified as persistent organic pollutants (POPs). They can pose serious, prolonged risks to human health and the environment. Given the hazards they present, the Stockholm Convention on Persistent Organic Pollutants was adopted, which aims to protect human health and the environment by taking measures to eliminate or reduce the release of listed POPs into the environment. Under the Convention, there are bans on the production and use of certain POPs. The POPs controlled under the Convention fall into three broad groups:

1. pesticides, such as dichlorodiphenyltrichloroethane (DTT) and pentachlorobenzene
2. unintentionally produced POPs, such as dioxins and furans, which can be produced from backyard burning and accidental fires
3. industrial POPs, such as specific chemicals containing bromine, fluorine or chlorine, including three specific PFAS (perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA) and perfluorohexanesulfonic acid (PFHxS)).

Ireland's last national implementation plan under the Stockholm Convention, which outlines measures taken to eliminate or reduce the release of POPs into the environment from intentional production, was published in 2018 (EPA, 2018). A revised plan is due to be published in 2024.

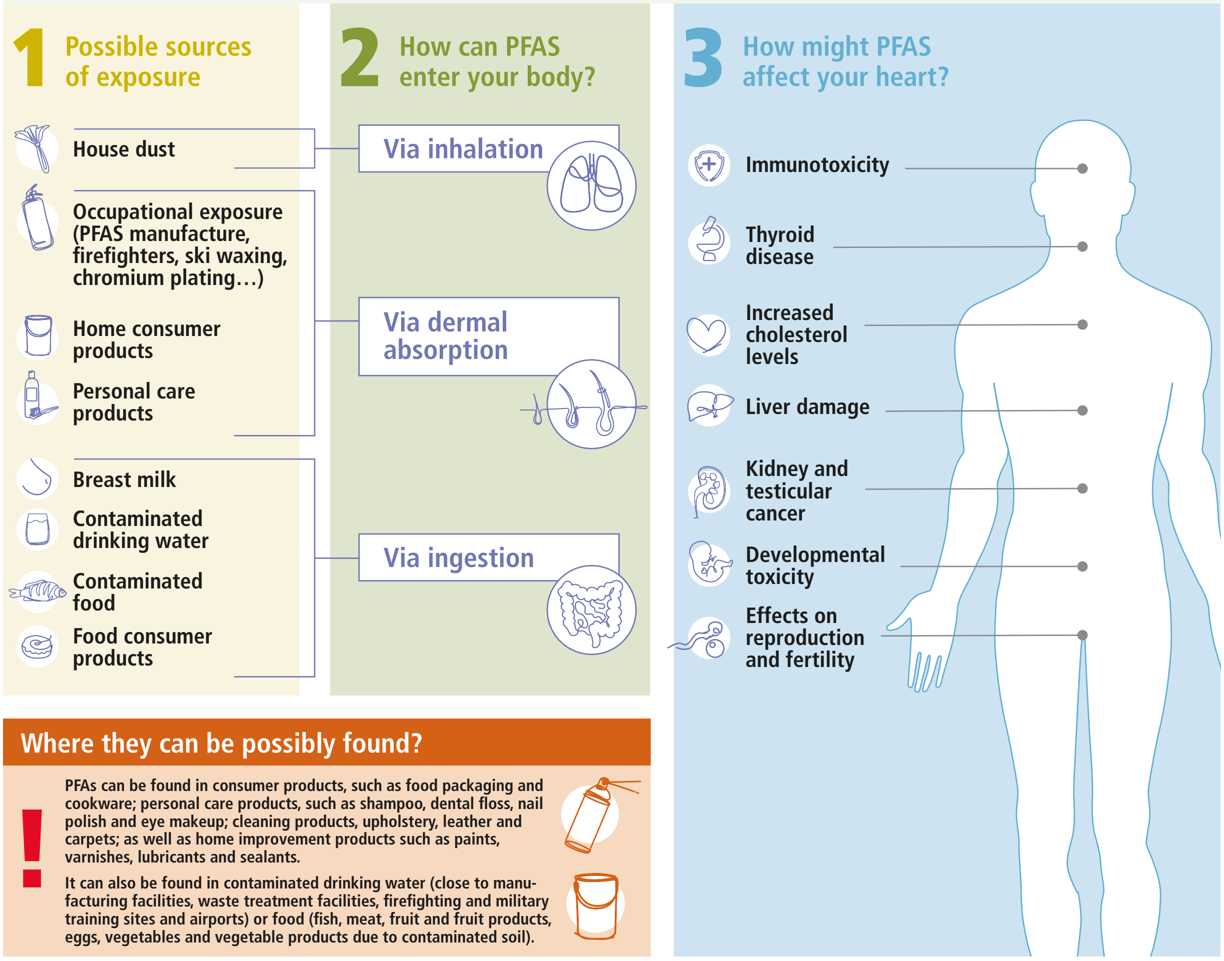
Per- and polyfluoroalkyl substances. PFAS (commonly known as 'forever chemicals') have attracted much attention on European and international stages in recent years. PFAS are part of a very large group of chemicals that are temperature and chemical resistant, are capable of imparting water and oil repellence and have surfactant properties. These chemical and physical properties have seen the widespread and ubiquitous use of PFAS in a range of consumer products and industrial processes over many years, such as in clothing, non-stick cookware, firefighting foams and food packaging.

10 ec.europa.eu/eurostat/statistics-explained/index.php?title=Chemicals_production_and_consumption_statistics (accessed 16 July 2024).

Many PFAS are toxic to humans and animals, with available epidemiological studies suggesting associations between PFAS and several health effects including cancer, immune system disruptions, increases in cholesterol, pregnancy complications and lower birth weights (ATSDR, 2021), with the risk of health effects dependent on many factors including exposure dose, frequency, route and duration, as well as individual and other factors. People may be exposed to PFAS through various routes (Figure 14.12). The European Food Safety Authority (EFSA) has recommended a maximum weekly intake of 4.4 ng/kg body weight[11] for a total of four selected PFAS, which is based on scientific opinion on the risks to human health arising from the presence of these substances in food. The EU Drinking Water Directive also sets limits for total amounts of PFAS allowed in water for human consumption.

PFAS were detected in the blood of all teenage study participants sampled under an EU human biomonitoring programme, with over 14% of samples exceeding the current EFSA guideline value.[12] While levels of two of the most prevalent and regulated PFAS, PFOA and PFOS, were found to be decreasing, levels of replacement PFAS were detected, highlighting the urgent need to avoid regrettable substitutions of hazardous chemicals such as PFAS.

Figure 14.12 Exposure sources, pathways and health effects associated with per- and polyfluoroalkyl substances



Source: HBM4EU, 2022

11 1 ng = 0.000000001 gram.

12 Study conducted under the European Human Biomonitoring for European Union project (HBM4EU).

The issue of PFAS is also one of national concern, with PFAS detected in the Irish environment, including in surface waters, groundwaters, transitional and coastal water bodies, sediments and certain biota. The EPA report *Water Quality in Ireland 2016–2021* indicated that 2.7% of surface waters failed to achieve good chemical status due to the presence of PFOS (EPA, 2022), a PFAS that has been restricted under the Stockholm Convention since 2009/2010. The EPA-funded FUEL project investigated the risks posed by PFAS in Irish landfills and highlighted a potential risk of PFAS contamination of groundwater sources from unlined or partially lined landfills, as well as waste water treatment facilities receiving landfill leachate (Harrad *et al*., 2020a).

Environmental monitoring performed at a number of sites at risk of PFAS contamination because of their close proximity to firefighting training facilities, large scale storage facilities and waste water treatment facilities, particularly those receiving landfill leachate, found elevated levels of PFAS in many instances (EPA, 2021a). A national human biomonitoring study examined the Irish population's exposure to PFAS through non-dietary sources, which was found to fall below the EFSA's tolerable weekly intake (Harrad *et al*., 2020b). Concentrations of PFAS found in Irish breastmilk did not indicate a health concern for nursing infants based on EFSA breastfeeding exposure scenarios. However, pharmacokinetic modelling of the level of adult exposure to PFAS that would result in the levels observed in breastmilk suggests that overall exposure of some individuals may approach or exceed EFSA's tolerable weekly intake, pointing to the need for an assessment of dietary exposure to PFAS in Ireland. This study highlights the power of human biomonitoring studies as valuable surveillance tools that can provide useful baseline data around population exposure to PFAS. Regular re-assessment should be performed nationally to facilitate ongoing monitoring and evaluation of the impact of measures taken to reduce human exposure to PFAS and other such chemicals. Many European countries have well-established human biomonitoring programmes in place as a tool for chemical risk assessment. While some human biomonitoring work has been undertaken in Ireland, consideration should be given to establishing a more formalised ongoing monitoring programme. An EPA-funded research project is currently conducting a feasibility study to determine the prospect of having an ongoing national human biomonitoring programme in Ireland.

While action is being taken at both EU and global levels to combat the harmful effects of PFAS, given the nature of the issue, progress is slow. The EU Chemicals Strategy for Sustainability (CSS) aims to phase out PFASs, allowing use only when they are essential for society. In 2024 the European Commission published guiding criteria and principles for the essential use concept in EU legislation dealing with chemicals to facilitate decision-making and increase regulatory efficiency to achieve the phasing out of harmful substances in non-essential uses (EC, 2024). While there are currently three groups of PFAS restricted under the Stockholm Convention, under the REACH Regulation[13] there are two proposed broad restrictions on the use of PFAS that point to a new way of tackling groups of chemicals rather than one at a time, that is, a generic risk assessment. The first proposal would see the use of PFAS in firefighting foams, the use of which has been a major source of pollution, particularly water contamination, prohibited completely. The other, more universal, proposed restriction on PFAS would strictly limit their use to applications where it is essential to society and where no alternative safer chemicals are available to fulfil the specific role. The European Chemicals Agency (ECHA) received 5600 comments from over 4400 organisations on the PFAS restriction proposal consultation in 2023. ECHA scientific committees will evaluate the proposed restrictions, along with comments from the consultation, throughout 2024.

A key task across Europe at present is to replace stockpiles of PFOA used in firefighting foams with safer alternatives and ensure that existing stockpiles of PFOA foams are managed in an environmentally sound manner. The EPA holds a register related to stockpiles of PFOA, a PFAS that was banned under the Stockholm Convention in 2019 but remains in a phase-out period (until July 2025) for certain uses. Those with stocks of PFOA must notify the EPA and provide details on the nature/use and storage conditions and confirmation of correct disposal. To date a total of approximately 498,000 kg of PFOA firefighting foam has been notified to the EPA via the online PFOA stockpile reporting system. Approximately 30% of this is reported as being still in use per the specific exemption. The remainder is reported as being in storage on site/awaiting disposal or as having been disposed of already. The EPA is working on checking and verification of this stockpile register. As part of this work, the EPA encourages various organisations and networks (e.g. industry trade associations, fire industry associations, local authority representatives) to raise awareness of the obligations and deadlines concerning stocks of PFOA.

13 The REACH Regulation ((EC) No. 1907/2006) is comprehensive legislation that aims to improve the protection of human health and the environment from the risks that can be posed by chemicals, while also enhancing the competitiveness of the EU chemicals industry. It also promotes alternative methods for the hazard assessment of substances to reduce the number of tests on animals. REACH has a very wide scope, as it applies to all chemical substances that are manufactured, imported, placed on the market or used within the EU, either on their own, in mixtures or in articles with intended release. Under the Chemicals Acts 2008 and 2010, the Health and Safety Authority is the lead competent and enforcement authority for REACH in Ireland.

European controls on chemicals. The EU has one of the most comprehensive chemical regulatory frameworks globally. The aim of chemical regulation at the EU level is to minimise the risks posed by the most harmful chemicals considered necessary, for example through reduction in human exposure and release to the environment, while striving to replace other harmful substances, thought to be non-essential.

EU Chemicals Strategy for Sustainability: Towards a Toxic-Free Environment. The European Green Deal is the overarching plan to transform the EU into a carbon-neutral and environmentally sustainable economy over the coming years. The Green Deal is supported by ambitious programmes such as the Zero Pollution Action Plan, the Circular Economy Action Plan and the Chemicals Strategy for Sustainability (CSS). Published in October 2020, the CSS supports the Green Deal initiative by aiming to better protect people and the environment from the harmful effects of chemicals. The strategy proposes actions needed to respond quickly and effectively to the challenges posed by harmful substances, with the aim that chemicals are produced and used in such a way that maximises their benefits to society while avoiding harm to humans and the environment. The strategy also seeks to boost innovation through the development and use of safer and more sustainable chemicals. In this regard, one of the key actions in the CSS, which has the potential to yield the greatest and longest-term effects is the 'safe and sustainable by design' approach. This approach emphasises the need for new chemicals and materials to be designed to be both safe and sustainable (for humans and the environment) not only at their design stage but also during their production and use and finally when they end up as waste.

As an action under the CSS, the EEA and ECHA have developed an indicator framework and online dashboard[14] that aim to monitor the drivers and impacts of chemical pollution and measure the effectiveness of chemicals legislation using a set of 25 quantitative indicators complemented by 22 signals providing additional insights (EEA, 2024). The first benchmarking assessment using the indicator framework has highlighted that the use of harmful chemicals is still growing but more slowly than the chemicals market overall. Moreover, the transition towards safer and more sustainable chemicals needs to be accelerated.

Market surveillance. Legislation covering restrictions and limits on certain hazardous substances in products (e.g. electrical equipment) is aimed at decreasing the general levels of hazardous chemicals in consumer products, thus reducing the risks posed by chemicals to consumers and the environment. This work also aims to improve recyclability, thereby supporting circular economy ambitions. Overall, market surveillance is important to maintain the proper functioning of the EU internal market by ensuring a high level of protection for consumers and their interests, including the environment. Market surveillance is carried out by public authorities to ensure that products on the market conform to applicable laws and regulations and to health and safety requirements.

14 www.eea.europa.eu/en/european-zero-pollution-dashboards/chemicals-strategy-for-sustainability (accessed 16 July 2024).

Other chemical contaminants. Other chemical contaminants of concern are as follows.

Pesticides. The widespread and excessive use of pesticides poses a considerable risk to soil health and water quality and is a significant contributor to biodiversity loss, particularly the reduction in insect populations that play a crucial role in ecosystems. Recent research on human exposure to pesticides across five European countries identified at least 46 pesticides and their metabolites in the urine of study participants, with at least two pesticides being detected in 84% of human samples analysed (Ottenbros *et al*., 2023). In Ireland, 17 water supplies failed to meet the EU pesticide standard in 2022, a decrease from the 31 and 33 supplies that failed in 2021 and 2020, respectively.

The herbicide MCPA (2-methyl-4-chlorophenoxyacetic acid), which is commonly used in Ireland to control rushes, continues to be the most common source of the exceedances. There were four supplies on the Remedial Action List for pesticides at the end of 2022, down from six in 2021. All supplies on the Remedial Action List have catchment focus groups in place.

Phthalates. These are chemicals used in products including plastics, food packaging, rubber tubing, and some cosmetics and personal care products. Some phthalates interfere with the hormone system, sometimes slowing the neurological development of children. Phthalates are regulated under REACH and EU food contact material legislation. People can be exposed to phthalates by using products containing them and by consuming contaminated food. EPA studies have found phthalates in waste plastic in effluent from waste water treatment plants and from leachate from landfills (Allen *et al*., 2021) as well as in rivers. Furthermore, some phthalates can build up in soils and end up in crops.

Microplastics. Growing levels of plastic production, use and disposal is exacerbating the already pervasive issue of plastic pollution seen in our environment. Many plastics do not biodegrade but instead break down over time, creating smaller fragments known as microplastics and nanoplastics (MNP). These small pieces of plastic are now found in the air we breathe and the food and drinking water we consume as well as in surrounding ecosystems. The health risks associated with exposure to MNP are beginning to be understood, with studies describing potential links with cardiovascular disease (Marfella *et al*., 2024) and inflammatory bowel disease (Yan *et al*., 2022). MNP are generally found in the environment as complex mixtures of chemicals: those that had been added during the manufacturing process and those adsorbed from the environment. Some of the common chemicals found in plastics such as phthalates, bisphenol A, flame retardants and POPs may leach out following ingestion (OECD, 2021). While concentrations of microplastic-associated chemicals may not currently represent a major exposure pathway relative to existing known exposure pathways, the known and suspected health effects (including endocrine disruption, carcinogenic and developmental toxicity and mutagenicity) warrant precautionary action. Under the EU REACH Regulation, the Commission has adopted measures to restrict intentionally added microplastics in many common products. Further proposals to reduce microplastic pollution are also in progress in as part of the Commission's ambitious target for the EU to reduce microplastic releases into the environment by 30% by 2030.

Hazardous waste. Appropriate hazardous waste management is fundamental to preventing human exposure to hazardous substances. Ireland generated 389,908 tonnes of hazardous waste in 2022. The management of these wastes is informed by the National Hazardous Waste Management Plan 2021–2027. The EPA has highlighted the need for a national take-back scheme for unused and expired human medicines (EPA, 2020f). The Department of Health is currently developing a policy paper to inform the development of such a scheme, with the establishment of a national scheme planned by 2025. A nationwide scheme for the collection and transfer of farm hazardous wastes, including unused veterinary products and pesticides, is also being progressed by the Department of Agriculture, Food and the Marine (EPA, 2024f). While progress is being made, these take-back schemes have been delayed and progress towards their delivery is needed. There is a considerable focus at the EU level on improving the collection infrastructure for householders, with Member States required to establish the separate collection of hazardous waste generated by households by 1 January 2025.

Landspreading. The application of organic agricultural wastes such as animal manure and slurry to agricultural land is a widespread practice in Ireland and elsewhere. Organic wastes from urban waste water treatment facilities, domestic septic tanks and industrial sources such as food processing and brewing provide materials that, due to their high nutrient and organic matter content, are used as a fertiliser or soil improver on agricultural land. The recycling of these materials to land can offer an economically favourable means of contributing to the circularity of the waste streams. Organic wastes can, however, contain a range of contaminants including pathogens, metals, chemicals such as pesticides and medicinal residues, and microplastics. Sewage sludge in particular acts as a sink for persistent contaminants emanating from waste water, with levels of these contaminants determined by the influent received by the treatment facility from the surrounding catchment (EEA, 2021b). The adoption of the EU Sewage Sludge Directive (86/278/EEC) almost 40 years ago came about due to concerns over environmental and human health impacts from the application of sewage sludge on land. However, the requirements of this directive no longer match current needs in the context of current and emerging chemicals and contaminants of concern (EC, 2023). There is potential for these contaminants to enter the food chain, affecting human and animal health and also soil health and water quality. With multiple applications over many years, a build-up of contaminants may occur as well as changes in soil microbial communities, the latter of which may contribute to the evolution of AMR in the environment, thereby posing a further risk. Effective management and treatment practices and robust regulation are therefore essential to minimise risks to animal and human health.

The Food Safety Authority of Ireland published a report in 2008 on the food safety implications of organic agricultural wastes spread on land used for food production in Ireland (FSAI, 2008). A re-examination of recommendations from this 2008 report was performed in 2023, with many remaining relevant and, importantly, still requiring action.

Some EU Member States have gone beyond the Sewage Sludge Directive requirements and introduced limits for organic pollutants not restricted by the directive (EEA, 2021b). Additional limits were also introduced in Ireland. Some Member States have also restricted the use of sewage sludge in agriculture, allowing its use instead in nutrient and energy recovery (EEA, 2021b). There is the potential for the volume of sewage sludge to increase significantly as a result of improvements in treatment and increases in the urban population (e.g. waste water sludge generated nationally will increase by more than 80% by 2040 as new and upgraded waste water treatment facilities are established). A national assessment of sewage sludge in the agricultural setting is needed to gather evidence to inform Ireland's management and tracking systems for these materials in the future.

4. Climate change and health

The climate crisis is a human health crisis. It represents the single greatest health threat facing humanity and is also a 'threat multiplier' compounding and exacerbating many significant environmental and health challenges. For example, climate change is fuelling an increase in the incidence and severity of many infectious diseases. A recent global systematic study examining the interactions of climatic hazards linked to human pathogenic diseases found that 58% of 375 diseases examined have been aggravated by climate change (Mora *et al*., 2022). In Ireland, flood hydrometeorology was shown to be associated with the incidence of gastroenteric infections caused by STEC/VTEC and *Cryptosporidium* spp. following the winter of 2015/2016, in which exceptional and widespread flooding was experienced (Boudou *et al*., 2021). Ireland's warmer winters now also have the potential to increase the numbers and activity of ticks and to extend their lifespan. Ticks are efficient vectors that host and can transmit an increasing number of pathogens to humans, including Lyme disease (Lambert, 2022). At a European level, the ECDC has reported a large increase in the geographical spread of a species of mosquito across previously unaffected areas (ECDC, 2023). The mosquito, which is a known vector for many diseases including dengue fever and yellow fever has now established itself in 13 EU and EEA countries compared with only eight countries 10 years ago.

Climate change, combined with other challenges, such as population growth, urbanisation and globalisation, is narrowing the interface between humans and the natural world, bringing zoonotic diseases physically closer to us. We now live in an increasingly interconnected world, with over half the world's population residing in urban areas and billions of us taking airline flights every year, making us increasingly vulnerable to the threat posed by infectious diseases (Baker *et al*., 2022). Continual degradation of our environment, coupled with climate change, increases the risk of emergence of disease from zoonotic reservoirs; the probability of us experiencing another extreme epidemic or pandemic similar to COVID-19 in our lifetime is currently estimated at 38%, which may double in years to come (Marani *et al*., 2021).

High water levels at St Vincent's Bridge, Cork City

At a national level, we need to place human health and wellbeing at the forefront of our climate preparedness and action. We need to prioritise and fast-track the implementation of ambitious climate adaptation and mitigation measures that can deliver health co-benefits, particularly to those vulnerable populations most affected by climate change. Modelling has indicated the potential health gains that can be accrued from health-focused mitigation actions tackling emissions while simultaneously taking action on air pollution, active travel and diets (Hamilton *et al*., 2021). There is a wealth of evidence on climate actions that can deliver health co-benefits. What is now required is a step change in the translation and implementation of practical actions at national and local levels to effect impactful and measurable change. COP28 (United Nations Climate Change Conference) in 2023 was the first to dedicate a day to focusing on health. We need to follow this global ambition and put health at the forefront of our national climate discussions and policies to safeguard current and future generations.

5. One Health approach

The ever-changing nature of our environment, as well as the many anthropogenic stressors placed on it, means that collaborative and cooperative action across the human–animal–environment nexus is needed to address the health challenges facing us. The One Health concept recognises that human, animal and environmental health are interlinked and interdependent, and it has become an important approach to global health. Collaboration between multiple disciplines and sectors is crucial to the success of the One Health approach.

Common One Health issues include zoonotic and vector-borne diseases, food safety, AMR and environmental pollution (e.g. air, water and chemical pollution). From a global standpoint, these areas already pose a considerable threat to health; however, a number of stressors are playing a substantial role in causing or exacerbating these issues. Land use change is causing habitat shrinkage or fragmentation, narrowing the interface between humans and the natural world, thereby increasing the likelihood of infectious agents jumping the species barrier – from wild animals to domestic animals and people. Biodiversity loss means that we are losing the essential buffer and critical dilution effect that can help shield us from harmful pathogens and disease transmission. In addition, climate change is changing the distribution of arthropod vectors of infectious diseases (such as mosquitos and ticks) and changing the frequency and the pattern of other food-borne and waterborne diseases. It has been estimated that there may be up to 700,000 viruses in mammals and birds that could be transmitted to humans (UNEP, 2021b).

The environment is a critical component of the One Health paradigm and functions as both a key reservoir of and a pathway for the transmission of harmful agents that can impact the health of humans and animals (Figure 14.13).

There is emerging international evidence for the economic benefit of using a One Health approach. The World Bank (World Bank, 2022) estimated the global cost of prevention using a One Health approach[15] to be US$10.3–11.5 billion per year, compared with the global cost for preparedness (monitoring and detecting disease spill-over) of US$30.1 billion per year. While the environment is a core part of the One Health triad, environmental considerations are often poorly represented, if not completely overlooked, which runs counter to the principles of a true One Health approach. The role of the environment, not only as a reservoir and pathway of harmful agents but also as a key determinant of human health and wellbeing, is evident when we look at the negative impacts of an unhealthy environment on people.

The quadripartite organisations – the Food and Agriculture Organization of the United Nations, the United Nations Environment Programme, the World Organisation for Animal Health and the WHO – launched a One Health Joint Plan of Action (2022–2026) as a framework for action to advance and sustainably scale up One Health. One of the six key interdependent actions included is ‘integrating the environment into One Health’. The quadripartite group has also launched a guide that provides practical guidance for countries on how to adopt and adapt the One Health Joint Plan of Action at a national level. There is also an ambition as part of the Eighth Environment Action Programme that there is to be full integration of One Health approaches across all levels of policymaking (Decision (EU) 2022/591).

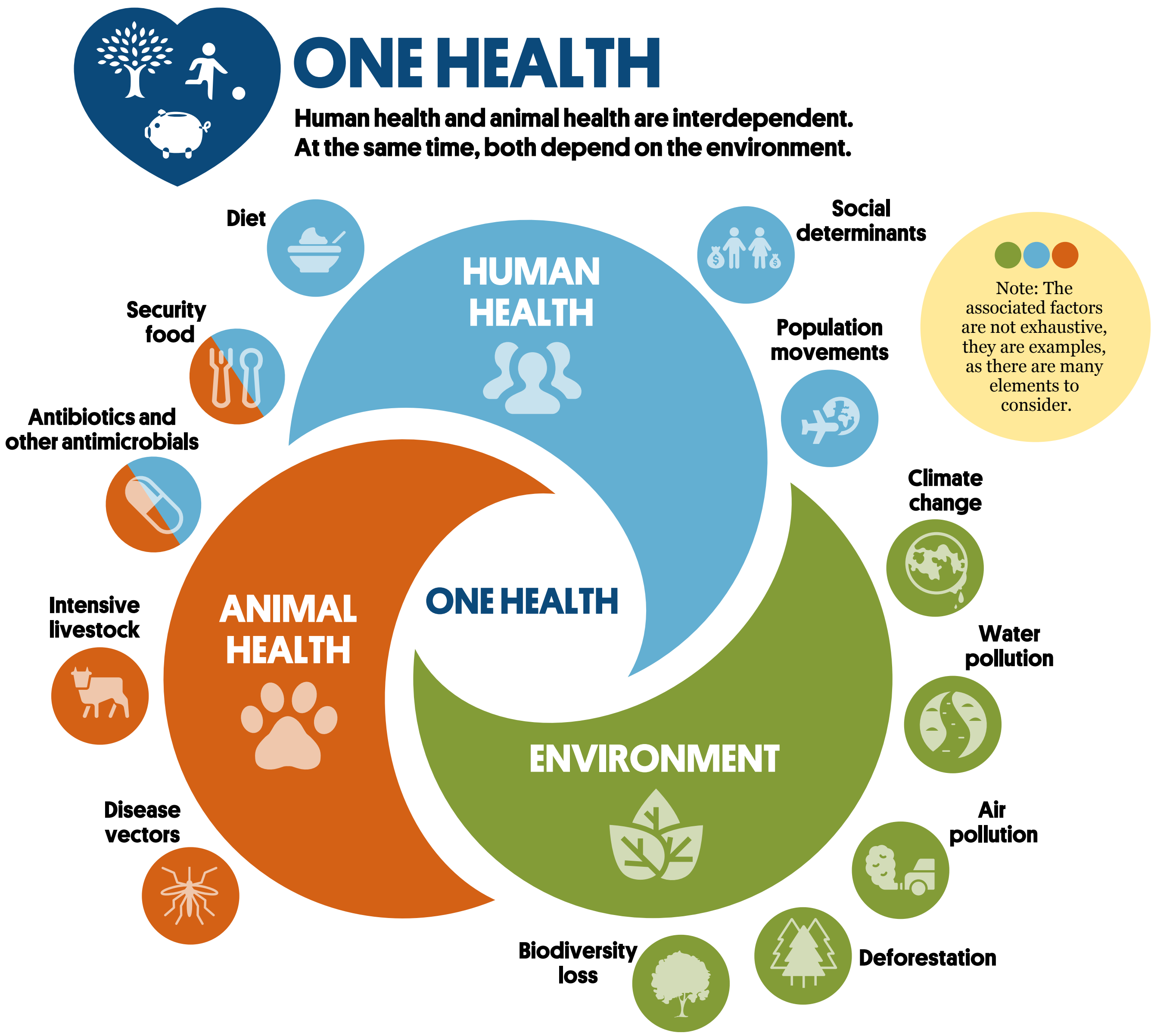
At the European level, five EU agencies – ECDC, ECHA, EEA, EFSA and the European Medicines Agency – have expressed their joint commitment to fully support the One Health agenda in Europe and have established a cross-agency task force to build stronger transdisciplinary cooperation among them.[16] In a joint statement issued in 2023 (EEA, 2023f), the five EU agencies outline that a One Health approach is necessary to address the multiple challenges faced by the EU across areas of human, animal and plant health, food safety, environmental sustainability and the climate crisis. They also outlined a commitment to ensure that relevant scientific advice from EU agencies is increasingly integrated and aligned with the One Health approach.

Ireland is also developing a more unified and holistic national approach to One Health with the recent establishment of a cross-government One Health Oversight Committee. It will be crucial that the work and activities of this committee ensure strong alignment with, and inclusion of, environmental considerations and actions, particularly in the context of our changing climate.

15 Prevention measures address drivers of emerging disease such as by improving farm biosecurity, strengthening animal health veterinary services, reducing deforestation and forest degradation, improving conservation and improving urban planning.

16 www.eea.europa.eu/en/topics/at-a-glance/health/cross-agency-knowledge-for-one-health-action-statement (accessed 16 July 2024).

Figure 14.13 Contributors to and dynamics within the One Health paradigm



Source: Adapted from ISGlobal, 2021

6. Conclusions

Our environment plays a crucial role as a determinant of our health. A good-quality environment providing clean air, clean water and productive soils will provide positive benefits for human and animal health. Conversely, a poor environment will negatively impact human and animal health. Reducing pollution, adapting to and mitigating climate impacts, and restoring ecosystems can have enormous benefits for our health and wellbeing. Healthier populations are also more resilient to climate impacts such as heatwaves.

The impact of environmental hazards and exposure is not equal across society, with vulnerable population groups, such as young and elderly people and those in disadvantaged communities, often being affected to a much greater extent than others. Efforts to assess and understand inequalities in exposure and in impact at a finer geographical scale in Ireland should be prioritised to allow us to assess how the inequality gap is changing over time.

Improving environmental quality can create healthier places for all members of society, regardless of age, socio-economic status and region. Health-centred spatial planning is also vital to enhance environmental quality and create connected and accessible spaces for people across all life stages. Healthy urban places can enable citizens to make more sustainable choices, live healthier lives and reduce hazardous environmental exposures they may be subject to.

While applied research and the continued collection and analysis of data are required to gain new knowledge and evidence, we already have enough knowledge and evidence in certain domains to allow us to take action against some of the most preventable environmental risks. We must prioritise and tackle those environmental hazards that we know are detrimentally affecting our health. For example, to better safeguard the public from exposure to the carcinogenic radioactive gas radon, which is causing approximately 350 new cases of lung cancer each year, we must shift our focus towards primary prevention measures in all new buildings in all parts of the country, irrespective of their radon risk designation. We are also acutely aware of the direct impacts of poor air quality on morbidity and mortality. We must plan for and take more immediate action in the short to medium term to accelerate achieving the WHO guideline limits included in the Clean Air Strategy. Further targeted policy measures will be required to ensure that improvements in air quality benefit those who are most exposed and/or most vulnerable to its effects. Similarly, a national noise policy statement and noise planning guidance are needed now more than ever to tackle the human health impacts of noise pollution. We have been aware of issues related to water quality for many years, particularly with regard to private drinking water supplies, which consistently underperform in quality compared with public supplies. Similarly, failure to fix faulty septic tanks is causing unnecessary risks to human health and the environment. Our changing climate will further compound already significant risks to human health, including those posed by infectious diseases. The persistence of many of these well-recognised issues and lack of meaningful progress on many indicates that our current approach to tackling these issues is not having the desired effect and points to a need to re-examine and step up our approach to many.

The right choice for society needs to be the easy choice. However, what might work for one sector of society may not work for another, meaning that we need to expand and tailor a suite of supportive interventions in policy areas, paying particular attention to those more vulnerable members of society for whom environmental inequalities are most evident. Enhancing the coherence between policies on population health, climate change and environmental quality, and recognising that multiple policy areas, from welfare to urban design, can help to reduce vulnerability and exposure to environmental health hazards, will be key. The Healthy Ireland Outcomes Framework, along with the WBF for Ireland, provide important national information by which progress in reducing inequalities in environmental exposure can be monitored. This work could be strengthened further by recognising the health implications of relevant environmental policies and implementing monitoring and evaluation of associated health outcomes and impacts on an ongoing basis.

Practices and choices in society are often driven by emerging areas of policy. It is essential that policy across all domains carefully considers measures in the context of our environment, our health and wellbeing, and health equity to ensure that there are synergistic outcomes and to avoid unintended consequences. For example, national retrofitting targets hope to bring us closer to becoming a sustainable, low-carbon and energy-efficient economy and society by retrofitting a substantial portion of our current building stock by 2030. In aiming to make our housing stock warmer and more comfortable while reducing energy demand and emissions, we must also ensure that ventilation is carefully considered to avoid any increase in concentrations of indoor pollutants and hazards, particularly radon gas.

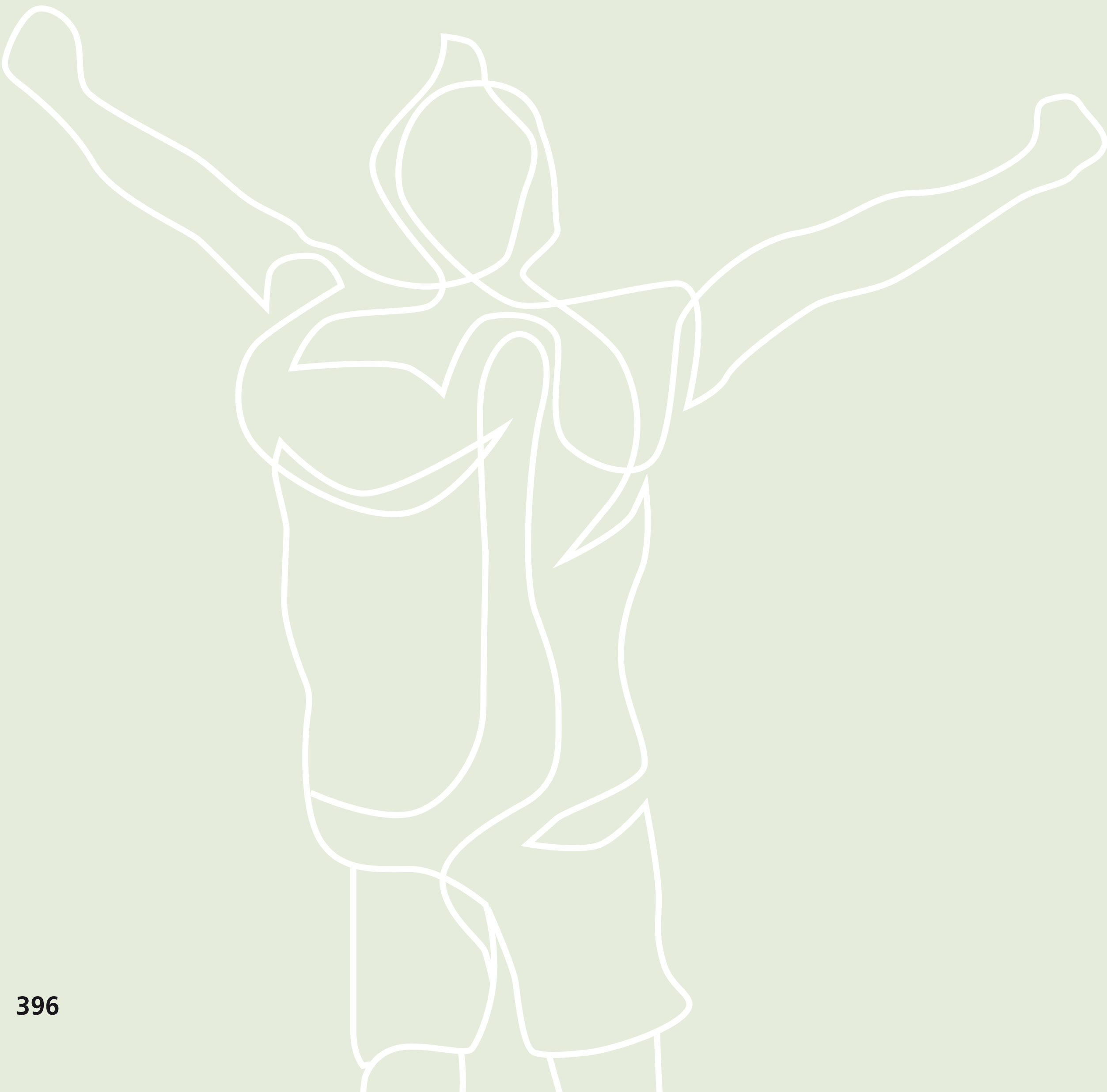
As recognised at the beginning of the chapter, primary prevention is key if we want to see a reduction in the levels of disease and early death from harmful environmental exposures in our population. We know the issues and we know that they are modifiable, so it is now time to tackle them in a meaningful way to effect change. Addressing these risks means that people can be healthier and live longer. Creating healthy places free from environmental hazards is key to creating a healthier and fairer society in which everyone can thrive.

Key chapter messages

1. Our health and wellbeing is inextricably linked to our surrounding environment. The health benefits of a vibrant natural world are countless, providing us with breathable air, drinkable water, productive soils and spaces for us to spend time in and enjoy, enhancing both our physical and mental health and wellbeing. Reducing pollution, adapting to and mitigating climate impacts, and restoring ecosystems can have enormous benefits for our health and wellbeing. Solutions that can help tackle one issue can have multiple co-benefits for others. Implementation of solutions that can maximise benefits across multiple domains should be prioritised.

2. The harmful environmental exposures causing disease and early death are modifiable. People are healthier and live longer when we address issues such as air and water pollution, radon exposure, chemical exposure and greenhouse gas emissions.

3. The impacts of environmental hazards and exposures are not equal across society. More efforts are required to assess inequalities in both levels of exposure and impact at a finer geographical scale to determine whether measures implemented are helping to bridge the gap.



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Chapter 15:
Circular Economy and Waste

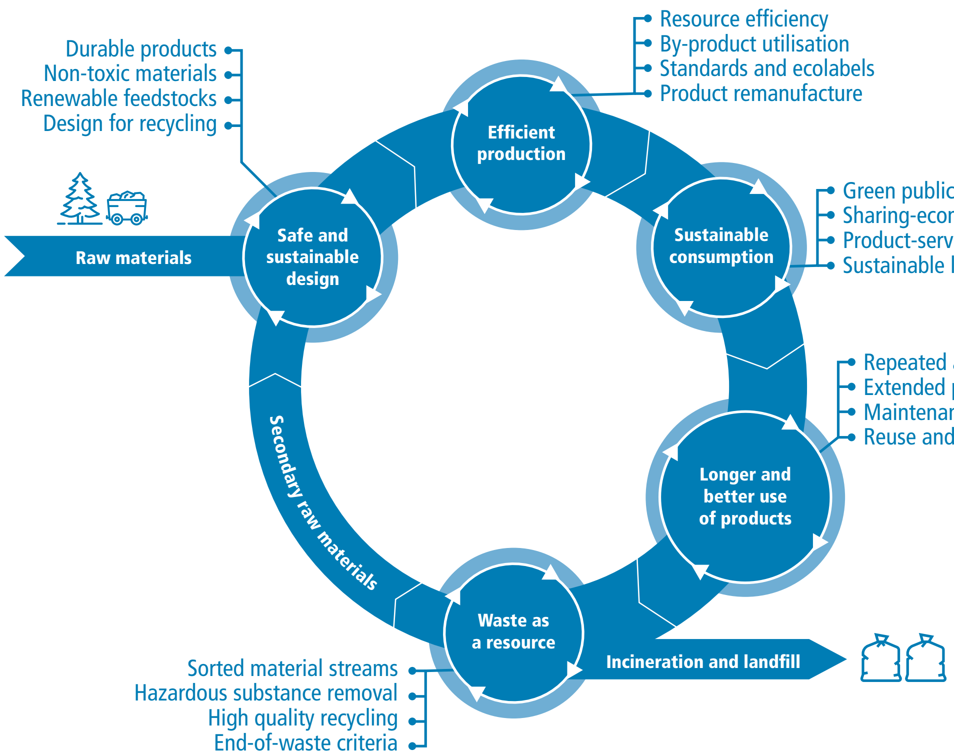
Circular Economy and Waste

1. Introduction

The circular economy is a 'model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible' (European Parliament, 2023). In striving to use existing resources, materials and products to their fullest extent, the circular economy model is less environmentally damaging than the traditional linear economic model and also promotes growth and prosperity. The traditional linear economic model, and its take–make–consume–throw away pattern cannot be sustained. Through its continued reliance on extracting natural resources and generating significant volumes of waste, the linear model endangers our climate, biodiversity, water resources and human health. The challenge for Ireland is to move to a circular economy as quickly as possible and in doing so meet key European Union (EU) waste targets.

EU circular economy strategies recognise the need to accelerate the transition from a linear economic model. In March 2020, the European Commission adopted the second Circular Economy Action Plan (EC, 2020). This plan is one of the main building blocks of the European Green Deal (EC, 2021) aiming to transform the EU into a resource-efficient economy with no net emissions of greenhouse gases by 2050. Figure 15.1 depicts the vision for Ireland's circular economy model.

Figure 15.1 Ireland's circular economy model



Source: EPA, 2023b (adapted from EEA[1])

1 www.eea.europa.eu/publications/accelerating-the-circular-economy (accessed 9 July 2024).

2. Circular economy and waste drivers

Legislative and policy drivers

In Ireland, circular economy policy has been slowly developing from waste management policy. The government's Waste Action Plan for a Circular Economy 2020–2025 (DECC, 2020), set out policies to ensure that Ireland meets statutory targets on waste recycling and recovery while also developing its circular economy. The Whole of Government Circular Economy Strategy 2022–2023: Living More, Using Less (DECC, 2021a), Ireland's first national circular economy strategy aims to address the absence of a joined-up national policy framework and the lack of awareness and understanding of circularity among households, businesses and policymakers.

Source: DECC, 2021a

The legislative framework for a circular economy was strengthened with the introduction of the Circular Economy and Miscellaneous Provisions Act (No. 26 of 2022; the Circular Economy Act). The Act provides the legal basis for national circular economy roadmaps, strategies, programmes and targets.

Government policy also committed to reconfiguring the National Waste Prevention Programme, led by the Environmental Protection Agency (EPA), which had been operating since 2004. In 2021, that programme was incorporated into the 2021–2027 Circular Economy Programme, also led by the EPA (EPA, 2021a). This programme is a statutory requirement under the Circular Economy Act and, together with local government's National Waste Management Plan for a Circular Economy,[2] is a key driver of Ireland's move to a circular economy.

Economic growth

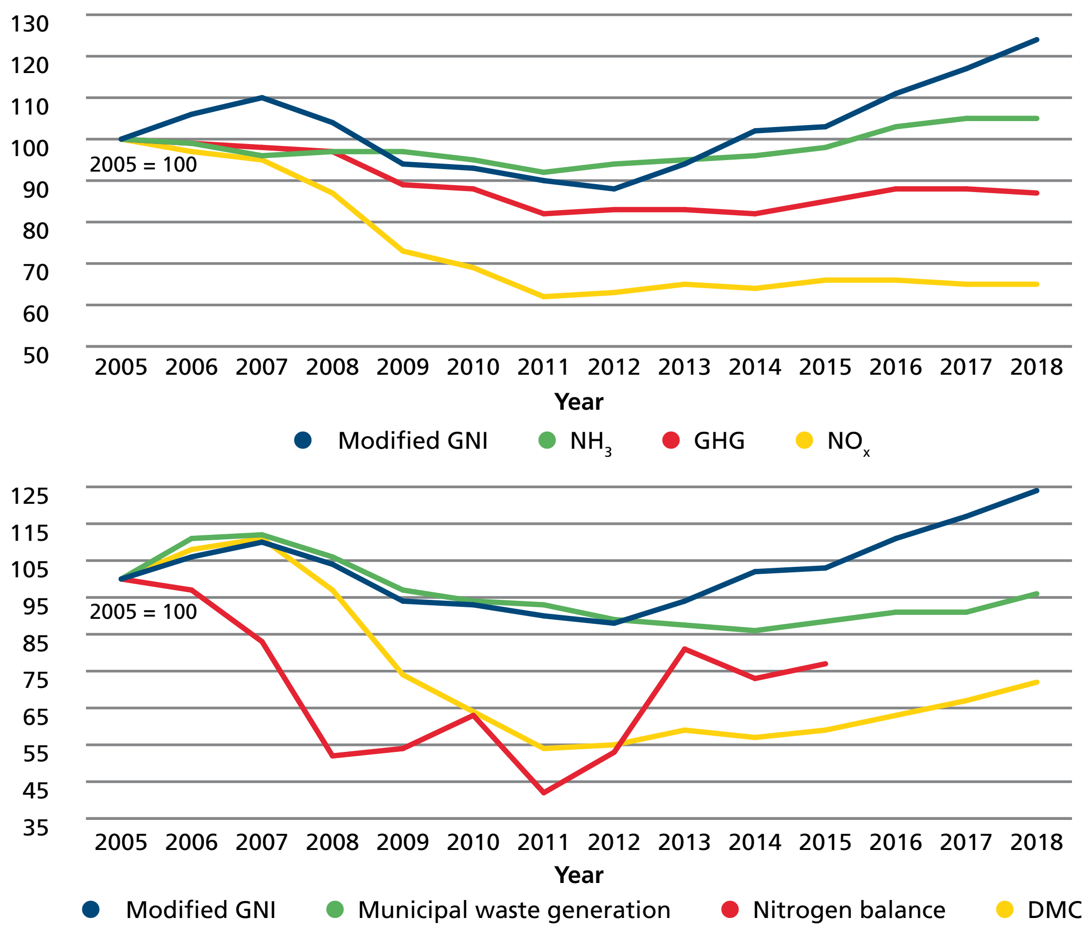
Ireland's National Planning Framework (DHPLG, 2018) and National Development Plan 2021–2030 (DPER, 2021) set out long-term planning and public investment (€165 billion) for the country. The National Development Plan identifies a circular economy's role in creating resilient supply chains. It reiterates Ireland's commitment to strategic investment in the circular economy by reconfiguring the Environment Fund as the Circular Economy Fund and by ensuring that funding is ring-fenced to support projects and initiatives focused on the environment and a circular economy. The plan commits to supporting investment under the government's Circular Economy Strategy (DECC, 2021a).

Current capital expenditure supports the transition to a circular economy, although these financial commitments are predicated upon continued expansion in the Irish economy. The circular economy model goes some way towards reframing older economic models of prosperity, which focused largely on measures of gross domestic product and consumption, to consider climate, environmental and social outcomes. Ireland's unemployment rate remains one of the lowest in Europe despite the cost-of-living crisis, which has significantly impacted many households. The Organisation for Economic Co-operation and Development (OECD, 2023) reported that household consumption remained resilient in 2023 due to increases in wages and employment rates and excess pandemic savings. This is reflected in the continued growth in household disposable income.[3] The OECD's review of Ireland's environmental performance (OECD, 2021) makes clear that decoupling across planetary boundaries, the limits within which humanity can continue to develop and thrive, is a core priority for Ireland (Figure 15.2). The report notes that 'Significant underinvestment in the wake of the recession affected the quality of infrastructure and slowed down environmental progress. Environmental pressures rose with the fast economic growth 2014–2019.' When considering the actions needed to address the imbalance, the report states that 'a circular economy approach will help increase resilience of supply chains and self-sufficiency.'

2 www.mywaste.ie/national-waste-management-plan/ (accessed 24 June 2024).

3 www.cso.ie/en/interactivezone/statisticsexplained/nationalaccountsexplained/householdgrossdisposableincome (accessed 24 June 2024).

Figure 15.2 OECD review of Ireland's environmental performance, 2021



Note: Modified GNI: Gross national income in constant prices, excluding highly mobile economic activities that affect the measurement of the Irish economy. GHG: greenhouse gas emissions, without land use, land use change and forestry. Nitrogen balance: calculated as the difference between the nutrient inputs and the nutrient outputs. NO_x: Nitrogen oxides. DMC: domestic material consumption, the sum of domestic extraction of raw materials used by an economy and their physical trade balance.

Source: OECD, 2021. © OECD

Waste generation in Ireland continues to follow our economic patterns as we continue to fail to break the link between, or decouple, waste generation and economic growth. The European Environment Agency (EEA) states that the only true way to decouple waste generation is through waste prevention (EEA, 2021). The EEA proposes new indicators to improve the effectiveness of monitoring waste prevention across Europe (EEA, 2023). These include a refocus on more quantitative measures to track and monitor waste prevention.

Population growth

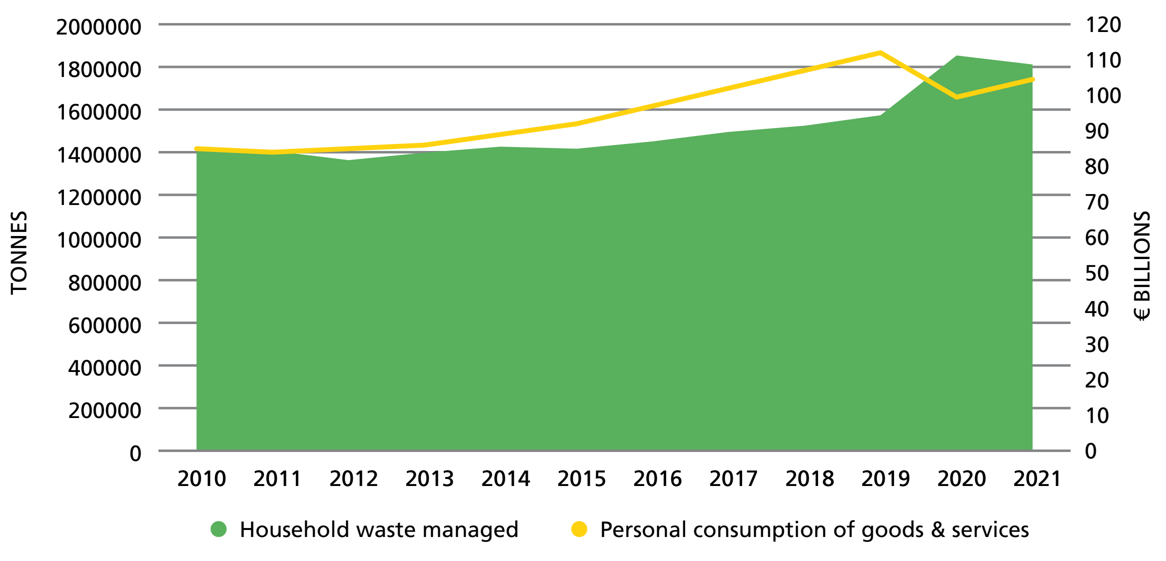
Waste generation in Ireland is linked to population growth through material consumption (Topic Box 15.1). Population growth is one of the main drivers of waste generation (EPA, 2022). Ireland's population increased by 8% between 2016 and 2022. For the first time in 171 years, Ireland's population exceeded 5 million, with 5,149,139 people usually resident in Ireland in 2022. Ireland's population is forecast to rise substantially, to 6.7 million, by 2051 (CSO, 2021).[4]

4 www.cso.ie/en/releasesandpublications/ep/p-plfp/populationandlabourforceprojections2017-2051/populationprojectionsresults/ (accessed 24 June 2024).

Topic Box 15.1 Focus on household waste

In 2021, 1.81 million tonnes of household waste were managed in Ireland. This equates to 361 kg/person, up from 314 kg/person in 2018. There has been an overall increase in the amount of household waste managed per capita in Ireland since 2010 (EPA, 2022), with a pronounced increase in 2020 due to the COVID-19 pandemic (Figure 15.3). The challenge for Ireland is to reverse this trend and reduce waste growth per capita.

Figure 15.3 Household waste managed and consumption of goods and services, 2010–2021



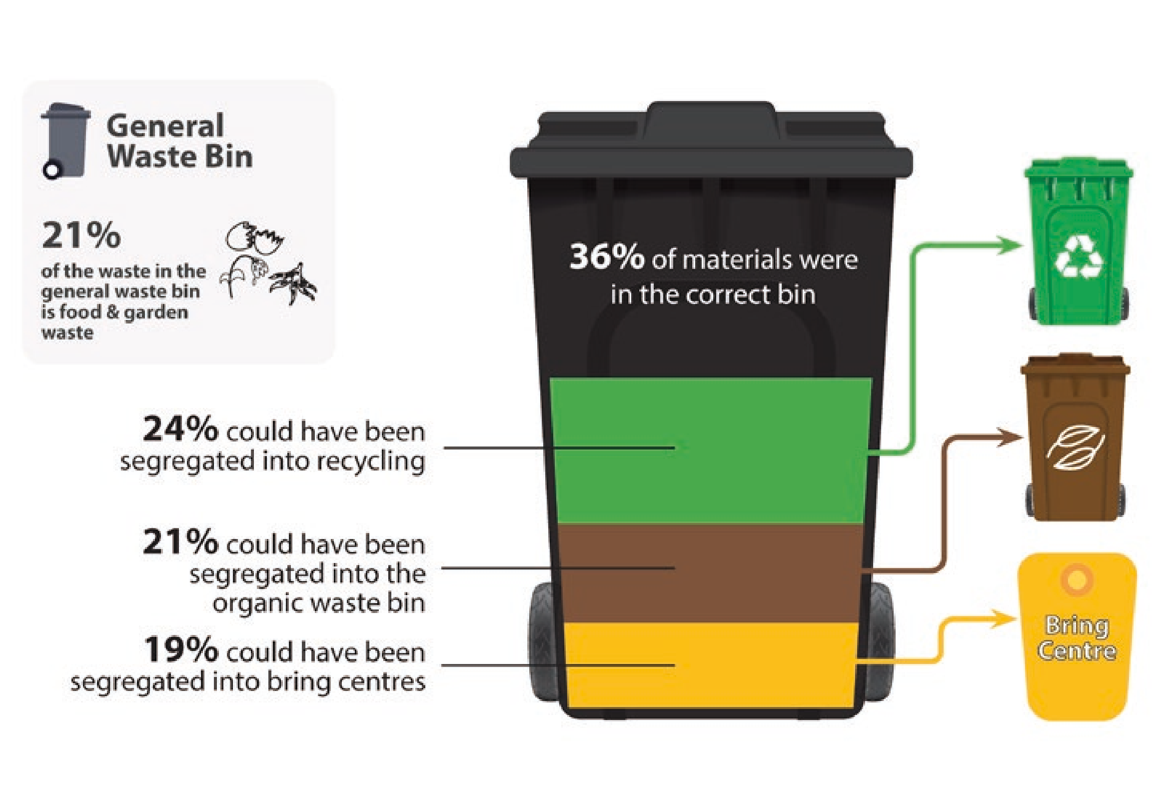
Source: Adapted from EPA, 2023b

The overall growth in household waste is concerning and is strongly related to high levels of consumption. Waste produced by households needs proper management, defined by good separation of materials to support and increase recycling rates. There is an opportunity for consistent segregation practices to ensure that recyclables and food waste are separated from residual waste. Waste characterisation surveys[5] have found that only 36% of the materials found in black bins should have been placed there (Figure 15.4). The other 64% should have been separated and collected through the organic bin, dry recyclables bin or bring bank system.

5 www.epa.ie/our-services/monitoring--assessment/waste/national-waste-statistics/waste-characterisation/ (accessed 24 June 2024).

Topic Box 15.1 Focus on household waste (continued)

Figure 15.4 Summary of the percentage of different waste materials found in household general waste bins



Source: EPA, 2023a

Production models and consumer behaviour

The Eighth Environmental Action Programme (Decision (EU) 2022/591) calls for a significant reduction in the EU's consumption footprint to bring European consumption-related impacts within planetary boundaries. This will require substantially transforming production and consumption systems.

Reporting on environment and climate pressures from household consumption in Europe, the EEA[6] stated that: 'unprecedented sustainability challenges from accumulating environmental and climate pressures and impacts – to a large extent caused by unsustainable consumption – require a fundamental shift in our production and consumption systems in Europe and beyond'.

6 www.eea.europa.eu/publications/environment-and-climate-pressures-from/environment-and-climate-pressures-from (accessed 24 June 2024).

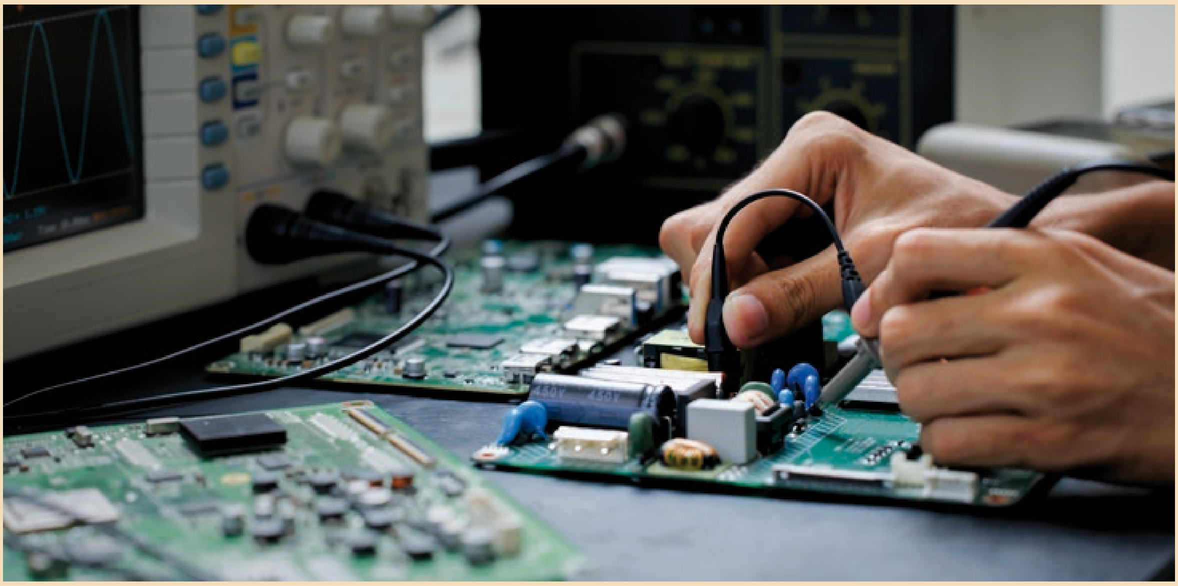
The economic value of household expenditure in Ireland increased by 50% between 2014 and 2022 (from €80.6 billion to €120.9 billion). Consumption had dropped by 10% between 2019 and 2020, mainly because of the COVID-19 pandemic-related downturn. The three areas of household consumption responsible for the greatest household expenditure in Ireland in 2022 were: food (28.7%), housing (28%) and services (21.3%).[7]

The Waste Action Plan for a Circular Economy 2020–2025 (DECC, 2020) clearly states that waste policy can no longer be limited to considering how to treat the waste we produce, an approach that is implicitly based on a linear, or take–make–consume–throw away model that cannot be sustained. Our policy focus must be broader and look at how people consume materials and resources and how the products that households and businesses use can be better designed (Topic Box 15.2) to prevent waste generation and resource consumption and extend the productive life of all goods and products in our society and economy.

Topic Box 15.2 Regulating for circular design of future products

The OECD report *The Circular Economy in Ireland* (OECD, 2022) states that 'circular waste management starts with ensuring that products are built to last by promoting or mandating ecodesign across the entire product life cycle.'

The current legislation related to ecodesign in Ireland is the EU Ecodesign Directive on energy-related products (2009/125/EC). The European Commission's Ecodesign for Sustainable Products Regulation[8] (2024/1781/EC) came into force in July 2024. This Regulation will allow the EU to set design requirements for a wide range of products to be sold in the EU with the aim of extending the lifetime of products, making them more resource-efficient, and making them easier to repair and recycle. A digital product passport will be introduced for all products regulated. The Regulation also bans the destruction of unsold textiles and footwear by large and medium enterprises, which will help reduce waste. The European Commission is also progressing legislation[9] supporting the right to repair for consumers, which will make it easier and more cost-effective to repair goods. These proposals are part of the Commission's sustainable products initiative, which aims to improve the design and repairability of products to extend their useful life.



7 ec.europa.eu/eurostat/databrowser/view/NAMA_10_CO3_P3/default/table?lang=en (accessed 24 June 2024).

8 commission.europa.eu/energy-climate-change-environment/standards-tools-and-labels/products-labelling-rules-and-requirements/sustainable-products/ecodesign-sustainable-products-regulation_en (accessed 25 July 2024).

9 Directive (EU) 2019/771 on common rules to promote the repair of goods for consumers.

Transition to a circular economy and its associated behavioural change will require action from all sectors of society. Positive practices and behaviours will need to be promoted while "bad habits" – built up over many years – will need to be discouraged or prohibited. (DECC, 2020)

It is clear that engaging the public and businesses to take action to support the implementation of a circular economy in Ireland requires insights and evidence to understand behaviours, knowledge and attitudes. Behavioural insights studies can inform evidence-based communication campaigns about waste and the circular economy and can inform policy. Figure 15.5 sets out a sample of the EPA's work seeking insights into consumer waste management behaviour.

Figure 15.5 Findings of EPA-commissioned consumer surveys on circular economy behaviour

Plastics[a]

There is a high level of confidence in knowing what plastic waste goes into each bin; however, when tested, there was some confusion among consumers about how to correctly segregate certain plastic wastes

Food waste[b]

Lack of planning is one of the key generators of home food waste – this finding informed subsequent Stop Food Waste communications campaigns

Textiles[c]

Only 31% of people see a clear link between the consumption of textiles and climate; 27% of people surveyed buy clothes they never wear. This proportion is higher for high-frequency purchasers with 46% of them buying clothes they never wear

Repair[d]

Percentages of the population who have bought or received:

- at least one second-hand item of clothing in the last 12 months – 38%
- electronic equipment – 16%
- furniture – 23%
- second-hand construction materials – 2%

Sources:

a www.epa.ie/publications/circular-economy/resources/plastics-attitudes-and-behaviours-in-ireland-2019---2021 (accessed 24 June 2024).

b www.epa.ie/publications/circular-economy/resources/food-waste-attitudes-and-behaviours-in-ireland-2021 (accessed 24 June 2024).

c www.epa.ie/our-services/monitoring--assessment/circular-economy/textiles-national-attitudes--behaviours-surveys/textiles-national-attitudes--behaviours-survey-2021/#d.en.102826 (accessed 28 June 2024).

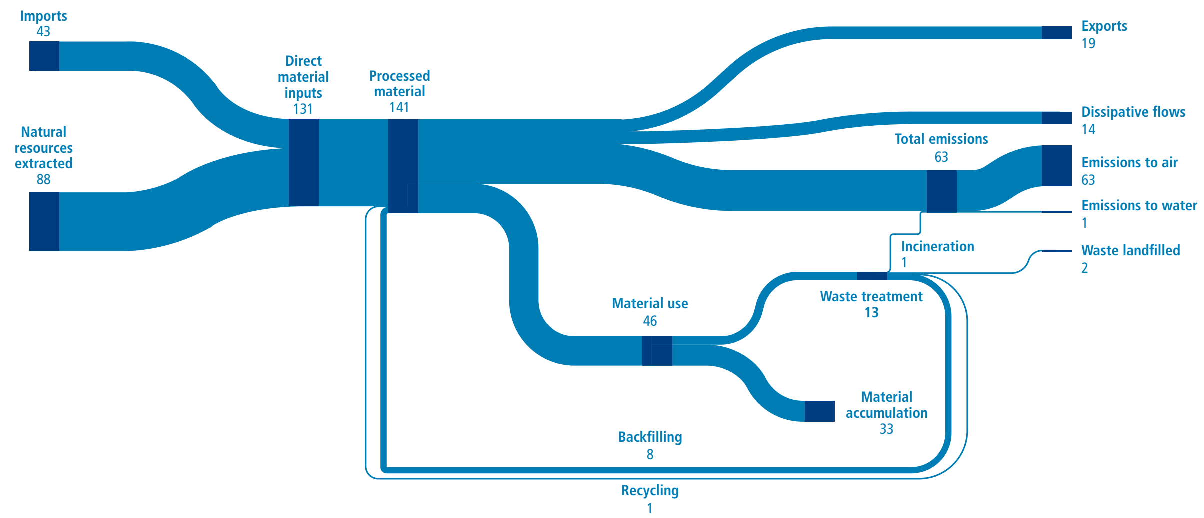
d www.epa.ie/publications/circular-economy/resources/EPA-Repair-National-Survey-2022-The-Repair-Economy.pdf (accessed 24 June 2024).

3. Current situation

Material consumption

Analysis of how materials flow[10] through the economy can help to identify waste and environmental emissions that would otherwise go unnoticed in conventional economic monitoring systems. It can also allow the exploration of solutions. As shown in Figure 15.6, Ireland's open economy consumed over 140 million tonnes of goods and primary raw materials in 2022: 31% from abroad and 69% extracted in Ireland. Of the inputs to the Irish economy in 2022 (141 million tonnes), only 28% (39 million tonnes) of materials was accumulated, 14% (19 million tonnes) was exported and 1% (1 million tonnes) was recycled.

Figure 15.6 The flow of material inputs to and outputs from the Irish economy, 2022 (million tonnes)



Source: Eurostat[11]

The circular material use rate, or circularity rate, is a measure of material reused, recycled and recovered and fed back into the economy. In 2022, Ireland's material circularity rate was 1.8%, while the average circularity rate in the EU was 11.5%. We are currently out of step with other Member States.

A recent EPA research report recommends interventions such as improving the domestic recycling of construction and mineral wastes while reducing the primary consumption of these materials (McCarthy *et al.*, 2024) to improve our circularity rate. The data suggest that there is significant scope to improve Ireland's material circularity rate, which is low by European standards, by reducing the extraction of natural resources and encouraging greater material efficiency and use of secondary materials. A higher circularity rate would mean that more secondary materials would be in use and would replace primary raw materials, thus reducing the environmental impacts of extracting raw materials.

10 The CSO, in compliance with Regulation (EU) No. 691/2011 on European environmental economic accounts, compiles this data for Eurostat. It is presented in Figure 15.6.

11 Click here to see the full EUROSTAT data timeseries and for more information on the material sources, flows and stages: ec.europa.eu/eurostat/cache/sankey/circular_economy/sankey.html?geos=EU27&year=2022&unit=MIO_T&materials=TOTAL&highlight=&nodeDisagg=0101100100&flowDisagg=false&language=EN&material=TOTALflow diagrams (europa.eu) (accessed 29 June 2024).

Waste generation and management

Waste generation is a subset of the flow of materials through the economy (Figure 15.6). In 2021, waste generated by Ireland's linear economy increased[12] to 17.6 million[13] tonnes (3.38 tonnes per person), up from 12.7 million tonnes (2.77 tonnes per person) in 2012 (Figure 15.7).

Increasing consumption and the current economic model of production using natural resources rather than secondary materials are leading to a growing waste generation problem (Figure 15.8).

Figure 15.7 Circular economy and waste data highlights, 2021

17.6 million tonnes of waste was generated in Ireland in 2021. This equates to 3.5 tonnes per person per year or 9.6 kg of waste per person per day. Key waste streams include municipal (including household), packaging and construction.

1.2 million tonnes or **38%** of all Municipal waste was exported for treatment in 2021.

This includes **800,000 tonnes** of municipal waste exported for recycling and **382,000 tonnes exported** for energy recovery through incineration.

69% of all Packaging waste recycled was sent abroad for recycling.

9 million tonnes of **Construction and Demolition** waste was generated in 2021. An increase of **10%** since 2020.

Packaging waste generation increased by **9%** to **1.2 million tonnes** in 2021. The recycling rate for Packaging waste **decreased** from 62% in 2020 to **58%** in 2021.

3.17 million tonnes of **Municipal Waste** was generated in 2021, this is relatively unchanged from 3.2 million tonnes in 2020. **41%** of Municipal waste was recycled in 2021, the same level as in 2020.

A total of **1.84 million tonnes** of **household waste** was generated in Ireland in 2021.This equates to just over one tonne, or 200 black bags worth of waste generated per household per year.

A record **72,000 tonnes** of Waste Electrical and Electronic Equipment **(WEEE)** were collected in 2021. This was an increase of 10% overall with Business to Business (B2B) Collection up **43%**.

In 2021, the collection rate of End-of-Life Vehicles (ELVs) increased by **22.5%**.

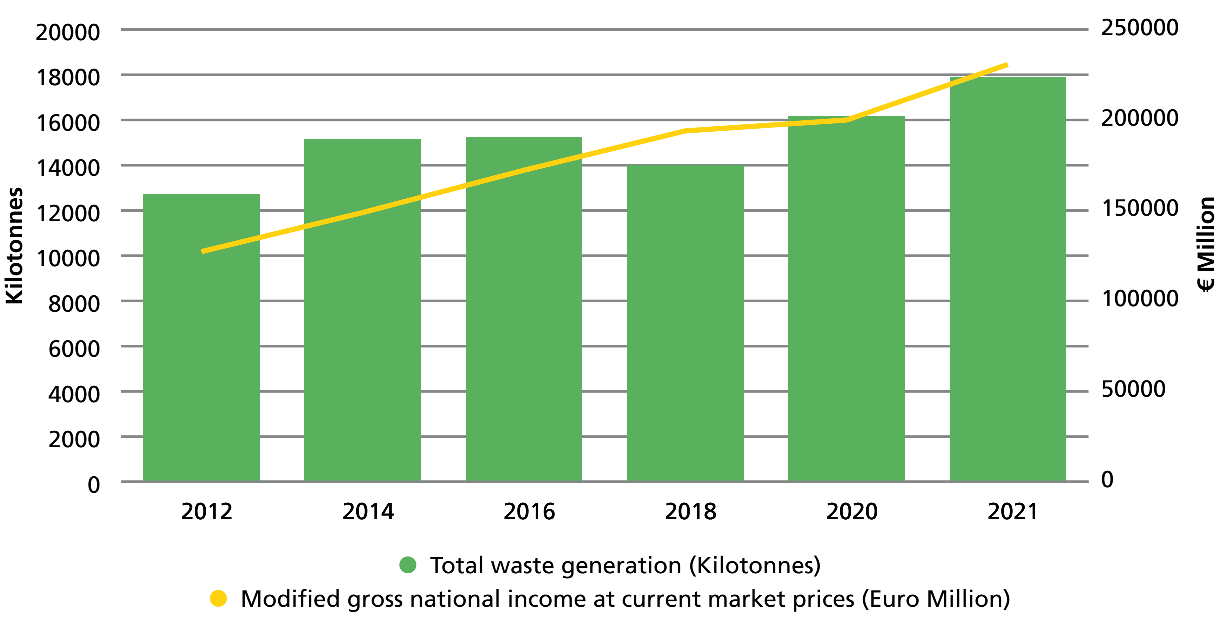
Ireland has a **Reuse** rate of **10.6 kg per person per year**. An estimated 11.4 million items of secondhand clothing were bought or exchanged in 2021.

Source: EPA, 2023b

12 Central Statistics Office (CSO) Waste Statistics Waste Generation 2020. Overall waste generation figure calculated biennially by CSO using EPA waste data in this report and scaled up for other industries/businesses: ec.europa.eu/eurostat/statistics-explained/index.php?title=Waste_statistics (accessed 24 June 2024).

13 www.epa.ie/our-services/monitoring--assessment/waste/national-waste-statistics/waste-generation/ (accessed 24 June 2024).

Figure 15.8 Trends in waste generation (tonnes) and modified gross national income, 2012–2021



Source: EPA, 2023b

Households, offices, schools and similar premises generated 3.2 million tonnes of municipal waste[14] in 2021, 41% of which was recycled. In 2021, 1.2 million tonnes of packaging waste was generated, an increase of 9% from the previous year (and an increase of 25% since 2016). Although recycling tonnages are increasing, improvements in recycling rates are being cancelled out by the increasing amount of waste generated. The amount of municipal waste recycled has increased by 11% since 2016, but total municipal waste generated also increased by 11%, resulting in a static recycling rate of 41%. The recycling rate of packaging waste has increased by 8% since 2016. However, this is just one-third of the rate of the increase in packaging waste generated (25%). Consequently, the packaging recycling rate decreased from 62% in 2020 to 58% in 2021. Current trends (Figure 15.9) mean that the statutory targets for 2025 are likely to be missed.

Reducing packaging waste generation is key to improving the current trends. Measures needed include avoiding packaging where possible; improving product design, including using lightweighting materials and more recyclable materials; and increasing the use of reusable products in supply chains, supported by targeted fiscal incentives.

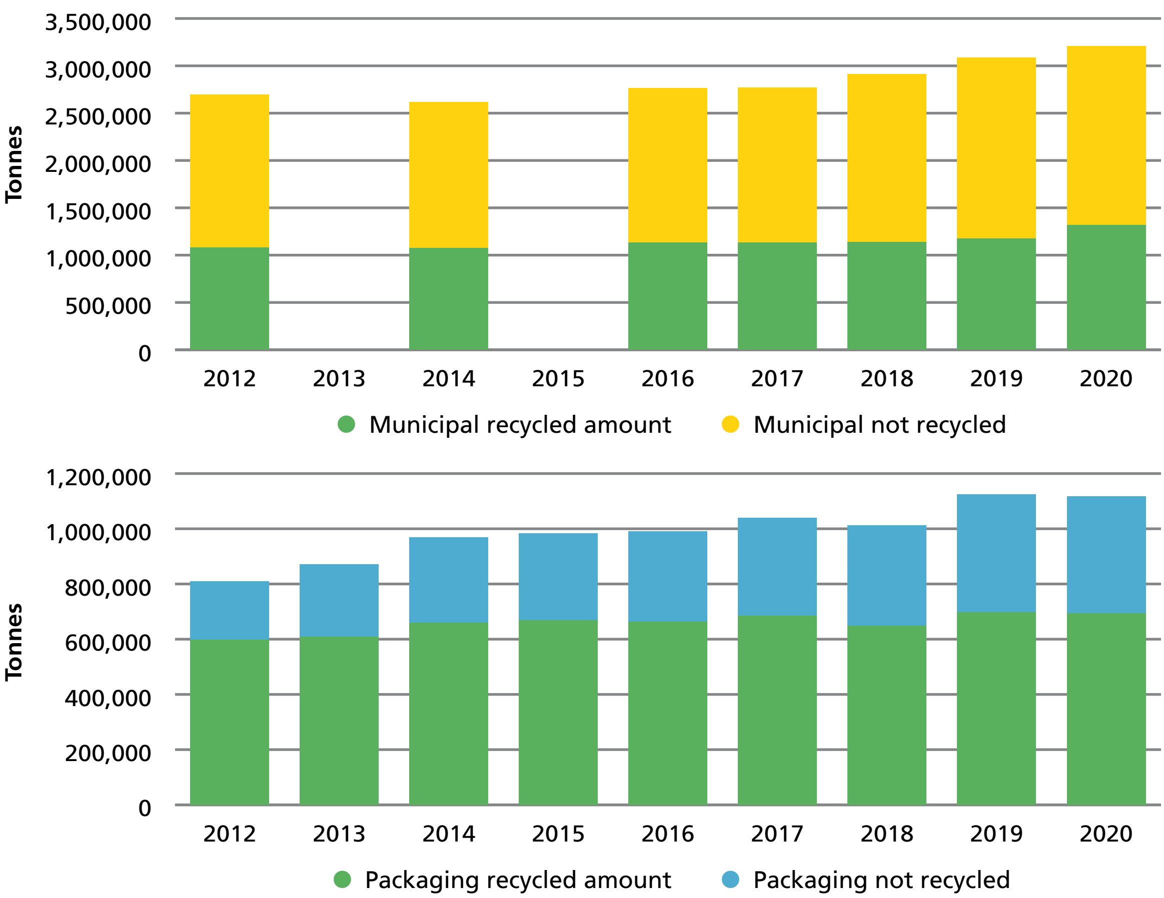
Food waste. Food waste can occur at any point along the food supply chain, from primary production to processing and manufacturing, from retail and distribution (unsold stock) to restaurants, and food services (food uneaten by customers) and households (purchased food uneaten).

It is a global problem that has environmental, social and economic consequences. The urgency and challenge of addressing food waste is highlighted at the international level through Target 12.3 of the United Nations' Sustainable Development Goals (UN, 2020), which states: 'By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses.' Tackling food waste is one of the key steps that we can take to achieve sustainability, to help combat climate change and to support the transition to a circular economy and bioeconomy (see 'Bioeconomy').

The EPA estimates that Ireland generated over 753,000 tonnes of food waste in 2021, a decrease of 2% from 2020. Approximately 29% of the total comes from households, another 29% from the processing and manufacturing sector, and the remainder comes from restaurants and food service (25%), primary production (7%) and retail and other distribution of food (10%).

14 For the most up-to-date statistics on waste generation and management in Ireland, see www.epa.ie/our-services/monitoring--assessment/waste/national-waste-statistics (accessed 24 June 2024).

Figure 15.9 Trends in municipal and packaging waste generation and recycling



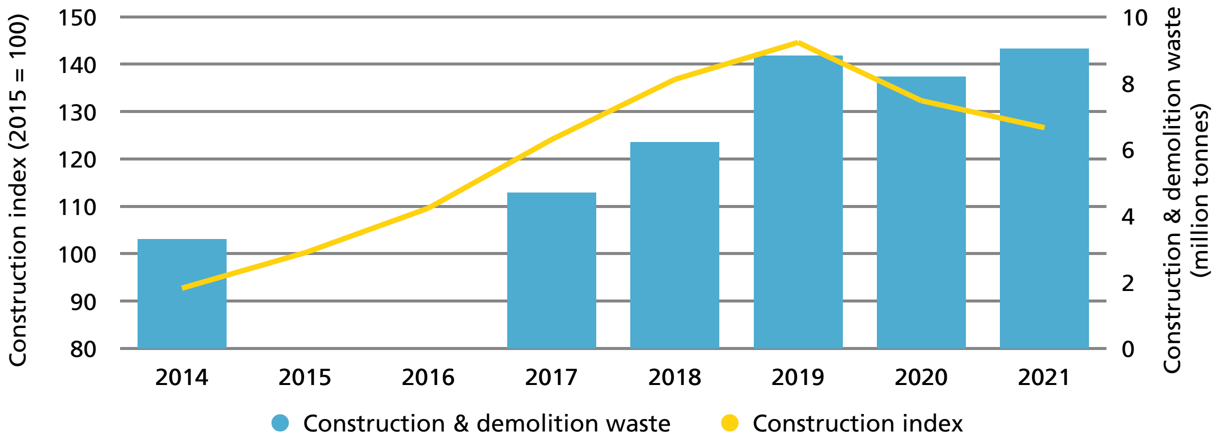
Source: EPA, 2023b

Construction and demolition waste. Construction waste accounts for over half of the total waste currently being generated in Ireland. Excavated soil and stone waste makes up about 85% of the total; the remainder includes concrete, brick, tiles, glass, metal, plastic and wood. Approximately 8% of total Irish construction and demolition waste is recycled or reused, with most being used as backfilling[15] material and some being sent for disposal. Based on 2021 figures, approximately 8.2 million tonnes of construction and demolition waste was backfilled (7.65 million tonnes) or disposed of at landfills (0.6 million tonnes). Given that so much of this waste is potentially preventable, reusable or recyclable, this is an unnecessary and largely avoidable cost for the construction industry. It also has very negative environmental consequences in terms of carbon emissions, waste capacity and Ireland's material circularity rate. The EPA has introduced national by-product and end-of-waste decisions for construction-based materials to reduce construction waste and to encourage increased reuse and recycling activities (see further information in section 5).

In Ireland, construction waste is the fastest growing waste stream and is increasing at an alarming rate (see Figure 15.10). The amount of construction and demolition waste rose to 9 million tonnes in 2021 from 3 million tonnes in 2014.

15 Backfilling is a waste recovery operation carried out at an authorised waste facility, where suitable soil and stone waste is used for land improvement, for reclamation purposes in excavated areas, or for engineering purposes in landscaping. Backfilling sits one tier above landfill but below recycling and reuse on the waste management hierarchy.

Figure 15.10 Quantity of construction and demolition waste managed in Ireland, compared with the Central Statistics Office construction index, 2014–2020



Sources: Compiled from data from the EPA, NWCPO and CSO

Infrastructure capacity to treat waste

Ireland remains overly reliant on export markets for the treatment of waste streams including residual municipal waste, hazardous waste, packaging waste and, more recently, biowastes. There is limited resilience in the system to deal with market shocks or unforeseen events that give rise to additional quantities of waste. Improving Ireland's self-sufficiency in treating our waste and expanding domestic residual and recycling capacity is of utmost importance in terms of building resilience and a national circular economy.

The capacity to manage municipal and construction and demolition wastes continues to be under pressure, particularly for hazardous soil and stone wastes. The most significant change in recent years has been the shift away from disposing of residual (i.e. black bin) waste in landfills to instead using it in energy recovery. Almost 3.2 million tonnes of municipal waste was generated in Ireland in 2021, up 4% from 2019. Of the municipal waste managed in Ireland in 2021, 41% was recycled, 43% was treated with energy recovery (waste-to-energy installations and cement kilns, down from 46% in 2019) and 16% was sent to landfills[16] (up slightly from 15% in 2019) (Figure 15.10).

Ireland's dependence on waste exports for the management of various waste streams also continues. Approximately 38% (1.2 million tonnes) of all municipal waste generated in 2021 was exported for treatment mainly in other EU Member States. Of the waste exported, most went for recycling (58%) or energy recovery (32%), while 8% went for composting or anaerobic digestion.

Hazardous waste. Similarly, the dependence on exports for the management of hazardous waste generated in Ireland persists. Industry is the largest generator of hazardous waste in Ireland (solvents, sludges, oils, chemicals) but other sectors also produce hazardous wastes, including paints, batteries, pesticides, asbestos and contaminated soil.

Ireland generated 389,908 tonnes of hazardous waste in 2022, a decrease of 16% (over 77,000 tonnes) from 2021. This decrease was driven by reduced dredging activities at Dublin Port, with dredged spoil quantities falling by almost 65,000 tonnes. In 2022, 57% of hazardous waste was treated abroad and 43% (169,000 tonnes) was treated in Ireland.

There are limited hazardous waste treatment operations in Ireland (these are mainly used for oil recovery, healthcare waste treatment and solvent reclamation), meaning that Ireland is heavily dependent on export for the treatment of many hazardous waste streams. The reliance on exports also highlights a possible missed opportunity for the treatment of more hazardous wastes in Ireland from an economic and circular economy perspective.

16 mywaste.ie/wp-content/uploads/2024/05/National-Waste-Management-Plan-for-a-Circular-Economy-Volume-I-Current-Situation-and-Challenges.pdf (accessed 23 September 2024).

Treatment capacity. In terms of waste infrastructure, Ireland has three active landfills that are authorised to accept municipal and other waste types (down from six in 2016 and 125 in 1996). There are also three waste-to-energy installations (two active incinerators and one inactive pyrolysis plant) and four cement kilns (accepting waste for co-incineration as an alternative to using fossil fuels). There is still no commercial hazardous waste landfill or hazardous waste incinerator in Ireland. This lack of infrastructure is a risk to the State, as Ireland remains reliant on facilities in European countries accepting exports of residual non-hazardous and hazardous wastes.

The EPA and the local authorities, through the regional waste management planning offices, regularly monitor waste treatment capacities nationally. Table 15.1 sets out the status of key elements of Ireland's waste infrastructure and capacity.

Table 15.1 Waste infrastructure and capacity, 2023

Infrastructure	Name and licence number	Authorised and Active Capacity (tpa)[a]	Comments
Landfills accepting municipal and other waste for disposal and recovery	Drehid Waste Management Facility (W0201-03) Knockharley Landfill Ltd (W0146-04) Ballynagran Landfill Ltd (W0165-02)	735,000	Waste types accepted and available capacities as per individual licence
Municipal waste-to-energy facilities	Meath Waste-to-Energy (W0167-03) Dublin Waste to Energy Ltd (W0232-02) Glanpower Ltd (W0282-01)	975,000	Glanpower Ltd is not active (May 2024)
Co-incineration of waste at cement kilns	Irish Cement Ltd, Platin (P0030-06) Irish Cement Ltd, Castlemungret (P0029-06) Breedon Cement Ireland Ltd (P0487-07) Mannok Cement Ltd (P0378-03)	787,875	Waste types accepted and available capacities as per individual licence
Composting and anaerobic digestion	18 facilities	968,100	Does not include industrial/agricultural facilities that treat their own waste
Soil and stone recovery capacity	20 facilities	5,700,000	Includes capacity of 2 inert landfills which accept soil and stone wastes
Civic amenity sites[b]	96 local authority civic amenity sites (in addition, there are approximately 20 private civic amenity sites)	–	–
Bring banks	Over 1800 bring banks	–	–
Pay-to-use compactors	Over 30 compactors	–	–

[a] Limitations to different waste types and quantities are defined within each licence

[b] Source: National Waste Management Plan for a Circular Economy, Volume 1[17]

17 mywaste.ie/wp-content/uploads/2024/05/National-Waste-Management-Plan-for-a-Circular-Economy-Volume-I-Current-Situation-and-Challenges.pdf (accessed 1 July 2024).

Waste enforcement

In Ireland, waste enforcement is undertaken by local authorities supported by the Waste Enforcement Regional Lead Authorities (WERLAs) shared service model, the National Transfrontier Shipment Office and the EPA (Table 15.2). The National Waste Enforcement Steering Committee (NWESC) was set up in 2016 to coordinate and support waste enforcement priorities nationally across several government agencies. The committee is co-chaired by the Department of the Environment, Climate and Communications (DECC) and the EPA and it has set five high-level priorities for waste enforcement activities for 2022–2024 (DECC, 2021b):

1. tackling significant illegal waste activity
2. construction and demolition activity
3. End-of Life Vehicles Directive and the waste metal industry
4. waste collection – household and commercial
5. producer responsibility initiatives and additional local priorities.

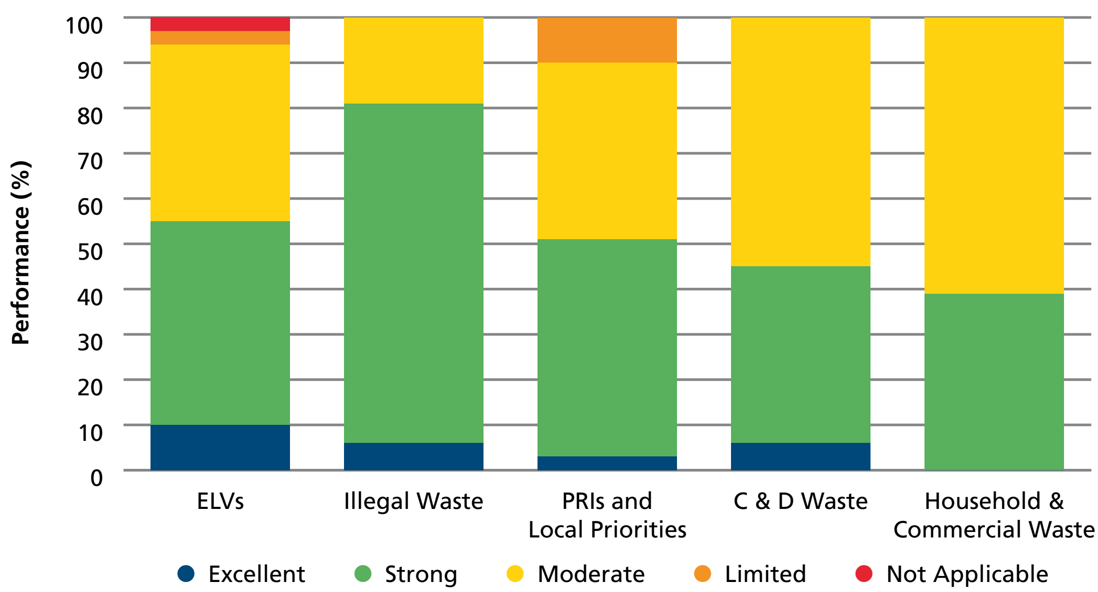
Table 15.2 Responsibilities of the waste enforcement bodies in Ireland

Regulator		**Responsibilities**
EPA		Enforcement of licensed activities – all disposal activities, all hazardous waste and incineration activities. Recovery activities over thresholds set out in legislation. Enforcement of certificate of registration sites and certificate of authorisation sites (historic landfills) issued to local authorities.
Local authorities	▪ Waste enforcement regional lead authorities (WERLAs)	Three regions (Eastern Midlands, Southern and Connacht-Ulster) with lead local authorities that coordinate local authority waste enforcement actions. Monitoring and enforcement of household waste kerbside collectors. Enforcement of priority sites and operators.
	▪ 31 functional areas	Enforcement of permitted waste facilities (recovery activities below certain thresholds set out in legislation) and certificate of registration sites issued to private sector. Enforcement of waste collection permits, which are authorised by the National Waste Collection Permit Office at Offaly County Council.
National TransFrontier Shipment Office at Dublin City Council		Competent authority for imports and exports of waste and transport of hazardous waste within Ireland.

Local authority personnel are the first responders to specific breaches of waste legislation and have significant powers to tackle illegal waste activity (DECC, 2021c). In 2022, local authorities handled approximately 62,000 waste complaints, carried out over 135,000 waste inspections and initiated 580 waste prosecutions (excluding litter). This work represents 90% of all environmental complaints received by local authorities, almost 70% of all local authority environmental inspections and 93% of the environmental prosecutions undertaken by local authorities (EPA, 2023c).

The WERLAs are a shared service governed by the local government sector through the *County and City Management Association* and have responsibility for coordinating the waste enforcement actions undertaken by local authorities within regions. Other responsibilities include monitoring and enforcement of household waste kerbside collectors and undertaking enforcement of priority sites and operators.

Figure 15.11 Overall performance of local authorities on national waste enforcement priorities, 2022



Source: EPA, 2023c

Section 63(2) of the EPA Act, as amended (No. 6 of 2023), provides for the EPA to carry out an assessment of the performance by a local authority of a statutory function of that authority in relation to environmental protection. This includes waste enforcement. The EPA carries out annual assessments of each local authority using the Local Authority Performance Framework to deliver the annual *Focus on Local Authority Environmental Enforcement Performance Report*. In relation to waste enforcement, the 2022 report found evidence of effective enforcement and collaboration by local authorities on combating illegal waste activities (Figure 15.11) while also identifying that further improvements could be made in relation to enforcement in the construction and municipal waste sectors (EPA, 2023c). The WERLAs publish an annual report that details how the national waste enforcement priorities are being addressed at a local authority level.

Licensed activities. In the EPA, waste enforcement is undertaken by the Office of Environmental Enforcement. In 2023, the EPA identified five priority areas for waste enforcement at licensed activities. It also undertook 369 inspections in the waste sector to assess:

1. controls in place to address fire risk at waste transfer facilities
2. aftercare at closed, unlined landfills and impact on groundwater and surface water bodies
3. nuisance issues at waste processing facilities
4. process management at anaerobic digestion plants
5. compliance as part of multi-agency enforcement activities.

The inspections found the following:

1. Fire remains a significant risk at waste transfer facilities (16 fires occurred during 2022–2023). Fire has the potential to remove the waste processing capacity needed to effectively service the market from the sector. The causes of these fires vary and include hot ashes, lithium batteries and pressurised cylinders/aerosols being inappropriately placed into the general waste stream, poor operational practices during plant maintenance (welding), poor housekeeping resulting in mobile plant overheating and anti-social behaviour.
2. Nine closed, unlined landfills operated by local authorities were identified as placing significant pressures on groundwater bodies. Poor aftercare may result in those water bodies failing to meet the Water Framework Directive (2000/60/EC) objectives of having, at minimum, good status. A leachate extraction system is critical infrastructure required to prevent pollution. Between 2021 and 2023, the EPA prosecuted four local authorities for failing to adequately manage leachate arising from closed landfills.

3. In 2023, the EPA handled 99 odour and six noise complaints relating to waste transfer facilities.
4. As a developing sector in Ireland, anaerobic digestion has the potential to displace fossil gas and decarbonise Ireland's agriculture sector. Six plants, licensed by the EPA, are operational. Significant compliance issues have arisen at these facilities, including inadequate process control, odour nuisance and digestate management. Developing appropriately skilled workers and technical capabilities at these plants is required to ensure compliance with licence conditions and to protect the environment.
5. The EPA has worked with local authorities, WERLAs, An Garda Síochána, the National Transfrontier Shipment Office and the three regional waste management planning offices on multi-agency enforcement. Activities have focused on improving compliance at authorised treatment facilities and metal sites, minimising the risk of national waste capacity shortfall, enforcing EPA guidance on waste acceptance criteria in the soil recovery sector and tackling contaminant levels in the recycling waste stream.

The EPA has developed a system for ranking industrial and waste licensed sites in order of priority for enforcement action and publishes its findings quarterly in a list of national priority sites.[18] Sites are ranked on performance-based indicators (see Chapter 10).

4. Pressure and impacts

The current linear economy consumes materials to provide a higher standard of living in Ireland than that experienced by previous generations or available in other parts of the world. The system of extraction of primary materials, manufacture and disposal frequently puts obstacles in the way of circular economy activities. While a circular economy aims to design waste out of the system, it also requires measures that inhibit linear activities such as removing the following: certain single-use products, the practice of built-in obsolescence and high repair costs compared with the cost of new purchases. The linear approach is facing significant limiting factors that are causing damage to our society and environment:

- ***High rates of material extraction.*** Using primary materials rather than secondary materials is the norm in Ireland (Figure 15.6). This is evidenced by Ireland's low material circularity rate (1.8% in 2022 compared with an EU average of 11.5%), indicating a linear flow of materials. A more circular economy keeps resources and materials in use for longer and can reduce emissions from Ireland's extractive, agricultural and industrial activities. A recent international report[19] highlighted the potential influence of a circular economy in mitigating the effects of climate change. It states that as much as 296 million tonnes of carbon dioxide per year (of the 530 million tonnes emitted from heavy industry) could be removed across the EU by 2050 – and some 3.6 billion tonnes per year globally.
- ***High rates of waste generation.*** A common theme across all waste types is one of increasing generation. Recycling rates are static because increases in wastes being recycled cannot keep up with waste generation increases. There is no indication that these trends are changing.

18 National priority sites list: www.epa.ie/our-services/compliance--enforcement/whats-happening/national-priority-sites-list/ (accessed 24 June 2024).

19 www.sitra.fi/en/publications/circular-economy-powerful-force-climate-mitigation/ (accessed 24 June 2024).

- ***Biodiversity loss and land use change.*** Extraction of resources (such as biomass, metal, minerals and peat) is contributing to the loss of Ireland's biodiversity and ecosystems (see Chapter 7). Globally, extracting and processing material resources accounts for 90% of biodiversity impacts (UNEP, 2019). Healthy ecosystems play a key role in climate resilience by absorbing and accumulating carbon dioxide from the atmosphere. Our current consumption of materials coupled with Ireland's poor circularity rates contribute to biodiversity loss, climate change, disruption to land management practices (see Chapter 5) and emissions to air and water.
- ***Reliance on export for waste treatment.*** Ireland's increasing waste generation rates and inability to treat all our own waste domestically has led to a reliance on exporting waste for treatment. At the same time, there is a reliance on lower tier treatment (e.g. disposal and recovery), rather than higher tier treatment such as prevention, reuse and recycling. Although there may always be a need to rely on other Member States for some waste treatment options, there are opportunities to increase the contribution of Ireland's recycling sector to the circular economy of the future.
- ***High consumption rate.*** Ireland is a large consumer of materials, as evidenced by our increasing waste generation rates (3.25 tonnes per person in 2020, up from 2.77 tonnes per person in 2012). All materials have carbon built into their supply chain. This can be released when the waste is treated, including when the material is recycled. Every tonne of material used contributes to our carbon emissions. To reduce our emissions, our current production models and consumption habits need to change. We need to tackle the linear economic model and take strong and urgent action to make it easier and affordable to prevent waste, increase reuse and expand recycling activities.

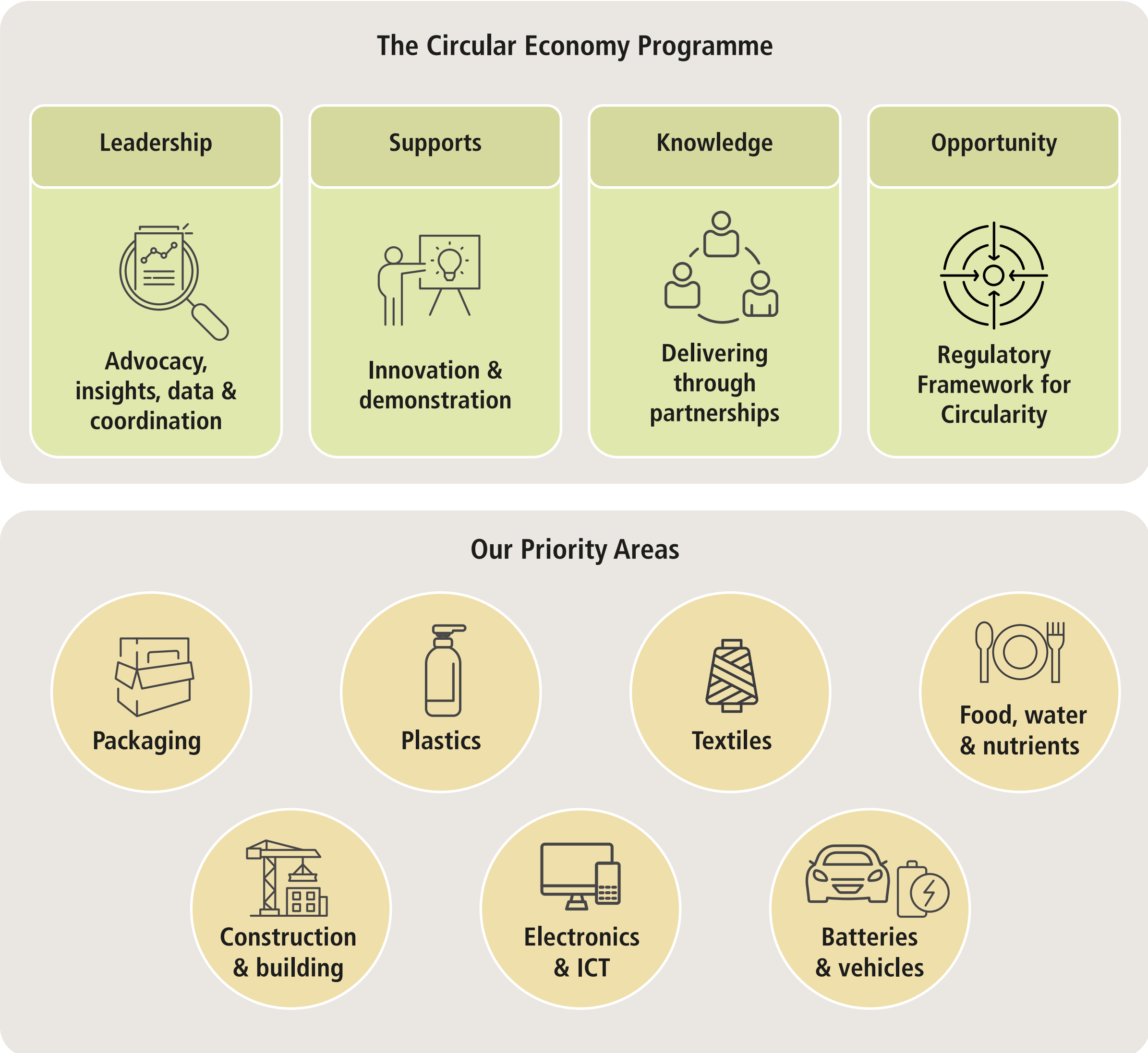
Current policy actions to reduce waste and support the circular economy are contained in the Waste Action Plan for a Circular Economy (DECC, 2020) and in Ireland's National Food Waste Prevention Roadmap (DECC, 2022). Although actions are supporting the transition to a circular economy, only a few are effective prevention measures and likely to result in a sustained reduction in waste generation. Future circular economy policy statements must aim to tackle linear consumption and waste generation in the first instance.

5. Responses

EPA Circular Economy Programme

Section 10 of the Circular Economy Act (2022) gives the EPA statutory responsibility for establishing a circular economy programme. The EPA's report on the Circular Economy Programme (EPA, 2021a), outlines the EPA's role in Ireland's transition to a circular economy. By means of the Circular Economy Programme, the EPA looks beyond waste management to lead a more coherent approach to circular thinking nationally, regionally and locally. The current programme includes four pillars and seven priority areas, aligned to the European Green Deal (Figure 15.12). Its focus is on delivering national measures, assessments, evidence and data to facilitate systemic change. Table 15.3 sets out the key activities under each of the four pillars.

Figure 15.12 The 2021-2027 Circular Economy Programme



Source: EPA, 2021a

Table 15.3 Key activities under the four pillars of the 2021-2027 Circular Economy Programme

Advocacy, insights, data, coordination

- National waste prevention programmes, including food waste prevention
- Behavioural insights programme
- Circular insights series
- Annual circular economy conference
- National waste and circular economy statistics
- National waste characterisation studies
- National Hazardous Waste Management Plan
- Supporting national roadmaps, education and awareness, EPA research programme

Innovation and demonstration

- Funding support for circular economy pilot and demonstration activities
- Supporting the implementation of green public procurement

Delivering through partnerships

- National reuse and repair network
- Industry, Circuléire (see Topic Box 15.3)
- Local authority sector partnership

Regulation for circularity

- End of waste decisions (national and single case)
- By-product decisions (national and single case)

Topic Box 15.3 Circuléire project

The Irish Manufacturing Research (IMR) project entitled Circuléire[20] began as a €4.5 million public–private partnership created by IMR, three strategic partners (DECC, EPA and EIT Climate-KIC[21]) and 25 founding industry members. Circuléire was the first cross-sectoral industry-led innovation network dedicated to closing the circular innovation gap and accelerating the net zero carbon circular economy in Ireland.

Between 2020 and 2022, Circuléire's activities included circularity assessments of members, thematic working groups and an innovation and mentoring programme for members. In-depth circularity assessments were completed for 18 founding members, identifying approximately 400 opportunities to reduce waste and carbon emissions through resource efficiency and circular practices. IMR is supporting the development of tailored key performance indicators for members to enable performance monitoring and emission reductions. It is also preparing a roadmap for a centre of excellence for circular innovation for industry that can build on the learning of Circuléire.

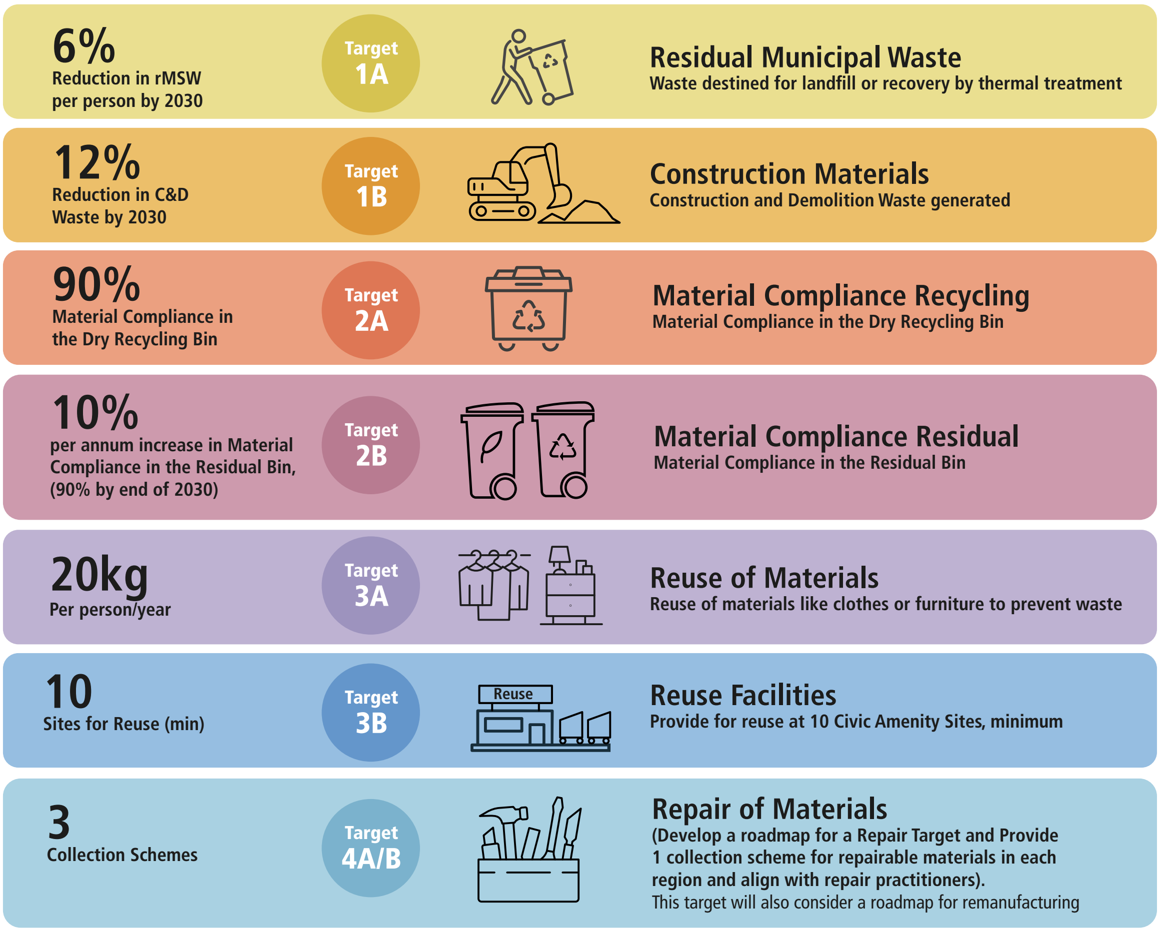
20 circuleire.ie/ (accessed 24 June 2024).

21 www.climate-kic.org (accessed 1 July 2024).

National Waste Management Plan for a Circular Economy 2024–2030

The three regional waste management planning offices recently produced an all-inclusive national waste management plan[22] with circular thinking at its core. The plan contains national targets (Figure 15.13) and an overarching ambition to reach 0% total waste growth per person in each year of its lifetime. On top of key EU recycling targets, overlapping international climate change targets and Sustainable Development Goals, the plan lays out roadmaps to achieve all relevant targets in a coherent and collaborative approach. These national targets provide the necessary strategic shift to focus planning, investment and resources further up the waste hierarchy, to prevent waste generation and to decouple it from economic growth.

Figure 15.13 National targets set out in the National Waste Management Plan



Source: www.mywaste.ie/national-waste-management-plan

22 www.mywaste.ie/national-waste-management-plan (accessed 24 June 2024).

Topic Box 15.4 EPA's role in preventing food waste

The EPA is the competent authority for delivering the statutory National Food Waste Prevention Programme, producing statutory reporting on food waste and delivering key actions in the National Food Waste Prevention Roadmap. The EPA delivers campaigns and supporting resources targeting food waste generation in households, across the supply chain and in the hospitality sector.

Stop Food Waste[23] is the public-facing national campaign to reduce household food waste generation in Ireland. The campaign runs awareness-raising initiatives to share easy tips and resources on how to make the most of our food, keep it fresher for longer and avoid generating food waste. Its messaging and intended audiences are informed by ongoing behavioural insights and market research. The theme for all campaigns is to encourage simple good behaviours around purchasing food and meal planning.

The EPA also manages and coordinates the national Food Waste Charter, relaunched in June 2023 and supported by five state agencies (Bord Bia, Bord Iascaigh Mhara, Enterprise Ireland, Fáilte Ireland and Teagasc) that pledged their support to champion the charter in their sustainability programmes. Businesses that sign up voluntarily commit to measuring their food waste using EPA methodologies, setting targets, taking action to reduce food waste and reporting their progress annually. Business that take these actions reduce their operational costs and contribute to organisational climate change mitigation and sustainability goals.

National Food Waste Prevention Roadmap

Ireland's National Food Waste Prevention Roadmap 2023–2025 (DECC, 2022) sets out 38 actions to steer efforts towards achieving Ireland's commitment to halve food waste by 2030. This commitment is in line with the UN Sustainable Development Goal Target 12.3 to halve global per capita food waste by 2030. The European Commission is also proposing legally binding food waste reduction targets to be achieved by Member States by 2030 as part of the revision of the Waste Framework Directive.

Key areas of focus in the roadmap include food waste measurement and reporting, extending the EPA's Food Waste Charter to food supply chain businesses, surplus food donation and redistribution measures, food waste segregation, communications and awareness on food waste prevention, research and innovation, and green public procurement (Topic Box 15.4). DECC is the lead government department developing Ireland's National Food Waste Prevention Roadmap and coordinating and reviewing its implementation. The Department of Agriculture, Food and the Marine is the lead government department for UN Sustainable Development Goal Target 12.3.

Construction sector roadmap and guidance

The Climate Action Plan 2023 (DECC, 2023a) sets a target of a 35% reduction in emissions (against 2018 levels) by 2030 from construction materials. The Circular Economy Strategy (DECC, 2021a) committed to developing a series of sectoral roadmaps for resource-intensive sectors of the economy.

The construction and demolition sector is the largest single source of waste in the Irish economy; this is also generally the case globally. However, only a small percentage (approximately 8%) of total Irish construction and demolition waste is recycled or reused, with most being backfilled and some being sent for disposal.

DECC is developing the Circular Economy Roadmap for the Construction Sector for draft publication in 2024. A full public consultation ahead of its finalisation is also planned for before the end of 2024.

The Circular Economy Roadmap for the Construction Sector will be informed by a report under development that is being led by the Construction Sector Group's Innovation and Digital Adoption Sub-Group. The Construction Sector Group was set up in 2018 by the Department of Public Expenditure and Reform as a forum for regular and open dialogue between the government and the construction industry. It focuses on how best to achieve and maintain a sustainable and innovative construction sector positioned to successfully deliver on the commitments in Project Ireland 2040. This report is due for completion in 2024.

23 stopfoodwaste.ie/ (accessed 1 July 2024).

In addition, the EPA has provided best practice guidelines (EPA, 2021b) for the preparation of resource and waste management plans for construction and demolition projects. The guidelines provide a practical approach, informed by best practice, for preventing and managing construction and demolition waste and resources, from the design stage through to construction and deconstruction (Topic Box 15.5). Currently voluntary in nature, the implementation of these guidelines would help drive circularity within the construction sector. To trial their implementation, the EPA, through the Circular Economy Network, has created a number of awards for the preparation of resource and waste plans for infrastructure and mixed-use developments.

Topic Box 15.5 Preventing and recycling construction waste by applying by-product and end-of-waste criteria

Preventing material from becoming waste diverts materials from waste treatment outlets, such as landfills, lowers industry costs and reduces the extraction of finite virgin materials and the associated environmental impacts. Under the Waste Framework Directive, the by-product regulatory mechanism can be used to prevent materials from becoming waste in the first instance. There is a strong demand for secondary construction products in Ireland to support the development of new infrastructure that has a low carbon footprint.

Another regulatory mechanism, end-of-waste criteria, supports the safe reclassification of waste as a material or product following the processing of the material in accordance with a set of national rules. This mechanism will support the growth of national markets for recycled materials and green purchasing activities.

National hazardous waste management plan

In December 2021, the EPA published the National Hazardous Waste Management Plan 2021–2027. This is the fourth such plan drawn up under Section 26 of the Waste Management Act 1996. The purpose of this plan is to protect the environment and human health in Ireland through best-practice management of hazardous wastes. The implementation of the plan is coordinated and driven by the EPA's Circular Economy Programme. The plan's priorities are set out in 20 recommendations which are grouped into the following categories: policy and regulation; prevention; collection and treatment; and implementation. Each recommendation is accompanied by an 'owner' and specific key actions required to be implemented. Progress is reported[24] annually by the EPA.

Circular economy economic instruments

Economic instruments can be effective measures for encouraging businesses and householders to make choices that support the implementation of environmental and circular economy policy. The following instruments are designed to support efforts towards a more circular model of resource use.

Plastics own resource. Since 2021, plastic packaging waste that is not recycled in EU Member States has been subject to a financial contribution to the EU budget, called the plastics own resource.[25] A uniform rate of €0.80 per kilogram is applied to the weight of plastic packaging waste that is not recycled.[26] In 2021, Ireland contributed €215 million. This EU-level instrument is designed to incentivise the recycling of plastic packaging by penalising Member States that produced high levels of non-recycled plastic packaging.

Environmental levies. The Circular Economy Act (2022) provides the Minister for the Environment, Climate and Communications with the power to introduce environmental levies on a range of single-use items. New levies will be implemented to incentivise the use of reusable and recyclable products and materials. Revenues raised from future levies will be ringfenced in the Circular Economy Fund and used to support projects relating to environmental and climate action objectives.

Single-use coffee cups. Nearly 200 million coffee cups are used and wasted every year in Ireland. This is entirely avoidable waste and is being addressed by the introduction of a levy on single-use cups for hot drinks. The coffee cup levy being considered is expected to incentivise the use of reusable cups and help reduce

24 www.epa.ie/our-services/monitoring--assessment/waste/hazardous-waste/06793-EPA-National-Hazardous-Waste-Management-Plan-2021-2027-Proof-04.pdf (accessed 24 June 2024).

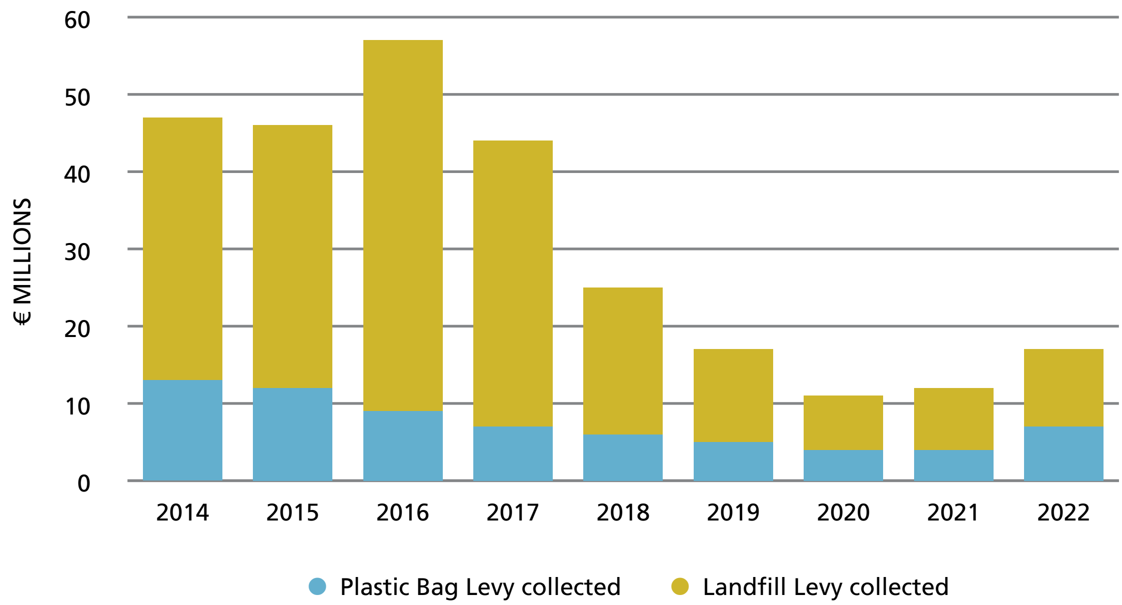
25 commission.europa.eu/strategy-and-policy/eu-budget/long-term-eu-budget/2021-2027/revenue/own-resources/plastics-own-resource_en (accessed 24 June 2024).

26 The contribution is initially calculated based on forecast figures and is then adjusted based on the actual tonnage of plastic packaging not recycled that is reported 2 years later.

single-use waste. The proposed levy is a flat rate of €0.20 on all single-use disposable cups and is due to be introduced by the end of 2024.

Waste disposal and recovery levies. A waste recovery levy[27] was introduced in September 2023. The measure applies a rate of €10 per tonne to municipal waste recovery operations at landfills, waste-to-energy plants and co-incineration plants and on the export of municipal waste for recovery abroad. At the same time, an additional €10 per tonne was applied to the existing landfill levy, raising it to €85 per tonne of waste disposed of. These measures are intended to drive behavioural change, encouraging better segregation of waste at source and moving treatment further up the waste hierarchy towards more recycling and reuse activities. Figure 15.14 documents the revenue generated from the plastic bag and landfill levies from 2014 to 2022.

Figure 15.14 Plastic bag and landfill levies collected (million euros), 2014–2022



Deposit return scheme. It is estimated that about 1.9 billion drinks bottles and cans are consumed each year in Ireland.[28] The introduction of the Re-turn[29] deposit return scheme in 2024 aims to boost the recycling of plastic bottles and aluminium cans by charging a small, refundable deposit for each bottle or can. The scheme covers PET (polyethylene terephthalate) plastic bottles and aluminium and steel cans of between 150 ml and 3 l volume. Deposits are €0.15 for containers of 500 ml or less and €0.25 for containers above 500 ml. The deposit is refunded to the consumer when they return the container to a retailer or collection point. In addition to supporting recycling efforts, the scheme helps reduce on-the-go waste.

27 A review of the waste recovery levy has been commissioned by DECC to examine the option to extend the levy to construction waste.

28 www.gov.ie/en/press-release/b3f2f-minister-smyth-launches-irelands-deposit-return-scheme/#:~:text=It%20is%20estimated%20that%20about,each%20plastic%20bottle%20or%20can (accessed 24 June 2024).

29 Re-turn.ie (accessed 24 June 2024).

Circular economy regulatory instruments

Ireland's regulatory instruments are responding to the challenges of moving from an economic model characterised by high volumes of waste towards one that encourages, incentivises and regulates the better use of resources and materials.

Commercial incentivised collections and household biowaste collection service. National policy commits Ireland to improving waste segregation and reducing waste. Regulations (S.I. No. 104/2023) introducing incentivised waste collection charging in the commercial sector came into force in 2023, along with a requirement for all commercial premises to be provided with a three-bin system (mixed dry recycling bin, organic waste bin and general waste bin), broadly mirroring the regime in the household sector. New legislation means that every household in the State is being provided with a brown bin for food waste and garden waste by their waste collector from 2024 onwards. This change is to meet a requirement in the EU Waste Framework Directive.

By-product and end of waste criteria. National by-product and end of waste regulations can contribute to growing the circular economy in Ireland. A by-product[30] is a residue of a production process (not the intended product) that has a certain and lawful use. A material determined to be a by-product never becomes waste; simply put, waste is prevented.

A material reaches end-of-waste[31] status when it is fully recovered and meets specific statutory criteria such as certainty of use and product standards. Products derived from materials with end-of-waste support the growth of national markets for secondary materials.

The EPA is responsible for assessing applications it receives on materials seeking by-product and end-of-waste status and can make single-case or national decisions. National criteria provide a framework for economic operators to obtain by-product or end-of-waste status for particular materials.

The EPA, in consultation with industry and the European Commission, has also prepared national decisions on:

- end of waste criteria for recycled aggregate
- by-product criteria for site-won asphalt (road planings).[32]

A third national decision for by-product criteria for greenfield soil and stone is currently in preparation. These national decisions provide pathways for the construction sector to tackle construction waste by preventing its generation, allowing for safe reuse, increasing recycling and supporting greener purchasing of materials. Outside the construction sector, there is significant and untapped potential for the application of end-of-waste and by-product criteria to significantly increase Ireland's circularity rating.

National end-of-waste criteria give the opportunity to increase recycled aggregate use in Ireland. With 30 million tonnes of crushed rock extracted in Ireland annually, widespread use of the new criteria has the potential to reduce primary extraction.

In 2022, the EPA made 122 by-product single-case project decisions of which 97 were for soil and stone by-products. That equated to approximately 2.7 million tonnes of soil and stone being prevented from becoming waste. The other significant by-product material notified to the EPA was road planings (e.g. site-won asphalt). Determining materials and resources to be by-products and not wastes offers clear environmental and economic benefits to projects and businesses. In 2022, the EPA made a by-product decision for a notified chemical material, which illustrates the benefits the mechanism offers to businesses and the environment (see Topic Box 15.6).

30 www.epa.ie/our-services/licensing/waste/by-products-regulation-27/ (accessed 24 June 2024).

31 www.epa.ie/our-services/licensing/waste/end-of-waste-art-28/ (accessed 24 June 2024).

32 Site-won asphalt is milled asphalt road layers or slabs that have been stripped from road surfaces. Asphalt is a mixture of bitumen and aggregate (sand/gravel/stone).

Topic Box 15.6 Chemical by-product case study

The company Vision Care uses propylene glycol (PG) as a hydration agent in the manufacture of contact lenses. The used material is in demand by the aviation sector for use in products such as de-icing fluid and heat transfer fluid. Planned expansion at the Vision Care manufacturing facility in Limerick is expected to increase volumes of used PG to 24,500 m^3 per year by 2025. The EPA made a decision to grant this material by-product status, which means that it no longer needs to be treated as a hazardous waste; it had previously been exported for recovery. The financial and environmental gains for the company are considerable. The decision will also have the knock-on effect of lowering Ireland's national hazardous waste figures (initially by an estimated 15,000 tonnes; this figure could grow depending on production of PG at the facility).

Enforcement

The NWESC has an oversight role in coordinating waste enforcement activities in Ireland. It seeks to drive compliance, public and environmental protection and consistency by setting national waste enforcement priorities for all waste regulators. The committee is co-chaired by DECC and the EPA and includes representatives from a wide range of regulatory authorities. Other stakeholders in the waste sector have input to the committee through an Industry Contact Group (DECC, 2021c). Following discussion and engagement, and the inclusion of recommendations from the EPA, DECC set out the high-level national enforcement priorities for the period 2022–2024 in a circular to all regulators in 2021 (DECC, 2021b). Each priority area has associated annual and multi-annual deliverables. An increased number of multi-agency investigations have been initiated since 2022 to give effect to the five national waste priorities set by the NWESC. Emphasis is placed on multi-agency investigations, recognising that waste moves across all types of authorisations regardless of whether they are issued and enforced by local authorities or the EPA.

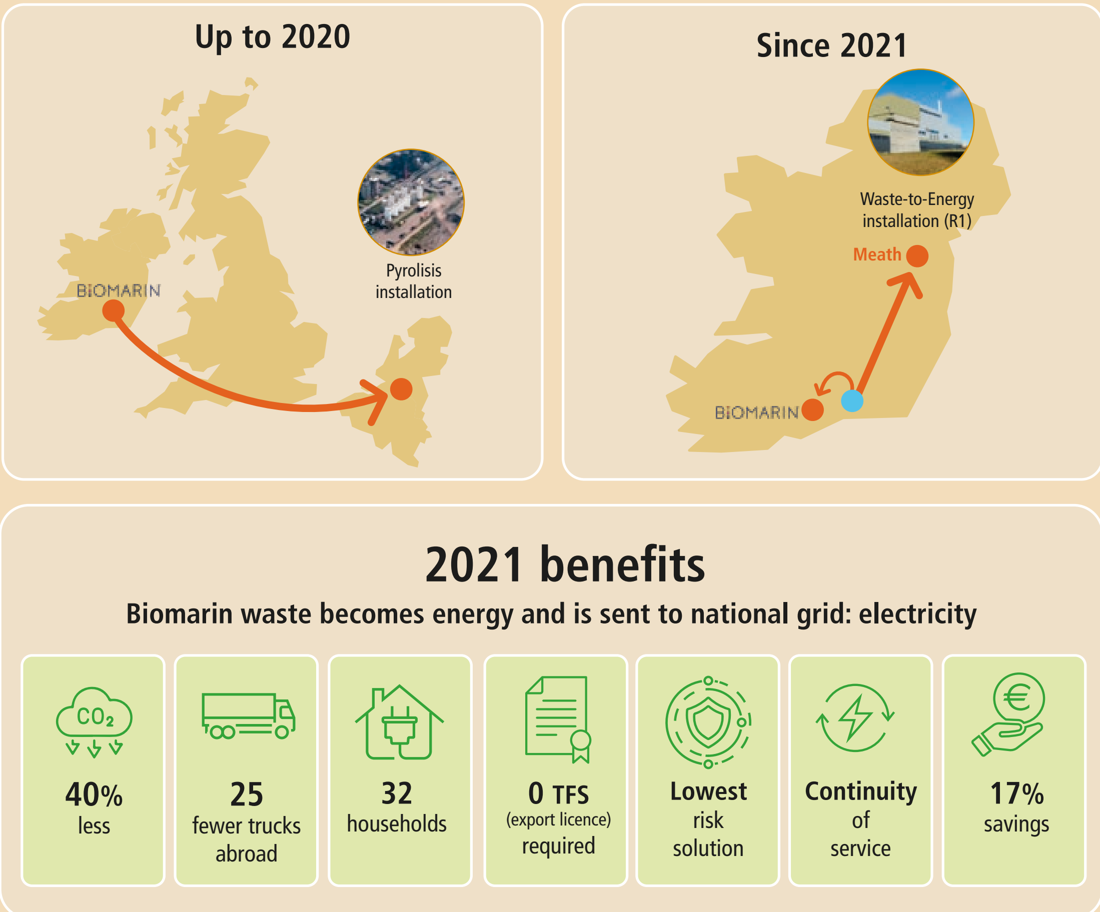
The EPA ensures that major industrial and waste operations in Ireland comply with their licences, be they industrial emissions, integrated pollution control or waste licences. The EPA launched the Beyond Compliance initiative, which aims to recognise operators who do more than their EPA licence requires and to encourage them to further reduce their environmental emissions and improve their performance (see case study in Topic Box 15.7). The beyond compliance concept is also discussed in Chapter 13.

Topic Box 15.7 EPA Beyond Compliance case study

In 2021, the EPA launched the Beyond Compliance initiative to promote moving beyond compliance at licensed sites (EPA, 2021c). One licensee that has gone beyond compliance is BioMarin International Ltd. Cork (licence number P0864-01). Some of the initiatives the company has taken relating to the circular economy and waste management are:

- Moving from passive to active shipping, removing the need for shippers, cold packs and templates. By doing so, the company produced 44 tonnes less waste in 2021.
- Eliminating eight chemicals and replacing at least ten further chemicals with more environmentally friendly alternatives. This was achieved by evaluating proposed new processes, evaluating chemical inventories, optimising chemical use, training and improved staff awareness.
- Reducing paper purchasing and use, from 430 boxes in 2019 to 278 boxes in 2020. This was achieved by introducing paperless training and digital signing systems.
- Changing waste flows in 2020/2021. This resulted in the re-routing of solid waste streams from treatment abroad to treatment within Ireland (Figure 15.15).

Figure 15.15 BioMarin solid waste treatment destinations up to 2020 (a) and since 2021 (b) and the resulting benefits (lower panel)



Source: BioMarin International Ltd

Green public procurement

The public sector has a vital role to play in leading Ireland's transition to a sustainable and carbon-neutral economy and society. In Ireland, public bodies (excluding utilities) spend an estimated €18.5 billion a year on goods, services and works.[33] Such purchasing power has significant potential to reduce emissions and protect the environment while saving money over the full life cycle of goods and services. Government commitment to green purchasing sends a powerful signal to the market.

DECC has published a 2024-2027 Green Public Procurement Strategy and Action Plan,[34] which will play a key role in driving the implementation of green and circular procurement practices across the public sector. The strategy is wide ranging and includes actions on policy, legislation, using green public procurement in public sector mandates, sectoral actions, training, awareness, monitoring and reporting. The strategy has set targets to increase the use of green criteria in key economic sectors.

The EPA supports green public procurement through the provision of national guidance and green criteria for priority sectors, materials and services. Ten national criteria have been developed and are available[35] to be incorporated into the procurement of, for example, food and catering services, road transport vehicles, lighting, information and communications technology, textiles, and office building design and construction.

Under the Climate Action Plan (DECC, 2019), the EPA has responsibility to monitor and report on green public procurement implementation in government departments and has published annual reports since 2022 (EPA 2022b, EPA 2023d, EPA 2024a). The findings are stark. The reports show a low level of implementation across government, even for the procurement of goods and services where national criteria have been in place since 2014. The EPA will continue to monitor spending in government departments and track progress against report recommendations. The most recent EPA report shows that, of the reported spend of €922 million on contracts worth over €25,000 signed in 2022, just one-third (34%) included green criteria, (EPA, 2024). This low level of green public procurement implementation across the government is a missed opportunity and needs to be urgently addressed.

Action 148 of the Climate Action Plan 2019 (DECC, 2019) requires government departments to measure and report on green public procurement on an annual basis. Successive climate action plans have introduced additional measures to improve the use of green criteria (DECC, 2023b). The report on the Climate Action Framework for the commercial semi-state sector (NTMA, 2022) includes a commitment to promote circular economy measures and green procurement (commitment 4) and stipulates that NewERA[36] reports biannually on behalf of commercial semi-state companies from 2023.

Bioeconomy

The bioeconomy refers to sectors and systems (e.g. agriculture, forestry, fisheries, food, marine, energy) that use renewable biological resources (such as crops, forests, fish, animals, microorganisms, biomass and organic waste) to produce valuable food, materials and energy. The opportunities for Ireland's circular bioeconomy are rich and diverse. The restorative and regenerative aspects of the bioeconomy will be an important aspect of ensuring that Ireland's natural capital is protected when incorporated into any circular economy model.

Commitments under the Climate Action Plan 2021 (DECC, 2021d), and the Bioeconomy Action Plan 2023–2025 (DECC and DAFM, 2023), includes actions to accelerate support for the development of the bioeconomy. The 2023 and 2024 Climate Action Plans (DECC, 2023a, 2024) aim to further develop Ireland's bioeconomy, in commercial, societal and policy terms while also increasing awareness and understanding of the bioeconomy more broadly. The Bioeconomy Action Plan seeks to enhance policy coordination and greater integration of the bioeconomy within sectoral policies. It will support the goal of moving biobased innovation and solutions from research to sustainable and circular industrial production at greater speed. It will also support more investment in demonstrating the bioeconomy concept, providing exemplars, and ensuring support for interactions and progress among multiple actors, including businesses, primary producers, scientific communities, policymakers, social movements and interest groups.

33 www.gov.ie/en/collection/06f1e-procurement-reform-annual-reports/ (accessed 24 June 2024).

34 www.gov.ie/en/publication/7b1f8-green-public-procurement-strategy-and-action-plan-2024-2027/ (accessed 24 June 2024).

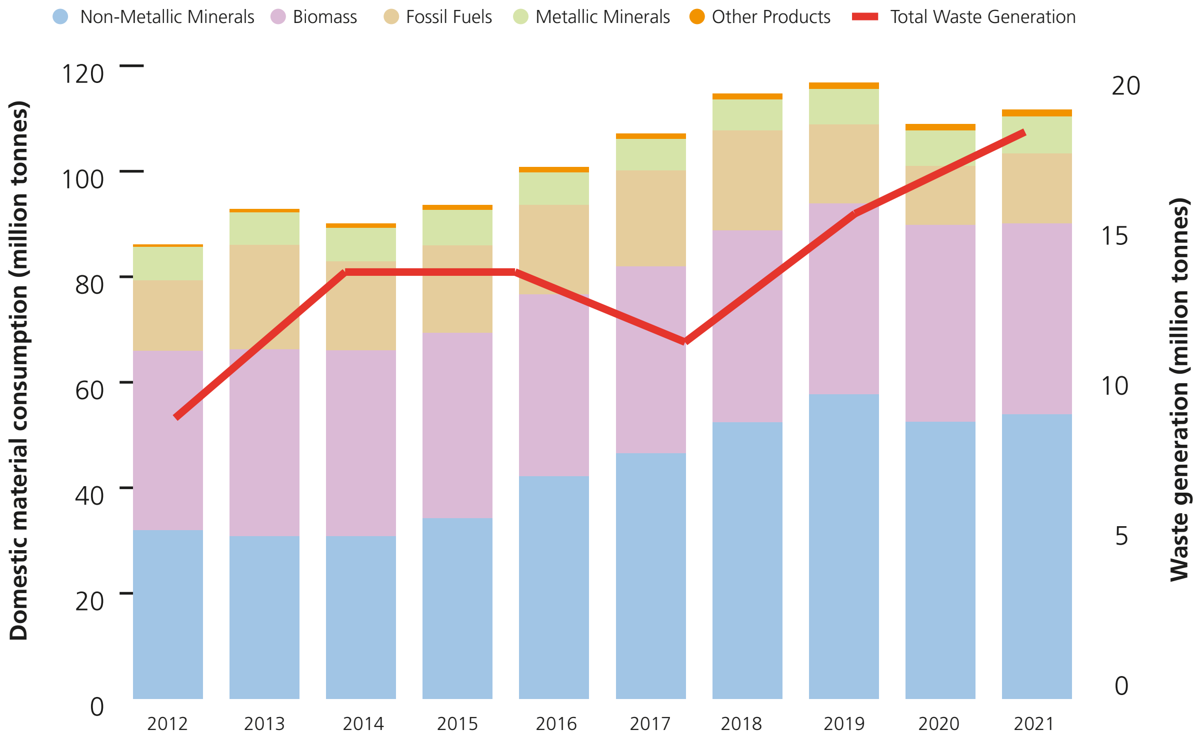
35 The criteria are available for direct use in tenders and contracts. They are accompanied by notes about relevant legislation, standards and labels and how to evaluate and verify the criteria.

36 NewERA is part of the National Treasury Management Agency.

6. Conclusions

Ireland's economy is characterised by high consumption, one of the highest in Europe, and high volumes of waste generated per capita. Central Statistics Office data showing the domestic consumption of various material categories in the Irish economy since 2012 confirm a direct correlation between rising material consumption and increased waste generation (Figure 15.16).

Figure 15.16 Domestic material consumption and total waste generation (million tonnes), 2012–2021



Source: EPA, 2023b

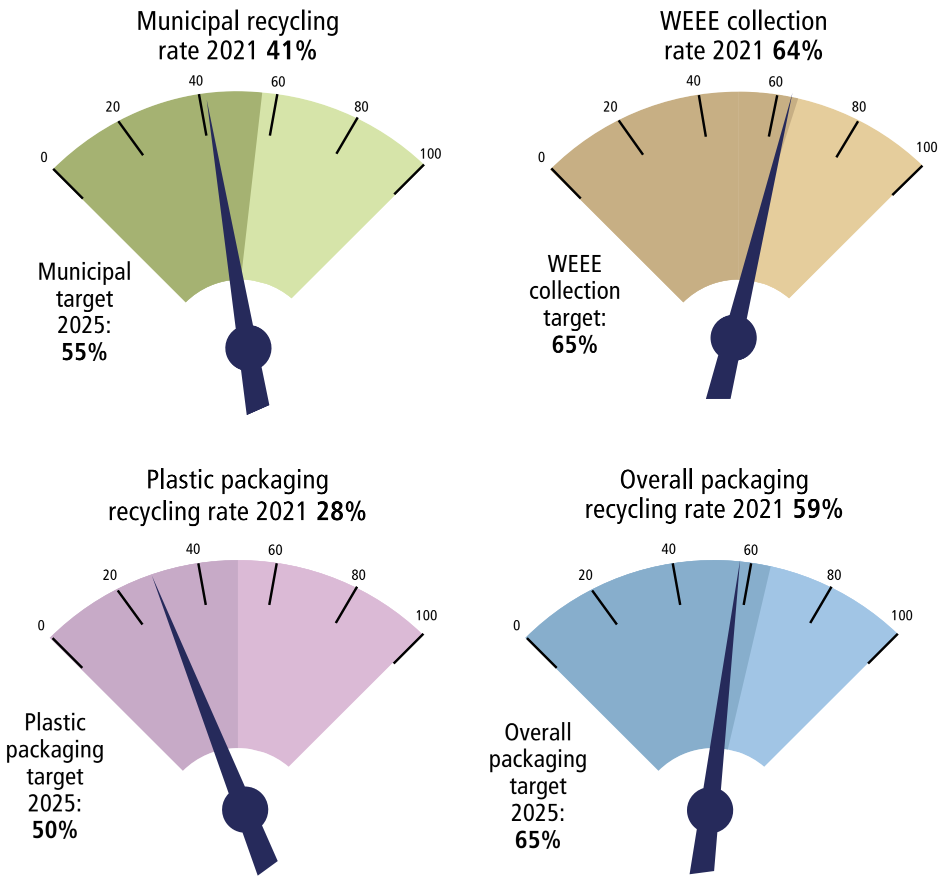
In 2021, high levels of waste generation were recorded in key waste streams such as construction and demolition waste, which increased by 10%, and packaging waste, which increased by 9%, compared with 2020. As discussed throughout this chapter, our current economic model is a damaging one, characterised by overconsumption of materials and goods, growing volumes of waste and supply chain emissions, biodiversity loss and water stress. Lowering consumption will help to reduce the emissions damaging our environment, including waste emissions.

We need to recognise that our current economic model and culture of consumption is negatively impacting our society, the health of people and our environment. Previous indicators of economic prosperity, focused largely on gross domestic product and wealth, need to be broadened to encompass the health and vitality of our society, the environment in which we live and the economic prosperity of national businesses trading alongside international companies. We need to reframe our view of economic growth beyond one of being solely a measure of gross domestic product and consider climate, environmental and social indicators. We need to interrogate the complex questions about continued and damaging economic growth as the primary policy driver and measure of success against a background of climate change, biodiversity loss, water stress and depletion of natural resources.

A circular economy strives to minimise the consumption of new and virgin materials while increasing the reuse and use of secondary or recycled materials. In 2022, Ireland's circular material use rate of 1.8% was well below the European average of 11.5% and far behind the 33% of the best performing Member State, the Netherlands. There is an urgent need for systemic change to accelerate the transition to a circular economy by normalising the right behaviours through effective regulation, incentives and enforcement.

Recycling levels for municipal, total packaging and plastic packaging waste streams cannot keep pace with waste generation levels and are undermining our efforts to improve Ireland's performance. For example, since 2016, volumes of packaging waste have risen by 25% while the recycling rate for packaging has risen by one-third of that (8%). As a result, Ireland is on course to miss EU waste recycling targets for municipal, total packaging and plastic packaging wastes for 2025, as shown in Figure 15.17.

Figure 15.17 Recycling and recovery rates and targets in municipal, waste electrical and electronic equipment (WEEE) and packaging waste, 2021



Source: EPA, 2023b

To have any prospect of meeting the 2025 recycling targets, we need to focus our efforts on reducing waste generation and improving source segregation of wastes to support recycling. As the latest waste characterisation reports show, households and businesses are not segregating wastes correctly, and many do not have a separate organic waste bin. There is a significant opportunity to improve recycling through the full implementation and use of a segregated system for residual waste, mixed dry recyclables and organic waste bins. Continuing awareness and enforcement measures are essential. So too is the urgent roll-out of organic waste bins to households and businesses that have not been provided with them to date.

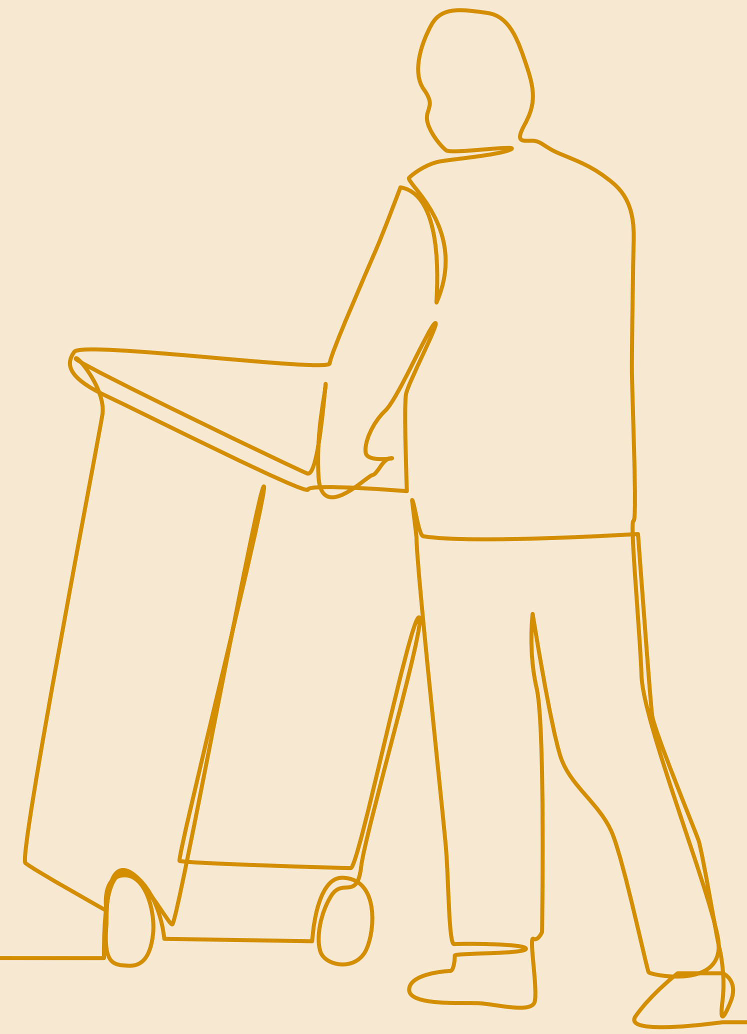
Ireland exported over 1.3 million tonnes of municipal waste in 2020 with over 400,000 tonnes sent for treatment by incineration with energy recovery. Ireland's insufficient capacity to treat domestic residual wastes and its continued reliance on overseas treatment facilities are risks to public health and to the waste sector. Exporting waste is an economic and environmental loss to Ireland, as other Member States benefit from the energy generated from our waste. National capacity to treat residual non-hazardous and hazardous wastes needs to be developed where feasible to build resilience and reduce dependence on exports.

Key chapter messages

1. Ireland has a damaging linear economy characterised by the overconsumption of materials and goods and the growing volumes of waste and greenhouse gas emissions. While recycling tonnages are increasing, these increases are being cancelled out by the growing amount of waste generated. Current trends pose a high risk of not meeting mandatory recycling targets. The challenge for Ireland is to reverse these trends and significantly reduce waste production.

2. Ireland's capacity to collect and treat waste is vulnerable and underperforming, with an over-reliance on other countries to treat our recycling materials, general municipal and hazardous wastes.

3. Systemic change is needed to accelerate the transition to an accessible, fair and affordable circular economy. Effective regulation, incentives and enforcement are required to influence businesses and consumers to adopt best practices in production, supply, purchasing, use and reuse of goods, products and services.



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Chapter 16:

Environmental Policy Implementation and Performance

Environmental Policy Implementation and Performance

1. Introduction

Ireland has an extensive and expanding suite of legislation and policies to safeguard the natural environment and protect human health. This includes laws, policies, plans and guidelines covering air and water quality, climate change adaptation and mitigation, protection of biodiversity, circular economy and waste management, noise pollution and land use planning. In a review of Ireland's environmental performance in 2021, the Organisation for Economic Co-operation and Development (OECD) noted that climate, circular economy and biodiversity policies have gained renewed impetus in Ireland, with various ambitious and well-designed policy initiatives and large public investment plans now in place. However, it also noted that these policies need to be swiftly implemented to alleviate the growing pressures from intensification of agricultural practices, population growth, urban sprawl and road traffic (OECD, 2021a). Ireland's strong population and economic growth in recent years is placing increased pressure on critical infrastructure, including water, energy, waste and transport services as well as the housing supply. The latest population projections undertaken by the Economic and Social Research Institute (ESRI), which are being used to inform the first statutory revision of the National Planning Framework, indicate that Ireland's population will reach 5.7 million by 2030, a decade sooner than was anticipated when the National Planning Framework was developed in 2018, and will reach 6.1 million by 2040 (Bergin and Egan, 2024).

This chapter presents a high-level overview of Ireland's performance in implementing global, European Union (EU) and national environmental policy and legislation. It highlights a number of key implementation gaps and shortcomings where Ireland has failed to adequately implement environmental policy and legislation, drawing on the findings of the European Commission's latest Environmental Implementation Review (EIR) for Ireland (EC, 2022) and the OECD's Environmental Performance Review of Ireland (OECD, 2021a). These implementation shortfalls, and the priority actions recommended to address them, are discussed in this chapter. Lastly, some enabling factors that support successful implementation are outlined.

Ireland's environmental legislation and policy landscape

Much of Ireland's environmental legislation stems from European directives and regulations. As a result of implementing EU and national legislation and policies over the last 30 years, Ireland has made significant strides in environmental protection. Since the 1990s, the Integrated Pollution Control and Industrial Emissions licensing systems have placed controls on emissions to air, water and land from specified industrial and agricultural activities. Bans on smoky coal have resulted in improved air quality in cities and towns. The progressive increase in the landfill tax has contributed to the diversion of waste from landfill, while the introduction of segregated waste collection has facilitated recycling and composting waste.

With increased recognition of the interlinked nature of many environmental problems, the policy focus in recent years has moved towards more integrated policy frameworks with a long-term societal transition perspective. The European Green Deal, published at the end of 2019, represents the EU's far-reaching policy response to the triple planetary crisis facing Europe – climate change, biodiversity loss and pollution – and sets out a roadmap for achieving a climate-neutral continent by 2050 (EC, 2019). In turn, Ireland's environmental policy landscape has evolved in response to EU and international policy developments. Figure 16.1 lists some of the current key legislation, policies and plans in place in Ireland that address water and air quality, waste and the circular economy, nature protection, and climate change mitigation and adaptation. The remainder of this chapter assesses how well Ireland is performing in implementing these and the outlook for it achieving its policy objectives and targets.

Figure 16.1 Summary of some key environmental legislation, policies and plans in Ireland across selected thematic areas

Climate Action

OBJECTIVES
- Reduce greenhouse gas emissions, improve energy efficiency and renewable energy, assess and manage adaptation to climate change

GLOBAL
- UN Framework Convention on Climate Change
- Paris Agreement
- Kyoto Protocol

EUROPEAN DIRECTIVES & POLICIES
- 2020 Climate & Energy Package
- 2030 Climate & Energy Framework
- Emissions Trading Directive
- Effort Sharing Regulation
- Floods Directive
- EU Strategy on Adaptation to Climate Change.
- LULUCF Regulation (EU 2018/841)
- Fit for 55
- Regulation on the Governance of the Energy Union
- European Climate Law

NATIONAL POLICIES/PLANS
- Climate Action Plan (2024)
- National Adaptation Framework (2024)
- Climate Action and Low Carbon Development Act (2015, as amended)
- Sectoral adaptation and mitigation plans (various)
- National Energy and Climate Plan (2021-2030)

LOCAL/REGIONAL PLANS
- Local Authority Climate Adaptation Plans & Low Carbon Roadmaps
- Flood Risk Management Plans
- Local Authority climate action plans

Air Quality

OBJECTIVES
- Reduce emissions of specified air pollutants (NO_x, SO_x, NMVOC, NH_3, and PM_{10}/ $PM_{2.5}$)

GLOBAL
- Convention on Long Range Transboundary Air Pollutants

EUROPEAN DIRECTIVES & POLICIES
- EU Green Deal
- Clean Air Package
- CAFE Directive
- National Emissions Ceiling Directive
- 8th Environmental Action Programme to 2030
- EU Zero Pollution Plan
- Climate Action Regulations

NATIONAL POLICIES/PLANS
- Clean Air Strategy for Ireland 2023
- National Air Pollution Control Programme
- Solid Fuel Regulations
- National Sustainable Mobility Policy
- Air Pollution Act 1987 (Solid Fuels) Regulations 2022

LOCAL/REGIONAL PLANS
- Local Authority noise action plans

Nature

OBJECTIVES
- Protect and conserve Ireland's natural heritage and biodiversity, including designated species and habitats

GLOBAL
- Convention on Biological Diversity and associated Strategic Plan for Biodiversity 2011-2020
- Bonn Convention
- Ramsar Convention
- Convention on International Trade in Endangered Species of Wild Fauna and Flora
- Kunming Montreal Global Biodiversity Framework
- Inclusive Conservation Initiative
- COP15
- Agreement (UNCLOS) for the conservation and sustainable use of marine biological diversity

EUROPEAN DIRECTIVES & POLICIES
- Birds & Habitats Directives
- EU Biodiversity Strategy for 2030
- EU Soil Strategy for 2030
- Commission Decision on Good Environmental Status 2017
- 8th Environmental Action Programme to 2030
- Nature Restoration Law

NATIONAL POLICIES/PLANS
- National Peatlands Strategy 2015
- National Raised-Bog SAC Management Plan 2017
- All Ireland Pollinator Plan 2021-2025
- Marine Protected Areas Bill 2022
- 4th National Biodiversity Action Plan 2023-2027

LOCAL/REGIONAL PLANS
- Local Authority Biodiversity Action Plans and Local Authority Green Infrastructure Strategies

Water Quality

OBJECTIVES
- To improve and maintain good water quality including groundwater, rivers, lakes, estuaries, coastal waters and bathing waters

GLOBAL
- OSPAR Convention
- MARPOL Convention

EUROPEAN DIRECTIVES & POLICIES
- Water Framework Directive
- Marine Strategy Framework Directive
- Bathing Water Directive
- Groundwater Directive
- Nitrates Directive
- Urban Waste Water Treatment Directive
- EU Biodiversity Strategy for 2030
- EC decision 2017/848 - criteria / standards for Good Environmental Status for marine waters

NATIONAL POLICIES/PLANS
- Water Action Plan 2024 – A River Basin Management Plan for Ireland
- Ireland's Marine Strategy Part 3 Programme of Measures
- National Marine Planning Framework
- Fifth Nitrates Action Programme 2022-2025
- Maritime Area Planning Act 2021
- National Plan for Sustainable Aquaculture 2021-2030

Draft/In prep:
- Water Services Strategic Plan
- Water and Planning Guidelines
- National Water Resources Management Plan

LOCAL/REGIONAL PLANS
- Priority action areas (in River Basin MP)

Draft/In prep:
- Designated maritime area plans
- catchment management plans

Waste & Circular Economy

OBJECTIVES
- Reduce waste generation, improve waste management and promote more efficient resource use

GLOBAL
- Basel Convention
- Global Alliance on Circular Economy and Resource Efficiency

EUROPEAN DIRECTIVES & POLICIES
- EU Green Deal and Circular Economy Action Plans
- Waste Framework Directive
- Individual producer responsibility directives on Packaging, WEEE, End-of-Life Vehicles, Batteries & Accumulators etc.
- Landfill Directive
- WEEE
- Single-use Plastics Directive
- Packaging and Packaging Waste Directive

NATIONAL POLICIES/PLANS
- Climate Action Plan (2024)
- Circular Economy Programme 2021-2027
- National Hazardous Waste Management Plan (2021-2027)
- Waste Action Plan for a Circular Economy 2024-2030
- National Waste Management Plan for a circular economy 2024-2030
- National Waste Prevention Programme Annual Reports

LOCAL/REGIONAL PLANS
- Litter management plans

Cross-cutting and Integrated Environmental Assessment

OBJECTIVES
- To improve environmental protection and promote sustainable development

GLOBAL
- UN Sustainable Development Agenda 2030
- Aarhus Convention

EUROPEAN DIRECTIVES & POLICIES
- EU Green Deal
- Industrial Emissions Directive
- Strategic Environmental Assessment Directive
- Environmental Impact Assessment Directive
- Environmental Liabilities Directive
- 8th Environmental Action Programme to 2030
- European Landscape convention

NATIONAL POLICIES/PLANS
- National Implementation Plan for the SDGs (2022-2024)
- Circular Economy Programme 2021-2027
- National Planning Framework / Project Ireland 2040

Key sectoral policies in Ireland

An enduring challenge is ensuring that sectoral policies and decision-making take account of, and are aligned with, Ireland's various environmental commitments, as discussed above. Some of Ireland's current key sectoral plans are listed in Figure 16.2 and include the National Planning Framework, which sets the vision and strategy for the development of Ireland to 2040, along with the National Development Plan 2021-2030, which provides the enabling investment to implement the National Planning Framework. Ensuring that the socio-economic ambitions in Ireland's various sectoral plans in areas such as agriculture, transport and forestry support rather than conflict with Ireland's environmental commitments can be challenging. The OECD identifies a number of challenges in the consideration of environmental and climate aspects in Ireland's long-term strategic planning and public investment decision-making, which increase the risk that a lack of coherence and consistency across sectoral policies will emerge (OECD, 2023a). The OECD also identifies a number of opportunities for strengthening the consideration of environmental issues in Ireland's long-term planning, which are touched on later in this chapter.

Figure 16.2 Overview of some key national sectoral policies, plans and programmes

Circular Economy

NATIONAL
- National Hazardous Waste Management Plan 2021-2027 (EPA)
- Whole of Government Circular Economy Strategy 2022-2023 -Living More, Using Less (DECC)
- A Waste Action Plan for a Circular Economy 2020-2025 (DECC)
- National Waste Management Plan for a Circular Economy 2024-2030 (DECC)

Built Environment

NATIONAL
- National Planning Framework / Project Ireland 2040 (DHLGH)
- Sustainable and Compact Settlements Guidelines for Planning Authorities – January 2024 (DHLGH)
- Ireland's National Waste Policy (DECC)

Draft/in prep:
- Project Ireland 2040 - Revision to the National Planning Framework – July 2024 (DHLGH)

REGIONAL
- Regional spatial & economic strategies (regional assemblies)

COUNTY
- County / City development plans

LOCAL
- LA area and development plans and SDZ planning schemes
- Local Authority climate action plan
- LA biodiversity action plans

Rural Development

NATIONAL
- Rural Development Programme Action Plan for Rural development (DRCD)
- Sustainable Rural Housing Development Guidelines (DHLGH)
- Our rural future: Rural Development Policy 2021-2025 (DCRD)

Agriculture

NATIONAL
- Food Vision 2030 Strategy - A world leader in sustainable food systems (DAFM)
- Good Agricultural Practice Regs (DHLGH)
- Code of Good Agricultural Practice for Reducing Ammonia Emissions from Agriculture (DAFM)
- CAP Strategic Plan 2023-2027 (DAFM)
- Ag-Climatise – a roadmap towards climate neutrality (2020) (DAFM)
- National Policy Statement on the bioeconomy (DoTaoiseach)
- Bioeconomy Action Plan 2023-2025 (DAFM)
- National Strategy for Horticulture 2023-2027 (DAFM)
- Fifth Nitrates Action Programme 2022-2025 (DAFM and DHLGH)

Forestry

NATIONAL
- National Forestry Programme 2023-2027 Forests & Water (DAFM)
- Forest Strategy to 2030 (DAFM)
- Forest Strategy 2023-2027 Implementation Plan (DAFM)
- Annual Forestry Licensing Plans (DAFM)
- Coillte Forest Estate Land Use Plan 2023-2050 (Coillte)

Draft/in prep:
- Forestry and Freshwater Pearl Mussel Plan (DAFM)

LOCAL
- Individual forestry plans
- Forestry Management plans

Fisheries

NATIONAL
- Harnessing Our Ocean Wealth – An Integrated Marine Plan for Ireland (2012) DAFM
- Operational Programme (2014-2020) (DAFM)
- National Marine Planning Framework (DECC)
- National Plan for Sustainable Aquaculture 2021-2030 (DAFM)
- Seafood Development Programme 2021-2027 (DAFM)

Biodiversity

NATIONAL
- National Peatlands Strategy (2015) (NPWS-DHLGH)
- Climate Action Plan 2024 (DECC)
- 4th Biodiversity Action Plan 2023-2027 (NPWS-DHLGH)
- National Raised Bog SAC Management Plan (2017-22) (NPWS-DHLGH)
- Hen Harrier Threat Response Plan 2023-2027 (NPWS-DHLGH)

COUNTY
- Local Authority Biodiversity Plans and Heritage plans/strategies

Energy

NATIONAL
- National Energy and Climate Plan (2021-2030) (DECC)
- National Biomethane Strategy 2024 (DAFM)
- National Hydrogen Strategy (DECC)
- Offshore Renewable Energy Development Plan (DECC)
- Policy Statement on Geothermal Energy for a Circular Economy (DECC)

Draft/in prep:
- Grid 25 Implementation Plan 2023-2028 (Eirgrid)

REGIONAL

In Prep:
- South Coast Designated Maritime Area Plan (DECC)

COUNTY
- Local Authority renewable energy strategies

Transport

NATIONAL
- National Sustainable Mobility Policy (DoT)
- Planning Framework for Alternative Fuel Infrastructure in Transport (DECC)
- National Investment Framework for Transport in Ireland (DoT)
- National Cycle Network Plan (DoT)
- BusConnects (NTA)
- All Island Strategic Rail Review 2024 (DoT)
- National eV Charging infrastructure Strategy (DoT)

Draft/in prep:
- Moving Together – A Strategic approach to the improved efficiency of the transport system in Ireland (DoT)
- Review of National Ports Policy (DoT)

COUNTY/LOCAL
- Greater Dublin Area Transport Strategy 2022-2042 (NTA)
- Metropolitan area transport strategies (NTA)
- Metropolitan area strategic plans (Regional Assemblies)
- Port / Harbour Masterplans

Water Services

NATIONAL
- Water Action Plan 2022-2027 – A river basin management plan for Ireland (DHLGH)
- Water Services Strategic Plan (2019-2024) (Uisce Éireann)
- National Water Resources Framework Plan (Uisce Éireann)
- 5th Nitrates Action Programme 2022-2025 (DAFM)

Draft/in prep:
- Arterial Drainage Maintenance Activities 2022-2027 (OPW)
- Water Services Policy Statement 2024-2030 (DHLGH)
- Water Services Strategic Plan 2050 (Uisce Éireann)

REGIONAL
- Regional water resource plans (Uisce Éireann)

Marine

NATIONAL
- National Marine Planning Framework (DHLGH)

Draft/in prep:
- Offshore Marine Planning Guidelines (DECC)
- Designated Maritime Area Plan Guidelines (DECC)
- Marine Planning Policy Statement (DECC)

Tourism

NATIONAL
- People, Plan and Policy – Growing Tourism to 2025 (DTCAGSM)
- National Greenway Strategy (DoT)
- 10- Year Tourism Strategy (Failte Ireland)

Draft/in prep:
- National tourism policy (DTCAGSM)

REGIONAL
- Regional tourism strategies (Failte Ireland).

COUNTY
- Local Authority tourism strategies

LOCAL
- Visitor experience and destination plans (Failte Ireland)

Health

NATIONAL
- Healthy Ireland (DoH)
- One Health, One Welfare – Ireland's Second One Health National Action Plan on Antimicrobial Resistance 2021-2025 (DAFM/DoH)
- National Radon Control Strategy (DECC)
- Understanding life in Ireland – National Well-Being Framework 2023

Strategic Environmental Assessment is needed for certain plans and programmes[a]
Appropriate Assessment is needed for plans, programmes and projects likely to impact on Natura sites[b]
Environmental Impact Assessment is need for certain projects[c]

a Guidance on Strategic Environmental Assessment (SEA) is available from the EPA at: www.epa.ie/monitoringassessment/assessment/sea/

b Guidance on Appropriate Assessment is available from the NPWS at: www.npws.ie/protected-sites/guidance-appropriate-assessment-planning-authorities

c Guidance on Environmental Impact Assessment (EIA) is available from DHPLG and EPA at: www.epa.ie/pubs/advice/ea/ & www.housing.gov.ie/planning/environmental-assessment/environmental-impact-assessment-eia/eia-portal

2. Assessment of Ireland's environmental performance

Environmental Implementation Review 2022

The European Commission undertakes a periodic Environmental Implementation Review (EIR), designed to improve the implementation of European environmental laws and policies in Member States. The EIR process provides an opportunity to identify implementation issues and seek solutions before issues reach the infringement stage. The latest EIR for Ireland, published in 2022 (EC, 2022), identifies the following key findings for Ireland.

Nature

- Ireland has made progress in designating nature sites within its terrestrial Natura 2000 network, and the terrestrial designations are now considered to be complete.
- There are significant knowledge and designation gaps in Ireland's marine Natura 2000 network, especially under the Birds Directive (2009/147/EC).
- The situation for forested areas protected under the nature directives is concerning, as half of the assessments show a bad conservation status.
- There are still concerns about the conservation of raised and blanket bogs designated as special areas of conservation (SACs), which remains the subject of an infringement procedure.
- Restoration work has still to be completed on many raised bog SACs and started on most blanket bog SACs.
- Moreover, illegal turf cutting still takes place on raised bog SACs, and Ireland has not made any progress in ensuring that turf cutting carried out on blanket bog SACs is managed in a way that is compatible with the conservation of this habitat.

Water

- Water treatment continues to be a concern. The rate of compliance with the Urban Waste Water Treatment Directive (91/271/EEC) is low because of the large number of non-compliant agglomerations.
- Ireland has not yet resolved problems with the quality of its drinking water.
- The quality of Ireland's bathing waters is below average.
- The country's new water pricing system requires monitoring to ensure that it works in practice.
- The powers to regulate water abstraction and hydromorphological controls are still not in place, as the proper legal framework is still absent.

Access to justice

- Access to justice in environmental matters remains an issue, and no progress has been achieved since the last EIR in 2019. The Commission is concerned about the cost of bringing an environmental legal action in Ireland.

Waste

- Ireland's waste generation continues to rise and remains significantly above the EU average.
- Landfilling and recycling rates for municipal waste and packaging waste, respectively, have declined since 2014, with more waste being sent for energy recovery.
- Although Ireland is well above the EU average in terms of resource productivity, its circular use of material is the second lowest in the EU.

Air

- On air quality, Ireland has made some progress in reducing emissions.
- However, emissions of ammonia have been increasing since 2011; ammonia emissions from agriculture in particular pose a significant problem.

Financing

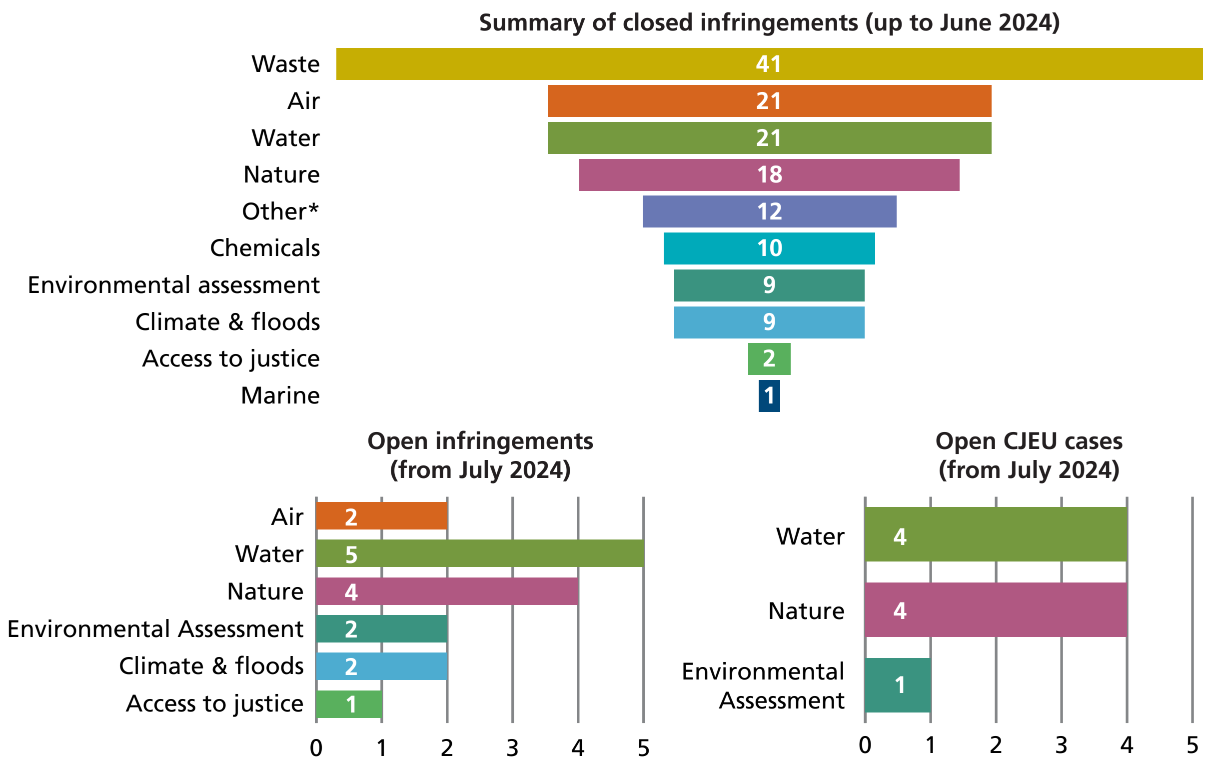
- EU financing continues to help Ireland substantially in tackling its environmental implementation gap.
- Ireland's overall environmental financing of investments is estimated to have been 0.3% of gross domestic product (GDP) in 2014-2020, mostly from national sources. The country's environmental investment needs in 2021-2027 amount to at least 0.48% of GDP, suggesting a financing gap of over 0.18% if baseline financing levels continue.
- Since 2019, Ireland has had to pay fines of over €13 million imposed by the Court of Justice of the European Union (CJEU) for non-conformity with environmental impact assessment (EIA) legislation.
- The EIR also sets out the priority actions across different thematic areas required for Ireland to address the implementation issues identified in the review. These priority actions are highlighted in a series of topic boxes throughout this chapter.

Infringement procedures for breaches of EU environmental law

The European Commission has the power to bring legal action – an infringement procedure – against Member States for failing to properly implement EU law. Infringement procedures can arise from the Commission's own investigations or following complaints from citizens, businesses or other stakeholders. The procedures follow a number of formal steps that require engagement between the Commission and the Member State. If the Member State fails to remedy the breach of EU law, the Commission may refer the matter to the CJEU, which, in certain cases, can impose financial penalties. Most cases are resolved before being referred to the CJEU. Unresolved infringements point to ongoing structural, administrative and legislative deficiencies in the implementation of environmental legislation and can be damaging to a country's international reputation. The number of open infringements fluctuates over time as existing infringement procedures are closed and new ones are opened.[1]

As shown in Figure 16.3, as of 21 June 2024, there were nine CJEU cases and 16 infringements open against Ireland for failures in implementing EU environmental legislation. The cases comprised four relating to water (poor application of the Urban Waste Water Treatment Directive, exceedances of trihalomethanes in drinking water and issues relating to incorrect transposition of the Water Framework Directive (2000/60/EC)), four relating to nature (failures to designate special protection areas (SPAs) and SACs and failures to fulfil obligations under the Invasive Alien Species Regulation ((EU) 1143/2014)) and one relating to impact assessment (not properly carrying out an EIA). The active infringements consist of five relating to water, four relating to nature, two each relating to air, climate and impact assessment, and one relating to access to justice. As illustrated in Figure 16.3, the majority of environmental infringement procedures pursued by the Commission against Ireland over the last 22 years have related to shortcomings in implementing waste, air, water and nature legislation.

Figure 16.3 Closed infringement procedures against Ireland since 1 January 2002 for failures in implementing EU environmental legislation



*The 'other' infringements related to the Seveso Directive, Noise Directive, Environmental Liability Directive, Integrated Pollution Prevention and Control Directive and the Nagoya Protocol on Access to Genetic Resources.

1 The latest information on infringements is available on the European Commission website (ec.europa.eu/info/law/infringements_en) accessed 1 August 2024.

Resolving the current infringement procedures, and avoiding future ones, will require proactive action and prioritised legislation and implementation by government and public authorities in Ireland.

Environmental enforcement performance of local authorities

Local authorities play a central role in the implementation of environmental legislation and policy on the ground in Ireland. They managed almost 70,000 environmental complaints and carried out 197,300 environmental inspections in 2022. Waste and litter accounted for the vast majority (about 90%) of complaints and almost 70% of inspections undertaken by local authorities in 2022 (EPA, 2023a). Some 93% of the environmental prosecutions undertaken by local authorities in 2022 were in the waste sector (excluding litter). The Environmental Protection Agency (EPA) has a supervisory role in relation to local authorities' performance of their statutory environmental protection duties. To help target environmental enforcement activity, enforcement priorities are agreed nationally, with a focus on water quality, air quality, noise and waste management. The EPA's latest report on local authority performance (EPA, 2023a) found that most local authorities performed well in some areas, but none performed well across all the national enforcement priorities. Reasons for underperformance included differences in local authority management priorities, resource variability and the quality of information reported. The report calls on local authorities to prioritise and resource environmental functions to ensure that national enforcement priorities are delivered (EPA, 2023a).

Enforcement of EPA-licensed industrial and waste facilities

The EPA undertakes enforcement activities at EPA-licensed industrial and waste sites nationally. A total of 889 industrial and waste licences were enforced by the EPA's Office of Environmental Enforcement in 2023, with 1202 inspections carried out at 535 individual licensed sites (EPA, 2024a). The number of complaints received by the EPA decreased by 29% in 2023 to 960. Odour and noise complaints continued to dominate, accounting for 90% of all complaints received in 2023. Twenty-two cases were heard in District and Circuit Courts in 2023 with fines of €137,750 imposed and total costs of €245,047 awarded to the EPA.

The National Priority Sites List is used by the EPA to target its enforcement efforts at licensed operators with the poorest environmental performance. A total of 50 facilities have appeared on the list since it was first published in 2017, with the majority in the food and drink sector (in particular dairy processing sites) and in the waste sector. Issues at these sites include discharges to water, odour and noise, and poor waste management. Chapter 13 discusses these issues in more detail and points to the need for continued investment and improvements to ensure that industrial sites comply with tighter environmental standards.

Enforcement efforts targeting illegal, industrial-scale commercial peat activities remain a key priority for the EPA. The Agency has deployed significant resources in taking action against this sector, resulting in successful legal proceedings in the High Court and District Courts. The EPA will continue to target its efforts against these unregulated operators.

The EPA also has concerns about the absence of regulation of the commercial peat extraction sector by local authorities and is exercising its powers under Section 63 of the Environmental Protection Agency Act 1992 to ensure that seven local authorities take the appropriate regulatory and enforcement action.

Ireland's performance on climate

Chapter 4 provides a detailed look at climate change in Ireland, including pressures and policy responses. It outlines that, despite our climate action ambitions, significantly faster progress is needed to decarbonise all sectors of Ireland's economy and to implement adaptation actions to deliver a climate-resilient future.

The European Climate Law (Regulation (EU) 2021/1119) writes into law the European Green Deal's goal of Europe's economy and society becoming climate neutral by 2050. Nationally, the Climate Action and Low Carbon Development (Amendment) Act 2021 sets out Ireland's objective of achieving a climate-resilient and climate-neutral economy by the end of 2050. It establishes 5-year carbon budgets for the economy and for specific sectors, provides for annual reviews of the Climate Action Plan and makes government departments responsible for achieving their carbon budgets and mitigation targets.

As detailed in Chapter 4, Ireland's greenhouse gas emissions per capita are among the highest in the EU. The EPA's latest provisional greenhouse gas emissions report for 2023, published in July 2024, presents some more positive news, noting that Ireland's greenhouse gas emissions decreased by 6.8% (4.0 Mt CO_2 eq (megatonnes of carbon dioxide equivalent)) in 2023, with reductions in almost all sectors (EPA, 2024b). This represents the lowest level of greenhouse gas emissions in three decades and is below the 1990 baseline. The sectors showing the largest single-year reductions were the energy and agriculture sectors, while residential emissions in 2023 were at their lowest since 1990 and transport emissions were below pre-COVID-19 levels. In terms of target compliance, Ireland complied with its EU Effort Sharing Regulation ((EU) 2023/857) commitments for 2021-2023 with the use of permitted flexibilities; however, Ireland's greenhouse gas emissions in 2023 were still only 10.1% below 2005 levels, well short of Ireland's EU Effort Sharing Regulation reduction commitment of 42% by 2030.

Chapter 4 also identifies that the implementation of climate adaptation measures is currently too slow and fragmented. It notes that more cross-sectoral and integrated adaptation actions can deliver multiple benefits and achieve just and equitable resilience.

Land use, land use change and forestry. Emissions from the land use, land use change and forestry (LULUCF) sector in 2023 were 12.0% above those in 1990. The contribution of Ireland's forest land sector to the removal of CO_2 from the atmosphere has reduced because of a long-term decline in the area of land afforested annually, an increase in the amount harvested and increased emissions from forestry on organic soils. Overall, Ireland's LULUCF sector currently releases more greenhouse gases than it stores, and Ireland is not on track to meet its 2030 target for net carbon removals through LULUCF. The European Commission notes that efforts need to be accelerated to expand Ireland's relatively small forested area, improve soil management and enhance peatland rehabilitation in order to improve the LULUCF sector's contribution to carbon sequestration (EC, 2024).

Transport. Decarbonising the transport sector will be critical to Ireland meeting its obligations to reduce greenhouse gas emissions. However, progress to date has been slow. In parallel to a rapid reduction in travel demand and a shift to more sustainable modes of transport, the Commission notes that Ireland needs to accelerate the deployment of electric vehicles and the recharging infrastructure (Ireland has about one publicly accessible charging point for every 23 electric vehicles, far fewer than the EU average of one for every ten vehicles) (EC, 2024).

Energy. While Ireland's renewable energy share has increased from 10.7% in 2018 (reported in the last State of the Environment Report) to 13.1% in 2022, this is the lowest level in the EU (well below the EU average of 23.0%), and Ireland is not on track to meet the EU-wide binding target of 42.5% renewable energy share by 2030. Reaching the target of 80% renewable electricity by 2030, while ensuring a stable energy supply, will require new capacity, a more flexible grid and increased interconnectivity (EC, 2024). Energy efficiency is also a key component of achieving climate objectives; however, improvements in Ireland are lagging. Despite comprehensive energy saving programmes, primary energy consumption increased by 4.5% between 2012 and 2021 and by 3.7% year-on-year from 2021 to 2022 (EC, 2024). Ireland's efforts are therefore not on track to achieve the EU-wide target of reducing final energy consumption by 11.7% by 2030.

The priority actions for Ireland to address climate change, identified in the Commission's EIR 2022, are listed in Topic Box 16.1.

Topic Box 16.1 Priority actions for Ireland on climate (EC, 2022)

- Increase the uptake of renewables.
- Decarbonise transport.
- Improve energy efficiency in existing residential and commercial buildings.
- Upgrade the current power infrastructure and strengthen its ability to cope with high shares of variable renewable generation.
- Reduce non-CO_2 emissions in agriculture while enabling the agri-food industry to transition to sustainable modes of production.
- Exercise continuous vigilance over the sustainable use of biomass and its actual impacts on carbon sinks and biodiversity due to the increasing share of biomass in the energy sector.

Ireland's performance on air

Chapter 2 provides a detailed look at air quality in Ireland, including pressures and policy responses. It notes that air pollution is the largest environmental health risk in Europe, causing cardiovascular and respiratory diseases that can lead to preventable deaths. Under the Zero Pollution Action Plan adopted in 2021, the European Commission has set a 2030 goal of reducing the number of premature deaths caused by fine particulate matter ($PM_{2.5}$) by at least 55% compared with 2005 levels. The zero-pollution vision for 2050 is for air, water and soil pollution to be reduced to levels no longer considered harmful to health and natural ecosystems, thereby creating a non-toxic environment.

In Ireland, the main policies addressing air quality are the National Air Pollution Control Programme and the Clean Air Strategy. The National Air Pollution Control Programme outlines the pathway Ireland will follow to achieve compliance with its commitments under the Emission reduction Commitments Directive (NECD) ((Directive 2016/2284), while the Clean Air Strategy promotes the integration of measures across government departments to reduce air pollution and achieve better air quality.

Overall, air quality in Ireland continues to be good when compared with other EU Member States. However, the latest EPA report notes that there are concerning localised issues relating to fine particulate matter from solid fuel combustion and nitrogen dioxide from vehicle emissions. While all EU air quality standards in 2022 were met, Ireland fell short of meeting the more stringent health-based World Health Organization (WHO) guidelines (EPA, 2023b).

Ireland's emissions of most air pollutants have fallen in recent years, with the exception of ammonia. Ammonia emissions are largely driven by the cattle population and nitrogen fertiliser use. While ammonia emission in 2022 were 1% below 2021 levels, Ireland exceeded its 2020 emission reduction commitment for a third year in a row (EPA, 2024c). Compliance with 2030 reduction commitments will be achieved only through comprehensive implementation of abatement measures such as low-emission slurry spreading and the use of inhibited urea fertiliser on farms.

As at 4 July 2024, there were two air-related infringement cases open against Ireland, relating to:

- failure to ensure correct implementation of the National Emission Reduction Commitments Directive ((EU) 2016/2284)
- non-conforming transposition of the Integrated Pollution Prevention and Control Directive (2010/75/EU) on industrial emissions.

The priority actions for Ireland to address air quality, as identified in the Commission's EIR 2022, are listed in Topic Box 16.2.

Topic Box 16.2 Priority actions for Ireland on air (EC, 2022)

- As part of the National Air Pollution Control Programme, take actions towards reducing emissions from the main sources of air pollution.
- Ensure full compliance with EU air quality standards and maintain downwards emissions trends for air pollutants to reduce adverse air pollution impacts on health and the economy, with a view to reaching WHO guideline values in the future.
- Accelerate the ratification of the amended Gothenburg Protocol under the United Nations Economic Commission for Europe Air Convention.

Ireland's performance on nature

Chapter 7 examines the status of nature in Ireland and discusses the serious threats posed by biodiversity loss and habitat deterioration. Globally, the Kunming-Montreal Global Biodiversity Framework sets out a pathway to reach a vision of a world living in harmony with nature by 2050. At the EU level, the Biodiversity Strategy for 2030 seeks to put biodiversity on a pathway to recovery and sets targets to help achieve resilient and healthy ecosystems. The EU Biodiversity Strategy works alongside the Farm to Fork Strategy, the revised Common Agricultural Policy (CAP) and the Soil Strategy for 2030 to support the transition to more sustainable agriculture. Together, they set four important targets for 2030: reducing the use of chemical pesticides by 50%, reducing nutrient losses from fertiliser by 50% while ensuring there is no deterioration in soil fertility, restoring a minimum of 10% of agricultural land with high-biodiversity landscape features, and increasing the area of land farmed organically to at least 25% (EC, 2022).

The EU Biodiversity Strategy is supported by the newly adopted EU Nature Restoration Law, which sets restoration targets for marine and terrestrial habitats. Under the Nature Restoration Law, ecosystems with the greatest potential for removing and storing carbon and preventing or reducing the impacts of natural disasters (such as floods) will be prioritised. Member States are required to submit national restoration plans to the Commission within 2 years of the law coming into force showing how they will achieve the restoration targets.

At national level, Ireland's 4th National Biodiversity Action Plan 2023-2030 sets out objectives, targets and actions to protect and restore biodiversity. Peatland rehabilitation will be crucial in meeting Ireland's biodiversity targets, as well as in improving the LULUCF sector's contribution to carbon sequestration. Plans such as the National Raised Bog Special Area of Conservation Management Plan are helping set out a roadmap for the long-term management, restoration and conservation of protected raised bogs nationally. Nature protection measures are also being implemented within various other sectoral plans, such as the National Planning Framework and Ireland's CAP Strategic Plan 2023-2027 for implementing the EU Common Agricultural Policy.

The EIR 2022 noted that Ireland legally protects 14% of its terrestrial area, which is low compared with the EU average of 26% (EC, 2022). Therefore, Ireland is not currently on track to meet the EU-wide target of legally protecting a minimum of 30% of the EU's land area by 2030, as set out in the EU Biodiversity Strategy. In 2022/2023 Ireland significantly increased the protection of its marine area from 2.3% to 9.2%. However, this remains far short of the EU target of legally protecting a minimum of 30% of the EU's sea area by 2030. Moreover, promised legislation on marine protected areas has been delayed; this legislation is essential to ensure that marine biodiversity is properly protected in the planning of future developments in the maritime area, including offshore renewable energy projects.

As discussed in Chapter 7, only 15% of Ireland's protected habitats and 56% of its protected species were in good conservation status, according to the latest report (NPWS, 2019). Ireland also faces significant challenges to protect birds in SPAs and in the wider countryside, with many species in serious decline and some at serious risk of extinction. A European Commission report in 2023 found that out of ten countries assessed, Ireland scored lowest across planning, implementation, site management, monitoring and conservation outcomes in SPAs (EC, 2023a).

The declines in species and habitats are due to changes in agricultural practices, including intensification, pollution, the spread of invasive species and the changing climate (discussed further in Chapter 7).

Ireland's rate of adoption of organic farming practices remains low. Only 2.2% of Ireland's utilised agricultural area was under organic farming in 2022, far below the EU average of 10.5%. Under the CAP Strategic Plan, Ireland aims to more than triple the area of agricultural land farmed organically to 7.5% by 2027 and to this end has increased the financial support available, while Ireland's Climate Action Plan 2024 sets a target of 10% of the agricultural land area to be organically farmed by 2030.

As at 4 July 2024, there were four nature-related CJEU cases open against Ireland, relating to:

- failing to protect peat bogs
- failing to adopt and to notify the penalties applicable to breaches of the Invasive Alien Species Regulation
- failing to classify SPAs
- failing to complete the designation of SACs under the Habitats Directive (92/43/EEC) and the establishment of the necessary conservation measures based on clearly defined conservation objectives.

The Commission also has concerns about Ireland's conservation of blanket and raised bog SACs, which are the subject of an infringement procedure. It notes that while Ireland has made progress on peatlands by publishing the National Peatlands Strategy in 2015 and a National Raised Bog Special Area of Conservation Management Plan 2017-2022, implementation gaps remain. The priority actions for Ireland to address nature and biodiversity, identified by the Commission, are listed in Topic Box 16.3.

Topic Box 16.3 Priority actions for Ireland on nature and biodiversity (EC, 2022)

- Address serious delays and deficiencies in Ireland's marine Natura 2000 network through the identification, selection and designation of sites under the Birds and Habitats Directives.
- Complete the designation of terrestrial SACs and put in place the necessary conservation measures based on clearly defined conservation objectives, so that Ireland may meet its objective of maintaining or restoring species and habitats of community interest to a favourable conservation status across their natural range.
- Take action to end illegal turf cutting on raised bog SACs and to ensure that any turf cutting on blanket bog SACs is fully compatible with their protection in Natura 2000 sites.
- Take practical steps to address the serious decline of wader populations and further develop the conservation programme for the curlew, both in Natura 2000 sites and in the wider countryside.
- Step up action on implementing the recommendations set out in Ireland's CAP Strategic Plan.

Marine ecosystems

- Implement the recommendations made by the Commission[2] in the staff working document accompanying the Commission communication[3] on recommendations for each Member State and region on the 2018 updated reports for Articles 8, 9 and 10 of the Marine Strategy Framework Directive (2008/56/EC).
- Ensure regional cooperation with Member States sharing the same marine (sub)region to address predominant pressures.

Ecosystem assessment and accounting

- Continue supporting the mapping and assessment of ecosystems and their services, and the development of ecosystem accounting, through appropriate indicators for integrating ecosystem extent, condition and services (including some monetary values) into national accounts.
- Continue supporting the development of national business and biodiversity platforms, including natural capital accounting systems to monitor and value the impact of business on biodiversity.

Ireland's performance on water

Chapters 8 and 9 discuss the status of Ireland's inland and marine waters and the pressures facing them. EU water policy is set by the Water Framework Directive and associated supporting national legislation. The Water Framework Directive establishes the objective of achieving at least 'good status' for all water bodies by 2015 (extended to 2027), implemented through river basin management plans that set out the measures needed to protect and restore water quality. Ireland has only recently delivered its third national River Basin Management Plan for 2022-2027, and in 2024 the Commission referred Ireland to the CJEU for being late in finalising the plan.

Another key water policy instrument is the Nitrates Action Programme, given effect by the Good Agricultural Practice for Protection of Waters Regulations (S.I. No. 113/2022), which seeks to prevent pollution of surface water and groundwater from agricultural sources.

In its latest semester report for Ireland, the Commission identifies the need for the country to improve its waste water treatment and drinking water infrastructure, noting that public water service infrastructure in Ireland is older than the EU average, with high leakage rates, drinking water supplies still breaching the law in parts of the country and about half of Ireland's urban waste water still not collected or treated in compliance with the Urban Waste Water Treatment Directive (EC, 2024). Only half of the urban waste water in Ireland is being treated according to all the requirements of the Urban Waste Water Treatment Directive based on the latest data for 2022 (EPA, 2023e), which was well below the EU average of 76% in 2021.[4]

In 2022 a new system for controlling surface water and groundwater abstractions was introduced in Ireland through the Water Environment (Abstractions and Associated Impoundments) Act 2022, requiring registration of abstractions of over 25 m^3/day. The level of risk due to water abstraction is deemed to be relatively low in Ireland compared with other water management pressures (EC, 2022). Ireland has yet to deliver a regime for regulating hydromorphological changes to water bodies (EC, 2024).

2 ec.europa.eu/transparency/documents-register/detail?ref=SWD(2022)55&lang=en; accessed 1 August 2024.

3 eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52022XC0314(01); accessed 1 August 2024.

4 water.europa.eu/freshwater/countries/uwwt/ireland (accessed 5 July 2024)

As at 4 July 2024, there was one water-related CJEU case open against Ireland, relating to:

- failure to ensure correct implementation of the Urban Waste Water Treatment Directive.

There was also one open infringement procedure against Ireland, relating to:

- failure to comply with the parametric limit for trihalomethanes in some drinking water supplies.

In terms of marine waters, the Marine Strategy Framework Directive requires Member States to achieve or maintain ‘good environmental status’ in the marine environment by 2020, while the Maritime Spatial Plan Directive is responsible for establishing a framework for maritime spatial planning. The Marine Strategy Framework Directive Programme of Measures sets out 25 binding environmental targets and associated methodological standards for achieving good environmental status. At a national level, the government published Ireland’s first National Marine Planning Framework in June 2021 (DHLGH, 2021). In addition, a new marine regulatory structure has been put in place in Ireland with the establishment of the Maritime Area Regulatory Authority (MARA) in July 2023. MARA’s remit includes granting marine consents for the maritime area, licensing of specific maritime activities and the administration of existing foreshore consents.

The priority actions for Ireland on water, identified in the Commission’s EIR 2022, are listed in Topic Box 16.4.

Topic Box 16.4 Priority actions for Ireland on water (EC, 2022)

- Assess new physical modifications of water bodies in line with Article 4(7) of the Water Framework Directive. In these assessments alternative options and adequate mitigation measures have to be considered.
- Maintain efforts to reduce diffuse nutrient pollution and to address hydromorphological pressures.
- Maintain efforts to improve monitoring, in particular of hydromorphological conditions, priority substances and groundwater quantity.
- Urgently ensure appropriate controls over water abstraction and hydromorphological changes in compliance with the Water Framework Directive.
- Improve the coordination of the implementation of water, marine and nature policies.
- Review the action programme regarding the high nutrients phosphorous surplus and continue to follow up on the monitoring of hotspot areas that show increasing nitrate concentrations.
- Complete implementation of the Urban Waste Water Treatment Directive for all agglomerations, by building up the necessary infrastructure.

Ireland's performance on waste and the circular economy

Chapter 15 provides a detailed look at Ireland's progress in managing waste and transitioning to a circular economy. It highlights that, despite ambitious new policies in place, to date there has been little tangible progress on transitioning to a circular economy. Significant recent policy initiatives include the Waste Action Plan for a Circular Economy adopted in 2020, the Whole-of-Government Circular Economy Strategy adopted in 2021 and put on a statutory footing via the Circular Economy Act 2022, and the National Waste Management Plan for a Circular Economy 2024-2030, which together provide the policy framework for moving Ireland from a linear to a circular economy. Recent measures to promote recycling include the recovery levy introduced in 2023, the Deposit Return Scheme for plastic drinks bottles and aluminium cans that came into operation in 2024 and the expansion of brown bins to all households being rolled out in 2024. In its latest semester report for Ireland, the Commission notes that Ireland's recycling, composting and anaerobic digestion levels are still insufficient and that Ireland's circular material use rate – at 1.8% in 2022 – remains significantly lower than the EU average (11.5%) (EC, 2024). While there are known limitations of using the circular material use rate in an Irish context due to methodological challenges around measuring the consumption and trade of waste for recycling (McCarthy *et al.*, 2024), Ireland's Circular Economy Strategy commits to significantly increasing the material use rate both in absolute terms and in comparison with other EU Member States, with the ambition of exceeding the EU average by 2030. Significant improvements in recycling and reductions in consumption will be needed to reach this objective. Topic Box 16.5 shows that if everybody in the world consumed resources at the rate people in Ireland do, the global population would require the equivalent of 3.3 Earths to satisfy its needs.

Topic Box 16.5 Ireland's global footprint – how many Earths?

The Global Footprint Network produces information on how many Earths would be needed if everyone on the planet lived like the residents of a particular country. They estimate that, if everybody in the world consumed resources at the rate people in Ireland do, the global population would require the equivalent of 3.3 Earths to satisfy its needs (Global Footprint Network, 2022).

Municipal waste generation in Ireland remains high, growing by 14.8% between 2016 and 2021. Over the same period, the quantity of materials recycled has increased at a similar level (15.8%), meaning that Ireland's recycling rate for municipal waste has essentially stagnated. With just 41% of Ireland's municipal waste recycled in 2021, urgent action is needed to significantly drive up recycling and reduce waste generation if Ireland is to meet the EU targets of 55% by 2025, 60% by 2030 and 65% by 2035 (EPA, 2023c). While Ireland has made significant progress in reducing disposal to landfill, 16% of municipal waste was disposed to landfill in 2021, meaning that further improvements are needed to meet the EU limit of 10% by 2035. Ireland also remains overly reliant on unpredictable export markets with almost 382,000 tonnes of residual waste sent for incineration abroad in 2022 (EPA, 2023c), which is neither environmentally nor economically sustainable. The government has committed to reducing food waste by 50% by 2030. The latest EPA data estimate that Ireland generated 750,000 tonnes of food waste in 2022, equating to 146 kg per person, which is higher than the EU average of 130 kg per person. There was relatively no change in the total amount of food waste generated in Ireland in 2022 compared with 2021, signalling the need for increased interventions to tackle food waste.

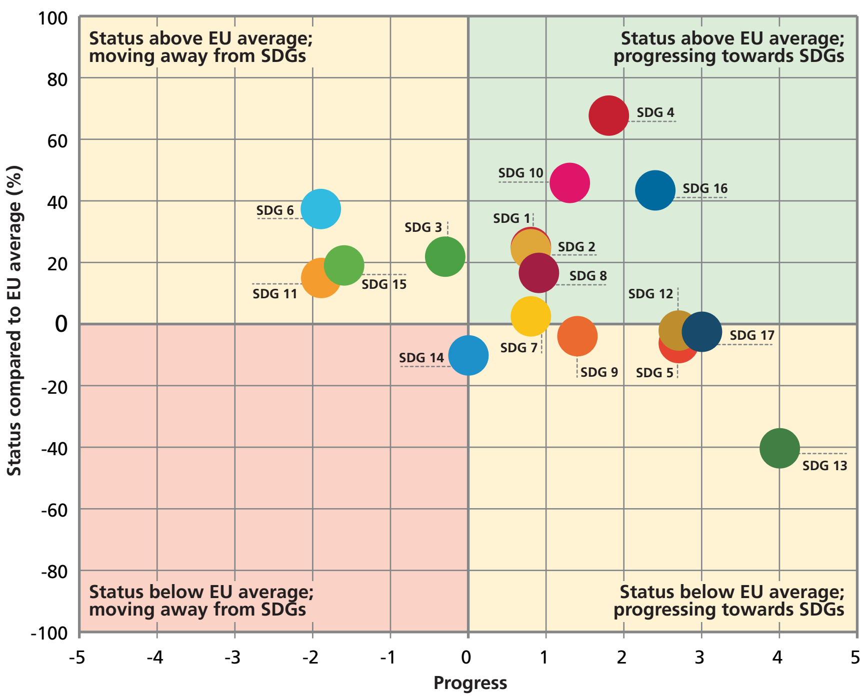
As noted earlier in this chapter, compliance issues are prevalent in the waste sector, with both the EPA and local authorities dealing with a high number of complaints and enforcement actions at waste sites. Ireland also has a poor track record of effectively implementing EU waste legislation, as evidenced by the high number of closed infringements shown in Table 16.1. In its report *The Circular Economy in Ireland*, the OECD identifies three main governance challenges for Ireland in transitioning towards a circular economy: (1) Ireland currently has a narrow view of the circular economy that is mainly based on waste, rather than a broader view of resource management; (2) Ireland's current approach tends to focus on recycling and recovery rather than preventing, repairing and reusing; and (3) there is a lack of place-based considerations that account for local specificities, such as differences in economic activities, income, population density and access to services (OECD, 2022a). The priority actions for Ireland to address waste and the circular economy, identified by the Commission in its EIR 2022, are listed in Topic Box 16.6.

In its recent semester report for Ireland (EC, 2024) the Commission identifies an investment gap in relation to the circular economy in Ireland, noting that more investment is required in areas such as eco-design, repair, reuse and remanufacturing and in infrastructure for separating waste collection and treatment and recycling facilities. It concludes that Ireland would benefit from making the waste management system more efficient, reducing waste production, increasing reused and recycled content, improving waste separation and achieving lower incineration rates (EC, 2024).

Topic Box 16.6 Priority actions for Ireland on waste and the circular economy (EC, 2022)

- Adopt the national Circular Economy Strategy.
- Adopt measures to improve the circular material use rate.
- Introduce new policy instruments, including economic instruments, to promote prevention and make reusing and recycling more economically attractive.
- Shift reuseable and recyclable waste away from incineration and landfilling.
- Increase recycling rates by making the separate collection obligation more effective.
- Carry out a review of recent reforms to the waste collection market.
- Ensure that a waste management plan in line with the revised Waste Framework Directive (2008/98/EC) is in place.

Figure 16.4 Ireland's progress with the SDGs



1. No poverty
2. Zero hunger
3. Good health and wellbeing
4. Quality education
5. Gender equality
6. Clean water and sanitation
7. Affordable and clean energy
8. Decent work and economic growth
9. Industry, innovation and infrastructure
10. Reduced inequalities
11. Sustainable cities and communities
12. Responsible consumption and production
13. Climate action
14. Life below water
15. Life on land
16. Peace, justice, and strong institutions
17. Partnerships for the goals

Source: Eurostat, 2024a

Ireland's performance on the United Nations Sustainable Development Goals

In 2015, all 193 United Nations Member States adopted the 2030 Agenda for Sustainable Development. At its core are 17 Sustainable Development Goals (SDGs) that cover the three dimensions of sustainable development: integrating economic growth, social well-being and environmental protection. Ireland's second National Implementation Plan for the SDGs for the period 2022-2024 was published in 2022 (DECC, 2022a).

Eurostat's most recent progress report on the SDGs (Eurostat, 2024), illustrated in Figure 16.4, shows that Ireland is performing well on the SDGs associated with macroeconomic stability (SDGs 8 and 16) and fairness (SDGs 1, 4, 5, 7, 8, 10) but, concerningly, is moving away from a number of SDGs related to environmental sustainability, including SDG 15 Life on land, SDG 11 Sustainable cities and communities and SDG 6 Clean water and sanitation.[5] While progress is being made on SDG 13 Climate action, Ireland ranks well below the EU average due to its high net greenhouse gas emissions per capita, particularly in the LULUCF sector. On SDG 12 Responsible consumption and production, Ireland's circular material use rate has increased marginally, from 1.7% in 2017 to 1.8% in 2022, but remains significantly lower than the EU average (11.5% in 2022). Overall, Ireland's underperformance across many of the environmental SDGs is a serious cause for concern.

Comparing Ireland's performance with that of other EU Member States

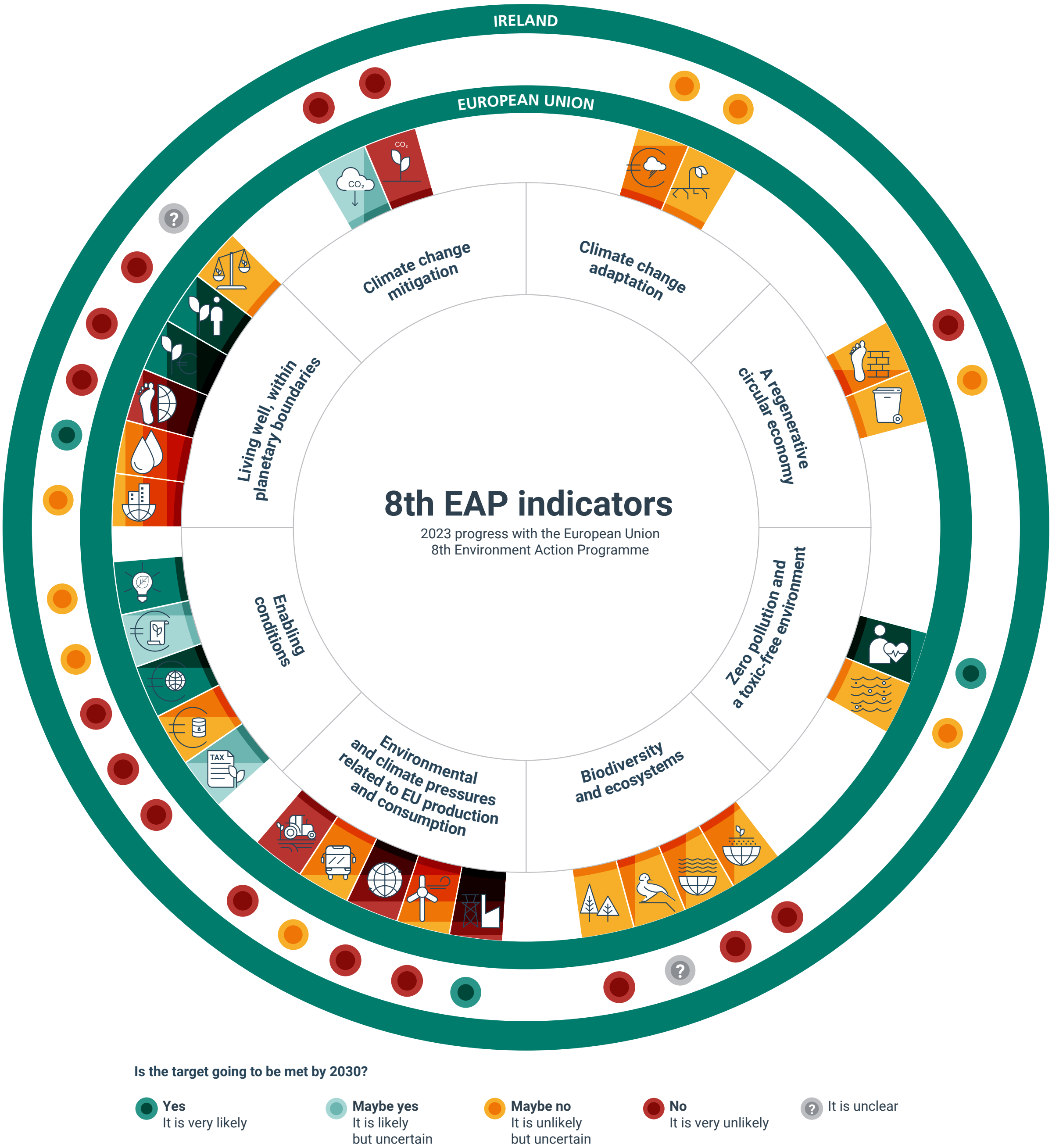
Building on the European Green Deal, the EU's Eighth Environment Action Programme (8th EAP) sets out 28 headline indicators to measure progress on achieving the EU's environment and climate goals. The first stocktake undertaken by the European Environment Agency (EEA) in 2023 found that, for most indicators, the prospect of the EU achieving the relevant 2030 targets is either uncertain or very unlikely (Figure 16.5). The indicators for 'Enabling conditions' were the best performing, indicating that progress is being made on putting in place the supporting conditions to meet the priority objectives of the 8th EAP. With the exception of fossil fuel subsidies, all other 'Enabling conditions' indicators (environmental taxes, environmental protection expenditure, green bonds, an eco-innovation index) are moving towards meeting the 2030 targets. The EEA notes that the European Green Deal is a key driver of these positive developments but that, nevertheless, these do not seem to be enough at present to produce the desired results in environmental protection and climate change.

Overall, the EEA concluded that strengthening the implementation of existing legislation, bringing forward additional policies and measures when necessary, and mainstreaming environment and climate change-related policies into other policy areas is urgently needed. The report concludes that there may also be a need for a deeper reflection on the dynamics at play and why, despite existing legislation, the EU still faces challenges in meeting many of its environmental and climate change-related objectives.

The outer circle in Figure 16.5 presents a comparison of how well Ireland is performing on the various 8th EAP indicators relative to other EU Member States. While it is acknowledged that directly comparing individual indicators for countries can be problematic due to differences in how the underlying data are collected and reported, looking across the suite of indicators provides an overall sense of where Ireland is performing well (and less well) relative to other EU countries.

5 The move away from SDG 15, Life on land, reflects the decrease in Ireland's forested area, from 22.4% in 2015 to 19.0% in 2018, which is significantly below the EU average of 43.5%. The move away from SDG 11, Sustainable cities and communities, reflects an increase in the severe housing deprivation rate and a higher percentage of the population reporting crime, violence or vandalism. The move away from SDG 6, Clean water and sanitation, reflects Ireland's relatively low percentage of the population connected to at least secondary waste water treatment (62.3% compared with an EU average of 80.9% in 2021).

Figure 16.5 Eighth Environment Action Programme monitoring results for 2023 for the EU as a whole (inner circle) and for Ireland (outer circle)



Note. The outer circle gives an overall sense of where Ireland is performing well (and less well) relative to other EU countries. Detailed information on individual indicators is available at www.eea.europa.eu/publications/european-union-8th-environment-action-programme

Source: Adapted from EEA, 2023

Overall, Ireland performs poorly relative to other Member States on 15 out of the 26 indicators for which country-specific information is available. This notably includes all of the 'Biodiversity and ecosystems' and 'Climate change mitigation' indicators, as well as many of the indicators for 'Enabling conditions', 'Living well, within the planetary boundaries' and 'Environmental and climate pressures related to EU production and consumption'. Ireland performs relatively well compared with other Member States on just three of the 26 indicators, namely 'Premature deaths due to exposure to air pollution', 'Energy consumption change' and 'Water exploitation index plus' (indicating that water scarcity is not prevalent in Ireland).

Overall, this high-level benchmarking exercise indicates that Ireland is lagging behind many other Member States on making progress with the 8th EAP objectives. It is particularly notable that Ireland performs poorly relative to other Member States on all of the 'Enabling conditions' indicators (environmental taxes, environmental protection expenditure, fossil fuel subsidies, green bonds and an eco-innovation index), suggesting that Ireland needs accelerated action to put in place the supporting conditions, including financial, to move towards the 2030 objectives in the 8th EAP and European Green Deal.

Summary assessment of Ireland's performance

Taking account of the findings and trends outlined in the previous sections, Table 16.1 presents a summary assessment of Ireland's performance on the five key policy areas of climate, air, nature, water, and circular economy and waste. Relevant indicators are used to illustrate the current status or level of compliance and the outlook for or prospect of Ireland meeting the relevant policy objectives/targets.

For some of the selected indicators shown in Table 16.1, the outlook is positive, with Ireland considered likely to achieve the relevant policy objectives or targets – this includes bathing water quality, groundwater quality, several air pollutants and landfilling of biodegradable municipal waste. However, for a considerable number of the indicators listed, the outlook is negative, with Ireland considered not on track to reach targets or policy objectives – this includes greenhouse gas emissions, urban waste water treatment, circular material use rate and all of the nature indicators. For the remaining indicators listed in Table 16.1, the outlook is considered uncertain. Overall, the outlook for the climate and nature policy areas is regarded as negative, while the outlook for the air, water and circular economy policy areas is uncertain.

Table 16.1 Current assessment and outlook for Ireland across key environmental policy areas

	INDICATOR	CURRENT ASSESSMENT	OUTLOOK	NOTES
CLIMATE	Greenhouse gas emissions	●	▼	Ireland was the third biggest net greenhouse gas emitter per capita in the EU in 2022. The latest greenhouse gas emissions projections indicate that Ireland is projected to achieve a 29% reduction in total greenhouse gas emissions by 2030, and is therefore not on track to meet the national 51% emissions reduction target (EPA, 2024d). While progress is being made in all sectors, the pace of emissions reductions is far too slow to meet national and international climate goals.
	Renewable energy share	●	▼	Although Ireland increased its renewable energy share (RES) to 13.1% in 2022 (up from 10.7% in 2018), this is the lowest level in the EU and well below the EU average of 23% (SEAI, 2023). Significant progress has been made in increasing the share of renewables in electricity generation, whereas there remains a marked distance to RES targets for both transport and heating. Ireland is not on track to meet the binding EU-wide target for overall RES of 42.5% by 2030.

	INDICATOR	CURRENT ASSESSMENT	OUTLOOK	NOTES
CLIMATE	Climate adaptation			A new National Adaptation Framework is in place and updated Sectoral Adaptation Plans are due to be produced by 2025. Local Authority Climate Action Plans have also been adopted by all local authorities. While adaptation governance structures, climate services and risk assessment capacity have been strengthened, there remains a need for a technical resilience target to support the national climate objective, and the new plans must contain clearly defined actions to achieve climate resilience accompanied by comprehensive outcome indicators.
	Overall climate assessment			While there has been progress in terms of beginning to reduce greenhouse gas emissions and in strengthening adaptation governance structures and support services, overall current assessment for climate is 'poor' (a slight improvement from 'very poor' in 2020). Full implementation of actions set out in the Climate Action Plan and additional actions are needed if Ireland is to meet its 2030 and 2050 climate targets.

	POLICY AREA	CURRENT ASSESSMENT	OUTLOOK	NOTES
AIR	**Air quality**			
	$PM_{2.5}$ (fine particulate matter)			Compliant in 2023 with EU limits for $PM_{2.5}$, but most monitoring stations are above the WHO guideline levels. Increased monitoring and modelling has highlighted high levels of $PM_{2.5}$ in many Irish cities, towns and villages. Particulate matter is estimated to cause 1600 premature deaths per year: the dominant source is the burning of solid fuel. Achieving Ireland's ambition to move towards the WHO guideline levels for $PM_{2.5}$, while challenging, will have a significant and positive impact on health.
	Nitrogen oxides			EU air quality limit values for nitrogen dioxide were exceeded at one station in Dublin in 2019 (EPA, 2020) and have not been exceeded since. Complying with the limit values outlined in the Clean Air Strategy and the proposed EU Air Quality Directive will be challenging. Climate action measures will have co-benefits for air quality and health.
	Ozone (ground level)			Ireland complied with EU legal values in 2026; however, ozone levels at 18 of 23 stations monitored were above WHO air quality guideline levels, pointing to future challenges in meeting tighter limit values.
	Polycyclic aromatic hydrocarbons			In 2023, no exceedances were recorded, and all stations monitored complied with EU legal values. However, three of four stations were above the EEA reference levels. Burning less and cleaner solid fuels will have benefits for air quality and health.

	POLICY AREA	CURRENT ASSESSMENT	OUTLOOK	NOTES
AIR	**Emissions to air**			
	Nitrogen oxides (NO_x)			NO_x emissions have reduced by 46.4% since 1990. Agriculture is the largest source (36.4%) of NO_x emissions, followed by transport (34.8%). Ireland is compliant with the 2020 emission reduction commitment for NO_x and is projected to comply with the 2030 commitment provided that planned measures are implemented.
	Sulphur dioxide			Emissions decreased by 94.9% between 1990 and 2022 (EPA, 2024c), driven mainly by a reduction in the combustion of fossil fuels at power stations and for residential and commercial heating. Ireland is compliant with its 2020 emission reduction commitment for sulphur dioxide and is projected to comply with future emission reduction commitments.
	Non-methane Volatile Organic Compounds			Emissions have reduced by 7.9% in the period 2005-2022, compared with the 25% reduction required under the NECD, indicating that Ireland is non-compliant. However, Ireland is allowed to utilise the prescribed flexibility mechanism under Directive 2016/2284 to account for improved national emission inventory methods; when the adjustment is considered, Ireland is compliant with the emission reduction commitment for NMVOCs for 2020, 2021 and 2022. Emissions are 28.7% lower than 1990. Agriculture is the largest source (39.1%). Production of food and beverages (beer and spirits) accounts for 28.2% (EPA, 2024c).
	Ammonia emissions			Although ammonia emissions in 2022 were 1% below 2021 levels, Ireland has exceeded its 2020 emission reduction commitment for a third year in succession (EPA, 2024c). National emissions are largely determined by cattle population and nitrogen fertiliser use. Compliance with 2030 reduction commitments will be achieved only through comprehensive implementation of abatement measures such as low-emission slurry spreading and the use of inhibited urea fertiliser on farms.
	$PM_{2.5}$ (fine particulate matter)			Emissions of $PM_{2.5}$ decreased by 32.7% in the period 2005-2021, driven mainly by fuel switching away from coal and peat. Ireland is compliant with its 2020 emission reduction commitment for $PM_{2.5}$ and is projected to comply with the 2030 target provided that planned measures are implemented.

	POLICY AREA	CURRENT ASSESSMENT	OUTLOOK	NOTES
AIR	Overall air assessment			The overall current assessment for air is 'moderate' (the same as in 2020). Ireland is compliant with current air quality standards for many air pollutants. However, Ireland is not meeting the guidelines set by WHO for multiple pollutants, including $PM_{2.5}$, and Ireland is non-compliant with the EU reduction target for ammonia and will remain so in the short term. Achieving the ambitions of the Clean Air Strategy and complying with the limit values of the proposed EU Air Quality Directive from 2030 onwards will be challenging, but will have a significant and positive impact on health.

	POLICY AREA	CURRENT ASSESSMENT	OUTLOOK	NOTES
NATURE	**Nature**			
	Protected habitats			Ireland has protected almost 14% of its land area as Natura 2000 sites (SACs and SPAs). The latest Article 17 report (NPWS, 2019) found that 85% of Ireland's protected habitats have inadequate or bad status, with only 15% having favourable conservation status. In terms of trends, 46% of habitats demonstrate ongoing declining trends, while only 2% are improving (NPWS, 2019). Of ten countries assessed by the Commission, Ireland scored lowest across planning, implementation, site management, monitoring and conservation outcomes at SPAs (EC, 2023a).
	Protected species			The latest Article 17 report found that 57% of protected species have favourable status and 30% have inadequate or bad status. In terms of trends, 55% of species are stable, 17% are improving and 15% are declining (NPWS, 2019).
	Bird populations			Populations of 54 (26%) of Ireland's regularly occurring bird species are in severe decline while a further 79 (37%) are showing moderate declines (Gilbert *et al.*, 2021). In all, 63% of Ireland's bird species are in serious trouble.
	Marine protected areas			Ireland significantly increased the area covered by marine protected areas, from 2.3% to 9.2%, in 2022-2023. However, the legislation to protect these areas is still not in place. Significant further progress will be needed to reach the target of 30% of Ireland's maritime area protected by 2030, as well as to implement and enforce their protection.
	Overall nature assessment			The overall current assessment for nature is 'very poor' (the same as in 2020). Deteriorating trends dominate, especially for protected habitats and bird populations, and Ireland is not on track to achieve policy objectives for nature. While the recent expansion of marine protected areas is welcome, additional far-reaching measures are needed to address the declines in nature and biodiversity.

	POLICY AREA	CURRENT ASSESSMENT	OUTLOOK	NOTES
WATER	Water			
	River water quality			Only half (50%) of Ireland's rivers are in satisfactory ecological condition (EPA 2022). There has been no net improvement in river biological quality in recent years (EPA, 2023d). Moreover, 42% of river sites, mostly in the south and south-east of the country, have unsatisfactory nitrate concentrations, while over a quarter of river sites (27%) have unsatisfactory phosphorous concentrations
	Lake water quality			Some 69% of Ireland's lakes are in satisfactory ecological condition (EPA, 2022). There has been a slight (2.7%) decrease in the proportion of lakes in satisfactory biological condition in recent years (EPA, 2023d), with over one-third (35%) of lakes having high phosphorous concentrations, particularly in the north-east of the country.
	Transitional water quality			Only 36% of Ireland's transitional waters (estuaries) are in satisfactory ecological condition. In recent years there has been a sharp decline (15.7%) in the number of monitored estuaries in satisfactory condition (EPA, 2022). The transitional waters in less than good ecological status are located primarily in the south and southeast of the country.
	Coastal water quality			Most (81%) of Ireland's coastal waters are in satisfactory ecological condition. However, in recent years there has been a significant decline (9.5%) in the number of monitored coastal water bodies in satisfactory ecological condition (EPA, 2022).
	Marine environment			Five of the 11 Marine Strategy Framework Directive descriptors are compatible with good ecological status, indicating partial compliance. Three descriptors have partially achieved good ecological status but some information is still lacking, and one descriptor has insufficient information to assess its status. Challenges remain for achieving full compliance (DHPLG, 2024).
	Groundwater quality			Some 468 (91%) of groundwater bodies are in good chemical and good quantitative status. In recent years there has been a very slight decline (0.8%; four water bodies) in the number of groundwater bodies assessed as having good status.

	POLICY AREA	CURRENT ASSESSMENT	OUTLOOK	NOTES
WATER	Urban waste water treatment			About 50% of Ireland's urban waste water is still not collected or treated in compliance with the Urban Waste Water Treatment Directive (compared with the EU average of 82%). Some 19 agglomerations had no treatment at the end of 2023 (down from 29 agglomerations the previous year); Uisce Éireann expects to have treatment in place for all these areas by 2030. While progress is being made, sustained investment in water services infrastructure is needed to achieve full compliance with the Urban Waste Water Treatment Directive and EPA waste water discharge authorisations (EPA, 2023e).
	Bathing water quality			Nationally, bathing water quality has continued to improve, with 97% of beaches (144) meeting or exceeding the minimum required standard of 'sufficient' (EPA 2024d). However, Ireland's share of bathing waters at 'excellent' quality (77%) remains below the EU average (85%) (EEA, 2024a; EPA, 2024e). The number of beaches with poor bathing water quality increased to five in 2023, up from three in 2022. Discharges from waste water overflows and drain misconnections are the main issues at these beaches.
	Drinking water quality			The quality of drinking water from public supplies remains very high, with over 99.7% compliance with bacterial and chemical limits. However, the resilience of drinking water supplies must improve as concerns remain over long-term boil water notices, detections of cryptosporidium, elevated levels of trihalomethanes and lead. 50 public supplies are on the EPA's Remedial Action List (as at Sept 2024) and Uisce Éireann's progress in addressing issues has been slow and will require sustained investment. Private supplies have poorer drinking water quality than public water supplies with 1 in 20 failing to meet the *E.coli* standards. Of the small private supplies, the total number remains unknown and are not being monitored by the local authorities, creating a potential public health risk for consumers.
	Overall water assessment			Overall current assessment for water is 'poor' (the same as in 2020). Trends remain mixed, with no net improvement in river or lake water quality in recent years, a sharp decline in the number of monitored estuaries in satisfactory ecological condition and continued direct discharges of raw or inadequately treated sewage to water from 19 agglomerations. Significant challenges remain for achieving full compliance with relevant EU obligations and national policy objectives.

CIRCULAR ECONOMY AND WASTE

POLICY AREA	CURRENT ASSESSMENT	OUTLOOK	NOTES
Circular economy and waste			
Generation of municipal waste			Municipal waste generation in Ireland continues to increase, growing by 14.8% between 2016 and 2021. Per capita municipal waste generation also increased over the same period by 9%, from 581 kg/person in 2016 to 633 kg/person in 2021. Reducing waste generation will require significant new waste prevention and consumption reduction measures.
Recycling of municipal waste			Ireland's recycling rate for municipal waste has plateaued at 41% (EPA, 2023c), presenting a considerable challenge to meeting the EU recycling targets of 55% by 2025 and 65% by 2035. Efforts to increase recycling are being outpaced by growing waste generation, highlighting that recent interventions to improve recycling need to be coupled with measures to reduce waste generation.
Recycling of plastic packaging waste			Ireland's recycling rate for plastic packaging waste was 28% in 2021, a considerable distance from the EU recycling target of 50% by 2025 (EPA, 2023c). Whether interventions such as the Deposit Return Scheme will be sufficient to meet the 2025 target remains to be seen.
Landfilling of municipal waste			Ireland's landfill rate for municipal waste was 16% in 2021, unchanged from the previous 2 years (EPA, 2023c). Ireland must reduce the share of municipal waste landfilled to 10% or less by 2035.
Biodegradable municipal waste diversion from landfill			After many years of a downwards trend, the amount of biodegradable municipal waste disposed to landfill in Ireland increased slightly in 2021 and 2022, mirroring a rise in the total amount of municipal waste landfilled. However, Ireland remains compliant (by a large margin) with the stricter limits introduced in 2020 (EPA, 2023g).
Collection and recovery of electrical and electronic waste			Ireland met the EU recovery, recycling and reuse targets for all categories of waste electronic and electrical equipment in 2022, and met most by a considerable margin (EPA, 2024f). However, Ireland has not succeeded in meeting the waste electronic and electrical equipment collection target of 65%, achieving a collection rate of 64% in 2021 (EPA, 2023c).

	POLICY AREA	CURRENT ASSESSMENT	OUTLOOK	NOTES
CIRCULAR ECONOMY AND WASTE	Circular material use rate	Very poor (red)	Largely not on track (red down arrow)	The circular material use rate (CMRU) measures the ratio between recycled materials and overall material use. Ireland's CMRU increased marginally from 1.7% in 2017 to 1.8% in 2022; however, this remains significantly lower than the EU average (11.5% in 2022). There are known methodological challenges and limitations to using the CMUR in an Irish context related to the structure of Ireland's economy. It is clear that significant improvements in recycling and reductions in the extraction and consumption of virgin materials are needed to improve Ireland's circularity rate.
	Overall circular economy and waste assessment	Poor (orange)	Partially on track (yellow dash)	The overall current assessment for the circular economy and waste is poor (the same as in 2020) but progress is being made in a number of areas to improve performance. Waste generation continues to grow, in absolute and per capita terms, and Ireland remains overly reliant on export markets for recycling and for treating municipal residual waste. Recycling rates for municipal and plastic packaging waste streams are at risk and need to increase urgently to achieve 2025 targets. Recent interventions, such as the Deposit Return Scheme, statutory roll-out of the organic waste collection service, recovery levy and national end-of waste and by-product decisions, are positive developments but the effects of these remain to be seen. The circular material use rates remains very low by comparison to the European average and Ireland needs to address specific sectoral challenges to accelerate moving from a linear to a circular economy.

SUMMARY OF CURRENT ENVIRONMENTAL PERFORMANCE, POLICY AND IMPLEMENTATION IN IRELAND	
Red	Very poor – significant environmental and/or compliance challenges to address
Orange	Poor – environmental and/or compliance challenges to address
Yellow	Moderate – on track generally/local or occasional challenges to address
Light green	Good – mainly achieving objectives
Dark green	Very good – fully achieving objectives

OUTLOOK OF CURRENT PROSPECTS OF MEETING POLICY OBJECTIVES AND/OR TARGETS	
Red down arrow	Largely not on track to meet policy objectives and targets. Significant challenges remain to achieving full compliance. Systemic and transformative change needed.
Yellow dash	Partially on track to achieving full compliance or measures in place or planned that will improve the situation. However, the outlook is dependent on existing and planned actions and measures and plans being fully implemented and effective.
Green up arrow	Largely on track to achieving full compliance. Measures in place provide prospect of meeting policy objectives and targets.

3. Improving environmental performance and policy implementation in Ireland

From the preceding sections, it is clear that improvements are needed in how environmental policy is implemented in Ireland to address the gaps and shortcomings highlighted in this chapter. In this section, some enablers that can increase the likelihood of successful implementation are discussed. Many of these enablers align with the Institute of Public Administration's findings based on its review of water governance in Ireland, shown in Topic Box 16.7.

Topic Box 16.7 Lessons learnt from water governance

Research undertaken by the Institute of Public Administration on water governance in Ireland (O'Riordan *et al.*, 2022) identifies six important lessons to support better policy implementation and governance:

1. Clearly assign roles and take ownership of responsibilities.
2. Encourage experimentation, a willingness to engage with varying perspectives and responsiveness to local contexts.
3. Make data central: its generation, monitoring, reporting and review.
4. Focus on building capacity and sharing learning.
5. Take a targeted and diverse approach to regulation.
6. Carefully manage stakeholder engagement.

The Institute of Public Administration recognises, however, that structures and processes on their own are not sufficient to achieve better outcomes and that the capability and competence of public servants is at the heart of good public administration (Boyle, 2020). Therefore, better structures and processes need to be married with enhanced capacity among the public servants involved to ensure better governance, and to ultimately deliver better policy outcomes.

Policy coherence

Policy coherence – ensuring that sectoral policies are aligned with environmental goals – is an important prerequisite to effective implementation. Ireland's Second National Implementation Plan for the Sustainable Development Goals 2022-2024 includes a commitment to mainstream the SDGs across national policies. Recent years have seen a move towards more integrated, whole-of-government approaches for certain plans and strategies that cut across multiple departments, such as the Circular Economy Strategy, Climate Action Plan, Biodiversity Action Plan, National Planning Framework and National Marine Planning Framework. For example, high-level integration is needed between land use planning and transport planning to support the move to more sustainable modes of transport. Environmental assessments (strategic environmental assessment, appropriate assessment, EIA) can help determine where conflicts, or synergies, might be arise between sectoral and environment goals. Achieving policy coherence is challenging, however, requiring effective and inclusive governance and institutional mechanisms to address policy interactions across sectors – including identifying and managing trade-offs – and aligning actions between different levels of government (OECD, 2023b). Many argue that the scale and urgency of the transformational change required to achieve a carbon-neutral, environmentally sustainable economy by 2050 demands a radically different approach to how public policies are designed and implemented. 'Systems thinking' has gained currency as one such paradigm shift (EEA, 2024b), focusing on interconnections and feedback between governance issues within and across systems (including energy, food and mobility systems) as a means of addressing global environmental and climate policy challenges in a more integrated, holistic and coherent way.

National policy position

In our last State of the Environment Report in 2020, we called on government to develop an integrated national policy position on protecting Ireland's environment (EPA, 2020). A national policy position would provide a shared, whole-of-government, long-term vision for protecting Ireland's environment to guide policy development and decision-making at all levels, from national to local. While progress has been made on developing a national policy position, it remains to be completed. Finalisation and publication of a national policy position should be prioritised by government to support policy coherence and greater coordination of environmental protection efforts among the many different departments and implementing agencies in Ireland.

Governance and implementation structures

Fragmented governance structures and processes inevitably lead to implementation challenges. As highlighted in this report, many different government departments, state agencies, and regional and local authorities in Ireland are involved in implementing environmental policies and legislation. To avoid inefficiencies, confusion, duplication of effort and poor implementation, there is a strong need for clarity around roles and responsibilities and effective collaboration and engagement. As previously noted, much of the responsibility for the implementation and enforcement of environmental regulations at the local level in Ireland lies with the local authorities. The latest EPA report on local authority enforcement performance calls on local authorities to prioritise and resource environmental functions to deliver the enforcement priorities identified (EPA, 2023a).

Resourcing and capacity building

The capability and competence of public servants is at the heart of good public administration (Boyle, 2020). Given the rapidly expanding breadth of issues being addressed by implementing agencies, particularly in quickly evolving policy areas such as climate action, the circular economy and nature restoration, reviewing levels of resourcing as part of strategic workforce planning is vital. Specialist technical expertise is essential and needs to be supported by training and knowledge sharing. High levels of staff turnover in the Irish public sector contribute to a loss of skills and expertise, which can impact productivity and outcomes.

Regulation and enforcement

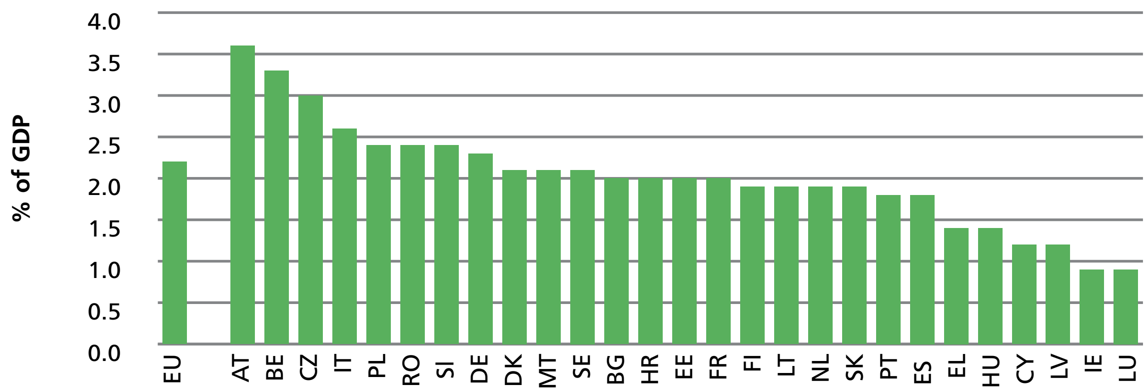
A robust regulatory framework that is appropriately enforced can support the implementation of environmental policy and legislation. Many of the chapters in this report identify the need for more rigorous enforcement of existing legislation to protect nature, water and air quality and to control industrial emissions, noise and waste management. Ensuring that regulatory regimes are fit for purpose and that 'regulation keeps up with innovation' can present challenges for new and evolving policy areas such as the circular economy and bioeconomy (O'Riordan, in press) and, reflecting this, the Bioeconomy Action Plan 2023-2025 includes a commitment to undertake a full regulatory analysis to assess the appropriateness and functionality of the current regulatory system. Smart regulation has become more common in recent years in the context of addressing 'wicked' environmental challenges, encompassing the use of a range of tailored regulatory instruments including self-regulation, co-regulation, economic instruments, and command and control regulation (O'Riordan *et al.*, 2022).

Investment and infrastructure

Finance, both public and private, is an important enabler of transitions and transformations. Unprecedented levels of investment are needed to deliver the infrastructure required to achieve climate neutrality by 2050. The European Commission's latest semester report for Ireland (EC, 2024) notes that Ireland's recovery and resilience plan includes measures to contribute to the green transition with investments in retrofitting, peatland rehabilitation and waste water management systems and also improving permitting, planning and grid connection procedures to accelerate the roll-out of renewables. The report concludes that Ireland would benefit from investing more in sustainable water management, in pollution prevention and control, and in the circular economy and waste. It states that over the 2014-2020 period, the environmental investment gap was estimated at €2.2 billion a year, or 0.7% of GDP (below the EU average of 0.8%). The gap is estimated to be increasing over the 2021-2027 period at €3.4 billion per year. There remains an opportunity to increase funding, in particular for water management (€910 million per year), pollution prevention and control (€838 million per year) and circular economy and waste (€827 million per year). While the investment gap for biodiversity and ecosystems decreased, the Commission noted that Ireland would benefit from further investing in biodiversity and ecosystems. Separately, the report notes that Ireland has low levels of investment in research and development relative to other EU Member States, which holds back innovation, productivity and growth (EC, 2024).

Expenditure on environmental protection is an indicator used by the European Commission and includes expenditure related to the abatement of air, water, soil and noise pollution, the protection of biodiversity, the management of waste water and waste, and environmental research and development. The 8th EAP progress report (EC, 2023b) shows Ireland as ranking bottom among EU states in terms of expenditure on environmental protection as a percentage of GDP (Figure 16.6). Based on the latest 2021 data, average expenditure on environmental protection accounted for 2.2% of GDP among EU Member States in 2021, while in Ireland it accounted for only 0.9% of GDP (Figure 16.6). Notwithstanding difficulties in using GDP for comparing expenditure given the nature of Ireland's open economy, it is clear that increased investment in environmental protection is needed in Ireland to address the deficits discussed in this report. Ireland's progress is also being hampered by lengthy delays in the delivery of critical infrastructure in areas such as energy, water and housing, which is being exacerbated by labour and skills shortages (EC, 2024). In its EIR 2022 the Commission included two priority actions for Ireland relating to environmental financing, shown in Topic Box 16.8 (EC, 2022).

Figure 16.6 Environmental protection expenditure in EU Member States in 2021



Source: Eurostat, 2024b

Topic Box 16.8 Priority actions for Ireland on finance (EC, 2022)

- To devise an environmental financing strategy to maximise opportunities for closing environmental implementation gaps, bringing together all relevant administrative levels.
- To ensure an increased level of financing, and further exploit opportunities in private financing, for the environment to cover the investment needs identified across the environmental objectives and to close investment gaps.

Ex post evaluation

The OECD notes that *ex post* evaluation mechanisms – designed to assess that environmental legislation, policies and plans are working as intended – are not systematically or routinely applied in Ireland (OECD, 2023c). The lack of *ex post* evaluation means that valuable insights from the relevant implementing agencies on the feasibility and impacts of implementation are not identified at an early stage. Expanding the use of *ex post* assessment of environmental legislation and policies would help support successful implementation (OECD, 2021a, 2022b, 2023c).

Data and evidence

Improvements are being made in Ireland's strategic policy infrastructure to ensure that data insights influence policy decisions. The Irish Government Economic and Evaluation Service and the Irish Government Statistical Service work to provide data and insights on priority policy issues. The planned establishment of strategic policy units in government departments will further strengthen capacity and capability to provide evidence-informed insights for the government. There is also significant focus nationally on enhancing connectivity and engagement between researchers and policy practitioners and improving access to publicly funded research outputs. As well as improving the supply of evidence, there is also a need to build absorptive capacity in the policy system and improve the demand for and use of evidence by policymakers through awareness raising and capacity building. Despite these improvements, the OECD notes that Ireland's public administration could benefit from stronger attention to data-based reform initiatives and that developing data-sharing networks and strengthening data skills across the civil service would allow Ireland to harness the potential of evidence-based decision-making (OECD, 2023c).

Effective monitoring

Monitoring and reporting on the implementation of plans and programmes has been shown to support better implementation. Publishing monitoring reports improves public access to information and increases the accountability of implementing bodies. Well-designed indicators can help to identify implementation shortcomings and signal where interventions or new approaches may be needed. Nationally, having a standardised set of environmental indicators aligned to key policy objectives would enable planners and policymakers to integrate these from the outset, supporting their delivery. Opportunities to share environmental indicator data would also help improve data quality and consistency and reduce the administrative and financial burden on public bodies.

Strategic foresight

Many 'drivers of change' that impact the environment are not of an environmental nature but have a significant impact on Ireland's and Europe's long-term environmental and sustainability outlook. As a result, there has been growing interest in anticipatory knowledge and strategic foresight, both in Ireland (OECD, 2021b) and internationally (OECD, 2023d) with a view to strengthening strategic policy discussions and designing more effective policies. Key drivers of change identified by the EEA include population growth; increasing urbanisation and global migration; accelerating technological change; global power shifts; climate change and environmental degradation; increasing scarcity of and global competition for resources; and diversifying values, lifestyles and governance approaches (EEA, 2020). Improved understanding of drivers of change and global megatrends should support better environmental policies and outcomes. The EEA recommends that reviews of existing European policies and plans are needed to make sure they are as resilient as possible and also dynamic enough to adapt to changes experienced.

Public engagement

The successful implementation of environmental policies and plans requires engagement, support and behavioural change from businesses, communities and citizens. Overcoming the barriers to individual and collective climate action, for example, necessitates understanding people's beliefs and attitudes and the challenges they face and providing positive support to incentivise change. Citizens can more effectively protect the environment if they can rely on the three 'pillars' of the Aarhus Convention: access to information, public participation in decision-making and access to justice in environmental matters (EC, 2022).

Ireland's Second National Implementation Plan for the Sustainable Development Goals 2022-2024 (DECC, 2022a) includes many actions around public engagement and partnerships to embed the principle of 'leaving no one behind'. The OECD, however, identifies the need for Ireland to develop more transparent and open stakeholder engagement mechanisms, noting that consultation practices do not yet operate on a systematic basis across government departments (OECD, 2022b).

On access to environmental information, the Commission reports that Ireland's implementation of the INSPIRE Directive (2007/2/EC) has been poor and that more efforts are needed to make spatial data more widely accessible, particularly high-value data sets (EC, 2022), while, on access to justice, the Commission identifies the very high costs of bringing legal action in Ireland as a very significant obstacle to accessing justice. It states that the Irish government needs to do more to address the prohibitively high costs of legal action, to better inform the public about their rights to access justice and to ensure that abusive strategic lawsuits against public participation, designed to deter legitimate access to environmental justice, are identified and prevented via the appropriate means (EC, 2022).

4. Conclusions

It is clear from this chapter, and the evidence presented elsewhere in this report, that a number of serious deficits remain in how Ireland has implemented EU environmental legislation and that we are not on track to achieve a considerable number of our environmental policy objectives and commitments.

While a growing number of ambitious policies are now in place, Ireland continues to face immense challenges in tackling water pollution, high greenhouse gas emissions, loss of nature and biodiversity, and unsustainably high levels of waste generation and, while progress has been made on air pollution, further reductions are needed in the years ahead to adequately protect human health.

Addressing these issues, particularly in the context of Ireland's strong population and economic growth, requires accelerated action and investment to implement existing environmental legislation in full and a move towards more holistic integration of environmental and climate considerations into policymaking.

Key chapter messages

1. Serious deficits remain in Ireland's implementation of environmental legislation and related plans and programmes. To achieve full compliance with existing environmental standards, we need to scale up and speed up the implementation of measures and critical infrastructure required to safeguard air and water quality and protect nature and human health.

2. Environmental policy responses to date have been insufficient to halt or reverse environmental decline. A national policy position on protecting Ireland's environment is urgently required to provide a shared whole-of-government vision for protecting our environment to guide decision-making, support policy coherence and improve the coordination of environmental protection efforts nationally.

3. Looking ahead to 2050, more ambitious and transformative policy responses are needed that set out a roadmap for achieving the transitions required across our food, energy, mobility, and production and consumption systems. These policies need to be supported by clear governance structures and the necessary investment plans to implement them.

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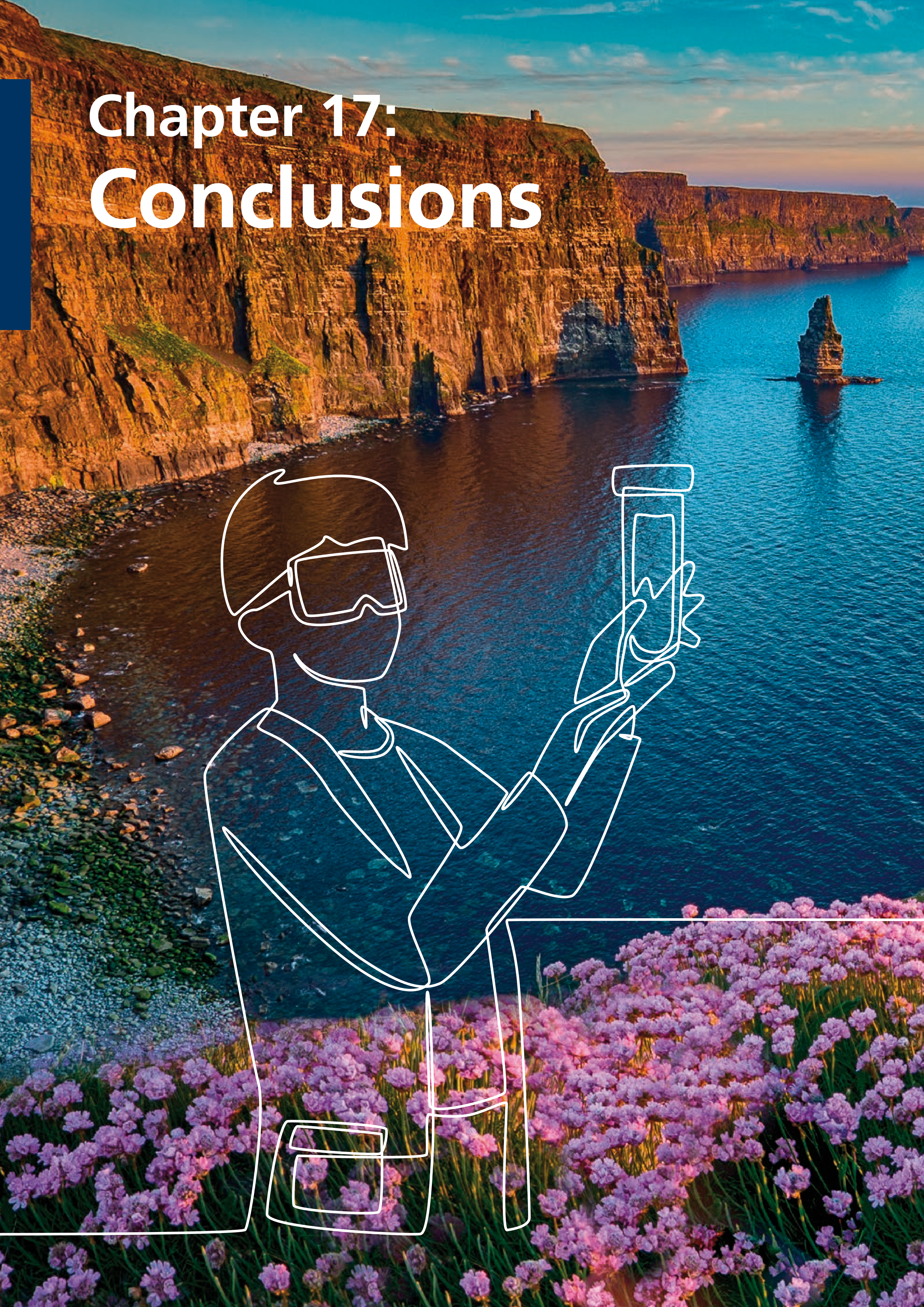
Chapter 17:
Conclusions



Conclusions

1. Introduction

The Irish state has been in existence for a little over a hundred years. In that century Ireland has changed radically, with more citizens now living longer, healthier lives in a safe society. These changes have become especially pronounced since Ireland joined the European Union (EU), with the value of exports increasing from just over €1 billion in the early 1970s to over €200 billion in 2022. Our population has also seen a dramatic increase from fewer than 3 million 50 years ago to over 5 million in the most recent census. Life expectancy in Ireland has grown significantly over the period of EU membership, from 71 years in 1971 to 82 years in 2022. The number of people enrolled in third level education also grew sevenfold over a similar time frame.[1] All of these signals indicate the substantial progress that has been made by Ireland as a country.

Looking ahead to the next 50 years, if we want to continue to be a successful and thriving country, then we must intensify our actions to restore our environment. A recent assessment shows that Ireland has achieved 80% of the 169 targets linked to the Sustainable Development Goals (SDGs) (DECC, 2023a). However, this success is set against the backdrop of climate and biodiversity emergencies and growing pressures on the environment. This is clear from the SDG targets that are not being achieved, which are associated with the goals on clean water and sanitation, affordable and clean energy, sustainable cities and communities, responsible consumption and production, and, critically, climate action.

As an active member of the EU over the past 50 years, Ireland has committed to EU targets and objectives to achieve clean air, healthy waters, less wasteful production and consumption, and climate change mitigation. The environmental scorecard for Ireland (Table 17.1) shows the challenges we face on climate, air, nature, water and the circular economy. While we are complying with existing EU limits on ambient air quality, we have a significant challenge in meeting the interim World Health Organization (WHO) guideline limits by 2026, as set out in the national Clean Air Strategy. Our water quality is not meeting the requirements of the Water Framework Directive (2000/60/EC) and trends in nutrient concentrations in water are not improving. Consumption of material resources has increased, and our recycling rates are not keeping pace, increasing the likelihood that we will not comply with EU recycling targets. Ireland generated 750,000 tonnes of food waste in 2022 and this has not significantly decreased over the first 3 years of national reporting. Critically, we are not on track to meet national and EU targets for climate mitigation, although some progress is being made. In summary, we are not meeting our legal requirements or, more importantly, the objective of those requirements, namely to provide a healthy environment.

The development of this report has led to insights on some of the key elements of change and action that are needed to set us on a trajectory to a sustainable, healthy future for Ireland. The five key priorities, informed by the insights emerging from the report, are set out in Figure 17.1.

1 www.cso.ie/en/releasesandpublications/ep/p-ieu50/irelandandtheeuat50/ (accessed 6 September 2024).

Figure 17.1 Five key priorities from the State of the Environment Report 2024

Delivering a national policy position on the environment

We urgently need to have a national policy position on the environment to address the complex interactions, synergies and trade-offs across environmental policy areas and to deal with its interactions with other policy domains.

Driving policy implementation

We must rigorously implement existing environmental plans and programmes to achieve the benefits that they were developed to deliver.

Transforming our systems

Transformation of our energy, transport, food and industrial sectors is critical to achieving a sustainable future.

Scaling up investment in infrastructure

Investment in water, energy, transport and waste management infrastructure is essential to protect the environment now and into the future.

Protecting the environment to protect our health

Protecting the environment is key to protecting our health and we must act to reduce the modifiable risks to our health from environmental exposures.

2. Environmental scorecard for Ireland

Table 17.1 sets out the overall assessment and outlook for Ireland across key environmental policy areas.

Table 17.1 Ireland's environmental scorecard

INDICATOR	CURRENT ASSESSMENT	OUTLOOK	NOTES
Climate	● (orange)	▼ (red)	While there has been progress in terms of beginning to reduce greenhouse gas emissions and in strengthening adaptation governance structures and support services, overall current assessment for climate is 'poor' (a slight improvement from 'very poor' in 2020). Full implementation of actions set out in the Climate Action Plan and additional actions are needed if Ireland is to meet its 2030 and 2050 climate targets.
Air quality and emissions to air	● (yellow)	⊖ (yellow)	The overall current assessment for air is 'moderate' (the same as in 2020). Ireland is compliant with current air quality standards for many air pollutants. However, Ireland is not meeting the guidelines set by WHO for multiple pollutants, including $PM_{2.5}$, and Ireland is non-compliant with the EU reduction target for ammonia and will remain so in the short term. Achieving the ambitions of the Clean Air Strategy and complying with the limit values of the proposed EU Air Quality Directive from 2030 onwards will be challenging, but will have a significant and positive impact on health.
Nature	● (red)	▼ (red)	The overall current assessment for nature is 'very poor' (the same as in 2020). Deteriorating trends dominate, especially for protected habitats and bird populations, and Ireland is not on track to achieve policy objectives for nature. While the recent expansion of marine protected areas is welcome, additional far-reaching measures are needed to address the declines in nature and biodiversity.

INDICATOR	CURRENT ASSESSMENT	OUTLOOK	NOTES
Water			Overall current assessment for water is 'poor' (the same as in 2020). Trends remain mixed, with no net improvement in river or lake water quality in recent years, a sharp decline in the number of monitored estuaries in satisfactory ecological condition and continued direct discharges of raw or inadequately treated sewage to water from 19 agglomerations. Significant challenges remain for achieving full compliance with relevant EU obligations and national policy objectives.
Circular economy and waste			The overall current assessment for the circular economy and waste is poor (the same as in 2020) but progress is being made in a number of areas to improve performance. Waste generation continues to grow, in absolute and per capita terms, and Ireland remains overly reliant on export markets for recycling and for treating municipal residual waste. Recycling rates for municipal and plastic packaging waste streams are at risk and need to increase urgently to achieve 2025 targets. Recent interventions, such as the Deposit Return Scheme, statutory roll-out of the organic waste collection service, recovery levy and national end-of waste and by-product decisions, are positive developments but the effects of these remain to be seen. The circular material use rates remains very low by comparison to the European average and Ireland needs to address specific sectoral challenges to accelerate moving from a linear to a circular economy.

SUMMARY OF CURRENT ENVIRONMENTAL PERFORMANCE, POLICY AND IMPLEMENTATION IN IRELAND	
	Very poor – significant environmental and/or compliance challenges to address
	Poor – environmental and/or compliance challenges to address
	Moderate – on track generally/local or occasional challenges
	Good – mainly achieving objectives
	Very good – full achieving objectives.

OUTLOOK OF CURRENT PROSPECTS OF MEETING POLICY OBJECTIVES AND/OR TARGETS	
	Largely not on track to meet policy objectives and targets. Significant challenges to achieving full compliance remain. Systemic and transformative change needed.
	Partially on track to achieving full compliance or measures in place or planned that will improve the situation. Outlook is dependent on existing and planned actions, measures and plans being fully implemented and effective.
	Trajectory improving but not yet on track to achieving full compliance. Measures in place and planned provide possibility of meeting policy objectives and targets.

3. Key challenges and priorities for Ireland's environment

Delivering a national policy position on the environment

We urgently need to have a national policy position on the environment to address the complex interactions, synergies and trade-offs across environmental policy areas and to deal with its interactions with other policy domains. Since the Environmental Protection Agency (EPA) published its last State of the Environment Report in 2020 (EPA, 2020), Ireland has set a national objective to transition to a climate-resilient, biodiversity-rich, environmentally sustainable and climate-neutral economy by 2050.[2] Achieving this multifaceted objective will be the most complex and interconnected environmental challenge for the next 25 years, and each step towards its achievement will present opportunities and challenges.

Environmental policy responses to date have been insufficient to halt environmental decline, and many of Ireland's agreed environmental targets will not be met in the short term or will be delivered late. Despite progress in some areas, the scale and speed of improvements are clearly insufficient to meet long-term EU and national objectives such as those covering water quality, nature protection and the ambition to achieve a climate-neutral economy and climate neutrality by 2050. Tackling these complex and interlinked challenges will require the development of more integrated, coherent and ambitious environmental policy frameworks. In this context, a central message of the 2020 State of the Environment Report was a call for a national policy position on the environment, which to date has not been delivered (EPA, 2020).

A key benefit of a national policy position would be improvements in policy coherency and setting out the country's ambition for the environment for the next generation. The United Nations 2030 Agenda for Sustainable Development called on all countries to enhance policy coherence as an essential means of implementation of all the SDGs. Policy coherence requires effective and inclusive governance and institutional mechanisms to address policy interactions across sectors, including identifying and managing trade-offs and aligning actions between different levels of government. To avoid inefficiencies and duplication of effort, there is a strong need for clarity around roles and responsibilities and for effective collaboration and engagement.

There will be many complex challenges to overcome and trade-offs to be addressed along the way, which will require a deep level of collaboration to address climate, air pollution and biodiversity issues. This will require all sectors of society to work together to deliver these changes. Some opportunities are clear. We have opportunities to address more than one issue by one action, for example by tackling climate and air quality issues together. Ireland's Climate Change Assessment[3] also emphasises that tackling climate change and biodiversity loss together enhances the many synergies that exist between actions to address these crises while minimising and managing any remaining trade-offs. In this context, the EPA sees a policy position on the environment as a crucial element of delivering a shared, whole-of-government vision to protect Ireland's environment, guide implementation, support integration and provide the policy coherence we need to tackle these complex problems.

2 Climate Action and Low Carbon Development (Amendment) Act 2021.

3 www.epa.ie/our-services/monitoring--assessment/climate-change/irelands-climate-change-assessment-icca/ (accessed 12 September 2024).

The policy position on the environment could also act to engage society in addressing environmental concerns. The EU's Joint Research Centre suggested that a just transition and a new social contract founded on sustainability are essential for Europe to seize sustainability transitions as processes that can inspire positive change and improve well-being. The national policy position could serve as the starting point for the development of an inclusive national contract across the economy and society so that we live sustainably in a healthy environment that is valued and protected by all.

Driving policy implementation

We must rigorously implement existing environmental plans and programmes to achieve the benefits that they were developed to deliver. Ireland has an extensive and expanding suite of legislation, policies, strategies and plans to safeguard the natural environment and protect human health. Environmental regulation of our industry has delivered significant reductions in pollution and places Ireland among the EU Member States with the lowest air emissions intensity of industry and has virtually eradicated serious water pollution. However, serious deficits remain in Ireland's implementation of other environmental legislation and related plans and programmes such as the Urban Waste Water Treatment Directive (91/271/EEC), Water Framework Directive and European Climate Law (Regulation (EU) 2021/1119). Ireland is not making adequate progress towards meeting its own nationally set targets and objectives. Our assessments show that substantial gaps remain between what is planned and what is being delivered. Our overall water quality and nutrient levels in waters are not improving, recycling is not keeping pace with the growth in consumption and we are not achieving our climate targets. We are also currently not achieving our ammonia emissions reduction target under the National Emissions Reduction Commitments Directive ((EU) 2016/2284). Existing plans and programmes already in place, if fully implemented, would go a long way towards resolving these persistent environmental issues.

The EU's Environmental Implementation Review for Ireland in 2022 highlighted challenges for Ireland relating to compliance with EU waste water treatment legislation, access to justice in environmental matters, conservation measures on marine natura sites and conservation of bogs.[4] The review noted the need for effective, swift and full implementation of EU legislation and strategies on the environment and the climate and striving for excellence in environmental performance at European, national, regional and local levels, as well as the prioritisation of enforcement of environmental law.

An essential part of implementation is the enforcement of environmental laws. While the EPA has a broad remit on environmental regulation and enforcement, local authorities also have a vital statutory responsibility in the protection of our local environment. They are responsible for enforcing much of Ireland's environmental protection legislation in their areas. The scale of environmental

4 eur-lex.europa.eu/legal-content/EN/TXT/?uri=comnat%3ASWD_2022_0260_FIN (accessed 9 September 2024).

enforcement work carried out by local authorities is significant, but in many aspects it is not delivering the necessary environmental outcomes, such as improved water and air quality, reduced noise exposure and improved circularity in the management of our resources. The EPA evaluates local authority performance against the national enforcement priorities, which are focused on achieving environmental outcomes. In 2022, only ten local authorities achieved the required standard of strong or excellent in 70% or more of the 20 national enforcement priorities. This EPA evaluation highlighted the need for local authorities to prioritise enforcement of the roll-out and use of three-bin systems to improve segregation and to undertake more farm inspections and follow-up enforcement to reduce the impact of agricultural activities on water quality. Moreover, local authorities also need to ensure that only approved solid fuels are available for sale in order to safeguard public health from harmful air pollutants. In the local authority context, one critical issue is the continuation of illegal industrial-scale peat extraction. These operations are leading to uncontrolled destruction of the natural environment. To protect Ireland's peatlands as a vital ecosystem and carbon sink, planning policy must proactively address the issue of unauthorised peat extraction operations. Full implementation of, and compliance with, legislation is a must to protect the environment.

Transforming our systems

Transformation of our energy, transport, food and industrial sectors is critical to achieving a sustainable future. Ireland, like Europe, faces persistent problems in areas such as biodiversity loss, inefficient resource use, climate change impacts and environmental risks to health and well-being. The European Environment Agency has identified that the most important factor underlying Europe's persistent environmental and sustainability challenges is that they are inextricably linked to economic activities and lifestyles, in particular the societal systems that provide us with food, energy and mobility (EEA, 2019). As a result, society's resource use and pollution are tied in complex ways to jobs and earnings across the value chain; to major investments in infrastructure, machinery, skills and knowledge; to behaviours and ways of living; and to public policies and institutions.

Since the first State of the Environment Report in 1985 we have seen, in Irish law and policy, a progression from seeking to be less polluting towards become more efficient (in terms of energy use, waste generation and material use). This has delivered substantial transformations; for example, our waste management system in Ireland has been completely transformed in the past 25 years, and smog in our cities is no longer an issue. While important, there is a need to go beyond reducing pollution and incremental efficiency improvements. Efficiencies alone will not get us to where we want to be in protecting the environment. Collectively, we must transform many of our entrenched wasteful systems to shift our society on to a sustainable trajectory, such as moving from transport based largely on private vehicles to sustainable mobility enabled by good planning and accessible public transport, delivering more efficient buildings and replacing fossil fuel-based heating in our homes and businesses.

Taking action now makes good economic sense as well as environmental sense. The Potsdam Institute for Climate Impact Research has estimated that the world economy will see an income reduction of 19% within the next 26 years independent of future emission choices as a consequence of climate impacts (Kotz *et al.*, 2024). These damages already outweigh the mitigation costs required to limit global warming to 2°C by sixfold over the near term. Given that internationally we are seeking to limit global warming to 1.5°C, this is a stark warning of the need to rapidly move away from the highly consumptive and fossil fuel-based economies and systems to achieve regenerative systems that deliver beneficial social and ecological outcomes.

Many of the activities set out in this report in relation to energy, food and transport are endeavouring to make this shift to more sustainable societal systems. A focus in the draft National Planning Framework on transport-oriented development is an element in this transformation. Progress is not, however, keeping pace with the pressures and is happening too slowly to address the growing locked-in pressures for the next decade. Consequently, the acceleration of transition is key to achieving a sustainable future. This will require immediate and concerted action, engaging diverse policy areas and actors across society in accelerating transformation in the core areas of energy, the circular economy, food systems and the just transition.

The revised Industrial Emissions Directive ((EU) 2024/1785 is the main EU instrument to reduce these emissions to air, water and land and to prevent waste generation from large industrial installations and intensive agriculture. The directive provides for transformation plans to be developed by operators that must contain information on how the operator will transform the installation during the 2030-2050 period to contribute to the emergence of a sustainable, clean, circular, resource-efficient and climate-neutral economy.

The role of land use in making the necessary transitions is key. Delivering climate neutrality (in the agriculture and land use sector) would need diversification, restoration of degraded peatlands and water table management across many thousands of hectares of organic soils under grassland, together with planting extremely large amounts of new forest (Styles *et al.*, 2024). The EU Biodiversity Strategy, the CAP Strategic Plan (including the Agri-Climate Rural Environment Scheme), EU Nature Restoration Law (Regulation (EU) 2024/1991) and Food Vision 2030 all set targets for space for nature within agricultural land.

There are many plans and programmes in place, with positive action being implemented on farm, but there is no clear evidence that the current measures will achieve the scale of environmental outcomes that is needed. Land will also be required to accommodate the increasing population's need for housing and services and the ongoing drive to provide renewable wind and solar power. While land-related policies and targets are often set at the national level, their implementation depends on the local scale: different locations are suited to different land use options. The development of mechanisms to allocate national targets at more granular levels is needed. The approach to allocation of renewable energy targets contained in the draft National Planning Framework may be an exemplar for such allocations, but clearly there is a need to develop extensive dialogue with private landowners who own the majority of land in Ireland.

Achieving transformation of our energy, mobility and food systems will require leadership and engagement across all parts of society, as it will require changes in how we work, travel and enjoy our lives. Consequently, there is a critical need to engage citizens, communities and businesses to work with the state. We need to lock into trajectories that will achieve sustainability across the core systems of our society. Once that has been achieved, Ireland stands to gain significantly by avoiding harm to nature and society and from the economic and social opportunities that sustainability creates.

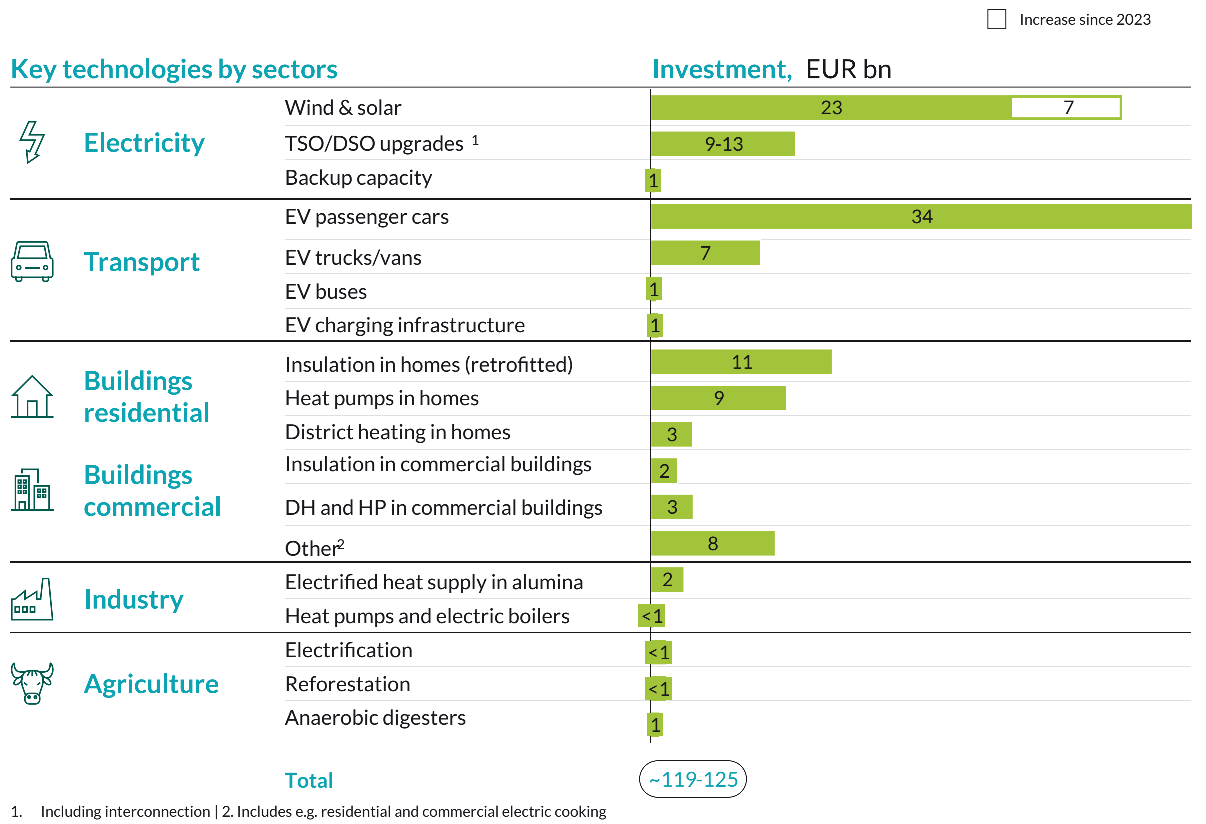
Scaling up investment in infrastructure

Investment in water, energy, transport and waste management infrastructure is essential to protect the environment now and into the future. The latest population projections undertaken by the Central Statistics Office (CSO) indicate that Ireland's population will reach 5.7 million by 2030. The population is projected to grow further to between 6.5 million and 7 million by 2057 in medium- and high-growth scenarios, respectively (CSO, 2024). Against this backdrop of a growing population, the National Competitiveness and Productivity Council has pointed out that persistent deficits in our energy, water and waste water infrastructure risk future demand from enterprises outstripping supply, representing a significant reputational risk for Ireland (NCPC, 2024).

Water. From an environmental perspective, Ireland has still not met all its obligations under the Urban Waste Water Treatment Directive some 30 years after the country was required to comply with the directive. Waste water continues to reduce the quality of our rivers, lakes, estuaries and coastal waters, and the EPA has highlighted that it will take a multi-billion-euro investment and at least two decades to bring all waste water treatment systems up to standard (EPA, 2023). Similarly, many drinking water supplies still lack robust treatment measures to guarantee their long-term resilience and safety,[5] and implementing drinking water safety plans that are crucial to improve the resilience of supplies will require sustained investment in drinking water services if we are to continue to provide a safe and secure supply into the future. The provision of water-related infrastructure must also guard against the impacts of extreme weather events and climate extremes on water services and the water environment.[6]

Energy. While progress is being made in the development of renewable electricity, the national grid requires unprecedented change in the period up to 2030. In 2020, the demand for electricity was twice the amount used in 1990. That demand is projected to increase substantially based on the increasing use of electricity for transport and heating and the increasing demand for electricity from high-demand users.[7] EirGrid has set out that between now and 2030 there needs to be a step change in the volume of network reinforcements delivered to support Ireland's renewable electricity ambition. It anticipates that over 350 projects are needed to reinforce the system and facilitate connections, which represents an investment of over €3 billion in the grids in Ireland and Northern Ireland and a substantial ramping up across the entire life cycle of project delivery. The Climate Action Plan 2023 suggested a total of €119 billion incremental and redirected capital investment in low-carbon technologies and infrastructure will be required in the period 2022-2030. The Climate Action Plan 2024 (DECC, 2023b) revised this figure to between €119 and €125 billion (Figure 17.2).

Figure 17.2 Estimated investment required to mobilise key technologies



Source: DECC, 2023b

5 www.epa.ie/news-releases/news-releases-2024/while-water-quality-is-very-high-the-resilience-of-drinking-water-supplies-must-improve-and-will-require-sustained-investment-into-the-future-says-epa.php (accessed 6 September 2024).

6 www.eea.europa.eu/publications/european-climate-risk-assessment (accessed 6 September 2024).

7 cms.eirgrid.ie/sites/default/files/2023-07/Shaping-Our-Electricity-Future_Version-1.1-Plain-English-Summary.pdf (accessed 6 September 2024).

Transport. The National Sustainable Mobility Policy set significant targets of at least 500,000 additional daily active travel and public transport journeys and a 10% reduction in kilometres driven by fossil-fuelled cars by 2030 (DoT, 2022). These were updated in the Climate Action Plan 2024 to a 50% increase in daily active travel journeys, a 130% increase in daily public transport journeys and a 20% reduction in total vehicle-kilometres travelled by 2030 (DECC, 2023b). In delivering on this ambition, key commitments were improving rail infrastructure in the five cities, commencing construction of MetroLink in Dublin, and continuing the design and development of other light rail projects in the Greater Dublin Area and Cork.

Housing. The draft First Revision to the National Planning Framework identifies the need for 50,000 new dwellings per annum to 2040. The recent Housing Commission report suggests an even larger need for up to an additional 1.92 million dwellings, based on population forecasts ranging between 6.25 and 7.25 million persons between 2024 and 2050 (Housing Commission, 2024). The delivery of this housing, together with water and energy services and transport infrastructure, will place an extremely large demand on nationally sourced construction products. In 2019, the Irish Concrete Federation estimated that 1.5 billion tonnes of aggregates were needed to meet the housing and infrastructure targets set down in the government's Project Ireland 2040 plan. Given the increasing population and ambition in the draft National Planning Framework, demand can be expected to grow over the coming years and it is essential that investment infrastructure is sustainable, using secondary raw materials preferentially where possible.

Circular economy. The European Commission's Ireland's Country Report 2024[8] highlighted that there is still an estimated investment gap of €827 million over 2021-2027 if we are to achieve the circular economy transition, with more investment required in eco-design, repair, reuse and remanufacturing and in infrastructure for separating waste and treatment and recycling facilities.

Collectively, these infrastructural projects constitute an extremely large delivery challenge to provide Ireland with the assets needed to meet the challenges of its growing population and economy while providing systems that protect the environment. Investment decisions made in this decade will define the infrastructure that will be available to our society for the next 50 years and need to be fully aligned with achieving the transition to a low-carbon society. Maintaining and enhancing current investment will be key to this delivery and will need to be a critical facet of national development in the coming decade.

Protecting the environment to protect our health

Protecting the environment is key to protecting our health and we must act to reduce the modifiable risks to our health from environmental exposures. Creating healthy places free from environmental hazards is key to creating a healthier and fairer society in which everyone can thrive. There is substantial evidence of the positive impact of engagement with nature and our environment, with links to better mental health and wellbeing, physical activity, stress reduction and social interactions. Our natural environment is also capable of reducing many hazards such as air pollution. On the other side, harmful exposures can have substantial impacts on our health and well-being, with one in ten premature deaths in Europe linked to environmental pollution (EEA, 2023a). In Ireland, more than 1600 premature deaths annually are due to air pollution (EEA, 2023b), and approximately 350 new cases of lung cancer each year in Ireland are linked to radon. Over 1.3 million people are estimated to be exposed to road traffic noise above the WHO guidance levels. Issues related to drinking water quality have persisted for many years, particularly with regard to private drinking water supplies and private wells.

8 economy-finance.ec.europa.eu/document/download/9f14e528-de10-41aa-8b4d-01c5848784c8_en?filename=SWD_2024_607_1_EN_Ireland.pdf (accessed 6 September 2024).

The impact of environmental hazards and exposures are not equal across society – the young, old, those already in poor health, and groups of disadvantaged socio-economic status tend to be more disproportionally impacted (EEA, 2019). At a European level, environmental inequalities are not well addressed by current policy and are likely to endure, and potentially expand, into the future (EEA, 2019). Research demonstrating that long-term, low-level exposure to fine particulate matter is associated with poorer mental health in older people in Ireland further confirms this (Lyons *et al.*, 2024). The Well-being Framework for Ireland has potential to bring key information into the policy spaces but, as recommended by NESC (2023), there is a need to collect more data to detect inequalities, including environmental ones. In this context, identifying and increasing the visibility of environmental exposure and inequalities at a local scale will be key to informing policies to address health and environment.

One key insight is that, in the main, the impacts of the environment on our health, both positive and negative, are modifiable (i.e. they can be changed) and addressing harmful exposure (to, for example, radon, air pollution, noise and water pollution) will have a beneficial impact on our health. Addressing these risks by reducing pollution, adapting to and mitigating climate change impacts, and restoring ecosystems means that people can be healthier and live longer.

4. Concluding statement

The immense value of Ireland's environment cannot be taken for granted, and societal progress will be severely hampered if our actions damage this essential asset on which we all depend for our air, water and resources. There is only one environment, and this integrated assessment of the state of Ireland's environment shows that the challenges facing it are closely linked and interrelated. Our understanding of these issues is greater than ever before and underpinned by comprehensive monitoring systems and research.

Some progress is being made. Ireland's greenhouse gas emissions in 2023 were at their lowest level in over three decades, signalling the impact of climate action across Ireland's economy and society. While this is positive, we are still well off track in meeting our climate 2030 targets (EPA, 2024b). Critically, this positive delivery is not evident across other areas of the environment, and we need to build momentum to deliver not only on our climate goals but also on our biodiversity, circular economy and pollution reduction goals. Delivering on these goals will require transformational change in many of the core systems of our society and, consequently, will involve everyone in providing a healthy environment for future generations.

Sweden has a goal of passing on to the next generation a society in which the major environmental problems have been solved. In Ireland, we also need to seek to be a generation that changes the path we are on and delivers an Ireland where our major environmental challenges have been solved.

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