



Ireland's Environment

An Integrated Assessment

2020

Environmental Protection Agency

The EPA is responsible for protecting and improving the environment as a valuable asset for the people of Ireland. We are committed to protecting people and the environment from the harmful effects of radiation and pollution.

The work of the EPA can be divided into three main areas:

- **Regulation:** Implementing regulation and environmental compliance systems to deliver good environmental outcomes and target those who don't comply.
- **Knowledge:** Providing high-quality, targeted and timely environmental data, information and assessment to inform decision making.
- **Advocacy:** Working with others to advocate for a clean, productive and well-protected environment and for sustainable environmental practices.

Our responsibilities include:

LICENSING

- Large-scale industrial waste and petrol storage activities;
- Urban wastewater discharges;
- The contained use and controlled release of genetically modified organisms;
- Sources of ionising radiation;
- Greenhouse gas emissions from industry and aviation through the EU Emissions Trading Scheme.

NATIONAL ENVIRONMENTAL ENFORCEMENT

- Audit and inspection of EPA-licensed facilities;
- Drive the implementation of best practice in regulated activities and facilities;
- Oversee local authority responsibilities for environmental protection;
- Regulate the quality of public drinking water and enforce urban wastewater discharge authorisations;
- Assess and report on public and private drinking water quality;
- Coordinate a network of public service organisations to support action against environmental crime;
- Prosecute those who flout environmental law and damage the environment.

WASTE MANAGEMENT AND CHEMICALS IN THE ENVIRONMENT

- Implement and enforce waste regulations including national enforcement issues;
- Prepare and publish national waste statistics and the National Hazardous Waste Management Plan;
- Develop and implement the National Waste Prevention Programme;
- Implement and report on legislation on the control of chemicals in the environment.

WATER MANAGEMENT

- Engage with national and regional governance and operational structures to implement the Water Framework Directive;
- Monitor, assess and report on the quality of rivers, lakes, transitional and coastal waters, bathing waters and groundwaters, and measurement of water levels and river flows.

CLIMATE SCIENCE AND CLIMATE CHANGE

- Publish Ireland's greenhouse gas emission inventories and projections;
- Provide the Secretariat to the Climate Change Advisory Council and support to the National Dialogue on Climate Action;
- Support National, EU and UN climate science and policy development activities.

ENVIRONMENTAL MONITORING & ASSESSMENT

- Design and implement national environmental monitoring systems: technology, data management, analysis and forecasting;
- Produce the State of Ireland's Environment and Indicator Reports;
- Monitor air quality and implement the EU Clean Air for Europe Directive, the Convention on Long Range Transboundary Air Pollution and the National Emissions Ceiling Directive;
- Oversee the implementation of the Environmental Noise Directive;
- Assess the impact of proposed plans and programmes on the Irish environment.

ENVIRONMENTAL RESEARCH AND DEVELOPMENT

- Coordinate and fund national environmental research activity to identify pressures, inform policy and provide solutions;
- Collaborate with national and EU environmental research activity.

RADIOLOGICAL PROTECTION

- Monitoring radiation levels and assess public exposure to ionising radiation and electromagnetic fields;
- Assist in developing national plans for emergencies arising from nuclear accidents;
- Monitor developments abroad relating to nuclear installations and radiological safety;
- Provide, or oversee the provision of, specialist radiation protection services.

GUIDANCE, AWARENESS RAISING, AND ACCESSIBLE INFORMATION

- Provide independent evidence-based reporting, advice and guidance to government, industry and the public on environmental and radiological protection topics;
- Promote the link between health and wellbeing, the economy and a clean environment;
- Promote environmental awareness including supporting behaviours for resource efficiency and climate transition;
- Promote radon testing in homes and workplaces and encourage remediation where necessary.

PARTNERSHIP AND NETWORKING

- Work with international and national agencies, regional and local authorities, non-governmental organisations, representative bodies and government departments to deliver environmental and radiological protection, research coordination and science-based decision making.

MANAGEMENT AND STRUCTURE OF THE EPA

The EPA is managed by a full-time Board, consisting of a Director General and five Directors. The work is carried out across five Offices:

- Office of Environmental Sustainability
- Office of Environmental Enforcement
- Office of Evidence and Assessment
- Office of Radiation Protection and Environmental Monitoring
- Office of Communications and Corporate Services

The EPA is assisted by advisory committees who meet regularly to discuss issues of concern and provide advice to the Board.

Ireland's Environment – An Integrated Assessment 2020

Editors

Brendan Wall, Annette Cahalane and Jonathan Derham

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Table of Contents

Foreword	4	Chapter 5: Land and Soil	99
Acknowledgements	6	1. Introduction	99
Acronyms and Abbreviations	9	2. Functions of Soils	99
Executive Summary	12	3. Land Cover	104
Chapter 1: Introduction	23	4. Sectoral Overview of Land Cover and Spatial Plans	109
1. Introduction	23	5. Research	119
2. Wider Context to Protecting Ireland's Environment	26	6. Conclusions	121
3. Content of the Report	29	References	124
References	31	Chapter 6: Nature	129
Chapter 2: Climate Change	35	1. Introduction	129
1. Introduction	35	2. State of Habitats and Species in an Irish and Global Context	129
2. The Causes of Climate Change	36	3. Current Status and Trends	131
3. International, European Union and National Policy Context	37	4. Drivers and Pressures	137
4. Key Greenhouse Gas Trends for Ireland	43	5. Responses	140
5. Impacts, Vulnerability and Adaptation: Natural and Managed Ecosystems, Forests, Sectors and Infrastructures, and Social and Economic Impacts	48	6. Research and Knowledge Base	151
6. Near-term Responses and Long-term Transition	49	7. Outlook	152
7. Research	56	8. Conclusions	152
8. Conclusions	57	References	156
References	59	Chapter 7: Water Quality	161
Chapter 3: Air Quality	63	1. Introduction	161
1. Introduction	63	2. Current Situation	161
2. Air Quality Standards and Policy in Ireland	63	3. Drivers and Pressures	171
3. Tracking Emissions of Transboundary Air Pollutants	66	4. Responses	178
4. Air Pollutants Monitored in the National Ambient Air Quality Monitoring Network	70	5. Outlook	186
5. Outlook for Air Quality in Ireland	77	6. Conclusions	188
6. Air Quality Research in Ireland	78	References	190
7. Conclusions	78	Chapter 8: The Marine Environment	193
References	81	1. Introduction	193
Chapter 4: Environmental Noise	85	2. Current Health of Irish Marine Waters	193
1. Introduction	85	3. Drivers, Pressures and Impacts	200
2. Assessment of Environmental Noise from Transport Sources in Ireland	86	4. Responses	207
3. Impact of Noise	89	5. Conclusions	217
4. Outlook for Noise Policy and Mitigation Measures	90	References	220
5. Conclusions	93		
References	96		

Chapter 9: Waste	225	Chapter 13: Environment and Agriculture	327
1. Introduction	225	1. Introduction	327
2. Current Situation	226	2. The Structure of Irish Agriculture	329
3. Drivers	237	3. Current Trends	332
4. Pressures	239	4. What's Being Done	339
5. Promoting Sustainable Behaviours and the Circular Economy	244	5. Conclusions	345
6. Conclusions	250	References	348
References	253	Chapter 14: Environment, Health and Wellbeing	353
Chapter 10: Environment and Industry	257	1. Introduction	353
1. Introduction	257	2. Health Benefits of our Natural Environment	353
2. Emissions from Licensed Facilities	263	3. National Issues around Protecting our Environment, Health and Wellbeing	356
3. Resource Use in Industrial Sectors	267	4. Global Issues – Local Challenges	374
4. Waste Generated by Industrial Sectors	268	5. Conclusions	378
5. Circular Economy for Resource Use and Waste	270	References	381
6. Enforcement of EPA Licences for Industrial Facilities	271	Chapter 15: Environmental Performance, Policy and Implementation	387
7. Industry and the National Transition Ambition	273	1. Introduction	387
8. Research on Industry and the Environment	274	2. European Assessment of Ireland's Environmental Performance	390
9. Conclusions	275	3. Assessment of Ireland's Performance Against Environmental Legislation, Plans and Programmes	392
References	277	4. The European and Global Policy Context	401
Chapter 11: Environment and Transport	281	5. Improving Environmental Performance and Policy Implementation	403
1. Introduction	281	6. Conclusions	408
2. Environmental Pressures from Transport	281	References	417
3. Understanding the Drivers of Transport Environmental Pressures	286	Chapter 16: Conclusions	421
4. Sustainable Mobility Transformation	290	1. Introduction	421
5. Conclusions	296	2. Environmental Scorecard for Ireland	425
References	299	3. Ireland in a European Context	428
Chapter 12: Environment and Energy	305	4. Key Environmental Messages for Ireland	431
1. Introduction	305	5. Conclusions	448
2. Energy Use, Human Health and Environmental Protection	305	References	454
3. European Union and National Energy Policy	306		
4. Energy Consumption in Ireland	309		
5. Challenges and Comparisons	317		
6. Conclusions	321		
References	324		

Foreword



This is the seventh state of the environment report published by the EPA since its first such report in 1995. These reports are important milestones for Ireland, as they provide a snapshot of the environment at a particular point, as well as showing trends and changes in the environment over time. The reports assess progress in meeting the main environmental challenges facing the country and evaluates how national policies are being implemented and if they are operating and delivering as intended. The evidence base and assessments provided by our State of Environment reports facilitate policymakers and decision-makers across all sectors of the economy to review developments in their areas, so that changes to their policies and approaches can be taken to address the main environmental priorities for Ireland in 2020.

This latest assessment indicates that the overall quality of Ireland's environment is not what it should be, and the outlook is not optimistic unless we accelerate the implementation of solutions across all sectors and society. The environmental challenges that Ireland faces are giving rise to complex and systemic issues. They cut across different environmental topics, such as climate, air, soil, water, biodiversity and waste, and across organisations and sectors, business and all levels of society.

Ireland is already losing much of what is important in its environment. Unspoilt areas are being squeezed out and we are losing our pristine waters and the habitats that provide vital spaces for biodiversity. Climate change, and the disruption that will flow from it, is impacting the established economic, social and natural structures of our world. We seem unable to stem the tide of nature's destruction and may not fully understand its full impact until it is too late.

Protection of our waters, air, soil, ecosystems is essential as these systems and species provide vital supporting services for our wellbeing and our economy. While there are many national plans and programmes in place that address individual environmental challenges, they suffer from a coherence challenge, as they are devised in the absence of a single, overarching framework. Modern environmental problems are complex and cross-cutting and need to be tackled in an integrated way. However, nationally we tend to examine separately how different parts of the environment function.

A key message from our assessment is that Ireland needs an overall integrated national environmental policy position, or it risks existing environmental protection measures failing or competing with each other. Such a policy position could set out an ambition for protecting Ireland's environment in the short, medium and long-term with the aim of having a clean, healthy environment, that is valued and protected by all. It should be a national vision to which all government departments, agencies, businesses, communities and individuals can sign up to play their part in protecting our environment.

In addition to such a policy position, our report also calls for better implementation and delivery of existing legislation and policies. There are many plans and programmes already in place for many areas, which, if fully implemented, would go a long way towards resolving persistent environmental issues. Full implementation of, and compliance with, legislation is a must to protect the environment.

While overall many of the national environmental indicators are going in the wrong direction this does mask good actions at local level in many areas. There are notable positives too in the report that point towards what can be achieved. Landfill operation has improved dramatically; integrated industrial regulation is highly successful; there has been an expansion in recent years of Ireland's renewable energy share; we have a well-funded and active environmental research programme; the integrity and monitoring of drinking water supplies has improved; national monitoring programmes for air and water have been greatly enhanced; and we are consistently amongst the top-performing EU states for reporting on environmental data.

Our report also attests to a greater awareness about the positive benefits of a clean environment for health and wellbeing. Notwithstanding the difficulties people face during the on-going COVID-19 crisis that began in March 2020, we live in a time when there is societal momentum for change. The crisis has led many of us to redefine what we truly value and has shown us the importance of the natural environment in our local areas. We all expect, and rightfully so, that the air we breathe is clean, that the water we drink is safe, and that when we go to the beach that the bathing waters we swim in are not polluted. Now more than ever, Ireland's green and blue spaces, which include urban parks, coasts, lakes and rivers, forests and bogs, are regarded as essential components of Ireland's health infrastructure. These blue and green spaces allow people to get out in nature and away from the everyday stresses to the benefit of our health and well-being and therefore they need to be clean and protected.

The COVID-19 pandemic has had a significant impact on Ireland's economy; the degree to which this impact will impede national environmental policy ambitions – including the transition to a climate-neutral economy – remains to be seen. It is imperative as we emerge from the pandemic crisis and look to stimulate economic recovery that we do so through a 'green investment' lens and so avoid spend that locks us into carbon intensive and otherwise unsustainable consumption and production patterns. Investment in a green recovery is rational and will yield substantial economic returns and outperform its less green counterparts on a number of important policy metrics. It can also provide the opportunity to deliver health and wellbeing co-benefits that will support resilience and recovery.

This report provides the public, policymakers, non-governmental organisations, community groups, businesses and others with the evidence base to help them make informed decisions about what they can do to help protect and improve our natural environment. I hope that you find the report valuable and informative and that it can help you play your part in this important endeavour.

Laura Burke

Director General

November 2020

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A Balance by Larry Stapleton

*Each year, that bit earlier,
that bit later, the grass
is green and growing,
birch and beech are leafy,
and Persephone in their shade
watches martins and swallows
hawking insects on the river.*

*That her earth time grows longer,
an old bargain being honoured
less and less as the years go by,
could not have gone unnoticed –*

*Hades turning to his brother,
and Poseidon ordaining
a winter of storms, and with it
a response more in kind – the tides
to be set free, so that all the seas
shall rise that bit higher
and higher again each year.*

The late Larry Stapleton was a former Director of the Environmental Protection Agency and former editor of the state of the environment report series. His poetry has been published in *Poetry Ireland Review*, *Irish Pages* and *The Irish Times*. A Balance was published as *The Irish Times* Poem of the Week on 8 December 2018.

Acronyms and Abbreviations

API	Active pharmaceutical ingredient	DCCA	Department of the Environment, Climate and Communications
AQIH	Air Quality Index for Health	DECC	Department of the Environment, Climate and Communications
ASI	Avoid–shift–improve	DHPLG	Department of Housing, Planning and Local Government
ASSAP	Agricultural Sustainability Support and Advisory Programme	DMC	Domestic material consumption
BaP	Benzo[a]pyrene	DWWTS	Domestic wastewater treatment system(s)
BAT	Best available techniques	EAP	Environment Action Programme
BECCS	Bioenergy with carbon capture and storage	ECHA	European Chemicals Agency
BER	Building Energy Rating	EEA	European Environment Agency
BIP	Biodiversity Indicators Partnership	EFSA	European Food Safety Authority
BMW	Border, Midland and Western	EIA	Environmental Impact Assessment
C&D	Construction and demolition	EIB	European Investment Bank
CAP	Common Agricultural Policy	EIP	European Innovation Partnership
CARO	Climate Action Regional Offices	EIR	Environmental Implementation Review
CBD	Convention on Biological Diversity	ELV	End-of-life vehicle
CCAC	Climate Change Advisory Council	EMF	Electromagnetic field
CCPC	Competition and Consumer Protection Commission	EMFF	European Maritime and Fisheries Fund
CDR	Carbon dioxide removal	END	Environmental Noise Directive
CEDaR	Centre for Environmental Data and Recording	EPA	Environmental Protection Agency
CEFAS	Centre for Environment, Fisheries and Aquaculture Science	EQS	Environmental quality standard
CFP	Common Fisheries Policy	ESB	Electricity Supply Board
CORINE	Coordination of Information on the Environment	ESD	Effort Sharing Decision
CORSIA	Carbon Offsets and Reduction Scheme in International Aviation	ESR	Effort Sharing Regulation
COVID-19	Coronavirus disease 2019	ETS	Emissions Trading System
CRCG	Climate Research Coordination Group	EU	European Union
CSO	Central Statistics Office	g CO₂eq/ kWh	Grams of carbon dioxide equivalent per kilowatt-hour
DAFM	Department of Agriculture Food and the Marine	GHG	Greenhouse gas
dB	Decibel	GLAS	Green, Low-Carbon, Agri-Environment Scheme
DBEI	Department of Business, Enterprise and Innovation	GMIT	Galway-Mayo Institute of Technology
		GPP	Green public procurement
		GW	Gigawatt
		HSE	Health Service Executive

ICAO	International Civil Aviation Organization	NDC	Nationally Determined Contribution
ICNIRP	International Commission on Non-Ionising Radiation Protection	NEC	National Emission Ceilings
ICPSS	Irish Coastal Protection Strategy Study	NECP	National Energy and Climate Plan
IED	Industrial Emissions Directive	NGO	Non-governmental organisation
INFOMAR	Integrated Mapping for the Sustainable Development of Ireland's Marine Resources	NHA	Natural Heritage Area
IPBES	Intergovernmental Science–Policy Platform on Biodiversity and Ecosystem Services	NMP	National Mitigation Plan
IPC	Industrial pollution control	NMPPF	National Marine Planning Framework
IPCC	Intergovernmental Panel on Climate Change	NMVO	Non-methane volatile organic compound
IPPC	Integrated Pollution Prevention and Control Directive	NO_x	Nitrogen oxides
IRWC	Irish Ramsar Wetlands Committee	NPF	National Planning Framework
IUCN	International Union for Conservation of Nature	NPWS	National Parks and Wildlife Service
kt	Kilotonne	NSV	Net selling value
LAWPRO	Local Authority Waters Programme	NWESC	National Waste Enforcement Steering Committee
L_{den}	Day–evening–night long-term average noise indicator	OECD	Organisation for Economic Co-operation and Development
L_{night}	Night-time long-term average noise indicator	OPW	Office of Public Works
LTES	Long-Term Emissions Strategies	ORED	Offshore Renewable Energy Development Plan
LULUCF	Land use, land use change and forestry	OSI	Ordnance Survey Ireland
MCP	Medium combustion plant	OSPAR Convention	Convention for the Protection of the Marine Environment of the North-East Atlantic
MCPA	2-Methyl-4-chlorophenoxyacetic acid	PAA	Priority area for action
MPA	Marine Protected Area	PAF	Prioritised Action Framework
MSFD	Marine Strategy Framework Directive	PAH	Polycyclic aromatic hydrocarbon
Mt CO₂eq	Million tonnes of carbon dioxide equivalent	PFAS	Per- and polyfluoroalkyl substances
Mt CO₂eq	Megatonnes of carbon dioxide equivalent	PM	Particulate matter
MWh	Megawatt-hour	PM_{2.5}	Particulate matter of 2.5 microns or less in diameter (fine particulate matter)
NACE	Statistical Classification of Economic Activities in the European Community	PM₁₀	Particulate matter of 10 microns or less in diameter (course particulate matter)
NAF	National Adaptation Framework	POP	Persistent organic pollutant
NAPCP	National Air Pollution Control Programme	PRI	Producer responsibility initiative
NBDC	National Biodiversity Data Centre	ProPG	<i>Professional Practice Guidance on Planning & Noise: New Residential Development</i>
NCAS	National Clean Air Strategy	RAL	Remedial Action List
		RBMP	River Basin Management Plan
		RES	Renewable Energy Share

RES-E	Renewable Energy Share – Electricity
RES-H	Renewable Energy Share – Heat
RES-T	Renewable Energy Share – Transport
SAC	Special Area of Conservation
SDG	Sustainable Development Goal
SEA	Strategic Environmental Assessment
SEAI	Sustainable Energy Authority of Ireland
S.I.	Statutory Instrument
SPA	Special Protection Area
SSCO	Site-specific conservation objective
STEC	Shiga toxin-producing Escherichia coli
SUMP	Sustainable urban mobility planning
SUV	Sport utility vehicle
TACT	Methodologies for Financing and Costing of Climate Impacts and Future Adaptation Actions
THM	Trihalomethane
TII	Transport Infrastructure Ireland
TOC	Total organic carbon
UCD	University College Dublin
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
UV	Ultraviolet
VAT	Value-added tax
VOC	Volatile organic compound
VTEC	Verocytotoxin-producing Escherichia coli
WEEE	Waste electrical and electronic equipment
WERLA	Waste enforcement regional lead authority
WFD	Water Framework Directive
WHO	World Health Organization

Executive Summary

An Integrated Assessment of the State of Ireland's Environment

The evidence from this assessment reveals that the overall quality of Ireland's environment is not what it should be, and the outlook is not optimistic unless we accelerate the implementation of solutions across all sectors and society. The environmental challenges that Ireland faces are giving rise to complex and systemic issues. They cut across different environmental topics, such as climate, air, soil, water, biodiversity and waste, and across organisations and sectors, business and all levels of society. They are taxing economically, sociologically, technically and administratively.

These challenges include the protection of health and wellbeing and ecosystems and reducing emissions and the consumption of resources. They are forcing a fundamental reconsideration of how we produce and consume, how we invest, how land use change affects the environment, and how we plan for the future. Climate change, and the disruption that will flow from it, is influencing the established economic, social and natural structures of our world. We are also witnessing the erosion of ecosystems and biodiversity on an unprecedented scale. We seem unable to stem the tide of nature's destruction and may not fully understand its full impact until it is too late. Opportunely, there are synergies between the solutions to many of the challenges we face. Biodiversity protection, land use and Ireland's transition to a climate-neutral, climate-resilient society are linked, for example, and can be worked on together.



Protection of our waters, air, soil, ecosystems and biodiversity is not to be considered as merely an ambition driven by altruism, as these systems and species provide essential supporting services for our wellbeing and our economy. There are lots of national plans and programmes that address individual environmental challenges, with many notable successes. To deliver the full intent and potential of these policies we need, however, to close gaps in implementation. These multiple plans also suffer from a coherence challenge as they are devised in the absence of a single, overarching, national environmental policy position.



The COVID-19 pandemic has had a significant impact on Ireland's economy; the degree to which this impact will impede national environmental policy ambitions – including the transition to a climate-neutral economy – remains to be seen. As we emerge from the pandemic crisis and look to stimulate economic recovery we should do so through a 'green investment' lens and so avoid technical and infrastructural spend that locks us into carbon-intensive, and otherwise unsustainable, consumption and production behaviours and technologies. A clean and safe environment provides the opportunity to deliver health and economic dividends that will assist resilience and support recovery. In this 'reset' of our economy we have an opportunity to pivot away from unsustainable practices and deliver the lasting, systemic changes needed to deliver on our environmental ambitions, as already outlined in many sector plans, programmes and strategies.

The Environmental Protection Agency (EPA) is required by statute to undertake and report – at four-year intervals – on an integrated assessment of Ireland’s natural environment. What do we mean by an ‘integrated assessment’? It means seeing the environment in its totality so that we can understand our impact, both positive and negative. In our human, ecological and physical systems everything is connected. Therefore, to allow us to understand how human activities can affect the environment, our assessments take more of a systems view, going beyond simply looking at individual parts of the environment to consider their interconnections and co-dependencies.

This, the seventh state of Ireland’s environment report, which includes input from key national agencies with core knowledge and data, is being published by the EPA at a time when Ireland is starting to sow the seeds of climate and wider environmental and sustainable development leadership. The report provides the up-to-date environmental, and wider sustainable development evidence base on which such leadership can continue to be built. The delivery of trusted and actionable knowledge on our environment is essential to allow us to plan with a degree of certainty for a better future.

The Importance of Our Environment

Ireland’s terrestrial, freshwater, coastal and marine environments host exceptional ecosystems that support a rich and diverse population of flora and fauna. These ecosystems provide essential services to people, including, for example, food, construction and manufacturing resources, recreation, healing, pollination, flood attenuation and clean water. Ireland’s atmospheric, terrestrial including soils, freshwater and marine systems are essential to the health of its citizens and the functioning of its economy. By helping to prevent damage to our environment, we are, by association, protecting our own health.

While aspects of environmental protection can be achieved through development and implementation of good government policy, it is the active engagement and participation of everyone that is essential if real and meaningful change is to be made.



Aerial view of part of Clew Bay, Co. Mayo

There is an ever-growing body of research evidence continually reinforcing the fact that engagement and contact with our surrounding natural environment is associated with measurable improvements in the health and wellbeing of the population. Exposure to green (parks, trees, hedgerows, countryside) and blue (river, lakes, canals, sea) spaces has been shown to have a positive influence on a range of health outcomes. Childhood exposure to the natural environment is of particular importance given the positive physical, cognitive and social development effects it affords. An investment in well-designed, high-quality and accessible green spaces, and the protection of blue spaces, is an investment in public health. The provision of health-promoting environments in urban spatial planning should be viewed as a necessary and integral component of urban infrastructure.

Every dimension of how we live – our homes, our workplaces, how we move, eat, play, commune and create – has the potential to impact on, or be impacted by, our environment. As a nation we rely on our natural environment – our rivers, seas, air and land – to accept, assimilate, cleanse or store our public, industrial and private effluents and wastes. Our natural environment provides such essential services but its bearing capacity must be understood and regulated in environmental planning, consumption and production processes. Similar constraints exist in how we draw on its resources to feed our society and our economy, including our soils, seas, freshwaters and other natural resources (mineral and biological). Many of the issues we face which negatively impact our environment, and our health and wellbeing, are inherently linked.



Ireland faces European-wide Challenges in Protecting the Environment that the European Green Deal Commits to Addressing

The 2020 State of Europe's Environment Report from the European Environment Agency (EEA) (published in 2019) adds to the growing evidence from international bodies advocating for more urgency in protecting the environment, safeguarding biodiversity and tackling climate change. The evidence in this recent EEA report resonates with that outlined in other significant publications including the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) report on biodiversity, the Intergovernmental Panel on Climate Change (IPCC) reports on climate and the European Green Deal from the European Commission.

According to the EEA, 'the overarching challenge of this century is how we achieve development across the world that balances societal, economic and environmental considerations'. Sustainability needs to become the guiding principle for ambitious and coherent policies and actions across society (EEA, 2019). The EEA report suggests that the focus now must be on scaling up, speeding up, streamlining and implementing the many solutions and innovations – both technological and social – which already exist, while stimulating additional research and development, catalysing behavioural shifts and, vitally, listening to and engaging with citizens. The European Green Deal offers room for optimism in dealing with these challenges as it promises a commitment to 'tackling climate and environmental-related challenges that is this generation's defining task'.

Current Assessment of Ireland's Environment

While there are many examples of local measures and projects that are working well to make a difference, overall the evidence shows that existing national measures have not been successful in addressing several environmental issues. Ireland has not reached targets in a number of environmental directives. This includes not meeting reduction targets set for greenhouse gas emissions. Rescue plans are now needed for our remaining high status water bodies to halt their decline. The water quality in our rivers especially has deteriorated over the past four years, and estuaries now have the lowest water quality ranking overall when compared with the targets.

Biodiversity is at risk because of habitat loss and damage. Unspoilt areas are being squeezed out, our pristine waters are being lost and the habitats that provide vital spaces for biodiversity are diminishing. Not enough of our seas have been designated as marine protected areas. These are all major systemic issues requiring integrated, immediate and relentless action.

The scorecard analysis shown in Table 1 suggests that the scale of improvements now being made is insufficient to meet long-term objectives and targets, especially for more diffuse and systemic issues. For climate, nature and water quality, the objective to deliver on people's expectations to live in a healthy and protected environment will not be met in the short or medium term (2030), unless there is an acceleration and full implementation of the measures needed to address these issues. For air and waste, while we are meeting most of our current objectives, it will be challenging to achieve the more stringent measures coming on stream in the future. Radiological risks in our homes and workplaces that are associated with natural geology or our technologies need to be understood and acted upon.

Table 1 Current summary assessment and future outlook scorecard for Ireland for selected environmental policy areas (Source: EPA, 2020, based on evidence and assessments presented in this report)

POLICY AREA	CURRENT ASSESSMENT	OUTLOOK
<p>Climate</p> 	<p> Continuing high emissions result in a 'very poor' current assessment, despite progress on renewable energy, ambitious climate action and adaptation plans and strategies, and new governance structures (e.g. the Climate Action Regional Offices). 2020 emissions reductions targets will not be met without relying on purchasing credits or allowances.</p>	<p> Major transitions and system change is needed to become a climate-neutral economy and society by 2050. The Climate Action Plan is the first step in the right direction, but accelerating implementation is needed to meet longer term (2050) targets. Latest projections suggest that, if all Climate Action Plan measures are adopted and fully implemented, 2030 targets will be met. A focus is also needed on delivering on the ambitions outlined in the climate adaptation plans and strategies.</p>
<p>Air Quality and Emissions</p> 	<p> While overall air quality in Ireland is good, there was an exceedance of nitrogen dioxide at one Dublin monitoring site in 2019. This exceedance is a warning about not being complacent in tackling air pollution. On occasions, air quality is not meeting all World Health Organization guideline values for some air pollutants (mainly particulates) that have serious potential health impacts. Ireland is not meeting EU targets on emissions of ammonia to air under the National Emissions Ceiling Directive (2016/2284/EU); agriculture is the main source of ammonia emissions. Mixed progress in reducing the overall emissions to air from transport and energy sources.</p>	<p> There is a risk of further exceedances of emissions targets set in the National Emissions Ceiling (NEC) Directive. Also there is a risk of local exceedances of air quality standards if reductions are not made in home heating emissions from burning solid fuels and in transport emissions from vehicles in urban areas. The exceedance of the NEC Directive for ammonia will continue unless measures are adopted at farm level. The prospect of meeting air quality targets is heavily dependent on national measures being implemented.</p>
<p>Water</p> 	<p> Overall, current assessment is poor. Trends are mixed with serious declines in pristine river sites. Just over 50% of surface water is in a satisfactory ecological condition. This means that almost half fails to meet the legal requirements of the Water Framework Directive (2000/60/EC). There have been deteriorating water quality trends over the past 20 years, especially for rivers, where there have been major decreases in the numbers of the cleanest and best quality rivers. Progress remains slow in improving urban wastewater treatment, eliminating untreated sewage discharges and reducing nutrient loss from agriculture.</p>	<p> Outlook is mixed, and significant challenges remain to achieving full compliance and meeting policy objectives. Extensive targeted action on water catchments, enforcement of existing legislation and implementation of best practice policies could potentially turn around the deteriorating trends. This depends on environmentally sustainable improvements in agriculture, wastewater investment and better management of nutrients and other land use drivers. A key factor is balancing nutrient emissions from the intensive agriculture sector with the need for better environmental protection.</p>

POLICY AREA	CURRENT ASSESSMENT	OUTLOOK
<p>Nature</p> 	<p></p> <p>Overall, current assessment is very poor. Deteriorating trends dominate, especially for protected habitats, with 85% of EU protected habitats having an unfavourable status. The picture for EU protected species is mixed, but 15% are in decline, with freshwater species most at risk. Agricultural practices are a key pressure. Habitat changes point towards a deteriorating trend in overall biodiversity. Some species, such as the curlew and some freshwater species, are under threat; measures are needed to halt their decline.</p>	<p></p> <p>Largely not on track to meet policy objectives. The outlook for biodiversity is challenging unless there are fundamental changes. Climate change adds to the challenge. Transformative change is needed to achieve the vision in the National Biodiversity Action Plan 2017-2021.</p>
<p>Waste and Circular Economy</p> 	<p></p> <p>While Ireland is meeting current targets, recycling rates have levelled off for municipal waste and packaging and in some cases declined. Waste generation remains high and linked to economic activity, while circular use of material remains very low. Most of the environmental complaints from the public relate to waste and litter, which means that waste enforcement work is still a key function for local authorities. There have been improvements in waste management brought about through the introduction of waste licensing and producer responsibility legislation and the amount of waste we landfill has decreased in favour of energy recovery.</p>	<p></p> <p>Work is needed to move towards a life-cycle-driven 'circular' economy, preventing waste, maximising use of resources during their life cycle and, where waste is generated, increasing the amount that is recycled. Illegal dumping, littering and the level of plastic waste in our seas are concerns that demand solutions. The publication of a new national waste policy, a Waste Action Plan for a Circular Economy, is welcome and brings a renewed impetus for change. Achieving future EU recycling targets, dealing with capacity challenges and achieving the circular economy goals will be dependent on the implementation of waste legislation, policy initiatives and related measures.</p>
<p>Radon</p> 	<p></p> <p>A modest reduction in indoor concentrations of radon has been measured since the 1990s (13%). Awareness levels nationally are high, at 75%. A government-led National Radon Control Strategy was adopted in 2014 and this has had a legal basis since 2019. Work carried out under the strategy addresses prevention in new buildings, raising awareness, providing advice, supporting radon services and addressing radon in workplaces. This work is supported by a comprehensive research programme. However, testing and remediation rates have not improved.</p>	<p></p> <p>Testing and remediation rates remain low, with approximately 6% of private homes tested. Of those homes that have been tested and are above the reference level, only 20% of householders take action to reduce radon concentrations. Financial support is needed for householders to increase testing and remediation rates. Workplace testing and remediation should become routine in high-risk areas. Radon testing should be a requirement when selling or renting a home. Building regulations should require stronger preventative measures to protect new buildings. The national retrofit programme should include measures to ensure that radon concentrations are addressed.</p>

CURRENT ASSESSMENT: Summary assessment 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/fully achieving objectives

OUTLOOK: Current prospect 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, 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.

In the report there are also many positive areas to highlight as well. Since the first of the series of Ireland's state of the environment reports was published in 1996, many examples of environmental improvement have been recorded. These include successes in the areas of industrial regulation and emissions, waste management and wastewater discharges. Ireland has a well-funded research programme and the findings from this research are covered in many chapters of this report. There are now many new national and community-level initiatives that are aimed at improving the environment and meeting legislative requirements. These initiatives include the new climate plans, climate dialogue, citizens' assembly, warmer home schemes, river basin management plans, work on sustainability and food waste, and nature conservation projects covered by the European Innovation Partnership for Agriculture Productivity and Sustainability.

Key Messages for Ireland on the State of the Environment in 2020

The overall assessment from this state of the environment report, *Ireland's Environment – An Integrated Assessment 2020*, shows that not only is there a need for urgent approaches to address climate change and biodiversity decline but also there are other environmental priorities for Ireland. These include tackling water pollution, investing in water services, improving recycling rates, improving air quality and mitigating radiological risks. In addition, we must also step back from intensive agricultural and land use practices that are affecting or posing threats to the environment and human health. The assessment indicates that we need much better approaches around managing conflicting land uses and practices in order to protect the environment. For example, we need to leave space for nature, maintain setback spaces along rivers to protect water quality, consider nature-based solutions for flood mitigation, promote areas best suited to high nature value farming and areas of bog that should be left and restored as spaces for carbon storage and nature.

The overall key messages identified for Ireland's Environment are summarised in Figure 1. Further details about these messages can be found in Chapter 16.

Figure 1 Summary of the overall key messages from the 2020 state of environment report for Ireland

We Need Vision and Implementation to Protect Ireland's Environment and our Health and Wellbeing



SOE 1: Environmental Policy Position

A national policy position for Ireland's environment.



SOE 2: Full Implementation

Full implementation of existing environmental legislation and a review of the governance around the coordination on environmental protection across public bodies.



SOE 3: Health and Wellbeing

Protecting the Environment is an Investment in Our Health and Wellbeing

Step Up to Protect the Environment Around Us as it is Under Increasing Threat



SOE 4: Climate

Systemic change is required for Ireland to become the climate-neutral and climate-resilient society and economy that it aspires to be.



SOE 5: Air Quality

Adoption of measures to meet the World Health Organization air quality guideline values should be the target to aim for in the Clean Air Strategy.



SOE 6: Nature

Safeguard nature and wild places as a national priority and to leave a legacy for future generations.



SOE 7: Water Quality

Improve the water environment and tackle water pollution locally at a water catchment level.



SOE 8: Marine

Reduce the human-induced pressures on the marine environment.

System Change – Delivery on Sectoral and Societal Outcomes Needs to be Accelerated



SOE 9: Clean Energy

Ireland needs to move rapidly away from the extensive use of fossil fuels to the use of clean energy systems.



SOE 10: Environmentally-sustainable Agriculture

An agriculture and food sector that demonstrates validated performance around producing food with a low environmental footprint.



SOE 11: Water Services

Drinking water and wastewater infrastructure must meet the needs of our society.



SOE 12: Circular Economy

Move to a less wasteful and circular economy where the priority is waste prevention, reuse, repair and recycling.



SOE 13: Land Use

Promote integrated land-mapping approaches to support decision-making on sustainable land use.

Sustained commitments to and progress in addressing these key SOE messages will be necessary to meet people's rightful expectations of living in a healthy environment. Progress in these areas will allow Ireland to evolve as a sustainable, climate-neutral, climate-resilient economy, which safeguards nature, prevents deterioration of local environments – important for wellbeing – and protects people's health from environmental pollutants.



Aerial view of Wexford town

The overarching message from this report is that system-wide change is now needed in how we look after our environment. Research has demonstrated that our health and the state of environment are intrinsically linked. System changes are needed across the energy, transport, and agriculture sectors and on the built environment, to improve sustainability and reduce emissions which are damaging our environment and health. Ireland needs to improve its performance in protecting nature and natural resources at community and national levels. Improvements are also needed in implementing environmental and radiological legalisation and policy. However, economy or society cannot make the right sustainable choices if the systems or policies around them make it difficult to implement measures to protect the environment. Collaboration and better connectivity across the different systems and policies are needed, as many are interlinked. Ireland has many plans in place with environmental commitments and for various sectors, yet our environment continues to be affected. To ensure the plans and projects are being carried out in the right way, in the right place and at the right time we need them to be implemented, monitored and accountable. A national policy position for Ireland's environment could help to achieve all of this.

Evidence-based policy decisions using assessment tools should play a central part in protecting Ireland's environment into the future. These tools include integrated environmental assessment, system-based approaches, spatial planning, the precautionary principle and ecosystem services assessment.



Killaun Bog, Co. Offaly

As national economic stimulus packages are being devised to help aid recovery post-coronavirus (COVID-19), now is also a time to consider the opportunities that will arise to leverage enduring environmental and public health benefits that address the challenges raised in this report.

We know that environmental protection is a local issue with global consequences. Ireland's environment is what connects us to our local places. It is part of our natural heritage and where we live. When added together, the solutions taken at home, in businesses or at a field level can result in local improvements to global problems. Such local perspectives and community engagement, linked with national policies, leadership and direction, are part of the transition needed to protect Ireland's environment into the future.

It is our health and our environment that matters. This decade will be pivotal in how we deal with the challenges around protecting both.



Actions for a Cleaner Greener Environment

Over the next decade, the challenges facing us are to:

- Halt any further deterioration in our natural environment while supporting our economy and accommodating our growing population.
- Accelerate action to decarbonise and green our economy and society, so achieving climate neutrality by 2050.
- Protect ourselves against the inevitable consequences of climate disruption.
- Start restoring the precious habitats and water bodies that we have lost.
- Leave space for nature as part of a new approach to biodiversity protection.
- Designate more of our marine area as protected areas.
- Protect air quality by switching to cleaner fuels and energy for transport and heating homes.
- Massively reduce our annual one million tonnes of food waste.
- Foster more sustainable agricultural production and land-use systems and management.
- Invest in essential water services infrastructure that protects drinking water supplies and eliminates discharges of raw sewage.
- Achieve greater efficiency in our production and consumption activities when using raw materials.
- Secure the improvements in our natural environment that we have made through regulation and investment.
- Integrate measures to protect against radon into our built environment.
- Leverage a growing public engagement with environmental issues.
- Act on the highlights identified in this report. Covering thematic, sectoral and integrated areas, these highlights are identified at the end of each chapter and they outline the scale of the challenges to be tackled. These key highlights are also collated in a table at the end of this report.

Chapter 1

Introduction





Introduction

1. Introduction

Today's environmental challenges, including the protection of the health of our citizens, ecosystems and the economy, are forcing a fundamental reconsideration of how we produce and consume, how we invest and how we plan for the future. As we emerge from the pandemic crisis of 2020 and look to stimulate economic recovery, we need to do so through a 'green investment' lens and avoid lock-in, or a return, to carbon-intensive and otherwise unsustainable consumption and production behaviours and technologies.

We live in a time of great uncertainty. Climate change, ecosystem loss and resource constraints, and the disruption that will flow from them, are challenging the established economic, social and natural structures of our world. This will alter our collective futures in ways that are not yet fully understood. Social and economic inequalities combined with natural climatic variations will mean that certain areas and communities will be disproportionately impacted. Today's environmental challenges are demanding a fundamental reconsideration of how we produce and consume, how we invest, how we develop and how we plan for the future. We are also witnessing the erosion of biodiversity at an unprecedented scale and seem unable to stem this tide of destruction. We know collectively that this must change, which is reflected in global agreements such as the Paris Agreement, the United Nations Sustainable Development Goals and the United Nations Convention on Biodiversity; in European initiatives such as the Environment Action Programmes (EAP)¹ and the European Green Deal; and in national initiatives such as the declaration of a climate and biodiversity emergency, the 2019 Climate Action Plan, Ireland 2040 and the many other plans and programmes in place to improve and protect our natural environment.

Ireland, the Environment and the Pandemic

The coronavirus (COVID-19) pandemic of 2020 has challenged public and institutional structures in relation to our social, technical and administrative abilities to cope with societal disruption. It has also awakened a stronger appreciation of our connectedness to global events, as well as to the environment on a local scale (within 5 km of where we live). Media reports over this year of confinement are full with examples of young and old re-engaging with their environment, enhancing their appreciation for nature and benefiting from access to it. Research undertaken for the Environmental Protection Agency (EPA) demonstrated that, among the citizens surveyed, the previously stated barriers to engaging with their local environment (lack of time from being at work, busy at home and poor weather) diminished in importance during the first half of 2020 (Kindermann *et al.*, 2020). The results of this survey also noted increases – in early 2020 relative to 2019 – of between 30 per cent and 45 per cent in the time spent in blue and green spaces for physical and mental health, with nearly half of the respondents reporting discovering new, or rediscovering old, green and blue spaces in their community.



¹ The 7th EAP is operational until the end of 2020 <https://ec.europa.eu/environment/action-programme/>. The European Commission in October 2020 launched a proposal for an 8th EAP <https://ec.europa.eu/environment/pdf/8EAP/2020/10/8EAP-draft.pdf>.



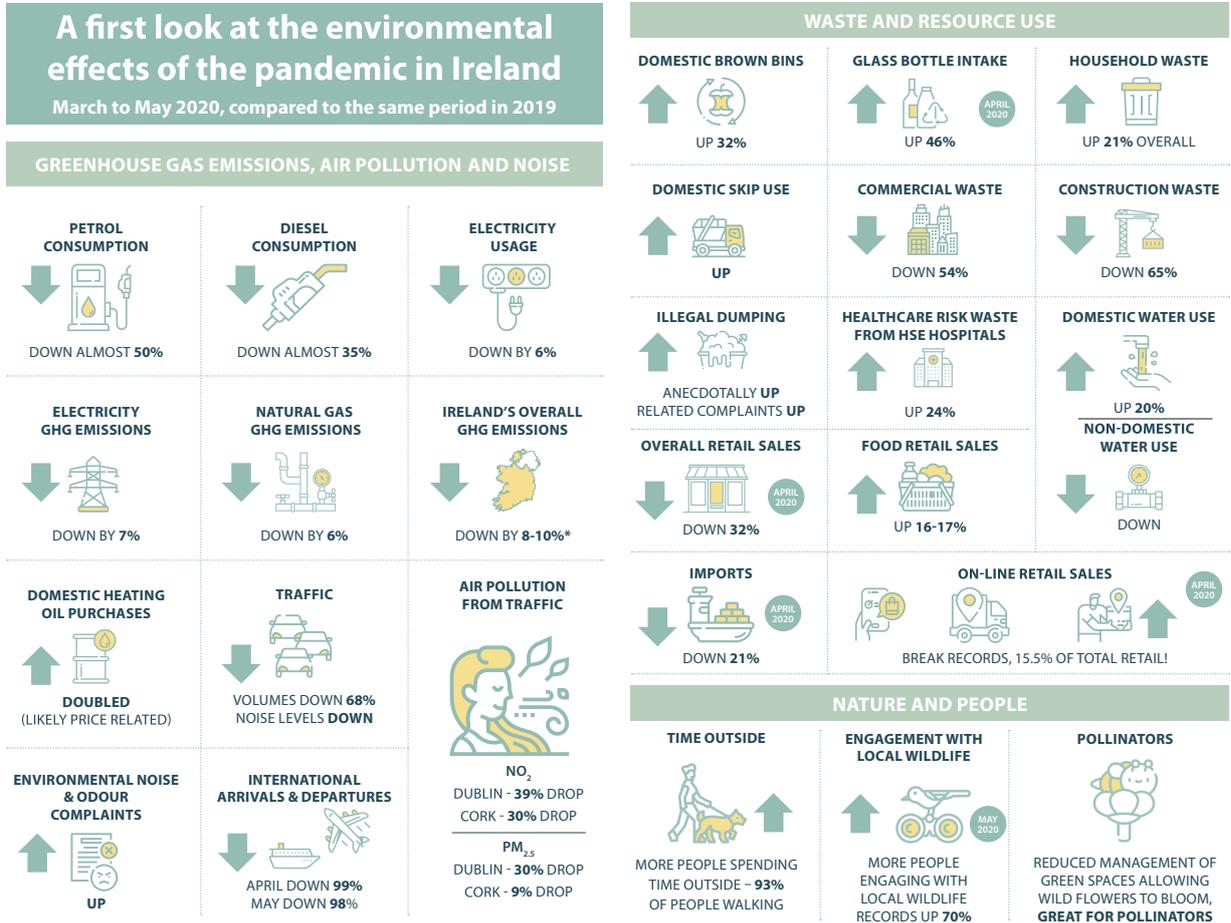
A positive outcome from the national response to the COVID-19 pandemic is a notable increase in the standing of science and trust in professional evidence-based assessment in informing public policy and citizens' behaviour. These authoritative voices have been important in guiding us through the challenges and solutions. There are useful lessons for safeguarding the environment agenda in this too. The pandemic challenge, although acute in nature, provides some knowledge that can be applied to chronic and incremental societal risks, in particular the need for whole-of-government and whole-of-society collaborative and integrated action on interconnected environmental challenges.

The COVID-19 outbreak has had a significant impact on Ireland's society and economy – the tragic loss of life and the distress that flows from that, the social disruption and the impact on businesses. The business impact has been seen not only in the specific sectors that were closed, but also in workplaces that remained open, in terms of the increased risk mitigation costs, and in the increased healthcare costs. The degree to which these acute stresses will impede national environmental policy ambitions – including the climate-neutral transition – remains to be seen.

In addition to a reported re-engagement with nature, the pandemic has had some notable environmental consequences. In April, the Irish Waste Management Association reported a reduction of over 50 per cent in commercial waste and a reduction of up to 70 per cent in construction and demolition waste (O'Leary *et al.*, 2020). As expected, healthcare risk waste has increased, but other notable increases associated with confinement were seen in domestic waste collections, as well as in public use of civic amenity sites. Our cities became quieter and were less polluted by traffic, and there was an increase in environmental complaints (EPA, 2020a; O'Leary *et al.*, 2020). Some of these observations are summarised in Figure 1.1.



Figure 1.1 Ireland in the pandemic – environmental indicators (Source: O’Leary, *et al.*, 2020, with updates on overall greenhouse gas (GHG) emissions from EPA)



*Ongoing work, subject to revision

It is imperative as we emerge from the pandemic crisis and look to stimulate economic recovery that we do so through a 'green investment' lens and so avoid recovery- and growth-promoting technical and infrastructural spending that locks us into carbon-intensive and otherwise unsustainable consumption and production behaviours and technologies. A clean environment, including one in which radiological risks from natural (e.g. radon) and technological (e.g. electromagnetic fields) sources are managed, provides the opportunity to deliver health and economic dividends that will assist resilience and support recovery. We have an opportunity in this 'reset' of our economy to pivot away from unsustainable practices and deliver lasting changes that support the climate-neutral transition, as well as other environmental ambitions. This is also known as 'building back better' (OECD, 2020).

International research by Bhattacharya *et al.* (2020) for the Coalition of Finance Ministers for Climate Action, the OECD (2020) and Hepburn *et al.* (2020) suggests that green recovery packages have many benefits over non-environmentally friendly recovery packages. First, they

are an effective mechanism to advance a climate-neutral society and economy; and, second, they have positive wellbeing and economic returns in both the immediate and the future horizons. Hepburn *et al.* (2020) examined a variety of possible policy options and surveyed over 200 central bank officials, finance ministry officials and other economic experts from G20 countries to investigate the optimal green recovery pathway. From this they identified five key policy areas that have the highest potential for creating positive economic multipliers and positive low-carbon and resilience impacts, namely:

1. clean physical infrastructure investment in the form of renewable energy assets, storage (including hydrogen), grid modernisation and carbon capture and storage technology
2. building efficiency retrofits
3. investment in education and training to address immediate unemployment as a result of the COVID-19 pandemic and to address structural shifts from decarbonisation



4. natural capital investment for ecosystem resilience and regeneration, including restoration of carbon-rich habitats and climate-friendly agriculture
5. clean research and development spending, including rural support scheme spending, particularly that associated with sustainable agriculture.

The OECD's (2020) *Building Back Better* report on the opportunity to embrace a more sustainable recovery articulates five dimensions of 'better' that can act to guide policy decisions (Figure 1.2).

Figure 1.2 Five dimensions of *Building Back Better* (after OECD, 2020)



Research by the OECD (2020), Bhattacharya *et al.* (2020), de Bruin and Monaghan (2020) and others suggests that investment in a green recovery package in the aftermath of the COVID-19 crisis is rational and will yield substantial economic returns and outperform its less green counterparts on a number of important policy metrics, and also deliver wellbeing co-benefits. The European Commission has made a clear commitment to a green recovery – proposing a €750 billion economic stimulus plan – and has articulated a sustainable finance taxonomy in support of this. This green taxonomy aims to ensure that investments correspond to a predefined set of environmental objectives (EU, 2020).

2. Wider Context to Protecting Ireland's Environment

Protection of our waters, air, soil, ecosystems and biodiversity should not be considered as merely an ambition driven by altruism, as these systems and species provide essential supporting services for our wellbeing and our economy. It is time for a holistic approach through the articulation of an overarching national policy position for the environment that will drive commitment and underpin coherence.

Since the publication of the EPA's sixth state of the environment report in 2016 (EPA, 2016), there is a much greater level of awareness in Ireland and globally that humanity has already significantly damaged and altered the planet on which we depend. More than 80 per cent of Irish citizens surveyed for the recently published Eurobarometer (EC, 2020) agreed that environmental issues have a direct effect on their daily life and their health – with no strong urban/rural difference. This survey also reported that, in Ireland, climate change is ranked as the most important environmental concern (57% of respondents), followed by waste (53%), water pollution (42%) and air pollution (37%). Twenty-nine per cent of Irish respondents expressed concern about agricultural pollution and 81 per cent agreed that their consumption habits adversely affect the environment in Europe and the rest of the world.

And yet, we remain locked into fossil fuel dependency, which in turn is adding more heat to the planet and will result in even greater problems in the future unless we radically reduce our reliance on such fuels. As an island in the North Atlantic Ocean, Ireland is particularly vulnerable to rising sea levels and changing weather patterns and has a major stake in ensuring that the world acts now to decarbonise our energy systems and to protect humanity and the natural world on which we depend from the inevitable consequences of the changes already made to our climate. These challenges are put rather starkly in the recently published *Climate Change Adaptation Plan for the Health Sector (2019-2024)* (Government of Ireland, 2019), which states that:

Without decisive adaptation action, climate change will have profound impacts for the health and wellbeing of people in Ireland, for the smooth delivery of our health and social care services, and for our critical infrastructure.



Europe is leading the way in setting a course for change with the European Green Deal (EC, 2019), which resets the European Union (EU) commitment to tackling climate- and environment-related challenges. The overarching vision for Europe's environment and society is set out in the Green Deal in the following stated aims:

- *To transform the EU into a fair and prosperous society, with a modern, resource-efficient and competitive economy where there are no net emissions of greenhouse gases in 2050 and where economic growth is decoupled from resource use: this transition must be just and inclusive.*
- *To protect, conserve and enhance the EU's natural capital, and protect the health and well-being of citizens from environment-related risks and impacts.*

This is the prize, but there is much work to be done by many actors – including citizens – to get us onto a collective pathway that will get us there. And where does Ireland fit into this? The declared ambition of Ireland's government is that Ireland will be a leader in responding to the challenges of climate change. However, the evidence shows that there is clearly a gap between aspiration and reality. Yet Ireland has much to gain from taking a leadership position, as the choice facing our country in 2020 is to be either a leader or a follower, a champion and beneficiary of change or a victim of circumstance.

This is the seventh state of the environment report published by the EPA since its first report in 1996, 24 years ago. We live in a very different Ireland now, with more than 1.3 million additional people living here according to Central Statistics Office (CSO) data, an increase of 36 per cent from 1996. The Irish population is projected to continue to grow by another million people between now and 2040 (CSO, 2018); this is against a backdrop of a much more modest population increase across the EU family of 28 nations (as was) of approximately 6.5 per cent between 1995 and 2019 (Eurostat, 2019). In spite of this, Ireland remains one of the least densely populated regions in the EU, with a population density of just over half of the European average (World Bank, 2019). Ireland has also become a far wealthier country, with CSO data indicating that gross national product has increased fourfold over the last 20 years (CSO, 2004, 2020). These economic and population changes have inevitably brought about changes in our natural environment. The increasing population and increasing levels of unsustainable production and consumption place pressures on water quality, air quality, biodiversity and land, and this is largely at the root of the continuing deterioration in environmental quality since the previously published integrated assessment of Ireland's environment in 2016. It is notable that in the recent Eurobarometer survey the two measures that are seen by Irish citizens as potentially the most effective at tackling environmental problems are (1) changing the way we consume (33%) and (2) changing the way we produce and trade (31%) (EC, 2020).

This seventh state of the environment report is being published by the EPA at a time when Ireland is starting to sow the seeds of climate change and wider environmental and sustainable development leadership. It provides the up-to-date environmental, radiological protection and wider sustainable development evidence base on which such leadership can be built.

People are not immune to the demands placed on our environment, as evidenced through the results of a Red C poll on public attitudes to the environment commissioned by the EPA and undertaken in 2020 (EPA, 2020b). It reported that an overwhelming majority of adults (87%) in Ireland recognise the importance of the environment as an asset to the country. Media coverage in the last 24 months in relation to climate change and biodiversity loss, including much space given to strong voices from national and international advocates, attests to this growing awareness and engagement.

Ireland's environment is also given standing through our nation's commitments to international processes, including the United Nations Sustainable Development Goals and the United Nations Conventions on Climate Change, Biological Diversity, Nuclear Safety, Long-range Transboundary Air Pollution, and the Law of the Sea, as well as a raft of obligations flowing from our membership of the EU. These processes provide essential context and all act to advance the ambition of protecting and enhancing our environment and the health of everybody who depend on it.

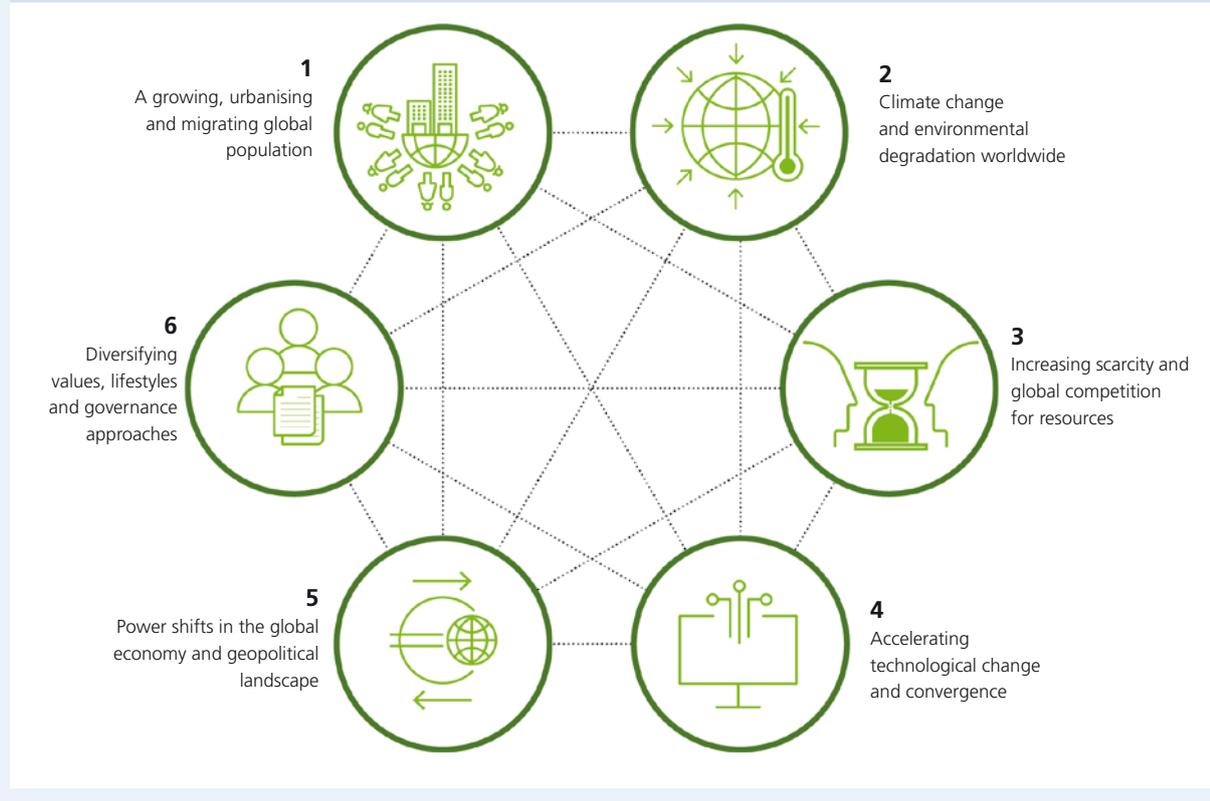
Recent international reports, including the 2020 state of environment report from the European Environment Agency (EEA, 2019) (Topic Box 1.1) and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services report (IPBES, 2019), outline stark warnings and an urgency around environmental protection challenges. They speak about the need to balance development covering society, economy, transport, energy and food systems with the need to protect the environment and human wellbeing. These reports call for urgent action on the protection of the environment, and especially actions to address climate change and biodiversity loss. They advocate not just for small changes but for a systemic change in how we look after our environment.



Topic Box 1.1 The EEA's State of Europe's Environment Report 2020

According to the EEA (2019), 'the overarching challenge of this century is how we achieve development across the world that balances societal, economic and environmental considerations'... Sustainability needs to become the guiding principle for ambitious and coherent policies and actions across society.' A wide range of drivers of change on the environment have been identified, which put unprecedented pressure on resources (Figure 1.3).

Figure 1.3 Clusters of drivers of change (Source: EEA, 2019)



Many of the issues highlighted at European and international levels mirror the challenges we are facing here in Ireland. They include complex issues in the areas of water quality, air quality in urban areas, resource use, climate change, biodiversity, ecosystem damage and environmental risks to health and wellbeing. Many national plans and programmes have been introduced to address these challenges, with many notable successes; however, we need to close the gap in implementation in order to deliver the full intent and potential of these policies. These multiple plans and programmes also suffer from a coherence challenge as they are devised in the absence of a single overarching national environmental policy position.

Perhaps the greatest positive change to our natural environment over the past 25 years has been a marked reduction in the gross pollution of water, air and land (the 'worst of the worst'). However, in parallel with this achievement there has been a loss of the most pristine and unspoilt water and terrestrial habitats (the 'best of the best'). The reduction in the 'worst of the worst' has largely been driven by stronger regulation and investment in environmental protection technology, such as wastewater treatment, air emissions abatement, soil remediation and landfill engineering, while the loss of the 'best of the best' has largely been driven by changing land management practices, diffuse pollution and human activity in areas previously relatively untouched by human intervention. Protection of biodiversity and ecosystems should not be considered as merely an ambition driven by altruism, as these systems and species provide essential supporting services for our wellbeing and our economy.



The challenge facing us over the next decade is to halt any further deterioration of our natural environment while our population continues to grow; secure the improvements in our natural environment that we have made through regulation and investment; integrate radiological protection into our built environment; start restoring some of the precious habitats and water bodies that we have lost; leverage growing public engagement on environmental issues and accelerate action to decarbonise and green our economy and society; and protect ourselves against the inevitable consequences of climate disruption for our island.

As noted earlier in this chapter, an immediate task facing Ireland in the context of this assessment of our national environment is to consider what opportunities there are through post-COVID-19 national economic stimulus packages to leverage enduring environmental and public health benefits that address the concerns raised here. At the very least, we need to ensure that economic interventions do not contribute to the 'locking in' of unsustainable high-carbon technologies; lead to the development of national infrastructure that is not climate resilient; compromise biodiversity and ecosystem services; contribute to a health burden for the population through emissions from poorly considered choices and from radiological sources; and generate irreversible environmental and cultural losses. Research and assessment undertaken by the CSO (2019) and the Economic and Social Research Institute (Morgenroth *et al.*, 2018) has identified that there exists within the national taxation and subsidy system a series of reliefs that are environmentally harmful. It will be essential that such market failures are identified and removed from the taxation code and subsidy schemes as they are incompatible with sustainable recovery ambitions.

National economic stimulus packages that are environmentally framed (i.e. through the EU green taxonomy; EU, 2020), allied to strong public awareness, present a real – and rational – opportunity to advance our transition ambitions and our adaptive capacity while delivering enduring economic and social benefits.



3. Content of the Report

The environment must be seen in its totality if we are to understand our impact on it, both positive and negative. Therefore, our assessments go beyond simply looking at individual parts of the environment and consider the interconnections that link them together and the human activities that can affect them.

This report, in common with the previous six reports, provides an overview of the current condition of Ireland's environment and whether it is getting better or worse. The EPA is required by law to periodically report on an integrated assessment of Ireland's natural environment, including radiological aspects. The EPA's evidence capability, comprising its expertise, experience, data, research and technologies, together informs and supports this assessment. We have also engaged with, and benefited from the input of, key national agencies with core knowledge and data relevant to sections of this report.

What do we mean by an integrated assessment? The environment must be seen in its totality if we are to understand our impact on it, both positive and negative. For example, measures to tackle climate change can have a negative impact on air quality and water quality if not planned carefully; and biodiversity can be affected by water quality, air quality and climate change. This means that our assessments have to go beyond simply looking at individual parts of the environment; rather, they must also consider the interconnections that link them together and the human activities that can affect them.

This report is therefore structured into two main parts: thematic assessments covering climate, air, noise, soil and land cover, nature and the freshwater and marine environment; and integrated assessments covering waste, the economy/industry, transport, energy, agriculture and the interactions between the environment and human health and wellbeing. For 2020, we have included a new chapter called 'Tracking Plans and Programmes', which addresses how Ireland is doing in the area of environmental policy implementation. The report concludes with a chapter covering integrated assessment and the key messages.



Chapter Highlights for Introduction



The absence of an overarching national environmental policy position is negatively affecting integration and progress across multiple environmentally related strategies, plans and programmes: the sum of the parts do not make up a coherent whole.



As Ireland emerges from the COVID-19 pandemic crisis and looks to stimulate economic recovery, it needs to apply a 'green investment' approach and avoid lock-in, or a return, to carbon-intensive consumption and unsustainable production behaviours, services and technologies. A clean environment provides the opportunity to deliver on health and economic dividends that will assist resilience and support recovery.



Protection of our waters, air, soil, ecosystems and biodiversity should not just be an ambition driven by altruism, as these systems and species provide essential supporting services for our wellbeing and our economy. The delivery of trusted and actionable knowledge about our environment is essential to allow Ireland to plan with any degree of certainty for a better future.



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Chapter 2

Climate Change





Climate Change

1. Introduction

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

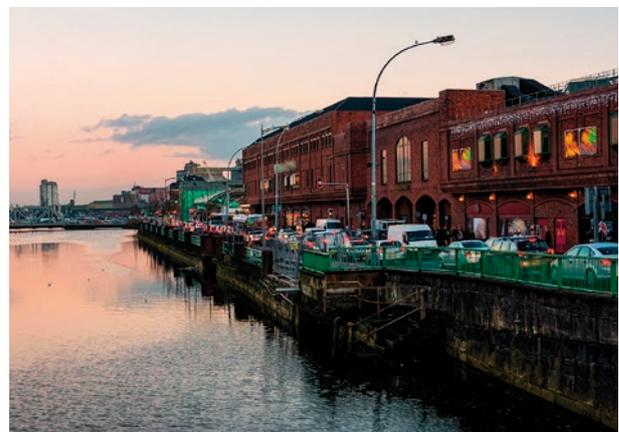
The 2015 Paris Agreement provides the framework for global actions to prevent dangerous and irreversible climate change. That agreement was adopted following confirmation by the Intergovernmental Panel on Climate Change (IPCC) in its Fifth Assessment Report that warming of the climate system is unequivocal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

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

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

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

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





2. The Causes of Climate Change

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

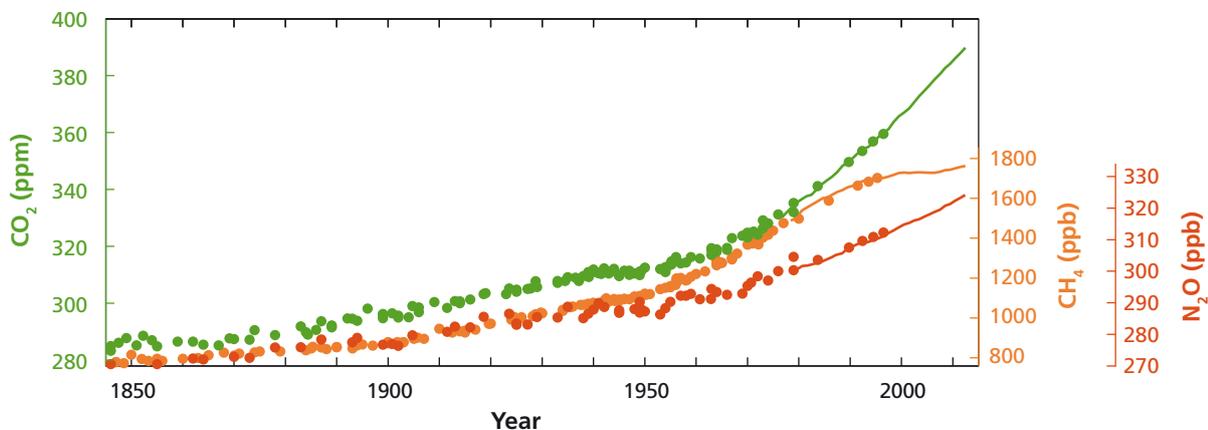
The Earth's energy balance (i.e. the balance between the amount of energy it receives from the Sun and that lost to space) has remained relatively stable for millennia. This balance is regulated by relatively small amounts of gases in the atmosphere, known as GHGs, as well as microscopic particles, dusts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

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

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

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

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



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



Global Changes, Local Impacts

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

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

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



3. International, European Union and National Policy Context

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

International Policy Context

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

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

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

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



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

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



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


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

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

Note: ETS, Emissions Trading System.



EU Climate Policy: Mitigation

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

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

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

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

EU Climate Policy: Adaptation

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

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

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

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

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



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

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

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

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

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

Ireland's Policy Context

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

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

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

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

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

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

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



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

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

Implementation of the National Policy Position: Mitigation

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

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

Implementation of the National Policy Position: Adaptation

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

Implementation of the National Policy Position: Other Policies

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

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





4. Key Greenhouse Gas Trends for Ireland

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

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

National Greenhouse Gas Emissions Trends

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

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

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

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

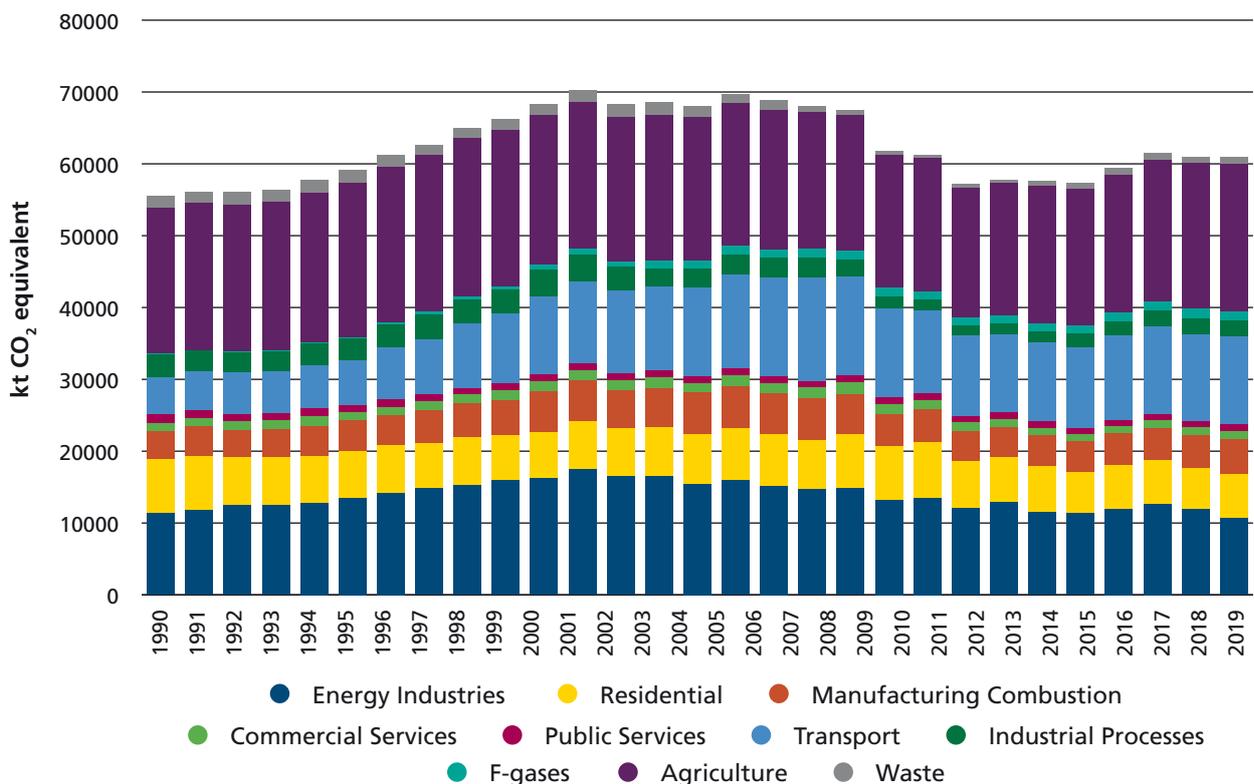
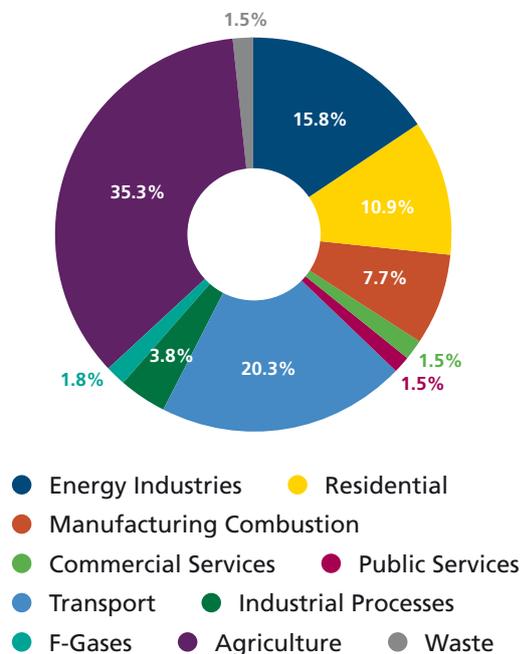




Figure 2.3 Sectoral contribution to overall GHG emissions in 2019 (Source: EPA, 2020b)



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

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

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

Agriculture Sector

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

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

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

Transport Emissions

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

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



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

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

Energy Industries

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

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

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

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

Residential Sector

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

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

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

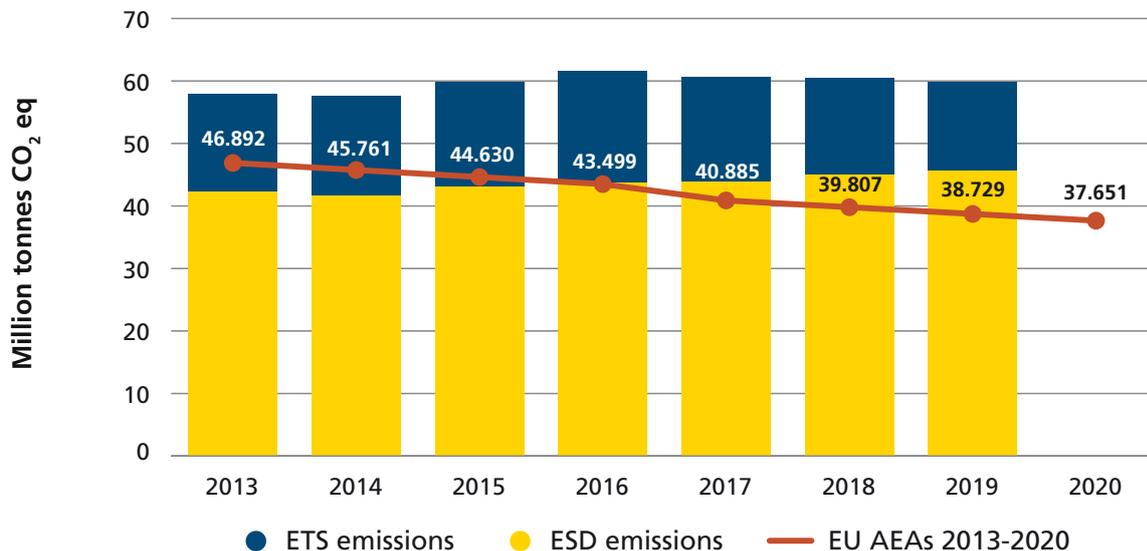
Meeting European Union and International Commitments

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

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



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



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

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

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

The National Policy Position and Greenhouse Gas Emissions in 2050

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

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



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

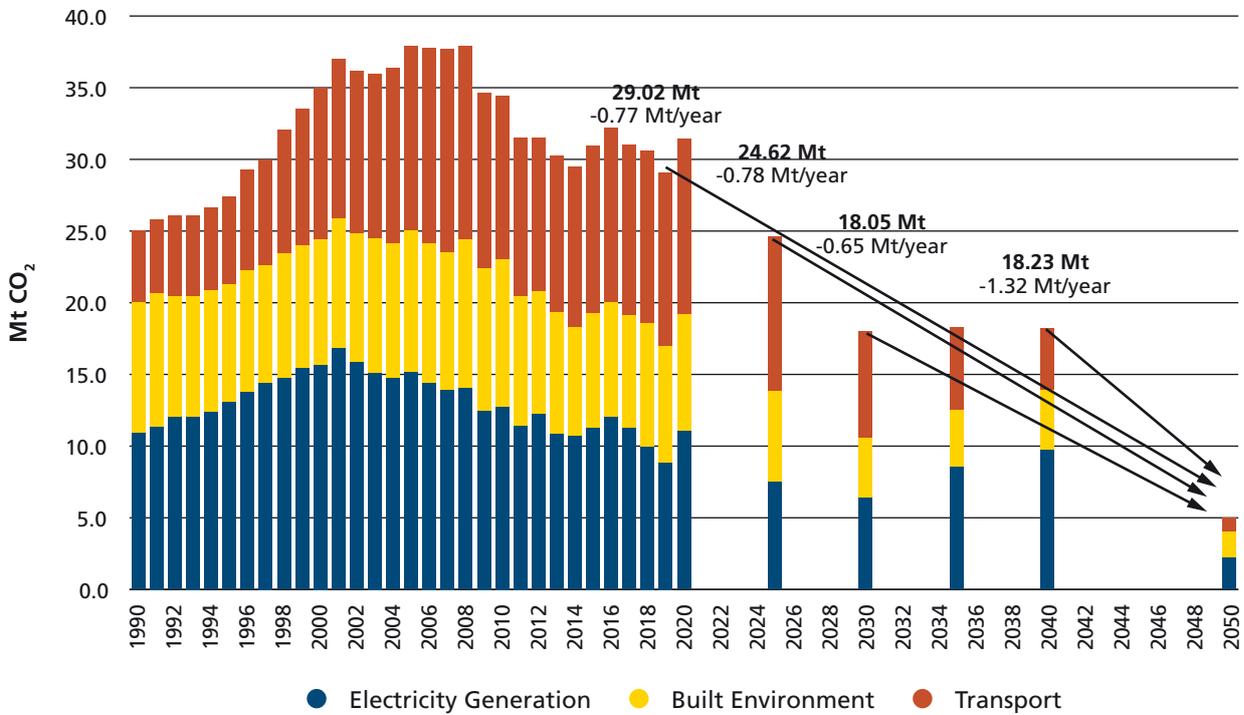


Figure 2.5 shows the latest historical and projected emissions (published in 2020) for carbon dioxide only (under the 'with additional measures' scenario) from the electricity generation, built environment and transport sectors, along the 2050 target pathway as set out in Ireland's National Policy Position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





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

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

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

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

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

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

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

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

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



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



6. Near-term Responses and Long-term Transition

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

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

Towards a Climate-neutral Resilient Society

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

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

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

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

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

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



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

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

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

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



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



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

Finance Flows

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

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

Public Finance

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

Private Finance

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

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

Realising the Opportunities

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

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

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

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



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

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

Supporting International Climate Action

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

Adaptation Planning and Governance: Towards a Climate-resilient Ireland

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

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

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

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



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

Support and Information Systems

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

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

¹² <http://www.climateireland.ie>



Figure 2.7 Ireland's Climate Information Platform, Climate Ireland



Public Participation: Societal Transitions

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

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

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

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

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



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



Topic Box 2.2 The National Dialogue on Climate Action

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

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

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



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

Just Transition: Progressing Climate Justice

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

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

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

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



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

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

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

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

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

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

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

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



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

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



7. Research

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

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

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

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

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

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

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

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

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

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

The next report is due in June 2021.

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



8. Conclusions

Climate Impacts

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

The Climate Challenge

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

Transformative Change

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

Ireland's Climate Actions and Ambitions

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

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

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

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

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



Chapter Highlights for Climate Change



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



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



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



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Chapter 3

Air Quality



Air Quality

1. Introduction

Air is of critical importance to supporting life in all its forms. Natural events such as volcanoes, desert dust and forest fires and occurrences such as sea salt particles being carried in the wind have always affected the quality of the air we breathe. But day-to-day human activities have a greater impact on our atmosphere. Emissions from home heating, agriculture, transport and energy generation all contribute to poorer air quality throughout the year. Poor air quality has serious health implications both in the short term (e.g. causing temporary illnesses such as headaches, breathing difficulties or eye irritation) and in the long term (e.g. causing chronic illnesses such as asthma, reduced liver function and cardiovascular diseases). The latest estimates from the European Environment Agency (EEA) calculate that in excess of 1300 premature deaths occur in Ireland each year because of poor air quality (EEA, 2020a).

In addition to emissions from various sources of air pollution, meteorological conditions influence air quality. Owing to Ireland's geographical location as an island on the periphery of Europe, with prevailing winds from the south-west, it is less frequently affected by transboundary air pollution from its neighbours. Historically too, the absence of large cities and heavy industry in Ireland resulted in less pressure on air quality. However, data from the expanded National Ambient Air Quality Monitoring Programme, which is providing more comprehensive air quality information, indicate several areas of poorer air quality across the country (EPA, 2017). It is becoming increasingly clear that there are challenges to good air quality in both urban and rural areas that need to be addressed.



2. Air Quality Standards and Policy in Ireland

European Directives on Air Quality and Emissions

EU directives set baseline standards for monitoring air quality and reducing emissions in Ireland.

The framework for the European Union (EU) clean air policy, illustrated in Figure 3.1, has a three-pillar approach that aims to protect EU citizens from the adverse health effects of poor air quality, as well as protect ecosystems. The framework uses a combination of standards and directives to regulate sources of air pollutants, obtain commitments to reduce national emission quantities and set limit values for levels of air pollutants in ambient air. The Clean Air Programme for Europe, published by the EU in 2013, provided a comprehensive review of emissions-related elements (EC, 2013). As a result, new targets were put in place through updated emissions ceilings levels and provisions in a new directive governing medium combustion plants.

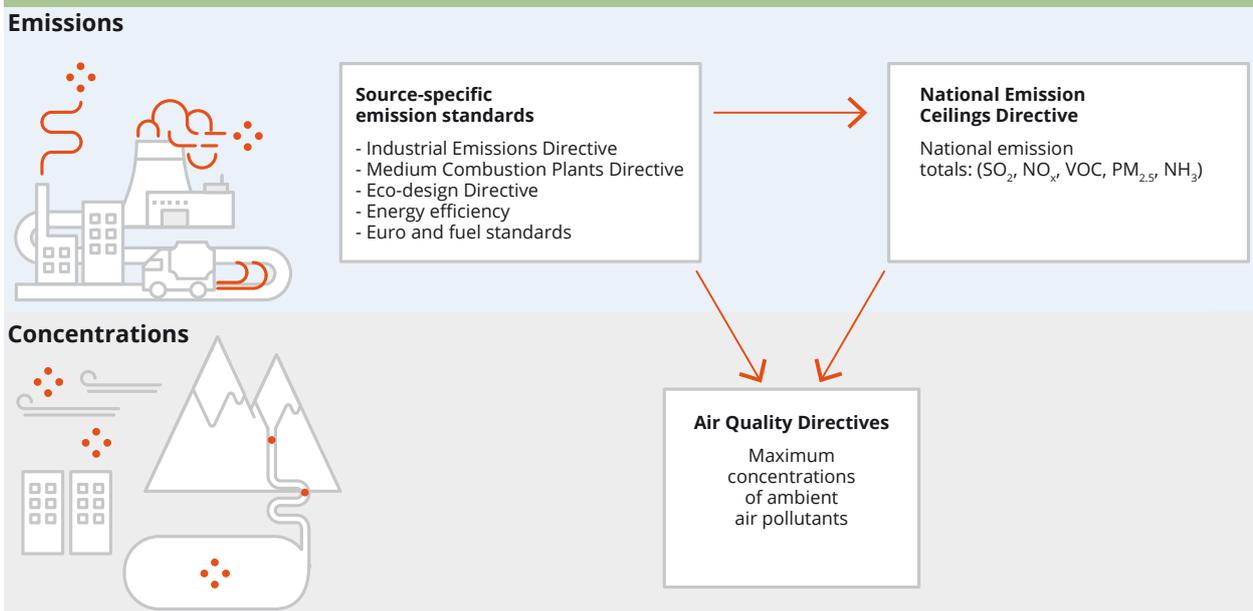
A new National Emission Ceilings (NEC) Directive (2016/2284/EU), which entered force on 31 December 2016, replaces earlier NEC directive (2001/81/EC) (EEA, 2020b). The NEC Directive, Annex II, set emissions reduction commitments for 2020 and 2030, based on a reduction from 2005 emissions, for the five main air pollutants (covered below). It also provided for the 2010 emission ceiling levels to remain applicable for Member States until the end of 2019. The NEC Directive transposes the reduction commitments for 2020 agreed by the EU and its Member States under the 2012 revised Gothenburg Protocol (UNECE, 2016a). The reduction commitments for 2030 are designed to reduce the health impacts of air pollution by half compared with 2005. The NEC Directive also requires that Member States, including Ireland, draw up a National Air Pollution Control Programme (NAPCP) to help implement air quality plans established under the Ambient Air Quality Directives (2008/50/EC and 2004/107/EC).



The Ambient Air Quality Directives set standards for 13 air quality pollutants that have an impact on human health and vegetation. When a Member State exceeds a limit value for a pollutant, it is required to prepare an air quality plan, which is also submitted to the European Commission. These plans must detail the measures that the Member State will take to bring the pollutant levels back under the limit value. A new air quality plan for Dublin will be required to address an exceedance of nitrogen dioxide limits in 2019.

The EU reviewed the effectiveness of the Ambient Air Quality Directives through a process of fitness checking and concluded that they have been partially effective in improving air quality and achieving air quality standards. Additional guidance or clarification of requirements in the directives could help to make monitoring, modelling and the provisions for plans and measures more effective and efficient (EC, 2019a).

Figure 3.1 EU clean air policy – the policy framework (Source: EEA, 2018)



NH₃, ammonia; NO_x, nitrogen oxides; PM_{2.5}, particulate matter; SO₂, sulphur dioxide; VOC, volatile organic compounds.

World Health Organization Guidelines on Air Quality

World Health Organization guideline values, which the EPA uses to assess air quality, are more stringent than EU ambient air quality legislative values.

The World Health Organization (WHO) first published guidance on the threshold limits for four air pollutants in 1987 (WHO, 2017). The guidance was produced based on accumulated scientific evidence and was designed to offer support in reducing the health impacts of air pollution. The guidelines have been reviewed several times, with the most recent version being completed in 2005 (WHO, 2006). In general, the guideline values recommended by the WHO are more stringent than the limits set in European legislation. The WHO is currently reviewing its air quality guidance in recognition of a much broader knowledge base regarding the adverse health effects related to short-term and long-term exposure to air pollutants (WHO, 2020).

Air Quality Policy in Ireland

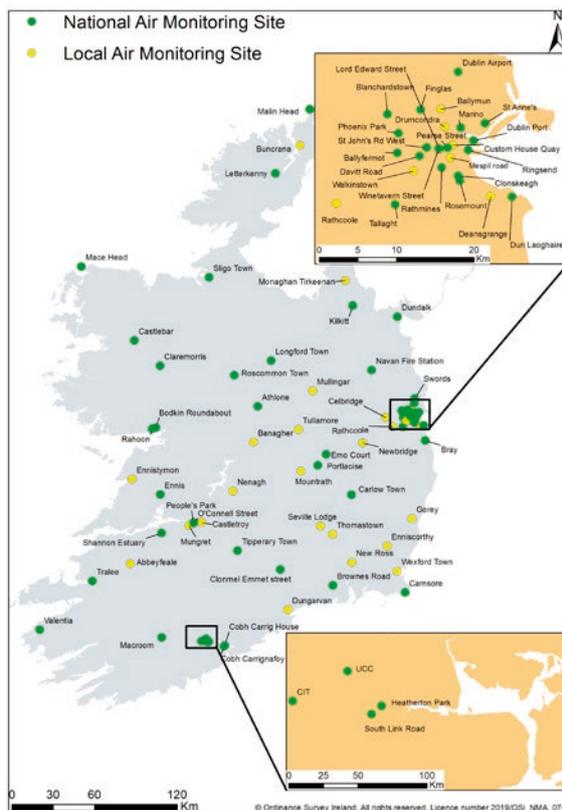
The Department of the Environment, Climate and Communications (DECC) has responsibility for ensuring that Ireland meets its air quality obligations under EU/international legislation and agreements. The Environmental Protection Agency (EPA) is the competent body for coordinating ambient air quality assessment. The DECC is preparing a National Clean Air Strategy (NCAS) as part of a wider NAPCP. The overall aim of the strategy will be the promotion of clean air policies to enhance and protect the quality of the air that we breathe (DCCA, 2017). As part of the preparatory process, a Clean Air Dialogue with the European Commission, including numerous stakeholders, took place. Some of the recommendations from the Clean Air Dialogue include tackling road transport-related nitrogen oxide emissions, monitoring of ammonia emissions from agriculture and taking action on residential solid fuel use and shipping emissions (DCCA, 2017).

Assessing Air Quality in Ireland

Data from the National Ambient Air Quality Monitoring Network are used for public information and reporting purposes.

Air pollution levels are assessed using specialised techniques and instruments at designated monitoring stations across the country. Figure 3.2 displays the national ambient air monitoring network. The stations collect air quality data for public information display (available at www.airquality.ie) and for assessment against both the European legal limit values and WHO guideline values. The data are reported to the EEA every hour. The network is managed by the EPA, in partnership with local authorities and other public bodies and third-level education institutions.

Figure 3.2 National Ambient Air Quality Monitoring Network in 2020 (Source: EPA)



National Ambient Air Quality Monitoring Programme 2017-2022

Following a review of ambient air quality monitoring in Ireland, the current national monitoring programme was launched at the end of 2017.

Following a review of ambient air quality monitoring in Ireland, a new national ambient air quality monitoring programme commenced at the end of 2017. The programme is providing more comprehensive, real-time, localised air quality information that is linked to public health advice. The programme involves a greatly expanded national monitoring network, supported by increased modelling capability to provide air quality information to the public. To date, the network has expanded from around 30 stations to more than 80, with a number of the existing stations upgraded to provide more real-time data. The EPA currently undertakes air quality monitoring, communicates these data to the public and reports data in compliance with the requirements of the Ambient Air Quality Directives. The programme also aims to involve the public through various citizen science initiatives to encourage greater public understanding of and involvement in air quality issues (Topic Box 3.1).

Topic Box 3.1 GLOBE Program



GLOBE¹ is an international science education programme running in more than 120 countries across the world. In Ireland, it is coordinated by the Environmental Education Unit of An Taisce in partnership with the EPA. Twice a year, students from schools across Ireland measure the air quality around their schools as part of the GLOBE Air Quality Campaigns. Students use diffusion tube samples to measure nitrogen dioxide – a principal pollutant from car exhaust emissions – at locations around their schools for one month. They then analyse the results and examine potential impacts on their health and wellbeing. Overall, the findings in Ireland have indicated generally good air quality. For most schools, the results ranged from 'excellent' to 'pretty good'. Nitrogen dioxide levels were higher for schools in major towns and cities than for schools in rural areas. Schools noted a deterioration in air quality at the school gate compared with more sheltered areas, such as school grounds.

1 <https://www.globe.gov/web/ireland/home/overview-of-air-quality-campaign>



Aerial image of Tullamore, Co. Offaly

3. Tracking Emissions of Transboundary Air Pollutants

The NEC Directive sets national emission reduction commitments for Member States and the EU for five important air pollutants: nitrogen oxides, non-methane volatile organic compounds (NMVOC), sulphur dioxide (SO₂), ammonia and fine particulate matter (PM_{2.5}). The position in Ireland concerning the requirements of the NEC Directive is as discussed below. An assessment of projected future emissions of these pollutants in 2020 and 2030 is provided, focusing on the 'With Additional Measures' scenario. This scenario includes the effect of Ireland's 2019 Climate Action Plan.

State of Progress for Limiting Transboundary Air Pollutants in Ireland

Nitrogen oxides (NO_x)

Overview: Nitrogen oxide emissions are linked to fuel combustion in transport, home heating and power stations and nitrogen (fertiliser and manures) in agriculture. Nitrogen oxide emissions contribute to acidification and eutrophication processes. Nitrogen dioxide, in particular, can have negative impacts on respiratory and cardiovascular health.

Progress against the emission ceiling target

Figure 3.3 shows nitrogen oxide emissions by sector before and after applying the flexibilities² as allowed under Article 5 of the NEC Directive. The figure shows that, even after applying the flexibilities, Ireland exceeded the emission ceiling of 65 kilotonnes in 2010 but was compliant in all subsequent years up to and including 2018. Current projections show Ireland's emissions exceeding the reduction commitment for 2020. Projections estimate compliance with the 2030 emission reduction ceiling on the basis of full implementation of the 2019 Climate Action Plan; however, further measures may be required to ensure compliance in 2030. Emissions of nitrogen oxides from manure management and agricultural soils are not within the scope of the NEC Directive for the purposes of complying with the reduction commitments applicable from 2020 onwards.

² The use of flexibilities is allowed under Article 5(1) of the NEC Directive (2016/2284/EU) as Ireland is non-compliant with national emission reduction commitments as a result of applying improved emission inventory methods updated in accordance with best scientific knowledge. The flexibility mechanism allows Member States to subtract emissions from new sources that have been included in the national inventory since the reduction commitments or ceilings were established or where the emission factors used to estimate emissions have changed significantly based on new science. Ireland's adjustments are reviewed under Article 10(3) of the NEC Directive.

Figure 3.3 Total nitrogen oxide emissions with and without the use of flexibilities, and projected emission figures (Source: EPA)

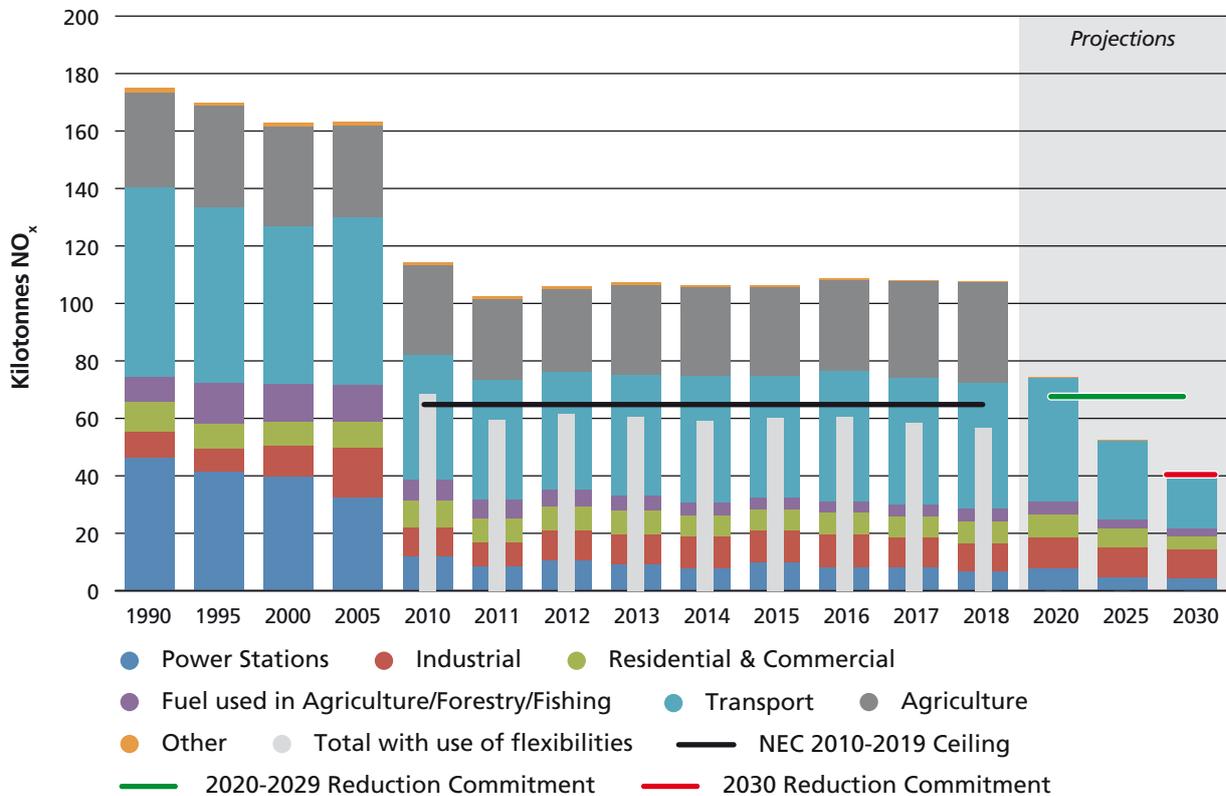


Figure 3.3 presents a scenario where the NO_x emissions from manure management and agricultural soils (Agriculture) are excluded, as these sources were not included in the national inventory at the time the 2020 and 2030 reduction ceilings were established.

Key steps towards achieving the target

A reduction in the contribution of transport combustion sources (mainly exhaust emissions from road transport) will be crucial for Ireland to achieve its commitments under the NEC Directive. Transforming the transport system by promoting measures such as public transport use, walking and cycling can reduce dependency on cars. This, combined with an overall transition to low-emission fuel and renewable energy use in road transport, is needed to address nitrogen oxide emission concerns in transport. This will also assist in reducing greenhouse gas emissions in the transport sector.

Sulphur Dioxide (SO₂)

Overview: Sulphur dioxide emissions are transboundary emissions that can cause acid deposition, damaging ecosystems and vegetation. Sulphur dioxide emissions have significantly reduced in Ireland since 1990 and are linked to combustion processes that use sulphur containing fuel.

Progress against the emission ceiling target

Ireland achieved the 2010 emission ceiling of 42 kilotonnes in 2010 and all subsequent years up to and including 2018. Current projections estimate that Ireland will be compliant with the 2020 and 2030 reduction commitments.

Key steps towards achieving the target

Fuel switching in the power generation and industrial sectors has aided the achievement of Ireland's commitments on sulphur dioxide. Reductions in the sulphur content of fuel oil, gas oil, diesel and gasoline, and a decrease in coal and peat use for power generation and heating in Irish homes, should help to maintain this situation.



Non-methane Volatile Organic Compounds (NMVOC)

Overview: NMVOC emissions are linked to paint and solvent use, the production of food and beverages (spirits), transport and agriculture. NMVOCs can have a number of direct damaging impacts on human health and can also have indirect effects on health by contributing to the formation of ground-level ozone, which causes respiratory and cardiovascular problems.

Progress against the emission ceiling target

Figure 3.4 shows NMVOC emissions by sector for recent years and projected amounts for 2020 and 2030. Ireland's emission ceiling for NMVOC is 55 kilotonnes and this was exceeded in 2010. Ireland was compliant in all subsequent years up to and including 2018 after applying flexibilities, as allowed under the NEC Directive. Current projections estimate that Ireland's emissions may meet the reduction commitment for 2020. Emissions are projected to exceed the 2030 reduction commitment and further measures may be required to ensure compliance in 2030.

Key steps towards achieving the target

Future trends in NMVOC emissions depend largely on the results from the implementation of EU directives on solvent and product uses and the levels of spirit production, solid fuel combustion in the residential sector, and cattle numbers in the agriculture sector in Ireland. Emissions of NMVOCs from manure management and agricultural soils are not within the scope of the NEC Directive for the purposes of complying with the reduction commitments applicable from 2020 onwards.

Ammonia (NH₃)

Overview: The agriculture sector accounts for nearly all (99%) ammonia emissions in Ireland. Uniquely for the pollutants under the NEC Directive, ammonia emissions are increasing year on year. Ammonia emissions can lead to the formation of secondary particulate matter, acidification and eutrophication.

Figure 3.4 Total NMVOC emissions with and without the use of flexibilities, and projected emission figures (Source: EPA)

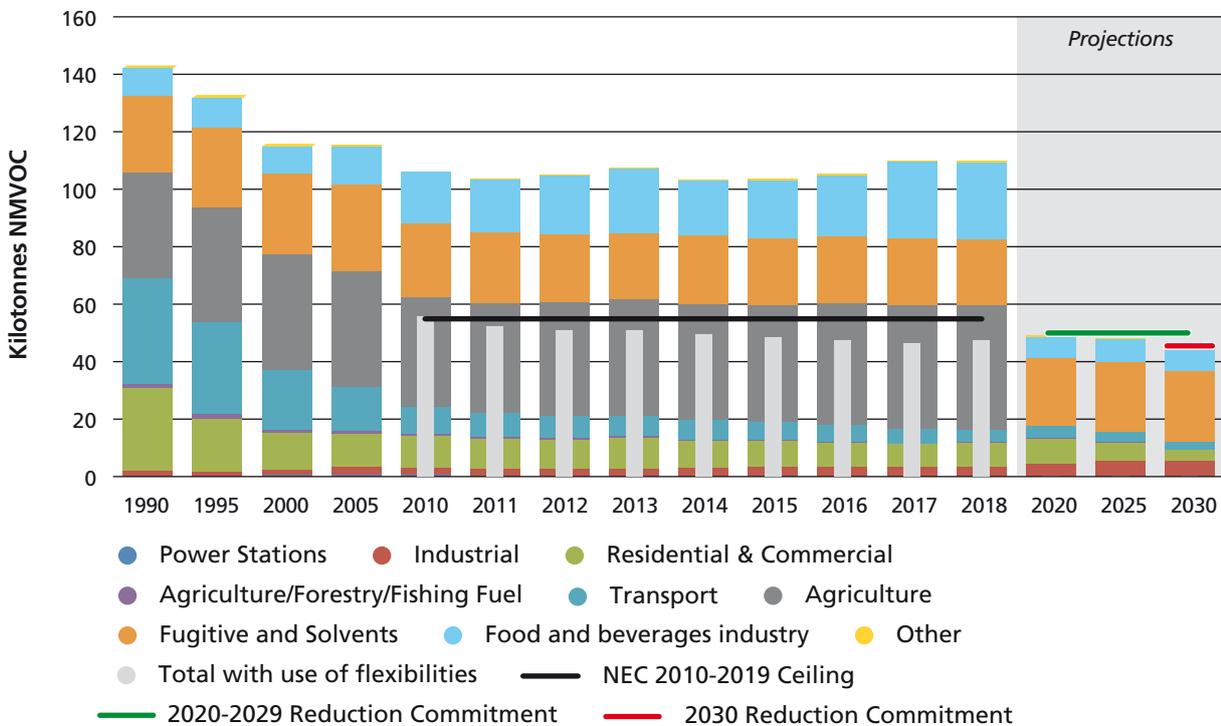


Fig 3.4 presents a scenario where the NMVOC emissions from spirit production (Food and beverages industry), manure management and agricultural soils (Agriculture) are excluded, as these sources were not included in the national inventory at the time the 2020 and 2030 reduction ceilings were established

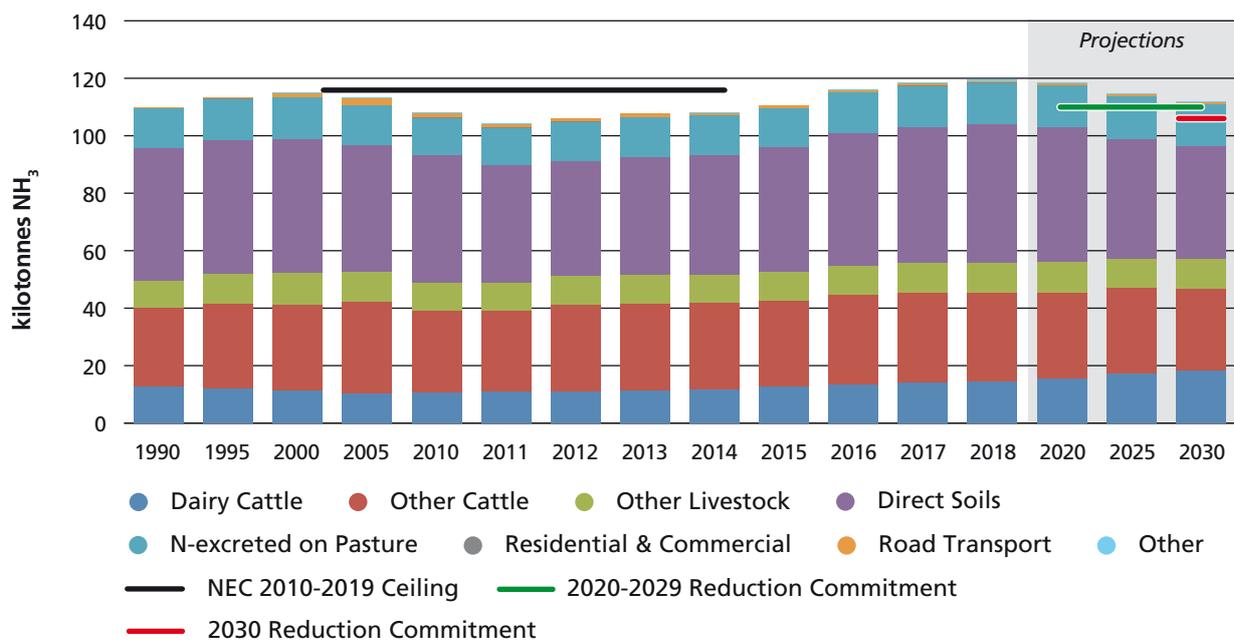
Progress against the emission ceiling target

Figure 3.5 shows ammonia emissions by sector. Ireland's national emission ceiling for ammonia under the NEC Directive is 116 kilotonnes, to be achieved by 2010 and in each year up to and including 2019. The emissions of ammonia complied with the 2010 NEC Directive ceiling for the years 2010-2015; however, Ireland exceeded the emission ceiling in the years 2016-2018. Current projections show Ireland's ammonia emissions exceeding the reduction commitments for 2020 and, without further measures, in 2030 and the intervening years.

Key steps towards achieving the target

The agriculture sector accounts for virtually all (99%) of ammonia emissions in Ireland. Limiting and reducing ammonia emissions in the future could be problematic given the strong performance of the agriculture sector, in line with the ambitious targets of Food Wise 2025 (DAFM, 2015) and the current discussions on the agri-food strategy to 2030. There is now an immediate requirement for focused implementation of abatement measures at the farm level. These measures include the use of low-emission manure-spreading techniques and the use of urea fertiliser products that include urease inhibitors. Furthermore, increases in nutrient use efficiencies at farm level through improvements in soil fertility and soil pH levels should lead to the more optimum use of manures and synthetic fertilisers.

Figure 3.5 Total ammonia emissions and projected emission figures (Source: EPA)



Particulate matter (PM_{2.5})

Overview: Particulate matter (PM_{2.5}) emissions are linked to the combustion of fuels in the residential sector, road transport, construction works and industry.

In addition, particulate matter can be formed from reactions between different pollutant gases. Fine particulate matter, PM_{2.5}, is associated with significant negative impacts on human health, including acute and chronic respiratory illnesses and cardiovascular diseases (Kim *et al.*, 2017).

Progress against the emission ceiling target

The NEC Directive sets out new national emission reduction commitments for PM_{2.5} that are applicable from 2020 to 2029 and from 2030 onwards. These new reduction commitments are relative to the emissions in 2005.

Key steps towards achieving the target

Future trends in PM_{2.5} emissions depend largely on solid fuel combustion in the residential sector. Current projections estimate that Ireland will be compliant with 2020 and 2030 reduction commitments.



4. Air Pollutants Monitored in the National Ambient Air Quality Monitoring Network

The EPA and partner bodies assess a range of air pollutants as part of the Irish air quality monitoring network.

The EPA and partner bodies use data from the National Ambient Air Quality Monitoring Network to assess levels of air pollutants. These include nitrogen oxides, sulphur dioxide, carbon monoxide, ground-level ozone, particulate matter (PM₁₀ and PM_{2.5}), benzene, heavy metals and polycyclic aromatic hydrocarbons (PAH). Across Europe, the most problematic pollutants have consistently been particulate matter, nitrogen oxides and ozone but, recently, PAHs have also been identified as pollutants of concern. The following section details the assessments of monitoring results for these four pollutants in Ireland.

Particulate Matter

Particulate matter in air consists of very small particles that have a very big impact on health.

Particulate matter is a mixture of very small solid or liquid particles suspended in air. Primary particulate matter is emitted directly into the atmosphere from natural and human activities, while secondary particulate matter is formed in the atmosphere from precursor compounds.

Particulate matter is usually referred to as PM with a number after it to show how small the particles are. The EPA monitors two types of PM, namely PM₁₀ and PM_{2.5}, and compares levels with limit values in the CAFE (Clean Air for Europe) Directive (2008/50/EC) and WHO guidelines. PM₁₀ means that the particulate matter is 10 microns or less in diameter, 1/10th the width of an average human hair. PM_{2.5} signifies particulate matter of 2.5 microns or less in diameter – 1/40th the width of an average human hair.

While PM₁₀ particles can penetrate and lodge deep inside the lungs, PM_{2.5} is even more health-damaging. These fine particles can penetrate the lungs and enter the blood system. Long-term exposure to particulate matter contributes to the risk of developing cardiovascular and respiratory diseases, as well as lung cancer (WHO, 2018).

In Ireland the dominant sources of particulate matter from human activities are:

- solid fuels used in home heating in winter
- the transport sector
- agricultural activities, particularly the formation of secondary particulate matter from nitrogen use.

Figure 3.6 illustrates the annual mean levels of PM₁₀ in Ireland from 2009 to 2019. The annual averages were well within the annual limit value of the EU standard. However, in recent years there have been breaches of the WHO annual guideline value of 20 µg/m³, including in Zone C (towns > 15,000 inhabitants) for 2014. Concentrations at the suburban background monitoring site in Rathmines (Zone A background on the graph) – which is influenced by a variety of sources, including residential heating – were in the range of 13-17 µg/m³ over the period, which is below the WHO guideline value. At both traffic monitoring sites in Cork and Dublin, the concentrations of PM₁₀ have slightly decreased, possibly because of reduced emissions from newer vehicles. For the most recent year, 2019, PM₁₀ was monitored at 30 sites. While there were no exceedances of the EU limit value (annual or daily), the WHO air quality daily guideline value of 50 µg/m³ was exceeded at 14 monitoring stations (EPA, 2020). The WHO annual guideline value of 20 µg/m³ was not breached.

Figure 3.7 displays annual mean levels of PM_{2.5} from 2009 to 2019. Levels of PM_{2.5} have been in exceedance of the WHO air quality guideline value at all monitoring locations since 2009. In 2019, both Dublin (Zone A) and Ennis (Zone C) exceeded the WHO air quality guideline value (Topic Box 3.2). The highest concentrations were measured in large towns of > 15,000 inhabitants (Zone C) and rural locations (Zone D) when compared with both Cork and Dublin. In 2019, PM_{2.5} was monitored at 30 stations. There were no exceedances of the EU annual limit value. However, the WHO air quality guideline annual value of 10 µg/m³ was exceeded at ten monitoring stations. The WHO air quality daily guideline value of 25 µg/m³ was exceeded at 25 monitoring stations. Numerous transboundary particulate matter events were measured in spring 2019.

Figure 3.6 Annual mean levels of PM₁₀ from 2009 to 2019 (Source: EPA)

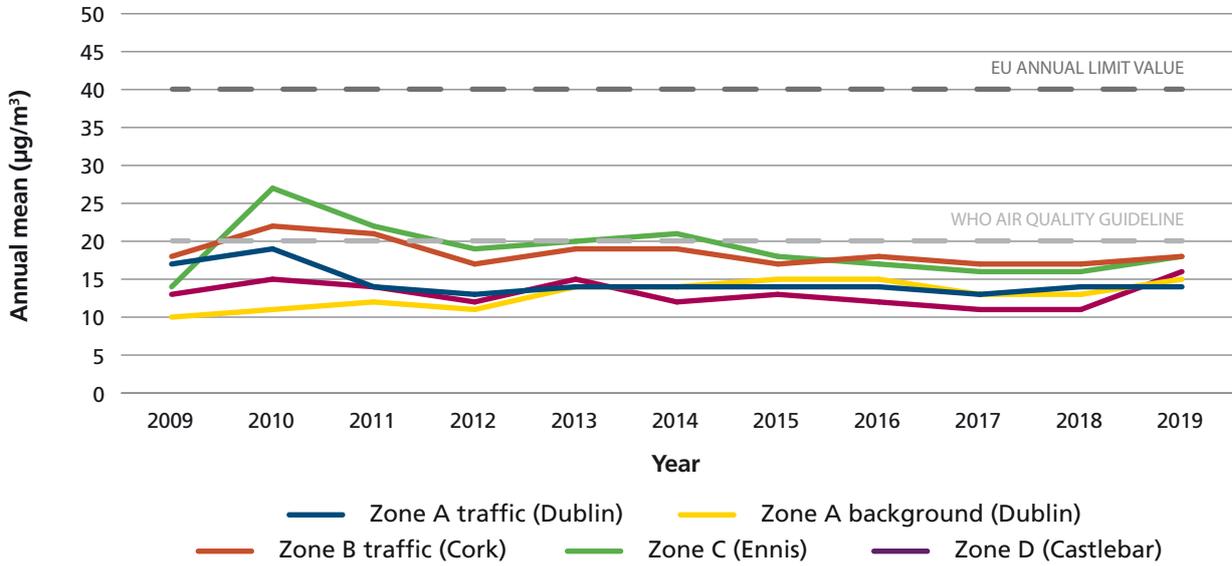
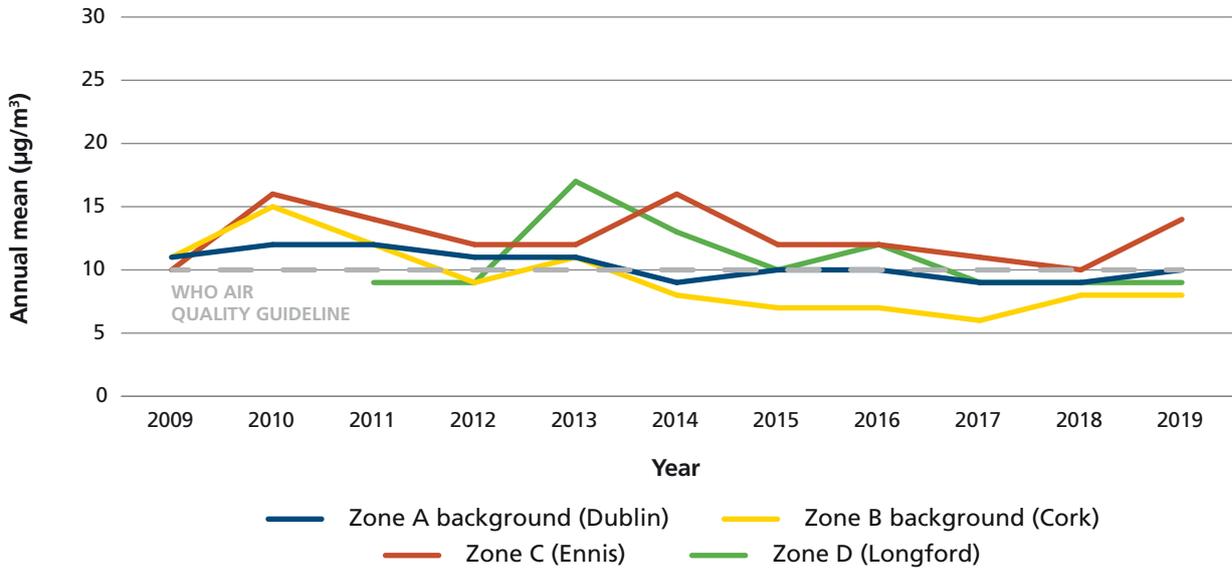


Figure 3.7 Annual mean levels of PM_{2.5} from 2009 to 2019 (Source: EPA)

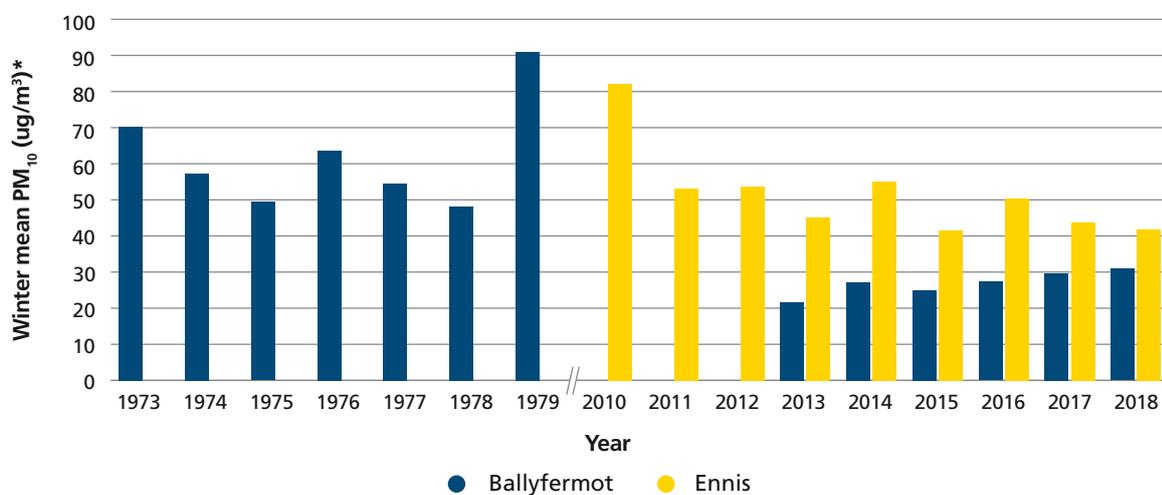




Topic Box 3.2 PM₁₀ Levels during the Winter in Ballyfermot and Ennis

Figure 3.8 shows approximate levels of PM₁₀ in Ballyfermot, Dublin, in the 1970s (these have been derived from black smoke measurements – AFF, 1981; Heal and Beverland, 2017), along with direct PM₁₀ measurements from 2010 to 2018 during the winter at Ballyfermot and Ennis. Both areas have smoky coal bans in place; the ban in Ballyfermot was introduced as part of the Dublin area ban in 1990, while the ban in Ennis was introduced in 2011. Both areas also have access to the national gas network. Currently there are 41 smoky coal ban specified areas nationally. This includes an additional 13 areas added from 1 September 2020. As can be seen from the graph, while the ban is effective in reducing concentrations of PM₁₀ in both areas, Ballyfermot experienced a greater overall improvement. This may reflect the difficulties in enforcing a ban in a smaller town when residents do not have to travel far to purchase smoky fuel from outside the ban area, compared with enforcing it in a large urban area such as Dublin (Goodman *et al.*, 2015).

Figure 3.8 Actual and estimated concentrations of PM₁₀ in Ballyfermot and Ennis (Source: EPA)



* Average black smoke concentrations from 1973 to 1979 have been adjusted by a factor of 1.3 to provide estimates of PM₁₀ levels (Heal and Beverland, 2017).

Nitrogen Oxides

Nitrogen oxides are gaseous pollutants associated with traffic exhaust emissions.

Nitrogen oxides include the gases nitrogen oxide (NO) and nitrogen dioxide (NO₂). Both pollutants are emitted to ambient air when petrol or diesel is burned in internal combustion engines. Nitrogen dioxide is more important from an ambient air quality perspective because of its increased impact on cardiovascular and respiratory health (EEA, 2014).

Internationally, epidemiological studies have shown that symptoms of bronchitis in asthmatic children increase in association with long-term exposure to nitrogen dioxide. In Ireland, research has shown an association between levels of nitrogen dioxide and rates of asthma in older adults (ESRI, 2020). Reduced lung function growth is also linked to nitrogen dioxide at concentrations currently measured in cities in Europe and North America (WHO, 2018).

In terms of ambient air quality, the main source of nitrogen oxides in Ireland is road transport. Diesel vehicles produce more nitrogen oxides than petrol vehicles, particularly older diesel vehicles. Other sources of nitrogen oxides in Ireland include non-road mobile machinery, for example heavy plant machinery, agricultural machinery, industry including energy production, and construction activities.

Measurements indicated an exceedance of the nitrogen dioxide EU limit value at one of the monitoring locations in Dublin during 2019.

Figure 3.9 details the annual average concentrations of nitrogen dioxide across the country from 2009 to 2019. Levels of nitrogen dioxide from transport decreased from 2009 to 2012; this may have been a result of decreased economic activity and favourable meteorological conditions. The highest nitrogen dioxide levels currently are associated with urban areas with the heaviest traffic. Two new air monitoring stations focusing on emissions from road traffic were installed in Dublin in 2018 (St John's Road West near Heuston Railway Station) and 2019 (Pearse Street) (Topic Box 3.3). The annual average nitrogen dioxide level at the St John's Road West site was $43 \mu\text{g}/\text{m}^3$ – an 8 per cent exceedance of the nitrogen dioxide EU limit value of $40 \mu\text{g}/\text{m}^3$ in Dublin for 2019 (EPA, 2020). Levels of nitrogen dioxide in other zones were below the EU limit value at the locations monitored. Under EU legislation, an Air Quality Action Plan is required from local authorities in the Dublin area to outline measures to reduce levels. As part of this process, the DECC and Department of Transport, Tourism and Sport have established the Urban Transport-Related Air Pollution Steering Group to address nitrogen dioxide and other traffic-related air pollution in Dublin.



Figure 3.9 Annual mean nitrogen dioxide concentrations from 2009 to 2019 (Source: EPA)

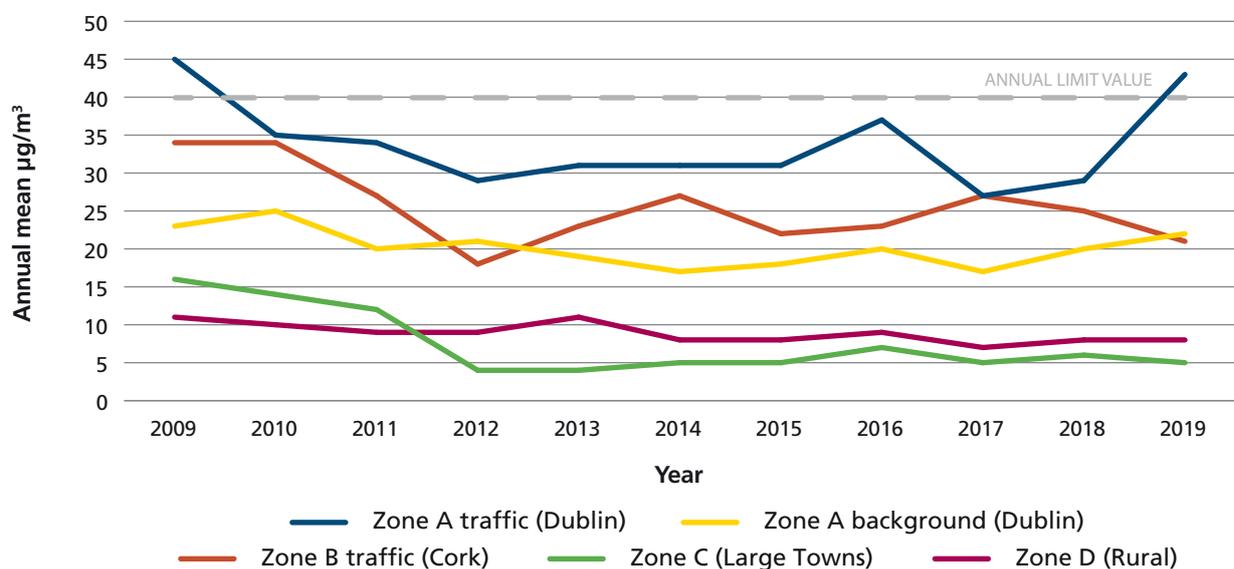




Figure 3.10 Modelled annual average nitrogen dioxide concentrations in Dublin for 2017



Topic Box 3.3 Modelling Air Quality in Dublin

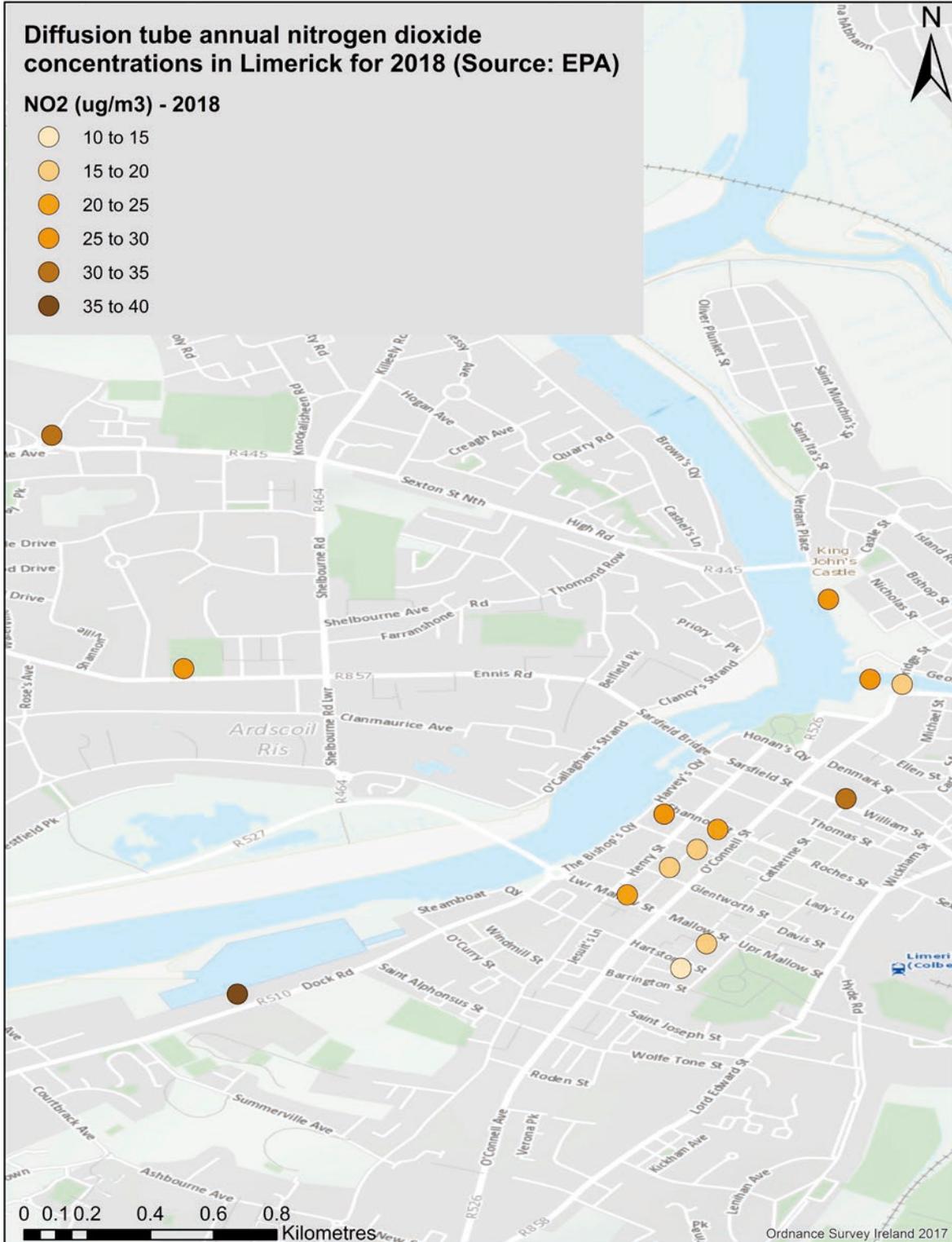
In 2019, the EPA released a report entitled *Urban Environmental Indicators: Nitrogen Dioxide Levels in Dublin*, which detailed modelled concentrations of nitrogen dioxide beyond monitoring stations (EPA, 2019a). The report found that based on air quality indicative monitoring and modelling predictions many areas across Dublin, in particular those close to busy roads, were above the EU nitrogen dioxide annual limit value of $40 \mu\text{g}/\text{m}^3$. The modelled concentrations of nitrogen dioxide were highest around the M50 motorway, along certain city centre streets, and around the entrance and exit of the Dublin Port tunnel. Away from busy roads, the modelling showed that levels of nitrogen dioxide are low. The modelled predictions have since been used, along with indicative measurements, to aid the siting of new monitoring stations such as those at the Pearse Street and St John's Road West sites. Figure 3.10 shows the modelled annual average nitrogen dioxide levels across Dublin.

Nitrogen Dioxide Diffusion Tube Results in Other Cities

Since 2017, the EPA, in partnership with local authorities in Dublin, Cork, Limerick, Galway and Waterford, has been monitoring indicative nitrogen dioxide levels using passive diffusion tubes. Diffusion tubes allow measurements to be obtained at additional locations beyond the permanent monitoring network. Figure 3.11 shows the indicative annual nitrogen dioxide levels from diffusion tubes around Limerick City. These studies have enabled areas of high nitrogen dioxide concentrations, associated with heavily trafficked roads, to be identified. Information for other cities and years are available on the EPA website at www.airquality.ie.

The air quality situation in 2020 has changed significantly as a result of restrictions on people's movement in response to the coronavirus (COVID-19) pandemic, especially during the period of 'full lockdown'. There is clear evidence that there was a decrease in air pollution, particularly towards the end of March and beginning of April 2020, which coincided with the introduction of restrictions on movement. The EPA has been assessing monthly concentrations of nitrogen dioxide and comparing them with the corresponding period in previous years. Owing to a strong association with road transport, nitrogen dioxide levels have been affected to the greatest extent, with decreases of up to 50 per cent compared with previous years. The largest decreases were observed at urban traffic monitoring stations in the National Ambient Air Quality Monitoring Network.

Figure 3.11 Diffusion tube annual nitrogen dioxide concentrations in Limerick for 2018 (Source: EPA)





Ozone

Ground-level ozone is formed when other air pollutants chemically react in the presence of strong sunlight.

Ground-level ozone is formed as a secondary pollutant from the chemical reaction of nitrogen oxides, carbon monoxide and volatile organic compounds in the presence of sunlight. Ozone concentrations tend to be highest in spring and summer. Ozone is a greenhouse gas that affects our climate.

Ozone can be present at ground level because of downwards movement from the ozone-rich stratosphere, where it occurs naturally and plays an important role in absorbing harmful ultraviolet radiation. Ozone is readily transported to Ireland from Atlantic and European regions as a result of the natural movement of air masses. Ground-level ozone is reduced through reactions with traffic-emitted pollutants; therefore, levels of ozone are higher in rural areas than in urban areas.

Elevated concentrations of ozone can decrease lung function. It can also aggravate respiratory ailments in sensitive individuals such as those with asthma and lung disease (EEA, 2014). Normally, elevated concentrations of ground-level ozone in Ireland are caused by transboundary ozone from continental Europe.

Ozone concentrations measured as 8-hour averages in Ireland for the period 2008-2018 show levels well below the maximum allowed number of exceedances per year (25 occurrences). In 2018, Valentia Observatory had the maximum number of exceedances in the network, at six. However, shorter-term ozone episodes do occur. During 2018, a hot and sunny spell of weather from 22 to 30 June led to an increase in ozone concentrations across the country (EPA, 2019b). The highest concentrations from the ozone monitoring network were observed at the rural background site in Kilkitt, County Monaghan, on 28 June 2018. During this episode, the concentrations reached $\approx 170 \mu\text{g}/\text{m}^3$. Had they reached $180 \mu\text{g}/\text{m}^3$, a public information alert would have been triggered to inform the public of the health impacts of elevated (raised) ozone concentrations.

This episode shows that ground-level ozone could be a potential problem pollutant in Ireland if suitable weather conditions are experienced again in the future.

Polycyclic Aromatic Hydrocarbons

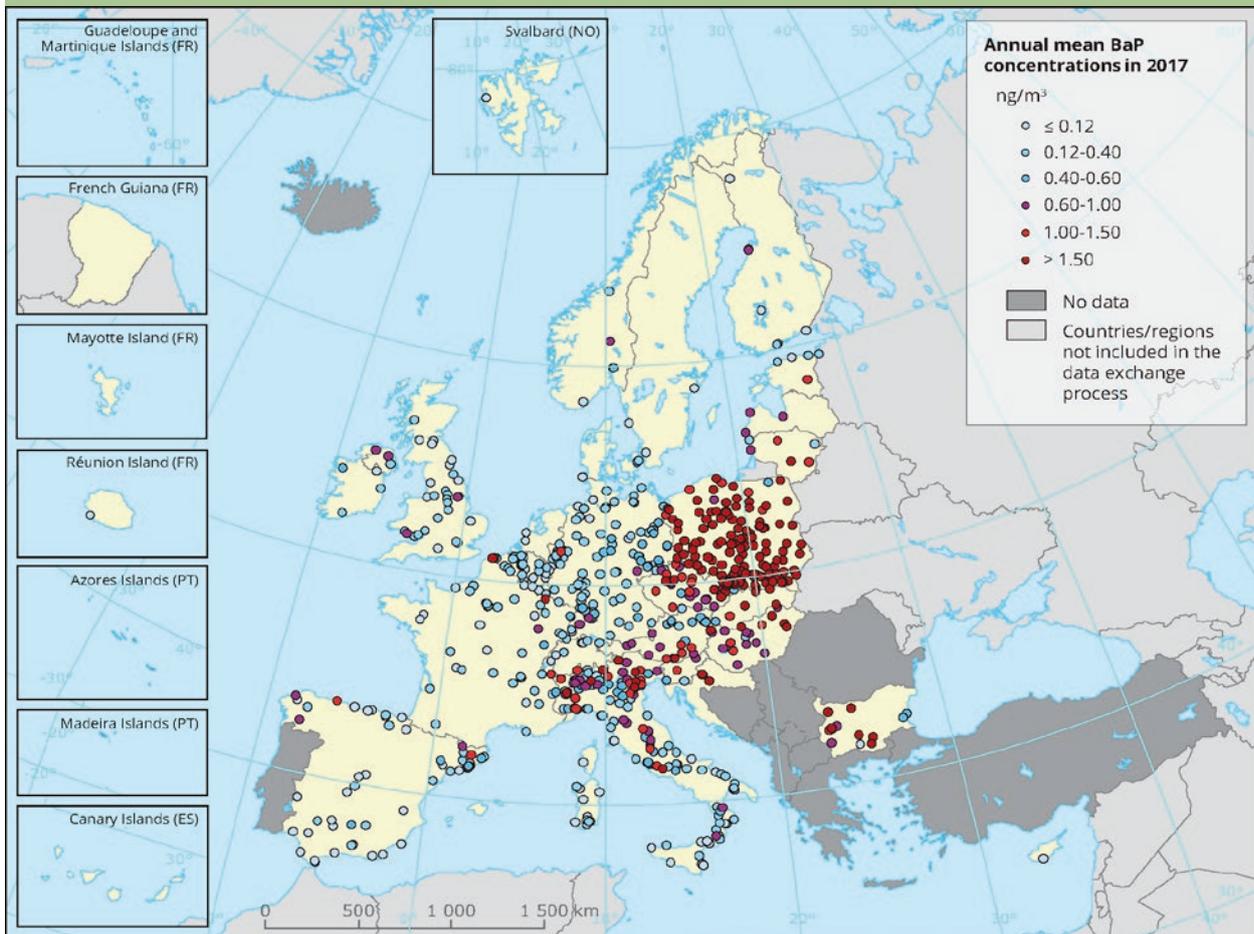
Polycyclic aromatic hydrocarbons are complex chemical compounds formed through the burning of solid fuel.

Polycyclic aromatic hydrocarbons (PAH) are chemical compounds that consist of two or more fused aromatic rings made entirely from carbon and hydrogen. Sources of PAH include industry, traffic emissions and the domestic use of solid fuels such as peat, wood and coal. Long-term exposure to low levels of PAH may cause several diseases, including cancer (EEA, 2014). PAH, in the form of the compound benzo[a]pyrene (BaP), were first monitored in Ireland in 2009 at five monitoring stations. In 2018, levels at three of the four monitoring stations were above the EEA reference value ($0.1 \text{ ng}/\text{m}^3$) but below the EU target value ($1 \text{ ng}/\text{m}^3$). Figure 3.12 details annual mean concentrations of BaP across Europe in 2017 (EEA, 2019). Reductions in emissions from the domestic use of solid fuel are required to reduce ambient levels of PAH. Previous EPA research studies on levels of PAH in various towns throughout Ireland have highlighted elevated levels during the heating season in particular (Goodman *et al.*, 2015).



Air monitoring station, Carrick-on-Shannon, Co. Leitrim, installed in September 2020.

Figure 3.12 Annual mean concentrations of benzo[a]pyrene (BaP) in 2017 (Source: EEA)



5. Outlook for Air Quality in Ireland

Tackling the sources of nitrogen dioxide and particulate matter is the key challenge in our cities and countryside.

While air quality in Ireland has been considered to be generally good, new evidence from increased monitoring and modelling, coupled with new research on the health impacts at lower levels of exposure to particulate matter, raises questions about that status.

Emissions from solid fuel use (coal, peat and wet wood) continue to contribute to localised high levels of particulate matter and PAH during the heating season. The most recent year's data for particulate matter show exceedances of the WHO guideline values throughout the country. There is a need to reduce the use of wet or green wood (i.e. wood that has not been either seasoned for a long period or dried). The level of harmful particulate emissions from such wood is almost four times higher than that for seasoned or dried wood. Having a standard to control the quality of wood for sale would support this reduction in use of wet or green wood.

Levels of nitrogen dioxide are expected to remain above the EU annual limit at several locations close to busy roads in Dublin. A monitored exceedance from the new Dublin city centre monitoring site at St John's Road West for 2019 confirms previous report findings of elevated nitrogen dioxide levels (EPA, 2020). Actions to tackle the key sources of road transport pollution are required to improve the current situation.

Planned actions as part of the National Clean Air Strategy, the National Air Pollution Control Programme, the Climate Action Plan and local air quality plans at a city level are designed to improve air quality for everyone (EC, 2019b). To tackle localised air quality impacts, further regulation of solid and biomass fuel (i.e. coal, peat, wet wood) is required in the area of residential home heating. The promotion of affordable alternatives in terms of home heating upgrades and public transport should be continued. At a European level, the planned implementation of the Ecodesign Directive (2009/125/EC) for domestic stoves will have a positive impact and will need to be implemented into Irish legislation by 2021.



6. Air Quality Research in Ireland

Since 2016, the EPA has invested €3.3 million in 17 new research projects in the air evidence area.

The EPA has funded 17 new research projects relevant to the air area since 2016; a commitment of €3.3 million. Air Science is a theme under the Climate Research Pillar of the EPA Research Programme 2014-2020 (a selected example is given in Topic Box 3.4). EPA-funded research projects³ include research on:

- addressing conflicts of climate and air pollution policy
- residential solid fuel use in Ireland
- eco-driving
- effects of air pollution on terrestrial ecosystems.

Topic Box 3.4 AEROSOURCE Research Project

Evidence from the UK (Defra, 2017) suggests that the contribution of wood burning to PM_{2.5} levels is increasing across both urban and rural areas. This in turn is leading to increased population exposure to particulate matter pollution. From an Irish research point of view, the evidence to date provided from the EPA-funded AEROSOURCE project (EPA, 2019b) suggests that there is a considerable contribution to particulate matter from residential solid fuel use in Dublin.

This research work, which is being conducted by the National University of Ireland Galway, involves examining the various sources that contribute to poor air quality, in particular those sectors that contribute to particulate matter levels. The process, known as source apportionment, involves the use of advanced measurement and assessment techniques to estimate the various source contributions at representative rural and urban locations. The outputs from this research will give a greater understanding of the dominant sources of particulate matter air pollution in Ireland. This will provide Irish policymakers with evidence that can be used to tackle the problem of particulate matter in a more focused manner.

7. Conclusions

Air Quality and Health

Air pollution is the single largest environmental health risk in Europe (EEA, 2020c). Latest figures for Ireland from the EEA attribute in excess of 1300 premature deaths annually to poor air quality. New evidence suggests that there are more extensive air quality issues than previously thought. It is now time to tackle the three key issues that have a negative impact on air quality in Ireland: emissions from the burning of solid fuels in our homes, transport emissions from vehicles in urban areas and ammonia emissions from agriculture.

Monitoring

As a result of the provision of additional data from the National Ambient Air Quality Monitoring Programme, a wider assessment of the state of Ireland's air quality continues to take place. Additional monitoring and modelling assessments are confirming previous EPA early warnings about higher-than-acceptable levels of nitrogen dioxide in our cities, particulate matter levels throughout the country, and ozone during summer time. To have a positive impact on air quality, responses at individual, local, national and EU levels are required.

Events linked to the impacts of transboundary air pollution on the Irish air mass continue to occur on an annual basis. Of concern from a transboundary point of view are continental ozone and particulate matter events, which occur most often during spring and summer. Cohesive EU-level coordinated action is required to tackle the issue of ozone levels throughout the EU.

Nitrogen dioxide

With regard to nitrogen dioxide levels in our cities and towns, action is required to reduce levels in Dublin to comply with the EU limit value. Additional indicative diffusion tube campaigns on nitrogen dioxide levels in other Irish cities indicate some areas of elevated concentrations close to busy streets. To reduce levels of nitrogen dioxide, local authorities will prepare and implement an air quality plan for Dublin. Measures could include those used in other European cities, such as promoting the use of public transport, cycling and walking, and restricting more polluting vehicles from central areas. The announcement that Dublin has become the first Irish city to sign up to the WHO Breathe Life campaign, which entails making a commitment to meeting the WHO guideline values by 2030 (Breathe Life, 2020), is a positive step.

³ More information on these projects is available from <http://www.epa.ie/researchandeducation/research/>. Air-related EPA research reports are available on the EPA website: <http://www.epa.ie/pubs/reports/research/air/>.



Particulate Matter

Particulate matter levels are a concern countrywide. All solid fuels (e.g. coal, peat and wood) produce fine particulate matter emissions. Fine particulate matter in our air has well-established impacts on respiratory and cardiovascular health. This is particularly problematic in or near towns and cities because of the cumulative effects of multiple sources of the pollutant and the large numbers of people exposed.

Home Heating

People are encouraged to think twice about using an open fire or a solid fuel stove unless they have no other form of heating available. For stoves and biomass boilers, emissions levels can vary depending on the quality of the installation, the choice of fuel, how well the stove/boiler is maintained and the way it is used.

Moving to cleaner ways of heating our homes will significantly improve air quality in our towns and cities. Air quality considerations need to be integrated into planning decisions at national and local levels. This includes considering healthier home heating options at the design stage for new homes and large-scale home renovations, as well as considering transport options when planning large housing developments. The EPA infographic *heating your home and its impact on air quality and health* from the 2019 air quality report outlines the spectrum of home heating choices. Any move along the spectrum towards cleaner choices will reduce air pollution in your local area and will also reduce the linked negative health impacts.⁴

Ammonia Emissions from Agriculture

From an emissions perspective, ammonia emissions from agriculture require immediate attention. Projections for future years up to 2030 show Ireland exceeding the reduction commitments for every year if further measures are not put in place. This presents a major challenge considering the agriculture and food sector's strong performance and ambition. There is a need for abatement measures to be adopted at the farm level for progress to be made.

Awareness

Continued education, public information and awareness raising are required to inform the public about air quality and its link to health impacts. Continued engagement with local communities through citizen science initiatives such as the GLOBE Programme can help to raise awareness of local air quality issues (EPA, 2020).

Integrated Solutions

Many air pollutant sources have an impact on both air quality and greenhouse gas emissions. Actions to mitigate climate change need to consider impacts on air quality and vice versa, so that we avoid unintended consequences. Actions should also link with measures to mitigate noise pollution from transport sources. There is no 'one size fits all' solution: for example, what works in rural areas may not work in urban areas. We need integrated approaches to meeting Ireland's climate targets and protecting its air quality. The National Clean Air Strategy as part of the National Air Pollution Control Programme which was first announced in 2017, should also include positive actions for climate change. The government's 2019 Climate Action Plan will also have co-benefits for air quality across a number of sectors, including residential heating and transport. Examples of planned actions include promotion of electric vehicles and upgrades to housing with improved insulation and cleaner modes of home heating. As a country we should have the ambition to adopt the WHO air quality guideline values as national air quality standards. This would provide for a higher level of public health protection and cleaner air for all. A nationwide smoky coal ban would allow the benefits of improved air quality to be experienced by all. At a European level, the implementation of the Zero-Pollution Action Plan, expected to be published in 2021, and the promotion of sustainable and smart mobility plans as part of the EU Green Deal, should have positive effects for Ireland provided that there are clear implementation pathways.

Air Quality Research

Continued research into the ever-evolving situation regarding air quality is necessary. Recently funded projects looking at additional emissions sources such as shipping and real-world traffic emissions and the impacts of agriculture on air quality are ongoing. The findings of this research will be needed to inform effective policy responses to the challenges in these areas.

⁴ <https://www.epa.ie/pubs/reports/air/quality/Air%20Quality%20In%20Ireland%202019.pdf>



Chapter Highlights for Air Quality



Monitoring and research show that Ireland has air quality issues that need to be resolved. Poor air quality has implications for public health. Identified solutions need to be implemented for the causes of poor air quality, which mainly relate to the residential use of solid fuels for home heating, emissions from transport, especially from diesel and petrol engine passenger cars, and ammonia-related emissions from livestock farming.



Using home heating choices that reduce air emissions, along with improved standards for the quality of solid fuel available, will help to minimise local air quality impacts. Reducing our reliance on diesel- and petrol-fuelled passenger cars and the adoption of best practices to reduce agricultural ammonia emissions on farms will have co-benefits for air quality, the climate, human health and biodiversity. In addition, the implementation of the commitments in the government's Climate Action Plan will have co-benefits for air quality.



The need for a National Clean Air Strategy supported by WHO standards is more pressing than ever. The publication and roll-out of actions as part of the National Clean Air Strategy will be a necessity. The adoption of the WHO guideline values as national air quality standards would provide for a higher level of public health protection.

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Chapter 4

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, the most widespread sources of environmental noise exposure in Ireland are various forms of transport.

Annoyance is one of the most prevalent responses to noise. Annoyance is described as a stress reaction that encompasses a wide range of negative feelings such as disturbance, dissatisfaction and distress. An individual’s response to noise depends not only on exposure levels but also on the context, the situation and personal factors (EEA, 2019a). The World Health Organization (WHO) has reported extensively on the health impacts of environmental noise pollution.

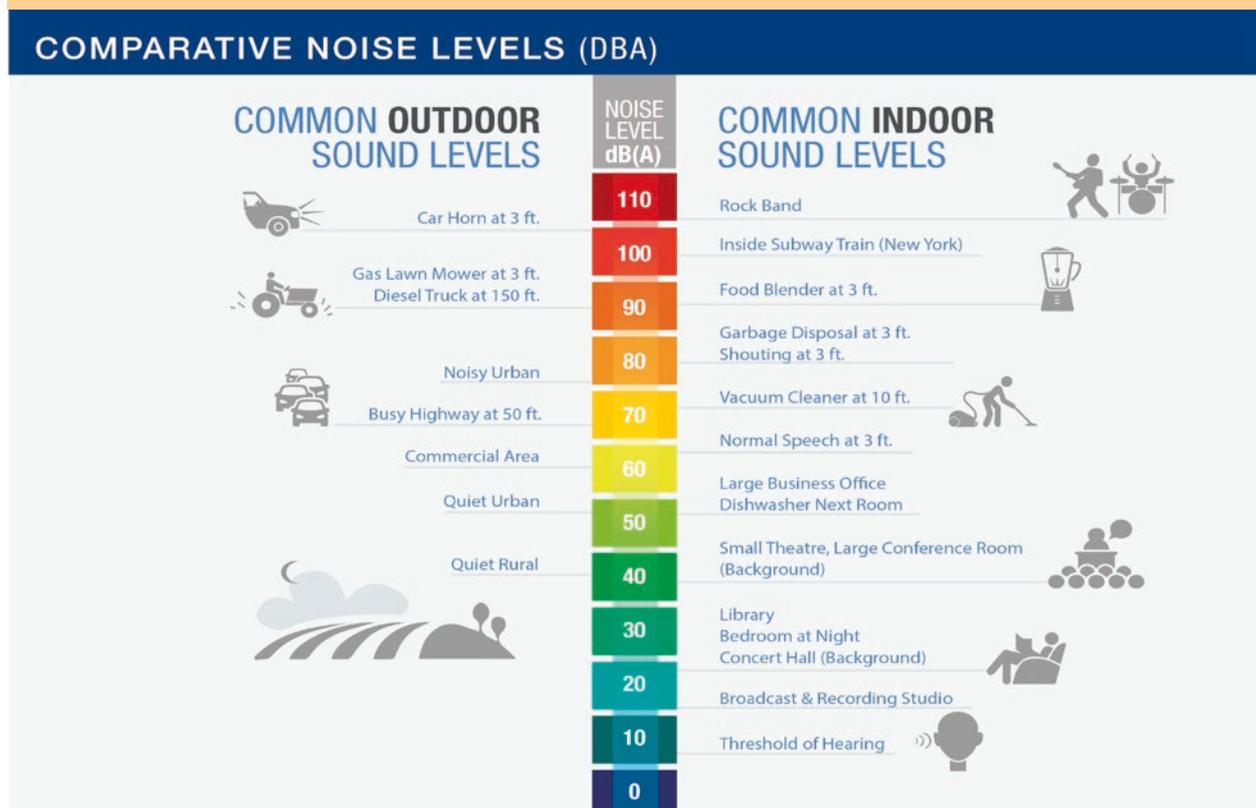
The human ear hears sound pressures over a wide range of frequencies. Decibels (dB), which are measured on a logarithmic scale, correspond to the way our ears interpret sound pressures. Figure 4.1 outlines some comparative noise levels for outdoor and indoor activities (US DT FAA, 2020).

Noise and Health

The WHO has identified long-term noise exposure as an important public health issue and the second most significant environmental cause of ill health in western Europe after air pollution.

In 2018, the WHO published the *Environmental Noise Guidelines for the European Region* (WHO, 2018). The guidelines set out how noise pollution in our towns and cities is increasing and how excessive noise, particularly from transport sources, has negative impacts on human health and wellbeing, adversely affecting sleep and cardiovascular and metabolic function. Night-time exposure to high levels of road traffic noise affects more than 78 million people in the 33 member countries of the European Environment Agency. In Europe more than 17 million people are exposed to high night-time noise levels from railways and approximately 1.3 million are exposed to high night-time noise levels from aircraft (EEA, 2019b). Data for Ireland from the transport noise mapping work, coordinated by the Environmental Protection Agency (EPA), are also available. These data are discussed later in this chapter (see section 2 for relevant discussion).

Figure 4.1 Comparison of indoor and outdoor sound levels (Source: US DT FAA, 2020)





Excessive noise is reported (WHO, 2020) to:

- seriously harm human health and interfere with people's daily activities
- disturb sleep and cause cardiovascular and psychophysiological effects and
- reduce performance and provoke annoyance responses and changes in social behaviour.

Long-term exposure to environmental noise from road traffic, railways, aircraft and industry contributes every year to about 48,000 new cases of heart disease and 12,000 premature deaths in Europe (EEA, 2020). Research is under way in Ireland on the health impacts of exposure to environmental noise in a national context. Meanwhile, environmental noise reduction measures complement the United Nations (UN) Sustainable Development Goals on Good Health and Wellbeing (Goal 3) and Sustainable Cities and Communities (Goal 11).

2. Assessment of Environmental Noise from Transport Sources in Ireland

European legislation requires the development of strategic noise maps and action plans on a 5-year cycle.

The European Union's (EU's) Environmental Noise Directive (END; 2002/49/EC) deals with environmental noise from major transport infrastructure including roads, railways and airports (EC, 2002). The END 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 industry and
- develop action plans to reduce the level of noise where necessary and to maintain environmental noise quality where it is good.

Strategic Noise Maps Covering Transport Noise Sources

Strategic noise maps show the predicted noise exposure in a given area resulting from transport noise sources.

The EPA is the national authority for overseeing the implementation of the Environmental Noise Regulations 2018.¹ 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, Irish Rail and the Dublin Airport Authority. The roles and responsibilities in terms of noise mapping in Ireland are outlined on the EPA website.²

Only the larger transport noise sources are required to be modelled and mapped. The thresholds that apply to the noise mapping are as follows: major roads – > three million vehicle passages/annum; major railways – > 30,000 train passages/annum; major airports – > 50,000 air movements/annum; and major cities – agglomerations with > 100,000 inhabitants, which in Ireland includes the cities of Dublin, Cork and, from 2020, Limerick.

Strategic noise maps show noise exposure levels. They 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. The noise maps are presented in terms of two noise indicators, L_{den} and L_{night} , as described in Topic Box 4.1.

Topic Box 4.1 Noise indicators

L_{den} is the day-evening-night long-term average noise indicator. It is 'weighted' to account for extra annoyance in the evening and night-time periods. The END defines an L_{den} threshold of 55 dB for reporting on the numbers of people exposed.

L_{night} is the night-time long-term average noise indicator and is used in the assessment of sleep disturbance. An L_{night} threshold of 50 dB is defined for reporting on the numbers of people exposed.

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

1 The European Communities (Environmental Noise) Regulations 2018 (S.I. No. 549/2018) both revise and revoke the Environmental Noise Regulations 2006. See <http://www.irishstatutebook.ie/eli/2018/si/549/made/en/print>.

2 Noise mapping – round 3; <http://www.epa.ie/monitoringassessment/noisemapping/>



Figure 4.2 Dublin agglomeration roads noise map (Source: EPA)

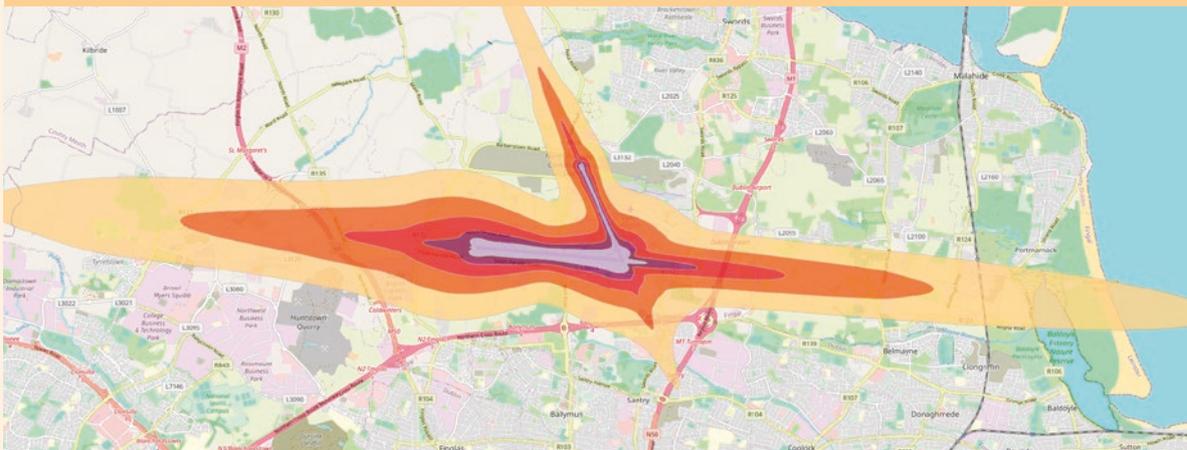


The strategic noise maps can be viewed on the EPA Maps section of the EPA website under 'Environment and Wellbeing – Noise'.³ The maps can be used to assess noise exposure in a given area (Topic Box 4.2). An example map for the Dublin agglomeration is shown in Figure 4.2. The purpose of this public information on noise mapping is to increase public awareness around these strategic maps and the noise action plans.

In Ireland, road transport, particularly in urban areas, is the predominant source of transport noise. In 2017, when the current maps were developed as part of the 5-yearly cycle, approximately 45 per cent of the total population living in the two urban areas of Dublin and Cork were exposed to a noise level of $L_{den} \geq 55$ dB from road transport noise. For those people living outside these urban areas, less than 5 per cent of the total population were exposed to a noise level of $L_{den} \geq 55$ dB from road transport noise. The mapping also showed that around 2 per cent of the urban population in Ireland were exposed to noise levels of $L_{den} \geq 55$ dB from rail or aircraft noise (EEA, 2019a).

Topic Box 4.2 EPA Maps Tool: using the noise maps as a public information resource

Figure 4.3 Dublin Airport noise map – L_{night} (Source: EPA)



In 2018, Fingal County Council received 580 submissions on its draft Dublin Airport Noise Action Plan. Fingal County Council officials used the noise mapping information on the EPA website to explain to the local community about the Fingal County and Dublin Airport noise maps (Figure 4.3). Residents were shown how to access their local map and zoom in to street level to see how they could be impacted by transport noise. The EPA Maps online facility enables users, for example planners, developers and the public at large, to assess the predicted noise levels along the busiest roads and in the larger cities, with a range of features to help visualise the data.

³ Environment and Wellbeing – Noise; <https://gis.epa.ie/EPAMaps/>



Noise Action Plans for Transport Noise Sources

Local authority noise action plans should identify measures to prevent and reduce transport noise and to protect quiet areas.

Following the preparation of the noise maps, the relevant action planning authorities, i.e. the relevant local authorities, are required to consult with the public in the preparation of noise action plans for those areas where the noise thresholds for L_{den} (55 dB) and L_{night} (50 dB) are exceeded. These action plans are designed to manage transport noise issues and effects, including the prevention and reduction of environmental noise where necessary.

As part of this process, each local authority identifies noise-sensitive locations. This may include drawing up a shortlist of potential areas for action, both above the recommended onset values for noise mitigation measures and below the recommended level for preservation, to help identify quiet areas.

A new requirement under the European Communities (Environmental Noise) Regulations 2018 is that local authorities must report progress on their noise action plans to the EPA early each year. Each local authority is required to set out the steps that have been taken to prevent, protect against and reduce excessive transport noise, as identified in the noise action plan (Topic Box 4.3).

Topic Box 4.3 Assessment of Noise Reduction Measures on the Luas

Actions to reduce transport noise can range from strategic and policy solutions around mobility and urban planning to more detailed engineering solutions to reduce specific noise sources. For example, rail transport can result in some noise pollution caused by the train wheels running over the tracks. However, acoustic mitigation measures are feasible. TII undertook a small-scale experimental trial of two noise reduction systems on a section of the Luas network with slab track: un-tuned rail dampers (Photo 4.1) and absorbing rubber infill panels (Photo 4.2). These noise reduction systems were installed on separate 100 m stretches of the Luas Green Line in Dublin. Noise for the section of track installed with rail dampers decreased by approximately 2-3.5 dB, while, for the section of track installed with the absorbing rubber infill panels, tram pass-by levels decreased by approximately 2.5-4.0 dB. These findings are being used when considering acoustic mitigation measures for future Luas lines.

Photo 4.1 Rail dampers on slab track



Photo 4.2 Rubber mats on slab track





Noise: EPA Research Programme 2014-2020

Since 2017, the EPA has funded two noise research projects representing a commitment of €0.6 million under its Health and Wellbeing research theme (Sustainability Pillar) in the areas of noise and health and strategic noise mapping (Noise Adapt).

These projects will add to the evidence base on environmental noise pollution in Ireland and its health impacts. The Noise Adapt project is due to be published in 2020, while the noise and health project is due to be published in 2021. Their findings should assist with the development and application of the new EU noise modelling and mapping methods that will be required in the next cycle of national mapping. More information is available at <http://www.epa.ie/researchandeducation/research/researchpublications/researchreports/>.

Another area to mention is the impact of noise on wildlife both on land and in the water. Underwater noise is covered in Chapter 8 The Marine Environment.

3. Impact of Noise

Noise complaints

The number of noise complaints has increased in recent years.

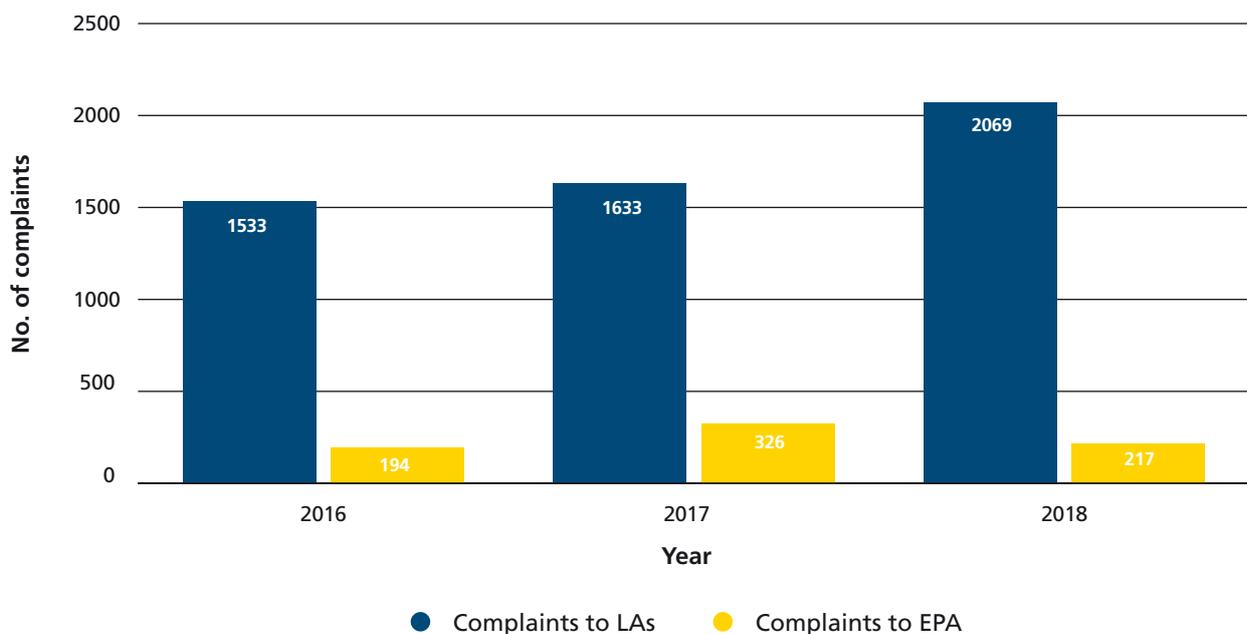
In Ireland, noise complaints normally fall under four main categories:

- complaints about entertainment, such as loud music
- domestic/neighbourhood noise
- industrial/commercial activities that cause noise and
- transport-related noise sources.

Figure 4.4 shows the noise complaints received by local authorities and the EPA for the years 2016-2018. Most of the complaints about noise received by local authorities were from urban areas, with Dublin local authorities receiving the most complaints. The number of noise complaints received by local authorities, as well as the number of noise complaints overall, increased from 2016 to 2018, the last 3 years for which data are available.

Almost one-third of all complaints received by the EPA about EPA-licensed sites related to noise issues (EPA, 2020).

Figure 4.4 General noise complaints received by local authorities (LAs) and noise complaints received by the EPA about EPA-licensed sites (2016-2018) (Source, EPA)





A detailed breakdown of the source of noise complaints (domestic, entertainment, transport or traffic noise, etc.) recorded by local authorities is not generally available. This is a data collection area that the EPA will be considering further as the breakdown of these data into categories would be a useful environmental indicator.

Transport Infrastructure Ireland is responsible for mapping all national roads that carry more than three million vehicles a year and for light rail lines, including the Luas network, under the Environmental Noise Regulations. Along with local authorities, TII has the main responsibility for dealing with road- and rail-related noise complaints.

Airport Noise: A Key Issue to Control When Passenger Numbers Increase Again

Dublin Airport welcomed 32.9 million passengers during 2019, setting a new record for traffic at the airport (Dublin Airport, 2020). Noise complaints around Dublin Airport have become a more significant issue in recent years, with the Dublin Airport Authority logging 1453 noise-related complaints in 2018 (Dublin Airport, 2019), although there has clearly been a major reduction in airport activities during the COVID-19 pandemic. The numbers of passengers using Cork (2.4 million passengers) and Shannon (1.85 million passengers) Airports had also increased in recent years, until the COVID-19 pandemic in 2020. However, both airports are currently below the threshold of 50,000 air movements per annum for noise mapping requirements. Over the last 3 years, according to the Dublin Airport Authority, there have been very few recorded noise complaints for Cork Airport and no noise complaints for Shannon Airport.

In 2019, Fingal County Council was appointed as the competent authority to regulate airport noise at Dublin Airport under EU Regulation No. 598/2014 (Government of Ireland, 2019), which covers noise-related operating restrictions at EU airports with more than 50,000 aircraft movements per year. The independent competent authority section within Fingal County Council is called the Airport Noise Competent Authority. This unit is responsible for ensuring that noise generated by aircraft activity at Dublin Airport is assessed in accordance with EU and Irish regulations. It ensures the application of the 'balanced approach' to aircraft noise management, as set out by the International Civil Aviation Organization (ICAO), in cases where a noise problem or potential noise problem is identified at the airport (ANCA, 2019).

4. Outlook for Noise Policy and Mitigation Measures

Acoustic Design, Planning and Noise

Project Ireland 2040 includes a national policy objective that will look to integrate noise management with health and planning.

The roll-out of Policy Objective 65 in the *Project Ireland 2040: National Planning Framework* (DHPLG, 2018) is expected to be a significant driver of environmental noise policy in Ireland over the coming decades. 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'.

The National Planning Framework further states that 'as we seek to promote more compact and efficient forms of development within our settlements, it is important to more proactively manage noise'. For larger urban areas, the extra value placed on 'quiet areas' is also highlighted as a key priority.

However, there is a need for national noise planning guidance for local authorities, to ensure better consistency in the assessment and conditioning of noise issues in planning applications across the country (Topic Box 4.4). Planning guidance is of upmost importance in mitigating the current and future health impacts of noise pollution and helping to promote the government policy of improved building standards and 'ensuring that the right development takes place in the right locations'.



Topic Box 4.4 UK Guidance on Planning and Noise

The Institute of Acoustics is the UK's professional body for those working in acoustics, noise and vibration. It has some 3000 members worldwide, with approximately 150 members in the Irish branch. In 2017, the Institute co-published guidance to provide practitioners with a recommended approach to the management of noise within the planning system in England. The *Professional Practice Guidance on Planning & Noise: New Residential Development* (ProPG) (IOA, 2017) is now widely used, including in Ireland (e.g. in Limerick; Topic Box 4.5). Importantly, it encourages the implementation of good acoustic design from the earliest stages of planning for new residential developments, which should help reduce noise pollution levels for residents.

The recommended approach provides opportunities to incorporate innovative and effective design interventions to enable residential development to proceed in acoustically challenging areas. In locations where it would not be appropriate to build new dwellings because of significant noise pollution, even with acoustic design considerations, the guidance encourages early identification of the risk of refusal and supports early decision-making, thereby avoiding unnecessary development and design costs.

Integrating Air Pollution and Noise Mitigation Measures

Integrating air pollution and noise mitigation measures can bring many benefits.

Many of the sources of environmental noise are also sources of air pollution, such as traffic. There is growing recognition internationally that integrating air pollution and noise mitigation measures can bring many benefits. For example, the Scottish Government Policy Guidance on local air quality management helps ensure that an integrated approach to managing air quality and noise is taken across government (Scotland Government, 2018). The guidance identifies that special consideration should be given to noise management areas identified in noise action plans.



Other potential measures include restrictions on heavy goods vehicles, reducing speeds on motorways and dual carriageways, the promotion of environmentally friendly vehicles. It also includes strategies to increase the separation between noise sources and sensitive receptors, including urban planning measures, measures to encourage an increase in greenery and the promotion of energy-efficient buildings.

This approach calls for effective coordination among the different health, planning, transport and environmental protection stakeholders so that they can work together to address noise and air pollution.

Topic Box 4.5 Promoting Walking and Cycling and Transport Noise Reduction as Part of the Renewal of Limerick City Centre

The overarching aim of the O'Connell Street Revitalisation Project is for the street to be primarily pedestrian, while being flexible in use. The project includes:

- wider footpaths and additional pedestrian areas to facilitate people gathering, on-street trading, and 'spill out zones' from shops and cafes on the street
- the provision of street furniture on O'Connell Street including seating areas, trees, bicycle stands and lighting
- introduction of a bus lane, with cyclists allowed to use the bus lane, and reduction in the number of private traffic lanes to one, as well as general reductions in the width of traffic lanes (Limerick City & County Council, 2019).

Limerick was awarded (co-winner) the European Green Leaf Award by the European Commission in 2020. The local authority is engaging with communities in Limerick to identify tranquil and calm areas using the Hush City framework. The framework uses public participation to describe the acoustic environment (the soundscape), with policymakers using the results to assess and plan quiet areas in their cities (Hush City Mobile Lab, 2017). One of the ways to collect data is through organised 'soundwalks', excursions whose main purpose is listening to the environment.

Limerick City & County Council is also using international guidance in assessing planning applications for new residential developments. It has incorporated the ProPG approach outlined earlier (IOA, 2017) in its Noise Action Plan 2018-2023.



World Health Organization Guidelines for the Protection of Human Health

The application of ambient noise targets and limits could help to provide consistent protection from noise for proposed noise-sensitive developments and for existing noise-sensitive premises.

In 2018, the WHO published guidance to policymakers on noise levels above which it considers that adverse effects on health and sleep occur (WHO, 2018). These WHO guidance levels are below the END mandatory noise level reporting thresholds for L_{den} (55 dB) and L_{night} (50 dB). Although the END includes a requirement to report and publicise any noise limit values in place, it neither introduces noise limit values nor requires noise limits to be introduced within Member States or by competent authorities. The recent publication of the amended Annex III of the END, establishing assessment methods for harmful effects of environmental noise, did not change this approach.

In view of the WHO guidance and the flexibility afforded by the END to allow countries to report noise levels below the mandatory reporting requirements, due consideration of feasibility, costs and preferences should be given before guidance on values or noise limits is introduced by the relevant department. These considerations are acknowledged in the WHO guidelines.

In addition to the END noise reporting levels, many European countries have target values or limits for noise. These values may be set at levels below the END mandatory reporting thresholds. Target noise levels are generally used to define the onset level above which noise management will be considered relevant. Higher noise levels are generally set as a noise limit, often as the upper level for new developments or the first target for reducing noise from existing sources.

Where only noise limits are published, there may be different limits for new and existing situations. Noise targets and limits tend to be used to protect residential areas and other noise-sensitive developments where long-term noise exposure is expected, for example from roads, railways, aircraft, industry and wind turbines.

While noise limits may be specified for industrial activities and attached to some planning permissions in Ireland, target and limit values for ambient noise are not specified. The application of ambient noise targets and/or limits would help to provide consistent protection from existing noise sources on proposed noise-sensitive developments. They would also protect people from the potential impacts of new developments on existing noise-sensitive premises, including dwellings, schools, hospitals and designated quiet areas (Topic Box 4.6).

Topic Box 4.6 Protection of Quiet Areas

In an urban environment, a 'quiet area' refers to a space that is not affected by noise from transport, industrial activities or recreational noise. Dublin City Council has identified eight 'quiet areas' and uses its noise action plan as a tool to preserve tranquil areas with existing low levels of environmental noise (Government of Ireland, 2013). The local authority has focused particularly on public parks in the city (Photo 4.3), aiming to provide quiet and peaceful spaces for people to escape to from the wider urban area with its higher levels of environmental noise.

Dublin City Council set noise thresholds to help in the designation of the quiet areas. The quiet area designation is considered in the context of any proposed future development in the vicinity of these quiet locations to determine whether the development might have the potential to negatively impact on the existing noise levels.

Photo 4.3 Quiet area in Dublin City



Wind Energy Noise and Health

Revision of the 2006 Wind Energy Guidelines is under way, covering noise management and noise monitoring aspects.

In 2020, the Department of Housing, Local Government and Heritage undertook a public consultation on its draft Revised Wind Energy Development Guidelines (DHPLG, 2019) as part of a review of the 2006 Wind Energy Guidelines. In line with the 'preferred approach', the draft guidelines include new guidance that aims to take account of technological advancements for the purpose of protecting residents and communities living beside new wind energy developments. The guidance is based on international best practice for wind turbine noise control, including the Institute of Acoustics guidelines (IOA, 2013) and the WHO guidelines (WHO, 2018).



A significant modification in the new guidelines is the consideration of special audible characteristics (e.g. tones, amplitude modulation and low frequency noise) (DHPLG, 2019). The implementation of a new noise monitoring framework is also proposed. It is envisaged that the EPA will have a supporting and advisory role in ensuring that local authorities have a robust noise monitoring framework in place. The Department of Housing, Local Government and Heritage and the Department of the Environment, Climate and Communications are considering submissions from the public consultation process with a view to publishing the final Wind Energy Development Guidelines before the end of 2020.

5. Conclusions

Noise Soundscape

While acknowledging the negative impact of noise on our society, we also recognise that our lives are enhanced by conversation, laughter and cheering, music and the sounds of nature. A healthy acoustic environment is more than simply the absence of unwanted sound. The term 'soundscape' refers to the acoustic environment as perceived, experienced and understood by people in any given context, and this includes beneficial and neutral sounds as well as noise. The protection of quiet areas and healthy soundscapes can be achieved through good urban sound planning. We also need to be mindful of the potential for changes in the soundscape where people live, from new developments in technology.

Noise and Health

Long-term exposure to environmental noise from road traffic, railways, aircraft and industry contributes every year to about 48,000 new cases of heart disease and 12,000 premature deaths in Europe. It is also estimated that 22 million people suffer from chronic high levels of annoyance and 6.5 million people suffer from chronic high levels of sleep disturbance (EEA, 2020). Some of these noise-related deaths and illnesses occur in Ireland, but it is not yet possible to estimate the health impact here. The EPA-funded noise health research project will provide a detailed review of the relationship between environmental noise and health and wellbeing in Ireland when it is published in 2021.

Implementation of Noise Action Plans

A reduction in road traffic volumes and the benefits of lower noise levels have been observed by the Irish public during the restrictions implemented because of the COVID-19 pandemic. As outlined earlier, each local authority is now required to set out the steps that they have taken each year to prevent, protect against and reduce excessive noise, as identified in their noise action plans. The EPA recommends that 'pilot' noise mitigation programmes should be considered in Dublin, Cork and Limerick as part of a national coordinated approach to the implementation of control measures identified in the noise action plans. This approach would require close cooperation between local authorities and the relevant transport authorities and government departments, such as TII, Irish Rail and the Dublin Airport Authority, where appropriate.

Cross-sectoral Approach

Interventions that reduce both the adverse effects of air pollution and the adverse effects of noise have the potential to positively impact a larger number of people than those targeting only one environmental stressor. The same can be said for integrating such interventions with relevant measures to reduce greenhouse gas emissions. In general, strategies that may be effective at mitigating both environmental noise and air pollution from transport or industry sources 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, as well as the use of energy-efficient buildings.

As well as reducing excessive noise, implementing such measures can also help to reduce greenhouse gas emissions, reduce traffic congestion, improve road safety and reduce the 'urban heat island' effect (see Chapters 2, 3, 11, and 14 for relevant discussion). Therefore, interventions intended to mitigate air pollution and noise will require a coordinated and collaborative approach among the different health, planning, transport and environmental protection stakeholders (EEA, 2019a).

The approach to environmental noise, including noise reduction strategies, is closely linked to the UN Sustainable Development Goals on Sustainable Cities and Communities (Goal 11). This goal can also be addressed through the preservation of quiet areas in both urban and rural areas and by developing urban soundscape plans for our larger cities. Noise can also impact on wildlife. The issue of underwater noise and marine mammals is covered in Chapter 8 The Marine Environment.



Credit: 4H4 Photography / Shutterstock.com

Developing a National Noise Policy or Strategy

Environmental noise originates from a wide range of sources: including transport, commercial and industrial sources as well as from wind turbines, entertainment and leisure sources, and domestic sources. As demonstrated in the 2018 WHO noise guidelines, excessive noise is an important public health issue. In Ireland, excessive noise mainly emanates from transport sources such as road traffic, aviation and railways, although, overall, the numbers of noise complaints across these different sources have been increasing in recent years. In this context, the development of a national noise policy statement or strategy has the potential to provide the policy framework within which integrated noise measures could be identified and promoted across government, industry and society.

Regional Approach to Air Quality and Noise Enforcement and Compliance

In Ireland, various regional enforcement/implementation models have already been established (in the areas of climate, water and waste) and are operating successfully to promote environmental enforcement and programme implementation. The impact of these regional structures has been very positive and the higher levels of support now available to local authority enforcement officers has resulted in enhanced outcomes. The Programme for Government commits to considering the development of a regional approach to clean air and noise compliance and enforcement.



Chapter Highlights for Environmental Noise



National noise planning guidance for local authorities is needed. This will support and promote the proactive management of noise where it is likely to have significant adverse impacts on health and quality of life. The guidance will also help to implement the noise objective in Project Ireland – National Planning Framework 2040 and should also consider the 2018 WHO noise and health guidelines.



Noise pollution complaints from the public have been increasing and current measures do not always allow for them to be adequately addressed. Local authorities need to take a much stronger leadership role in dealing with noise issues, particularly in more urban areas.



Integrating air pollution and noise mitigation measures (and climate actions), particularly in transport management, can bring many benefits. Such integration of options could be explored under the plans for a clean air strategy for Ireland. Local authorities should also designate quiet areas in their cities for health and wellbeing value.



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Chapter 5

Land and Soil





Land and Soil

1. Introduction

Our soils and land are precious resources that need to be managed carefully. They have a variety of uses including food production, forestry, development of national and commercial infrastructure, housing and leisure activities. Policies and practices linked with land and soils can directly impact on biodiversity, climate change, air quality and our aquatic environment. Sustainable land use and spatial planning are therefore extremely important. This chapter summarises the functions of soils and the main land cover and land use types in Ireland and examines the current trends in land cover change.

2. Functions of Soils

Healthy soils that are properly managed support farming and environmental protection.

Soils consist of a biologically active, complex mixture of weathered minerals, organic matter, organisms, air and water. They form over long periods of time and are limited resources needing careful management. Our soils, land use and landscape are shaped by natural processes and human interventions.

About a quarter of all living species, such as fungi, bacteria and insects, live in our soils. Healthy soils provide us with clean air, food and water. They also support plant and animal growth and provide the foundations for human habitats, buildings and infrastructure. They provide important ecosystem services including agricultural food production, flood alleviation, water filtration and storage, carbon sequestration, pollution control and development of pharmaceuticals. Many widely used antibiotics have come from soil. Penicillin, for example, came from a fungus (*Penicillium*) found in soil. Seven of the United Nations Sustainable Development Goals have direct links to soils, while a further two depend indirectly on healthy soils (Tóth *et al.*, 2018).



Carbon stored in soils plays an important role in maintaining soil functionality, in water and air quality and in climate change. Proper land use management is essential to prevent carbon stored in soil from being released into the atmosphere and further contributing to greenhouse gas emissions and climate change. Measured in pH units, the acidity or alkalinity of soil plays a role in supporting its fertility. The increased use of lime is resulting in increased levels of soil fertility, leading to better soil pH management (Teagasc, 2019). Teagasc has indicated that the optimal soil pH for agriculturally productive grasslands is at or above pH 6.3. This optimal soil pH leads to improved grass yields and more efficient application of fertilisers. In the period from 2017 to 2019, 57 per cent of Teagasc soil samples had an optimum pH (Simo *et al.*, 2019). This was a significant improvement on the value of 34 per cent for the period from 2014 to 2016.

Before deciding on what constitutes 'optimal' soil pH, or indeed other soil parameters such as nutrient levels, it is wise to decide the best primary use for a piece of land. The parts of the country with higher levels of agricultural productivity are generally the areas with productive soils, a conducive climate and a history of agricultural intensification. Many other areas support land that is better suited to providing low or modest levels of agricultural productivity, coupled with other hugely valuable services such as high nature value farming. Such services include supporting biodiversity, delivering wildlife habitats for pollinators and others, and providing for carbon sequestration and storage, better water quality or water attenuation.

In the coming years, farming support schemes will be targeted at these areas of high nature value farmland, with lots of semi-natural habitats. Land management can then be better planned across a range of services and not solely focused on agricultural production.

Teagasc has indicated that targeted improvements in soil quality should lead to better nutrient uptake from applied fertiliser and organic manures. Fewer losses of nutrients to water and air should, in turn, result in reductions in agriculture-related emissions to water and air.



Soils, Land Management and Carbon Sequestration

In Ireland, land use, land use change and forestry (LULUCF) is a net source of CO₂, but this needs to be reversed so that land is used to store carbon to meet greenhouse gas and carbon neutrality targets.

Healthy soils play a role in carbon sequestration from the atmosphere. Land management activities can help or hinder carbon sequestration in soils. Overall, LULUCF in Ireland is a net source of CO₂, with net emissions of 3.3 million tonnes CO₂ equivalent in 2018 (EPA, 2020a). Previous Environmental Protection Agency (EPA)-funded research has suggested that there is significant potential for carbon sequestration by soils used for growing crops and grasses (Kiely, *et al.*, 2017). More recently, Teagasc indicated that much of our grassland soil is already high in carbon, with little change in this carbon stock in recent years. Teagasc also highlighted the importance of protecting the carbon already sequestered and indicated that the largest potential for increased carbon sequestration is in the rewetting of organic agricultural soils (Lanigan and Donnellan, 2019).

Peat-rich soils, such as in bogs, for example, are usually good at sequestering and storing carbon; however, if they are drained and dried out, this process is reversed, and they emit carbon back into the atmosphere. A recent EPA-funded research project, the Soil Organic Carbon and Land Use Mapping (SOLUM) project,¹ combines high-resolution spatial data, Teagasc's Soil Information System and remote sensing tools with the aim of providing a verifiable land use and soils inventory for Ireland. Additionally, recent research from Teagasc is assessing the importance of subsoils for carbon sequestration (Simo *et al.*, 2019).

In a special report on climate change and land (IPCC, 2019), the Intergovernmental Panel on Climate Change affirmed that sustainable land management helps to prevent and reduce land degradation. It also maintains land productivity and may contribute to reversing the negative impacts of climate change. Sustainable land management can be progressed by integrating climate- and land-related policies and fostering engagement and collaboration between different sectors, thus saving resources, improving social resilience and supporting ecological restoration. While effective land management is one element that can contribute to climate mitigation, reducing greenhouse gas emissions across all sectors is needed if global warming is to be kept below 2°C, if not 1.5°C. This is discussed in more detail in Chapter 2. Responding to climate

change and reducing greenhouse gas emissions involves many different sectors working together. It is therefore important that land use and sectoral planning become more integrated and coordinated across multiple sectors, in a national effort to address environmental challenges consistently.

Soil and Water Management

Properly managed soils can act as a trap to hold on to nutrients and as a sponge to hold back water flows, minimising flooding risks.

Soils play an important role in filtering water as it travels through the ground. Soils also hold onto nutrients and store them for release later. Wetland areas help store, move and filter water at the surface. They are also able to remove excess nutrients, such as nitrogen and phosphorus, and sediments, and play an important role in natural flood management, by slowing the movement and release of flood waters.

Water pollution can be reduced by using and maintaining urban and rural sustainable drainage systems and limiting nutrient run-off from soils and surfaces in rural areas. Nutrients and soils that enter our waters can impact on water quality by chemically or physically changing water body conditions, which in turn can affect aquatic plants and animals, particularly those that are sensitive to changes in their environment. Chapters 6 and 7 provide more information on land use pressures affecting nature and water quality.



¹ <https://epasolumproject.wixsite.com/solum>



Pressures on Soils as a Result of Land Management Practices

Urbanisation and building account for some of the biggest losses of soil areas in Ireland.

The European Environment Agency recognises that soil degradation is not well monitored, and often remains hidden, but its effects can be widespread and diverse in nature (EEA, 2019a). It also recognises that there is increasing evidence that land and soil degradation have major economic consequences, whereas the cost of preventing damage is significantly lower. Without careful management and monitoring measures, the negative impacts of intensive land use, coupled with climatic events, may result in irreversible land degradation (EEA, 2019b). Intensive land management can lead to negative impacts on soil biodiversity, which is the key driver of terrestrial ecosystem carbon and nutrient cycling.

There are six overarching degradation processes that can impact on soils. These are soil sealing (where soils are closed off from the surface of the land, e.g. road and building developments close off soils from the land surface by building on top of it), erosion, organic matter decline, compaction, salination and landslides. The CORINE (Co-ordinated Information on the Environment) data series, produced by the European Environment Agency for the European Union, compiles geospatial environmental data in a standardised and comparable manner across Europe. The latest CORINE land cover data (2018) for Ireland supports previous research findings (Kiely, *et al.*, 2014) that the main soil quality pressure in Ireland relates to soil sealing. One of the reasons for this is the presence of a dense road network in what is a sparsely populated country (Prokop *et al.*, 2011). Artificial areas with sealed soil surfaces have increased by 65 per cent since 1990, although there has been little change since 2012. The sealing of soils impacts their ability to absorb pollutants, reduces their biodiversity and productivity and can also increase flooding in built areas by affecting natural drainage patterns. This in turn may lead to pollutants more easily entering our waters, potentially causing more widespread pollution. In urban areas, sustainable urban drainage systems, if correctly maintained, prevent pollutants entering our waters.

Soil compaction is also a recognised key threat to the quality of Irish soils. It can lead to increased surface run-off, flooding, erosion and transport of nutrients and agrochemicals to open water (EC JRC, 2016a).

Recently, the *Global Assessment Report on Biodiversity and Ecosystem Services* (IPBES, 2019) reported some startling findings. The assessment showed that, globally, about 75 per cent of the land surface has already been significantly altered and over 85 per cent of the wetland area has been lost. It stated that 'nature across most of

the globe has now been significantly altered by multiple human drivers, with the great majority of indicators of ecosystems and biodiversity showing rapid decline' (p. 11).

Human activity is a significant driver of degradation through poor or inappropriate land management practices. Practising sustainable land management and soil conservation principles at the heart of the planning process means shifting away from a reliance on zoning of greenfield lands towards more brownfield development opportunities in and around our major cities and towns. For example, for every 20,000 dwellings completed each year in Ireland, there could potentially be a loss of around 1150 hectares of greenfield agricultural land.² Typically, greenfield lands around Ireland's major cities and towns contain high-quality, highly productive soils that, once sealed under new developments, are lost forever.

Ireland must adopt a more proactive approach both nationally and locally in addressing this decline in nature. Better land management is an important step in this approach. The publication of the National Planning Framework in 2018, which introduced the first brownfield development target to deliver at least 40 per cent of all new homes nationally within the built-up footprint of existing settlements (Government of Ireland, 2018, p. 29), is an important first step. Clear definitions of what does and does not constitute brownfield development in mandatory planning guidelines, the widening of brownfield targets to embrace the increasingly greenfield nature of new business parks and employment locations, and effective monitoring of the implementation of targets using geographical information systems data will be essential.



² Assuming that 20% (4000 homes) of the 20,000 dwellings are constructed annually as one-off dwellings in countryside settings and require a site area of a minimum of 0.5 acres (total 809 hectares) under the EPA Code of Practice for Wastewater Treatment Systems for Single Houses (2010); 20% (4000 homes) of the housing provision is brownfield development, i.e. redevelopment of formerly developed lands; and 12,000 homes are constructed at an average density (minimum under planning guidelines) of 35 dwellings per hectare, resulting in a land area requirement of 340 hectares.



More widely, notwithstanding the policy advances here in Ireland, the European Union (EU) currently lacks a comprehensive and coherent policy framework for protecting land and soil resources (EEA, 2019b). There is no European legislation that focuses exclusively on soil, which has contributed to the continuous degradation of many soils within Europe (Günel *et al.*, 2015; Virto *et al.*, 2015). The underlying drivers of soil degradation are not projected to change favourably, so the functionality of soils is under even more pressure. Consistent and representative soil monitoring is needed to establish early warning systems for exceedances of critical thresholds and to guide sustainable soil management.

The European Environment Agency produces indicator-based assessments on a range of topics, including land use and soils. These cover aspects such as land take (the amount of land used for a specific use), imperviousness, contaminated sites, soil moisture, soil erosion and soil organic carbon. Further indicators on fragmentation and land recycling are planned.

Soils and Construction and Demolition Wastes

Excavated soil and construction and demolition waste must be managed properly to comply with legal and environmental requirements.

Uncontaminated soil and other naturally occurring excavated materials from development activities can be used as backfill material on the same site, or on other sites, when certain requirements are met. In some cases, uncontaminated excess soil and other naturally occurring excavated materials can be managed as by-products rather than waste, and the EPA has produced guidance to help with compliance with the legal and environmental requirements. Waste prevention through reusing these materials as by-products is in line with the objectives of the circular economy. Where these materials are contaminated, they need to be remediated before being reused. This remediation can take place on-site or off-site (usually abroad) depending on the level of treatment needed. Table 5.1 shows the different treatment destinations and volumes of contaminated soils sent for treatment between 2009 and 2018.

Table 5.1 Treatment of contaminated soil, 2009-2018 (Source: EPA, 2020b)

CONTAMINATED SOIL	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Treated in Ireland (tonnes)	12,428	6260	7094	4426	4830	1630	5938	682	608	18,733
Exported for treatment (tonnes)	476	2590	10,203	3638	7659	5701	14,329	79,591	101,440	74,912
Total	12,904	8850	17,297	8064	12,489	7331	20,267	80,273	102,048	93,645

Contaminated soils may come from old industrial sites and are often contaminated with hazardous chemicals. Soil contamination can also occur from unauthorised waste-related activities, leakages and accidental spillages of chemicals. When sites licensed by the EPA close, they require aftercare to remove any remaining contamination, according to the closure, restoration and aftercare requirements laid out in individual licences.

Research carried out by Cahill and Plant (2017) has investigated converting suitable closed landfill sites into parkland amenities and nature conservation areas. It found that no national policy prescribes the after-use of landfill sites once they close and recommended that this be addressed. For example, former landfill sites may be used as amenity areas once the proper steps are taken to protect environmental infrastructure, such as gas and leachate wells. These sites need ongoing monitoring and management after they close. One example of a restored landfill site (the Kinsale Road landfill site) that has been developed for public access and amenities is Tramore Valley Park in Cork City. Similar restoration works have been carried out at Rogerstown Park in Fingal, previously the Balleally landfill site. More recently, restoration works are progressing at the East Tip on Haulbowline Island (Cork Harbour).



Governance Covering Soil Management

In Ireland, there is little specific legislation to protect soils, apart from legislation on key habitats/ecosystems associated with peat soils and site-specific regulation linked to industrial and waste facilities.

The EU Seventh Environment Action Programme commits Member States to increase efforts to reduce soil erosion, increase soil organic matter and remediate contaminated sites by 2020. The Environmental Liability Directive (2004/35/EC) and related national regulations set out a framework for environmental liability assessment based on the 'polluter pays' principle. This includes preventing environmental damage to soils. The European Commission is engaged in a review programme to evaluate whether the Environmental Liability Directive is fit for purpose.

In Ireland, apart from the National Planning Framework targets described above, there are few specific legislative or policy mechanisms to protect soils, apart from legislation on key habitats/ecosystems associated with peat soils and site-specific regulation linked to industrial and waste facilities. There is also no specific contaminated land policy in Ireland and, as a result, there is no legislation dealing specifically with the remediation of contaminated soils.



3. Land Cover

Land cover describes what is visible on the land surface, such as grassland or urban areas. Land use describes the use the land has been put to from a human perspective, such as pasture or residential housing.

The interactions between different types of human activity, such as farming, forestry and town and country planning, shapes our environment, landscape and biodiversity. Land is often subjected to competing demands from different sectors. National policies for forestry, agriculture, peatlands and the built environment influence land use change, land and soil resources. Figure 5.1 shows the main land cover types in Ireland.

The Current Situation

The latest CORINE land cover mapping information for 2018 shows the recent changes in land use patterns in Ireland. Of particular concern is the long-term downward trend in wetland areas.

Currently, the most complete national land cover dataset is the CORINE dataset. This pan-European dataset was produced in 1990, 2000, 2006, 2012 and 2018 for the European Environment Agency under the Copernicus Land Monitoring Service (Topic Box 5.2). It is a low-resolution dataset at 25 hectares that can be used as a high-level indicator of land cover changes.

Topic Box 5.1 Copernicus Land Monitoring Service

Copernicus is the name of the EU's Earth Observation Programme. It provides data from satellites, called Sentinels, which monitor the Earth's surface. These data are analysed to provide information on the environment. The Copernicus land, marine, atmosphere and climate services are free and open to public access. This is also the case for the Sentinel satellite imagery.

The Copernicus Land Monitoring Service aims to provide frequent and detailed information on land cover and land use. The data range from low-resolution pan-European data (e.g. CORINE) to high-resolution data but with a lower spatial distribution (e.g. an urban atlas for all major cities). The aim is to improve the resolution, distribution and frequency of all data produced by the Copernicus programme.

In combination with national land mapping activities, the Copernicus programme will provide significant benefits in terms of monitoring land cover and land use and understanding the wider environmental impacts of these changes. Further information on Copernicus is available at <https://www.copernicus.eu/en>.



Figure 5.1 CORINE land cover types

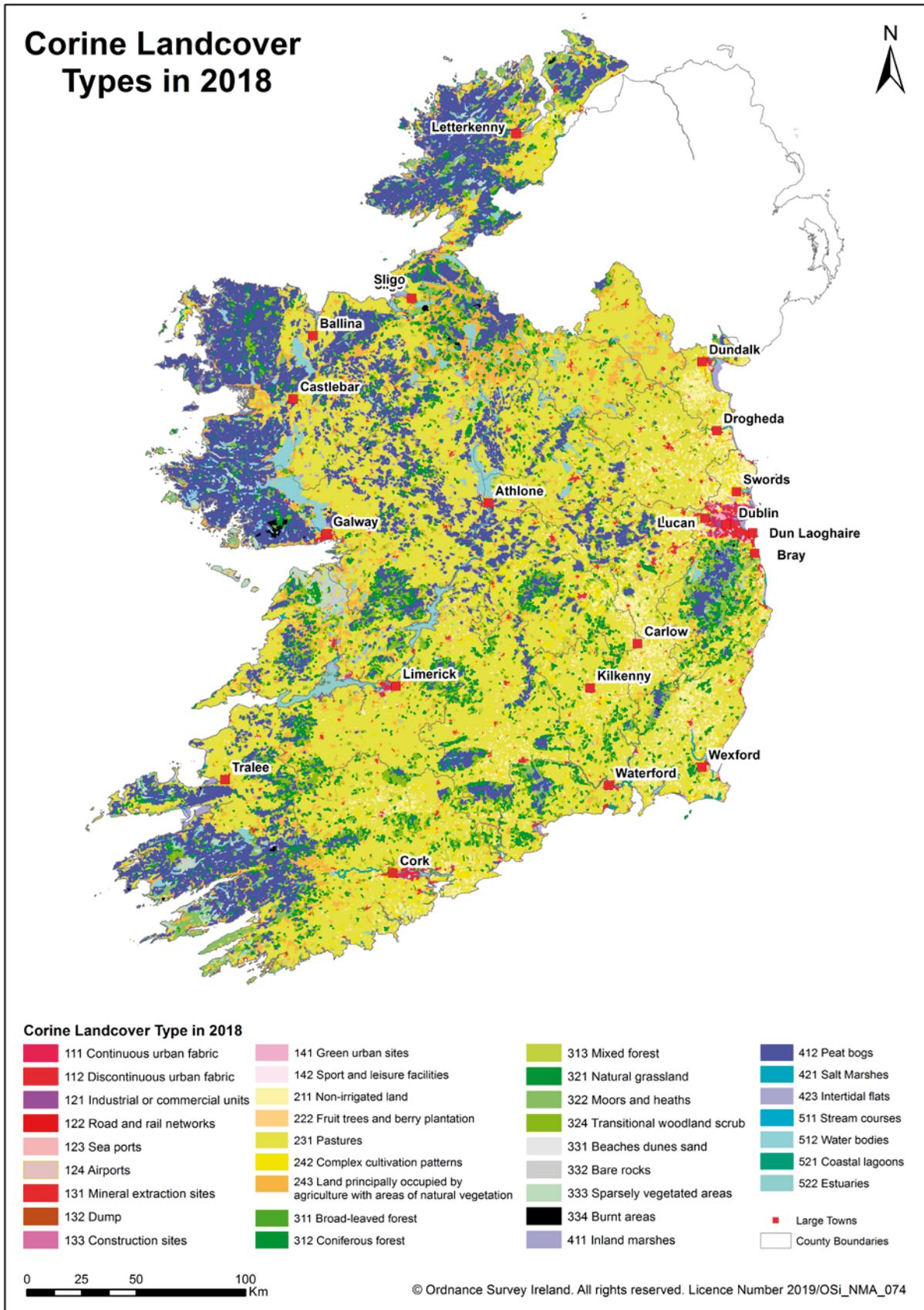
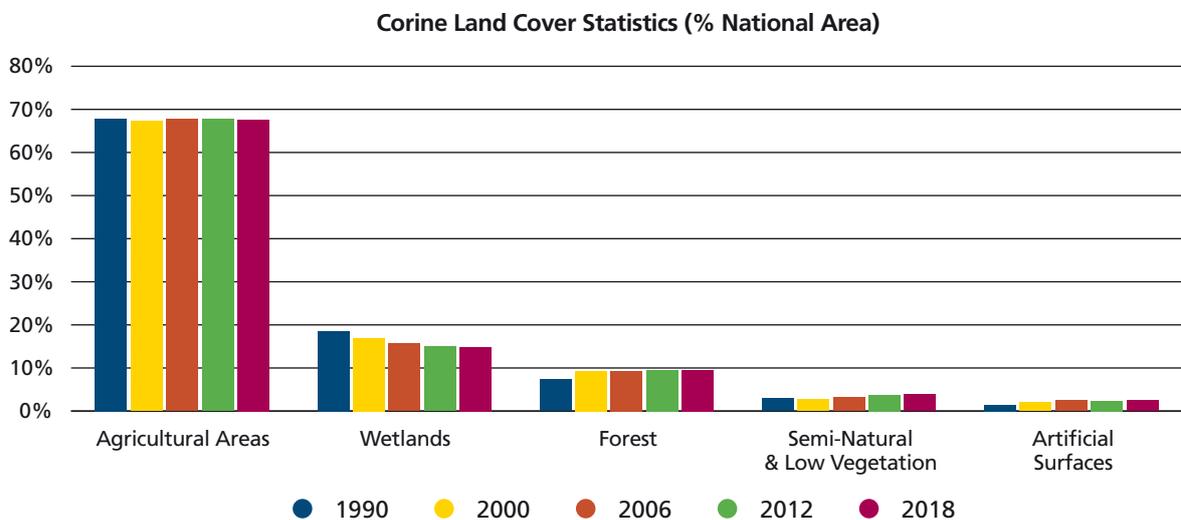




Figure 5.2 Summary of CORINE land cover and trend statistics from 1990 to 2018 (Source: EPA analysis of CORINE data time series)

CORINE 2018 SUMMARY		
Land cover class	2018 % of national area	% change since 2012
Agricultural areas	67.6	-0.10
Wetlands	14.9	-0.06
Forests	9.5	0.02
Semi-natural and low vegetation	3.8	0.10
Artificial surfaces	2.4	0.03



Analysis of CORINE data as an indicator of land change

The latest CORINE information available for 2018 is summarised in Figure 5.2. It shows that agriculture is the dominant national land cover type, representing 67.6 per cent of the national area in 2018. While this represents a small decrease since 2012, there is an overall downward trend, with a reduction of 8230 hectares since 1990. The main change in land cover has been from agriculture to forestry and artificial areas.

In 2018, wetlands represented 14.9 per cent of the national area, a moderate decrease since 2012. However, in 1990, wetlands represented 18.6 per cent of the national area. There has therefore been a 20 per cent reduction in this important land cover type since 1990, with a loss of 258,800 hectares. The primary change was from peat bogs to transitional woodland scrub and coniferous planting in the 1990s. This transition in land cover type usually happens after peat is extracted or on peats that have been reclaimed for agricultural use. Other reductions in wetlands relate to recently burnt areas and the re-mapping of intertidal mudflats. In summary; there has been a definite long-term downward trend in the percentage of the national area covered with wetlands.



In 2018, forestry represented 9.5 per cent of the national area. There has been a general upward trend in the percentage of the national area covered with forestry since 1990, with a 0.02 per cent increase since 2012. Most of this growth relates to an increase in commercial coniferous plantations. The aim is to increase forest cover to 18 per cent by the year 2050. There is clearly a need to accelerate afforestation levels to meet this target. It is important, however, that the right types of forest are planted in the right places and are managed correctly.

Semi-natural and low vegetation areas have increased in area by about 7030 hectares since 2012. The summers were particularly dry in 2017 and 2018, with many forest and peatland fires during this period. These burnt areas represent the major change of land cover to the semi-natural and low vegetation class.

While artificial surfaces accounted for only 2.4 per cent of the 2018 national land cover, they have increased in area by 65 per cent since 1990. Most of this increase occurred between 1990 and 2006, with it slowing between 2006 and 2012 (probably linked to the economic recession) and showing signs of increasing again in 2018. The primary changes have been increases in discontinuous urban development, commercial/industrial areas, transport infrastructure, and sports and leisure facilities. These changes have mainly resulted in losses of agricultural areas, with some smaller losses of forestry and wetland areas.

Improving Data and Knowledge

A high-resolution mapping project is under way in Ireland to produce more detailed land cover maps that could be used for a range of environment work, including on climate change, biodiversity, air quality and water quality.

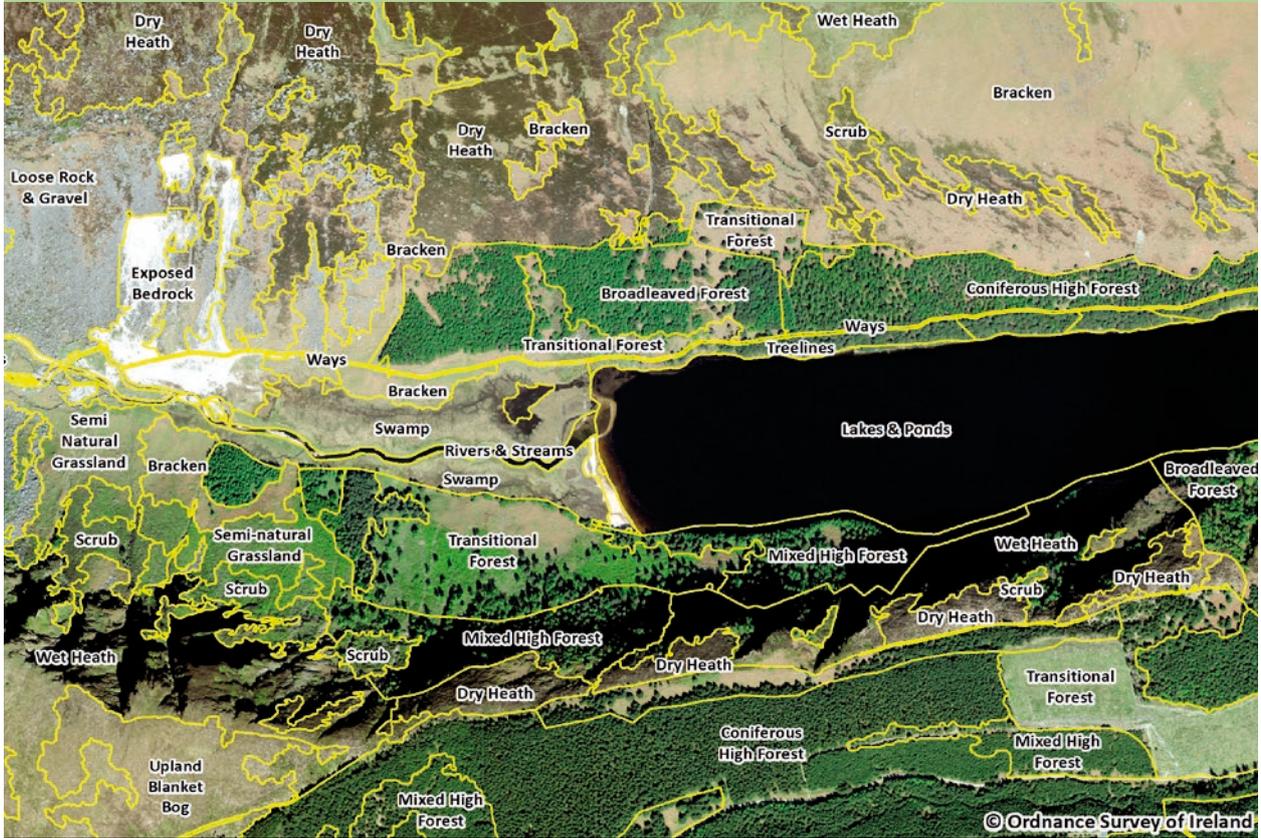
The quality of the CORINE data varies significantly. This is because of its poor resolution (25 hectares) and the varied data mapping methods used over the time series. Often more detailed sectoral data exist, and these should be used ahead of the CORINE data, as previously documented for the forestry sector (Black *et al.*, 2008).

Previous EPA state of the environment reports for Ireland have highlighted the need for more detailed data on land. In response, a national land cover mapping programme has begun. Since 2018, Ordnance Survey Ireland has been developing a high-resolution land cover map in partnership with the EPA. The project will present baseline data for 2018 and is due to be delivered in 2021. Integration of sectoral data will allow for a more consistent representation of national land cover and land use. Additionally, the EPA aims to develop a national land use map for application in reporting under the LULUCF regulations [Regulation (EU) 2018/841]. This will be directly related to the outputs of the national land cover mapping programme.

The importance of the programme to produce more detailed land cover maps cannot be overstated. Once complete, it will transform our understanding of national land cover and land use. High-resolution data, at a minimum of land parcel scale, will provide detailed information on the status of the land. It will form the basis for assessing past and future changes and will enable detailed environmental assessments and research. From an environmental perspective it will directly improve our understanding of climate change, biodiversity, air quality and water quality and responses to these challenges. County Wicklow is the first area to be mapped using this approach and the detail and quality of the data are very encouraging, as outlined in Figure 5.3.



Figure 5.3 Initial land cover map of Wicklow highlighting the more detailed information that will be available nationally





4. Sectoral Overview of Land Cover and Spatial Plans

Land cover describes the physical land type on the Earth's surface, such as wetlands or forests. This section provides an overview of the main land cover sectors and the key plans within each sector that are helping to address the environmental pressures and challenges. Commentary is also provided on wider interactions within spatial planning processes and opportunities to bring land cover matters more deeply into these processes. Where more detailed sectoral land cover data exist, they are presented instead of the lower resolution CORINE data.

Development by relevant government departments and agencies and wider stakeholders of an integrated national land cover strategy, supported by detailed mapping, monitoring and reporting, would be highly beneficial. It would ensure that sectoral policies for extensive categories of land cover, such as forestry, peatlands and agriculture, align with national-level environmental policy commitments. It would also help inform both higher level spatial planning strategies, such as the National Planning Framework, and spatial planning at regional and local levels. Coordination of the management of land cover, discussed in more detail in the following sections for agriculture, peatlands, wetlands and forestry is particularly important to allow us to manage and coordinate Ireland's response to climate change, in both a sectoral and a complementary manner. Chapter 2 provides more information on Ireland's climate change response and sets out some key recommendations.

Agriculture

Agriculture is the dominant land use type in Ireland, accounting for over 65 per cent of national land cover.

Farming in Ireland is closely linked to the EU Common Agricultural Policy and associated schemes. These encourage the maintenance of soil fertility and organic matter levels in farming practices. It is also worth noting that grasslands in Ireland are a net source of CO₂ as a result of the drainage of organic soils. This is discussed in more detail in Chapter 13.

Correct soil management forms part of farm 'cross-compliance' activities and Good Agricultural and Environmental Conditions regulations. These activities and regulations provide for the protection and maintenance of soil organic matter, the prevention of the deterioration of habitats and water protection. In general, this involves farming in a more sustainable way. Soil nutrient testing helps identify the nutrient concentrations in agricultural soils and the nutrient requirements to allow crop growth in an environmentally sustainable manner. Examples of activities considered under cross-compliance include poaching, eco-schemes such as GLAS (Green, Low-Carbon Agri-Environment Scheme), nutrient management planning and mandatory liming to increase soil pH. In 2018, the European Commission published its proposals for the Common Agricultural Policy beyond 2020. It set out ambitious requirements including protecting wetlands and peatlands to preserve carbon-rich soils and the use of specific nutrient management tools.





One important positive initiative to note in relation to land use is 'high nature value' farming. This differs from 'regular' farming as it tends to have a wealth of biodiversity associated with it and can support important species and habitats. Teagasc-funded research (the Ideal-HNV project)³ has produced a high nature value farming map.

High nature value farming mostly occurs in the west of Ireland and in upland areas. It often coincides with locations of high status water areas (Moran and Sullivan, 2017). Poor land management in these areas can greatly impact sensitive habitats, species and waters. This EPA research identified the need to support more of these locally driven initiatives, which have multiple environmental benefits and also support sustainable farming practices and local communities. For more information on agriculture in Ireland, see Chapter 13.

Topic Box 5.2 Progress in Soils Management Research

The Terra Soil project⁴ was launched by the Geological Survey Ireland and Teagasc in 2018. Using thousands of soil samples combined with geochemical data, the project aims to support better farming efficiencies by helping farmers make more targeted and science-based decisions.

Teagasc's SQUARE project continues to develop a toolbox for farmers to assess soils and the impacts of soil degradation (Bacher *et al.*, 2018, 2019; Bondi *et al.*, 2018; Emmet-Booth *et al.*, 2018, 2019). Teagasc recommends that soil-specific management measures based on soil type are needed. Teagasc has also published a soil management manual to assist farmers in this regard (Teagasc, 2013).

The DANÚ Farming Group,⁵ a European Innovation Partnership project for Agricultural Productivity and Sustainability (EIP-AGRI) funded by the Department of Agriculture, Food and the Marine, combines the best practices of conventional and organic farming. This project places an emphasis on having productive soils that display high levels of biological activity.

The outcomes of these projects, if implemented correctly, should result in smarter agriculture, fewer environmental impacts and fewer wasted resources.

Peatlands

Currently, many peatlands, including those protected under national and European legislation, are in an unfavourable state, but if they were restored, they could play a key role as carbon sinks and provide a space for nature.

Peatlands provide many important ecosystem services, including maintaining biodiversity, carbon storage, supporting agriculture and forestry, water regulation and flood attenuation. Intact peatlands play an important role in sequestering and storing CO₂ from the atmosphere. If, however, they are degraded or dried out, peatlands become oxidised, which leads to CO₂ being released into the atmosphere.

A report from the Joint Committee on Climate Action, *Climate Change: A Cross-party Consensus for Action* (Houses of the Oireachtas, 2019), acknowledged that our peatlands are currently a large net source of carbon emissions. This is because we have already drained and degraded most of our peat bogs. Our peatlands continue to be impacted by land drainage for agricultural purposes, afforestation and peat extraction. The latest national emissions inventory for Ireland (EPA, 2020a) reported total peat-related greenhouse gas emissions of 1.15 million tonnes CO₂ equivalent in 2018. In April 2018, peatland restoration was highlighted as a priority by the Citizen's Assembly (Citizen's Assembly, 2018). Peat extraction for use as fuel within power generation and domestic heating, and its use within horticulture, are unsustainable. Any plans to halt peat extraction must, however, include services and resources to support local communities once peat extraction operations cease. In this context, it is worth noting that Bord na Móna has stopped the extraction of peat for electricity generation purposes and Coillte has also engaged in peatland restoration in recent years.

Currently, it is government policy that domestic turf cutters are permitted to cut turf if there is no impact on the conservation objectives of bogs. The Department of Culture, Heritage and the Gaeltacht has reported a slight decrease in turf cutting within the current network of 62 Special Areas of Conservation (SACs) and 36 retained Natural Heritage Areas (NHAs); however, activity at raised bogs continued at 22 SACs and 6 NHAs in 2018. Active raised bogs (an Annex I priority habitat) continue to have an overall 'bad' conservation status, with a continuing deteriorating trend; similarly, the overall conservation status of blanket bogs is described as 'unfavourable to bad', with a continuing deteriorating trend (DCHG, 2019a).

³ <https://idealthnv.wordpress.com/>

⁴ <https://www.gsi.ie/en-ie/programmes-and-projects/tellus/activities/tellus-product-development/smart-agriculture/Pages/Terra-Soil.aspx>

⁵ <https://ec.europa.eu/eip/agriculture/en/find-connect/projects/dan%C3%BA-farming-group-project-plan-biological-farming>



Ireland's Climate Action Plan 2019 (Government of Ireland, 2019) includes actions to implement peatland conservation measures. It aims to restore 22,107 hectares of raised bog habitat to directly reduce or halt carbon loss. It is due for delivery by 2035.

The National Peatlands Strategy (DAHG, 2015a) is the key national plan responsible for the management and conservation of peatlands. It estimates that our peatlands store approximately 1566 million tonnes of carbon, representing about 64 per cent of the total soil organic carbon stock present in Ireland. It aims to restore, protect and manage our peatlands and the benefits they provide us. It reports that only 10 per cent of the original raised bogs and 28 per cent of the original blanket peatlands are deemed suitable for conservation (as natural peatlands). However, even where restoration is not possible, it is important to improve the management of peatlands to reduce or eliminate carbon losses and to restore at least some of their other ecosystem services.

The EPA-funded VAPOR project (Renou-Wilson and Wilson, 2018) has improved our understanding of the links between the climate, hydrology, ecology and greenhouse gas interactions of peatlands. This research identified a need for a national plan to manage and maintain water table levels in natural and rewetted peatlands. Doing so could help sustain the ecosystem and climate-related services provided by peatlands, even in circumstances where full restoration is not practicable. Drained peatlands, previously used for agriculture and peat extraction, could

be targeted for rewetting to prevent greenhouse gas emissions in the future. The need to rewet our peatlands, where feasible, was also acknowledged by the Joint Committee on Climate Action (Houses of the Oireachtas, 2019).

Bord na Móna Peatland Rehabilitation/ Restoration Activities

Rehabilitation works are required for licensed Bord na Móna extraction activities, as part of their EPA licences.

As part of Bord na Móna's peatland restoration programme, the company reports having restored over 1200 hectares of raised bog at 12 different sites, including areas that had not been fully brought into peat production. A further 1000 hectares of restoration works are also under way, although not all cutaway bogs are suitable for restoration. Other land uses may be considered in these cases, for example wind or solar farms. In 2016, Bord na Móna launched its Biodiversity Action Plan 2016-2021 to support ongoing restoration, rehabilitation and management activities (BNM, 2016). The company reviews this plan's progress every year. The 2018 review noted its progress in rehabilitating former peat production areas: 15,000 hectares had been rehabilitated, with a further 1250 hectares in the process of being rehabilitated.



Topic Box 5.3 Living Bog Project

The Living Bog project,⁶ launched in 2016, is the largest single raised bog restoration project that has been undertaken in Ireland. It is funded by the EU's LIFE programme and the Department of Culture, Heritage and the Gaeltacht.

Under this project, restoration works across 12 raised bog SACs are being carried out in seven different counties. Over 200 km of drainage channels will be blocked, using almost 14,000 peat and plastic dams. The blocking of these channels will help raise the water table and recreate the hydrological and ecological conditions under which new peat forms.

The aim is to improve over 2500 hectares of critically endangered raised bog habitat and add 750 hectares of active raised bog habitat to the relatively small amount of living bog left. Restoring and protecting this important habitat will help conserve and protect many endangered species, such as the red grouse and curlew, rare insects, spiders and amphibians, and many plant species.

Other activities carried out include the infilling of drains, scrub removal, fencing and walkway improvements, the development of fire plans, a comprehensive schools outreach programme and amenity provision. Community engagement is central to the project, and community-led amenities at the bogs, such as new walking trails, boardwalks and signage, will be developed to facilitate outdoor educational and recreational use.

In other related positive developments, restoration plans are now in place for 53 raised bog SACs to be developed further in consultation with local stakeholders. Restoration plans for the raised bog NHAs and drainage management plans for the raised bog SACs are also in development. The National Parks and Wildlife Service of the Department of Culture, Heritage and the Gaeltacht has also published a best practice manual for raised bog restoration (Mackin *et al.*, 2017).





Topic Box 5.4 Some Developments in Protecting and Managing Peatlands

- The Wildlife (Amendment) Bill 2016 was proceeding through the Houses of the Oireachtas. The bill lapsed on 14 January 2020 with the dissolution of the Dáil and Seanad.
- The Department of Culture, Heritage and the Gaeltacht is restoring active raised bogs at 12 SACs⁷ and plans to restore over 1800 hectares at up to nine raised bog-designated sites across seven counties in 2020, with funding in the 2020 budget for peatland restoration increased to €5 million.
- The Department of Culture, Heritage and the Gaeltacht has completed restoration measures on state lands at a further three raised bog SACs and one raised bog NHA since 2018, with the restoration of state-owned land within a number of other protected raised bogs currently being planned.
- Restoration plans for the network of raised bog NHAs are due for completion in 2020.
- Bogs where peat extraction activities licensed by the EPA are currently under way will be rehabilitated when extraction has ceased.
- In September 2019, the High Court ruled that the 2019 European Union (Environmental Impact Assessment) (Peat Extraction) Regulations and the Planning and Development Act 2000 (Exempted Development) Regulations 2019 should be set aside, following a successful legal challenge. The decision means that peat cannot be extracted from areas larger than 30 hectares.
- The Department of Housing, Local Government and Heritage is preparing regulations for smaller scale peat extraction activities.
- The SWAMP project⁸ is aiming to improve water quality in managed peatlands.
- The Smart Bog project⁹ is assessing the impacts of human activities on greenhouse gas emissions and removals from peatlands ecosystems, using high-quality imagery and satellite data.
- The NEROS project (Renou-Wilson *et al.*, 2018) involves the monitoring of rewetted and restored peatlands for climate and biodiversity benefits (for both raised and blanket bogs).
- The Raised Bog EU LIFE project has been under way since 2016.
- The AUGER project¹⁰ is currently assessing peatland properties influencing greenhouse gas emissions/removals.

Forestry

Forests are expected to play a bigger role as carbon reservoirs in the future, but environmental assessments are necessary to ensure that the right types of forest are planted and developed in the right places and are managed correctly, to avoid wider impacts on our environment.

Forests provide us with renewable sources of fuel and raw materials. In addition to supporting our economy, they have many important environmental functions, including water regulation, biodiversity conservation, recreation, and improved health and wellbeing. They play an important role in climate change by removing CO₂ from the atmosphere. Ireland's national forest estate is an important carbon reservoir, amounting to over 3.82 million tonnes of CO₂ in 2018 (EPA, 2020a). Ireland's forests and wood products have removed, on average, 4.26 million tonnes of CO₂ per year from the atmosphere since 1990

and are expected to contribute significantly to meeting Ireland's 2030 greenhouse gas emissions reduction target under the Effort Sharing Regulations and the Climate Action Plan 2019.

Ireland's Climate Action Plan (Government of Ireland, 2019) commits to increasing afforestation to an average of 8000 hectares each year, to reach a national forestry land cover target of 18 per cent by the second half of this century. The target for new forestation is to plant about 440 million trees over the next 20 years. The plan also includes several actions covering the forest sector, including implementing the Forestry Programme 2014-2020 in line with the recommendations and targets of the mid-term review of the programme (DAFM, 2018a). Other actions aim to increase the productivity and resilience of the national forest estate and tree species, to deliver additional carbon sequestration potential.

7 www.raisedbogs.ie

8 <https://www.ucd.ie/swamp/>

9 <http://www.smartbog.com/>

10 <https://www.ucd.ie/auger/>



The Department of Agriculture, Food and the Marine has identified climate change mitigation, the need for sustainable increases in wood production and the need to contribute to renewable energy source production as key drivers for continued afforestation (DAFM, 2014). It also reports that our forest cover continues to be at its highest level in over 350 years, with the level of forest cover estimated at 11 per cent of the total land area (c.773,229 hectares); 65.5 per cent of the forest stock is conifer forest, 20.5 per cent is broadleaf forest and 14 per cent is mixed forest. Since 1990, Ireland has had the highest rate of forest expansion (as a percentage of total forest cover) of all EU Member states. We still, however, have one of the lowest afforestation levels in the EU (DAFM, 2018a).

It is important that forward planning and forestry management activities within the sector, at all levels, are supported by the proper environmental assessments, to ensure that the right forests are planted and developed in the right places and are managed correctly, to avoid impacts on our environment. The mid-term review of the current forestry programme was carried out in 2018 and introduced several enhancements, including targeted broadleaf afforestation and increased financial support

for planting of more diverse species. Additional measures such as support for deer tree shelters, continuous cover forestry and the second thinning of broadleaf forests were also developed in 2018 and introduced in early 2019.

Afforestation and harvesting can impact negatively on natural vegetation, soils, biodiversity and the landscape. They can cause water quality issues through acidification and nutrient mobilisation. Tree felling, planting and replanting activities can also allow soils to enter water courses if not carefully managed and monitored. When planted on peaty soils, forestry can also act as a source of carbon emissions.

Ireland's Forestry Programme (2014-2020) is an important national plan for the forestry sector. In 2018, a review of this programme showed that the overall planting level was about 7 per cent less than the government target. The shortfall in the planting target for native woodlands, agroforestry and forestry for fibre combined was much greater, however, at 74 per cent (Table 5.2). Annual afforestation has decreased from over 20,000 hectares in 1996 to only 3550 hectares in 2019 (adapted from DAFM, 2018a).

Table 5.2 Targets and actual afforestation (hectares) between 2015 and 2019

FOREST TYPE	2015		2016		2017		2018		2019	
	Target	Actual								
Overall target	6000	6293	6660	6500	7140	5536	7205	4026	8115	3550
Native woodland	300	138	300	159	300	266	340	374	350	310
Agroforestry	10	0	20	1	25	5	40	1	50	7
Forestry for fibre	100	3	200	1	500	0	500	1	1000	4

Source: adapted from DAFM (2018e).

This review identified four specific needs to address: increase the level of forest cover; provide for species diversification and seek commitments to meet the 30 per cent broadleaf planting target; contribute to national efforts to meet environmental obligations associated with climate, water and biodiversity; and support private forest holders in actively managing their forests, including increasing the supply of forest-based biomass.

Positive Developments in Managing and Restoring Native Woodlands

The Woodlands of Ireland charity, in partnership with government bodies and native woodland stakeholders, prepared the national Native Woodland Strategy 2016-2020. It aims to promote woodland-related ecosystem services, protect native woodlands near watercourses, integrate climate change into forest management and advocate for non-timber uses, including those associated with biodiversity, health, recreation, eco-tourism and landscapes.



The national Forestry Programme 2014-2020 includes targets to restore 2000 hectares of existing native woodland and create 2700 hectares of new native woodland. It also provides measures and commitments to protect our natural environment while supporting sustainable sectoral growth (DRCD, 2019). In 2016, the Department of Agriculture, Food and the Marine established environmental requirements for afforestation. In 2018, it published a draft plan to help sustainably manage forest activities in priority freshwater pearl mussel catchment areas (DAFM, 2018b). Recently, in efforts to help achieve planting targets, it also approved funding for an additional 15 proposals for sustainable forest management activities in 2019 and 2020. The Department of Culture, Heritage and the Gaeltacht has also reported that broadleaf planting levels have increased from 21 per cent to 27 per cent compared with 2017 levels.

Built Environment

Our cities, towns and villages need to be developed in a sustainable, planned and integrated manner.

Good planning is good for our environment. As highlighted in the National Planning Framework, 'a major new policy emphasis on renewing and developing existing settlements will be required, rather than continual expansion and sprawl into the countryside, at the expense of town centres and smaller villages' (Government of Ireland, 2018, p. 11). More compact urban centres and efficient resource use reduces the tendency towards sprawl and a reliance on mainly carbon-intensive greenfield development, which leads to biodiversity loss, soil loss and increased soil sealing, with potential impacts on water quality.

Population and settlement growth are drivers of land use change in urban areas. These changes have implications for soil quality, climate change, biodiversity integrity, air quality, flood risk and water quality. Soil sealing relates to the covering of natural surfaces by impermeable materials and is one of the main causes of soil degradation within the EU. It often affects fertile agricultural lands, puts biodiversity at risk, increases the risk of flooding and water scarcity, and contributes to global warming.

The Seventh Environment Action Programme (EU, 2013) proposed having policies in place by 2020 to achieve 'no net land take by 2050'. It also set targets for reducing soil erosion and loss of soil organic matter. Now that the government has published the National Planning Framework with initial targets for compact brownfield development, the next challenge for Ireland will be in measuring and monitoring how these targets are being met, the factors that are key to their success and what scope there should be for their enhancement.

An important issue in this regard relates to the form and location of future housing provision, particularly in the extensive rural parts of Ireland beyond the 1.7 per cent of the country that was under settlement in 2017, as reported by the Central Statistics Office (CSO).¹¹

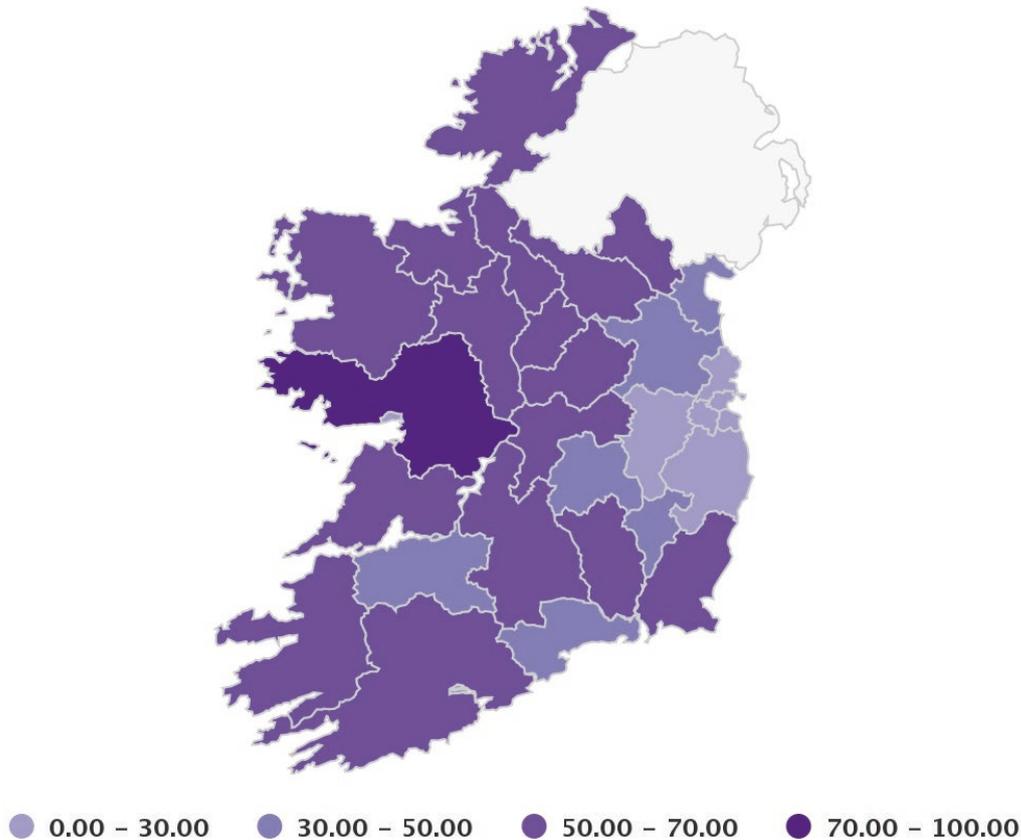
Ireland's population could reach about 6 million by 2051 (CSO, 2018). The CSO reported that there were 442,669 one-off houses (defined by the CSO as 'occupied detached houses with individual sewerage systems') in 2016 (CSO, 2016). This represents 26 per cent of all occupied dwellings, with almost 40 per cent of all homes constructed between the 2011 and 2016 census periods being one-off houses (Figure 5.4). The darker coloured areas in Figure 5.4 represent greater levels of one-off housing. For 17 counties, one-off housing comprised over half of all dwellings built since 2011. For example, over 60 per cent of households in County Galway were one-off houses, the highest in the country. Counties Roscommon (56%) and Leitrim (52%) also had a large proportion of this type of housing.

This type of housing depends on further on-site wastewater systems and the use of private cars for travel to places of work and learning and for leisure and services. Implementing robust policies in relation to rural settlements is very important to secure shared positive environmental outcomes.

11 <https://www.cso.ie/en/releasesandpublications/ep/p-eii/eii19/landuse/>



Figure 5.4 Percentage of homes constructed since 2011 that are one-off houses in 2016 (Source: CSO, 2016)



Providing housing in rural settings in a carefully planned, designed and environmentally sustainable way that meets the needs of rural communities and economic activities, can be achieved. For example, clustered rural housing close to or within rural villages, micro-generation of electricity using renewable technologies such as solar, wind and heat pumps, and adherence to strict standards for wastewater treatment and disposal all have a part to play in sustainable rural development.

However, the accelerating rate of development of one-off commuter-driven housing in rural areas close to larger cities and towns and along transport corridors, such as the motorway network, is locking in long-term environmental impacts.

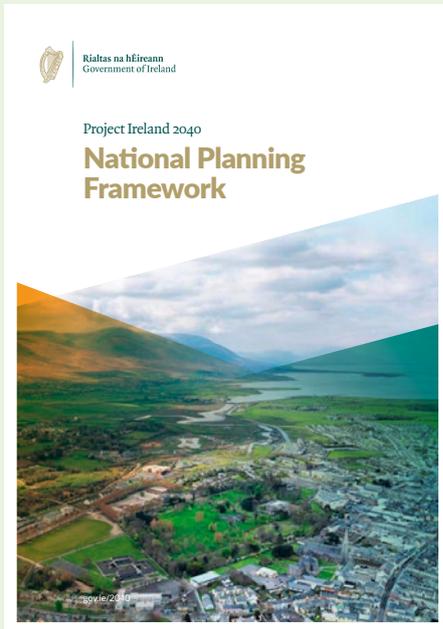
These impacts include climate impacts (from long-distance commuting in private vehicles), water quality impacts (because of poorly performing or maintained domestic wastewater treatment systems), the fragmentation of ecological linkages and habitats, and the fragmentation of agricultural land holdings. These result in a loss of food production and ecosystems, as well as limiting the opportunities for sensitive infill development and coordinated development of rural villages and small towns, many of which are in long-term decline.

At the same time, the key reasons why the housing needs of rural communities are not being met in smaller rural towns and villages include a lack of physical infrastructure, such as water service infrastructure, as well as affordable access to self-build options, such as low-cost local authority individual sites.



Topic Box 5.5 National Planning Framework

The National Planning Framework, published in 2018, is Ireland's top-level statutory land use plan (Government of Ireland, 2018).



It sets out a vision for how Ireland can sustainably accommodate an additional 1 million people by 2040 and grow our economy and society. It commits, where possible, to prioritising the development of brownfield and regeneration areas over greenfield development. It aims to focus growth primarily in our cities, while also supporting focused targeted growth in towns, villages and rural areas.

Regarding rural settlement in particular, the National Planning Framework (Policy Objective 18b) committed the government to developing 'a programme for new homes in small towns and villages with local authorities, public infrastructure agencies such as Irish Water and local communities to provide serviced sites with appropriate infrastructure to attract people to build their own homes and live in small towns and villages' (p. 162).

Currently, Policy Objective 18b is still to be implemented and needs to be allied to the careful management of rural areas under pressure of random and uncoordinated single-home development; its implementation will be essential to achieving the wider National Planning Framework policy objectives of compact growth and use of brownfield over greenfield development.

The Regional Assemblies will implement the National Planning Framework through their regional spatial and economic strategies, which in turn will be implemented through the local authority planning process. This will help ensure that sustainable development is promoted in local and regional authority land use planning.

The Office of the Planning Regulator, established in April 2019, is responsible for evaluating and assessing statutory plans made under the Planning and Development Act 2000, as amended. Its role includes reviewing development plans and local area plans for consistency with the National Planning Framework, regional spatial and economic strategies, ministerial guidelines and government policies, as well as obligations related to climate change mitigation and adaptation.

The National Planning Framework also recognises the importance of the maritime economy and seafood sector in sustaining our more remote rural coastal and island communities. Offshore, the National Marine Planning Framework, being prepared by the Department of Housing, Local Government and Heritage, will set out a vision of how Ireland will use, protect and enjoy our marine area. It is important that spatial planning, both onshore and offshore, is closely aligned and integrated to ensure that environmentally sustainable development is achieved.

Flood Risk Management

The use of nature-based and natural water retention measures should not be forgotten when considering solutions for flood protection and flood alleviation works.

Flood risk management, including integrated coastal zone management, helps protect our homes, businesses, lands and supporting infrastructure from flooding. Flood risk management guidelines were prepared in 2009.

These require planning authorities to carry out flood risk assessments to help ensure that land use (and associated land use zoning) is compatible with the risk of flooding identified.

In 2018, the Office of Public Works published 29 flood risk management plans and 40,000 flood maps for 300 communities as part of the first cycle of flood risk management planning required under the EU Floods Directive (2007/60/EC). These plans will help inform how and where our settlements develop into the future. Work is progressing on the second cycle of flood risk mapping. This will cover areas not previously assessed, including agricultural lands.

There are many environmental challenges when it comes to constructing flood alleviation works and relief schemes, especially where extensive engineering works are required. If not carefully planned, implemented and monitored, there is the potential for significant negative environmental



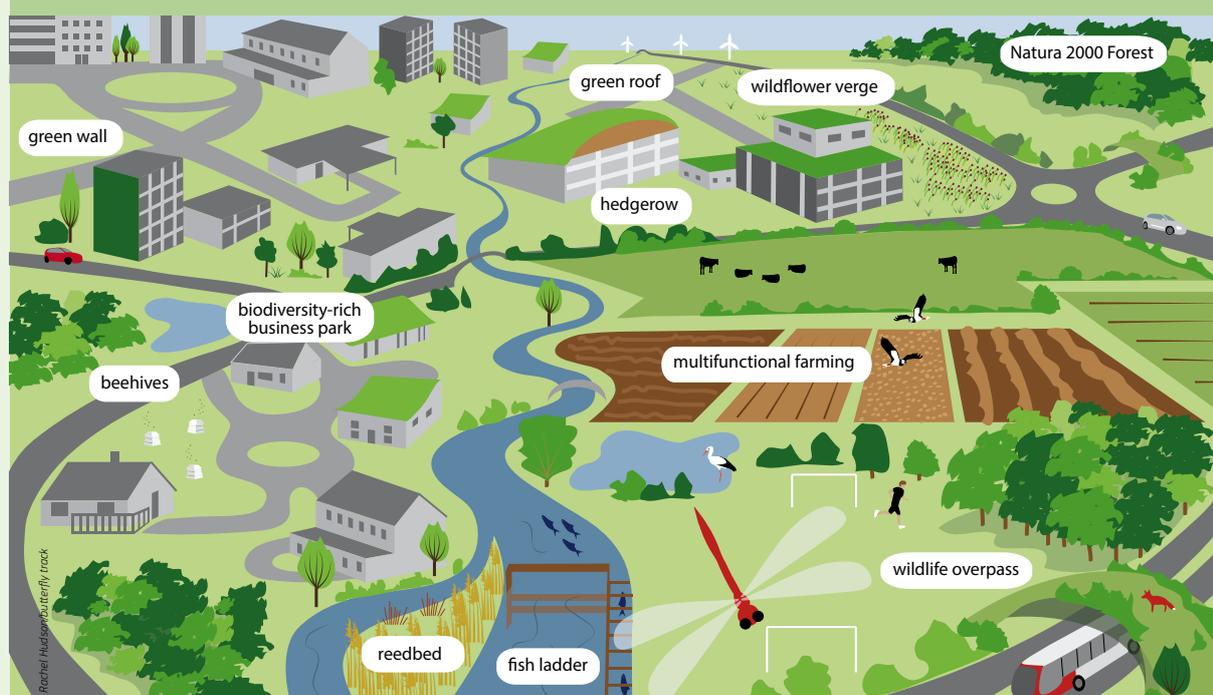
impacts on water quality and associated habitats and species. Nature-based and natural water retention measures should also be considered as solutions for flood protection and flood alleviation works. Example of these measures include restoring ecosystems such as wetlands

and reconnecting floodplains with water courses to better regulate the flow and transport of water. These types of solutions are encouraged in EU policies, as outlined by the European Environment Agency (EEA, 2019a).

Topic Box 5.6 Greener More Sustainable Cities and Urban Regeneration

Green infrastructure is based on the idea that protecting and enhancing nature and natural processes, which provide many benefits to society, needs to be integrated into spatial planning to underpin sustainable development. Green infrastructure consists of strategically planned and managed networks of natural and semi-natural areas. These areas provide a wide range of ecosystem services including biodiversity support, water purification, air quality, flood management, recreation and climate mitigation and adaptation (Figure 5.5). This network of green spaces (and blue spaces, for water linkages) helps to sustain (and can improve) our environment, our health and our quality of life. It also creates job opportunities and supports the green economy. Green infrastructure planning involves recognising the many benefits that green (and blue) spaces provide and protecting and managing these spaces within statutory land use plans.

Figure 5.5 Components of Green Infrastructure (Source: EC, 2013)



The European Commission (EC, 2011) identified that restoring at least 15 per cent of degraded ecosystems in the EU and expanding green infrastructure use will help overcome land fragmentation. Land fragmentation involves splitting up the landscape into smaller areas. This can impact on natural habitats and make it more difficult for animals to move safely in the modified landscape.

Ireland's National Planning Framework requires local authorities to incorporate planning for green infrastructure and ecosystem services into statutory land use plans. Similar commitments are also provided in regional spatial and economic strategies and at the county level, for example Fingal's Green Infrastructure Strategy.

Significant growth in green and blue schemes has occurred in Ireland since 2016. Recent examples of successful schemes include the Waterford Greenway and the Barrow Blueway. These schemes offer many environmental and health benefits, as well as providing opportunities for sustainable tourism and support to the local economy. If not carefully designed and developed and subjected to the proper environmental assessments, however, these types of schemes have the potential to impact on existing green infrastructure. For example, projects that aim to provide routes through Special Areas of Conservation or Special Protection Areas may risk undermining these designations.



Landscape

Ireland's National Landscape Strategy sets out the principles for protecting and enhancing the landscape while positively managing changes.

Our landscape has been shaped by long-running natural processes and human intervention throughout history. It forms an important part of our cultural and natural identity. It contributes to the wellbeing of our economy (e.g. the tourism industry), society and environment. How we value and protect our landscape plays an important role in where (and how) our settlements grow and where any supporting infrastructure should be placed.

The European Landscape Convention aims to balance spatial planning, development and landscape protection. In Ireland, this is being provided for through the Planning and Development Act Regulations 2000-2010 and Local Government Reform Act 2014. The Department of Agriculture, Food and the Marine has produced forestry-related landscape guidance since 2000. It also designates hedgerows, ditches and open drains as 'landscape features' to be protected under the Good Agricultural and Environmental Condition of cross-compliance. Archaeological sites and monuments are also recognised as important features to protect.

Ireland's National Landscape Strategy (DAHG, 2015b) sets out the principles for protecting and enhancing the landscape while positively managing changes. It recognises the need to establish a landscape policy framework approach to inform planning authorities' decision-making. It includes an action requiring public authorities to prepare 'State of the Landscape' reports, which would then be summarised by the Department of Culture, Heritage and the Gaeltacht. Although this was a positive commitment in 2015, to date it has not been implemented. The National Planning Framework similarly committed to preparing a national landscape character map as a specific objective; however, this has also not yet been implemented. The

absence of a national landscape character map makes it more difficult to plan for important strategic infrastructure, such as windfarms, for example.

The National Planning Framework also commits to developing guidance on local landscape character assessments (including historic landscape characterisation), to provide for a more consistent landscape character assessment approach across administrative boundaries.

The Marine Institute has recently developed a Seascape Character Assessment¹² for the first time. This will help define the key characteristics of our coastal seascapes, at a regional level and should help inform planning decisions on land and in the marine environment.

Regionally, the regional spatial and economic strategies will help coordinate local authority landscape character assessments. This should improve consistency between adjoining local authorities, in valuing, protecting and managing their shared landscape resources.

5. Research

We need to continue supporting ongoing collaborative research to address environmental knowledge gaps covering land use, soils and spatial planning.

Ongoing research will help inform national soil-related policies and interactions with wider environmental protection. The EPA research programme funds research to inform land and soil policy, implementation, enforcement and sustainable use. The range of projects funded includes desk and medium-scale studies, scholarships and fellowships. Some of these research projects are listed in Topic Box 5.7.

¹² <https://emff.marine.ie/blue-growth/project-13-definition-and-classification-ireland%E2%80%99s-seascapes>



Topic Box 5.7 Some Recent Developments in Mapping Technology

Significant improvements have been made in how geographical information systems and satellite imagery are used to map land cover. Continued research in this area will help improve our understanding of soils and land cover, as well as monitoring changes that occur.

One recent development arising from EPA-funded research was the launch of the Environmental Sensitivity Mapping Webtool in 2019. It helps planners highlight areas that are more environmentally sensitive, to inform better planning decisions and environmental assessments. It brings together over 100 datasets and allows users to create plan-specific environmental sensitivity maps. These maps can help identify suitable development locations, while also protecting the environment. It is available at www.enviromap.ie.

Some other relevant research in this area is shown below in Table 5.3.

Table 5.3 Some soils and landcover online resources

Soils map of Ireland ¹³ (Teagasc – EPA)	Soil information to inform land management activities
Irish wetlands mapping project ¹⁴	Information on the location and status of wetlands
Bird sensitivity mapping for wind energy developments ¹⁵ (Birdwatch Ireland)	Assists in locating wind energy developments, to minimise impacts on birds
Flood maps ¹⁶ (Office of Public Works)	Provides flood maps to inform land use planning
Catchments.ie ¹⁷ (EPA)	Information on and stories about our water catchments

Soils and Land Cover: EPA Research Programme 2014-2020

Since 2016, the EPA has funded 40 new research projects relevant to the Soils and Land Cover area; a commitment of €6.5 million. These projects were funded under the Sustainability (Natural Capital), Water and Climate Pillars of the EPA Research Programme 2014-2020.

During 2020 several new EPA research reports have been published that are relevant to the topics covered in this chapter. They include the two research reports mentioned in Table 5.4 below. All reports are available on the research pages of the EPA website.¹⁸

These EPA-funded projects include research on:

- habitat mapping, assessment and monitoring using high-resolution imagery
- Irish natural capital accounting
- peatlands and
- planning.

Table 5.4 Some recent EPA-funded research projects on soils, land cover and land use

- Ecohydrology, Greenhouse Gas Dynamics and Restoration Guidelines for Degraded Raised Bogs (Regan *et al.*, 2020)
- Evaluating the Suitability of the Land Parcel Identification System for Assessing Land Use and Land Use Change-Related Greenhouse Gas Emissions (Zimmerman *et al.*, 2020)
- TaLAM: Mapping land cover in lowlands and uplands with satellite imagery (Cawkwell *et al.*, 2018)
- SoilC – feasibility of grassland soil carbon survey (Kiely *et al.*, 2017)
- Mapping and monitoring land cover, use and change (Cawkwell *et al.*, 2017)
- 21st century deforestation in Ireland (Devaney *et al.*, 2017)
- Irish soil information system: soil property maps (Creamer *et al.*, 2016)
- Soil status and protection (Bampa *et al.*, 2016)

¹³ <http://gis.teagasc.ie/soils/>

¹⁴ <http://www.wetlandssurveysireland.com/wetlands/map-of-irish-wetlands--index.html>

¹⁵ <https://www.birdwatchireland.ie/OurWork/PolicyAdvocacy/BirdSensitivityMapping/tabid/1312/Default.aspx>

¹⁶ <http://www.floodinfo.ie/>

¹⁷ <https://www.catchments.ie/>

¹⁸ www.epa.ie/researchandeducation/research/researchpublications/researchreports/



The EU 2020 LANDMARK project¹⁹ considered local, regional and EU-scale aspects of soils and land cover. Pillar 1 (local) developed a Soil Navigator²⁰ as a decision support tool for use at local scales by farmers and advisors. It aims to assess and optimise soil functions in an integrated manner to inform long-term sustainability. Teagasc recommends that further research is carried out to refine this for use with Irish conditions and management regimes.

At the regional scale (Pillar 2), a monitoring scheme covering the many functions of soils, coupled with a set of indicators to describe soil functions, has been developed. This could support the development of a national-level monitoring scheme for soils in Ireland.

Finally, at the EU scale (Pillar 3), a set of policy options was proposed to optimise agronomic (using agricultural plants for food, fuel, fibre and land restoration) and associated environmental outcomes. Teagasc indicates that these policy options could be used and refined to inform national agricultural policy.

More information is available at <http://www.epa.ie/researchandeducation/research/>.

6. Conclusions

Soils and Land Resources

Our soils, land cover and landscape resources need to be protected, monitored and managed responsibly. This needs to happen in national policies right down to local management scale, covering cross-sector activities on farms, on forest plantations, on peatlands, and in urban and rural areas.

We must fully implement existing environmental policies, planning frameworks and strategies, as well as sectoral commitments, to protect, maintain and enhance our remaining biodiversity and ecosystem resources, including peatlands, forests and wetlands. In preparing sectoral plans and programmes, detailed land cover mapping information should, where available, be taken into account. This should be supported with continued environmental monitoring and reporting.

Land Cover Mapping

The national land cover mapping programme, once complete, will provide a detailed evidence base to allow better and more integrated decision-making across many sectors. We need to be able to monitor how well policies, plans and programmes are being implemented from an environmental standpoint. Developing and implementing a new national approach to land cover, land use and land management would allow us to coordinate how major environmental challenges, such as addressing climate change mitigation and the decline in nature, and improving water quality in our catchments, are being addressed across different sectors.

Protecting Peatlands

Our peatlands are a unique and important habitat, rich in historical, cultural and community significance. Although our peatlands have served our fuel and power needs, especially in the past, we need to continue the transition to using cleaner, more renewable sources of fuel.

Nationally, there needs to be a concerted effort to fully implement the commitments of the National Peatlands Strategy and the National Raised Bog SAC Management Plan 2017-2022 (DCHG, 2018). Rewetting degraded peatlands will help eliminate and reduce losses of carbon. Where peatland restoration is feasible, it will further improve the capacity of our peatlands to store CO₂. It will also help protect and, where possible, enhance important habitats and the many ecosystem services they provide us with.

Where peat extraction activities are still ongoing within national and European designated sites, these should continue to be regulated. We need to continue to progress options to rehabilitate and restore existing industrial cutaway and cutover bogs, with the overall aim of better protection and timely restoration of peatlands as carbon sinks.

¹⁹ <http://landmark2020.eu>

²⁰ www.soilnavigator.eu



Forestry

With regard to forestry, there needs to be a focus on increasing the level of forest cover, supporting further broadleaf planting and species diversification and maximising sustainable forest management practices (such as the right tree in the right place). We also need to better understand the barriers to uptake of forestry by landowners, to help increase the amount of planting of native woodlands, agroforestry and forestry for fibre.

Spatial Planning

We must ensure that our cities, towns, villages and rural areas are developed in an environmentally sustainable way. Active steps will be needed by many stakeholders, including government, local authorities, infrastructure bodies and local communities, to implement alternatives to urban sprawl and the suburbanisation of Ireland's countryside. These aims are well outlined in the National Planning Framework and include planned town and village development, measured controls on sporadic housing development in rural areas near cities, towns and major road corridors, implementing brownfield regeneration and delivering affordable town and village self-build housing options close to employment, services and amenities.

The importance of our green and blue spaces for our health and wellbeing, for providing quiet areas and for local biodiversity is now widely recognised. We should aim to protect existing natural green infrastructure and increase levels of green and blue infrastructure in towns and cities through county- and local-level land use planning.

In terms of wider planning and land management considerations, we should, where possible, aim to incorporate nature-based and natural water retention measures as solutions in flood risk management planning. For old industrial and waste areas, there is still a need to develop a national policy to remediate contaminated and degraded land and soil, as this is a gap at present.

Landscape

Regarding landscape protection, there has been little progress in achieving the aims of the National Landscape Strategy to date. We need to deliver on the commitments of the National Landscape Strategy and the National Planning Framework, as well as to prepare a national landscape character map. This will help us provide for planned economic and social development while also ensuring that we protect, enhance and manage changes in our landscapes in a coherent manner. Such strategies and frameworks will also help us understand and take account of the interactions between environmental and landscape sensitivities in our sectoral and land use planning activities.

Research

There is need to continue supporting collaborative research to address environmental knowledge gaps. Outputs of environmental research help inform policymaking to address the many environmental challenges facing us. Good examples of applied research include the Environmental Sensitivity Mapping Webtool, which is helping local authorities to prepare land use plans and related environmental assessments and the Soil Navigator, which helps farmers capture the trade-off and synergies between different soil functions.

Agriculture

With regard to agriculture, we need to continue improving our knowledge of soils and the functions and services they provide. This includes looking at how to maximise the potential for soils in Ireland to be carbon sinks. We must continue to carefully manage soil enrichment and land management activities, to avoid or minimise greenhouse gas emissions into the air or nutrient and sediment losses into our water catchments. The consequences of nutrient loss for Ireland's water quality are outlined in Chapters 7 and 8.

We should also continue to support high nature value farming and environmentally sustainable farming practices, for the many environmental benefits they provide.



Chapter Highlights for Land and Soil



Our soils and land need to become net sinks for capturing and storing carbon dioxide. The facilitation of further carbon storage will require widespread rehabilitation and protection of peatlands, increased levels of forestry and woodland, and changes to land management practices. Where land management is providing a store for carbon, this should be maintained or enhanced. Where land management is resulting in emissions of carbon dioxide, this source should be reduced or eliminated, and where land is degraded or has lost its ability to absorb or store carbon dioxide it should be restored. Nationally, there needs to be a concerted effort to fully implement the commitments of the strategies and plans to protect and restore peatlands.



A progressive approach to land cover, land use and land management is required to promote land practices that are sustainable and right for our environment and our people. Implementing such an approach will help coordinate, prioritise and measure Ireland's response to significant environmental issues such as climate change and the decline in nature across multiple sectors. An integrated national approach to land mapping will be needed to support this work.



We need to continue to improve our knowledge of soils and the functions and services they provide. Careful management of soil enrichment and land management activities will avoid or minimise GHG emissions into the air, as well as nutrient and sediment losses into water catchments. This needs to happen from the national policy level to the local management scale, covering cross-sectoral activities on farms, forest plantations and peatlands and within both urban and rural areas.



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Chapter 6

Nature





Nature

1. Introduction

Nature is invaluable and underpins our economy, security, health and wellbeing yet it is not always protected.

The terms 'biodiversity' and 'nature' are often used interchangeably and refer to the variety of life forms on this planet, including humans. They also refer to how species interact with each other and the habitats in which they live. We are deeply connected to nature and rely on biodiversity for our existence yet many of us take this for granted. While having a value in its own right, biodiversity also underpins our economy, security, health and wellbeing. It plays a key role in the functioning of ecosystems, their resilience and their continuing ability to provide ecosystem services. Ecosystem services are how nature benefits us. Nature provides us with clean air and water, food and the raw materials to produce many medical treatments. It is also important to our wellbeing and affords us many opportunities for recreation (IPBES, 2018).

Human society depends on the natural world for its survival. Decisions we make now about how we produce and use food, how we use water or natural resources and the range of other benefits derived from nature, will impact on what ecosystem services will continue to be available to society. The health and integrity of the natural world also impacts on our quality of life and that of future generations.

In Ireland, the challenges of managing the modified landscape we have created over generations cannot be overstated. The most recent report on the status of Ireland's habitats and species by the National Parks and Wildlife Service (NPWS) concludes that most Irish habitats listed in the Habitats Directive have an unfavourable status and almost half are demonstrating ongoing declines (NPWS, 2019).

The role of the NPWS is wide ranging and includes: the conservation of a representative range of ecosystems to maintain and enhance populations of flora and fauna in Ireland; designating, advising and consulting on the protection of habitats and species identified for nature conservation; arranging for the implementation of National and EU legislation and policies for nature conservation and biodiversity; managing State-owned National Parks and Nature Reserves, and promoting awareness of natural heritage and biodiversity issues.¹

2. State of Habitats and Species in an Irish and Global Context

Nature is declining globally and nationally.

The United Nations Sustainable Development Goals (SDGs) outline global efforts towards achieving sustainable development by 2030. One of the goals, SDG 15: Life on Land, aims to 'sustainably manage forests, combat desertification, halt and reverse land degradation, and halt biodiversity loss' (UN, 2015). SDG 14 Life Below Water is also relevant covering sustainable use of the marine environment (Chapter 8). The 2018 report, *Sustainable Development in the European Union*, warned of an unprecedented decline in nature globally with accelerating species extinction rates and monitored progress towards the SDGs in a European Union (EU) context (EU, 2018a). Short-term (2010-2015) and long-term (2000-2015) EU trends for the biodiversity indices in SDG 15 were assessed as follows:

- surface of terrestrial sites designated under Natura 2000 – steadily increasing since 2008 (too few data to analyse the long-term trend)
- common bird index (integrates the abundance and diversity of a selection of common bird species associated with specific habitats) – long-term overall decline but with a small annual increase in the short term
- grassland butterfly index (population trends of 17 butterfly species with data from 15 Member States, including Ireland) – both long-term and short-term severe declines after a period of stabilisation in 2000.

The European Environment Agency's assessment of the state of Europe's biodiversity (EEA, 2019) reported a similar outlook. Despite the ambitious targets that have been set, Europe's biodiversity continues to decline. It is very unlikely that policy targets will be met. The report stated that 'Europe faces persistent problems in areas such as biodiversity loss, resource use, climate change impacts and environmental risks to health and well-being'.

The *Living Planet Report* published by the World Wide Fund for Nature (WWF, 2018) pointed to the fact that biodiversity loss is continuing. It outlined that, 'without a dramatic move beyond "business as usual", the current severe decline of the natural systems that support modern societies will continue – with serious consequences for nature and people'. The latest living planet report (WWF, 2020) states that biodiversity is now being destroyed at an unprecedented rate in human history and that climate change is further accelerating changes to our natural world.

¹ National Parks and Wildlife Service <https://www.npws.ie/>



The recent United Nations *Global Environment Outlook – GEO-6* report (UN Environment, 2019) stated that biodiversity is in crisis. This assessment found that biodiversity policy responses at all levels have been insufficient or too slow to reverse the decline in global biodiversity. The report asserted that the cost of inaction is large and escalating in terms of global biodiversity and that increased investment in conservation is critical. The *Global Outlook Biodiversity 5* report states that humanity is now at a crossroads with regard to the legacy it leaves for future generations and that bold, interdependent actions are needed across a number of fronts to follow a pathway to a sustainable future (Secretariat of the Convention on Biological Diversity, 2020).

The *National Biodiversity Indicators: 2017 Status & Trends* report (NBDC, 2017) summarised the trends in the health of our species and habitats, as well as examining our relationship with nature. The indicators cover areas where improvements are needed to conserve nature including habitats designated under EU law that are of 'inadequate' or 'bad' status and also species protection. While awareness, knowledge and action to protect biodiversity in Ireland are growing these actions are happening too slowly for us to meet our biodiversity targets.

Protection of nature is still a key challenge. The next section outlines the overall trends and status for nature but local issues are also a problem such as site specific habitat damage, hedge cutting and protection of birds of prey (Table 6.1). These are also areas that need to be tackled and enforced in order to improve wildlife and habitat protection.

The National Parks & Wildlife Service has reported a total of 338 incidents involving birds of prey between 2007 and 2019.² A wide range of causes are listed, including poisoning, persecution, fence, road and turbine collisions. Incidents have been recorded in every county of Ireland. Incidents involving illegal acts or misuse of poisons. Poison incidents accounted for 71.5 per cent of such cases, while shootings accounted for 28 per cent and trapping/mutilation accounted for 0.5 per cent of such cases. All regularly breeding native Irish raptor species were confirmed to have suffered some form of poisoning, persecution or other direct anthropogenic non-habitat related cause of injury or mortality. It was also confirmed in October 2020 that a new Wildlife Crime Unit will be established within NPWS that will be involved in tackling these issues.

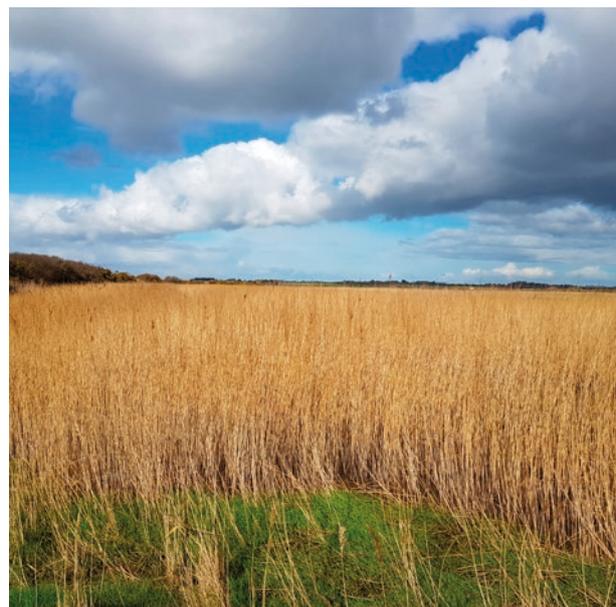
Table 6.1 Numbers of environmental complaints and bird of prey incident reports sent to the National Parks and Wildlife Service in 2018 and 2019 (Source: NPWS)

COMPLAINT/INCIDENT	NUMBER
Complaint ^a	
Environmental/habitat damage/destruction	25
Habitat damage during a development	6
Habitat management	1
Animal welfare	2
Hedge cutting	455
Birds of prey incident report ^b	60

^a Based on complaints received through the Email address: nature.conservation@chg.gov.ie.

^b Not all bird of prey incidents involved illegal activity.

EU Member States are required to monitor habitats and species across Europe that are considered to be threatened and that are listed in the Habitats Directive (92/43/EEC). The conservation status of habitats and species is assessed at a national level, not just in protected areas. The third report on the status of habitats and species in Ireland, prepared by the National Parks and Wildlife Service (NPWS, 2019), stated that, although most of Ireland's listed habitats can be classified as having an unfavourable status, our species are doing better, with the majority having a favourable status. Freshwater species are seen to be most at risk, generally from water pollution.



² https://merriestreet.ie/en/News-Room/Releases/NPWS_publishes_review_of_incidents_impacting_birds_of_pre_2007-2019.html



3. Current Status and Trends

Sixth National Report to the Convention on Biological Diversity

Performance indicators objectively track progress towards our biodiversity commitments and targets at a time when nature is under increasing pressure.

Ireland's 6th National Report to the Convention on Biological Diversity (DCHG, 2019a) reviewed our progress in relation to the five Strategic Goals and 20 Aichi Biodiversity Targets set out in 2011 for implementation by 2020.³ The report found that progress towards many of our national biodiversity targets is partially effective but too slow. A 'transformational change' is needed if Ireland is to achieve the vision outlined in the National Biodiversity Action Plan 2017-2021 (DCHG, 2017).

An online indicator dashboard has been launched by the Biodiversity Indicators Partnership (BIP) to accompany the Convention on Biological Diversity (CBD) report. The BIP is a global initiative to promote the development and delivery of biodiversity indicators and it responds to requests from the CBD, Intergovernmental Science–Policy Platform on Biodiversity and Ecosystem Services (IPBES) and the United Nations (SDGs), among others. The dashboard provides an update of a country's biodiversity targets according to the Aichi Biodiversity Targets, the United Nations SDGs and any multilateral environmental agreements that are in place. Further information can be found on the BIP website.⁴

Habitat Trends

Marine, peatland, grassland and woodland habitats are under threat in Ireland.

Although Ireland naturally has a less diverse population of plants, insects and animals than mainland Europe, it has some habitats that are of EU importance, such as our peatlands. Our aquatic systems and wetlands (see Topic Box 6.1) also support populations of birds, fish and invertebrates that are of international importance.

A recent report by the NPWS (2019) provided the current status of Ireland's 59 protected natural habitats and 60 protected species naturally occurring in Ireland (Figure 6.1).

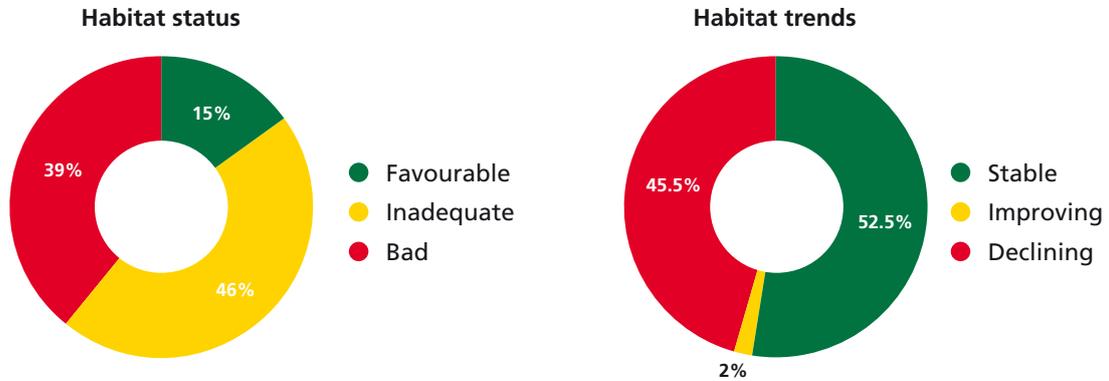
Most habitats assessed in Ireland have an unfavourable status and almost half show ongoing declines, including marine, peatland, grassland and woodland habitats. Further details on peatlands, their protection and restoration is covered in Chapter 5.

³ <https://www.cbd.int/sp/targets/>

⁴ <http://bipdashboard.natureserve.org/bip/SelectIndicator.html?iso=IRL®=Europe>



Figure 6.1 Overall assessment results for the status of and trends in habitats protected under the EU Habitats Directive in Ireland (Source: NPWS Article 17 Data 2019)



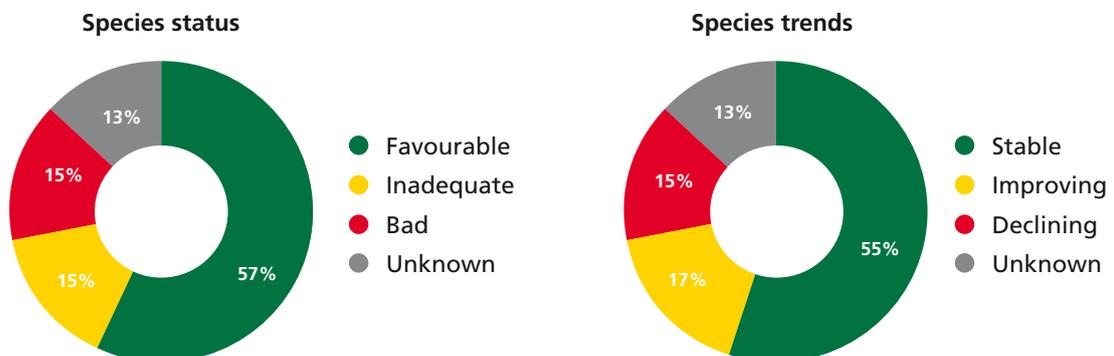
Species Trends

Some species, such as the pine marten and otter, are increasing in numbers while others, such as the freshwater pearl mussel, are in decline.

The NPWS (2019) reported that populations of 72 per cent of species protected under the EU Habitats Directive are stable or improving. Overall, 57 per cent of species assessed have a favourable conservation status (Figure 6.2). Species such as the pine marten and otter have shown an increasing trend, with the pine marten showing an increase in range. Some key species, however, are declining. One of the species of greatest concern is the pollution-sensitive freshwater pearl mussel; only a few rivers have populations that include young individuals, with populations without young individuals likely to die out (NPWS, 2019).



Figure 6.2 Overall assessment results for the status of and trends in species protected under the EU Habitats Directive in Ireland (Source: NPWS Article 17 Data 2019)



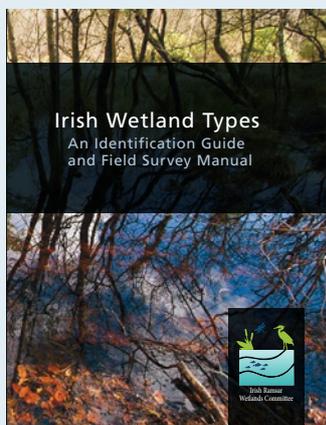


Topic Box 6.1 Wetlands are in Danger and Need Better Protection

Ireland's wetlands are worth protecting, not only because of the biodiversity they support, but also because of the role they play in providing essential ecosystem services such as flood attenuation and improved water quality. To understand and protect these valuable natural, cultural and economic assets, it is vital that practitioners (planners, agricultural advisors, etc.) and the public (farmers, community groups, etc.) can recognise and classify them. This will allow for more accurate wetland classification in the national landcover mapping project, for example.



Killaun bog © Tina Claffey.



Wetlands are particularly vulnerable to damaging activities such as drainage, infilling, turf cutting, nutrient enrichment, overgrazing, agricultural improvements, afforestation and the spread of invasive species. From 1990 to 2018 we lost 258,800 hectares of wetlands, an area greater than the size of County Roscommon (Coordination of Information on the Environment – CORINE – data; Chapter 5).

The Irish Wetland Bird Survey (I-WeBS), which has been running for over 25 years, is coordinated by BirdWatch Ireland and funded by the NPWS. The survey results indicate that the number of waterbirds wintering in Ireland has declined by 15 per cent from 2011/2012 to 2015/2016. More alarming is the comparison over a longer time period, which shows that our wintering waterbirds have declined by almost 500,000 individuals (40%) since the mid-1990s (Burke *et al.*, 2018).

The *Irish Wetland Types – An Identification Guide and Field Survey Manual* (IRWC, 2018) helps the non-specialist identify and record Irish wetland habitat types in the field. Published by the Environmental Protection Agency (EPA) in association with the Irish Ramsar Wetlands Committee (IRWC), it also helps to identify pressures on wetlands by using indicators of human-induced pressures, such as weirs or dams causing impoundment and alterations of the water table. The manual and associated field survey form can be accessed on the IRWC website.⁵

Birds

Although 30 per cent of the populations of Ireland's breeding bird species are stable or have increased, a fifth are in long-term decline and one, the corn bunting, became extinct here in the 1990s.

The protection of bird species at EU level is provided for under the Birds Directive (2009/147/EC). Under Article 12 of this Directive, Member States are obliged to report on the progress made with implementation of the Directive. This requires reporting on aspects of the status of all regularly occurring bird species both within and outside protected areas. Ireland reported on trends in bird populations in 2019.⁶ The short-term (12 year) and long-term (since the early 1980s) trends in Ireland's breeding and wintering bird populations are illustrated in Figure 6.3.



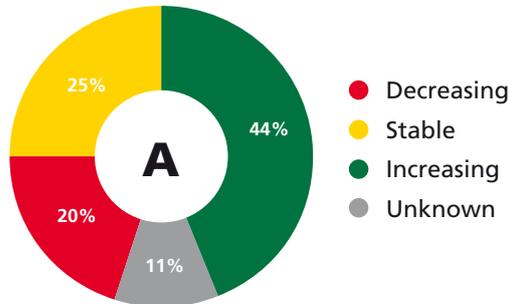
⁵ <http://irishwetlands.ie/index.php/resources/>

⁶ <https://nature-art12.eionet.europa.eu/article12/report?period=3&country=IE>.

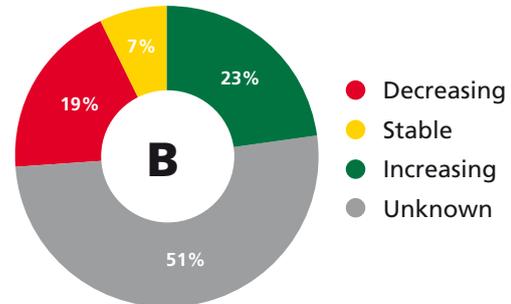


Figure 6.3 Trends in Ireland's breeding and wintering bird populations, showing short-term (12 year) and long-term (since the early 1980s) population trends (Source: NPWS Article 12 Data 2019)

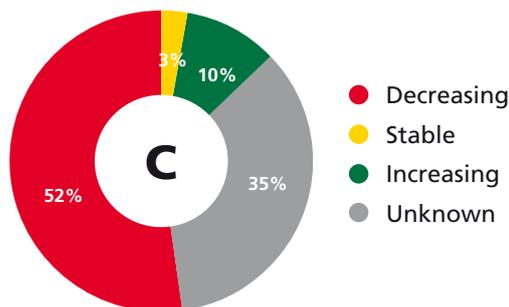
**Short-term population trend
– Breeding Species**



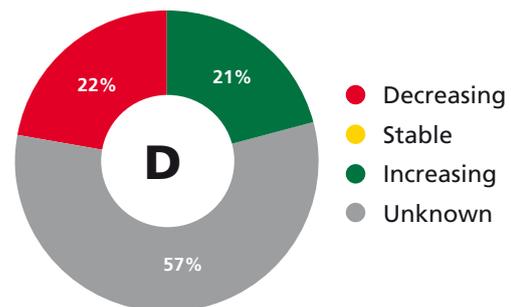
**Long-term population trend
– Breeding Species**



**Short-term population trend
– Winter Species**



**Long-term population trend
– Winter Species**



The estimated proportions of breeding bird populations in each of the trend categories (Figure 6.3a and b) remain relatively unchanged. The data show that almost 20 per cent of Ireland's breeding bird species are in long-term decline, with the corn bunting becoming extinct as a breeding species since the Birds Directive came into force in Ireland. Approximately 30 per cent of breeding species populations are stable or have increased over the long term. This includes relatively recent colonists that are showing strong population growth, such as the little egret and great spotted woodpecker, as well as species such as the blackcap, bullfinch and buzzard. Some of our breeding farmland songbirds are under increasing pressures from the modernisation and intensification of agricultural practices; for example, there are estimated to be fewer than 100 breeding pairs of the whinchat and twite in Ireland. Breeding waders such as the curlew (Topic Box 6.2), lapwing, redshank and dunlin have seen a 93 per cent decline in breeding populations over the long term.

Most of the wintering species assessed (Figure 6.3c and d) are waterbirds such as geese, ducks, swans and waders that are seasonal visitors to Ireland. Ireland is an internationally important location for hundreds

of thousands of visiting waterbirds every year. The populations of over half of these wintering birds are declining over the short term; this includes waders such as the curlew (a greater than 20% decline in winter visitor numbers) and duck species such as the pochard, which has suffered a 91 per cent decline over the short term (Burke *et al.*, 2018). Other priority bird species are also showing declines, such as the hen harrier, whose numbers are estimated to have declined by almost 9 per cent since 2010 (Ruddock *et al.*, 2016), and the merlin (Irish Raptor Study Group, 2018). Recently, data from the 'Hen Harrier Programme' are showing some increased breeding success of this bird of prey species in protected areas.

Ireland's wintering waterbirds may be responding to climate change as many species are showing a north-easterly shift in their range across Europe (Burke *et al.*, 2018; NPWS, 2020). Decades of land use change and habitat degradation have led to large declines in our ground nesting birds, as highlighted by the long-term declines seen in curlew, corncrake and lapwing, for example.



Topic Box 6.2 Bringing Back the Call of the Curlew

The curlew (*Numenius arquata*) is our largest wader and its call was once a familiar sound to many Irish people. It is now almost extinct as a breeding species in Ireland.

Ireland is visited by thousands of curlew every winter; however, the resident population that breeds in Ireland has decreased dramatically in number. Between 1980 and 2018 the population decreased by 96 per cent to 138 pairs (O'Donoghue *et al.*, 2019). Breeding curlew also no longer occur in areas they previously visited – there has been an estimated 78 per cent reduction in their range. This extensive loss has happened because the habitats they depend on have been lost and because of changes in how land is used. This iconic Irish species is listed as 'near threatened' on the global International Union for Conservation of Nature (IUCN) Red List of threatened species.⁷

The Curlew Conservation Programme,⁸ implemented in 2017, was Ireland's response to these dramatic declines and resulted in the formation of Curlew Action Teams across the country. Local advisors, champions and nest protection officers work closely with landowners and other local interests to protect curlew habitats and breeding sites. A Curlew Task Force was also established to reverse the dramatic decline and the public have been asked to be alert to the presence of breeding curlew in their locality, particularly during spring and summer, and to report any observations to the NPWS. Knowing the locations of breeding curlew enables landowners to protect them.



The elusive curlew (*Numenius arquata*) (Source: Colum Clarke)

Red List Species

Species on the national Red Lists are most at risk of extinction.

'Red Lists' identify species at risk that need to be actively protected and conserved. Species are categorised into nine groups under an international system (IUCN): extinct; extinct in the wild; critically endangered; endangered; vulnerable; near threatened; least concern; data deficient; and not evaluated. Endangered species face a very high risk of extinction in the wild (IUCN, 2012). The NPWS and Northern Ireland Environment Agency (NIEA) coordinate Red Lists in Ireland and the lists are available on the NPWS website.⁹ Just over 14 per cent of species assessed in Ireland are under threat of extinction (DCHG, 2017). These include the European eel, Arctic char and natterjack toad. The details from the Red List assessment presented in Ireland's '6th National Report on the Convention on Biological Diversity' are shown in Figure 6.4a (DCHG, 2019a).

New Red List assessments have been undertaken in Ireland since 2016, namely for vascular plants – also called higher plants (Wyse Jackson *et al.*, 2016); cartilaginous fish – a group of fish that includes sharks and their relatives (Clarke *et al.*, 2016) and mammals (Marnell *et al.*, 2019) (Figure 6.4b). A study published in 2019 found that one shark species, the angel shark, currently classified as critically endangered, is now nearing extinction in Irish waters (Shephard *et al.*, 2019). In addition an assessment for plecoptera (stoneflies) was published in 2020 (Feeley *et al.*, 2020) (Figure 6.4b).



The critically endangered angel shark (*Squatina squatina*)

7 <https://www.iucnredlist.org/>

8 <https://www.npws.ie/farmers-and-landowners/schemes/curlew-conservation-programme>

9 <https://www.npws.ie/publications/red-lists>



Figure 6.4a National Biodiversity Indicator: Proportion of total species assessed under various IUCN Red List threat categories (Source: Ireland's 6th National Report to the Convention on Biological Diversity, NPWS)

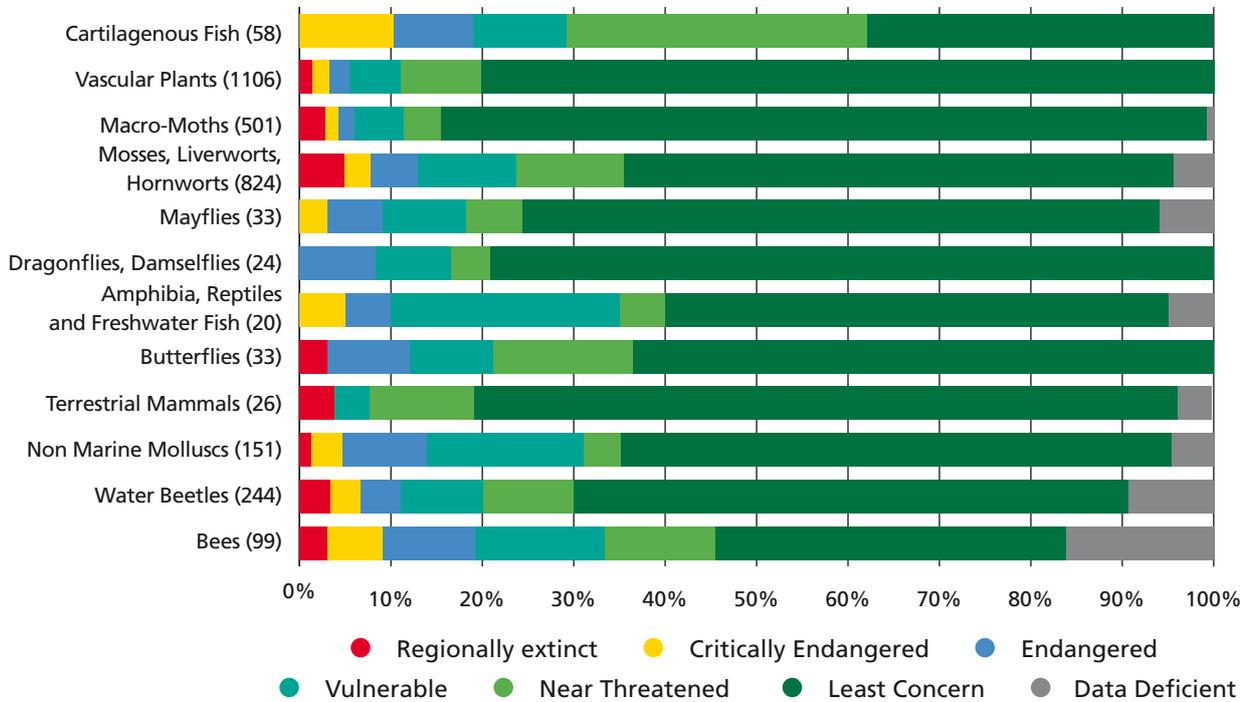
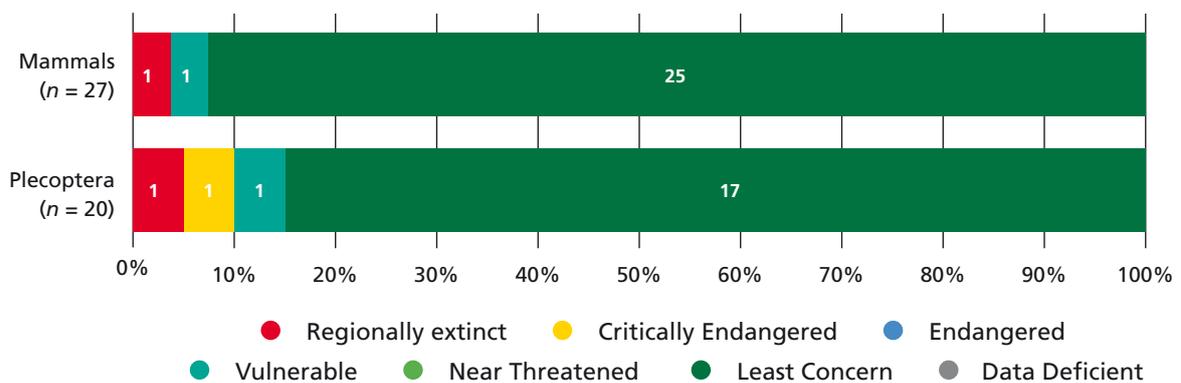


Figure 6.4b Red List conservation status of mammals and plecoptera, published in 2019 and 2020 (Sources: Marnell *et al.*, 2019; Feeley *et al.*, 2020)





4. Drivers and Pressures

Key Pressures on Ireland’s Habitats and Species

Changing land use, pollution and unsustainable exploitation are degrading and fragmenting habitats and impacting species.

The main pressures on Ireland’s protected habitats are agriculture and other land uses such as extraction of resources (including minerals and peat) and forestry, urbanisation, recreation and invasive species (Figure 6.5). It is likely that pressures due to climate change, agricultural system changes and invasive species will remain the same or increase unless action is taken now (DCHG, 2017).

The pressures on our protected species (Figure 6.6) are similar and can sometimes be quite specific, such as physical barriers in rivers affecting fish movement. A wide range of species are reported to be negatively affected by agricultural activities and extraction of resources (NPWS, 2019). Pollution, as illustrated in Fig 6.6, appears to impact relatively few habitats, but this is because pollution from agricultural sources and forestry is accounted for in these categories.

Figure 6.5 Percentage of habitats impacted by pressure/threat categories of medium and high importance (Source: NPWS, 2019)

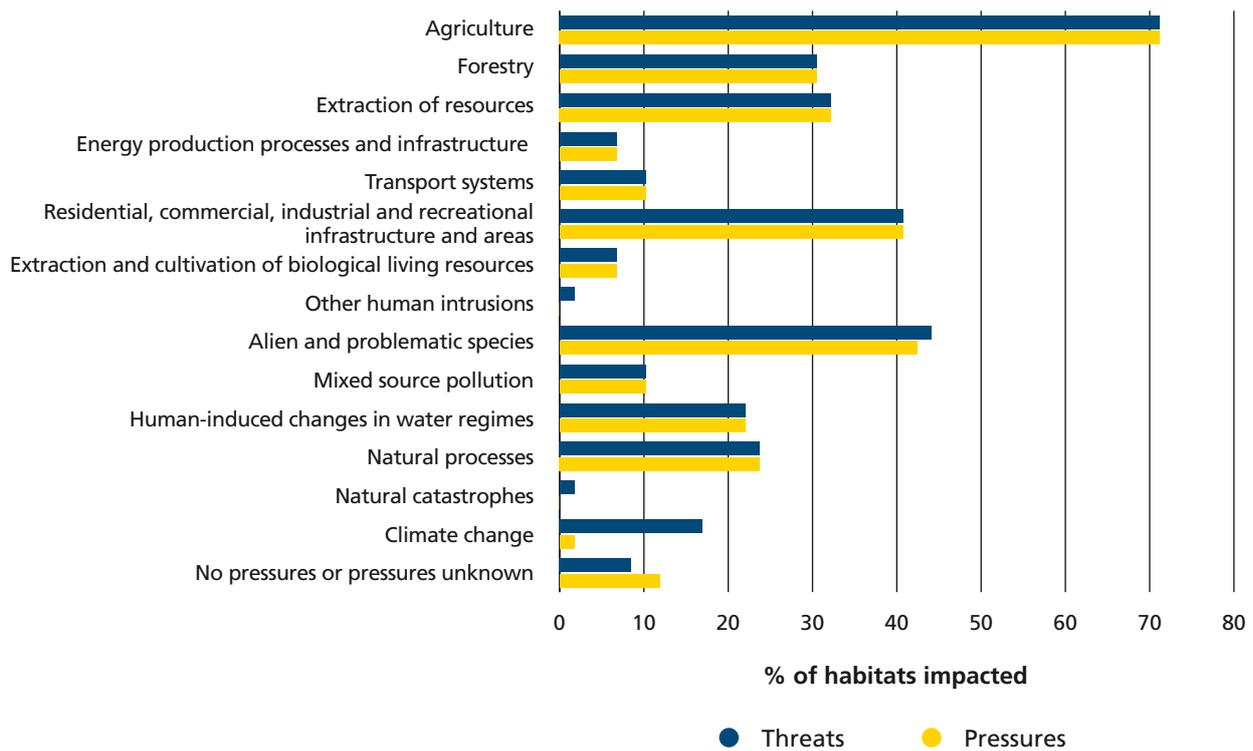
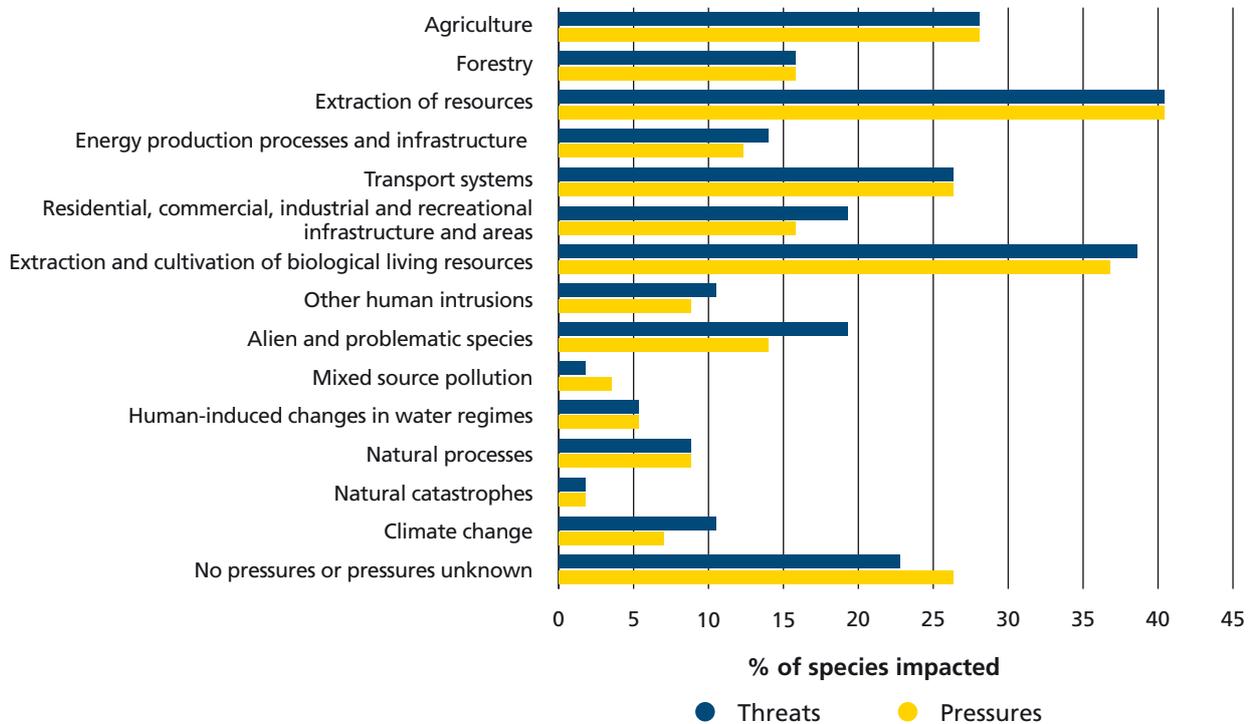




Figure 6.6 Percentage of species impacted by pressure/threat categories of medium and high importance (Source NPWS, 2019)



Human population growth, land use change, unsustainable consumption and overexploitation of resources magnify these pressures. A limited awareness of biodiversity, its benefits and its economic value to society by both the public and policymakers creates further impacts.

Agriculture

Changes in intensification of agricultural practices have impacted on biodiversity.

Drainage of land, fertiliser application, clear-felling, undergrazing and abandonment of land are known pressures that, although local in extent, may influence a much wider area, especially if they affect groundwater supplies or nearby watercourses (Chapter 13).

The decline in bees, butterflies and other insects is largely the result of monoculture and the drive for ever-increasing levels of productivity, characterised by a loss or neglect of hedgerows, farmland edges and scrub (Chapter 13). The plans for the development of a new 10-year strategy for the agriculture and food sector for the period to 2030, to follow on from Food Wise 2015, presents an opportunity to address the negative effects on the environment that have occurred in recent years with respect to biodiversity, water quality, greenhouse gas emissions and ammonia emissions. The EPA has outlined these challenges in its 2020 submission to DAFM in relation to the strategy.¹⁰



¹⁰ <http://www.epa.ie/pubs/epasub/epasubmissionontheagri-foodstrategy2030.html>



Invasive Alien Species

Threats to nature and the economy from invasive species are increasing.

Invasive alien species are species 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 new invasive species arriving is high. They 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). The rate of spread of invasive species globally has not decreased in the last decade and may actually be increasing (Davis *et al.*, 2019). The National Biodiversity Action Plan (DCHG, 2017) highlighted that the occurrence and spread of invasive alien species in Ireland is increasing; indeed, the impact of invasive species on Ireland's protected species is expected to increase over the next decade (NPWS, 2019). The annual cost of invasive species to Ireland's economy is estimated to be over €200 million (Kelly *et al.*, 2013a) and this figure may increase with future introductions of invasive species.

Invasive non-native species, such as the zebra mussel, grey squirrel and Pacific oyster, have displaced species naturally occurring in Ireland and damaged ecosystems. The rhododendron continues to threaten our oak woodlands, mink threaten ground-nesting birds and an increased number of water bodies are subject to crayfish plague (Topic Box 6.3). However, the increase in pine marten numbers has resulted in grey squirrel declines in recent years.

The EU regulation on the prevention and management of the introduction and spread of invasive alien species [Regulation (EU) No 1143/2014] was enacted in 2015. This regulation, among other things, put the responsibility on Member States to complete a risk assessment of which species might be a threat to their biodiversity.

The National Biodiversity Data Centre (NBDC) maintains the National Invasive Species Database, which provides distribution information on invasive species. This work aims to facilitate the updating of risk assessments undertaken by Invasive Species Ireland (Kelly *et al.*, 2013b) and establish an early warning system to alert various stakeholders to new arrivals on the island of Ireland. Members of the public can submit records of invasive alien species and find advice on how to deal with them and prevent their spread on the NBDC website.¹¹

Topic Box 6.3 Crayfish Plague and the White-clawed Crayfish



The white-clawed crayfish (*Austropotamobius pallipes*) is a protected species of crustacean that is naturally occurring in Ireland and resembles a small lobster. It is widespread in rivers and lakes in Ireland.

Ireland's crayfish are especially vulnerable to a disease from North America called crayfish plague and outbreaks can cause their populations to collapse. Ireland is seen as a European stronghold of the species but there have been several confirmed outbreaks of crayfish plague in Ireland since 2015.

The recent crayfish plague outbreaks are putting the future of this species in Ireland at risk. The Marine Institute and NPWS are undertaking a 2-year national crayfish plague surveillance programme (2018-2020) to investigate the spread of the disease (MI, 2019).

What can you do?

Those engaged in water activities should continue to be vigilant and do what they can to minimise the risk of spreading the disease. The single most effective action that can be taken is to follow the Check, Clean, Dry protocol before and after entering a watercourse: check that equipment, footwear and clothes are free from any plant material or other debris; clean them using the appropriate method; and leave them to dry for at least 48 hours. Further information on the Check, Clean, Dry protocol, as well as practical advice, can be found on the NBDC website.¹²

Any suspected sightings of non-native crayfish or large numbers of dead white-clawed crayfish should be reported to the NBDC online.¹³

11 <http://www.biodiversityireland.ie/projects/invasive-species/>

12 <http://www.biodiversityireland.ie/projects/invasive-species/crayfish-plague/>

13 <https://records.biodiversityireland.ie/record/invasives>



Topic Box 6.4 Tourism and Recreational Pressures

The European Commission in its 2017 Environmental Implementation Review of Ireland highlighted the opportunity to make better use of the significant potential of nature for tourism by better managing and protecting natural sites (EU, 2017).



Tourism and the public demand for access to nature creates many opportunities to showcase and nurture an appreciation for nature. The challenge is to realise these benefits without damaging nature. Fáilte Ireland's Overseas Holidaymakers Attitudes Survey¹⁴ studied the expectations of holidaymakers in Ireland. It identified that nature is ranked fourth for exceeding expectations, with scenery ranked second. The survey results highlight our culture and landscape as Ireland's unique selling points. Biodiversity loss damages Ireland's habitats and landscapes and hence their amenity value. This makes a strong case for implementing measures to safeguard and enhance the environmental assets on which tourism depends.

Fáilte Ireland prepared an Environmental Surveying and Monitoring Strategy as part of the Wild Atlantic Way Operational Programme in 2015 (Fáilte Ireland, 2015). It describes the purpose of this strategy as 'to work with and demonstrate to our stakeholders and partners that we are committed to the sustainable development of the Wild Atlantic Way, and to be able to pre-empt and avoid environmental effects in the future should they occur'. An external monitoring group oversaw and guided the monitoring programme over its lifetime (2015-2019).

In 2018, Ireland published its tourism masterplan entitled *Experiencing the Wild Heart of Ireland* (DCHG, 2018). The plan is a product of the Department of Culture, Heritage and the Gaeltacht and Fáilte Ireland's strategic partnership, established with the shared aim of enhancing and promoting Ireland's national parks and nature reserves. The plan sets out a framework to guide the phased development of enhanced visitor centre experiences and improved visitor facilities at the parks, based on research into international best practice, and aims to strategically plan for conservation and biodiversity while balancing the impact of increasing visitor numbers to the sites.

5. Responses

The Natura 2000 Network and Beyond

EU nature directives facilitate the legal protection of habitats and species.

Implementing the EU Habitats and Birds Directives across Europe involved the creation of a network of sites for the legal protection of EU listed habitats and species (as opposed to all other nationally protected species), the Natura 2000 network.¹⁵ The network consists of Special Protection Areas (SPAs) protected under the Birds Directive and Special Areas of Conservation (SACs) protected under the Habitats Directive.

While this network of Natura 2000 sites provides the primary means of protecting our most important and most vulnerable wildlife, the areas outside these designations also play a significant role in species and habitat protection and are afforded some legal protection through European and/or national legislation. Table 6.2 and Figures 6.7 and 6.8 outline the areas of land designated as SACs and SPAs in Ireland.

Table 6.2 Natura 2000 sites designated as SACs and SPAs in Ireland (Source: NPWS)

NATURA 2000 SITES	AREA (HA)
SACs	1,696,559
SPAs	597,227
SACs and SPAs	1,950,239 ^a

^a Combined number does not equal the sum of the individual numbers because of overlap in the designated areas.

¹⁴ <http://www.failteireland.ie/Utility/News-Library/Latest-Overseas-Holidaymaker-Survey-Confirms-Satis.aspx>

¹⁵ <https://www.npws.ie/protected-sites>



Figure 6.7 Areas of SAC designation in Ireland, with the inset showing the marine SACs (Source: data from NPWS)

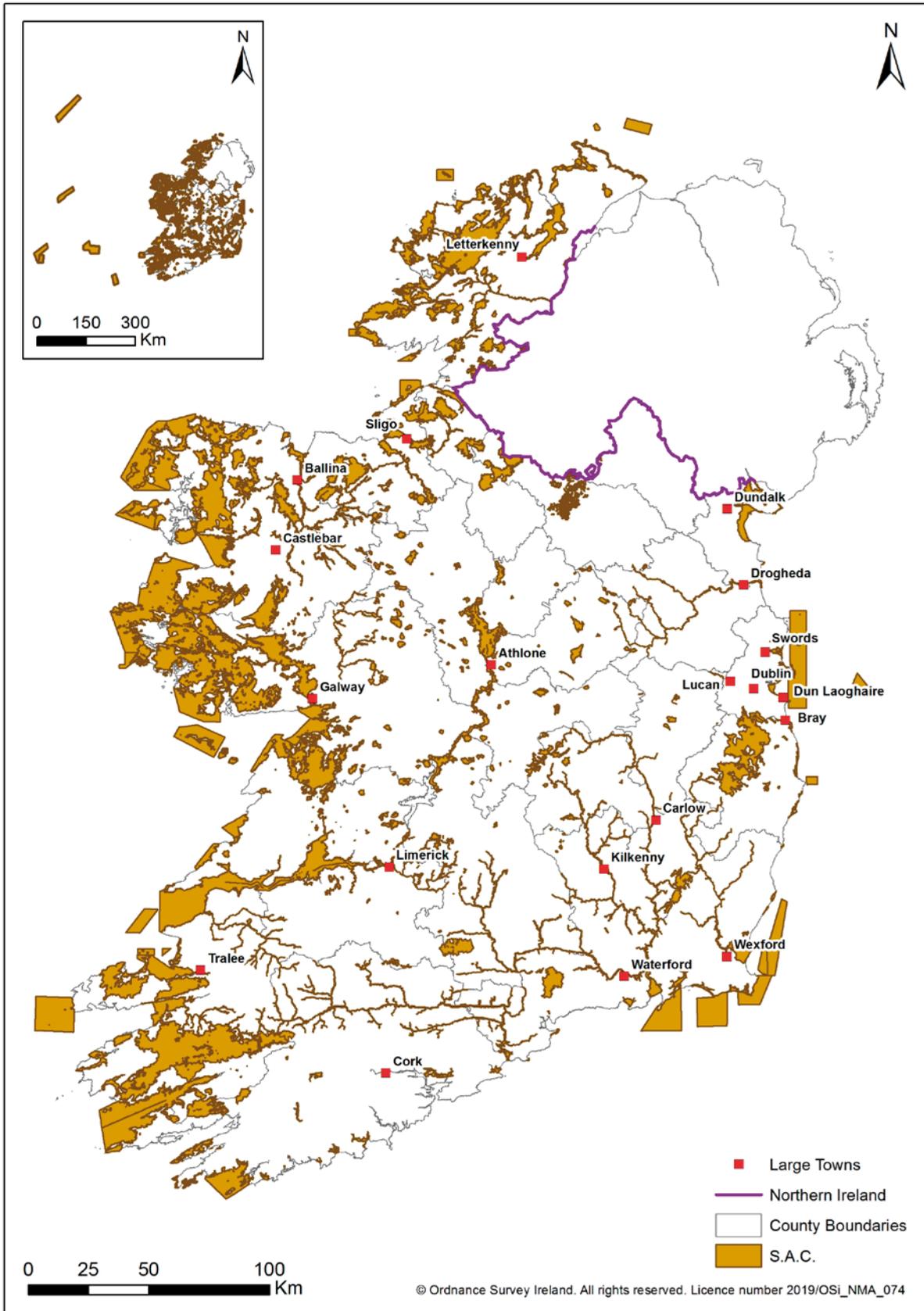
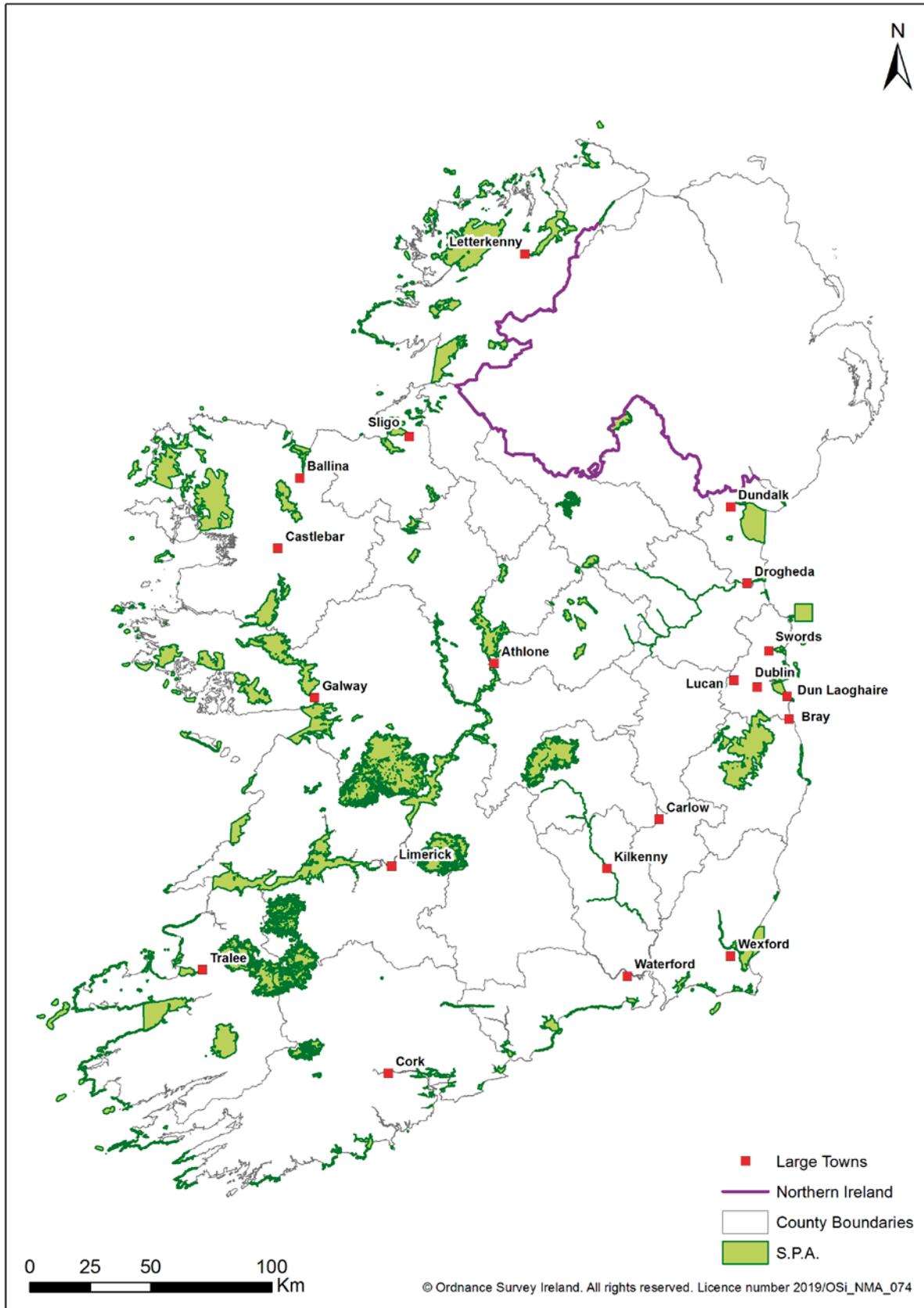




Figure 6.8 Areas of SPA designation in Ireland (Source: data from NPWS)





Designations in Ireland

Conservation and protection priority actions are designed to enhance Ireland's biodiversity.

Ireland was obliged to establish the conservation priorities, objectives and measures to maintain or restore the species and habitats present in SACs to a favourable condition by 2014. In April 2016, the European Commission called on Ireland to step up its nature protection measures by formally designating SACs and establishing conservation objectives and measures.¹⁶ A total of 430 SACs are legally protected in Ireland, although currently a little over 40 per cent of these have yet to be formally designated by statutory instruments (DCHG, 2019a). To date, 150 of the 154 SPAs in Ireland are statutorily designated, although all share full protection under the European Communities (Birds and Natural Habitats) Regulations 2011.

In January 2019, the European Commission also urged Ireland, among other Member States, to protect the environment against alien species through implementation of the EU regulation on invasive alien species [Regulation (EU) No 1143/2014] and to step up implementation of the Marine Strategy Framework Directive (2008/56/EC) to protect marine waters.¹⁷

In Ireland's 2019 Environmental Implementation Review (EU, 2019), the European Commission outlined the priority actions that should be taken to protect, conserve and enhance our natural capital. These include:

- complete the Natura 2000 designation process and put in place clearly defined conservation objectives along with the necessary measures to meet those objectives
- ensure that burning in uplands (particularly in Natura 2000 areas) and hedgerow cutting are fully compatible with the requirements of the Habitats and Birds Directives
- increase efforts to manage blanket bogs
- take practical steps to address the serious decline of waders and to further develop the conservation programme for the curlew, both inside and outside protected areas.

In July 2020, the European Commission announced that it had decided to refer Ireland to the Court of Justice of the EU in relation to the designation of Special Areas of Conservation under the Habitats Directive (Directive 92/43/EEC). The Commission stated that 154 Sites of Community Importance (out of 423) had not yet been designated as SACs in the Atlantic biogeographical region, site-specific conservation objectives had not been established for 87 sites, and the necessary conservation measures had not been established at any of the 423 sites.¹⁸

¹⁶ https://ec.europa.eu/commission/presscorner/detail/en/MEMO_16_1452

¹⁷ http://europa.eu/rapid/press-release_MEMO-19-462_en.htm

¹⁸ https://ec.europa.eu/commission/presscorner/detail/en/IP_20_1235

Beyond the Natura Network

Ireland has a network of Natural Heritage Areas (NHAs), which are given protection under the Wildlife (Amendment) Act (2000). Some 140 peatlands have been designated as NHAs and there are a further 630 proposed NHAs, which are afforded limited protection before formal designation. Measures are needed to ensure that these areas can add value to the network of protected areas across the country, linking habitats and enhancing landscapes to help reverse the current decline in habitats and species. Marine Protected Areas are covered in Chapter 8 The Marine Environment.

Opportunities exist to find solutions to the decline in nature through floodwater management, the Water Framework Directive (2000/60/EC; Chapter 7), European Innovation Partnership projects (Chapter 13), agri-environment schemes and the Common Agricultural Policy (CAP; Chapter 13). CAP4Nature¹⁹ is a set of key principles identified by independent scientists that underpins the multiple benefits that nature provides to agriculture and society. Incorporating nature-based farming solutions into Ireland's CAP Strategic Plan, being developed for implementation post-2020, can enhance farmers' livelihoods through payments for environmental public goods.

The Heritage Bill was signed into Irish law in 2018.²⁰ One of the issues covered under the Bill has highlighted a lack of available information about the breeding season for some species of birds in Ireland, pointing to a need for further research and discussion to gather the evidence base on which legislative decisions affecting and protecting nature are made. Under the Bill, the Minister for Culture, Heritage and the Gaeltacht has the discretion to alter the period during the year when the burning of vegetation and hedgerow cutting are allowed, under certain conditions and dependent on the presence of protected species, for a pilot phase of 2 years. The Minister decided not to alter either period in 2019 or the spring of 2020; however, the passing of this legislation has sparked concerns for some breeding bird species.

¹⁹ <https://www.cap4nature.com>

²⁰ <https://data.oireachtas.ie/ie/oireachtas/act/2018/15/eng/enacted/a1518.pdf>



Prioritised Action Framework and Biodiversity Funding

Implementing national biodiversity policies requires funding and can give rise to indirect co-benefits for other sectors.

The Prioritised Action Framework (PAF) for Natura 2000 for 2014-2020 (EU, 2014) was approved by the government in 2014 and submitted to the EU. This framework identifies a range of actions needed to help improve the status of Ireland's habitats and wildlife, including conservation management strategies, more focused agri-environment schemes and habitat restoration. Ireland plans to finalise the PAF for the period 2021-2027 in 2020.

In 2017, the European Commission adopted an Action Plan for Nature, People and the Economy (EC, 2017a). The plan focused on four priority areas and comprised 15 actions to be carried out during 2019. In 2019 the Commission, in conjunction with the NPWS, hosted a workshop on strengthening investments in Natura 2000. Member States are encouraged to use the updated PAFs to maximise funding for nature protection.

A review of the amount of money spent directly on biodiversity in Ireland estimated a total spend of €1.4 billion (Morrison and Bullock, 2018) between 2010 and 2015, with an annual average spend of €250 million. Eighty-five per cent of this expenditure went towards agri-environment schemes. This figure represents less than 1 per cent of total government expenditure in Ireland.

There is now a wider understanding that nature funding needs to be included in the wider socio-economic context. While some funding streams may not be directly related to nature protection, the results can often lead to indirect co-benefits. More information about the financing of nature protection through the Natura 2000 network after 2020 can be found in the European Commission report *Opportunities for Innovative Biodiversity Financing in the EU* (EC, 2017b).

Convention on Biological Diversity and EU Biodiversity Strategy

Halting the loss of biodiversity across Europe and the degradation of ecosystem services requires more ambitious efforts.

The Convention on Biological Diversity (CBD) is a global convention under the auspices of the United Nations and came into being in 1993. It has three main objectives:

- the conservation of biological diversity
- the sustainable use of the components of biological diversity
- the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources.

Ireland is a party to the CBD and as such has agreed to meet the 20 Aichi Biodiversity Targets organised under five Strategic Goals, with the overall aim of halting biodiversity loss by 2020. A post-2020 biodiversity framework will be agreed by all parties to the convention at the 15th Conference of the Parties to the United Nations CBD. The ambitions of the post-2020 global biodiversity framework are 'to implement broad-based action to bring about a transformation in society's relationship with biodiversity and to ensure that, by 2050, the shared vision of living in harmony with nature is fulfilled'.²¹

The EU Biodiversity Strategy to 2020 (EU, 2011) aims to halt the loss of biodiversity and the degradation of ecosystem services in the EU by 2020, and to restore them, as far as is feasible, while stepping up the EU contribution to averting global biodiversity loss. The strategy is seen as a building block to achieving the 2050 vision: 'By 2050, European Union biodiversity and the ecosystem services it provides – its natural capital – are protected, valued and appropriately restored for biodiversity's intrinsic value and for their essential contribution to human well-being and economic prosperity, and so that catastrophic changes caused by the loss of biodiversity are avoided'.

The mid-term review of the strategy concluded that implementation and enforcement efforts needed to become 'considerably bolder and more ambitious' (EC, 2015). At the current rate of implementation, biodiversity loss and degradation of ecosystem services will continue, with knock-on effects for humanity in the future.

The EU has published its Biodiversity Strategy for 2030.²² The aim of this initiative is to outline the EU ambition for the post-2020 global biodiversity framework, to be adopted at the 15th Conference of the Parties to the United Nations CBD. The EU aims to put forward at the conference commitments and measures to address the main causes of biodiversity loss in the EU, which will include a follow-on of concrete implementation actions by 2021. In addition to this, the European Green Deal²³ was published in December 2019. The Green Deal aims to protect Europe's natural habitats and make Europe climate neutral. The purpose of the deal is to improve the wellbeing of people through a just and inclusive transition to a cleaner environment.

21 <https://www.cbd.int/article/zero-draft-update-august-2020>

22 <https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12096-EU-2030-Biodiversity-Strategy>

23 https://ec.europa.eu/commission/presscorner/detail/en/fs_19_6714



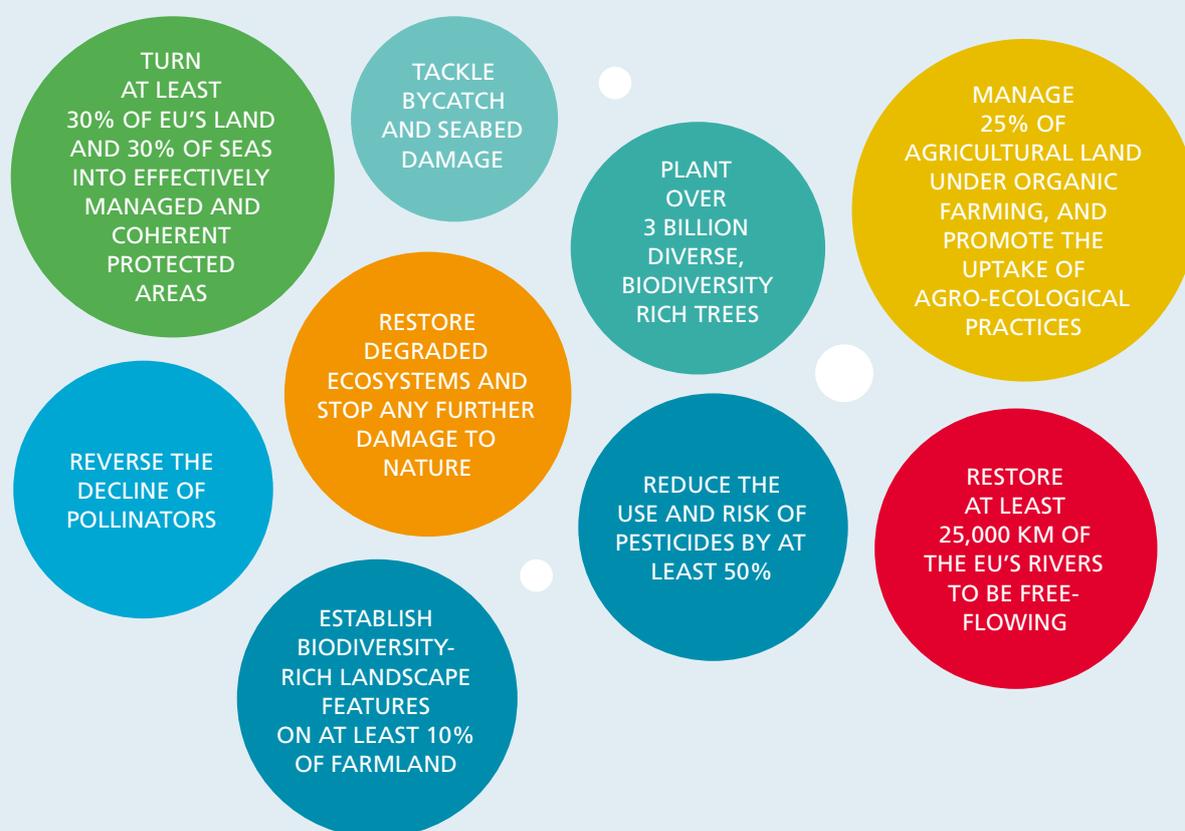
Topic Box 6.5 EU Biodiversity Strategy for 2030: Bringing Nature Back into our Lives

In 2020 the EU adopted the 2030 Biodiversity Strategy (EU, 2020a). The aim of the strategy is to put Europe's biodiversity on the path to recovery by 2030 for the benefit of the people, climate and planet. It also commits the EU to a leading role in the upcoming post-2020 global biodiversity framework as the world emerges from the COVID-19 crisis.

The strategy is a core part of the European Green Deal and it is hoped that it will support a sustainable economic recovery in a post-pandemic landscape.

The strategy builds on the existing EU Birds and Habitats Directives and the Natura 2000 network but also sets ambitious targets to achieve healthy and resilient ecosystems (Figure 6.9).

Figure 6.9 Examples of targets and commitments from the EU Biodiversity Strategy for 2030
Recreated from the EU factsheet *Bringing Nature Back into our Lives* (EU, 2020b)



The key commitments for the protection of nature by 2030 are:

1. legally protect a minimum of 30 per cent of the EU's land area and 30 per cent of the EU's sea area and integrate ecological corridors, as part of a true Trans-European Nature Network
2. strictly protect at least a third of the EU's protected areas, including all remaining EU primary and old-growth forests
3. effectively manage all protected areas, defining clear conservation objectives and measures, and monitoring them appropriately.

It is also intended that the biodiversity strategy will be closely aligned with the new Farm to Fork Strategy and the new CAP (Chapter 13).

Progress on implementation of the strategy will be reviewed by the EU in 2024.



National Biodiversity Action Plan 2017-2021 and the National Planning Framework

Ireland is committed to protecting our biodiversity for the benefit of all sectors of society through a series of targeted strategies and actions.

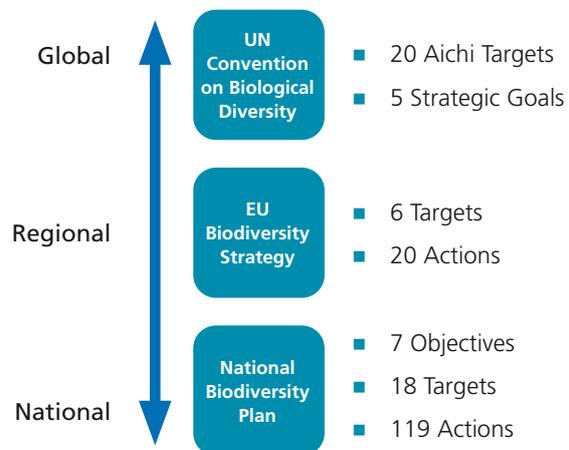
The National Biodiversity Action Plan 2017-2021 (DCHG, 2017), the third such plan for Ireland, seeks to ensure that 'biodiversity and ecosystems in Ireland are conserved and restored, delivering benefits essential for all sectors of society and that Ireland contributes to efforts to halt the loss of biodiversity and the degradation of ecosystems in the EU and globally'.

Oversight of the current plan is undertaken through the Biodiversity Working Group, a group of government departments, agencies and other bodies that have a role in carrying out the actions of the plan. The Biodiversity Working Group published an interim review of the plan in 2020 (Biodiversity Working Group, 2020), concluding that, of the 119 actions, 8 have been implemented and 98 are ongoing; for 13, there has been limited progress. Positive highlights outlined in the review include the LIFE schemes covering Raptor LIFE, Kerry LIFE and Roseate tern LIFE, curlew conservation projects, and also the DAFM funded European Innovation Partnership projects. The EIPs are local-led projects, developed with farmers and communities and covering areas such as habitat and species protection (including hen harrier, freshwater pearl mussel, corncrake) on a range of types of farmland. The review also reports that EU co-funding is contributing to restoration efforts in peatlands and more sustainable agricultural and fishing practices, resulting in greater collaboration across sectors. A positive outcome in the review is the mention that there is a shift in public opinion towards a greater appreciation of biodiversity.



Areas identified in the interim review that need more emphasis include building on the success of the Burren Programme, developing new farming models to aid both the diversification of agriculture and an appropriate reduction in intensification in some areas, developing management plans for protected habitats and species, developing restoration plans for species in severe decline, and accelerating the establishment of Marine Protected Areas. The establishment of new frameworks for private sector investment and innovation and the restructuring of legacy non-productive, badly-sited conifer plantations; especially on peatlands are also highlighted. The review also highlighted that there has been limited progress in tackling invasive species. In addition to this the Biodiversity Forum will monitor the execution of the plan. The forum has representatives from economic sectors, non-governmental organisations, academia and other stakeholders. Figure 6.10 shows how the plan fits in with global and EU biodiversity policy.

Figure 6.10 Biodiversity policies from a global scale to a national scale, adapted from Ireland's Biodiversity Sectoral Climate Change Adaptation Plan (DCHG, 2019b)



The National Planning Framework (NPF; DHPLG, 2018), a high-level strategic plan that outlines the future development and growth of Ireland up to 2040, contains biodiversity objectives. One of the policy objectives is that integrated planning for green infrastructure and ecosystem services will be incorporated into the preparation of statutory land use plans. The National Development Plan 2018-2027 (DPER, 2018) details the investment needed if Ireland is to successfully implement the NPF. The NPF aims to enhance the conservation status and improve the management of protected areas and protected species.



Biodiversity Climate Change Adaptation Plan

Adaptation choices can help protect biodiversity and ecosystem services from the impacts of a changing climate.

Ireland's Biodiversity Climate Change Sectoral Adaptation Plan (DCHG, 2019b) states that, by the end of the century, climate change is likely to become the most significant driver of biodiversity loss. The goal of the plan is to protect biodiversity from the impacts of climate change and to conserve and manage ecosystems so that they deliver services that increase the adaptive capacity of people and biodiversity. This is achieved by identifying adaptation options that will help to protect biodiversity and ecosystem services from the impacts of changing climate. Climate change has a major impact on nature through interaction with other pressures and is dealt with in more detail in Chapter 2.

Sustainable Forestry

Conserving and increasing native woodland will enhance forestry's contribution to biodiversity protection.

The European Investment Bank is investing in the forestry operations of the state-owned forestry company, Coillte, for the 2016-2020 period (EIB, 2017). This includes the replanting of existing forest stands and nurseries, as well as upgrading forest trails and infrastructure. In 2018 Coillte launched Bioclass, a tool for recording and reporting areas of biodiversity value on lands owned by Coillte. The tool will assist with the integrated planning and management of key biodiversity sites across Coillte's 440,000-hectare estate. In 2019 Coillte also established a not-for-profit entity called Coillte Nature, which will focus on the environment and recreational forests. Coillte Nature aims to deliver new woodlands so that they can be areas for biodiversity and carbon sequestration.

Measures in Ireland's Forestry Programme 2014-2020 (DAFM, 2015) include increasing the amount of native woodland in Ireland through the Native Woodland Establishment Scheme and Native Woodland Conservation Scheme.

Pollinators and bumblebees

One-third of our bee species are threatened with extinction in Ireland.

Pollinators are animals, such as bees, hoverflies, butterflies and moths, that transfer pollen from one plant to another while feeding, thereby enabling plant fertilisation and reproduction. In doing so, pollinators support a steady supply of healthy and economically valuable food for people and sustain entire ecosystems (Science for Environment Policy, 2020).

According to the National Biodiversity Data Centre (NBDC), bee species in Ireland are threatened with extinction because we have drastically reduced the amount of food (flowers) and safe nesting sites in our landscapes.²⁴ While some bumblebee species can be a regular sight, other species are endangered, including the great yellow bumblebee which is in severe decline in Ireland.



The All-Ireland Pollinator Plan led by the NBDC provides information about what people can do to help pollinator conservation (Stout *et al.*, 2019). The plan covers all types of habitats ranging from gardens, to schools, to road-side verges managed by local authorities, to farmland. The plan is about everybody playing their part to try 'to create an Ireland where pollinators can survive and thrive'. It also advises how people can get involved in recording sightings to help track trends in the distribution and abundance of species.

24 <https://pollinators.ie/>



Citizen Science

Citizen science generates valuable data that track changes in nature over time.

Citizen science is the involvement of volunteers in scientific research conducted, in whole or in part, by members of the public. It allows everybody to play their part in contributing to the evidence and data needed for nature conservation. Citizen science is now gathering wider recognition from public bodies, including the European Commission, as a tool for collecting environmental data (EC, 2017c). Citizen science is included in the EPA Strategic Plan 2016-2020 (EPA, 2016a) with the objective of engaging the public in the protection and improvement of the environment. Integrated citizen science projects that cut across thematic areas can also play a part in linking data collection for nature protection with the pressures on habitats and water quality.



National Biodiversity Data Centre

Better data strengthen the knowledge base for nature protection.

In order to manage and protect our nature we need to know how it is distributed across Ireland and how it is changing over time. The NBDC collates, manages, analyses and disseminates data on Ireland's biodiversity. The centre currently manages four million biological records representing over 16,000 species (DCHG, 2019a). Citizen science initiatives coordinated by the NBDC include structured monitoring schemes such as the Irish Butterfly Monitoring Scheme, All-Ireland Bumblebee Monitoring Scheme, Marsh Fritillary Monitoring Scheme, Dragonfly Ireland, Explore Your Shore! and Rare Plant Monitoring Scheme. The butterfly and bumblebee monitoring schemes produce annual population indices. Members of the public can also submit biodiversity records to the NBDC via their website²⁵ or through the mobile phone app.



25 <https://www.biodiversityireland.ie>

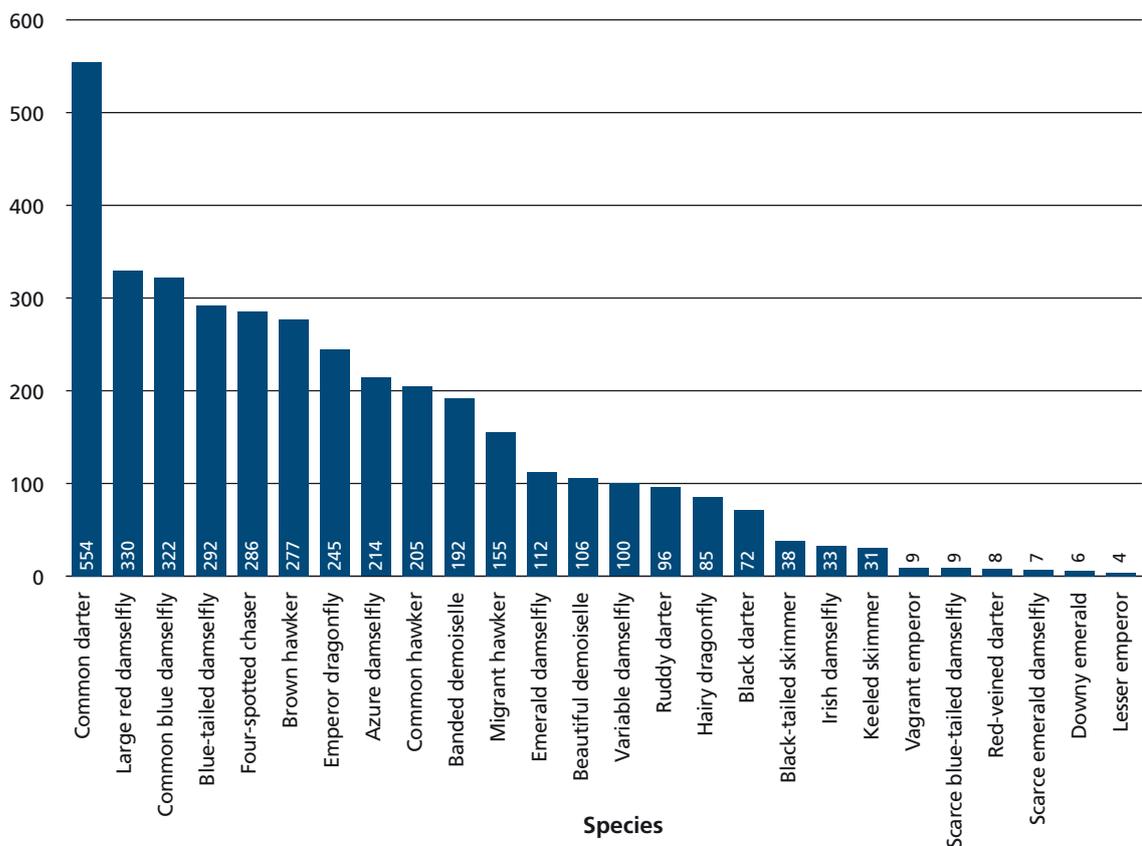
**Topic Box 6.6 Dragonfly Ireland: Monitoring Dragonflies, Habitats and Water Quality Using Citizen Science**

The NBDC, with support from the EPA, developed the Dragonfly Ireland 2019-2024 survey. The goal of this citizen science survey is to produce an updated Dragonfly and Damselfly Atlas for Ireland. This is a key motivator for citizen scientists who want to participate and contribute to our understanding and protection of these species. The project is also examining the use of dragonflies and damselflies as indicators of freshwater habitat and water quality.

The survey relies on volunteers to collect information on dragonflies and damselflies in freshwater habitats across Ireland. Three levels of survey are available to participants, to facilitate as wide a range of volunteer experiences as possible. These are the Dragonfly Spotter, which facilitates and encourages the collection of casual dragonfly and damselfly records; the intermediate Dragonfly Recorder; and the more detailed Dragonfly Monitor, where participants are asked to survey selected sites at least four times per annum, at least twice from late May to the end of June and at least twice from July to early September, to cover the flight period of all Irish dragonfly and damselfly species. Observations are also made of habitat and water quality, as well as noting any impacts.

The NBDC reported that by the end of 2019 it had received 2856 dragonfly and damselfly records. After validating the records, they were combined with the Northern Ireland records from the Centre for Environmental Data and Recording (CEDaR), giving 3788 records from across the island of Ireland (NBDC, 2020). Data submitted to the NBDC in 2019 are now available online.²⁶ Records were received for 499 out of a possible 1000 10-km-square grid squares. Records for 26 dragonfly and damselfly species were received in 2019 (Figure 6.11). Further details on the survey and how to take part are available on the NBDC website.²⁷

Figure 6.11 Validated dragonfly and damselfly records received by the NBDC and CEDaR by species from January to December 2019



²⁶ <https://maps.biodiversityireland.ie>

²⁷ <http://www.biodiversityireland.ie/recordbiodiversity/dragonfly-ireland-2019-2024/>



Voluntary Organisations that are Linking Citizen Science and Conservation Work

Citizen science has been widely used to gather valuable observations that have helped monitor the trends in and distributions of various species in Ireland. BirdWatch Ireland, a non-governmental organisation, celebrated 50 years of conservation work in 2019.²⁸ It works to protect Ireland's birds and their habitats. Many of its bird surveys involve volunteers drawn from its 15,000 members and the general public. There are several ways that people can get involved in protecting birds and biodiversity, including the annual Irish Garden Bird Survey.

Other examples of citizen science in action are the bat monitoring schemes and surveys run by Bat Conservation Ireland²⁹ with the help of hundreds of volunteers each year. Stimulating and maintaining community involvement in citizen science projects such as these can be challenging and require a considerable amount of effort.

Topic Box 6.7 Swift Conservation Project: A Citizen Science Initiative to Help a Species of Breeding Bird That is in Decline in Ireland

The Swift Conservation Project helps to protect Ireland's declining swift populations. Full-county swift surveys have been completed in Offaly, Westmeath, Laois and Tipperary, with more under way in Meath, Sligo and Wicklow.³⁰ The surveys, with the support of local volunteers and Tidy Towns groups, record swift nest sites in towns and villages to establish the distribution of nesting swifts. The data collected allow planners and decision-makers to more effectively protect swifts at site level. Surveys will also be completed of swifts at Office of Public Works (OPW) Heritage Sites across Ireland. The results of these surveys will enable the OPW to more effectively manage sites where swifts are present and, in some cases, attract swifts back to sites where they have been lost.



Collaborative Action for the Natura Network project

The Interreg VA Programme, an EU funding stream, is designed to finance strategic cross-border cooperation to achieve prosperity and increased sustainability. One recently funded project under the programme was the CANN (Collaborative Action for the Natura Network) project, which covers Northern Ireland, the border region of Ireland and western Scotland. The project aims to protect endangered species and restore natural habitats on a cross-border basis. It is hoped that the project will result in an improved conservation status for over 3000 hectares of protected habitats through direct on-the-ground conservation actions.

Local Community Action

Community engagement and local projects have a big part to play in protecting nature. The Community Wetlands Forum represents community groups who undertake projects that benefit local ecosystems. Their mission statement perfectly sums up what this local work is all about: 'to support the protection, management and wise use of Ireland's wetlands for sustainable communities, by providing a network for community wetland groups to share knowledge, ideas, research, and best practice'.³¹ Well-established wetland projects include the Abbeyleix Bog Project, Co. Laois, Cabragh Wetlands, Co. Tipperary, and Fenor Bog, Co. Waterford. All these projects have shown the benefits of local community engagement.³²

The Local Authority Biodiversity Grant Scheme operated by the NPWS provides funding to assist local authority biodiversity officers (and heritage officers in local authorities without a biodiversity officer) with projects that promote actions contained in the National Biodiversity Action Plan 2017-2021. This scheme supports actions for biodiversity in local areas as engagement with communities and local authorities is crucial to the implementation of the Plan. The grants help raise awareness of biodiversity issues locally, regionally and nationally.³³ The Heritage in Schools Scheme is another project that provides local support through a panel of 160 Heritage Specialists who visit primary schools throughout the country. These specialists support the objectives of the Social, Scientific and Environmental Education (SESE) curriculum and provide an additional educational resource for teachers to cover nature projects.³⁴

28 www.birdwatchireland.ie

29 <https://www.batconservationireland.org/get-involved/volunteer-time>

30 www.swiftconservation.ie

31 <https://www.communitywetlandsforum.ie/>

32 <https://www.catchments.ie/sustainable-community-engagement-in-wetlands/>

33 <https://www.npws.ie/news/minister-noonan-announces-31-local-authorities-will-carry-out-over-50-projects-promote>

34 <http://www.heritageinschools.ie/>



6. Research and Knowledge Base

One of the objectives of the National Biodiversity Action Plan is to 'strengthen the knowledge base for conservation, management, and sustainable use of biodiversity' (DCHG, 2017); this objective addresses the need for research to strengthen biodiversity conservation. Ireland's 6th CBD report outlines the progress made by research to fulfil this objective and is a good synopsis of activities undertaken in this area (DCHG, 2019a). The report found that the measures taken to achieve this objective have been effective.

LIFE Funding

The EU LIFE programme is the EU's funding stream for the environment and climate. The current funding period spans from 2014 to 2020 and has a budget of €3.4 billion. Details of some of the LIFE projects that have been funded in Ireland, such as Burren LIFE, Aran LIFE, Kerry LIFE and Raised Bog Restoration LIFE, were outlined in the previous state of the environment report (EPA, 2016b). The Department of Housing, Local Government and Heritage has been awarded EU LIFE funding of €5.9 million for a 5-year project on corncrake conservation called LIFE Atlantic Crax, and funding of €20.6 million for an integrated project targeting blanket bog restoration called LIFE Wild Atlantic Nature. The Department of Housing, Local Government and Heritage has also been awarded over €9 million in funding for an integrated project, Waters of LIFE, targeting work towards high status waters (see the Blue Dot programme in Chapter 7).

EPA Research

EPA-funded biodiversity research has a strong focus on ecosystem services, natural capital and Ireland's peatlands.

The EPA has a statutory role in coordinating environmental research. EPA-funded research has a strong focus on policy and is driven by national regulations and European directives. Policy-related research plays a vital role in ensuring that EU and national policies are implemented in the most cost-effective manner. Since 2016, the EPA has funded up to 50 new research projects relevant to the Nature area; a commitment of €9.5 million. These were funded mostly under the Sustainability (Natural Capital) and Water Pillars of the EPA Research Programme 2014-2020. More information on EPA-funded research can be found on the EPA website.³⁵

Research on the Biodiversity Benefits of Rewetted Peatlands

Natural peatlands are biodiverse. They are under severe threat in Ireland and globally through practices such as drainage and peat extraction. The EPA-funded NEROS project (Network Monitoring Rewetted and Restored Peatlands/Organic Soils for Climate and Biodiversity Benefits; Renou-Wilson *et al.*, 2018) investigated the biodiversity and climate mitigation benefits of rewetting peatlands. A recommendation of the project is that high-resolution maps of Irish peatlands, under various management and disturbance regimes, should be developed to target priority sites for biodiversity and/or climate benefits.



Sundew

Ecosystem Services and Natural Capital

The ecosystem approach, incorporating natural capital accounting, seeks to ensure that biodiversity is recognised as part of a wider socio-economic ecological system and is considered in decision making. The ecosystem approach is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way.

Natural capital accounting³⁶ involves attributing a measurable economic and/ or ecological value to the ecosystem goods and services that provide benefits to society. Natural capital accounting has been the subject of a recent EPA funded research project 'Irish Natural Capital Accounting for Sustainable Environments: Stage 1 Feasibility Report' (Farrell and Stout, 2020). This project aims to apply Natural Capital Accounting at a pilot (catchment) scale in Ireland. This interim Report reviews natural capital accounting approaches, data requirements for the project, catchment selection, potential applications and feasibility.

The 2020 review of the National Biodiversity Action Plan notes that the integration of natural capital accounts into decision making is an area for more emphasis within the plan.

³⁵ <http://www.epa.ie/researchandeducation/research/>

³⁶ <https://www.naturalcapitalireland.com/>



7. Outlook

Transformative change is required to bend the curve of biodiversity loss.

To achieve the transformative change required to bend the curve of biodiversity loss, IPBES has recommended five interventions or levers (IPBES, 2019). These levers are: incentives and capacity-building; cross-sectoral cooperation; pre-emptive action; decision-making in the context of resilience and uncertainty; and environmental law and implementation. These levers are also relevant to dealing with the challenges facing biodiversity in Ireland. Environmental law and implementation is a key lever not only covering implementation of existing plans and programmes but also enforcement of existing nature protection legislation.

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) outlined 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 numerous positive initiatives, trends are going in the wrong direction, but the environment, and nature in general, is increasingly becoming part of the public discourse, particularly with our younger generation. Education and communication are some of the most powerful tools we have at our disposal and there is evidence that awareness of biodiversity issues is increasing. Although a study on the attitudes of Europeans towards biodiversity (EU, 2018b) reported that 82 per cent of those surveyed in Ireland have never heard of Natura 2000 and that 11 per cent have heard of it but do not know what it means, 43 per cent of those surveyed did know what biodiversity is and what it means and 97 per cent agreed to some level that biodiversity needs to be protected.

Recent successes such as the increases in pine marten and buzzard numbers³⁷ show that species declines can be reversed. Nature can bounce back under the right conditions. While the outlook remains challenging, we can look to such successes and learn from them as we strive to change things for the better.

8. Conclusions

The challenges involved in protecting Ireland's habitats and species are more serious than ever.

The quality of habitats and how we look after species in the environment is at a tipping point both globally and nationally. The challenges are serious and unprecedented. But they are not new. Valuing and protecting our natural environment were identified as key challenges in the 2012 and 2016 state of the environment reports.

To change path will require far more consideration of biodiversity at every step of development and in sectoral plans and policies. It will also require detailed consideration around the governance structures in place nationally to protect biodiversity. Some of the most pressing and effective steps that Ireland needs to take are outlined in the following sections.

Biodiversity Plans

Biodiversity plans are in place but must be resourced, implemented and monitored.

There is a clear gap between research, policy and policy implementation at all levels. A large body of robust peer-reviewed scientific research exists about nature protection and conservation. Ireland needs to be better at incorporating the findings of this research into biodiversity policies at national and local levels. There is no shortage of plans aimed at protecting nature but the data presented here shows that there are still ongoing declines in our habitats and some of our freshwater species, such as the freshwater pearl mussel and white-clawed crayfish. National and local plans are of great benefit when implemented and measured. Biodiversity targets must be quantifiable; it is difficult to gauge progress with intangible targets.

A key policy driver for biodiversity protection for the next decade will be the new EU Biodiversity Strategy for 2030. In launching it, the European Commission stressed that 'making nature healthy again is key to our physical and mental wellbeing and is an ally in the fight against climate change and disease outbreaks' (EC, 2020). There is now an opportunity to use this new strategy to develop a new roadmap for biodiversity protection in Ireland. This could be achieved through the development of the 4th National Biodiversity Action Plan which will need to become the key policy driver for change at national level.

There is a need to prepare a national integrated land cover and use plan, to coordinate how people, nature and food production can be supported in a sustainable manner. Such a plan should span all sectors and serve as a means of managing our response to climate change and biodiversity loss, in a coherent and consistent manner (Chapters 5 and 13).

³⁷ <https://maps.biodiversityireland.ie/Species/TerrestrialDistributionMapPrintSize/11192>



Agricultural Policy and Biodiversity

Encourage farming practices that restore and enhance biodiversity through agricultural policies and schemes.

The review of the National Biodiversity Action Plan 2017-2021 in 2020 reports that 'in Ireland, 85% of EU protected habitats are reported as being in unfavourable status with 46% demonstrating ongoing declines. The main drivers of this decline are agricultural practices which are negatively impacting over 70% of habitats, particularly ecologically unsuitable grazing, abandonment and pollution.' (Biodiversity Working Group, 2020).

The CAP is a system of subsidies and support programmes for agriculture operated by the EU to support the long-term viability of Irish farms. Currently, under this scheme, farmers receive payments for the amount of land that is classified as being agricultural and maintained in a state suitable for grazing or cultivation.

Additionally, the national agri-environment scheme GLAS (Green, Low-Carbon, Agri-Environment Scheme) rewards farmers for managing land in a way that is beneficial to nature and GLAS Plus provides a further payment to farmers for exceptional environmental commitment on farms that have been identified as habitats for endangered birds. For example, if farmers have breeding curlews on their land, they will become a priority for access to GLAS.

Current implementation of the Basic Payment Scheme means that farmers receive no payment for land that is 'unworked', such as scrub and wetlands, which are naturally biodiverse habitats. This incentivises the clearance of such habitats to make them suitable for agriculture, in direct opposition to the environmental incentives within the CAP and GLAS. The CAP, in its current form, will reach a conclusion in 2020 and is undergoing a reform process at the time of writing this report. There will be a 1-year transitional period ending on 31 December 2021 to ensure the continuation of the current CAP rules. It is important that this imbalance is addressed in the post-2020 CAP to protect farmland habitats.

The plans for the development of a new 10-year strategy for the agriculture and food sector for the period to 2030, to follow on from Food Wise 2015, presents an opportunity to address the negative effects on the environment that have occurred in recent years. As outlined by the EPA in its 2020 submission to DAFM in relation to the strategy, these include biodiversity, water quality, greenhouse gas emissions and ammonia emissions (Chapter 13).

Citizen Science and Education for Nature

Citizen Science and education improve people's engagement in biodiversity protection activities.

One of the objectives of the National Biodiversity Action Plan (DCHG, 2017), to 'increase awareness and appreciation of biodiversity and ecosystem services', recognises the importance of education in enhancing proactive behaviour and engaging relevant bodies in the wider community. The plan outlines the educational initiatives that various agencies and bodies are implementing around the country. The 2016 state of the environment report (EPA, 2016b) recorded an increase in public awareness of biodiversity. The trend is continuing, as borne out by the increased media coverage of the current global biodiversity crisis and the public reaction to it. It is important to capitalise on this increased interest and understanding of biodiversity issues. Education on nature for primary- and second-level school students, as well as for the wider community, needs to be a priority if we are to tackle current and future challenges. In this way, future leaders and policymakers will have a greater appreciation of the importance of nature for our continued survival.

Operating on contract to the Heritage Council, the NBDC plays an important role in increasing people's understanding of nature in Ireland and the challenges it faces. The NBDC hosts, and provides, data on species observations collected by the state and by citizen science volunteers from across the country, as well as coordinating many citizen science projects, such as the successful All-Ireland Pollinator Plan. Initiatives such as the NBDC are vital cogs in implementing the National Biodiversity Action Plan. The continuing threat of invasive alien species to our wildlife also needs to be constantly monitored and guarded against.



Strengthening Biodiversity Protection

Protecting and restoring biodiversity and ecosystems in Ireland requires careful implementation.

The urgency around improving biodiversity protection in Ireland was recognised at national level through Dáil Éireann declaring a climate and biodiversity emergency in 2019 (Dáil Éireann, 2019). The proposed Citizens' Assembly for Biodiversity presents an opportunity for inclusive stakeholder engagement with respect to our biodiversity laws and policies.

To protect nature, the Government's National Biodiversity Action Plan includes the creation of a biodiversity duty across sectors to ensure they promote biodiversity and reduce the impact of their work.

Research is ongoing into Natural Capital and Ecosystem Services approaches that seek to ensure biodiversity is considered in decision making. The review of the National Biodiversity Action Plan notes that integration of natural capital accounts into decision making is an area for more emphasis within the plan.

The Heritage Bill was signed into Irish law in 2018. It has highlighted the need for research to gather the evidence base on which legislative decisions affecting and protecting nature are made, for example, information about the breeding season for some species of birds in Ireland that could be affected by the burning of vegetation and hedgerow cutting.

Valuing Nature

People value nature and are willing to make changes to conserve it.

Perhaps the most challenging aspect of the biodiversity crisis is the fact that we need to change how we live our lives both at a societal level and at a personal level. The 2019 IPBES global assessment of biodiversity and ecosystem services summarised it as follows: 'Goals for conserving and sustainably using nature and achieving sustainability cannot be met by current trajectories, and goals for 2030 and beyond may only be achieved through transformative changes across economic, social, political and technological factors' (IPBES, 2019).

Transformative changes need to be fast-tracked and in the shorter term we can all make changes in our everyday lives that can make a difference. Avoiding the use of weedkillers and pesticides in our gardens and allowing wildflowers to thrive is a simple and effective way to welcome nature back into our homes. Such nature-friendly spaces create corridors of connectivity throughout the landscape and give nature much-needed refuge.

Community engagement and local projects, such as those mentioned in this chapter, have a big part to play in protecting nature. These projects are crucial to the implementation of the National Biodiversity Action Plan 2017-2021 and need to be supported. Local interventions are important but nationally Ireland needs to prioritise actions to protect nature and bend the curve of biodiversity loss. The five interventions or levers recommended by IPBES, as mentioned earlier in this chapter, could be the drivers for transformative change.

As a people we are rightly proud of our rivers, mountains, beaches and parks and the species that live in them. We can all play our part to help stop the decline of biodiversity.



Chapter Highlights for Nature



Ireland needs to prioritise actions to protect nature. The challenges facing vital pollinators such as bumblebees, and the extensive loss of the curlew as a breeding bird species, should be the alarm calls needed nationally to focus on the transformative changes required in how we value and protect nature. More engagement on nature protection across stakeholder groups is needed, together with a review of governance, with solutions fast-tracked at policy and regulatory levels to protect habitats and halt biodiversity loss.



The challenges involved in protecting Ireland's habitats and species are now more serious than ever and need urgent action. But nature can bounce back under the right conditions. Implementing national biodiversity policies, such as the National Biodiversity Action Plan, requires an increased level of collaboration and coordination across multiple sectors and the whole of society. This can also give rise to indirect co-benefits for other sectors and environmental issues such as climate change and water quality.



Education, monitoring and citizen science initiatives are vital steps in protecting biodiversity. To promote more proactive and widespread engagement we need to continue to systematically survey habitats and species, track threats from invasive species and develop collaborative projects between scientists, farming sectors and the public. Regulatory aspects also need to be in place, with conservation plans for the management of Natura 2000 areas.



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Chapter 7

Water Quality





Water Quality

1. Introduction

Water is needed to sustain life and is an important and integral part of our everyday existence. In the home, it is used to clean and cook the food we eat, while at work water is a vital raw material in numerous processes from food production to the manufacture of computer components. Water is also used for recreational purposes such as swimming and canoeing, while fishing and angling activities attract thousands of tourists to Ireland every year. Ireland's rivers, lakes, estuaries and coastal waters are home to thousands of plant and animal species ranging from tiny river insects and marine invertebrates to birds such as kingfishers and animals such as otters to name but a few. Therefore, maintaining our waters in a healthy condition is critical if we are to maintain a vibrant and healthy society and an aquatic environment that will support a rich diversity of species and habitats (see Chapter 6 on biodiversity).

Water is a hugely important national resource that provides a multitude of benefits to the people of Ireland. This resource needs to be protected to ensure that the benefits that currently arise can be enjoyed by future generations. Our waters need to be protected against a range of human activities that cause water pollution and affect the physical integrity of water bodies and habitats. These human activities, together with climate change, continue to threaten the quality and availability of water. Protecting our freshwater resources also protects the marine waters that our rivers flow into (see Chapter 8 on the marine environment). The aim of European Union (EU) and national water policy is to protect clean waters and to restore polluted waters. However, water quality in Ireland is now getting worse after a period of relative stability and improvement (EPA, 2019a). Not only are we seeing a persistent decline in the highest quality waters, but we are also seeing an increase in the number of most polluted rivers. Many of Ireland's protected water habitats also have unfavourable conservation status as a result of declining water quality (see Chapter 6 on biodiversity).

Ireland has established a National River Basin Management Plan 2018-2021, which sets out the steps to be taken to protect and improve water quality. The plan outlines the key measures that will be put in place to address water quality issues and the level of improvement expected from these measures (Government of Ireland, 2018).

This chapter presents an overview of the status of Ireland's surface water (i.e. rivers, lakes, estuaries, lagoons and nearshore coastal waters) and groundwater resources together with information on the pressures and impacts caused by various human activities. The chapter will also outline the resources and measures that are being put in place to address water pollution. Other issues that affect the broader marine environment such as overfishing, climate change and marine litter are covered in Chapter 8, while general habitat quality and species diversity in surface waters is discussed in Chapter 6. Some key water and health issues are covered in Chapter 14.

2. Current Situation

The State of Our Surface Waters

Nearly half of the surface waters in Ireland are failing to meet the legally binding water quality objectives set by the EU Water Framework Directive because of pollution and other human disturbance.

The ecological health of Ireland's rivers, lakes, canals, estuaries and nearshore coastal waters is assessed by looking at a range of different aquatic organisms whose presence, diversity and number tell us about the ability of these waters to support healthy and diverse biological communities. For example, the abundance and composition of river macroinvertebrates (tiny animals without backbones such as insects, worms and snails) is used to assess river biological quality. Information on biology and general water quality (e.g. nutrients, dissolved oxygen, pH) is used to assess ecological status, which is an expression of the ecological health of these waters.

The ecological status indicates whether a water body is being damaged by pollution, water abstraction or habitat degradation. Waters at high and good ecological status show only minor or slight changes from natural conditions, whereas waters at less than good status (i.e. moderate, poor or bad) are moderately to severely damaged by pollution or habitat degradation. Assessing the ecological status of water bodies helps guide the identification of appropriate management measures for their protection and restoration.



In the most recent assessment, based on information collected between 2013 and 2018 (Topic Box 7.1 describes the type of information collected), it was found that 53 per cent of surface waters were in satisfactory ecological status and the remaining 47 per cent of surface waters in moderate, poor or bad ecological status (Figure 7.1; EPA, 2019a). This means that nearly half of the surface water bodies in Ireland are failing to meet the objectives set by the EU Water Framework Directive (2000/60/EC) because of pollution and other human disturbance (Figure 7.3). Coastal waters had the highest percentage of waters in good or better ecological status (80%) followed by rivers (53%), lakes (50.5%) and estuaries (38%), which have the worst water quality (Figure 7.2).

Figure 7.1 Surface water overall ecological status, 2013-2018 (Source: EPA)

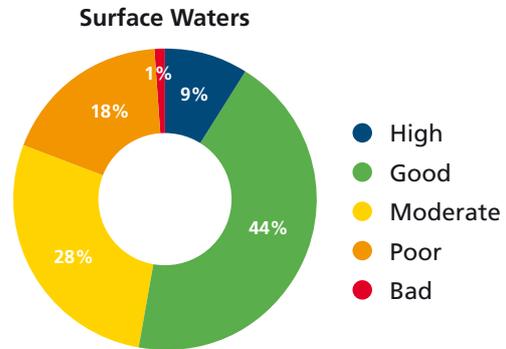


Figure 7.2 Surface water ecological status by water category, 2013-2018 (Source: EPA)

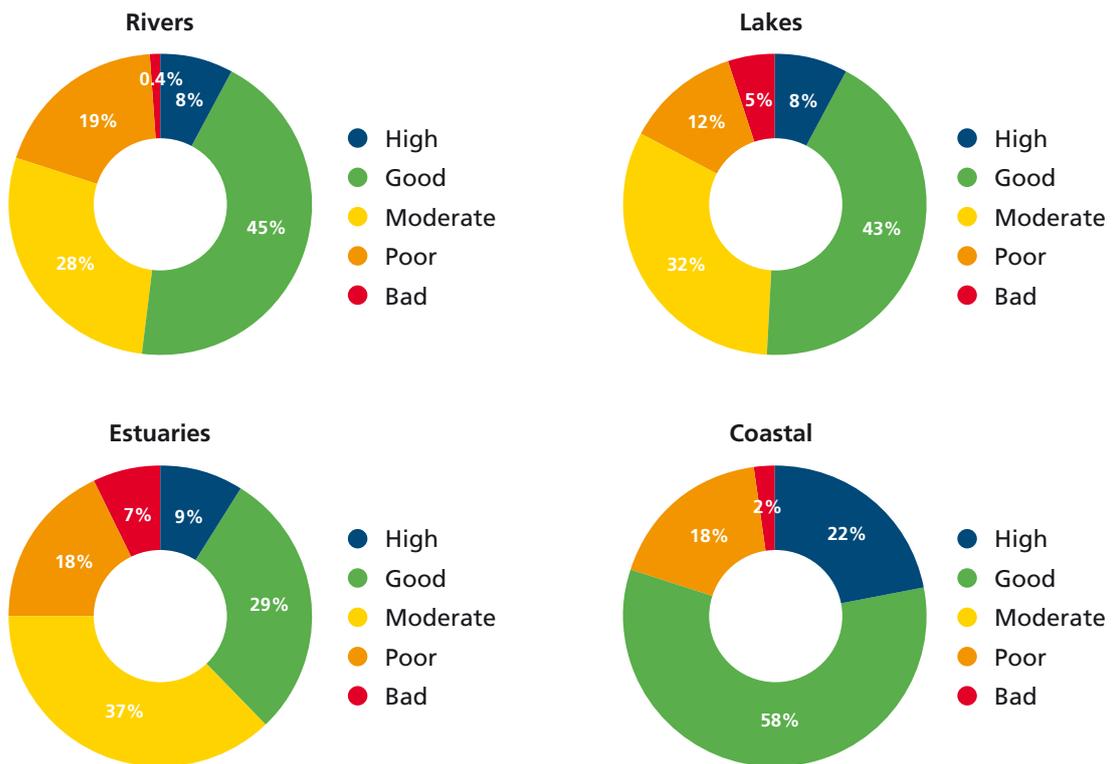
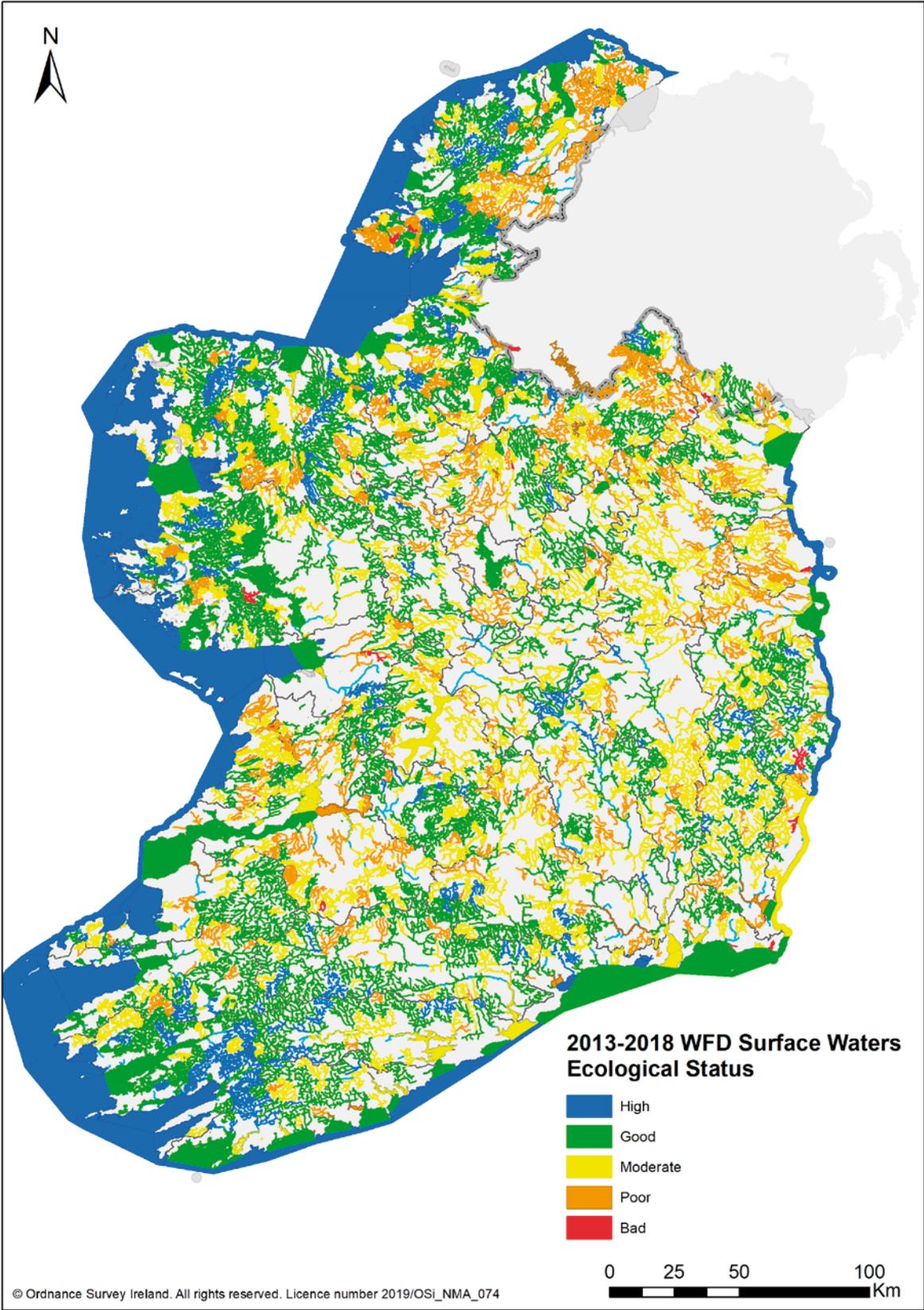




Figure 7.3 The ecological status of Ireland's surface waters under the Water Framework Directive (WFD), 2013-2018 (Source: EPA)





Topic Box 7.1 Monitoring the Aquatic Environment

Information on the presence and condition of various algal, plant and animal communities is used to assess the ecological health of Ireland's aquatic environment. Every year, hundreds of river sites and dozens of lakes are sampled by field biologists. At each river site the presence of macroinvertebrates, such as snails and worms and the larval stages of aquatic insects, that live in the river is assessed. The types and numbers of macroinvertebrates present tells us about the quality of the water.



The presence of sensitive species or groups, such as stoneflies and mayflies, indicates that the river is unpolluted, whereas the presence of pollution-tolerant species, such as certain types of snails, leeches and worms, indicates that the river is polluted. In lakes the composition of aquatic plants and the depth to which they grow is used as a measure of ecological status; plants are found at greater depths in unpolluted lakes. Most of the large estuaries around the coast are also sampled on an annual basis, and here field biologists monitor the frequency of phytoplankton blooms and the occurrence of opportunistic green seaweed mats. The information collected in the field is subsequently used to assess the ecological status of these waters.

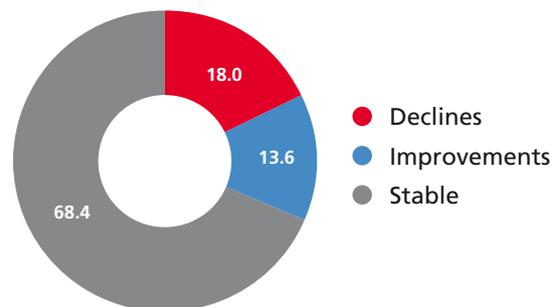
An EPA river biologist examines a kick-sample (lower right) for the presence of different macroinvertebrate indicators (top right).

Changes and Trends in Water Quality

The latest assessment of water quality in Ireland (2013-2018) shows that there is a continuing decline in high status water bodies, which is the cleanest water category, and an increase in the number of water bodies in poor ecological health. Even more stark is the dramatic reduction in the number of our most pristine rivers, which has fallen from over 500 sites to only 20 sites in 30 years.

The Water Framework Directive specifically prohibits declines in ecological status. Ireland's latest assessment of water quality shows that, while just over two-thirds of water bodies (1825) had not changed status since the last assessment (2010-2015), 483 water bodies declined in status and 368 improved (Figure 7.4). This resulted in an overall net decline in 115 surface water bodies or 4.4 per cent. This was driven mostly by the 5.5 per cent net decline in river water bodies. The only surface water categories to display a net improvement in status were coastal waters (a net improvement in two coastal water bodies) and lakes (a net improvement in 12 lakes).

Figure 7.4 Percentage change in ecological status of surface waters between the assessment periods 2010-2015 and 2013-2018 (Source: EPA)



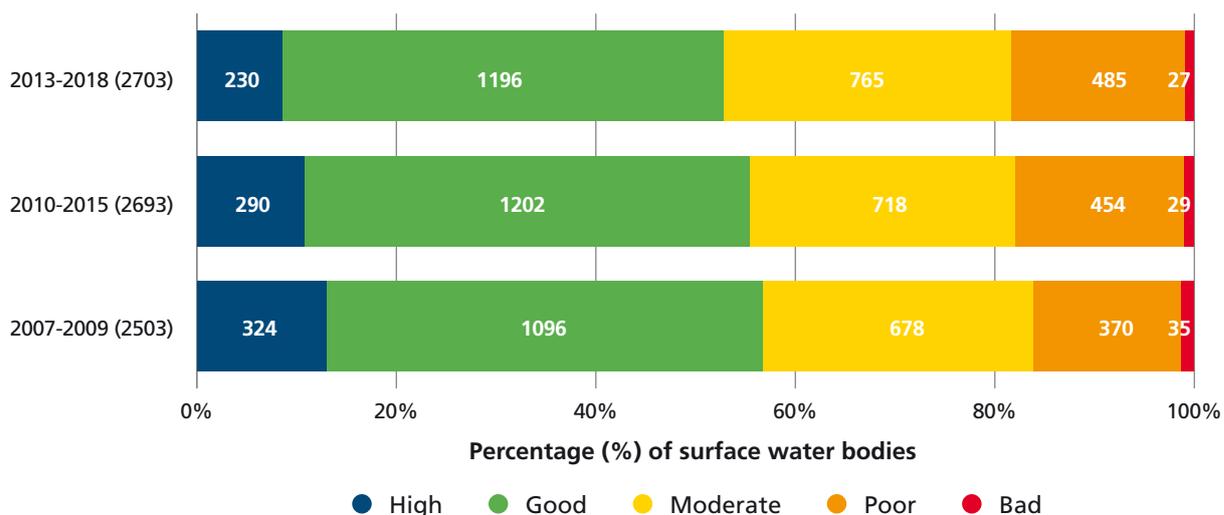


Of most concern is the continuing decline in high status water bodies and the increase in the number of water bodies in poor ecological health. The proportion of high status surface water bodies has decreased by one-third (94 water bodies) since the period 2007-2009, while the proportion of poor status surface water bodies increased by one-third (115 water bodies) over the same period (Figure 7.5). The loss of high status waters has implications for the survival of certain protected species sensitive to small changes in water quality such as the freshwater pearl mussel (*Margaritifera margaritifera*), while at the other end of the spectrum the ecology of poor status waters is so significantly altered that their ability to function normally in terms of food web dynamics and nutrient cycling is greatly diminished.



The Laney river upstream of Macroom, Co. Cork. One of the few remaining highest quality (Q5) rivers

Figure 7.5 Change in each of the five Water Framework Directive status categories over three assessment periods for all surface waters (number of water bodies in each class) (Source: EPA)



Biological monitoring by the EPA on the River Dargle.



Table 7.1 Surface water bodies with bad ecological status, 2013-2018 (Source: EPA)

WATER BODY	ECOLOGICAL STATUS	COUNTY
Rivers		
Avoca (two sections)	Bad	Wicklow
Aughboy	Bad	Wexford
Ahavarraga stream	Bad	Limerick
Kilmihil stream	Bad	Clare
Kilgolgan	Bad	Galway
Owenriff	Bad	Galway
Ballaghadoo	Bad	Donegal
Roechrow	Bad	Donegal
Lakes		
Lough Alewnaghta	Bad	Clare and Galway
Ballyquirke lough	Bad	Galway
Corglass lough	Bad	Cavan
Lough Egish	Bad	Monaghan
Lickeen lough	Bad	Clare
Lough Macnean Lower	Bad	Cavan and Fermanagh
Lough Muckno or Blayney	Bad	Monaghan
Lough Naglack	Bad	Monaghan
Rinn lough	Bad	Leitrim
Templehouse	Bad	Sligo
Urlaur	Bad	Mayo
Estuaries and lagoons		
Lough Donnell	Bad	Clare
Cuskinny lake	Bad	Cork
Kilkerran lake	Bad	Cork
Rogerstown estuary	Bad	Dublin
Lady's Island lake	Bad	Wexford
Ballyteige channels	Bad	Wexford
Rincarna pools	Bad	Galway

The number of bad-status water bodies (the worst of the worst) has fallen marginally over each assessment period, but there are still 27 water bodies in the most polluted category. These include nine rivers, 11 lakes and seven estuarine water bodies (Table 7.1). This classification means that these water bodies are being severely damaged by pollution and other human disturbance to an extent that prevents them from supporting most types of aquatic life.

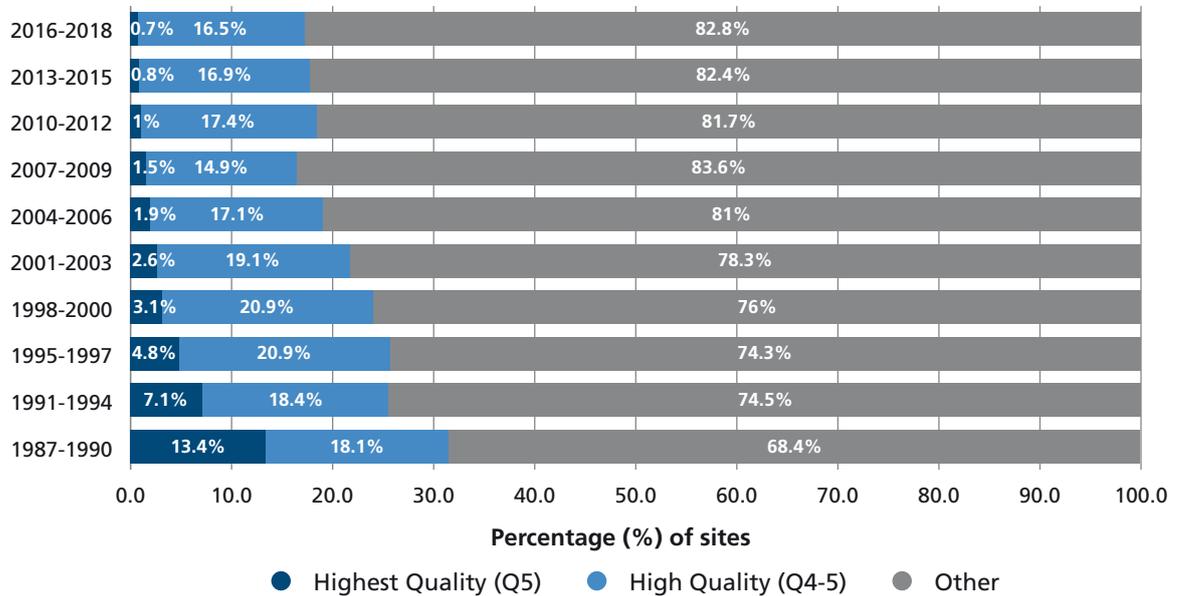
At the other end of the scale our best-quality, least-polluted and least impacted, high status waters are important reservoirs of aquatic biodiversity. These waters provide a home for species sensitive to pollution including river insects such as stoneflies and mayflies and the young and larval stages of salmon and trout. Their loss is a significant concern. The proportion of high-quality sites (Q5, Q4-5) has almost halved since the late 1980s declining from 31.6 per cent of rivers in 1987-1990 to just 17.2 per cent in 2013-2018 (Figure 7.6). Even more worrying is the dramatic reduction in the number of our most pristine rivers – the best of the best (Q5) – which has fallen from 573 sites to only 20 sites over the same period.



A macroalgal bloom in Rogerstown Estuary, Co. Dublin. These blooms can form extensive dense mats which can smother other animals in the sediments below them.



Figure 7.6 Change in the percentage of high ecological quality (macroinvertebrate) river sites in each survey period between 1987 and 2018 (Source: EPA)



Chemical Status of our Surface Waters

While water bodies were mostly at good chemical status, except for the presence of some ubiquitous priority substances, the presence of low levels of some herbicides in rivers was widespread.

The chemical status of waters is assessed to ensure that certain chemical substances, known as priority substances, are not causing harm to aquatic organisms or posing a risk to drinking water supplies. These substances are assessed against a range of environmental quality standards (EQSs), which have been set at levels to protect the most sensitive aquatic organisms and to ensure that these pollutants do not end up accumulating in the food chain.

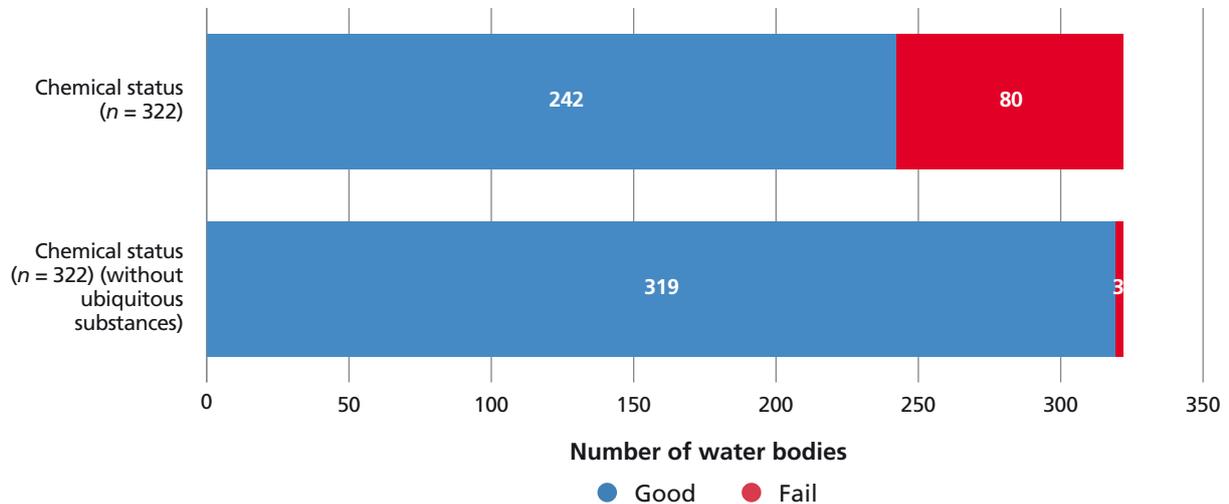
Three-quarters of the 322 water bodies assessed over the period 2013-2018 are in good chemical status (EPA, 2019a) (Figure 7.7). This increases to 99 per cent of surface water bodies when ubiquitous priority substances, such as mercury and polycyclic aromatic hydrocarbons (PAHs), which are already widely distributed in the environment, are omitted. The three water bodies that have poor chemical status when ubiquitous substances are omitted are the Owvane river, Co. Cork (which fails for hexachlorobutadiene), the Glenealo river, Co. Wicklow (for cadmium), and the Avoca estuary, Co. Wicklow (for copper, zinc and cadmium).

Because of their ability to persist in the environment and bioaccumulate, ubiquitous substances can be found in the environment many decades after international measures have been put in place to reduce or eliminate them. Many are also capable of long-range transport from their place of origin. This means that a ubiquitous substance detected in a water body is unlikely to have come from a source in that water body or even from a source in the surrounding catchment. Information on these substances is presented separately to ensure that their presence does not obscure the presence of other substances that may have arisen from local sources, which can be addressed by local measures.

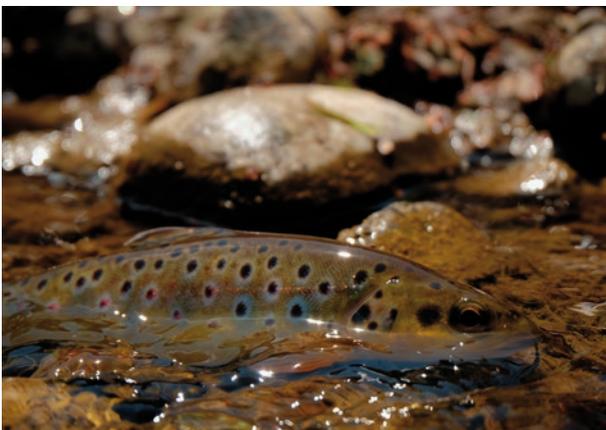




Figure 7.7 Chemical status of surface water bodies, with (top) and without (bottom) ubiquitous substances, 2013-2018 (Source: EPA)



Many of the chemical substances monitored are pesticides and, while none of the pesticides assessed exceeded their environmental quality standards (where applicable), some were detected in a high proportion of monitored rivers. 2,6-dichlorobenzamide, MCPA (2-methyl-4-chlorophenoxyacetic acid) and mecoprop (methylchlorophenoxypropionic acid) were the most widely observed substances: the first two substances occurred in over half of the rivers surveyed and mecoprop was present in over one-third (EPA, 2019a). All three substances are herbicides, which are used to control weeds. MCPA is widely used in agriculture to control rushes in grassland. The presence of these substances in water can harm very sensitive aquatic wildlife such as river insects and cause problems in drinking water supplies (see Chapter 14 on health and wellbeing).



Fish Kills in Rivers, Lakes and Estuaries

The increase in the number of fish kills in 2018 may have been indirectly linked to the drought-like conditions experienced in the summer of 2018. Lower oxygen levels associated with low flows and high water temperatures are likely to have increased the vulnerability of fish populations to water pollution.

A fish kill is usually an indicator that serious pollution has occurred. There are many possible causes, but depleted oxygen levels in the water is the principle mechanism leading to fish deaths. Oxygen depletion can occur following the breakdown by bacteria of organic matter contained in algal blooms or from agricultural, municipal and industrial sources.

After declining to a historical low of 14 fish kills in 2017, the number of fish kills increased to 40 in 2018 but decreased again to 20 in 2019. The low-flow conditions and higher water temperatures (warmer water holds less oxygen) in the summer of 2018 may have contributed to the increase that year by reducing ambient oxygen concentrations and increasing the vulnerability of fish to underlying levels of pollution or to acute pollution events. This highlights the importance of water body resilience: water bodies in good ecological health are likely to be more resilient than those in poorer ecological health, and therefore in a better position to withstand the additional pressures caused by climate change.



The State of Our Groundwaters

With a few localised exceptions, the quality of groundwater in Ireland is generally good. At least 92 per cent of groundwater bodies have good chemical and quantitative status, and the amount of rainfall replenishing groundwater is generally enough to sustainably support the volume of water being abstracted.

Groundwater is water located in spaces and cracks in rocks and the subsoil. It is the source of drinking water for approximately one-quarter of the population in Ireland and contributes a significant proportion of the flow in our rivers during dry weather.

The quality of groundwater in Ireland is good: 92 per cent of groundwater water bodies have good chemical status (Figure 7.8; EPA, 2019a). Water bodies that failed to meet their objectives (38 water bodies in total) are typically associated with historical contamination from industrial sites and, although significant, this pollution is generally very localised. Since 2013, nitrogen concentrations in groundwater, predominantly arising from losses to groundwater from agricultural soils, have started to increase in the southern and south-eastern parts of the country. The microbiological quality of groundwater is also an important factor in areas where wells and boreholes are used to abstract drinking water. The risks from the

presence of microbial pathogens such as verocytotoxin-producing *Escherichia coli* (VTEC) needs to be considered when sourcing and using drinking water for household wells. Drinking water and VTEC is covered in Chapter 14.

Over 99 per cent of groundwater bodies have good quantitative status, i.e. the amount of rainfall replenishing groundwater is generally enough to sustainably support the volume of water being abstracted (Figure 7.7). Only two groundwater bodies failed to achieve good quantitative status. Similarly, the volume, location and operation of groundwater abstractions mean that very few groundwater abstractions deplete surface water resources. The National River Basin Management Plan highlighted that only 6 per cent of water bodies require further assessment of water abstraction pressures. Nonetheless, there is a small number of groundwater abstractions that, while not currently causing an environmental impact, may require active management to ensure that they remain environmentally sustainable in the context of a changing climate and the impact that may have on water resources. The Environmental Protection Agency (EPA) is reviewing the data gathered under the 2018 Abstraction Registration Regulations (S.I. No. 261/2018) to identify those abstractions that put significant pressure on water bodies, potentially preventing them from achieving their environmental objectives, and require measures to ensure that they are managed sustainably.

Figure 7.8 Chemical and quantitative status of groundwater, 2013-2018 (Source: EPA)





Water Quality across Europe

Ireland's rivers, lakes and estuaries that have good and high status need to be protected as nationally important ecosystems for wildlife and people

The most recent European assessment of water quality is based on data collected between 2010 and 2015 (EEA, 2018).¹ Overall, Ireland's current surface water quality compares favourably with its European neighbours (Table 7.2): 52.8 per cent of Ireland's waters have good or better ecological status compared with only 44 per cent of surface waters across Europe. However, there is no room for complacency, as Ireland, with its relatively low population density and lack of heavy industry, would be expected to have better water quality than many other parts of Europe. Furthermore, recent declines in river water quality means that fewer of our surface waters will meet their environmental objectives as set out by the EU Water Framework Directive. The challenge in Ireland is to protect waters that are still in good, or near pristine, condition and restore waters that have been allowed to deteriorate through pollution or physical modifications.

Table 7.2 Percentage of water bodies at good or high ecological status and good chemical and quantitative status in Ireland and across Europe, 2010-2015 (Source: EPA)

TYPE OF WATER BODY	IRELAND (2013-2018)	EUROPE (2010-2015)
Surface waters		
<i>Rivers</i>	53	42
<i>Lakes</i>	50.5	54
<i>Estuaries</i>	38	31
<i>Coastal waters</i>	80	54
All surface waters	52.8	44
Groundwater		
<i>Chemical status</i>	92	80
<i>Quantitative status</i>	99	86

Similarly, the percentages of Ireland's groundwater with good chemical status and quantitative status are higher than the corresponding European averages. Ireland does not have groundwater over-abstraction issues, as do many of the drier European countries, nor does it have widespread pollution from industrial activities or regular exceedances of nitrate or pesticide concentrations in groundwater, and therefore it compares favourably with its European neighbours.

With regard to water quality and management, the European Commission's Environmental Implementation Review for Ireland in 2019 (EC, 2019) noted with concern the low rate of compliance with the Urban Waste Water Treatment Directive (91/271/EEC). The review pointed out that almost half of the agglomerations that are required to have more stringent treatment systems in place are not in compliance with the Directive. Other issues highlighted by the review included the lack of controls on water abstractions and of regulation of activities that may result in physical modifications to water bodies (see Chapter 14 for more on urban wastewater and Chapter 15 for the Environmental Implementation Review).



¹ See also: <https://www.eea.europa.eu/data-and-maps/explore-interactive-maps/water-framework-directive-2nd-rbmp>



3. Drivers and Pressures

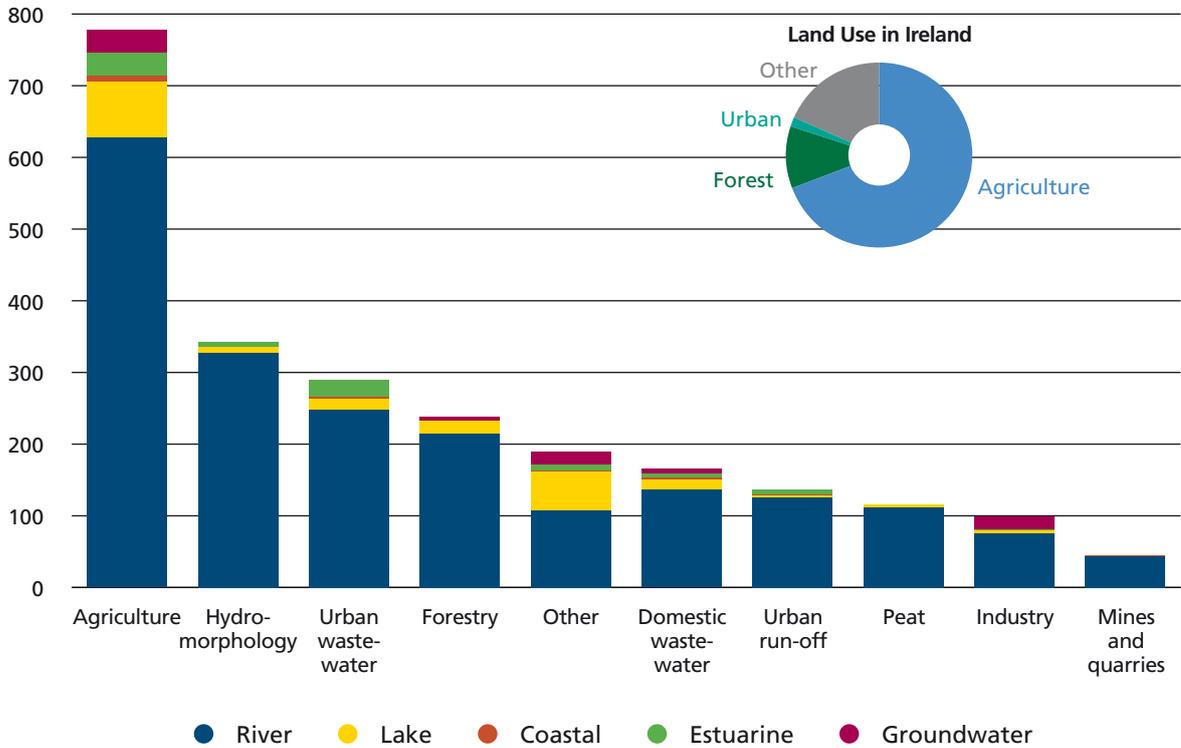
The Significant Pressures on Ireland's Aquatic Environment

The top three significant pressures on the ecological health and quality of our waters are agriculture, hydromorphology (physical changes) and urban wastewater.



Ireland's surface waters are being damaged by pressures arising from various human activities. The most significant pressures, those considered to put a water body at risk of not meeting its environmental objectives, were identified and reported in the National River Basin Management Plan 2018-2021, following a comprehensive assessment by the EPA of various human activities and their potential impact on the aquatic environment. This information is available at www.catchments.ie. The assessment showed that the most significant pressures, in terms of the number of water bodies at risk of not achieving good status, were agriculture (53% of water bodies at risk), hydromorphology (i.e. change in the shape and flow of water bodies due to physical alterations: 24%), urban wastewater (20%) and forestry (16%). The complete breakdown is shown in Figure 7.9.

Figure 7.9 Significant pressures on Ireland's aquatic environment (Source: EPA)





Significant agricultural pressures include run-off of nutrients and sediment from agricultural land and farmyards and the contamination of surface waters with pesticides. Drainage of agricultural land can also damage the physical integrity of streams and rivers and increase the loss of sediment to larger downstream rivers.

More generally, work done to protect river banks, to prevent flooding or to maintain navigation channels in rivers and estuaries may damage sensitive water habitats if the hydrology and morphology of these waters are substantially changed in character.

Discharges from wastewater treatment plants can lead to organic and nutrient enrichment with consequent effects on dissolved oxygen levels and biological communities. Poorly treated sewage can also pose a risk to public health by potentially contaminating the source of drinking water supplies with harmful bacteria and viruses. Over half (56%) of the combined sewage loading that arises in large urban areas in Ireland is discharged from plants that are not meeting the required European standard (EPA, 2020a). Furthermore, raw sewage from the equivalent of 78,000 people in 35 towns and villages is still released into the environment every day. The majority of this (from 31 of the towns and villages) is discharged directly into estuaries and coastal areas.

In relation to forestry, inappropriately sited forests and poorly managed forest operations can negatively affect water quality and aquatic habitats and species. The most common water quality problems arising from forestry in Ireland are the release of sediment and nutrients to the aquatic environment and impacts from acidification. Forestry may also give rise to modified stream flow regimes caused by associated land drainage.

Impacts of Nutrients (Nitrogen and Phosphorus) on Water Quality in Ireland

One-third of rivers and lakes and one-quarter of estuaries already have too much nutrient in their waters, and nutrient concentrations in our rivers and nutrient inputs to our marine environment are increasing.

One of the main problems damaging the quality of surface waters is nutrient pollution caused by too much nitrogen and phosphorus (see Topic Box 7.2). Nitrogen pollution in the south and south-east of the country is damaging the ecological health of many of our estuaries and nearshore coastal waters. In these areas, which have freely draining soils, nitrate seeps rapidly into groundwater, and losses are closely correlated with the intensiveness of farming: the higher the rate of application of nitrogen, the higher the nitrate concentrations in waters. Since 2013, nitrogen emissions have increased as both cattle numbers and fertiliser use have increased.

In freshwaters and in some of our more river-dominated estuaries, phosphorus is often the nutrient of most concern. Phosphorus concentrations are elevated in various parts of the country, particularly along the east coast and in parts of the south (see Figure 7.9b). Phosphorus losses come primarily from wastewater discharges and run-off from agricultural land on poorly draining soils. Diffuse phosphorus losses from agriculture are difficult to tackle, as the sources do not occur uniformly in the landscape but in 'hot spots' or critical source areas.





Topic Box 7.2 Nutrient Enrichment and Ecological Impacts

One-third of rivers and lakes and one-quarter of estuaries have too much nutrient in their waters, and there is also evidence that nutrient concentrations in our rivers and nutrient inputs to our marine environment are increasing (EPA, 2019a). At least one-quarter of river sites monitored have increasing nutrient concentrations, while nitrogen and phosphorus loads to the sea have increased by 16 per cent and 31 per cent, respectively (see Figure 7.10a and b). These nutrients cause excessive plant and algal growth in our rivers and increase the likelihood of harmful algal blooms in our lakes and estuarine waters. In rivers, for example, too much plant growth uses up oxygen, particularly during the hours of darkness. This can lower oxygen concentrations in water to levels that harm other animals such as certain species of river insects (e.g. the larval stage of stoneflies and some mayfly species), which are sensitive to low oxygen levels.

In some lakes the proliferation of phytoplankton blooms can reduce the depth to which light penetrates and this in turn can restrict the growth of bottom-dwelling lake plants. In our estuaries, nutrient enrichment can cause the extensive growth of opportunistic green seaweed mats, which can blanket intertidal areas and smother the animals living in the underlying sediments. These are just some examples of how nutrient enrichment can harm the natural balance of different categories of water and their ecological functioning.

The trend of increasing nutrient concentration in our rivers is continuing with the latest EPA assessment of data on water quality (for a water indicators report that is due out shortly) is showing that nitrate concentrations have increased in nearly half (44%) of river sites surveyed between 2013 and 2019 (EPA, 2020b). The data assessment also confirms that nitrogen loads to the sea are also continuing to rise.



A bloom of green seaweed in Youghal harbour, Co. Cork, as a result of too much nutrient in the water.



Figure 7.10a Nitrate (left) and phosphorus (right) concentrations in rivers, 2013-2018, showing trends increasing (red dots), stable (yellow dots) and decreasing (blue dots) (Source: EPA)

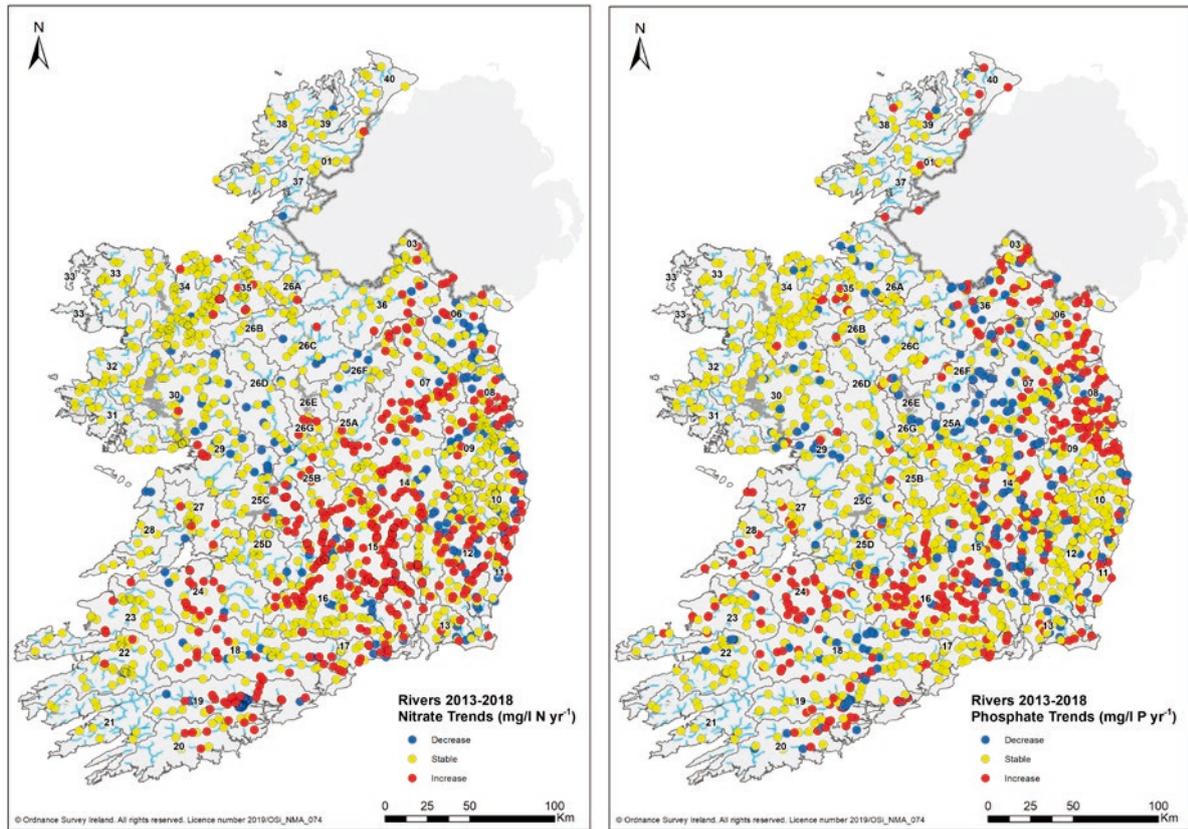
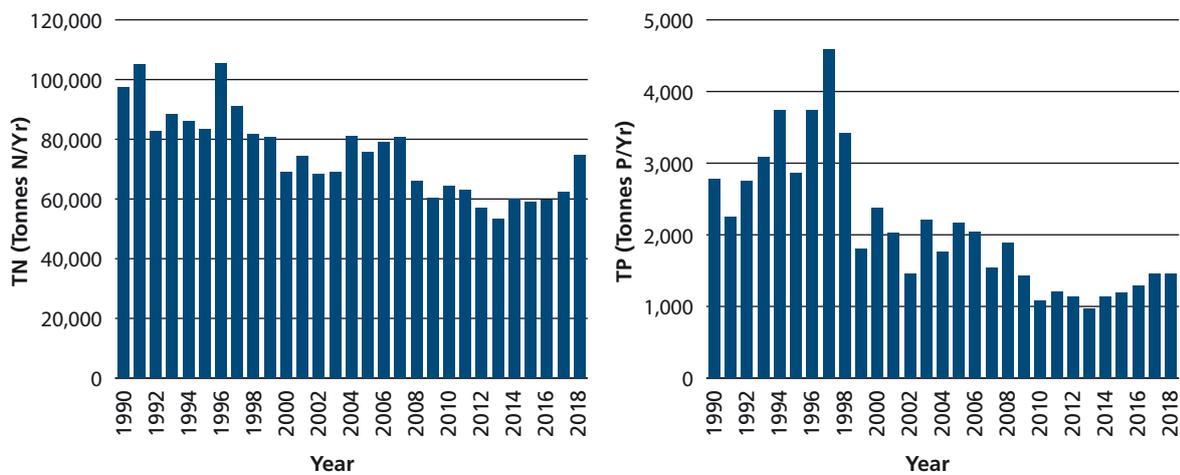


Figure 7.10b Annual loads of total nitrogen (TN; left) and total phosphorus (TP; right) from rivers to the sea, 1990-2018. Loads of TN and TP have increased by 8800 (16%) tonnes and 326 (31%) tonnes, respectively, since 2012-2014 (Source: EPA)





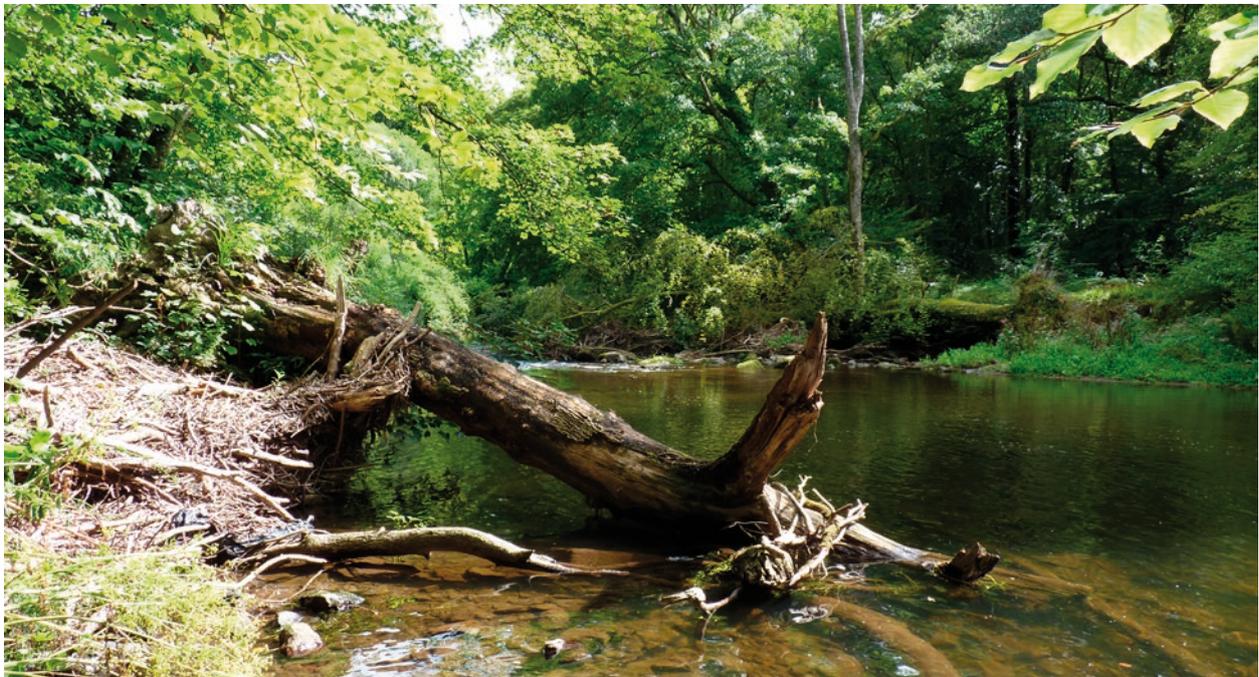
Hydromorphological Alterations and Their Impacts on Surface Water

Barriers, such as weirs and dams, can prevent the movement of fish and can be severely detrimental to migratory fish species. Other modifications, such as land drainage and channelisation can also impact surface water ecology.

Hydromorphological alterations (i.e. physical changes) associated with agricultural drainage, land reclamation, channelisation, flood protection work and navigational dredging, among others, can damage the morphology and hydrology of surface water bodies and can prevent waters from reaching good ecological status. For example, the presence of physical barriers, such as weirs, dams and channel diversions, can damage river habitats and prevent the movement of fish and can be extremely detrimental to migratory fish species such as salmon, sea trout and lamprey (see Topic Box 7.3). Changes in hydrological flow as a result of physical morphological changes can also increase sedimentation rates and alter the composition of river and lake substrates, which in turn can affect bottom-dwelling organisms. For example, increased sedimentation is known to be one of the main environmental factors affecting the critically endangered freshwater pearl mussel in Irish rivers (Moorkens, 1999).

Furthermore, over-abstraction of water can reduce river flows and lake levels to an extent that can damage their ecology. In general, abstractions in Ireland are not considered to be a widespread significant pressure on surface water or groundwater resources. During drier periods, however, such as the 2018 drought (see Topic Box 7.4), some abstractions require active management to ensure that they do not have a negative impact on waters.

In early June 2020 Irish Water brought into effect a national hosepipe ban lasting until 21 July 2020. This was legally backed up by a National Water Conservation Order. The reason for the order was an increased demand for water and widespread drought conditions. In bringing in the ban, the utility company noted that Met Éireann had confirmed that May 2020 had been the driest May since 1850. Irish Water reported that 27 of its drinking water schemes were in drought and 50 were at risk of going into drought (Irish Water, 2020).



River Clodiagh (Portlaw), an example of good hydromorphological conditions.



Topic Box 7.3 River Barriers

Removing barriers improves river continuity for fish passage.

Barriers have been installed in rivers from the earliest of times and have served many purposes from aiding navigation (e.g. locks) and harnessing river power (e.g. water mills and electricity generation) to creating reservoirs and amenities for water sports. The presence of a physical barrier across a river can prevent the movement of both biological organisms and sediment. Barriers can prevent the movement of migrating fish trying to get to their spawning grounds and the transport downstream of sediment needed to replenish lower reaches. In some cases, in summer, water trapped behind a barrier can reach temperatures that can harm aquatic organisms.

Conservation monitoring of protected species such as salmon, shad, lamprey and the European eel show the damage caused by barriers impeding the upstream migration of these species. Such barriers are a major impediment to achieving the conservation objectives for shad and migratory lamprey in Irish rivers designated special areas of conservation under the Habitats Directive.

In many cases, the ideal solution would be their complete removal. However, the social and economic benefits provided by barriers does not always permit this, and before a barrier can be removed an assessment is required to understand the full impact of removal. There may also be environmental reasons for not removing a barrier. In some situations, for instance, the presence of a barrier may prevent the spread upstream of invasive species. For example, the presence of natural and artificial barriers is considered important in protecting some Arctic char populations in Irish lakes from the impact of invasive fish species (Connor *et al.*, 2019).

Several nationally and EU-funded research projects are looking at barriers and how various mitigation measures can be used to improve river continuity and the functioning of natural processes such as fish migration and sediment transport (e.g. the EU Horizon 2020 project AMBER – Adaptive Management of Barriers in European Rivers; the EPA-funded Reconnect barriers project; and the Interreg-funded Catchment CARE project).

Inland Fisheries Ireland is undertaking studies to identify and locate barriers and develop guidance on mitigation strategies that can be examined and implemented. A selection of these barriers will be prioritised for a national mitigation programme under the next National River Basin Management Plan (2022-2027).



A barrier that has been ameliorated by the construction of a fish passage

The importance of free-flowing rivers has been recognised in the European Commission's recently adopted Biodiversity Strategy for 2030, which has set a target of restoring at least 25,000 km of rivers as free-flowing watercourses by 2030 through the removal of obsolete barriers and the restoration of floodplains and wetlands.



Topic Box 7.4 The 2018 Drought

The impact of the drought in 2018 on river flows and lake water levels was severe, particularly in July, but it was neither as prolonged a national phenomenon as the 1975-1976 drought nor as severe as the 1995 drought in the Midlands and Western regions.

The dry weather resulted in a large soil moisture deficit, and almost two-thirds of all rivers fell below their 95th percentile flow (i.e. very low flow conditions). The main impact was on the provision of drinking water, and restrictions on water use were in place for several weeks between July and September. Inland Fisheries Ireland reported an increase in fish kills during 2018 (EPA, 2019a), and the low flows may have both directly and indirectly contributed to this rise by increasing the vulnerability of fish to pollution events (i.e. increased water temperature, depressed oxygen concentration).



Low flow levels encountered in the Owenbrin river, Co. Mayo, during the summer of 2018.

Our lake, reservoir and groundwater levels were buffered by the elevated precipitation and snow melt early in 2018, and, although their levels dropped, they did not fall to the same critical levels observed in approximately half of the rivers in the country. By November 2018, river flow and lake, reservoir and groundwater levels had returned to 'normal', except for a few lakes in the Midland region.

Overall, the drought highlighted the vulnerability of certain water supplies in Ireland, because when these water supplies were first built, they were designed to cater for a smaller population and therefore supply lower volumes of water. This vulnerability may be magnified by the impacts of climate change and highlights the need for robust water supply and water resource management to ensure a safe and secure water supply in the future.

Invasive Species

The introduction of invasive species can also cause damage by displacing native species and affecting the functioning of aquatic ecosystems. In Ireland, the most invasive aquatic species include the zebra mussel (*Dreissena polymorpha*), the Asian clam (*Corbicula fluminea*) and plants such as the curly waterweed (*Lagarisiphon major*) and Nuttall's waterweed (*Elodea nuttallii*). Other invasive species that occur along rivers such as Japanese knotweed (*Fallopia japonica*) and Himalayan balsam (*Impatiens glandulifera*) can destabilise river banks increasing erosion. Invasive species can also be vectors of disease or a direct cause of disease. For example, crayfish plague (caused by *Aphanomyces astaci*), a fungal disease introduced to

Europe most probably on American crayfish imported for aquaculture, has devastated river populations of Ireland's native crayfish species (see Chapter 6).

The National Biodiversity Data Centre maintains the National Invasive Species Database, which provides information on the distribution of invasive species. This work aims to facilitate the updating of risk assessments undertaken by Invasive Species Ireland and establishes an early warning system to alert us to new arrivals on the island of Ireland. This is covered further in Chapter 6.



4. Responses

The National River Basin Management Plan 2018-2021 is the main policy response to improve water quality.

Water management in Ireland in the last two decades has focused on implementing the EU Water Framework Directive. In broad terms, the objectives of the Directive are to protect, enhance and restore all bodies of water, with the aim of achieving at least good status, and to comply with the water-related requirements for protected areas such as designated bathing waters, shellfish-growing areas, areas protected for the conservation of species and habitats and areas protected for the abstraction of drinking water. The objectives, and the measures required to achieve them, are set out in national river basin management plans. The government published Ireland's second National River Basin Management Plan (RBMP) 2018-2021 in April 2018, and this will be followed by a third plan covering the period 2022-2027.

The current RBMP identified water bodies that are under significant pressure and prioritised a range of measures to address the impacts on them. Overall, 1460 individual water bodies (30% of the total number) were identified as being at risk of not achieving their environmental objectives because of the damage being caused by significant pressures.

Some of the key measures set out in the plan include:

- establishing the Local Authority Waters Programme (LAWPRO) to carry out local catchment assessments to identify water quality issues and potential associated sources and to promote the implementation of mitigation measures to improve water quality at a local level
- setting up the Agricultural Sustainability Support and Advisory Programme (ASSAP), which is run by Teagasc and the dairy cooperatives and will provide advice to the farming community on appropriate measures to address water quality issues while working closely with LAWPRO.
- establishing the Blue Dot Catchments Programme to ensure the protection of our remaining high status waters and restoration of those whose status has declined
- Irish Water investing €1.7 billion in wastewater projects, programmes and asset maintenance.

The RBMP includes specific measures for each of the key sectors that are putting pressure on the aquatic environment. These are summarised in Table 7.3.



Connecting a community with their catchment, a guided nature walk along the Cunnigar sand spit, a natural feature that extends from An Rinn into Dungarvan Harbour, Waterford. (LAWPRO)



Table 7.3 Summary of the main measures in the National River Basin Management Plan 2018-2021

SECTOR/PRESSURE	MEASURE
All pressures	<ul style="list-style-type: none"> ■ Establishment of the Local Authority Waters Programme (LAWPRO) to undertake water catchment assessments and develop action plans for priority areas for action.
Agriculture	<ul style="list-style-type: none"> ■ Establishment of an Agricultural Sustainability Support and Advisory Programme (ASSAP) to undertake farm assessments and provide advice to farmers on what measures to take to address water quality issues. ■ Implementation of agri-environment schemes through the Rural Development Programme. ■ Implementation of the enhanced Nitrates Action Programme for 2018-2021 and the associated inspection regime. ■ Knowledge-transfer programmes to promote, among other things, better nutrient management and point-source pollution management.
Hydromorphology	<ul style="list-style-type: none"> ■ Introduction of improved assessment methods and knowledge of hydromorphological impacts. ■ Evaluation and removal of barriers to fish migration. ■ Implementation of mitigation measures to reduce the impact of river channelisation.
Urban wastewater treatment	<ul style="list-style-type: none"> ■ Investment by Irish Water of €1.7 billion in wastewater projects, programmes and asset maintenance.
Forestry	<ul style="list-style-type: none"> ■ Realignment and full implementation of forestry regulations and policy to contribute to achieving water quality objectives. ■ Promotion and strategic deployment of forestry funding schemes and other resources to protect and improve water quality.
Domestic wastewater treatment	<ul style="list-style-type: none"> ■ 1000 inspections of domestic wastewater systems to be carried out nationally by local authorities each year using a risk-based approach.
Water abstraction	<ul style="list-style-type: none"> ■ Risk assessment of water abstractions and licensing of large abstractions and those that put significant pressure on water resources.
Other pressures	<ul style="list-style-type: none"> ■ Other significant pressures including industry, peat extraction and mining are also addressed in the plan, which is available to download (see https://www.housing.gov.ie/water/water-quality/river-basin-management-plans/river-basin-management-plan-2018-2021).

Implementing the Integrated Catchment Management Approach

The integrated catchment-based approach has prioritised a total of 190 areas for action under the National River Basin Management Plan 2018-2021.

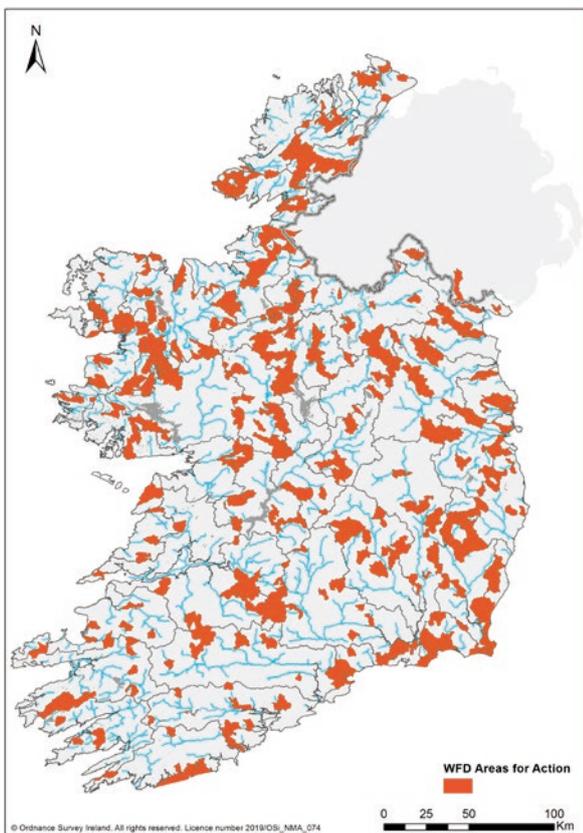
One of the key strategies in implementing the RBMP has been the adoption of an integrated catchment-based approach. This is being led by LAWPRO, which is undertaking local catchment assessments in areas that have been prioritised for action in the RBMP. Each assessment includes a detailed desk study, field investigations and catchment walks. Public meetings are held in advance of any field work to inform the local community about the planned assessments and to seek

its input. The purpose of the local catchment assessments is to determine what the water quality issues are and then to identify the activities and pressures causing them. Once these are known, the right measure can be put in place to address the water quality issue identified. When an action to improve water quality is identified, LAWPRO refers it to the relevant implementing body for follow-up. In total, 190 priority areas for action (PAAs) have been identified (see Figure 7.11). By the end of 2019, LAWPRO had progressed local catchment assessments in 90 of the 190 PAAs and identified referrals and action plans for 46 of them.



The objective set out in the RBMP is to deliver water quality improvements (e.g. a change in nutrient trends) in 726 water bodies located within the 190 PAAs and for 152 of these to have improved sufficiently to achieve good or high ecological status. The RBMP envisages that water bodies outside PAAs will benefit from existing and newly introduced measures such as the adoption of good agricultural practices and the provision of new and improved municipal wastewater treatment infrastructure.

Figure 7.11 Location of the areas for action prioritised in Ireland's River Basin Management Plan 2018-2021 (Source: EPA)



The Blue Dot Catchments Programme – Protecting our High status Waters

The Blue Dot Catchments Programme was established to improve the protection and restoration of high status water bodies whose status is declining more than that of other water bodies.

One of the most concerning water quality trends in recent years has been the continued loss of the highest quality (best of the best) river sites, which have suffered a tenfold decline since the late 1980s. These near-pristine unpolluted waters are important reservoirs of aquatic biodiversity and provide an important refuge for species sensitive to pollution. Over half are failing to meet their high status objective and over one-fifth of high status objective river water bodies have declined since 2015 (EPA, 2019a). The picture is even worse for lake and estuarine waters with one-quarter of high status objective lakes and just under half of high status objective estuaries having declined in status since 2015. The level of decline in high status objective water bodies is much greater than the 4.4 per cent decline in status seen nationally across all water bodies.

The Blue Dot Catchments Programme was established in 2019 under the RBMP specifically to improve the protection and restoration of these precious water bodies. A significant collaborative effort is now required from all stakeholders to ensure that the loss of these high status waters is halted and, where possible, reversed. A work programme has been developed by the newly established Blue Dot Catchments Programme to begin the process of developing strengthened actions in these catchments. The work of LAWPRO in PAAs will guide the level of local catchment assessment and actions required in these catchments.

The recently approved Water of Life integrated project, co-funded by the Irish Government and the European Commission, aims to support the implementation of measures to protect and enhance high status waters and thus support the work of the Blue Dot Catchments Programme. The project will act as a catchment-scale demonstration project to test and validate the effectiveness of implementing locally tailored, best practice measures across a range of land uses typically seen in the catchments of high status waters.



Agricultural Measures to Improve Water Quality and Reduce Nutrient Loss

Agriculture is the most common pressure affecting water quality and a significant response is required from this sector to reduce its impact.

Agriculture covers over 67.6 per cent of the land area of Ireland and is the most common significant pressure on water bodies that are failing to meet their environmental objectives.

Ireland's Nitrates Action Programme is designed to prevent pollution of surface waters and groundwater from agricultural sources and to protect and improve water quality. Ireland's fourth programme came into operation in 2017 and will be reviewed in 2021. The measures, which relate to livestock stocking densities, periods when land spreading of livestock manure is prohibited and setting levels for the storage of livestock manure, are given legal effect by the Good Agricultural Practice for Protection of Waters Regulations (S.I. No. 605 of 2017, S.I. No. 65 of 2018 and S.I. No. 40 of 2020).

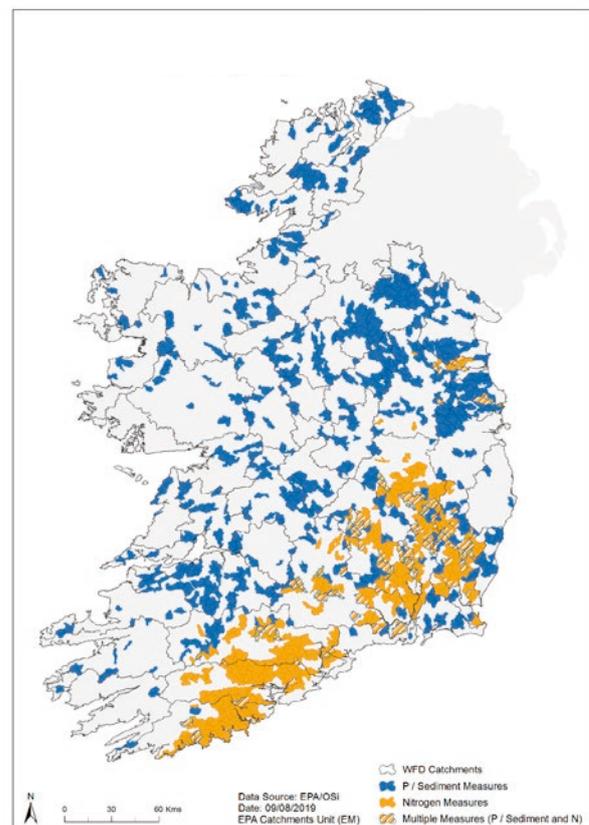
Under these Regulations, local authorities carry out approximately 3500 farm inspections every year while the Department of Agriculture Food and Marine (DAFM) carry out approximately 1600 under an agreement with Department of Housing, Local Government and Heritage. Among the group of farms selected for inspection by DAFM based on risk, over 21 per cent were found to have breached the regulations each year between 2016 and 2018. Of the breaches found in 2018, 56 per cent were due to the poor management of livestock manures and other organic fertilisers, 16 per cent were due to failure to minimise soiled water contamination and 12 per cent were due to structural defects in manure storage facilities. There is clearly room for improvement in the management of manures and organic fertilisers, while breaches for poor management of soiled waters can be solved by reasonably straightforward changes in the management of farmyards.

When LAWPRO identifies a water quality issue related to agriculture they notify ASSAP, which in turn works with the local farming community to identify where improvements in water quality can be made. This can involve a whole-farm assessment, which focuses on the significant water quality issue identified by LAWPRO. In this way, LAWPRO and ASSAP teams facilitate a highly targeted approach in terms of delivering the right measure in the right place to improve water quality. At the end of 2019, ASSAP had undertaken 1168 farm assessments in 68 PAAs.

The EPA is supporting these teams by providing the science-based evidence needed to target their efforts to get the best environmental outcomes. Information on hydrological setting and nutrient pathways has been used to identify where measures to reduce nitrogen and phosphorus losses from farmland need to be targeted (Figure 7.12).

Agri-environment schemes, such as the Green Low Carbon Agri-Environment Scheme (GLAS), and other initiatives, such as the dairy sustainability initiative, have the potential to reduce the loss of nutrients by increasing knowledge exchange on field-based nutrient management and the management of farmyard point sources. Finally, structural changes to the Common Agricultural Policy (CAP) and its greater emphasis on environmental sustainability is likely to lead to more sustainable farming practices. Furthermore, the recently adopted European Commission Farm to Fork strategy means that Member States will need to take into account the targets set in the strategy when preparing their CAP strategic plans. These targets include a reduction in nutrient losses from agricultural land of 50 per cent, a reduction in the use of artificial fertilisers by at least 20 per cent and a reduction in the use of chemical pesticides by 50 per cent, all by 2030. Furthermore, at least 25 per cent of the EU's agricultural land must be organically farmed by 2030. The role of agriculture in water quality and measures needed to address pressures from this sector are also covered in Chapter 13.

Figure 7.12 Locations where agricultural measures are needed to target nitrogen (N) and phosphorus (P) losses from farmland (Source: EPA)





Hydromorphology (Physical Alterations to Water Bodies and Habitats)

Methods are needed to assess the impacts that physical structures and changes to water bodies have on their ecology; solutions will also need to be implemented to address significant pressures.

Hydromorphological alterations that can affect the flow and structure of water bodies is the second most common pressure in at-risk water bodies (24%). As acknowledged in the RBMP, the effects of hydromorphological alterations on the ecology of surface waters needs to be better understood before effective management measures can be put in place.

One of the important steps in bridging this gap is the development of tools to assess the hydromorphological condition of surface waters, and good progress is being made in this regard with the development of assessment indices for both rivers and estuarine and coastal waters [e.g. River Morphological Quality Index (MQI) and TraC Hydromorphological Quality Index]. These indices provide a measure of hydromorphological change that will provide a basis for better understanding the impact of these changes on ecology. A knowledge of the relationship between ecology and hydromorphology will be required to develop environmental quality standards to help regulate activities that cause physical modifications and to select measures that will deliver ecological benefits to aquatic systems. These and other work packages, including the designation of heavily modified water bodies (and matching objectives) and the development of a monitoring programme, form part of the National Hydromorphology Work Programme led by the EPA.

In relation to river barriers, Inland Fisheries Ireland's National Barrier Programme has catalogued 73,055 structures nationally as potential barriers to fish passage. To date 15,700 of these potential barriers have been assessed and 2054 have been identified as barriers to fish passage. Since 2010 Inland Fisheries Ireland has instigated 50 large-scale barrier remedial works, removing 14 barriers, installing 29 fish passage solutions and creating three bypass channels to allow fish to pass.



Investment to Improve the Collection and Treatment of Urban Wastewater

There has been slow progress in addressing areas where wastewater has been identified as a significant pressure preventing water bodies from meeting their environmental objectives and in areas where untreated sewage is still being discharged into the environment.

Wastewater from urban treatment systems (including storm water overflows) is the third most significant pressure on at-risk water bodies (20%). Over the period 2017-2021, Irish Water committed to investing approximately €1.7 billion in wastewater projects, programmes and asset maintenance. This was to include investment in 255 wastewater treatment projects (to be completed by the year 2025), improvements in collection systems in 41 urban areas, and further investment and upgrades to existing plants. In devising its capital infrastructure plan, Irish Water has considered the objectives and priorities set out in the national RBMP. These include supporting the protection of protected areas (special areas of conservation, special protection areas, shellfish and bathing waters), supporting high status waters and preventing deterioration in the status of water bodies that are already meeting their objectives.

Progress in delivering these projects has been mixed. Of the 255 wastewater treatment projects identified for investment, 108 were completed by the end of 2019, a further 98 are scheduled to be completed by the end of 2024 and 48 are likely to extend to 2025 or beyond. As of 2019, Irish Water had yet to identify and schedule the improvements required to address almost half (23 of 48) of the areas where addressing wastewater is a priority for achieving water quality objectives. Repeated delays in completing essential work to eliminate discharges of raw sewage mean that it will continue to be released into the environment from 33 towns and villages beyond 2021.

Irish Water must reduce the time taken to put in place the required improvements and to eliminate the discharge of raw sewage to the environment. Extending the time to eliminate discharges of untreated wastewater prolongs the risks to the environment and public health. It is important to provide the outstanding infrastructure to end discharges of untreated wastewater without further delay. Irish Water must also complete the improvements needed to ensure that wastewater does not prevent receiving waters from meeting their environmental objectives.



Forestry Measures to Protect Water Quality

Forestry is the predominant pressure affecting high status water bodies, and further improvements in the sector are needed to reduce pressures on these nationally important water bodies.

Forestry is the fourth most common pressure in at-risk water bodies, affecting 238 water bodies or 16 per cent of the 1460 water bodies at risk. Furthermore, forestry is the predominant pressure affecting at-risk high status objective water bodies, which are typically located in the upper areas of catchments where forestry activities take place.

The Forest Service of the DAFM is responsible for consenting forestry activities in the state. The DAFM document *Forests and Water: Achieving Objectives under Ireland's River Basin Management Plan 2018-2021* outlines the principal forestry-related legislative, policy, regulatory and promotional elements now in place to address the challenges and opportunities for forestry set out in the RBMP. The aims of these measures are to safeguard water during all forestry operations, to restructure existing forests to protect water quality and to situate and design new forests, particularly native woodlands, in a way that contributes to achieving the environmental objectives set out in the plan.

The environmental enhancement of forests to support Water Framework Directive objectives is being supported through a number of policies, requirements and procedures, including the Land Types for Afforestation procedure, Environmental Requirements for Afforestation procedure, Acid Sensitivity Protocol, Felling and Reforestation Policy and most recently, Interim Standards for Felling and Reforestation (October 2019). Support schemes of relevance to water include the Native Woodland Establishment and Conservation Schemes, the Continuous Cover Forestry Scheme and the Agro-Forestry Scheme. Initiatives such as the Woodland for Water model and the Woodland Environmental Fund are also highly relevant: the former provides a vision for using new native woodland to protect water, and the latter encourages major businesses and public bodies to become involved in encouraging private landowners to create new native woodland under the Native Woodland Establishment Scheme.



Lough Ouler, Co, Wicklow

In practical terms, measures include restructuring of conifer forests at the clearfell/reforestation stage to include larger water setbacks, the direct conversion of existing conifer stands into native woodland (where appropriate), the creation of new native woodlands and agro-forests on sites adjoining watercourses, and a stronger focus on unplanted setbacks alongside important watercourses. Through the Land Types for Afforestation procedure, afforestation has been redirected away from the more marginal upland water-sensitive sites that would have been planted in the past. Restrictions on operations such as on-site drainage and cultivation, herbicide and fertiliser application, temporary and permanent crossings, and the on-site location of potentially hazardous material have been clarified and strengthened, as have the use of other measures to reduce flow velocities and to aid the retention of silt and nutrients on site. In addition, the operation of the Forestry Appeals Committee, independently of the DAFM, enables referral bodies and third parties to appeal an approval before work commences, while the application of an internal procedure is helping to ensure a rapid and targeted Department response to any ongoing incident creating concerns for water quality.



Domestic Wastewater Treatment

The high failure rate encountered in septic tank inspections by local authorities (as high as 48% in 2016) indicates that significant improvements are required to reduce pollution from these systems.

Domestic wastewater treatment systems used by rural householders to treat sewage are a significant pressure for 11 per cent of at-risk water bodies. There are nearly 500,000 septic tank systems nationally serving a population equivalent of 1.4 million people. In 2017 and 2018, as part of the National Inspection Plan, 2371 septic tank inspections were carried out by local authorities in areas that are considered to be at greater risk of pollution from these systems (see Chapter 14). Nearly half (1135) of the septic tanks inspected failed to meet the required standard (EPA, 2019b), indicating that significant improvements are required to reduce pollution from these systems.

The EPA has advised householders that they should ensure that their systems are properly built and maintained, fix systems that fail inspections (nearly one-third of systems that had previously failed inspection remain unfixed) and ensure that their sewage does not pollute their well. Local authorities must continue to complete their inspections under the National Inspection Plan and have an effective enforcement system in place to ensure that householders fix systems that fail inspection.

A grant scheme has been in place since 2013 to support householders to undertake remedial work on septic tanks that fail inspection under the National Inspection Plan. The scheme has been expanded to support the water quality objectives set out in the RBMP. This includes households with defective septic tanks located within high status objective catchment areas and households in PAAs where LAWPRO teams have identified their systems through their catchment assessments as potential pollution sources.



Improving Governance and Public Participation

Citizen science and river trusts are being promoted as means to engage with communities in protecting water quality.

In addition to the measures addressing significant pressures, the governance structures for implementing the Water Framework Directive have been reformed through the creation of a three-tiered structure comprising government departments, national agencies and local authorities. The RBMP also places significant emphasis on public engagement, and several initiatives have been put in place including the appointment of community water officers (put in place in 2016) in LAWPRO, the creation of a Community Water Development Fund (in 2018) and the establishment of An Fóram Uisce – the Water Forum (in 2018) – a national platform for public engagement on all matters relating to Ireland's water resource.

Other initiatives include actively encouraging the participation of volunteers and citizen scientists. For example, there are now a number of rivers trust charities stretching from Donegal to Wexford (e.g. Slaney Rivers Trust, Nore Suir Rivers Trust, Blackwater Rivers Trust, Waterville Lakes and Rivers Trust, Mague Rivers Trust, Moy Rivers Trust, Erne Rivers Trust and Inishowen Rivers Trust). Local volunteers are involved in projects ranging from looking at the effectiveness of natural water retention measures (Inishowen Rivers Trust) to tackling the impact of invasive species (e.g. giant hogweed on the River Mague) and working with landowners to reduce river bank erosion as a result of livestock access (Moy Rivers Trust). Further information on the Rivers Trust network in Ireland and the UK can be found at <https://www.theriverstrust.org/>

Citizen science projects include the Dragonfly Ireland 2019-2024 project, which is seeking volunteers to record sightings of dragonflies and damselflies along our waters, and the Explore Your Shore project, which is looking for volunteers to identify the different types of animals and plants found in seashore rockpools. These citizen science projects are being led by the National Biodiversity Data Centre and funded by the EPA. Further information on the two projects is available at www.biodiversityireland.ie² and www.ExploreYourShore.ie

Work being carried out to monitor and protect Ireland's water quality also links closely with Goal 6 of the United Nations Sustainable Development Goals and its targets and indicators covering water quality and integrated water resource management.

2 <https://www.biodiversityireland.ie/projects/monitoring-scheme-initiatives/dragonfly-ireland-2019-2024/>



Water Research

Research is helping to inform measures to protect water quality.

Since 2016, the EPA has funded 65 new research projects relevant to the Water area; an investment of €15.4 million. These were funded mostly under the Water Pillar of the EPA Research Programme 2014-2020. The topics covered included the evaluation of ecosystem services (ESManage), managing invasive alien species, assessing the extent of barriers on river connectivity (ReConnect), assessing the use of Earth observation to assess lake water quality (Infer), the use of drones to take lake water samples and *in situ* measurements (DroPLEts), the detection and monitoring of contaminants of emerging concern (IMPACT), assessing the benefits of natural water retention measures in the Irish landscape (SLOWWATERS), guidelines to encourage better operation of septic tanks, use of biophysical models to improve water quality forecasts in lakes (PROGNOS) and along the freshwater-marine continuum (Land2Sea), and finding measures to restore water bodies and water habitats (Macro-Man, CLEAR, SWAMP).

During 2020 several new EPA research reports have been published that are relevant to the topics covered in this chapter. They include the research reports below which are available on the EPA research publications webpage: <https://www.epa.ie/pubs/reports/research/water/>

Research 330: COSAINT: Cattle Exclusion from Watercourses: Environmental and Socio-economic Implications <http://www.epa.ie/researchandeducation/research/researchpublications/researchreports/research330.html>

Research 312: Incorporation of Ecosystem Services Values in the Integrated Management of Irish Freshwater Resources: ESManage <https://www.epa.ie/pubs/reports/research/water/research312.html>

This research helps to identify the main pressures damaging the health of the aquatic environment and the solutions needed to address these pressures. Further information is available at <http://www.epa.ie/researchandeducation/research/> and water-related EPA research reports are available at <http://www.epa.ie/pubs/reports/research/water/>

Several projects co-funded by the Irish Government and the EU are working with farmers and other local stakeholders to improve water quality in their catchments. A number of EU co-funded European Innovation Partnership (EIP) projects, such as Mulkear EIP, Duncannon EIP and Duhallow EIP, are supporting local farmers to work collaboratively with other stakeholders to develop catchment-sensitive farming practices to improve local water quality. The Duhallow EIP has a focus on protecting and restoring high ecological status waters of the Allow river catchment, while the Duncannon EIP is specifically looking at measures to help restore the blue flag status at Duncannon beach. The Freshwater Pearl Mussel (EIP) project is incentivising farmers to adopt good land management practices to help protect the freshwater pearl mussel. The amount that farmers are paid is linked to the nature quality of their farm. The higher the nature value of their farm, the higher the payment. Further information on these projects can be found on the respective project websites. Although these projects are operating in local catchments on specific issues, the important thing will be to ensure that the lessons learned from them help to inform the selection of measures needed to protect and restore water quality across the country.



5. Outlook

Significant Progress Is Needed to Reach the Environmental Objectives and Legal Requirements of the Water Framework Directive

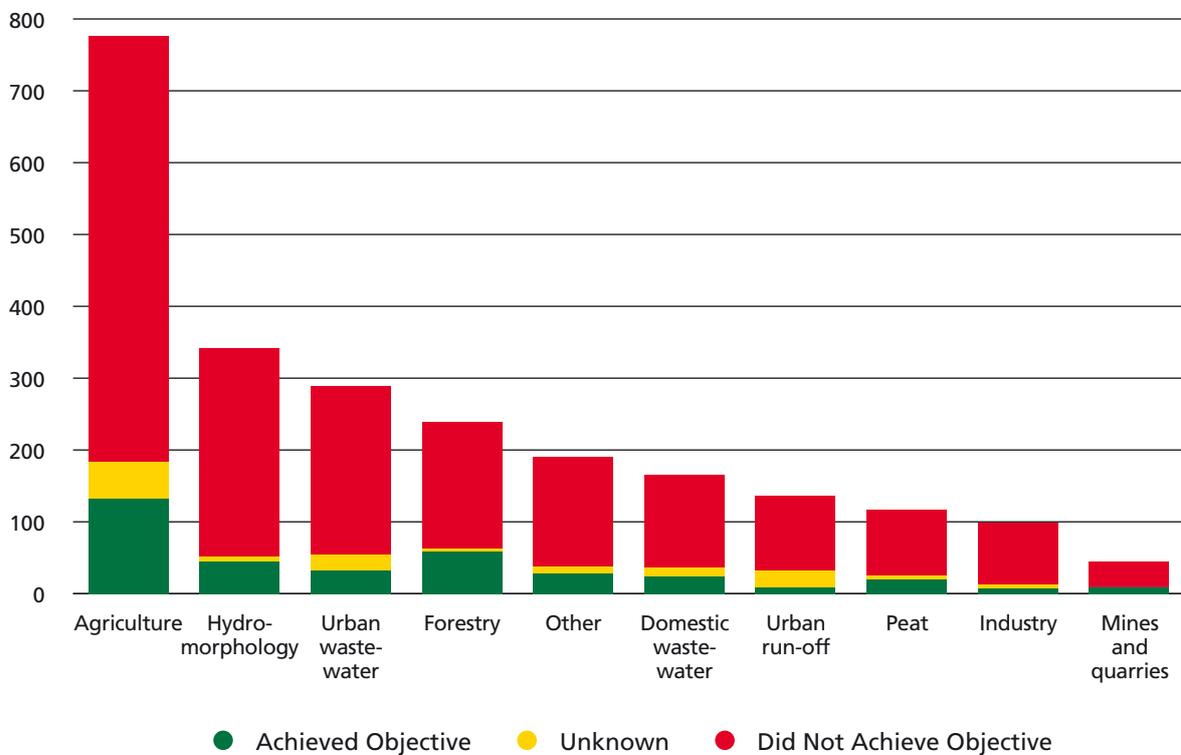
While overall water quality has deteriorated nationally, in the most recent assessment undertaken by the EPA there were some positive signs in the prioritised areas for action.

The river basin management planning process identified 1460 water bodies as being at risk of not meeting their water quality objectives because of the damage being caused by significant pressures. The most recent assessment of the condition of these waters shows that 16.5 per cent (242) of these water bodies are now meeting their environmental objectives and are no longer considered to be at risk (EPA, 2019a). However, the significant proportion of water bodies still at risk highlights the magnitude of the challenge that remains (Figure 7.13).

While overall water quality deteriorated nationally in the most recent assessment undertaken by the EPA (EPA, 2019a) there was an overall net improvement in river water quality in the PAAs in the RBMP. This suggests that when action is taken to improve water quality it delivers results. The current plan runs to 2021, so there will be another year's worth of monitoring data to determine the overall impact of these measures in this second RBMP cycle. Many of these improvements have been achieved as a result of the ongoing efforts of local authorities and other public bodies in these areas. Further improvements are expected as the LAWPRO and ASSAP programmes mature.

The challenge now must be to learn from the successes seen in PAAs and apply them nationally to reverse the negative trends we are seeing in water quality. We must also ensure that the knowledge gathered in water-related research projects and EIPs, as outlined above, is used more widely to provide solutions to water quality problems and to inform policy development in this area.

Figure 7.13 Progress made in each sector since 2016 in addressing the significant pressures on Ireland's aquatic environment (Source: EPA)





Targeted Approaches and Existing Legislation Must Be Fully Implemented to Reduce Pressures on Water Bodies

Nutrients inputs from different sectors need to be reduced across the board to improve water quality.

Managing the additional pressures that are likely to come with the expansion in certain sectors (e.g. Food Wise 2025 and Food Strategy 2030 in the agriculture sector and planned expansion in forestry) will be difficult when existing pressures are already causing a net decline in the quality of our surface waters.

In agriculture, the current expansion in the size of the national herd means that additional measures are required to reduce nutrient pollution from this sector. The nature of these measures will depend on the nutrient in question and the landscape setting. For nitrogen, the riskiest areas are the freely draining soils, and the approach must be to reduce the loss of nitrogen from source, for example by reducing the use of artificial fertiliser. This can be achieved by improving soil fertility and better nutrient management planning. For phosphorus, the riskiest areas are the poorly draining soils, and in these areas measures are needed to break the pathway between the source of phosphorus and the receiving water body. For example, strategically located buffer zones can prevent pollutants from entering waterways. These, and other approaches can be used to ensure that the right measures are being applied in the right place. These measures can also have multiple benefits for other environmental objectives. For example, reducing the use of chemical nitrogen fertiliser can have benefits for greenhouse gas reduction and improvement of air quality, while buffer zones to intercept phosphorus can also have benefits for biodiversity. In parts of the country with different soil types and physical settings, however, these measures may be less effective in preventing water pollution. It may not always be possible to put measures in place to intercept surface flows of phosphorus or prevent nitrogen from seeping into groundwaters and reaching sensitive downstream

water bodies. This means that some areas of the country are more vulnerable to nutrient pollution and less suitable for agricultural intensification.

In addition to nutrient pollution, changes to the physical nature of water bodies and water habitats through direct physical modifications or as a result of excessive sedimentation must also be addressed. While progress is being made in assessing the hydromorphological condition of surface waters, further work is required to better understand what measures are required to address hydromorphological impacts and to inform the development of regulatory systems for activities that physically modify water bodies.

There are still too many areas where discharges of inadequately treated sewage from urban wastewater treatment systems are harming the environment and putting public health at risk. Progress has been slow in addressing areas where wastewater from urban treatment systems has been identified as a significant pressure preventing water bodies from meeting their environmental objectives and in areas where untreated sewage is still being discharged into the environment. The rate at which wastewater treatment infrastructure is being delivered must improve and must target those areas that would benefit the most in terms of protecting the environment and public health.

In forestry, the greater awareness of water-related issues being displayed by the sector is encouraging. The challenge now is to ensure that the environmental conditions stipulated in forestry licenses are being adhered to while at the same time encouraging and supporting the uptake of forestry-related environmental schemes such as the Native Woodland Establishment Scheme and Forestry for Water Measure.

The EPA is undertaking the next round of characterisation in preparation for Ireland's third RBMP Plan 2022-2027. This information will be used to identify the water bodies at risk from significant pressures and the measures needed to address these pressures over the period of the next plan.



Buffer zone to prevent pollution from entering the river



6. Conclusions

Water Quality under Significant Pressure

The findings presented in this chapter indicate that the quality of Ireland's surface water resource is under significant pressure from human activities. Overall, just over half (52.8%) of its surface waters are in good or better ecological health, which means that just under half (47.2%) are failing to meet their environmental objectives. An analysis of the pressures has found that the main activities affecting the quality of Ireland's surface water and groundwater resource are agriculture, hydromorphological alterations, discharges from urban wastewater treatment plants and forestry.

Continued Decline in Ecology of Water Bodies

These activities are damaging the ecological health of our rivers, lakes and estuaries. Of most concern is the increase in the number of water bodies with poor ecological status, which have increased by one-third since 2009, and the continuing loss of our high status river water bodies, which have declined by one-third since 2009. The loss of our high status waters continues the unwelcome longer term trend seen in the loss of our most pristine river waters, whose sites have declined tenfold since the late 1980s. Currently there are only 20 such sites left in the country.

Climate Change likely to Exacerbate the Damage caused to Rivers and Estuaries by Water Pollution

The continuing decline in the ecological health of our surface waters, and in particular our rivers and estuaries, is associated with impacts from various human activities. Both water categories are being damaged by increasing nutrient levels and physical alterations, while our rivers are being further affected by siltation and pesticides. The combined effects of these different stressors mean that these waters are not as clean or healthy as they should be and, as a result, their capacity, or resilience, to recover from further pollution impacts or external shocks is greatly reduced. These shocks will intensify in the context of climate change as more extreme weather brings extremes in water temperatures and water flows, which are likely to exacerbate the damage caused by underlying water pollution.

Reduce Nutrient Inputs to Protect Water Quality

The challenge now is to ensure that our waters are as clean, healthy and resilient as they can be. This can be achieved by reducing nutrient inputs from agriculture and wastewater treatment and delivering on the key objectives of the Water Framework Directive. We need effective action as part of the River Basin Management Plans to ensure that the current decline in water quality is halted and that the condition of our most polluted waters is improved. We must continue to focus on the protection of our remaining high status waters and prioritise the restoration of water bodies that have recently declined to poor and bad status. This can be achieved by ensuring that the right measures are put in place to address the significant pressures damaging the quality of our waters.

Water Catchment-based Approaches

The establishment of the Local Authority Waters Programme (LAWPRO) and the adoption of a catchment-based approach to managing water resources are now the main platforms for dealing with water quality issues. The efforts of LAWPRO, working in collaboration with the Agricultural Sustainability Support and Advisory Programme (ASSAP) and other public bodies, including the EPA, now means that we are developing a comprehensive understanding of where and what the problems are and how to address them.

Fully Implement River Basin Management Plan

Actions are being taken across all pressure types and sectors, but significant work in all sectors remains. The challenge now is to ensure that the actions set out in Ireland's national River Basin Management Plan 2018-2021 are fully implemented. This will deliver not only benefits for water quality but also multiple benefits for human health and the broader environment in terms of drinking water quality, biodiversity and climate change.



Chapter Highlights for Water Quality



Ireland has seen a continuing decline in high status water bodies and an increase in the number of water bodies in poor ecological health. Even more stark is the dramatic reduction in the number of our most pristine rivers, which have fallen in 30 years from over 500 sites in 1990 to only 20 sites in 2020. Rapid action is needed to protect our remaining pristine sites before they are lost. More urgent focus also needs to be given to protecting our estuaries, as these water bodies have the worst status overall and specific measures for their improvement and protection should be identified and implemented.



The decline in river water quality is being driven primarily by nutrient pollution coming from agriculture and wastewater systems. Fertiliser spreading, slurry spreading and other nutrient losses that are causing pollution need to be covered by tighter measures in the next River Basin Management Plan and Nitrates Action Programme. Irish Water must ensure that the necessary wastewater infrastructure is in place and is not causing pollution, as legally required in EPA authorisations.



Overall, water quality has declined in Ireland, despite the actions taken to date to reverse this trend. Continued targeted action at local water catchment level that is based on science is key to improving water quality. The Local Authority Waters Programme and Agricultural Sustainability Support and Advisory Programme have key roles in implementing this targeted action and providing guidance at water catchment and farm levels to improve water quality. There also needs to be a national focus on measures to deliver solutions that protect and restore all water bodies.



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Chapter 8

The Marine Environment





The Marine Environment

1. Introduction

Ireland's coastal and marine areas¹ provide us with vital environmental, recreational, cultural and economic goods and services. Approximately 40 per cent of the Irish population lives within 5 kilometres of the coast² and our actions, both positive and negative, can impact on the wellbeing of these important ecosystems. Our marine ecosystems can be damaged by human-induced pressures and pollution, which can be of both global (e.g. climate change, marine litter, fisheries) and local (e.g. industry, agriculture, domestic wastewater) origin. Although Ireland's offshore waters can be considered relatively clean and healthy, our nearshore coastal systems³ are less so.

The European Union (EU) Marine Strategy Framework Directive (MSFD; 2008/56/EC)⁴ aims to protect the marine environment beyond the areas considered under the Water Framework Directive (WFD; 2000/60/EC).⁵ It requires the application of an ecosystem-based approach to the management of human activities, enabling sustainable use of marine resources, goods and services. The aim of the Directive is to achieve Good Environmental Status for our marine waters by 2020. This means that our marine waters should be clean, healthy, biologically diverse and productive. In Ireland, the Department of Housing, Local Government and Heritage is the lead body for the implementation of the MSFD and is supported by several other government departments and state agencies, in particular, the Marine Institute. The Marine Institute is the state agency responsible for marine research, technology development and innovation in Ireland. The Institute provides scientific and technical advice to the government to inform policy and support the sustainable development of Ireland's marine resources.

In this chapter we present information on the current status of Ireland's marine environment and discuss the main human activities that may damage the environmental status of these waters. The main legislative responses to these challenges are also discussed.

2. Current Health of Irish Marine Waters

Ireland's marine territory is one of the largest in Europe and, while it remains relatively unpolluted, our waters are vulnerable to damage.

The recent Marine Strategy Framework assessment of environmental status showed that our nearshore coastal and offshore marine waters are predominantly clean, healthy and biologically diverse; however, additional measures are required to protect our valuable ecosystems and species.

Ireland's MSFD assessment area is 488,762 km². It incorporates the exclusive economic zone and area of continental shelf that extends beyond 200 nautical miles into a region abutting the Porcupine Abyssal Plain. The overall health of Irish offshore marine waters is determined through the assessments undertaken under the auspices of the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention) and the MSFD, while the ecological health of nearshore coastal waters is assessed under the WFD. There is an overlap in the coverage between both Directives for 1 nautical mile from high water and certain pressures are only assessed under the MSFD.⁶ In addition, the conservation status of protected habitats and species (except birds) is assessed under the Habitats Directive (92/43/EEC),⁷ while the status and population trends for relevant bird species are assessed under the Birds Directive (2009/147/EC).⁸



1 Ireland's maritime territory covers 880,000 km² and is one of the largest in Europe

2 <https://www.cso.ie/en/releasesandpublications/ep/p-cp2tc/cp2pdm/pd/>

3 For the purpose of this report Ireland's near shore coastal waters are defined as those within one nautical mile of the coast, while our offshore waters are beyond these limits.

4 <https://eur-lex.europa.eu/eli/dir/2008/56/oj>

5 <https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1571840481303&uri=CELEX:32000L0060>

6 MSFD Annex I – particularly marine litter and anthropogenic noise

7 <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:31992L0043>

8 <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32009L0147>



Table 8.1 Environmental status of the 11 qualitative descriptors outlined in Annex 1 of the MSFD for the determination of Good Environmental Status (Source: DHPLG, 2020)

DESCRIPTOR	COMMON NAME	GOOD ENVIRONMENTAL STATUS (GES)
D1	Biodiversity	Some elements compatible with GES
D2	Non-indigenous species	Compatible with GES
D3	Commercial fish and shellfish	Some elements compatible with GES
D4	Food webs	Compatibility with GES not known
D5	Eutrophication	Compatible with GES
D6	Sea-floor integrity	Some elements compatible with GES
D7	Hydrographical conditions	Compatible with GES
D8	Contaminants	Compatible with GES
D9	Contaminants in seafood	Compatible with GES
D10	Marine litter	Compatible with GES for the elements assessed
D11	Energy, including underwater noise	Compatible with GES for the elements assessed

The Department of Housing, Planning and Local Government (DHPLG),⁹ reported the environmental status for each of the 11 descriptors considered under the MSFD for the determination of Good Environmental Status (DHPLG, 2020; Table 8.1). Further information on the issues covered by these descriptors is provided in the following sections.

Ecological and Chemical Status of Nearshore Coastal and Transitional (Estuarine) Waters under the Water Framework Directive

Recent assessments show that 80 per cent of our coastal water bodies and 38 per cent of our transitional water bodies have a high or good ecological status.

Ireland's transitional (estuaries and coastal lagoons) and coastal (up to 1 nautical mile from the shore) waters contain 194 and 110 water bodies, respectively. These areas are assessed under the WFD. The latest assessment (2013-2018) indicates that only 30 (38%) of the transitional waters monitored in Ireland are of good or high ecological status, with 49 (62%) being of moderate, poor or bad ecological status (Figure 8.1; EPA, 2019a). Coastal waters are in a better condition, with 36 (80%) of those monitored being of high or good status (EPA, 2019a). This corresponds to 93 per cent of the surface area of coastal water bodies. Eight coastal water bodies (20%) are of moderate ecological status and a single water body is of bad status (Figure 8.1). The

factors driving the ecological status of transitional and coastal waters include biological factors (phytoplankton, benthic invertebrates, macroalgae) and chemical factors (oxygenation conditions, nutrients, priority substances). Loading of nitrogen and phosphorus from Irish rivers into the transitional and marine environment has been monitored since 1990. This can provide a helpful indicator of the transfer of nutrients from anthropogenic sources (EPA, 2019a). Loads of nitrogen and phosphorus have increased by 16 per cent and 31 per cent, respectively, between 2012 and 2014 and between 2016 and 2018. Further information on the status of the supporting elements, trends in status, and drivers and pressures is provided in Chapter 7.



⁹ DHPLG is now called the Department of Housing, Local Government and Heritage.

**Figure 8.1** Status of transitional (left) and coastal (right) waters during 2013-2018 by number (Source: EPA)

The chemical status¹⁰ of coastal and marine waters is based on allowable concentrations of certain chemicals and substances. This aims to protect the most sensitive species from direct toxicity, including predators and humans, through secondary poisoning. A smaller group of 'priority hazardous substances' are identified in the Priority Substances (2013/39/EU)¹¹ as uPBT (ubiquitous, persistent, bio-accumulative and toxic). Under the WFD, Irish coastal areas are considered to have acceptable levels of priority substances (EPA, 2019a). Under the MSFD (Descriptors 8 and 9), initial assessment concentrations of contaminants in shellfish and commercial fish are generally above OSPAR background levels; however, they are not high enough to expect adverse effects (DHPLG, 2020).

Topic Box 8.1 TBT contamination in Irish Coastal waters

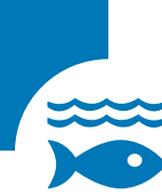
Imposex monitoring to assess the impacts of historical tributyltin (TBT) usage in Ireland has now been under way for around 30 years. Imposex is a disorder of sea snails resulting from the toxic effects of certain marine pollutants. These pollutants cause female sea snails (marine gastropod molluscs) to develop male sex organs. A 2018 assessment concluded that, with a small number of exceptions, there has been a dramatic reduction in TBT contamination around the Irish coast, with almost all locations found to be at, or close to, background levels, and there is little evidence of imposex. This demonstrates that measures taken nationally and internationally to phase out known toxic substances, in this case the use of TBT in anti-fouling paint for marine vessels, can be very effective at reducing marine pollution.



Dogwhelks, a type of sea snail found on Ireland's rocky shore.

10 <https://www.eea.europa.eu/themes/water/european-waters/water-quality-and-water-assessment/water-assessments/chemical-status-of-surface-water-bodies>

11 <https://eur-lex.europa.eu/legal-content/EN/ALLI?uri=CELEX:32013L0039>



Eutrophication Status of Marine Offshore Areas

Assessment of Ireland's offshore waters indicates the absence of nutrient enrichment.

The OSPAR Convention, the Oslo Paris Convention for the Protection of the Environment of the North East Atlantic has worked since 1972 to identify threats to the marine environment and has organised, across its maritime area, programmes and measures to ensure effective national action to combat them. The OSPAR Comprehensive Procedure uses a set of indicators to evaluate the eutrophic status of marine waters. Ireland classified all its marine offshore waters as non-problem areas for the period between 2006 and 2014 (EPA and MI, 2016, Figure 8.2). Trend analysis indicates that there has been little change in nutrient levels between 1997 and 2014 and these levels do not exceed those expected in a healthy marine environment. The Comprehensive Procedure will be updated for Ireland in 2023.

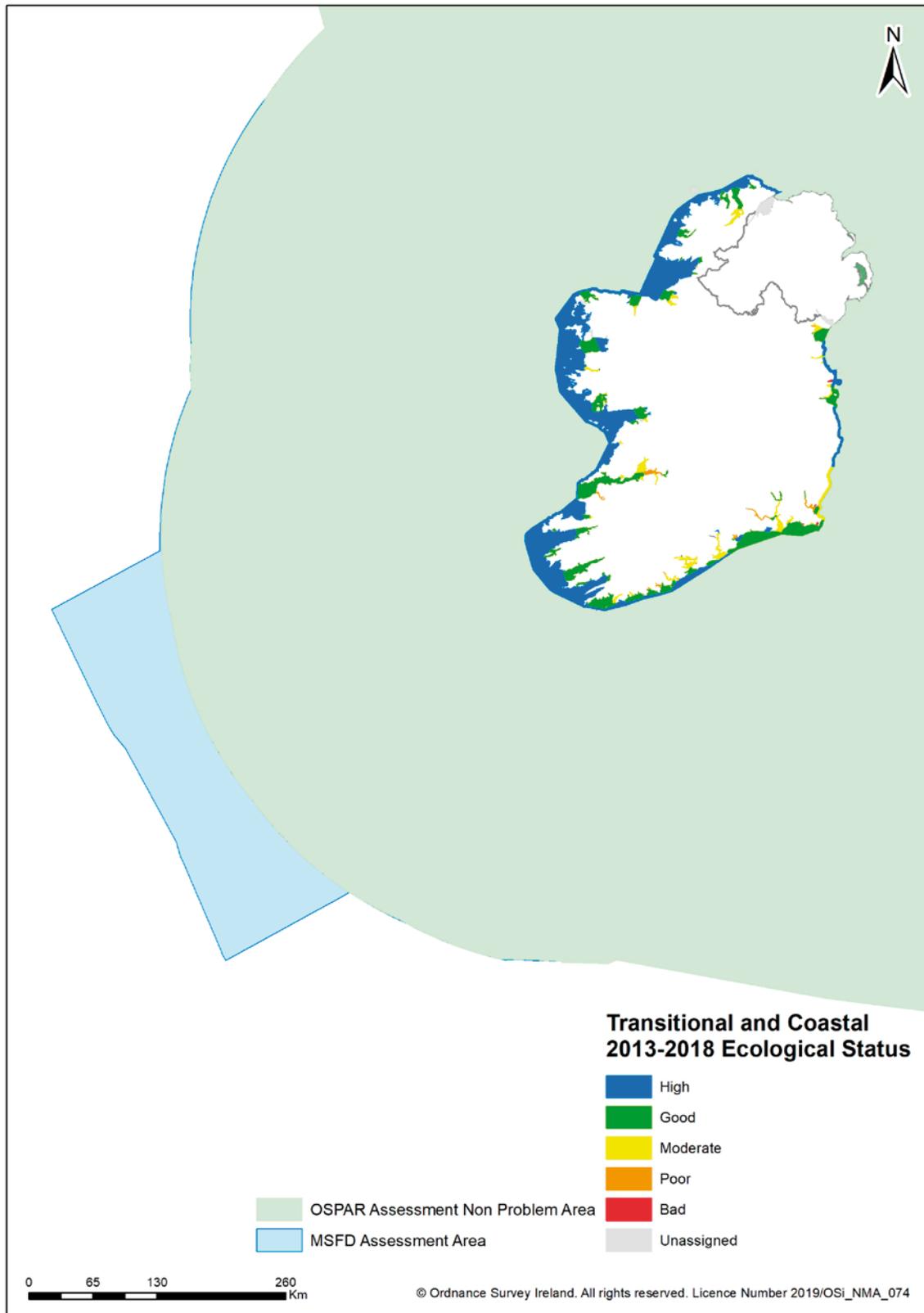
Ireland's latest report on environmental status under the current cycle of the MSFD considered the OSPAR Comprehensive Procedure (2009-2014) (OSPAR, 2017). This indicates that all offshore areas have reached Good Environmental Status for eutrophication (DHPLG, 2020).

In European coastal and marine waters, for example the Baltic Sea, eutrophication can result in dead zones where oxygen levels are considered to be too low to sustain life. The expansion of these dead zones is a globally important issue. Dead zones have not been detected in Irish waters to date; however, continual monitoring should be carried out to enable any changes in oxygen levels to be detected should they arise.





Figure 8.2 Eutrophication status of transitional, coastal (WFD) and marine (OSPAR Common Procedure/MSFD) waters. Eutrophication issues are nearly entirely restricted to transitional (estuarine) and coastal waters. The issue of nutrient enrichment is covered more extensively in Chapter 7





Biodiversity

Monitoring shows that several marine fish and bird species and some marine habitats are under threat or in poor condition.

The EU adopted the new 2030 biodiversity strategy in 2020 which aims to put Europe's biodiversity on the path to recovery by 2030 (see Topic Box 6.5 in Chapter 6 for more details) (EU, 2020). Ireland's National Biodiversity Action Plan aims to address the loss of biodiversity in Ireland. Reporting on marine biodiversity is challenging and providing conclusions on whether or not the loss of marine biodiversity has been halted is difficult. Several nationally important marine species are currently considered to be under threat (NPWS, 2019). Two species of the calcareous red algae maërl, which are found in ten marine Special Areas of Conservation (SACs), have an unfavourable bad status, while nine of these habitats are in an unfavourable condition (NPWS, 2019). The National Parks and Wildlife Service (NPWS) and Northern Ireland Environment Agency have recently updated the Red List, which identifies species in most need of conservation interventions (Chapter 6). The migratory fish, sea lamprey, and the twaite shad are listed as near threatened and vulnerable, respectively (King *et al.*, 2011). An assessment of 58 cartilaginous marine fish found that six were critically endangered: Portuguese dogfish (*Centroscymnus coelolepis*); common (blue) skate (*Dipturus batis* (= flossada)); flapper skate (*Dipturus intermedius*); porbeagle shark (*Lamna nasus*); white skate (*Rostroraja alba*); and angel shark (*Squatina squatina*). The angel shark is considered to be in danger of extinction (Clarke *et al.*, 2016). Five species were assessed as endangered and six as vulnerable. OSPAR has compiled a list of threatened and declining species and habitats in the North East Atlantic which are considered a priority for protection.¹²

Fish species in Irish marine waters that are not fished or sold on the market (non-commercial fish) are not all achieving Good Environmental Status under MSFD Descriptor 1 (biological diversity). Only 11 species achieve GES, 18 species are not achieving GES and the environmental status of a further 23 non-commercial species is unknown (DHPLG, 2020).

National surveys of seabird populations indicate that populations of 17 of the 20 species monitored have increased over the last 16 years, populations of two species are considered stable and the population of one species has decreased (Cummins *et al.*, 2019). Breeding pairs of the black-legged kittiwake, globally the most numerous gull species, have declined by 32 per cent from 1998-2002 to 2015-2018 (Cummins *et al.*, 2019; DHPLG, 2020). Numerous resident and migratory water bird species that spend the winter at coastal sites in Ireland, such as estuaries and lagoons, are showing significant and continued population declines (Lewis *et al.*, 2019). For example, the

grey plover (*Pluvialis squatarola*) migrates from breeding grounds in Arctic Russia and Canada to overwinter on Ireland's coast. This species, which is monitored via the Irish Wetland Bird Survey (I-WeBS), underwent a population decline of 62 per cent between 1994 and 2016 (Lewis *et al.*, 2019). Unfortunately, until recently there has been comparatively little monitoring data on those species that overwinter offshore, such as seaducks and divers.

Long-term data on communities of offshore marine mammals, such as the migratory baleen whales or deep-diving toothed cetaceans (whales, dolphins and porpoises) are not yet available for all species. However, recent abundance data from Ireland's exclusive economic zone have indicated that some species' numbers are higher than previously thought (Rogan *et al.*, 2018; NPWS, 2019). The harbour porpoise is frequently recorded in Irish waters (Rogan *et al.*, 2018). Although accidental by-catches of this and other small cetacean and seal species during fishing operations do occur, for several species their relatively high abundance and spatial distribution suggest that such pressures are currently not impacting their populations (DHPLG, 2020). The grey seal and harbour seal have grown in number and distribution in recent decades and are considered to be achieving Good Environmental Status (Morris and Duck, 2019; NPWS, 2019).

Further information on wider biodiversity issues, policy and legislation covering this area is provided in Chapter 6.

Marine Protected Areas

Recent assessments indicate that 65 per cent of Ireland's coastal habitat types are considered to be in an unfavourable condition.

Currently, only 2.1 per cent of Ireland's maritime area has been designated for protection¹³ under existing conservation-based legislation (e.g. Birds and Natural Habitats Regulations). This estimate of existing includes SACs under the Habitats Directive, 19 of which are also recognised as OSPAR Marine Protected Areas (MPAs). Ireland's 2019 Habitats Directive Article 17 report (NPWS, 2019) indicates that, of the 23 coastal and/or marine habitat types listed under the Habitats Directive, five have a favourable status nationally (Table 8.2). The remaining 15 types have either an unfavourable – inadequate ($n = 12$) or an unfavourable – bad ($n = 3$) status. In particular, lagoons, large shallow inlets and bays, halophilous scrub and fixed dunes are in an unfavourable-bad status and are declining. The causes of the unfavourable-bad status assignment in these nearshore areas are: persistent eutrophication issues (in lagoons, large shallow inlets and bays), loss of species (seagrass and maërl in large shallow inlets and bays), human-induced impacts and the presence of invasive species (in fixed dunes).

¹² <https://www.ospar.org/work-areas/bdc/species-habitats/list-of-threatened-declining-species-habitats>

¹³ The value of 2.1% is based on the existing marine component of Natura sites and Ireland's maritime area as the baseline (488,762 km²).



Table 8.2 Assessment results for each habitat type listed under the Habitats Directive for 2007, 2013 and 2019 (Source: NPWS, 2019)

COMMON NAME	CODE	2007 OVERALL STATUS	2013 OVERALL STATUS AND OPERATOR	2019 OVERALL STATUS AND TREND
Sandbanks	1110	●	●	●
Estuaries	1130	●	▲	▼
Tidal mudflats and sandflats	1140	●	▲	▼
Lagoons*	1150	●	●	▼
Large shallow inlets and bays	1160	●	▲	▼
Reefs	1170	●	▼	●
Submarine structures made by leaking gases	1180	●	●	●
Drift lines	1210	●	▼	▼
Shingle	1220	●	●	●
Sea cliffs	1230	●	●	●
Salicornia mud	1310	●	▼	●
Atlantic salt meadows	1330	●	●	▼
Mediterranean salt meadows	1410	●	●	▼
Halophilous scrub	1420	●	▼	▼
Embryonic shifting dunes	2110	●	●	●
Marram dunes (white dunes)	2120	●	●	●
Fixed dunes (grey dunes)*	2130	●	●	▼
Empetrum dunes*	2140	●	●	●
Dune heath*	2150	●	●	●
Dunes with creeping willow	2170	●	●	●
Dune slacks	2190	●	▼	▼
Machair*	21A0	●	●	●
Sea caves	8330	●	●	●

STATUS: ● Favourable ● Unfavourable-Inadequate ● Unfavourable-Bad ● Unknown

TREND: ▲ Improving = Stable ▼ Declining

* priority habitat



Bathing Water

In total, 97 per cent of designated coastal bathing waters were classified as being of either 'excellent' or 'good' quality in 2019.

Ireland's coastal and inland bathing water quality can be considered to be very high, with 95 per cent (140 of 147 coastal bathing waters) meeting or exceeding the minimum EU standard for sufficient water quality (EPA, 2019b).¹⁴ Of these, 131 bathing waters (89%) were classed as being of either excellent or good quality, with most of these ($n = 107$) being in the excellent category. Five locations were assessed to be of poor quality. In 2019 there was an increase in the number of 'prior warning' notices issued, which advise the public of possible short-term pollution events. This was probably the result of the wetter summer and more local authorities using this precautionary approach to protect bathers' health. Most of these warnings did not result in bathing water pollution incidents and, overall, bathing water quality continued to improve in 2019.

3. Drivers, Pressures and Impacts

Our marine areas are impacted by many human-induced pressures, including fishing, climate change, eutrophication, litter, noise and other forms of pollution. While independently these issues continue to put pressure on our fragile marine systems, their combined influence is difficult to accurately determine and needs further assessment.

Marine Fisheries

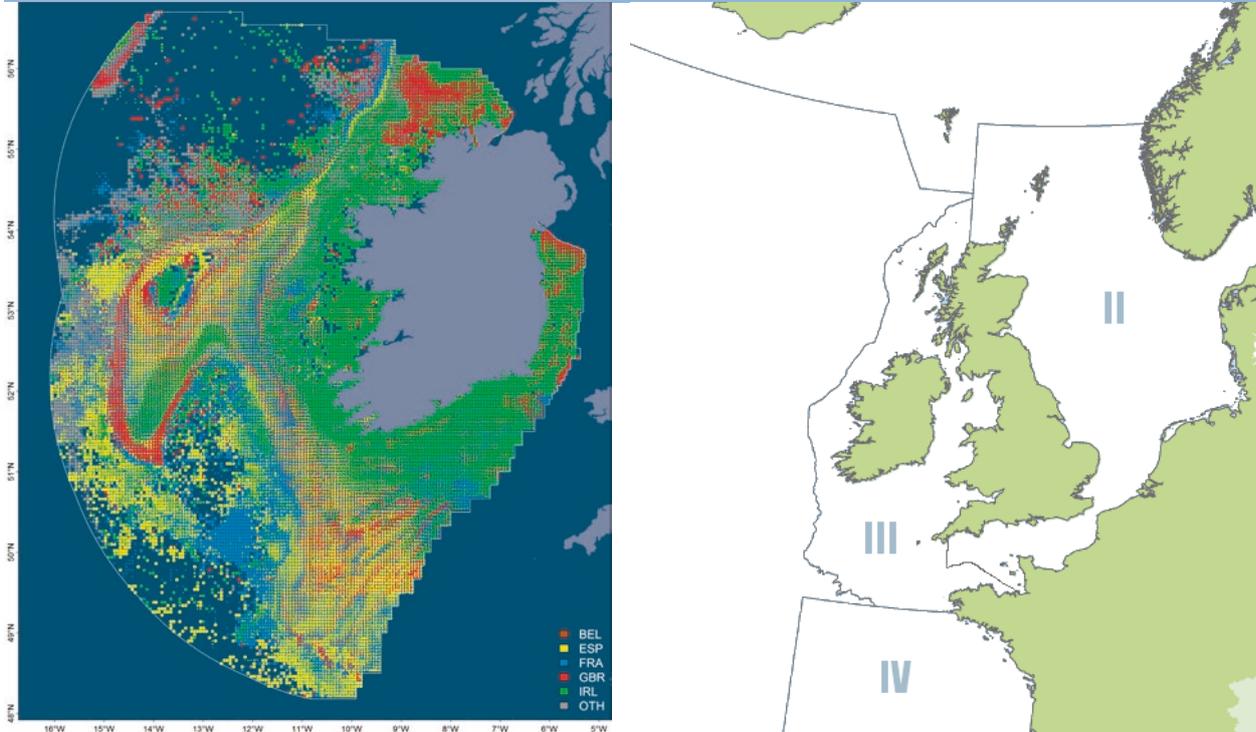
Fish stocks in Irish waters have fallen because of pressures from overfishing, physical disturbance and damage to seafloor habitats.

Ireland's seafood sector was worth €1.25 billion in 2018 (BIM, 2019) and its marine area is considered to be an extensive resource for commercial fishing and aquaculture. However, extensive and prolonged overfishing has had a severe impact on commercial fish and shellfish stocks. The MSFD status results indicate that 34 stocks (18 per cent) of assessed fish and shellfish stocks have achieved Good Environmental Status; however, in the case of 44 stocks (22 per cent) Good Environmental Status has not been achieved. The environmental status of 99 stocks (60 per cent) is currently unknown (DHPLG, 2020). To rectify the impacts of fishing, catches of cod, haddock and herring are now limited. The use or location of nursery and feeding habitats is still poorly understood and many benthic habitats, including reefs, are thought to have been severely damaged by bottom-contacting fishing gears. Physical disturbance to the seabed from international fishing pressures is widespread in the continental shelf area surrounding Ireland within OSPAR Region III, occurring to some degree in 70 per cent of the assessed area, with a high level of disturbance recorded in 46 per cent of the area. This assessment is limited to OPSAR Region III only and does not cover all of Ireland maritime area (Figure 8.3). Physical disturbance occurs in 64,860 square kilometres or 13.29 per cent of the overall area (OSPAR Region III – Celtic Seas, and Region V-Wider Atlantic). OPSAR Region V accounts for 69 per cent of Ireland's maritime waters, with the remainder lying in OSPAR Region III.

¹⁴ Ireland's bathing waters include 138 coastal bathing waters (includes coastal and transitional waters) and nine inland bathing waters. The 2019 classification for inland waters classified eight as being of excellent quality and one as being of poor quality. The 2019 classification for coastal waters classified 123 as being of excellent or good quality, 9 as being of sufficient quality and four as being of poor quality, and two new bathing waters which will be classified in 2020.



Figure 8.3 Pressure map of fishing efforts in Irish waters on the left (Gerritsen and Kelly, 2019). OSPAR Region III is shown on the right



Aquaculture

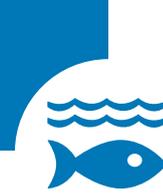
Aquaculture is an important sector that can potentially impact the marine environment through a number of pressures.

In Ireland, aquaculture mainly consists of shellfish (oysters and mussels) and finfish (mostly salmon) farms. Ireland has 64 designated shellfish growing areas, which have specified water quality requirements to support shellfish life and growth. The Irish aquaculture output in 2017 was worth €208.4 million, with production relatively constant over the last decade. Aquaculture can impact the marine environment through escaped farmed salmon, spreading of disease to native populations, disturbance to and displacement of fish, shellfish, birds and other wildlife populations, and water pollution and is considered a pressure for a number of protected habitats (Bresnihan, 2016; NPWS, 2019). Recent Irish research has indicated that wild Salmon smolts (young Salmon which are ready to migrate to the sea) with mild-to-moderate lice infestations from coastal aquaculture may show greater sensitivity to ocean warming and fewer returns to rivers in following years (Shepard and Gargan, 2020). Pollution risks to shellfish water and environmental health aspects are discussed in Chapter 14.

Climate Change and its effects on the Marine Environment

Since 1994, temperatures in Irish coastal waters have increased at a rate of 0.6°C per decade. Climate change can impact ocean and coastal processes through changes to their, physico-chemistry and temperature and have effects on ecosystem components including valuable commercial fish stocks.

Climate change impacts on the coastal and marine environment manifest through a shift in the baseline conditions for ecosystem structure (coastal erosion, sea level rise), physico-chemical conditions (temperature and ocean acidification) and the transport of anthropogenic pressures, such as nutrients, from land-based sources. These shifts can have very clear, and in some cases, irreversible impacts on marine ecosystems including the organisms that live in them.



Ocean Warming, Sea Level Rise and Coastal Erosion

Evidence of warming waters and sea level rise has been recorded around Ireland's coasts and poses a serious risk to Ireland's coastal areas, particularly major coastal cities.

Global sea surface temperature has been increasing consistently over the last three decades and the world's oceans were the warmest in recorded human history in 2019 (Cheng *et al.*, 2020; von Schuckmann *et al.*, 2020;). Since 1994, temperatures in Irish coastal waters have increased at a rate of 0.6°C per decade (Nolan *et al.*, 2010), which is unprecedented in the 158 years of observational records available. Warm water organisms, such as certain species of zooplankton, jellyfish and comb jellies, have been more evident since 1997, particularly in warm years (Nolan *et al.*, 2010). A number of warm water fish species have also become more abundant around the northern-most coasts of Ireland and in the Celtic Sea. This phenomenon is expected to continue as temperatures increase.

Increasing temperatures have also been shown to alter kelp forests globally (Krumhansl *et al.*, 2016). At the warmest edges of their range, some of these forests are decreasing in size, while in Arctic regions the geographical distribution of certain species has increased (Filbee-Dexter *et al.*, 2019). Estimates based on seabed type indicate Ireland has abundant kelp forests (Werner and Kraan, 2004). These are not only an important food source and habitat for many types of flora and fauna but also capture and store carbon. While no large-scale changes have been recorded thus far, a southern European kelp species (*Laminaria ochroleuca*, Bachelot de pylaie) was recently identified in Béal an Mhuirthead, County Mayo, suggesting the possible movement of the species northwards (Schoenrock *et al.*, 2019). A possible threat to Ireland's kelp forest from changes in geographical range due to increasing temperatures has not yet been identified but may need to be considered in future scenarios.



Future warming is expected to increase the intensity of storms (Desmond *et al.*, 2017). Coupled with this, sea level rise has been recorded globally (3.3 ± 0.4 mm per year since 1993, Von Schuckmann *et al.*, 2020), in Ireland (2-3 mm per year since the early 1990s) using satellite data¹⁵ and in the south-west of England (3.8 mm per year since 1993) using tide gauges (Bradshaw *et al.*, 2016). Under current scenarios, the sea level will continue to rise (Flood and Sweeney, 2012). According to the latest report from the Intergovernmental Panel on Climate Change, the sea level is predicted to rise by between 0.43 metres and 0.84 metres by the end of the century, based on emission scenarios compatible with achieving the long-term temperature goal set out in the Paris Agreement (IPCC, 2019). Incidents of coastal erosion and flooding from increased storm activity will be magnified by sea level rise and pose a serious risk to Ireland's coastal areas, particularly major coastal cities. Increasing annual mean river flows have also been recorded (DCCA, 2018). If this continues, it could exacerbate the transport of nutrients from soil and anthropogenic sources to coastal and marine areas, as well as increasing the risk of flooding.

Ocean Acidification

Increasing seawater acidity, caused by carbon emissions, could particularly impact Ireland's shellfish industry.

The oceans currently absorb a quarter of anthropogenic carbon dioxide emissions, resulting in them becoming more acidic. This progressive acidification can make it difficult for organisms such as corals, shellfish and crabs to build their outer calcium carbonate shells. This in turn can impact the functioning of the food web, including structural changes in phytoplankton communities and keystone species, alteration of fish populations through habitat modification, and the potential to disrupt nutrient and carbon cycles (Mostofa *et al.*, 2016).

Seawater acidity increased in the Labrador Sea waters of the Rockall Trough between 1991 and 2010 at a rate of 0.02 pH units per decade (McGrath *et al.*, 2012). If this rate continues it could have an impact on the Irish shellfish aquaculture industry, particularly on high-value rope mussels and Pacific oysters. A recent study of Irish coastal and transitional (estuarine) systems indicates that local vulnerability to future acidification will be dependent on geology, freshwater discharge and biological activity (McGrath *et al.*, 2019).

¹⁵ Information and data from the European Space Agency's Climate Change Initiative, the Sea Level project, are available at <http://www.esa-sealevel-cci.org/>.



Marine Litter

Marine litter, including plastics and microplastics can be found throughout our marine waters; more research to assess their impact on marine life, food webs and human health is required.

Public awareness of the impacts of marine litter and, including, microplastics on marine ecosystems and life forms has been growing over the last few years. Marine litter, including microplastics have been recorded in every part of the world's oceans (Lusher, 2015), on our beaches, and in many marine organisms.

The EU Commission's Joint Research Council Technical Report on the Harm Caused by Marine Litter (Werner *et al.*, 2016) concluded that, 'although the extent of harm of marine litter to ecosystems has yet to be determined there is evidence of harm to individuals or groups of marine animals or plants'. Ingestion may also provide a pathway for the transport of harmful chemicals into marine food webs. These harmful chemicals include persistent organic pollutants such as polychlorinated biphenyls (PCBs) which can bioaccumulate in apex predators such as killer whales (Schlingermann *et al.*, 2019). Laboratory tests suggest that high levels of exposure to harmful chemicals under specific circumstances can result in physical and chemical toxicity (SAPEA, 2019). Chapter 14 provides further details on plastic pollution.

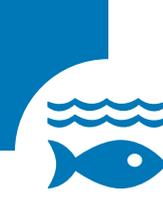


Nutrient Enrichment

While eutrophication is currently not a major concern for coastal and marine waters, future warming due to climate change could increase the impacts of nutrient enrichment.

Excess nutrients in coastal and offshore marine areas can stimulate the growth of aquatic plant life and result in the depletion of oxygen, leading to eutrophication. This reduction in oxygen can have negative knock-on effects for fish and marine fauna living in these areas and can result in the loss of sensitive aquatic species. The build-up of phytoplankton blooms and large green seaweed in coastal areas can also be detrimental for tourism, recreation and fisheries. In Ireland, eutrophication increases with proximity to human activity and land-based sources of nutrients (see Chapter 7 for further details). While our estuaries are affected by eutrophication, our coastal regions are healthier, and no eutrophication issues have been found in outer marine areas. Coastal and marine systems benefit from their proximity to the Atlantic Ocean, which can dilute nutrients and decrease contaminant loads originating from land-based sources.

However, in coastal and marine systems eutrophication impacts could be exacerbated by warmer growth conditions for phytoplankton and seaweed. A recent analysis of long-term monitoring data indicates that, after nutrient concentrations, temperature is the factor that most influences the health of the phytoplankton community in Irish transitional and coastal waters (Ní Longphuirt *et al.*, 2019). Similarly, global warming scenarios are expected to have an impact on green tides (opportunistic algal blooms) in Irish coastal areas if nutrient conditions are not improved (Bermajo *et al.*, 2019). Consideration of the combined impact of pressures such as climate change and eutrophication is essential to understand the future health of marine ecosystems.



Dredging and Dumping at Sea

Material that is dredged at sea must be disposed of under permit in authorised locations.

The removal of seabed material for maintenance and navigational purposes is a common occurrence in harbours around Ireland. The disposal at sea of this dredged material can occur only under a Dumping at Sea permit authorised by the Environmental Protection Agency (EPA). Permit returns show that, in 2018, over 2.8 million tonnes of material were dredged and deposited at 12 licensed disposal sites around the Irish coast (Figure 8.4). Traditional technologies such as trailing suction hopper dredging and plough dredging account for most dredging operations in Ireland. Water injection dredging, an alternative technology, has been partially utilised in Cork Harbour and the Malahide Marina. Several nationally significant infrastructure expansion projects are under way in the marine sector that involve the dredging of uncontaminated sediments from ports and their disposal at sea in authorised locations.

- In Dublin Port, preparatory works for the redevelopment of the Alexandra Basin are under way. This involves deepening of the navigation channel and the construction of new berths and ancillary facilities to accommodate larger ships. This €230 million redevelopment project will be the largest strategic infrastructure project in the port's history.
- In Cork, relocation of the Port of Cork has commenced at a cost of €100 million. This will transpose the port 10 kilometres from the city centre to the Ringaskiddy Terminal, which has adequate water depths, channel width and space to accommodate larger vessels.
- Development works are also proposed for Shannon Foynes Port as part of a €64 million development plan. The Shannon Foynes Port Company intends to convert over 33 hectares east of its existing port into a site for marine-related industry, as well as implement changes to its existing jetties and quays. This work will be the biggest infrastructure development programme ever undertaken by the company.
- In County Donegal, construction work on Killybegs Fishery Harbour Centre costing €6.5 million is also scheduled to commence. This will provide an additional 120 metres of berthing space by extending the quay wall and deepening the berthing pocket.

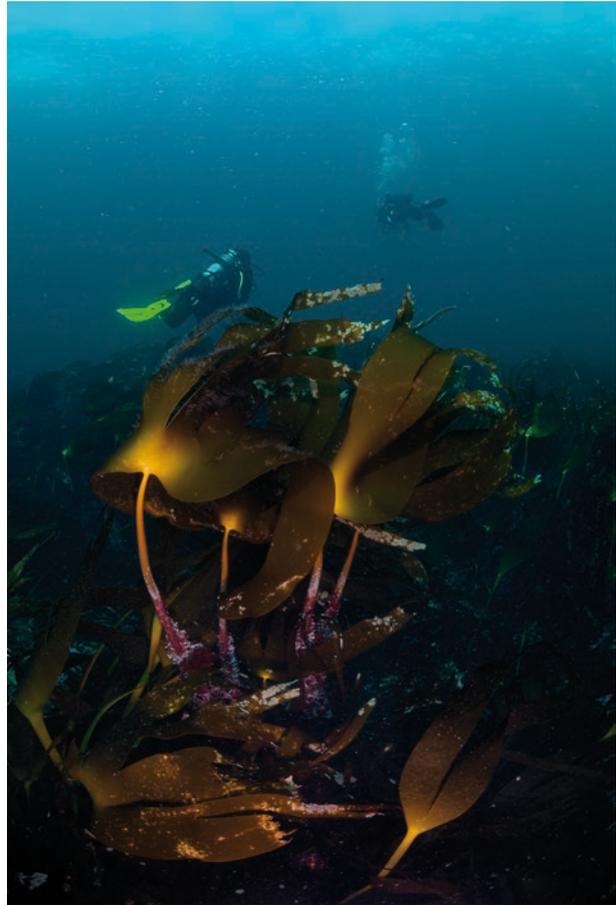
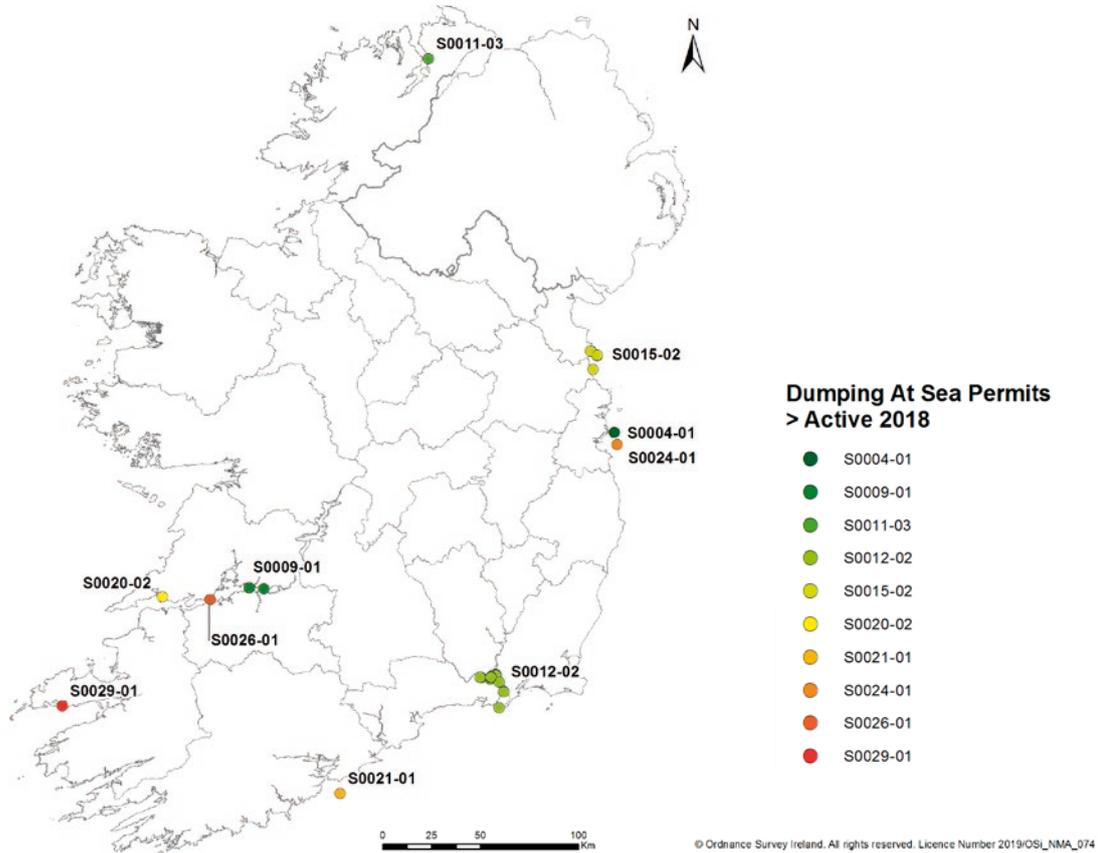




Figure 8.4 This table provides a list of dumping at sea permits and areas where dredging occurred in 2018 (confined or unconfined)¹⁶



NO.	REG NO.	ORGANISATION	LICENCE NAME	DREDGES IN 2018	TONNAGES
1	S0004-01	Dublin Port Company	Dublin Port	Yes	178,558
2	S0009-02	Shannon Foynes Port Company	Shannon Foynes Port Company	Yes	168,020
3	S0011-03	Donegal County Council	Buncrana Harbour	Yes	5335
4	S0012-02	Port of Waterford Company	Port of Waterford	Yes	295,881
5	S0015-02	Drogheda Port Company	Drogheda Port	Yes	236,649
6	S0020-02	L&M Keating	Kilrush Marina	Yes	834
7	S0021-01	Port of Cork Company – East	Ringaskiddy	Yes	193,067
8	S0024-01	Dublin Port Company	North Wall Quay Extension in the River Liffey Channel	Yes	1,625,937
9	S0026-01	Aughinish Alumina Limited	Aughinish	Yes	1677
10	S0029-01	Department of Agriculture, Food and the Marine	Dingle Harbour	Yes	95,325

¹⁶ Confined dumping relates to material that is excavated at one site (by trailing suction hopper dredging or grab dredging) and dumped at a designated offshore site. Unconfined dumping relates to plough dredging or water injection dredging where dredged material remains at the site.

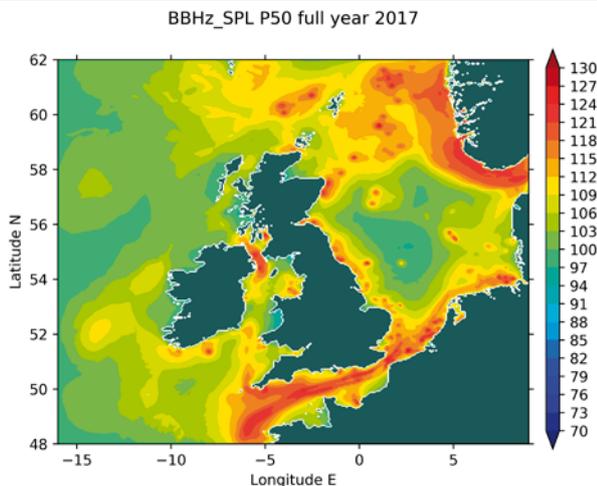


Underwater Noise

Anthropogenic underwater noise can interfere with the navigation, communication and prey location of marine mammals, but is not considered a significant threat in most of Ireland's marine waters.

Anthropogenic underwater noise related to vessel movement, seismic surveys, drilling, use of sonar, pile driving, underwater explosions and dredging has increased as these sectors expand. This noise can interfere with the habitat condition, navigation, communication and prey location of marine animals up to tens of kilometres from the noise source. Recent research on underwater noise has produced noise risk maps for high-, medium- and low-frequency cetacean groups (Sutton *et al.*, 2014). A map of shipping noise has been produced by the UK Centre for Environment, Fisheries and Aquaculture Science (CEFAS) for Irish and UK waters (Farcas, *et al.*, 2020). This indicates that the areas with the greatest shipping noise in Irish waters are located on the south-west and north-east coasts of Ireland (Figure 8.5). The levels of impulsive underwater noise-causing activities within Ireland's maritime area were considered low during 2016-2018 and Good Environmental Status is currently being achieved (DHPLG, 2020), although gaps in knowledge on the impacts of this pressure are acknowledged. Work continues through the EU Technical Group on Noise and the OSPAR Group on Noise to address the knowledge gaps and to create harmonised assessments and standards.

Figure 8.5 Map of shipping noise produced by CEFAS. The map was produced using data captured by microphones placed on the seabed (Farcas *et al.*, 2020). Annual P50 total noise; colour scale shows sound pressure level in units of dB re 1 μ Pa



Seaweed Harvesting

Traditional hand harvesting of intertidal seaweed takes place in Ireland but interest in mechanical harvesting has increased.

Traditional seaweed harvesting and processing has been carried out on the west coast of Ireland for many centuries. This involves the collection of bladder wrack (*Ascophyllum nodosum*) at low tide with the use of sickles, knives and, in some cases, rakes. Local harvesters leave a section of the root to ensure that this renewable resource is maintained. Currently, in areas where existing rights to harvest are in place, seaweed harvesting licences cannot be given to new applicants.¹⁷ While traditional harvesting has generally been focused on intertidal wrack species, more recently interest in using mechanical means to harvest subtidal kelp communities has increased. Additional pressures on habitats and marine biodiversity and loss of storm surge protection are associated with mechanical harvesting (Smale *et al.*, 2013). KelpRes¹⁸ is a recently funded project that will investigate the diversity and resilience of these ecosystems in Ireland.



¹⁷ <https://www.housing.gov.ie/planning/foreshore/minister-english-clarifies-legal-position-around-seaweed-harvesting-and>

¹⁸ <http://www.nuigalway.ie/zoology/research/kelpres/>



4. Responses

Ireland's marine area includes many nationally and internationally important ecosystems, communities and species. Protection, recovery and expansion of these will be achieved only by recognition of their importance, identification of their geographical range and the creation of a legislative structure for their sustainable protection.

The Strategic Plan for Biodiversity 2011-2020¹⁹ of the Convention on Biological Diversity has set Aichi biodiversity targets that aim to 'take effective and urgent action to halt the loss of biodiversity in order to ensure that by 2020 ecosystems are resilient and continue to provide essential services, thereby securing the planet's variety of life, and contributing to human well-being, and poverty eradication'. These targets are mainly aimed at protecting and restoring marine ecosystem functioning and biodiversity.

The United Nations Sustainable Development Goals (SDGs), developed in 2016, include SDG 14 (Life Below Water), which focuses on the conservation and sustainable use of the oceans, seas and marine resources for sustainable development. SDG 14 has several targets, which include preventing and reducing marine debris and nutrient pollution; sustainably managing, protecting and restoring marine and coastal ecosystems; minimising and addressing ocean acidification; regulating and ending overfishing and destructive fishing practices; and conserving at least 10 per cent of all coastal and marine areas (also included in Aichi target 11). The recent EU Biodiversity Strategy for 2030 aims to increase the area legally protected to a minimum of 30 per cent of the EU's sea area and integrate ecological corridors as part of a Trans-European Nature Network (EU, 2020).

The SDGs global initiative is being delivered in the EU through a series of EU policies and legislation, which includes the MSFD, the EU Integrated Maritime Policy and the Habitats and Birds Directives. This work is further supported through the long-term efforts under the OSPAR Convention. Ireland has produced a National Implementation Plan 2018-2020²⁰ to move towards implementing the 17 SDGs. Information on the progress of Ireland's SDGs can be tracked on the SDGs data hub.²¹

The EU recently reported on implementation of environmental policy and law in Ireland (EC, 2019). Within this, priority actions for Ireland in relation to the marine sector were identified and can be considered as a template for future measures, particularly in relation to the MSFD. These are stated in the report as follows.

- 'Determine the timelines for achieving good environmental status, when these have not been reported.
- Provide more information about measures. Decide on more measures that directly impact the pressures on marine and coastal habitats. Quantify the expected level of reduction in the pressure as a result of these measures.
- Ensure regional cooperation with Member States sharing the same marine (sub) region to address the leading sources of pressures.
- Ensure reporting of the different elements under the Marine Strategy Framework Directive by the set deadline.'

Several solutions for halting the loss of marine biodiversity and restoring ecosystem resilience are available and need to be implemented so an equilibrium between our economic expectations of our seas and the long-term policy vision for clean, healthy and productive seas is to be found (EEA, 2019).

Spatial Planning

Detailed spatial plans and seabed mapping are key tools needed to protect the marine environment.

Ireland is developing a National Marine Planning Framework (NMPF) as part of the Marine Spatial Planning Directive (2014/89/EU). This framework will provide guidance on the sustainable planning and management of marine resources, balancing ecological, economic and social objectives in relation to aspects such as the environment and biodiversity, commercial fisheries, and renewable energy and hydrocarbons. According to the directive, the Marine Spatial Plan must be in place by March 2021. A roadmap for this plan was developed in 2017 (DHPLG, 2017).

Public consultation on the draft National Marine Planning Framework was launched in November 2019 and consultation closed in April 2020 (DHPLG, 2019). The draft sets out supporting policies around a range of marine activities and environmental areas. The 'Programme for Government June 2020' reported that the government will bring forward Ireland's first ever National Marine Planning Framework, as well as publishing Ireland's first ever marine spatial planning policy, setting out a clear vision for the future development of our marine planning system. This will be part of 'Project Ireland Marine 2040' (Government of Ireland, 2020).

19 <https://www.cbd.int/sp/>

20 <https://www.gov.ie/en/publication/7cde9f-the-sustainable-development-goals-national-implementation-plan-2018-/>

21 <https://irelandsdg.geohive.ie/>

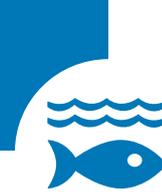
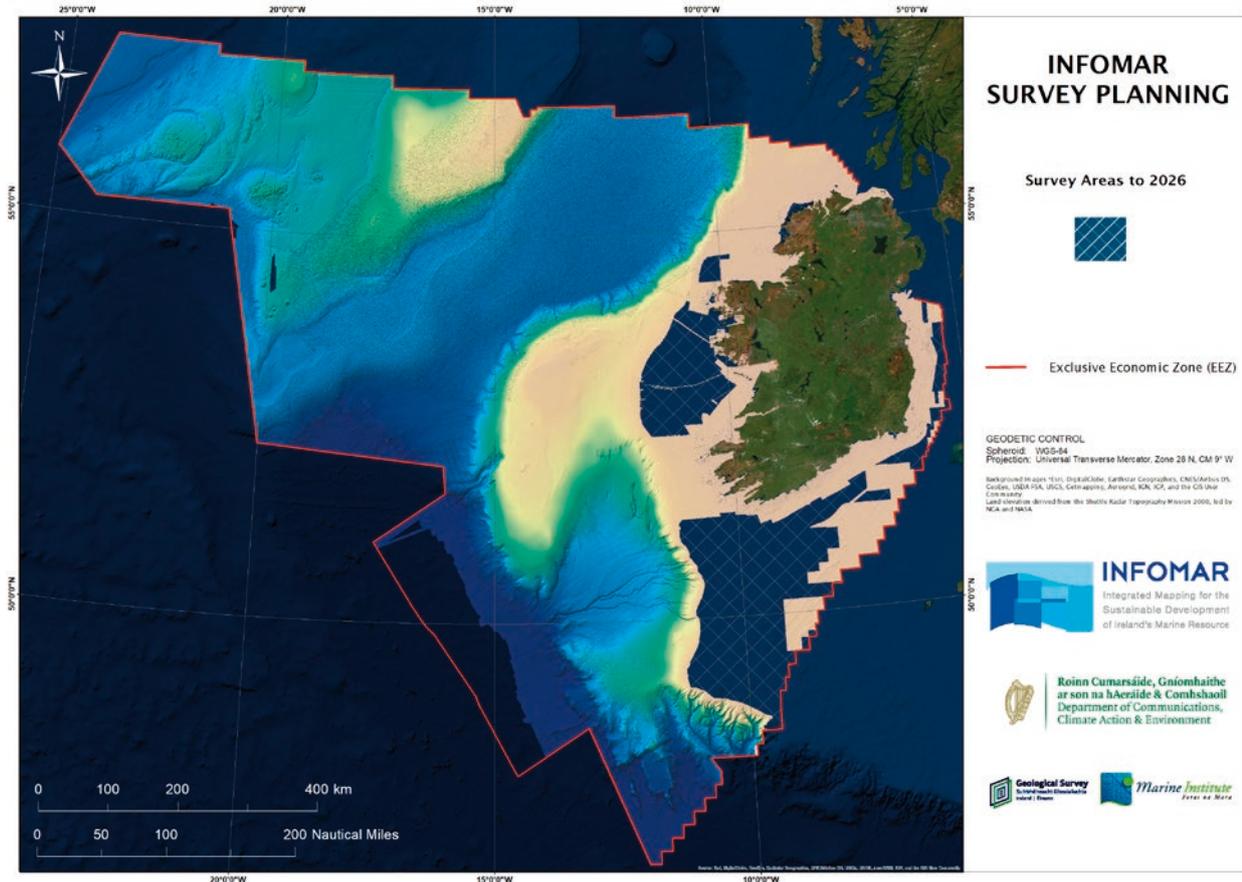


Figure 8.6 INFOMAR survey mapped areas to date and survey planning to 2026



The NMPF is supported by INFOMAR (Integrated Mapping for Sustainable Development of Ireland's Marine Resource). This 20-year programme aims to map Ireland's seabeds, such as vulnerable offshore reefs (Topic Box 8.2 and Figure 8.6). INFOMAR provides information for Ireland's Marine Atlas,²² which is a publicly accessible reporting and investigative tool. The atlas includes marine data on, for example, administrative boundaries, ocean features, fisheries and aquaculture sites, marine monitoring, seabed habitats, tourism and leisure, transport, infrastructure, discharge point sources and Natura sites.

22 <https://atlas.marine.ie>



Topic Box 8.2 INFOMAR and Ireland's Coral Reefs

The European Maritime and Fisheries Fund (EMFF) Offshore Reef project has shown the wealth of biodiversity in Ireland's offshore habitats and will contribute to our understanding of these little-studied habitats, thus helping us to afford them better protection.

An extensive offshore reef survey of Ireland's north-west continental margin was commissioned in 2017 by the NPWS. It was funded by the EMFF and coordinated and led by INFOMAR (Integrated Mapping for the Sustainable Development of Ireland's Marine Resources) and the Marine Institute.

The objective of the 3-year project was to implement the EMFF's Marine Biodiversity Scheme, 'Fisheries Natura', by mapping offshore reef habitats to protect them from deterioration as a result of fishing pressures. The Offshore Reef project aligns with subarticle 6.2 of the Habitats Directive, which requires Member States to take measures to avoid the deterioration of protected habitats. The first two SeaRover surveys²³ were completed in 2017 and 2018 using the Marine Institute's remotely operated vehicle, Holland 1 (Figure 8.7). In addition to mapping reef habitats, the following discoveries were made:

- previously unknown vulnerable marine ecosystems
- cold-water coral species forming reefs at depths greater than 1600 m
- coral species previously unrecorded in Irish waters, including one species that may be new to science
- previously undocumented habitats off Ireland's north-west continental shelf, for example underwater sea mountains and steep cliff faces.

Some of the cold-water coral species grow at a rate of 1 mm per year and locating reefs that are thousands of years old was an important scientific find.

INFOMAR is a 20-year programme to map the physical, chemical and biological features of Ireland's seabed. The project is funded by the Department of the Environment, Climate and Communications and jointly managed by Geological Survey Ireland and the Marine Institute.²⁴

Figure 8.7 Images of 'Coral Garden' and 'Lophelia Reef' (Source: ©SeaRover survey/Irish Government/European Maritime and Fisheries Fund)



23 <https://www.infomar.ie/rd-and-education/case-studies/deep-water-coral-reefs>

24 <https://www.infomar.ie/about-us>



Marine Fisheries

Quota management and monitoring are key to protection measures covering commercial fisheries.

The Common Fisheries Policy (CFP) governs the fishing sector in Ireland. 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 CFP reform has led to the phased introduction of landing obligations for species subject to catch limits. This aims to eliminate the practice of discarding unwanted catches. It is expected that these obligations, together with changes in fishing gear and fishing methods, could lead to an improvement in fish stocks and a more sustainable fishing industry. The recent EU Biodiversity Strategy also outlines the need for marine resources to be harvested sustainably and the need for zero-tolerance for illegal processes (EU, 2020). Bord Iscaigh Mhara (BIM) has produced a fisheries management chart that details the landing obligations and quotas for 2019.²⁵

Fishing vessels over 18 metres have been excluded from trawling within 6 nautical miles of the coast since January 2020.²⁶ This measure, regulated by Inland Fisheries Ireland, aims to protect coastal marine areas and, specifically, juvenile fish, which often spend their nursery years in shallower waters around the coast. Similarly, since 2003 the level of fishing effort has been regulated in an area off the south-east coast of Ireland called the Irish Conservation Box, which follows the 200 metre bathymetric contour. It was defined on scientific grounds by the Marine Institute because of its importance for spawning and as a nursery area for certain commercially exploited fish.

The Marine Institute also produces the *Stock Book* (Marine Institute, 2018), an annual review of commercial fish stocks in Irish waters. This informs fisheries quota management for the year ahead. Additional measures that aim to protect and manage marine ecosystems include the restriction of bottom trawling below a depth of 800 metres on deep sea reef habitats designated under the Habitats Directive (EU Regulation 2016/2336).²⁷ The 800 metre limit builds on existing industry-led voluntary measures that are applied in EU waters and considers the specificities of deep-sea fisheries in these waters.

Under the CFP, the UK and Ireland have historically fished in each other's waters for Atlantic mackerel and Dublin Bay prawns. As the UK withdraws from the EU,

any exclusion of fishing effort from UK waters may displace the EU fishing effort from UK waters to Irish national waters, resulting in an increased burden on Irish ecosystems. The future of fishing rights is likely to depend on decisions made as part of Brexit negotiations between the EU and the UK (O'Higgins and O'Hagan, 2019).

Aquaculture

Monitoring and regulation are important for minimising the impact of the aquaculture sector on the environment.

A national strategic plan for aquaculture²⁸ was developed in 2015; this aims to sustainably grow the aquaculture sector while ensuring environmental protection of marine ecosystems. However, this growth will have to be considered in relation to its impact on environmental status under the WFD and MSFD, as well as on the conservation objectives and status of sites protected under the Habitats Directive (SACs) and the Birds Directive (Special Protection Areas – SPAs). Aquaculture licensing is administered through a substantial appraisal system by the Department of Agriculture, Food and the Marine (DAFM) and includes the requirement for an appropriate assessment (Bresnihan, 2016).

To minimise any potential impact of aquaculture activities on the environment, the DAFM has developed a range of Marine Finfish Protocols to which each licensed producer must adhere. These protocols cover areas such as benthic monitoring, water quality monitoring, sea lice monitoring, fallowing and structural design.²⁹ Benthic and sea lice surveys are carried out at each active marine finfish culture site annually. The latest survey indicates that sea lice levels on salmon smolts (age 1-3 years) are below treatment trigger levels, suggesting that control methods and practices can have a positive impact on the control of sea lice in Irish salmon farms (O'Donohoe *et al.*, 2019).

In relation to disease prevention, all aquaculture production businesses are regulated for fish health purposes through EU Directive on animal health requirements for aquaculture animals and products thereof, and on the prevention and control of certain diseases in aquatic animals (2006/88/EC)³⁰ and Statutory Instrument No. 261 of 2008. The Marine Institute monitors aquaculture sites using risk-based surveillance programmes incorporating planned periodic site inspections and sampling. In addition, outbreaks of disease are investigated by the Marine Institute, as required.³¹

25 <https://www.agriculture.gov.ie/seafood/marineagenciesprogrammesdivision/aquaculturepolicy/http://www.bim.ie/media/bim/content/downloads/BIM-fisheries-management-chart-2019.pdf>

26 This Policy Directive was deemed void and of no legal effect following an application of a judicial review in 2020.

27 <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R2336&rid=4>

28 <https://www.agriculture.gov.ie/seafood/marineagenciesprogrammesdivision/aquaculturepolicy/nationalstrategicplanforsustainableaquaculturedevelopment/>

29 <https://www.agriculture.gov.ie/seafood/aquacultureforeshoremanagement/marinelifinfishprotocols>

30 <https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32006L0088>

31 <https://www.fishhealth.ie>



Climate Mitigation and Adaptation

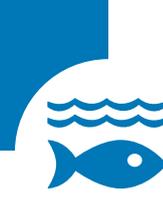
Ireland needs to adapt and plan for the risks of floods, storms and erosion in coastal areas and their impact on communities.

The Climate Change Advisory Council,³² an independent advisory body tasked with reviewing national climate policy, has outlined the need to consider coastal issues relating to climate change, such as erosion, in sectoral adaptation plans (CCAC, 2019).

The National Adaptation Framework (DCCA, 2018) acknowledges that 'the most immediate risks to Ireland which can be influenced by climate change are predominantly those associated with changes in extremes, such as floods, precipitation and storms'. This is extremely relevant to the coastal and marine environment. Managing the response to climate change requires mitigation of carbon dioxide emissions, nature-based solutions, emergency planning and long-term adaptation solutions. In the case of coastal erosion, regional flood hazard mapping, assessment and strategy formulation have been carried out under the Irish Coastal Protection Strategy Study (ICPSS). This study considered the current level of hazard and projected future climate change scenarios. Guidelines on coastal erosion risk management allow for assessment of a range of potential solutions that may be required in response to climate change, including 'hold-the-line', managed realignment and managed retreat (see Topic Box 8.3).

The 2019 Agriculture, Forest and Seafood Climate Change Sectoral Adaptation Plan (DAFM, 2019b) aims to build resilience to the effects of climate change and weather-related events in the agriculture, forestry and seafood sector. Through case studies it outlines the possible implications of, and the steps required to build resilience to, increases in harmful algal blooms, shifts in fish stock distributions, increases in ocean acidification and shifts in the composition of plankton communities (including copepods and jellyfish). It is hoped that these steps will allow Ireland to plan effective and anticipatory adaptive responses to the impacts of the changing climate. The plan also makes the link between biodiversity, climate change and fish stocks, recognising an increase in the numbers of warm water marine fish species in Irish waters and increased sightings of exotic fish. In 2019, the Department of Culture, Heritage and the Gaeltacht also published the Biodiversity Climate Change Sectoral Adaptation Plan (DCHG, 2019), which includes a number of actions relevant to the marine area.

³² <http://www.climatecouncil.ie/>



Topic Box 8.3 Sea Level Rise: Coastal Protection and Managed Realignment

Projections for the influence of climate change in Ireland include the effects of sea level rise, coastal erosion and flooding. Supported by the Local Authority Climate Action Regional Offices, several local authorities have recently released climate adaptation and mitigation plans (Chapter 2). These have considered areas identified to be at risk by the ICPS to formulate policy and planning solutions to tackle storm surges and sea level rise. Solutions can include coastal defences (sea walls, beach groynes, beach supplementation), zoning to restrict further development in flood risk areas and nature-based solutions.

The Office of Public Works provides funding to local authorities to carry out minor coastal protection projects. In 2018, ten projects were approved, with just under half of these being flood risk management studies and the other half relating to the construction or repair of hard engineering coastal defences, such as rock revetments and sea walls. However, the cost of installing or maintaining these defences must be balanced against the value of the land that is being protected (Nottage and Robertson, 2005). In addition, it could result in coastal habitat loss or 'coastal squeeze', where intertidal habitats are lost because the high-water mark is fixed by a defensive structure such as a sea wall and the low water mark moves landwards towards this structure in response to sea level rise.

One nature-based solution to projected sea level rise and flooding is managed realignment. This allows previously reclaimed land in coastal areas and estuaries to be surrendered back to natural tidal processes. This can improve coastal protection while at the same time providing intertidal habitats for protected species. The recent EPA-funded SAMPHIRES (Saltmarsh Function and Human Impacts in Relation to Ecological Status) project has reviewed a number of systems in Ireland where managed and unmanaged (or unplanned) realignment has occurred (Perrin *et al.*, 2020).

One such example is Harper's Island in Cork. This system was managed as farmland until its abandonment in 2006 (Figure 8.8). Following this, a subsurface breach in a levee allowed saline waters to enter and saltmarsh vegetation rapidly established itself on the island. Cork County Council now own and manage the island as a bird reserve in partnership with Birdwatch Ireland and Glounthaune Community Association. Other examples of managed and unmanaged realignment include projects carried out in Kilmacleague West Wetlands (Co. Waterford), Ballymacoda (Co. Cork), Rogerstown Estuary (Co. Dublin) and Tramore Strand (Co. Waterford).

Managed realignment may result in the creation or movement inland of saltmarshes, mudflats or lagoons, all of which are habitats protected under the Habitats Directive Annex 1. Indeed, modelling studies suggest that, in future sea level rise scenarios, managed realignment and long-term planning will be necessary to ensure conservation in terms of both species present and habitat extent (Perrin *et al.*, 2020). Although Ireland has yet to adopt managed realignment as a mainstream coastal engineering option, evidence from other EU countries suggests that this could be a proactive and cost-effective management option to adapt to, and protect from, climate-driven coastal flooding (Esteves and Williams, 2017).

Figure 8.8 Aerial images of the site at Harper's Island from 2003 (left) and 2017 (right), before and after the unmanaged realignment of the system, respectively (Source: Google Earth from Perrin *et al.*, 2020)





Research

Marine EPA Research Programme 2014-2020 covering key challenges and emerging issues.

Research into the resilience, vulnerability and adaptation of Ireland's coastal and marine systems to climate pressures is ongoing and is supported by maintaining the marine observation network (marine data buoy, tide gauge and wave buoy networks). Ireland also contributes to the annual International Council for the Exploration of the Seas (ICES) Report on Ocean Climate. Some recent and current Irish research projects on coastal and marine systems include:

- Challenges of Transformative Climate Change Adaptation: Insights from Flood Risk Management (Clark and Murphy, 2019)
- Achieving Resilience in the Marine and Coastal Environment in Ireland (EPA funded)
- Integrating Multidisciplinary Geoscientific Data into Forecasting Models to Monitor and Predict Coastal Change: Proof of Concept in Dublin Bay (PREDICT Project) (Science Foundation Ireland, Geological Survey Ireland and Marine Institute funded)
- Mapping, Modelling and Monitoring Key Processes and Controls on Cold-water Coral Habitats in Submarine Canyons (MMMonKey_Pro) (Science Foundation Ireland, Geological Survey Ireland and Marine Institute funded)
- Ireland also has representation at an international level on the Joint Programming Initiative Health and Productive Seas and Oceans (JPI Oceans).³³

Additional information on climate mitigation and adaptation is provided in Chapter 2.

Since 2016, the EPA has funded up to 13 new research projects relevant to the Marine area; a commitment of €2.6 million. These projects were funded mostly under the Water Pillar of the EPA Research Programme 2014-2020.

These EPA-funded projects included research on:

- Nutrient Dynamics and Ecophysiology of Opportunistic Macroalgal Blooms in Irish Estuaries and Coastal Bays (Sea-MAT) <http://www.seamatproject.net/home.html>
- Algal blooms in transitional and coastal waters <https://macromanproject.com/>
- Coastal lagoons <https://www.projectclear.ie/>
- Physico-chemical cycling of nutrients and carbon in marine transitional zones <http://www.nuigalway.ie/science/school-of-natural-sciences/disciplines/earth-ocean-science/research/nutsbolts/index.html>

- Partial funding of a project on Integrated modelling of consequences of terrestrial activities and climate change for freshwater and coastal marine biodiversity and ecosystem services <https://www.biodiversa.org/1424>
- Saltmarsh Function and Human Impacts in Relation to Ecological Status (SAMFHIREs)
- Ecosystem Tipping Points: Learning from the Past to Manage for the Future <https://ecosystemtippingpoints.com/>

Marine system-related EPA Research Reports are available at <http://www.epa.ie/pubs/reports/research/water/>

Further information on EPA-funded environmental research is available at <http://www.epa.ie/researchandeducation/research/researchpublications/researchreports/>

Marine Litter and Plastics

Plastic and marine litter needs to be tackled at source so that it does not end up on beaches or in the ocean.

Knowledge and understanding of the overall ecological impacts of marine litter and plastics is evolving rapidly. It is projected that if current usage patterns and trends continue then impacts may become insurmountable (SAPEA, 2019). It is therefore considered prudent to adopt a precautionary principle when it comes to marine litter and, in particular, plastics. Several regulatory and legal frameworks exist or are emerging that are of relevance to marine litter and microplastics (SAPEA, 2019).

The MSFD includes several goals that are relevant to marine litter and states that Member States must ensure that levels of litter do not cause harm to the coastal and marine environment. OSPAR has also produced a Marine Litter Regional Action Plan, which includes various actions and goals to reduce marine litter. Ireland is leading several actions under the plan, which include investigation of the use of alternatives to polystyrene, investigation of wastewater and stormwater as vectors for litter and assessment of economic and regulatory measures to deal with single-use plastics.

Ninety vessels and 12 ports are taking part in the BIM initiative, Fishing for Litter. This encourages fisherfolk to take ashore the litter they encounter at sea while fishing and to manage their onboard waste appropriately.

33 <http://www.jpi-oceans.eu/>



Irish institutes and researchers are involved in two large projects funded by the INTERREG Atlantic Area funding programme. Clean Atlantic³⁴ is a project focused on gathering and assessing data, knowledge and gaps relating to marine litter in the Atlantic area. Ocean Wise³⁵ is aimed at developing long-term measures to reduce the impact of polystyrene, the most common item found in beach surveys, in the North-East Atlantic. Additional information on land-based initiatives can be found in Chapter 14.

Marine Communities, SPAs, SACs and MPAs

The expansion of MPAs for Ireland's coastal and marine ecosystems is an ongoing process.

Ireland's third National Biodiversity Action Plan 2017-2021³⁶ has been developed to protect and enhance Ireland's biodiversity. Objective 5 of the plan aims to 'conserve and restore biodiversity and ecosystem services in the marine environment'. The full implementation of the MSFD, WFD, Habitats and Birds Directives and revised CFP is considered the conduit for achieving this objective.

In Ireland, the Habitats Directive is currently the only legislative instrument providing protection to habitats in the marine environment, through the designation of SACs. These have been chosen to represent a sample of important habitats and species populations under Annex I and Annex II of the Directive, respectively. Ireland is committed to maintaining or restoring the protected habitats and species within these sites to 'favourable conservation status'. INFOMAR (Section 3.1) provided a platform for the designation of seven new marine SACs, which were proposed in 2012 and 2015.

Special Protection Areas are designated under the Birds Directive for the protection of particular species or communities of birds and/or wetland areas that provide essential resources for resident or migrating birds. These are either intertidal or coastal areas and are mainly coincident in their boundary with SACs (Figure 8.9).

Under the OSPAR Convention, Ireland has 19 MPAs, which cover 4135 square kilometres. All of Ireland's OSPAR sites are also either SACs or SPAs and so currently they do not have any legal protection outside that associated with their SAC designation.

A European network of important ecological sites, the Natura 2000 network of SACs and SPAs, is managed through the development of site-specific conservation objectives (SSCOs) (see Chapter 6 for further details). The NPWS is delivering a programme of work to finalise the SSCO for all SPAs and SACs. Generic conservation objectives are in place for those sites that remain without SSCO. Ensuring that the current and future SACs and SPAs are properly managed and supported as a network was highlighted in *Ireland's 6th National Report to the Convention on Biological Diversity* (DCHG, 2019). This would serve to increase resilience in the face of anthropogenic pressures.

The need to protect marine mammals such as harbour porpoises, dolphins and seals from active acoustic surveys has been recognised through the restriction of these activities in 24 SACs. This includes the Lower River Shannon SAC and its resident bottlenose dolphin population, and Lambay Island SAC and its population of grey and common seals. It is an offence to carry out the specified activity within the 24 SACs without the consent of the Minister for Culture, Heritage and the Gaeltacht.³⁷

Ireland is committed to the Convention on Biological Diversity and adopted target 11, that 10 per cent of all coastal and marine areas are conserved through well-connected systems of protected areas, in 2010 (Aichi target 11, SDG 14.5). The EU Biodiversity Strategy 2030 has committed to a minimum of 30 per cent protection of EU's Sea areas, with strict protection for a third of these areas (EU, 2020). Currently, only 2.1 per cent of our marine areas are protected. The MSFD recognises that one measure for achieving Good Environmental Status is the establishment of a representative and coherent network of MPAs to preserve marine biodiversity³⁸. In general terms MPAs are identifiable coastal/marine areas that, among other features, are considered to be of particular importance for ecosystem functioning, natural ecology and biological diversity. In Ireland there is currently no legal definition of the term Marine Protected Area however, nor specific stand-alone legislation underpinning the designation or management of such sites.

34 <http://www.cleanatlantic.eu/packages/>

35 <https://ocean.org/>

36 <https://www.npws.ie/legislation/national-biodiversity-plan>

37 Further information on activities requiring consent (ARCs) is available at <https://www.npws.ie/farmers-and-landowners/activities-requiring-consent>.

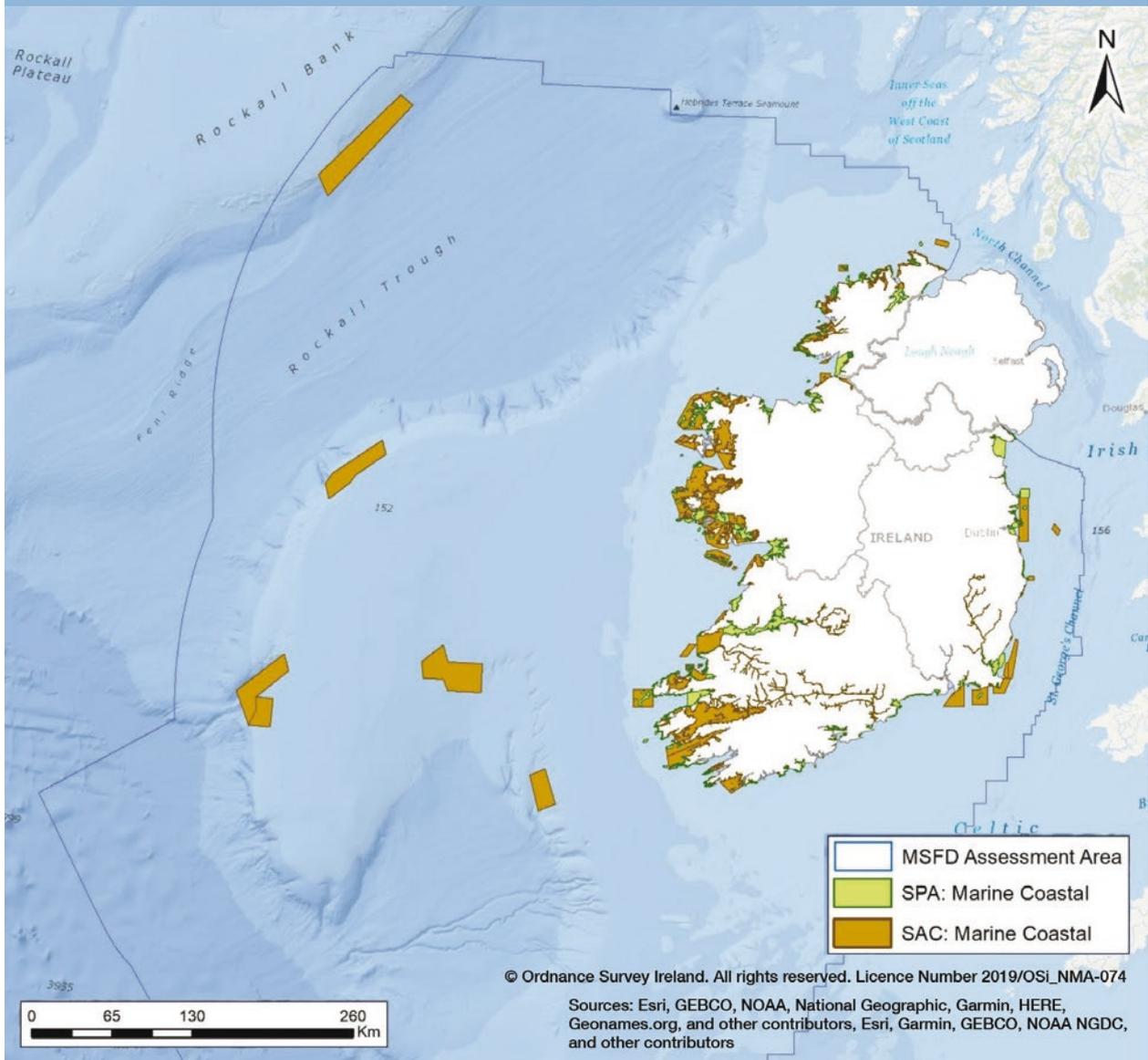
38 2008/56/EC Article 13.4



An expert advisory group was established in late 2019 by the government to produce a report containing advice and recommendations that will support the expansion of Ireland’s network of Marine Protected Areas. The ongoing work of the MPA Process Advisory Group is an initial component that is intended to focus and facilitate implementation of national obligations around area-based protection under the National Biodiversity Action Plan 2017-2021, in addition to the MSFD and Ireland’s responsibilities under the OSPAR Convention. Protection of the network of MPAs in Ireland should consider, among other things, the connectivity, representativity and replication of areas to allow for the coordinated support of systems (Rees *et al.*, 2015).

The protection of marine communities in areas beyond the national jurisdiction is currently being considered by the United Nations. This includes an area of 230 million square kilometres, or about 45 per cent of the surface of the planet. This ongoing process will consider recommendations to develop an international legally binding instrument or treaty under the United Nations Convention on the Law of the Sea on the conservation and sustainable use of marine biological diversity in areas beyond national jurisdictions.

Figure 8.9 Map of Ireland’s marine SPAs and SACs. The blue line indicates Ireland’s maritime area which encompasses the MSFD assessment area





Mapping of the Seabed, Ecosystems and Communities

The mapping of Ireland's sensitive marine habitats and species will help to protect them.

A classification of marine benthic communities is currently being finalised by the Department of Culture, Heritage and the Gaeltacht and the National University of Ireland Galway in accordance with the pan-European EUNIS classification system. A number of sensitive marine communities, including maërl beds and seagrass meadows, have been mapped to date. These communities, with a few exceptions, occur within SACs and should be afforded the highest degree of protection, with no disturbing activity allowed within a 50 metre buffer zone. Offshore reef habitats have also been mapped (see Topic Box 8.2).

This survey work is complemented by ongoing environmental research, for example research into the distribution and abundance of protected vertebrate species as part of the government-funded ObSERVE Programme.³⁹

Citizen Science

We need the support of the public and communities to collect important data on marine biodiversity.

Several marine-related citizen science projects and initiatives are currently under way in Ireland.



- Explore your Shore⁴⁰ is a citizen science project funded by the EPA and coordinated by the National Biodiversity Data Centre. It aims to increase our knowledge of the distribution of intertidal species, exploring their potential as bio-indicators of water quality and climate change.

- The Irish Whale and Dolphin Group⁴¹ is dedicated to the conservation and better understanding of whales, dolphins and porpoises in Irish waters. It provides courses on marine mammal observation and records sightings and strandings of marine whales, dolphins and porpoises with the help of the public.
- Coastwatch⁴² is a voluntary organisation that has carried out annual surveys of Ireland's coast for the last 30 years. The long-term data are available at <https://coastwatch.org/europe/all-ireland-historical-data/>
- Seasearch Ireland⁴³ is a citizen science biodiversity recording scheme for divers and snorkelers. The scheme uses volunteer recreational divers to record subtidal species at dive sites around Ireland and Britain.
- The Big Jellyfish hunt,⁴⁴ Purse Search Ireland,⁴⁵ the Irish Basking Shark Project⁴⁶ and KelpRes⁴⁷ are all projects that include a citizen science component asking the public to record sightings of specific flora and fauna on Ireland's shoreline and in coastal waters.



41 <https://iwdg.ie/>

42 <http://coastwatch.org/europe/>

43 <https://diving.ie/seasearchireland/>

44 <https://records.biodiversityireland.ie/record/jellyfish#7153.4551-8.016>

45 <https://marinedimensions.ie/purse-search-ireland/>

46 <https://www.baskingshark.ie/>

47 <http://www.nuigalway.ie/zoology/research/kelpres/>

39 <https://www.gov.ie/en/publication/12374-observe-programme/>

40 <https://exploreyourshore.ie/>



5. Conclusions

Pressures on the Marine Environment

Ensuring that our marine ecosystems are clean, healthy, biologically diverse and productive requires more than the restriction of nutrient pollution and sustainable fishing and aquaculture levels. A myriad of pressures such as climate change, mechanical destruction, physical disturbance, noise, toxic substances and litter will impact and interact to threaten the health of such ecosystems. These pressures need to be considered through an integrated approach to ensure the long-term health of both local and global oceans.

An Island Nation

Ireland is an island nation with a rich biodiversity, a strong cultural linkage between people and the sea, and proud coastal communities and, as such, we have lots to protect. Initiatives such as the Wild Atlantic Way⁴⁸ have served to focus and highlight these attributes. As an island nation with an extensive marine area we need to ensure that the proper legislative framework supported by sufficient knowledge, is in place to protect our marine ecosystems, as well as the goods and services they provide. Ongoing research and monitoring programmes, many under existing EU and international laws, should provide the evidence to support the legislative process and allow the level of protection required for different parts of our maritime area. This will need to consider not only current conditions but also the future implications of climate-driven pressures and alterations to our ecosystems and the communities and species they contain.

Water Quality

Overall, assessments of ecosystem status show that, in terms of eutrophication, our coastal and marine waters are considered to be healthy. However, additional measures and mitigation are required to protect our valuable ecosystems, habitats and species from anthropogenic pressures. The latest WFD assessment (2013-2018) indicates that only 30 (38%) of the transitional water bodies (estuaries) monitored in Ireland are of good or high ecological status, with 49 (62%) being of moderate, poor or bad ecological status. The specific factors causing the decline in ecological status of estuaries should be addressed through the action programmes developed under the WFD.

Environmental Status

The MSFD environmental status for Ireland indicates that, although five descriptors are fully compatible with Good Environmental Status, two others are considered to have achieved Good Environmental Status for the primary criteria assessed (marine litter and noise) while three are only partially compatible (biodiversity, commercial fish and shellfish and sea floor integrity). Information on Descriptor 4, food webs, is not sufficient to make an assessment. Overall, the assessment outlines the gaps in knowledge for some descriptors and the improvements required to bring them to Good Environmental Status.

Marine Habitats

A substantial proportion of the protected marine habitats underpinned by Ireland's Natura 2000 network has not yet achieved favourable conservation status, as required under the Habitats Directive. This is particularly evident in habitats such as lagoons, large shallow inlets and bays and fixed dunes. The expansion of a network of MPAs underpinned by legislation to protect these areas may act as a key conservation measure to enable the achievement of favourable conservation status, Good Environmental Status and other environmental commitments such as those for the OSPAR's list of threatened and/or declining species and habitats.

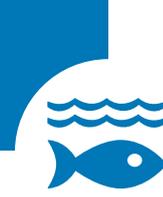
Climate Change

Climate-induced changes in sea temperature and pH have been recorded in Irish marine waters. Continuous monitoring, assessment and modelling of the impacts of climate change are essential to ensure proper adaptation to future scenarios.

Fish Stocks

Of the commercial fish and shellfish stocks assessed, 34 are considered to be compatible with Good Environmental Status, while 44 are not. The compatibility of 99 stocks with Good Environmental Status is unknown. Overall, the status of commercial fish and shellfish stocks is not fully compatible with Good Environmental Status. However, of the main stocks assessed in recent years, there has been an 80 per cent improvement in the number harvested sustainably. Ensuring that Ireland implements a transition to sustainable fisheries, and heeds scientific advice and catch limits, is crucial to ensure not only the continued availability of this resource but also the health of the associated food webs.

48 <https://www.wildatlanticway.com/home>



Endangered and Threatened Species

A number of non-commercial fish species (e.g. sea lamprey, twaite shad, angel shark) are threatened because of habitat loss/disruption and by-catch. Several elasmobranch species, including the sharks, rays and skates, are listed as critically endangered under Ireland's Red List while other comparatively long-lived protected species remain vulnerable to environmental degradation from human activities in Ireland's maritime area (e.g. some marine bird species and other top predators, migratory baleen whales, deep-diving cetaceans).

Protecting Marine and Coastal Areas

Our marine and coastal areas are impacted by several human-induced pressures, including fishing, eutrophication, climate change and litter. While independently these issues continue to put pressure on our fragile marine systems, their combined impact is not fully understood and needs to be assessed through additional research and monitoring. Programmes of measures for the marine environment rely heavily on existing measures under the WFD and Common Fisheries Policy. While the integration of measures under instruments and Marine Strategy Framework, Birds and Habitats Directives are important, measures that directly protect the marine water column and wider seabed habitats need to be implemented.



Chapter Highlights for Marine Environment



Ireland's marine waters are clean and reasonably healthy but not as biologically diverse and productive as they could be. They are affected by several human-induced pressures including fishing, climate change and marine litter such as plastics.



The area covered by Marine Protected Areas needs to be expanded significantly to meet the international requirement to conserve 10 per cent of all coastal and marine areas, rising to 30 per cent in future targets under the EU Biodiversity Strategy 2030. The expansion will promote the remediation of environmental damage and the protection of marine ecosystems and biodiversity.



As an island nation with an extensive marine area, Ireland needs to ensure that robust governance and legal frameworks are in place to protect marine ecosystems and the services they provide to society. There needs to be governance systems in place that coordinate and integrate the implementation of directives where there are crossovers, such as those covering marine strategy, marine spatial planning, water quality, waste, biodiversity and protecting fish stocks.



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Chapter 9

Waste





Waste

1. Introduction

Waste comes from the production and consumption of resources, products and services. The quantity of waste generated, its nature and composition, and how and where it is treated all cause environmental pressures, affecting where we live and work and our recreational spaces. Land use, air quality and water quality are all affected to an extent and poor waste management practices can affect our health and wellbeing.

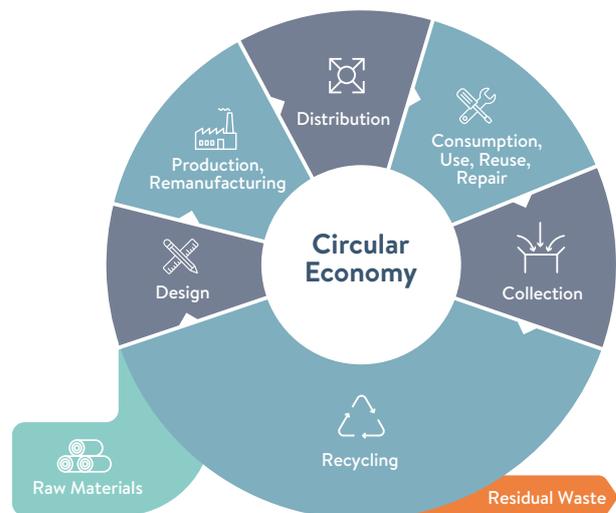
While Ireland is meeting current waste legislative targets, future targets under circular economy legislation will be a challenge given recent performance.¹ Ireland's municipal landfills and waste to energy facilities are operating at capacity, and we are reliant on export markets to treat much of our residual, recyclable and hazardous waste. This presents a significant risk for the country.

Much waste generation is linked to our consumer values and lifestyles and to products and packaging not being designed for reuse, durability, repairability or recyclability. Waste characterisation studies have provided evidence of poor segregation of household and commercial kerbside bins, which results in waste that could be recycled being sent for disposal or energy recovery, the least preferred options in the waste hierarchy. Wasteful behaviours, such as wasting food, cost households and businesses money each year. There is potential to reduce carbon emissions by improving our waste management behaviours and by becoming more self-sufficient in waste management.



We are at a pivotal point in Ireland's waste policy, legislation and planning. A National Waste Action Plan for a Circular Economy was published in September (see Topic Box 9.1). Waste legislation is being amended to bring in challenging new targets and obligations on producers. Statutory waste prevention and waste management plans will be reviewed in 2020/2021. This pivot point provides opportunity for change. The ambition for Ireland is a circular economy (Figure 9.1) in which waste is prevented, consumption of single-use items is reduced, reuse and repair initiatives are incentivised, recycling is maximised, and waste is used as an energy source to replace fossil fuels. The 2019 National Climate Action Plan identified the challenge of the sustainable use of resources and the opportunity for making carbon savings in a circular economy.

Figure 9.1 Circular economy (Source: EPA)

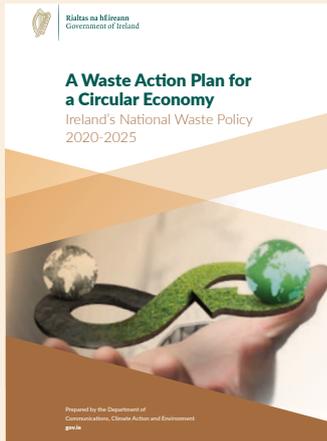


¹ Unless otherwise specified, the Environmental Protection Agency is the source of the waste data presented. For more information, see <http://www.epa.ie/nationalwastestatistics>



Topic Box 9.1 A Waste Action Plan for a Circular Economy. Ireland's National Waste Policy 2020-2015

In September 2020, the Department of Environment launched new national waste policy, *A Waste Action Plan for a Circular Economy* (DCCAE, 2020a). This Waste Action Plan recognises that there are opportunities to introduce circular economy measures within our national recovery post COVID-19. Circular economy measures present opportunities for job creation in design, reuse, repair, re-manufacturing and recycling which have the potential to reduce our carbon footprint and meet our climate targets.



While waste prevention has been a focus of waste policy since the 1990s, there is a much stronger focus in this policy document. A key objective is to shift attention from waste treatment (how products and materials are treated at end of life) to product design for circular economy (use of secondary versus raw materials, designing out hazardous materials, products that are designed for reuse, for easy repair and which are ultimately recyclable at end of life), reducing our consumption of single use products and extended producer responsibility for products placed on the market. All these actions are circular economy activities (Figure 9.1) and linked to the European Commission's ambitions for circular economy under the European Green Deal.

The Plan gives effect to commitments in the Programme for Government, including the introduction of a deposit and return scheme for plastic bottles and measures to support the development of indigenous treatment capacity, supporting national economic recovery.

The Action Plan sets out challenges and measures to achieve optimum results for priority areas including food waste, single use plastic, waste enforcement, waste data and waste flows and citizen engagement.

A Waste Management (Circular Economy) Bill will be introduced to provide the legislative underpinning of the policy measures identified and the Department of Environment will chair a cross-sectoral Waste Advisory Group to support the policy's implementation.

2. Current Situation

National Waste Generation

Ireland generated 14 million tonnes of waste in 2018.

It is estimated that almost 14 million tonnes of waste were generated in Ireland in 2018 across all economic sectors and households, corresponding to 2.9 tonnes per person (EPA, 2020a).



Municipal Waste

The variety and composition of municipal waste makes it challenging to manage and treat.

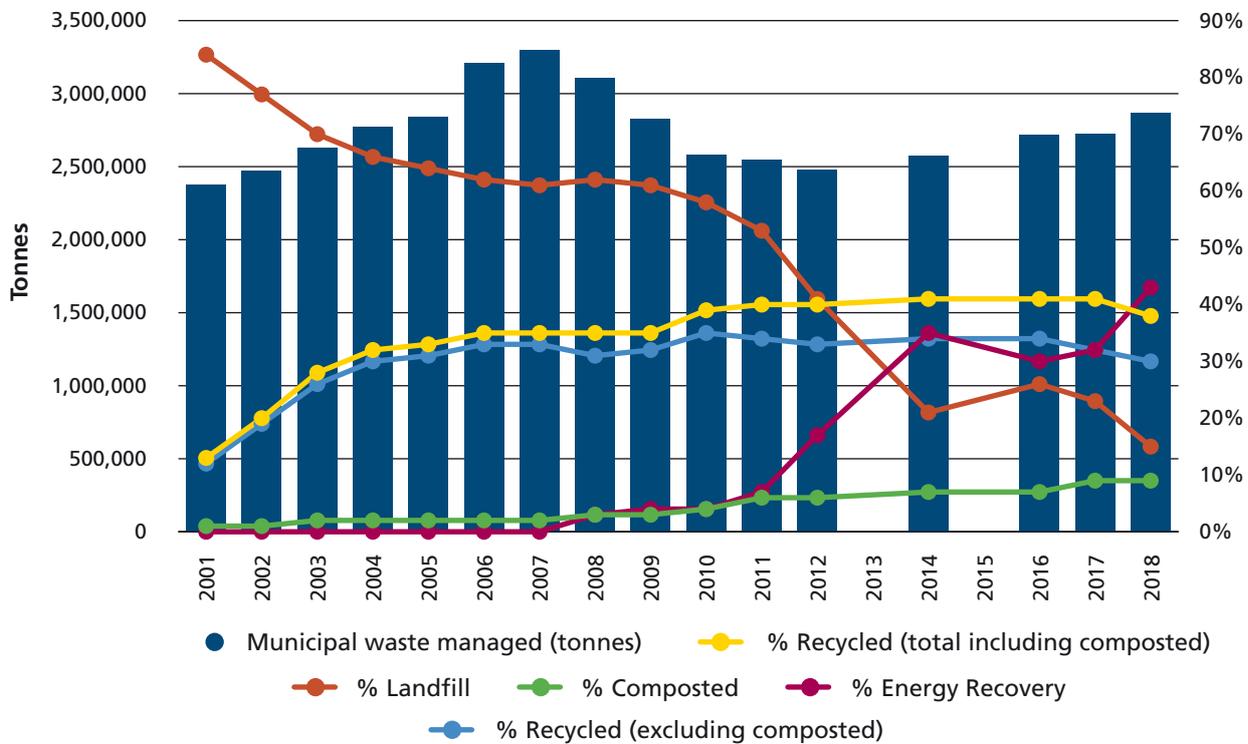
Municipal waste is household waste and commercial waste that is similar in nature to household waste. It is challenging to manage and treat because of its varied nature and composition.² Over 2.9 million tonnes were generated in 2018, 53 per cent from households and 47 per cent from commercial sources. One million tonnes, over one-third of municipal waste, was exported for treatment: 729,000 tonnes for recycling and 287,000 tonnes for energy recovery.

Since 2012, municipal waste generation has increased by 15 per cent. The quantity disposed of to landfill has decreased, but the shift has been towards energy recovery rather than recycling, as recycling rates initially plateaued from 2010 to 2017 and then decreased in 2018 (Figure 9.2). Under the waste hierarchy, prevention, reuse, reduction and recycling are all preferred over energy recovery.

² Glass, metal, paper and card, plastic, textiles, wood and composite materials. Packaging and non-packaging wastes, waste electrical and electronic equipment, food and garden waste, batteries, medicines and pesticides.



Figure 9.2 Trends in municipal waste management, 2001 to 2018 (Source: EPA)



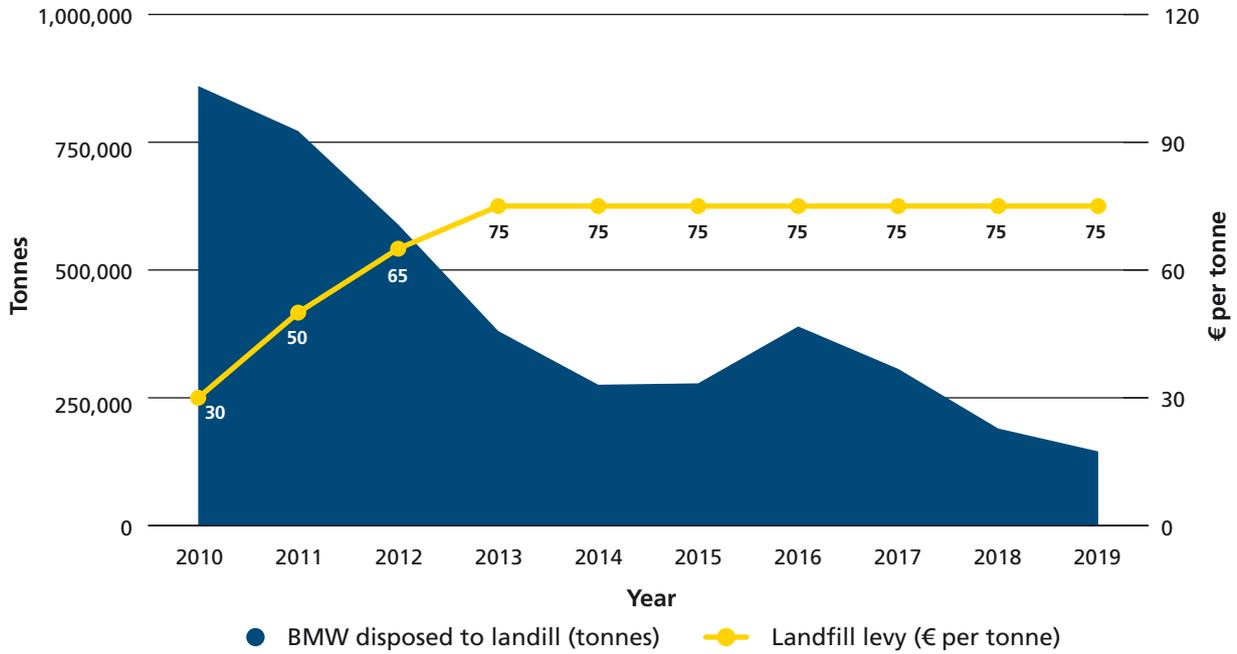
In 2018, 38 per cent of municipal waste was recycled, 43 per cent used for energy recovery and 14 per cent disposed to landfill. These rates are quite a distance from the 2020 target to recycle 50 per cent of municipal waste (increasing to 65% in 2035) and the 2035 target to dispose of 10 per cent or less in landfill.

The Landfill Directive (1999/31/EC) sets a limit on the quantity of the biodegradable element of municipal waste (food and garden waste, paper and cardboard and other biodegradable material) disposed of to landfill compared with the baseline year 1995. Ireland has been meeting its targets under the Landfill Directive and is on track to meet its 2020 target. Increases in the landfill levy have been successful in disincentivising disposal of waste (Figure 9.3) as well as the municipal waste incineration (energy recovery) capacity coming into operation since 2012. The increased roll-out of household and commercial organic kerbside bins to households under the biowaste regulations has diverted increasing amounts of organic waste to recycling. There is scope for further diversion, however, as described in the 'Food Waste' section.





Figure 9.3 Biodegradable municipal waste disposed of to landfill (tonnes) and landfill levy (euro per tonne), 2010-2019 (Source: EPA)

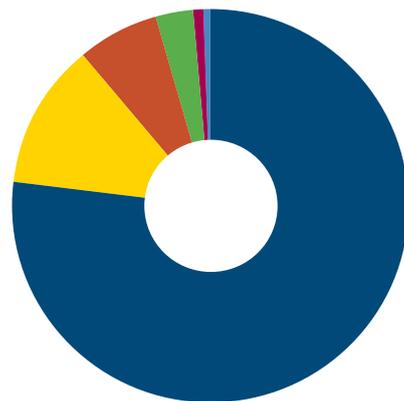


Construction and Demolition Waste

Waste generated in construction and demolition is a substantial waste stream in terms of volume and weight.

Construction and demolition (C&D) and the renovation of buildings and roads generates significant quantities of waste. In 2018, 6.2 million tonnes were collected for treatment, up significantly from 4.7 million tonnes in 2017. The majority of this consisted of soil and stone (77%) with the remainder made up of concrete, brick, tile and gypsum waste (12%) and mixed waste (7%) (See Figure 9.4). Soil and stone also includes a small amount of dredging spoil that was brought onto land for treatment. Dredging spoil that is dumped at sea is covered in Chapter 8.

Figure 9.4 Construction and demolition waste collected, 2018 (Source: EPA)



- Waste soil and stone and dredging spoil (77.0%)
- Concrete, brick, tile and gypsum waste (12.1%)
- Mixed C&D waste (6.7%)
- Metal waste (2.9%)
- Waste bituminous mixtures (1.0%)
- Segregated wood, glass and plastic waste (0.4%)



There is a legislative target to achieve 70 per cent material recovery (excluding energy recovery) of C&D waste by 2020.³ In 2018, Ireland's recovery rate was 78 per cent. Most C&D waste underwent final treatment in Ireland (96%) with 4 per cent exported for treatment. The majority of C&D waste (including exports) was recovered by backfilling (89%, >5 million tonnes)⁴ with just over 9 per cent (>524,000 tonnes) recycled. Recycling was the dominant treatment type for C&D waste metal, plastic and glass, while disposal was mainly relevant for C&D waste treatment residues.

There is great scope for circular economy initiatives within the construction sector, which handles large volumes of natural resources. The Waste Framework Directive (2008/98/EC as recast by 2018/851/EC) provides for uncontaminated excavated soil and other naturally occurring material to be considered by-products and not waste (see 'By-products and End of Waste' section).

Hazardous Waste

The amount of hazardous waste generated has been increasing.

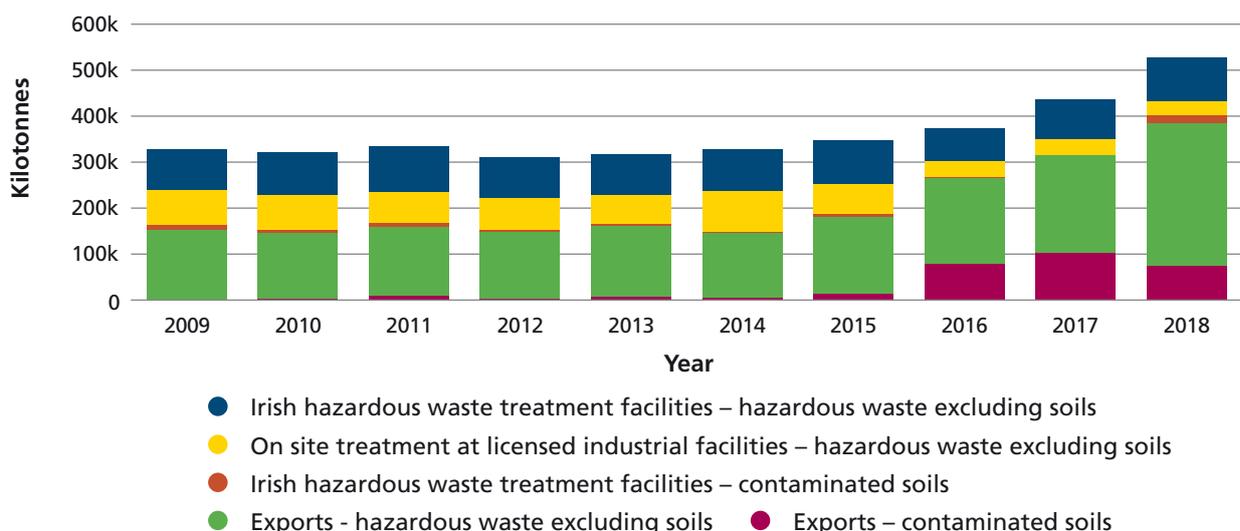
Industry is the largest generator of hazardous waste in Ireland (solvents, sludges, oils, chemicals) but other sectors produce hazardous wastes including paints, batteries, pesticides, asbestos and contaminated soil.

In 2018, 526,397 tonnes of hazardous waste were generated. The amount of hazardous waste generated in Ireland has been increasing since 2012, with larger quantities of incinerator ash⁵ and contaminated soil⁶ the main sources of the increase (Figure 9.5).

In 2018, 73 per cent of hazardous waste was exported for treatment (mainly to the Netherlands, the UK, Germany and Belgium), 21 per cent was treated at commercial hazardous waste treatment facilities in Ireland and 6 per cent was treated by industry at the site of generation under licence from the Environmental Protection Agency (EPA). Hazardous waste exported for treatment, such as contaminated soil and incinerator ash, is generally what we do not have capacity to treat in Ireland.

The mid-term review of the National Hazardous Waste Management Plan 2014-2020 found that 23 of the 27 recommended actions were in progress or completed but that further work was needed on the recommended actions that remained at risk: focused engagement on hazardous waste prevention; promotion of Ireland's self-sufficiency goals for hazardous waste treatment; and developing hazardous waste collection networks and take-back schemes for small-scale hazardous wastes from households and small businesses (EPA, 2018a).

Figure 9.5 Hazardous waste generation and location of treatment, 2009-2018 (Source: EPA)



³ This recovery target excludes the soil and stone and hazardous waste portions of C&D waste.

⁴ Backfilling is a recovery operation in which suitable waste is used for reclamation purposes in excavated areas or for engineering purposes in landscaping and the waste is a substitute for non-waste materials.

⁵ The first municipal waste incinerator started operations in 2012 and the second in 2017. Note that bottom ash generated at these sites was exported as hazardous waste up to 2020 but now has been classified as non-hazardous. Fly-ash is still exported as hazardous waste.

⁶ Contaminated soil from old industrial sites, gas works and petrol stations.



Food Waste

Ireland generates over 1 million tonnes of food waste annually.

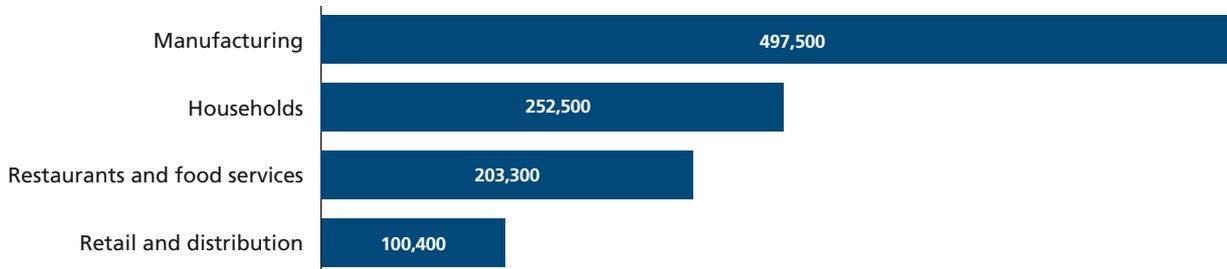
Ireland generates approximately 1.05 million tonnes of food waste annually,⁷ 53 per cent of which is generated by commercial and household sectors and 47 per cent generated by the manufacturing sector (Figure 9.6) (EPA, 2020a). An Irish household throws out on average 150 kg of food waste each year at a cost of €700, and food waste is estimated to cost Irish businesses over €2 billion each year (EPA, 2019a).

Producer Responsibility Initiatives

Six waste streams are the subject of producer responsibility initiatives.

Producer responsibility initiatives (PRIs) are based on the producer pays principle, where producers have a responsibility to finance the collection and environmentally sound management of their products when they become waste.⁸ All PRI statutory targets are currently being achieved (Table 9.1).

Figure 9.6 Estimated food waste (in tonnes) generated in Ireland, 2018 (Source: EPA)



Preventing food waste (avoiding its generation) is the highest priority, but where there is unavoidable food waste (such as peelings or bones) it needs to be segregated for separate collection for recycling.

A significant amount of household and commercial food waste is not being segregated for separate collection. Over 60 per cent of household organic waste is deposited in the residual or recycling bin and one-third of the commercial residual bin consists of organic waste that could be segregated for recycling (EPA, 2018b). A survey on brown bin use in the commercial sector found that over 30 per cent of businesses surveyed did not use a food waste bin, despite biowaste regulations requiring such segregation since 2009 (Cré, 2019). In 2018, only 43 per cent of households had a brown bin (EPA, 2020a) but new national waste policy provides for the mandatory provision of an organic waste bin as part of the household waste collection service. Separate collection of biowaste will be mandatory from the end of 2023 under circular economy legislation, not just from households but also from offices, restaurants, retailers and comparable waste from food processing plants.

Ireland has committed to halving food waste by 2030, in line with its EU and United Nations (UN) Sustainable Development Goal (SDG) commitments, and it will be required to report on food waste generated at each stage of the food supply chain for the reference year, 2020 and onwards.



⁷ Excluding food waste from primary production (agriculture) for which no data are currently available.

⁸ For more information on progress to targets, see <https://www.epa.ie/nationalwastestatistics/>



Table 9.1 Producer responsibility initiatives in Ireland (Source: EPA)

	WASTE STREAM	EU OR NATIONAL	STATUS
	Packaging	EU	In 2018, >1 million tonnes of packaging waste were generated, of which 64% was recycled (66% in 2017). Most packaging waste was paper and cardboard (40%) and plastic (25%) with smaller amounts of glass, wood, metal and textiles. See Topic Box 9.2.
	Waste electrical and electronic equipment (WEEE)	EU	More than 62,700 tonnes of WEEE were collected for treatment in 2018. Ireland's 61% WEEE collection rate exceeded the EU's 45% target; moreover, a challenging 65% target comes into force for reference year 2019. Some 55,754 tonnes of WEEE were recovered in 2018 and 52,010 tonnes were prepared for reuse or recycling (increases of 17% and 19%, respectively on the 2017 quantities). Of the WEEE collected, 73% was treated in Ireland (nearly all of this was then exported for final treatment).
	End-of-life vehicles (ELVs) ^a	EU	More than 162,500 ELVs were treated in Ireland in 2018, an increase of almost 22,000 vehicles (or 16%) on the previous year. Ireland achieved full compliance with the current targets for the first time in 2018, achieving a reuse and recycling rate of 86% and a reuse and recovery rate of 95%.
	Batteries and accumulators	EU	All legislative targets for portable battery collection rates and for the recycling efficiency of various battery types have been met. In 2019, 47% of portable waste batteries were collected ^b (EU target 45%).
	End-of-life tyres	National	Producers placed 3.8 million car tyres on the market in 2018 and 31,000 tonnes of waste tyres were recovered: 1% were reused, 96% were recycled and 3% were sent for energy recovery (Repak ELT, 2019).
	Farm plastics	National	The Irish Farm Film Producers Group operates over 230 bring centres annually and provides a farmyard collection service. Between 28,000 and 30,000 tonnes of farm plastics are recycled each year (IFFPG, 2020).

^a ELVs are cars or light commercial vehicles weighing less than 3.5 tonnes that are discarded as waste.

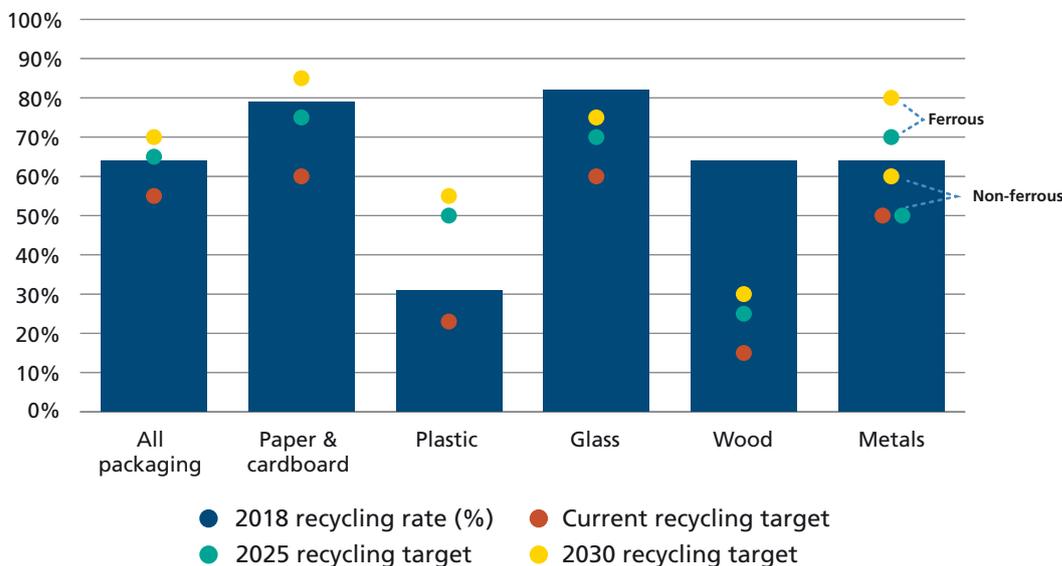
^b In reference to portable batteries placed on the market in the preceding 3 years.



Topic Box 9.2 Focus on Packaging Waste

EPA characterisation studies have found that packaging waste accounts for one-third of all household waste collected at the kerbside and the proportion of packaging has increased in the last decade. Almost two-thirds of plastic packaging found in kerbside bins is not on Ireland's recycling list (including soft plastics such as films and wrappers) and ends up in the residual bin, which is disposed of to landfill or sent for energy recovery (EPA, 2018b). Circular economy legislation is introducing higher recycling targets from 2025 onwards, which will be a challenge to meet, given that recycling rates for overall packaging and plastic packaging have been declining, coinciding with an increase in the quantity of packaging sent for energy recovery. In 2018 less than one third of plastic packaging waste was recycled (82,000 tonnes was recycled and 170,000 tonnes incinerated with energy recovery). Figure 9.7 shows that plastic and metal packaging are at the greatest distance from achieving future targets based on current rates. Urgent action is needed to reduce unnecessary packaging, increase the recyclability of packaging placed on the market and maximise recycling of waste packaging.

Figure 9.7 Recycling of packaging waste streams in 2018 relative to current and future targets (Source: EPA)



Sewage Sludge

Sewage sludge is mainly used as a soil improver or fertiliser on agricultural land.

In 2019, wastewater treatment plants produced 58,630 tonnes of sewage sludge (Table 9.2). Sludge is rich in nutrients and is primarily used as a soil improver or fertiliser on agricultural land. All sludge sent for composting was subsequently used in agriculture (EPA, 2020b).

Radioactive Waste Management

A further reduction in the national inventory of disused radioactive sources has been achieved.

In 2011, 63 licensees held over 3300 disused radioactive sources (with half-lives greater than 10 years). This reduced to 16 disused sources by 2019, representing a 99 per cent reduction. Through legislative requirements and enhanced regulatory enforcement, it is expected that this number will trend towards zero by 2021. Radioactive waste is exported, as there is no treatment capacity in Ireland. Importation of radioactive waste is prohibited.



Table 9.2 Treatment routes for sewage sludge (tonnes dry solids), 2016-2019 (Source: EPA)

YEAR	AGRICULTURE	COMPOST	LANDFILL	OTHER ^a	TOTAL
2016	45,344	9610	102	962	56,018
2017	46,487	10,065	87	2134	58,773
2018	44,003	10,605	91	527	55,226
2019	52,139	6,099	115	277	58,630

^a Treated sludge that was in storage or used in anaerobic digestion or as a fuel in cement kilns.



Litter and Backyard Burning

Littering is a persistent problem.

The National Litter Pollution Monitoring System is a Department of Environment initiative to report on litter pollution countrywide and measure changes over time through annual reporting. In 2018, the proportion of areas considered unpolluted was 20.5 per cent (15.6% in 2017) and the amount of grossly polluted areas was 0.4 per cent (0.3% in 2017) (DCCAE, 2019a). The main causes of litter pollution were passing pedestrians (42%) and passing motorists (22%) and the main constituents were cigarette-related litter (54%) and packaging items (18%), measured as litter counts versus weights.

The EPA estimates that 47,307 tonnes of household waste went unmanaged⁹ in 2018, reflecting a minority of citizens illegally dumping or burning their waste. During the coronavirus (COVID-19) pandemic 2020 lockdown period, the EPA received a four-fold increase in enquires in relation to illegal backyard burning and there was evidence that illegal dumping had increased (EPA, 2020c). It is estimated that 70,000 tonnes of street cleaning and fly-tipped wastes were managed by local authorities in 2018 (EPA, unpublished data).^{10,11}

⁹ Unmanaged waste being waste that was not collected at the kerbside or brought to waste collection centres.

¹⁰ Not including litter and street bin waste (23,000 tonnes).

¹¹ The EPA has conducted a characterisation study on litter bin and street sweeping waste.

Unauthorised Waste Disposal

Enforcement of unauthorised waste disposal is a priority action for regulators.

The EPA is carrying out a study into the nature and extent of waste crime in Ireland, which will report on the scale, costs and impact of waste crime and assess the extent of illegal dumping over the last 10 years.¹² Enforcement of unauthorised waste disposal is a priority action for regulators. Multi-agency waste enforcement operations have stopped significant illegal waste activities (Council of the European Union, 2018).

Historic Landfills

The past reliance on landfills means that remediation and ongoing monitoring of closed sites are a significant ongoing cost to the State.

For many years, disposal to landfill was the primary method for treating waste in Ireland and there is a significant ongoing cost to the State for the remediation and monitoring of landfills, of which 611 have been registered. A report by the Comptroller and Auditor General identified that nearly €106 million has been provided in grants to local authorities to undertake remediation works on 121 landfill sites, with works on 22 sites completed, but there is no estimate of the expenditure that may be required for the sites where remediation is ongoing or where the risk assessment is yet to be completed (Comptroller and Auditor General, 2020).

¹² The last report on unauthorised waste disposal was published in 2005 (EPA, 2005).



Marine Litter

Growing evidence and awareness of the problems associated with marine litter has led to legislative and citizen initiatives.

Pollution from litter, including plastic and microplastics, are of concern for the ecology of marine flora and fauna (Chapter 8, The Marine Environment). Reducing marine litter is a key action under several national and international commitments including the Marine Strategy Framework Directive (MSFD) and UN SDG 14: Life Below Water. Irish marine litter arises from littering, mismanaged waste or accidental spillage and through abrasion, wear and fragmentation. It can come from land-based and maritime human activities as well as transboundary sources. Litter from land-based sources can be carried to the marine environment by rivers, streams, drains, sewage and other wastewater outflows.

Beach litter data is available from Ireland's OSPAR beach litter surveys which are used to monitor national trends as part of the MSFD. By the end of 2018, there was a 20 per cent decrease (from 61 to 49 items) in the median number of beach litter items found on the selected Irish beaches in the OSPAR surveys (DHPLG, 2020). The overwhelming bulk of beach litter found in these surveys is plastic. Ireland's MSFD assessment report from 2020 highlights that plastic string and cord (diameter less than 1cm) and plastic/polystyrene pieces (0-2.5cm) makes up 37.5 per cent and 11.5 per cent respectively of all waste found. These are part of the non-single-use plastic items found as beach litter that includes larger lost or discarded re-usable items such as fishing or aquaculture gear, strings, plastic fragments, discarded clothing etc. Litter is not just a beach issue. Seabed litter was reported on average in 62 per cent of seabed survey trawls in Irish waters between 2012-2018 (excluding 2015) (DHPLG, 2020).

The percentage of single-use plastic items in the total amount of beach litter identified in Irish OSPAR beach litter surveys 2013-2018 was 25.79 per cent. The Single-use Plastics Directive (2019/904) focuses on reducing the consumption of single-use plastic products, given their prevalence in marine litter. Additional national targets will be set in relation to the median number of litter items found in beach litter surveys and single-use plastic items, which are to be prohibited from being placed on the market from 2021 by the Single-use Plastics Directive (DHPLG, 2020).



Non-governmental organisations are actively involved in beach clean-ups and litter surveys. The #2minutebeachcleanup is an An Taisce Clean Coasts initiative. Clean Coasts groups adopt stretches of Irish coastline and welcome volunteers to take part in beach clean-ups and other environmental and educational activities. In a 2019 survey, another NGO, Coastwatch, found that the amount of plastic bottle and aluminium can litter had halved compared with the previous year, but an increase in polystyrene and wet wipes was observed; wet wipes are associated with sewage discharges (O'Sullivan, 2020).





Aerial view of Poolbeg, Dublin

Waste Imports and Exports

Ireland exports 21 times as much waste for treatment as it imports.

In 2019, over 100,000 tonnes of waste were imported and just under 2.1 million tonnes exported (Table 9.3).

Imported waste is mainly refuse-derived fuel for energy recovery, plastics and scrap lead. Exports of bottom ash from incineration plants have increased since 2017 following the commissioning of the second municipal waste-to-energy facility and soil and stone exports increased,¹³ reflecting increased activity in the construction sector and the lack of a national treatment capacity. One million tonnes (over one-third) of municipal waste was exported for treatment: 729,000 tonnes for recycling and 287,000 tonnes for energy recovery (EPA, 2020a).

In 2019, paper and cardboard and metals accounted for over 75 per cent by weight of green list¹⁴ waste exports. At the time of the last state of the environment report in 2016, China was the main destination for green list waste exports (245,000 tonnes) but, following China's ban on the importation of waste plastics in 2018, Ireland now exports waste paper, plastics and metals to a broader range of countries in South East Asia (NTFSO, 2020).

Table 9.3 Waste imports and exports, tonnes, 2019
(Source: National TransFrontier Shipment Office)

WASTE SHIPMENT REGISTER	WASTE IMPORTS	WASTE EXPORTS
Amber list ^a	52,860	1,105,996
Green list ^b	48,602	981,773
Total	101,462	2,087,769

^a Amber list wastes are hazardous or mixed wastes shipped for disposal or recovery (e.g. combustible wastes).

^b Green list wastes are non-hazardous, non-mixed wastes shipped for recovery (e.g. recyclable wastes such as plastics, metals, wood).



¹³ In 2019 soil and stone accounted for 10 per cent of all notified transfrontier shipment exports.

¹⁴ Green list wastes are non-hazardous, non-mixed wastes shipped for recovery (e.g. recyclable wastes such as plastics, metals, wood).



Table 9.4 Enforcement responsibilities in Ireland, 2020

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 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.
	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.

Waste Enforcement

Multiple agencies have roles and powers to enforce and direct the enforcement of waste legislation.

The EPA and local authorities have statutory responsibilities for authorising and enforcing waste collection and management activities (Table 9.4).

More than 4000 authorisations (licences, permits, certificates of registration) are in force for waste collection, storage, treatment and transfrontier shipment. The number of permitted waste collectors fell from over 3000 to 2104 in 2018, indicating consolidation of the sector (EPA, 2020a).

Funding from the Department of Communications, Climate Action and Environment (DCCAE) to support waste enforcement was €11.48 million in 2019 (up from €10.23 million in 2018) (DCCAE, 2020b).

The EPA's waste enforcement approach is governed by a compliance and enforcement policy (EPA, 2019b). The non-hazardous waste transfer sector accounts for the highest number of operational waste sector licences to be enforced (Table 9.5) and across all sectors licensed by the EPA; this sector ranked second highest for non-compliances in 2017 and 2018 (after the food and drink sector).

Between January and June 2020, four of the eight licensees featured on the EPA's national priority sites for enforcement were waste licensees (EPA, 2020d). Eleven prosecutions of waste licensees have concluded in convictions from 2016 to date, one involving the Director of Public Prosecutions (EPA, 2020e).





Table 9.5 EPA waste sector licence enforcement activities in 2019

CATEGORY	NUMBER	DETAILS OF MAIN ACTIVITIES
Non-compliances (breaches of licence conditions) ^a	569	271 (48%) related to non-hazardous waste transfer stations, 146 (26%) related to landfill sector
Inspections	416	173 (42%) routine sampling visits, 114 (27%) enforcement plan visits and 96 (23%) visits related to complaints, non-compliances and incidents
Complaints received	165	97 (59%) related to non-hazardous waste transfer stations and 34 (21%) to landfills

^a For example, exceedance of licence emission limits, failure to notify incidents.

Source: EPA.

Local authorities prepare annual inspection and enforcement plans¹⁵ and report on the implementation of these plans. The EPA, in its statutory role of supervising local authority enforcement, evaluates the plans using a framework of indicators to drive continual improvement. Areas identified by the EPA for improvement included early notification of any illegal waste sites to the waste enforcement regional lead authorities (WERLAs); a focus on enforcing the food waste regulations to increase segregation of food waste by businesses and households;¹⁶ prioritising enforcement of waste management at construction sites; and improving the timeliness of validating and sharing waste data to ensure that illegal waste activities can be detected and prevented (EPA, 2020f). Table 9.6 provides information on the extent of some local authority waste enforcement activities in 2018. Local authority waste enforcement activities reported include not only permit enforcement, but also enforcement of producer responsibility initiatives and litter.

Table 9.6 Local authority waste enforcement activities in 2018 (Source: EPA)

ACTIVITY	NUMBER
Enforcement actions	17,000
Inspections	112,000
Complaints received	> 70,000 (bulk related to litter)
Prosecutions	790 (bulk related to unpaid litter fines)

¹⁵ Under the EU's recommendation providing for minimum criteria for environmental inspections.

¹⁶ Roll-out of the household organic bin began in 2013, and since July 2016 organic bins must be provided in population centres with greater than 500 inhabitants (EPA, 2020f). Municipal waste characterisation indicates poor segregation of food waste at commercial premises (EPA, 2018b).

The work of the WERLAs is overseen by a National Waste Enforcement Steering Committee (NWESC), which includes representatives from a wide range of regulatory authorities. The NWESC identified the following enforcement priorities for 2020: tackling significant illegal waste activity including illegal dumping and unauthorised C&D waste activity; inspections of authorised treatment facilities for end-of-life vehicles (ELVs); waste collection compliance (including roll-out of the organic bin under the biowaste regulations); and tracking waste flows.

3. Drivers

Waste Policy and Legislation

National waste policies are evolving to encompass the circular economy and climate change, in line with EU and UN priorities.

A National Waste Action Plan for a Circular Economy was published in September (DCCAE, 2020a) (see Topic Box 9.1), replacing the previous national waste policy *A Resource Opportunity: Waste Management Policy in Ireland* (DCCAE, 2012).¹⁷ Ireland's Climate Action Plan, published in 2019, includes ten actions for waste; if implemented these will be important drivers of change (DCCAE, 2019b). Legislative changes driven by the European Commission's 2015 Circular Economy Action Plan will be transposed into national law in 2020/2021 and introduce:

- challenging recycling targets
- new separate collection obligations and in some cases collection targets (certain plastic beverage bottles, textiles, waste oils and household hazardous wastes)

¹⁷ This focuses on treating waste as a resource and virtually eliminating landfilling.



- new data reporting obligations (food waste generated along the supply chain, oils and waste oils, placed on the market data¹⁸ for lightweight plastic bags, home composting, reuse)
- restrictions on placing certain single-use plastic products on the market (cotton bud sticks, cutlery, plates and straws)
- labelling requirements for certain single-use plastic products
- new extended producer responsibility initiatives and measures to reduce the consumption of certain single-use plastic products.

The Commission is also considering the introduction of food waste reduction, overall waste reduction and product reuse targets. The EU Green Deal,¹⁹ the EU's roadmap to sustainability published in late 2019, includes a European Industrial Strategy, a second Circular Economy Action Plan and a Farm to Fork Strategy.

New legislative targets coming into force from 2020 onwards will be a challenge in some cases, particularly for plastic packaging recycling and municipal recycling but also for waste electrical and electronic equipment (WEEE) collection rates and the limits for municipal waste disposal to landfill. Statutory targets will be a driver for change and give opportunities to introduce new policy instruments to incentivise repair, to incentivise kerbside bin segregation (particularly for commercial waste for which 70% of what is presented in the residual bin is potentially recyclable) and to introduce new methods of waste management such as deposit return schemes.

Producer responsibility legislation has been an important driver of funding the collection and environmentally sound management of six waste streams (see 'Producer Responsibility Initiatives' section). The ambition of the PRI legislation to increase the durability, reparability and recyclability of products at the point of design and manufacture has been strengthened under the revised provision under the 2018 Waste Framework Directive and will have an increased focus under the EU Green Deal's sustainable products initiative. Circular economy legislation is extending the requirements for producer responsibility schemes and the Single-use Plastics Directive (2019/904/EC) will introduce new extended producer responsibilities for tobacco products, wet wipes, balloons and fishing gear containing plastic.

Waste Plans and Programmes

Waste plans and programmes provide a framework, but drivers for implementation are needed.

There are statutory requirements for waste prevention and waste management plans, each with governance structures and timeframes (Table 9.7).

Table 9.7 Statutory waste planning in Ireland (Source: EPA)

PLAN	RESPONSIBILITY	DURATION/ CYCLE
National Waste Prevention Programme	EPA	Current programme 2014-2020
Regional waste management plans	Local authorities Three Regions: Connacht-Ulster Region Eastern Midlands Region Southern Region	Current plans 2015-2021
National Hazardous Waste Management Plan	EPA	Current plan 2014-2020
Litter management plans	Local authorities	Every 3 years

Selected infographic from the Waste Action Plan for a Circular Economy (<https://www.gov.ie/en/publication/4221c-waste-action-plan-for-a-circular-economy/>)

HOUSEHOLD AND BUSINESS

- RECYCLING TARGETS FOR WASTE COLLECTORS
- STANDARDISED BIN COLOURS ACROSS THE STATE: GREEN FOR RECYCLING, BLACK FOR RESIDUAL AND BROWN FOR ORGANIC WASTE
- WASTE RECOVERY LEVY TO ENCOURAGE RECYCLING
- WASTE OVERSIGHT BODY TO MANAGE CONSUMER RIGHTS
- EDUCATION AND AWARENESS CAMPAIGN TO IMPROVE WASTE SEGREGATION

FOOD WASTE

- HALVE OUR FOOD WASTE BY 2030
- WASTE SEGREGATION INFRASTRUCTURE FOR APARTMENT DWELLERS
- SUSTAINABLE FOOD WASTE MANAGEMENT OPTIONS FOR ALL HOMES AND BUSINESSES

PLASTIC, PACKAGING AND SINGLE USE PLASTIC (SUP)

- DEPOSIT AND RETURN SCHEME FOR PLASTIC BOTTLES AND ALUMINIUM CANS
- SINGLE USE ITEMS BANNED FROM JULY 2021: COTTON BUD STICKS, CUTLERY, PLATES, STIRRERS, CHOPSTICKS, STRAWS, POLYSTYRENE CONTAINERS AND OXO-DEGRADABLE PLASTIC PRODUCTS
- SIGNIFICANTLY REDUCE SUPS BEING PLACED ON THE MARKET BY 2026
- ALL PACKAGING REUSABLE OR RECYCLABLE BY 2030
- EXTENDED PRODUCER RESPONSIBILITY (EPR)
- MANDATORY EPR FOR ALL PACKAGING PRODUCERS BEFORE 2024 EU DEADLINE
- NEW RULES FOR EPR SCHEMES TO INCENTIVISE GOOD PRACTICE IN WASTE RECYCLING AND DRIVE BETTER PRODUCT DESIGN
- PRODUCERS LIABLE FOR MODULATION FEES

18 Measured at the point when a product is supplied or made available to a third party for payment or free of charge (including imported). This is a different approach from that for measuring waste generated.
 19 See https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en



4. Pressures

Economy

Ireland's use of resources and generation of waste are high.

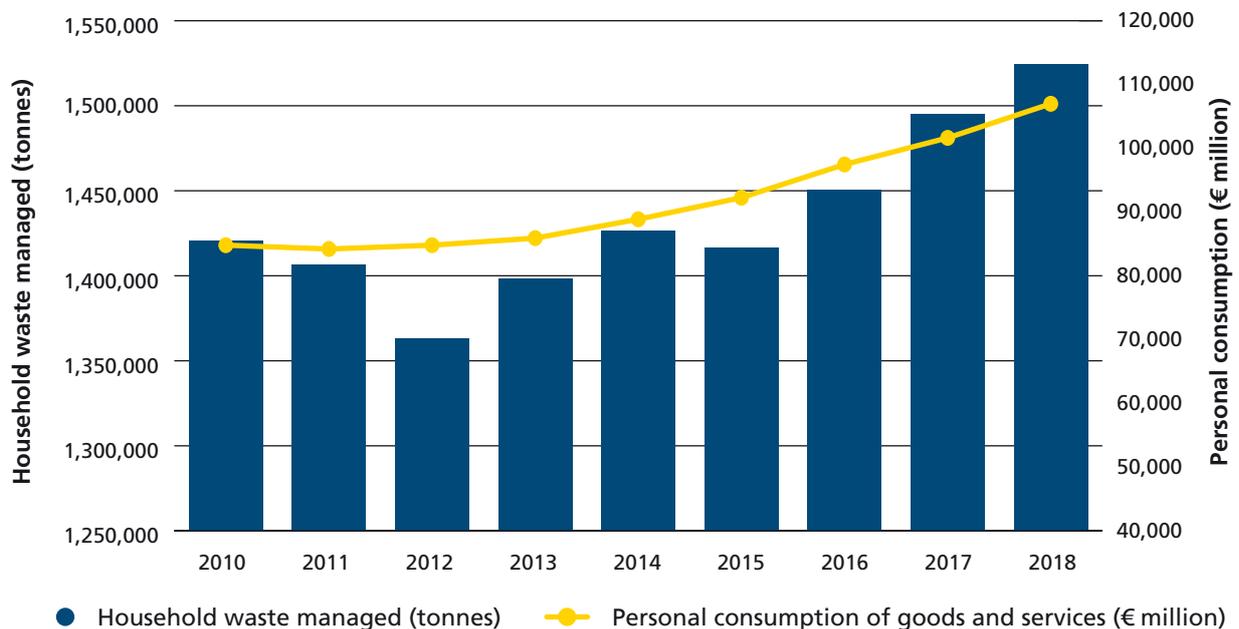
As well as affecting public health, the COVID-19 pandemic has had a significant impact on our economy and the implications of this in relation to waste generation and management will become evident in time (see Topic Box 9.3).

Domestic material consumption (DMC)²⁰ measures the amount of materials used by an economy and provides an assessment of its use of resources; if materials are used more efficiently, it reduces stresses on the environment, including waste generation. Ireland's DMC is significantly above the EU average (24.35 tonnes per person compared with the EU-28 average of 13.14 tonnes per person; Eurostat, 2020).

Project Ireland 2040 includes a public capital investment of €116 billion, which will result in significant growth in the construction sector (DPER, 2019). Projections from the waste management planning regions indicate that by 2028 up to 7.5 million tonnes of C&D waste will be collected (high-growth scenario) (RWMPOs, 2020).

The quantity of household waste managed correlates closely with Central Statistics Office data on personal consumption of goods and services, both of which have shown a predominantly upward trend since 2012 (Figure 9.8) and indicate that household waste generation is closely linked to consumption patterns.

Figure 9.8 Household waste managed and personal consumption of goods and services, 2010-2018 (Sources: EPA, Central Statistics Office)



²⁰ DMC is defined as the annual quantity of raw materials extracted from the domestic territory (biomass, minerals, fossil fuels) plus all physical imports minus all physical exports.



Topic Box 9.3 COVID-19's implications for waste generation and management

Waste management services were designated an essential service throughout the COVID-19 crisis and bin collections and most waste treatment facilities continued to operate. Surveys carried out by the regional waste management planning offices found that household waste increased by 21 per cent on average and commercial waste generation volumes went down by 50 per cent during the initial phase of restrictions. This trend is understandable given that all but essential services were closed for a time and people were working from home where possible. C&D waste decreased by 70 per cent, as this sector also ceased operating for a time. Skip hire and civic amenity facility activities increased because of clear-out and do-it-yourself activities (EPA, 2020c). The COVID-19 pandemic has the potential to affect waste policy in the short term and national waste statistics in the longer term.

Consumer Behaviours

Consumer behaviours affect waste generation and management.

How consumers behave affects the quantity and types of waste generated and how these wastes are managed. Examining the waste collected provides important insights into the amounts and types of waste presented,²² whether the waste was deposited in the correct bin and the extent of contamination of the recyclables.

The latest national municipal waste characterisation study (EPA, 2018b) found that 11 per cent of material in household bins should not have been there at all (WEEE, batteries, textiles, paint) and that the recycling bin had higher levels of contamination and non-target materials than 10 years previously. Half of household organic waste is being deposited in residual or recycling bins, rather than being deposited in organic bins. Even more starkly, 70 per cent of waste presented in the commercial residual bin was potentially recyclable. Two-thirds of the plastic waste deposited was soft plastics (films, bags and wrappers), which are not currently accepted in the kerbside recyclables bin.

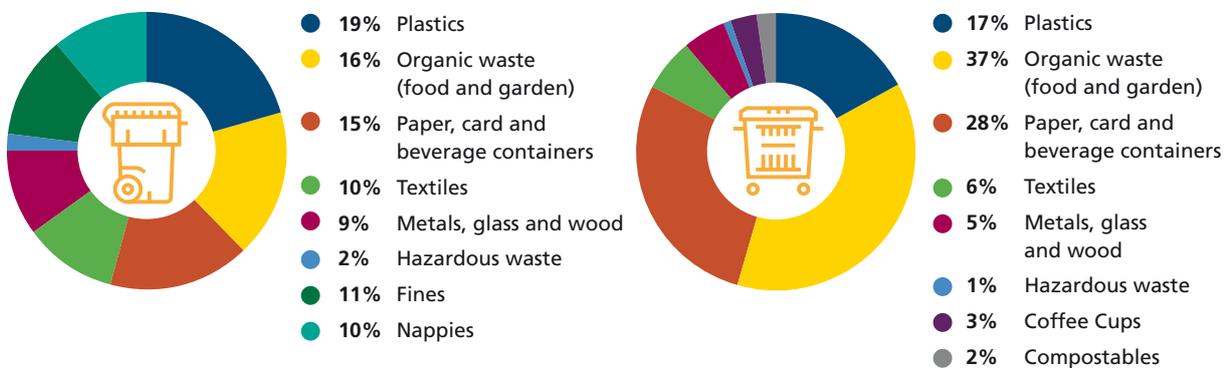
Since the previous study in 2008, there was a change in the materials placed on the market and consumer behaviour; this is reflected in the decrease in the amount of newspaper in recycling bins and an increase in the amount of single-use items (plastics, coffee cups, tissue paper). Regulators and policymakers use this evidence to target enforcement and awareness and education campaigns on correctly segregating and presenting waste (Figure 9.9).

Population

Population growth is likely to drive further waste generation.

Ireland's population is forecast to be up to 6.7 million by 2051 (CSO, 2019). Based on 2018 waste generation figures, a population of 6.7 million would generate 3.9 million tonnes of municipal waste (2.9 million tonnes in 2018) and a potential 19.3 million tonnes of overall waste (14 million tonnes currently).²¹

Figure 9.9 Municipal waste characterisation insights from household (left) and commercial (right) residual waste bins (Source: EPA; for more information, see EPA, 2018b)



²¹ Based on latest data and not allowing for economic growth or contraction.

²² Typically, three kerbside bins: residual waste, dry recyclables (co-mingled rigid plastics, paper and cardboard, metals) and organic waste (food waste, sometimes green waste). Some collection operators provide a separate bin for glass. For commercial premises, cardboard waste is often a separate collection.



Market Structure

The structure of Ireland's household waste collection market is atypical.

Local authorities are responsible for collecting or arranging for the collection of household waste under the Waste Management Act, 1996. Atypically, compared with other Member States, the household waste collection market is privatised; householders contract directly with the operator for provision of the service.²³ In 'side-by-side competition' for the waste collection market, waste operators can offer their services in any location and there may be more than one collector in any location. A study by the Competition and Consumer Protection Commission (CCPC) to assess the nature and scale of household and operator issues in the household waste collection market reported that the market is highly concentrated, consumers have little or no power to influence operators' behaviour and the current structure affects the achievement of environmental goals. The CCPC also reported that, although there are numerous regulators, there are few state economic levers to ensure that policy on waste collection services is delivered and environmental goals achieved (CCPC, 2018).

Waste Infrastructure and Capacity

Ireland has limited, and in some cases zero, national capacity to treat the wastes generated.

Local authorities are statutorily responsible for waste management planning and provision of infrastructure. A network of civic amenity sites and bring banks are owned and managed by local authorities (or their management is

subcontracted to the private sector) and local authorities manage legacy sites, particularly closed landfills, but the private sector primarily provides waste collection and treatment facilities.

Waste treatment capacity is finely balanced, particularly for municipal and non-inert C&D wastes (Table 9.8). In 2016, landfill capacity was critically low and additional capacity had to be authorised to prevent environmental impacts. Municipal and non-inert C&D waste treatment capacity is now monitored quarterly by the regional waste management planning offices to ensure continuity of collection and processing capacity (also healthcare waste capacity since COVID-19). There is no contingent landfill capacity currently in place, although some suitable sites have been identified, and the process of assigning contingency capacity is under way. Lack of capacity has affected the state's availability to repatriate certain legacy waste that had been deposited illegally at sites in Northern Ireland. There is currently no commercial hazardous waste landfill or hazardous waste incinerator in Ireland²⁴ and no facility for radioactive waste treatment. This lack of infrastructure is a risk to the state. While the EU single market gives us security of movement, there are risks that export markets for hazardous and recyclable wastes may close at short notice because of lack of capacity or cost-effectiveness.²⁵ Waste exports are also lost resources; some wastes can be repaired for reuse, others used as fuel and others mined for recycling.

²³ Kerry County Council and Kilkenny City Council continue to collect household kerbside waste for fewer than 2,325 urban households (2019 data).

²⁴ A licence review application for Bord na Móna Dredhú Landfill includes for hazardous waste landfill. Indaver Ireland Limited has applied for a licence for a hazardous waste incinerator in Co. Cork.

²⁵ The Netherlands and Sweden introduced waste-to-energy levies in 2020.



Table 9.8 Waste infrastructure and capacity, 2020 (Source: EPA)

INFRASTRUCTURE	DETAILS	AUTHORISED CAPACITY	COMMENTS
Landfills accepting municipal and other waste for disposal and recovery ^a	Drehid landfill Knockharley landfill Ballynagran landfill	470,000 tonnes a year ^b	Three landfills, compared with six in 2016.
Municipal waste-to-energy facilities	Indaver waste-to-energy facility Dublin waste-to-energy facility	835,000 tonnes a year	A pyrolysis plant in Co. Offaly with a licence to process 65,000 tonnes a year is due to start operations in 2021.
Co-incineration of solid recovered fuel at cement kilns	Irish Cement Platin Quinn Cement Breedon Cement Ireland Limited	343,000 tonnes a year	A licence application for Irish Cement Mungret is under consideration by the EPA.
Composting and anaerobic digestion ^c	33 commercial facilities	688,000 tonnes a year	Does not include industrial/agricultural facilities that treat their own waste.
Soil and stone recovery capacity		>20 million tonnes ²⁶	In 2019, waste facility permit regulations were amended to increase the threshold for recovery of inert wastes from 100,000 tonnes to 200,000 tonnes over the lifetime of a facility.
Civic amenity sites	121 (96 local authority and approx. 25 private sector)		Approx. 17% of household waste managed is accepted at these sites.
Bring banks	Approx. 1850		
Pay-to-use compactors	Approx. 30		

^a Ballaghveny landfill, operated by Tipperary County Council, is due to reopen in 2021 to accept non-municipal wastes such as non-hazardous C&D waste.

^b In 2018, 418,029 tonnes of municipal waste were disposed of to landfill. In that year there were five operational landfills accepting municipal waste.

^c In 2018, 436,000 tonnes of biodegradable waste were accepted for treatment at these sites, an increase of 15% on the 2017 tonnage.

Authorised capacity reported here is based on licence/permit conditions but there may also be planning restrictions. Note authorised capacity does not always equal operational capacity, as the capacity may not be built or commissioned and may be subject to shut-down/maintenance at times.

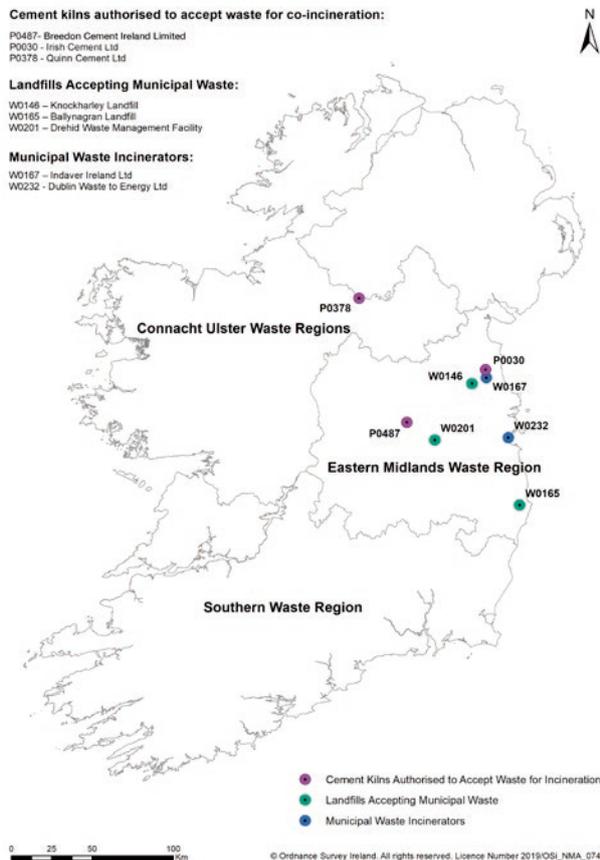
At present, registers of waste collection and facility permits are maintained by the National Waste Collection Permit Office, and the EPA maintains a register of waste sector licences. The State would benefit from a national, online, open-source register of waste infrastructure and capacity.

Municipal waste disposal and thermal treatment infrastructure is concentrated in the Eastern Midlands waste region (Figure 9.10).

²⁶ This figure represents EPA authorised capacity and does not include capacity for soil & stone recovery at local authority authorised waste facilities.
http://www.epa.ie/pubs/reports/other/corporate/2019-09-11_EPA_AnnualReport_English_2018web.pdf



Figure 9.10 Municipal waste landfill and waste-to-energy treatment infrastructure (Source: EPA)



Waste Management Planning and Regulation Responsibilities

Interagency cooperation is vital given the existing planning and regulatory systems.

Ireland's waste planning and regulatory responsibilities and systems have developed over the last 25 years, and the EPA and local authorities have statutory roles. The EPA's Office of Environmental Enforcement (OEE) is responsible for enforcing EPA waste sector licences and supervises the environmental protection activities of local authorities. The OEE coordinates the activities of NIECE, the Network for Ireland's Environmental Compliance and Enforcement (Topic Box 9.4).

Topic Box 9.4 Network for Ireland's Environmental Compliance and Enforcement

NIECE was set up to improve the implementation of environmental protection legislation through enhanced promotion, engagement and collaboration among public authorities (EPA, 2018c). Waste is a thematic area²⁷ and priorities such as illegal dumping, C&D waste, ELVs, tyres and landfills have been a focus.



Regional local authority structures are in place for waste management, waste enforcement and climate action planning. The National TransFrontier Shipment Office at Dublin City Council is the competent authority for waste shipments and hazardous waste movements within the State while the National Waste Collection Permit Office at Offaly County Council is responsible for waste collection permitting.

An evaluation of Ireland's implementation and operation of European policies on preventing and combatting waste crime was broadly positive, and it made a number of observations and recommendations, including compiling waste crime statistics at a national level, keeping the EPA and National TransFrontier Shipment Office's capacity under review to allow them to effectively fulfil their tasks, and considering evaluating the benefits of specialised judges in waste crimes or providing judges with structured and ongoing training in waste crime. They also identified an overlap in competences and gaps between the authorities responsible for the enforcement of environmental legislation and suggested enhanced cooperation between the stakeholders responsible for enforcement, given that waste crime is a concern and interagency cooperation is vital (Council of the European Union, 2018).

²⁷ Water and air/climate are the other thematic areas.



Timely Waste Data

The provision of good-quality, timely waste data is a priority action.

Provision of quality and timely waste data is a priority action for Ireland (EC, 2019). To meet this priority, waste management operators must provide good-quality data to regulators when they need it. Local authorities must complete data validation work in good time to allow timely publication of national waste statistics. Regulators should identify waste statistics that can be provided on a more up-to-date basis, even as preliminary information, to inform enforcement and investment in the waste industry and for decision-making by policymakers. Fixed penalty notices could be an effective administrative sanction to introduce for operators that fail to report on time or whose data reporting requires significant validation efforts. Introducing a legislative requirement to make certain waste collection and facility data accessible online, without compromising commercial sensitivity, should be considered. The circular economy legislation is introducing new reporting obligations and calculation methods, and setting up data sources and reporting methodologies will need significant resources in the short term.

5. Promoting Sustainable Behaviours and the Circular Economy

National Waste Prevention Programme

The National Waste Prevention Programme supports national initiatives that prevent waste and drive the circular economy.

The National Waste Prevention Programme supports national-level, strategic programmes to prevent waste and drive the circular economy.



Programmes include the Green Enterprise²⁸ innovation funding programme, the Local Authority Prevention Network²⁹ and Smart Farming.³⁰ Food waste prevention has greater priority in the National Waste Prevention Programme since its review in 2018, and new initiatives are being undertaken to examine the nature and extent of food waste in Ireland and estimate carbon impacts. The programme will continue to build on the successful consumer-focused Stop Food Waste³¹ and business-focused Food Waste Charter, Retail Action Group and Food Waste Forum.

Green Public Procurement – Public Sector as Leader

Green public procurement can be a stimulus for waste prevention and the circular economy.

Green public procurement (GPP) has significant potential to create a critical mass of demand for more sustainable goods and services, given that public sector purchasing accounts for up to 12 per cent of Ireland's gross domestic product each year (Topic Box 9.5). The Climate Action Plan recognises that the public sector has a leadership role in GPP (DCCA, 2019b), as does the Green Government initiative (DCCA, 2019c). The programme for government 'Our Shared Future' commits to developing and implementing a sustainable procurement policy and to mandating the inclusion of green criteria in all procurement using public funds within 36 months (Government of Ireland, 2020).

The EPA's *Green Procurement Guidance for the Public Sector* (EPA, 2014) is under review and a revised version will be published in early 2021. GPP training for government departments and public bodies has started in 2020 and a GPP monitoring and reporting template for government departments is in preparation. The EU Green Deal flags the potential for GPP legislative targets, and the Farm to Fork Strategy proposes minimum mandatory GPP for public food and catering contracts.

28 <http://www.epa.ie/researchandeducation/research/epafunding/greenenterprise/>

29 <https://localprevention.ie>

30 <https://smartfarming.ie>

31 <https://stopfoodwaste.ie>



Topic Box 9.5 Green and Social Public Procurement

In 2019, the National Waste Collection Permit Office procured the delivery, assembly and installation of upcycled furniture for its new office in Tullamore. Community Resources Network Ireland led a consortium of ten social enterprises to complete the project and fitted the office with 97 items of upcycled furniture, saving approximately 2.6 tonnes of carbon dioxide. Seeking reused and upcycled furniture through procurement has the potential to prevent waste and also support organisations delivering circular economy activities in Ireland.



(Source: Community Resources Network Ireland)

Environmental Levies

Levies encourage better waste disposal practices and deter overconsumption.

There are environmental taxes on disposal of waste to landfill and consumption of certain plastic bags. In 2019, €6 million was collected from the plastic bag levy and €12 million was collected from the landfill levy (Table 9.9). In the period 2004-2019, the maximum amount collected under the landfill levy was €52 million in 2012 and the maximum under the plastic bag levy was €27 million in 2008 (CSO, 2020).

The European Commission's Environmental Implementation Review recommended that Ireland introduce new economic instruments to promote prevention and make reuse and recycling more economically attractive (EC, 2019). In 2019, the government held a public consultation on the proposed introduction of a waste recovery levy and coffee cup levy and increases in the existing plastic bag and landfill levies (DCCAE, 2019d). A *Waste Action Plan for a Circular Economy* has stated that levies will be introduced on disposable coffee cups and also that a new waste recovery levy of €5 per tonne will be introduced to incentivise recycling over energy recovery and backfilling. Levies for virgin plastic usage, cold drinks cups and food containers are also proposed in the new national waste policy.

Table 9.9 Plastic bag and landfill levies collected (€ million), 2012-2019 (Source: CSO, 2020)

LEVY	2012	2013	2014	2015	2016	2017	2018	2019 ^a
Plastic bag levy	14	15	13	12	9	7	6	6
Landfill levy	52	43	34	34	48	37	19	12

^a Provisional figure.



By-products and End-of-waste

The numbers of by-product notifications and end-of-waste applications are increasing.

The Waste Framework Directive 2008 introduced provisions for by-products and end-of-waste materials, aiming to keep resources in the economy as part of a circular economy.³² The by-products provision allows economic operators to decide that a substance or object produced by them is a by-product and not a waste. These decisions must be notified to the EPA, which may decide to agree with the decision or may determine that the material should be considered waste. In excess of 1300 by-product notifications have been made, mostly relating to soil and stone,³³ road planings³⁴ and other C&D materials. Where the EPA has made decisions, 37 per cent were accepted as a by-product, 33 per cent were determined to be waste and 29 per cent of the decisions were withdrawn. The EPA has published guidance on soil and stone as a by-product, and draft guidance on the preparation and submission of by-product notifications will be finalised in 2020 following a public consultation period.

The European Commission has developed end-of-waste criteria for iron, steel and aluminium scrap and glass cullet. The EPA is responsible for making national decisions and single-case decisions on end-of-waste criteria if there are no criteria at EU level. Recent single-case decisions relate to plastic, recycled aggregate, ash from energy generation and recovered ammonium sulphate.³⁵ The EPA has published draft end-of-waste guidance, which will be finalised in 2020 following a public consultation period.

Consumer-led Sustainability Initiatives

The UN SDGs and the EU's Circular Economy Package have put increased focus on prevention of food waste and reducing consumption of single-use plastic products. Many social enterprises and charity and citizen initiatives have been set up to prevent waste and deliver circular economy initiatives (Topic Box 9.6).

Topic Box 9.6 Examples of Circular Economy Initiatives



Refill.ie

Refill.ie is a not-for-profit social enterprise working to make Ireland's towns and cities' tap water 'refill friendly' for everyone while on the go. They work with business communities, public organisations, community groups and local authorities to create and maintain locations where reusable water bottles can be refilled for free. The aim is to prevent plastic waste through reducing the amount of single-use plastic bottles consumed. Over 1300 locations are on Refill.ie's TAP MAP at www.refill.ie or on its app.



FoodCloud

FoodCloud is a not-for-profit social enterprise established in 2013 as the first national surplus food redistribution network. FoodCloud connects businesses with surplus, edible food to community groups that can use it, providing the opportunity for businesses and community groups to work together to increase social inclusion while addressing the problem of food waste. FoodCloud has helped to facilitate the redistribution of 30,893 tonnes of surplus food to community groups across Ireland, the UK and internationally, the equivalent of over 37 million meals.³⁶ <https://food.cloud/>



Repairmystuff.ie

Repairmystuff.ie is an online repair directory platform, developed by Monaghan County Council through grant support from the National Waste Prevention Programme's Local Authority Prevention Network. Its purpose is to support repair for reuse, a core ambition of a circular economy. Repair organisations can register for free, and the public can search for repair businesses in their local area by category. <https://www.repairmystuff.ie/>



Conscious Cup Campaign

The Conscious Cup Campaign is an environmental non-governmental organisation (NGO)³⁷ that started in 2016 with the ambition of reducing the use of single-use cups in Ireland by encouraging cafes and other outlets to incentivise, through rewards, customers who bring their own cups. Its Cafe Map shows outlets that provide such discounts or incentives to customers. The campaign also supports the food-to-go industry to eliminate single-use items by implementing reuse solutions for both front and back of house. <https://consciouscup.ie/>

32 Typically known as Article 27 and Article 28 under Irish transposing legislation.

33 Typically produced in excavations for construction.

34 Materials from removing the surface of a road or pavement during maintenance or construction.

35 Decisions can be found here: <http://www.epa.ie/waste/wastereg/art28/>

36 The volume of surplus food redistributed in Ireland to date is 8767 tonnes, the equivalent of 20.9 million meals.

37 Funded by the regional waste management planning offices and supported by VOICE (environmental NGO).



Waste Awareness and Information Initiatives

Waste data and information is now more accessible online.

The EPA's National Waste Statistics website was established to provide accessible and timely waste data and information for the public: <http://www.epa.ie/nationalwastestatistics/>.



The EPA also provides information on industrial and waste sector licence enforcement in an online resource: <https://www.epa.ie/industrialwastedata/>.



MyWaste³⁸ is a Government of Ireland initiative, developed by the regional waste management planning offices. The website provides the public with a single national online resource for information on how to manage waste responsibly and efficiently, where to find local waste services and recycling facilities and information on all aspects of the waste hierarchy, from prevention to disposal. Awareness campaigns focus on gaps in citizens' knowledge and are informed by the waste industry and other stakeholders.

mywaste

Incentivising Household Waste Management

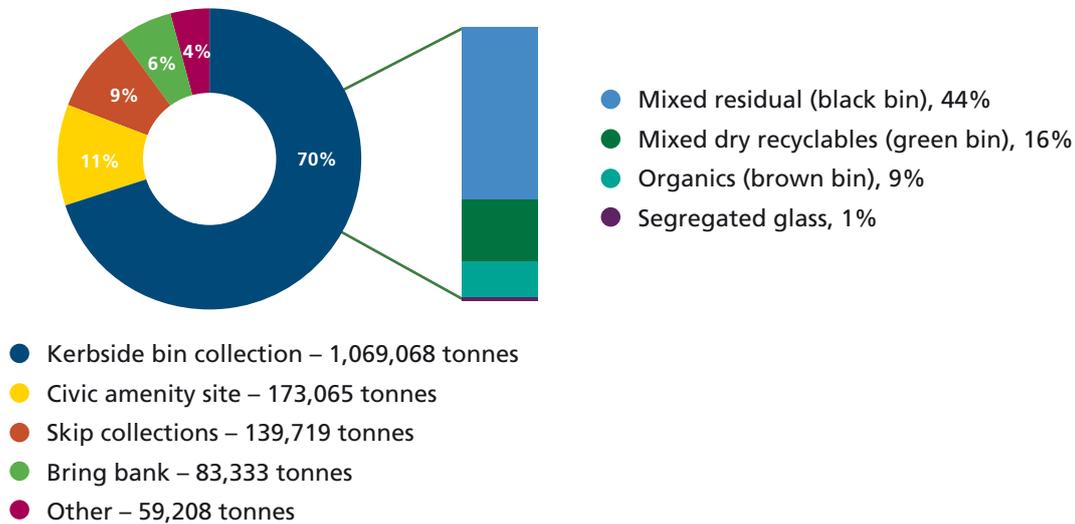
Waste bye-laws have been introduced, obliging households and commercial premises to provide proof of how they manage their waste.

Local authorities have introduced waste bye-laws obliging all households, apartments and commercial premises to participate in an authorised waste collection service or provide documentary proof of alternative means they use to dispose of their waste. The latest available estimates are that 84 per cent of households have kerbside bins or share kerbside bins, 4 per cent use a pre-paid bag collection service, 8 per cent bring it to a recycling centre and 1 per cent bring it to work (CSO, 2016).





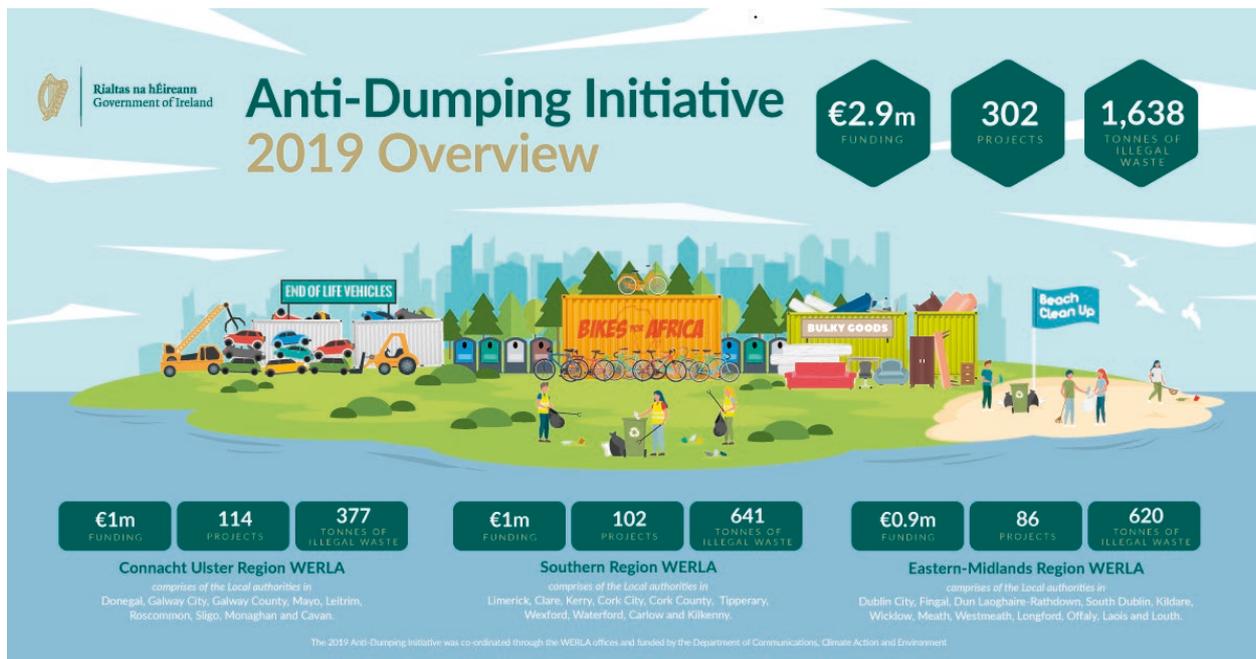
Figure 9.11 Collection of household waste in Ireland, 2018 (Source: EPA)



Since September 2017, all household waste collection contracts must be weight based.³⁹ A price monitoring group is tracking pricing in the market quarterly and has found that costs have remained broadly stable (Government of Ireland, 2019). The objective of weight-based contracts was to prevent waste by raising householders' awareness of the waste they generate and to improve segregation of waste. National waste statistics show, however, that household waste increased between 2016 and 2018 (305 kg per person in 2016, 312 kg per person in 2017, 315 kg per person in 2018). There is also room for improvement in the segregation of household waste, as shown in characterisation studies.

Kerbside collection is the primary route for managing household waste, with 70 per cent collected at the kerbside in 2018 and smaller quantities collected at civic amenity sites, bring banks and in skips (Figure 9.11). Almost half of household kerbside waste was placed in the residual bin (44%), 16 per cent in the recycling bin and 9 per cent in the organic waste bin. From waste characterisation studies the EPA estimates that the amount of residual waste could be reduced by half with proper segregation of recyclable and organic waste and that almost one-third of the waste placed in the recycling bin belongs in the residual or organic bin.

³⁹ The planned introduction of pay-by-weight charges for household kerbside collections in 2016 was met with public opposition and the policy focus shifted to the phasing out of flat-rate fees.



Enforcement Initiatives

Dumping and littering remain significant issues that are being tackled through government initiatives.

The Department of Communications, Climate Action and Environment introduced an anti-dumping initiative in 2017, which is coordinated by the WERLAs. Initiatives have included the use of drones to identify illegal dumping spots; a pilot initiative in Sligo to create and maintain a register of how households are managing their waste using Eircode information; and mattress/bulky waste amnesties (WERLA, 2020). In 2019, €2.9 million in funding was provided for 302 projects that managed to clean up 1638 tonnes of waste. In April 2020, the government announced that €1 million of the anti-dumping initiative's funds would be ring-fenced to allow local authorities to respond quickly and decisively to incidents of illegal dumping during the COVID-19 crisis (EPA, 2020c).

Topic Box 9.7 EPA Waste Research Programme

Research into waste-related topics provides valuable solutions and information.

Since 2016, the EPA has funded up to 53 new research projects relevant to the waste area, representing a commitment of €7.2 million. These projects were funded mostly under the Sustainability (Resource Efficiency) Pillar of the EPA Research Programme 2014-2020 and the EPA Green Enterprise Scheme.

Areas of waste research include:

- commercial food waste arisings
- supporting preparation for reuse of WEEE
- measuring persistent organic pollutants in waste
- sustainable compostable and recyclable plastics
- packaging waste statistics
- end-of-waste standards for good-quality compost and digestate
- potential use of wastes as geopolymer construction materials
- managing waste amalgam dental fillings.

Reports are available from:

<http://www.epa.ie/pubs/reports/research/waste/>



6. Conclusions

Waste Management in Ireland

Ireland's waste management landscape changed radically with the implementation of the Waste Management Act in 1996. From a low base, our country made great strides in reducing disposal to landfill, providing an infrastructure for the collection of recyclables and developing expertise in waste management and regulation. Ireland showed innovation by being the first country to introduce a plastic bag tax and to launch a National Waste Prevention Programme. However, Ireland has reached a plateau in relation to waste management; to further deliver the necessary waste prevention and circular economy ambitions will be a challenge.

The latest waste statistics indicate that waste generation is increasing in many waste streams, including municipal, C&D waste, hazardous waste, WEEE and ELVs. The link between economic growth, consumption levels and waste generation has not been broken.

Waste Infrastructure

National municipal landfills and waste-to-energy facilities are operating at capacity and Ireland has some significant waste infrastructure deficits, as evidenced by its high dependence on export markets for treating municipal and hazardous wastes. There is a risk to the state in the event of export markets closing at short notice and the planned contingency landfill capacity needs to be secured without delay. Developing new recycling industries and markets in Ireland would build its self-sufficiency, while recognising that viability may be an issue given the volumes produced here. Civic amenity sites and bring banks serve an important function in Ireland's waste management infrastructure, and there is potential to increase their number, aligned with population density, and for the role of civic amenity sites to be expanded to include opportunities for reuse and repair activities.⁴⁰

Waste Legislative Targets

While Ireland is meeting current legislative targets for waste collection, recovery and recycling, and diversion from landfill, future targets will be a significant challenge given our current performance, particularly municipal and packaging recycling targets for which rates have plateaued or are declining. National waste statistics indicate that much municipal and packaging waste is sent for energy recovery. While this waste management option is preferred over disposal to landfill, there is a risk that it may disincentivise extraction of recyclable

materials from residual waste. Future EU legislative targets are for recycling (none for recovery) and reuse targets are expected in future. While waste prevention has been central to national waste policy since the 1990s, circular economy policy is making prevention and reuse more urgent and necessary.

Composition of Household and Commercial Waste

Municipal waste characterisation studies have given us valuable evidence on the composition of household and commercial waste bins. On the positive side, the roll-out of organic bins has had an impact in terms of diverting food and garden waste to recycling but there are stark results regarding poor segregation, and correct segregation could reduce residual waste by half and increase Ireland's recycling rates. Education and awareness play a role as well as enforcement activities.

Regulating the Waste Sector

Non-compliance in the regulated waste sector is an ongoing issue, and the EPA and local authorities are responsible for enforcement. A risk-based approach is taken and resources directed to national priority areas. There is a significant level of enforcement activity and, given that enforcement responsibilities are shared across regulators, it is important to maintain a high level of interagency cooperation to ensure consistent approaches are taken and information and data shared efficiently and effectively. Waste crime is a significant cost to the state, from staff resources to remediation costs, and illegal activity ranges from littering to backyard burning to large-scale unauthorised waste disposal. Waste legislation needs to be effective and enforceable and the range, level and application of penalties for breaches of waste management legislation sufficient to deter unwanted behaviours. A review of litter legislation and the regulation of by-products and end-of-waste materials would be useful to ensure that provisions and regulatory processes are efficient and effective. The forthcoming EPA-led study on the nature and extent of waste crime in Ireland is welcome as a way of identifying the current status, as the last report on unauthorised waste activity was published in 2005.

⁴⁰ A review of civic amenity site operations carried out by the regional waste management planning offices will be published shortly.



A Circular Economy

The government can leverage a circular economy approach and influence behaviour change through multiple activities: policy signals, legislation, national targets, economic levies, restrictions on placing on the market, improved labelling, extended producer responsibility, and incentivising new circular economy business models and initiatives to reduce consumption of single-use items. While it is a challenge to influence citizens to change their consumption and waste management behaviours, there is increasing public appetite, as evidenced by citizen-led sustainability initiatives. The level of environmental taxes is low in Ireland and the plans to introduce for new levies under new waste policy is welcomed – we know that the existing landfill and plastic bag levies have been important drivers of change. GPP also has significant potential for the public sector to show leadership in procuring sustainable products and services.

Waste and the Pandemic

The full impact of the COVID-19 pandemic on waste in Ireland is yet to be determined. Initial data indicate that waste management services operated well, although reports of illegal dumping and backyard burning increased.

Waste Policy and Planning

This is a pivotal time, as *A Waste Action Plan for a Circular Economy* is published by government, circular economy legislation is being transposed into national law and national waste management and prevention plans are in a review phase. Ireland has the opportunity to introduce systemic change in waste management through policy and planning to drive circular economy and climate action in Ireland. While plans and programmes provide important frameworks, statutory obligations and targets are needed to drive change, as well as effective enforcement and penalties to deter illegal behaviours. We have shown our capacity in the past to be innovative, creative and open to change in terms of waste prevention and management. We have the potential through this next phase of change to positively impact not only our terrestrial and marine environments but also our health and wellbeing.



Chapter Highlights for Waste



Ireland needs to do more to prevent waste at all stages of a product's life cycle, incentivise reuse and repair, increase recycling and extract the maximum resources from waste that cannot be recycled. Implementing the policy initiatives under the *Waste Action Plan for a Circular Economy* will be central to delivering the systemic changes needed.



Strong, consistent, multi-agency enforcement and campaigns to change public behaviour are needed to effectively target littering in urban and rural areas, to prevent waste crime and to ensure that those who break the law are held accountable.



How we manage and recycle our waste needs to be reviewed. Municipal and packaging waste recycling rates have stagnated or declined but improved segregation of kerbside bins could bring about significant improvement in rates. Landfill and waste-to-energy treatment in Ireland is at capacity and the country is highly dependent on export markets to treat residual, recyclable and hazardous wastes. We need to build in resilience to Ireland's waste management capacity in the event of emergencies.



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Chapter 10

Environment and Industry





Environment and Industry

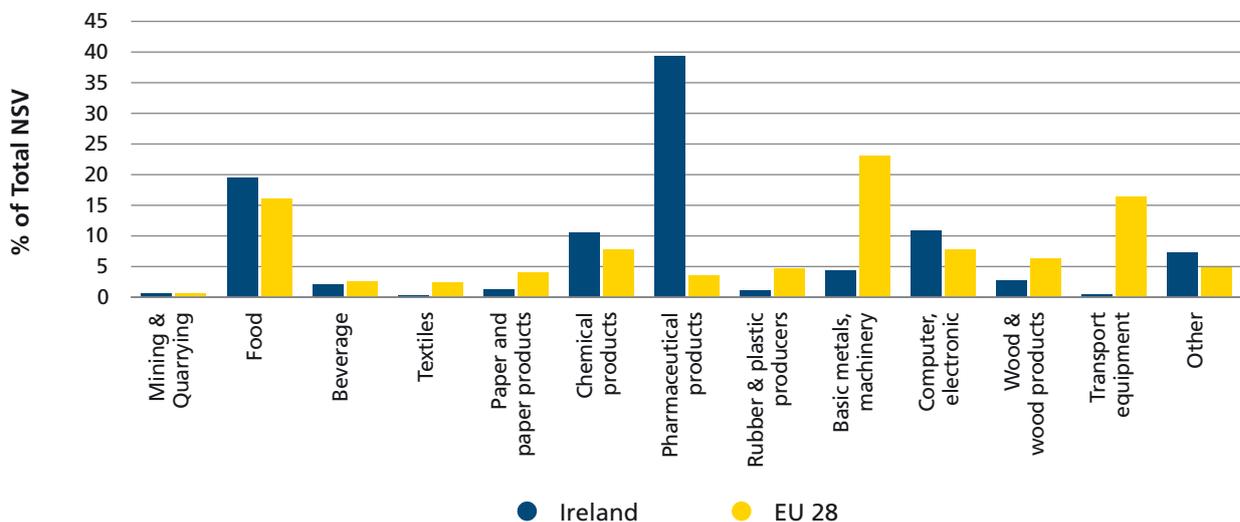
1. Introduction

Industrial activities play an important role in the economic wellbeing of Ireland. Industrial activities contribute to sustainable growth where there are effective environmental management systems in place to ensure that long-term growth does not lead to environmental pollution or the overuse of non-renewable resources.

The Industrial Emissions Directive, 2010/75/EU (IED), is the primary instrument in place to control and mitigate the environmental and human health impacts arising from industrial emissions in Ireland and across the EU. It replaced seven previous directives including the Integrated Pollution Prevention and Control Directive (IPPC). Across 65 industrial activity types listed in the IED, an operator requires a licence to carry out the industrial activity. The Environmental Protection Agency (EPA) is the competent licensing authority in Ireland for the IED¹ (Topic Box 10.1).

The profile of industries in Ireland is quite different from that across Europe. In terms of net selling value (NSV),² in Ireland the four largest sectors – pharmaceutical products (39%), food (19%), computers, electronic, optical and electrical equipment (11%) and chemicals (11%) (Figure 10.1) – accounted for 80.2 per cent or €97.4 billion of total NSV in 2018 (CSO, 2019). In contrast, across the EU-28 countries as a whole, the pharmaceutical sector accounted for only 3.5 per cent of total NSV in 2017. Another difference is that NSV for the EU-28 is more evenly spread over a larger number of industrial sectors. The most dominant sectors in the EU-28 in 2017 were basic metals (23%), food products (16%) and transport equipment (16%) (CSO, 2019).

Figure 10.1 Sectoral composition of Net Selling Value (NSV) in Ireland and the EU-28 (Source: CSO, 2019)



¹ The EPA is also the competent authority for the industrial pollution control (IPC) licensing regime in Ireland. This covers specified industries such as mining, peat extraction, certain food and drink activities and other specified industrial activities listed in the First Schedule to the EPA Act.

² Net selling value means, in relation to a commodity or service that is sold by a person or undertaking, the amount received by the person or undertaking in respect of such sale, less value added tax (VAT). The classification of industrial activities is the Eurostat Statistical Classification of Economic Activities in the European Community (NACE) Rev. 2 classification at two digits.



Topic Box 10.1 Industrial Licensing Process – Public Participation

Before the EPA can decide on a licence application, the Agency must carry out a thorough assessment of the application. This includes, in many cases, an environmental impact assessment (EIA) as required under the EIA Directive, and an appropriate assessment as required under the Habitats Directive. The assessment process is multidisciplinary, involving specialists from different environmental areas such as noise, air emissions, and so forth. Prediction modelling is also undertaken to determine local environmental impacts. Public participation and consultation with statutory consultees are central elements of the EPA licence assessment process. If deemed appropriate, an IED licence may be issued with conditions to prevent, reduce and eliminate emissions into air, water and soil as far as possible. The IED promotes the use of techniques that reduce pollutant emissions and that are energy and resource efficient.

The Industrial Emissions Directive ensures that the public has a right to participate in the decision-making process and be informed of its decisions and assessments by having access to licence applications, licences and the results of the monitoring of releases. On the EPA's website³ each installation has a homepage from where key information can be viewed, such as the licence application, licence(s), correspondence regarding the licence application and inspection, and other enforcement reports (see Figure 10.2 for a flowchart of the licensing process).

The European Environmental Bureau – the largest network of citizens' environmental organisations in Europe – examined how effectively European countries are making information about industrial pollution available to the public online, and identified the EPA website as best practice (EEB, 2017).

Continuous emission-monitoring systems can sometimes be used for monitoring important pollutants or processes. Continuous monitoring information has been made available to regulators and the public in a small number of European countries. In Ireland, boiler furnace temperature data from a licensed hazardous waste incinerator are published on the licensee's website in real time, and half-hourly averaged emissions are published 1 day delayed (Dublin Waste to Energy Ltd, 2020).

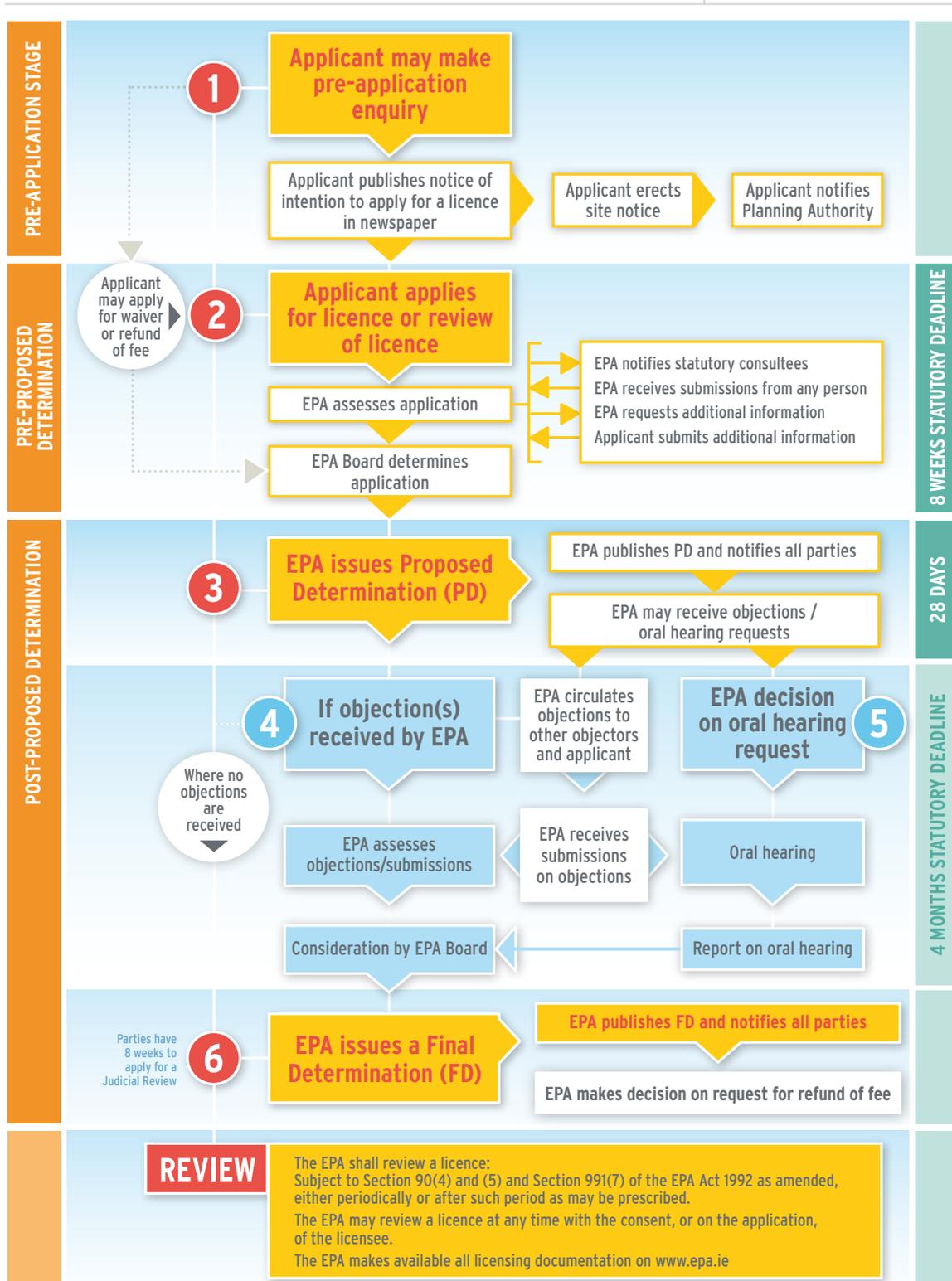


³ <http://www.epa.ie/licensing/>



Figure 10.2 Flowchart of the licensing process (Source: EPA)

SUMMARY OF INDUSTRIAL EMISSIONS & IPC LICENSING PROCESSES

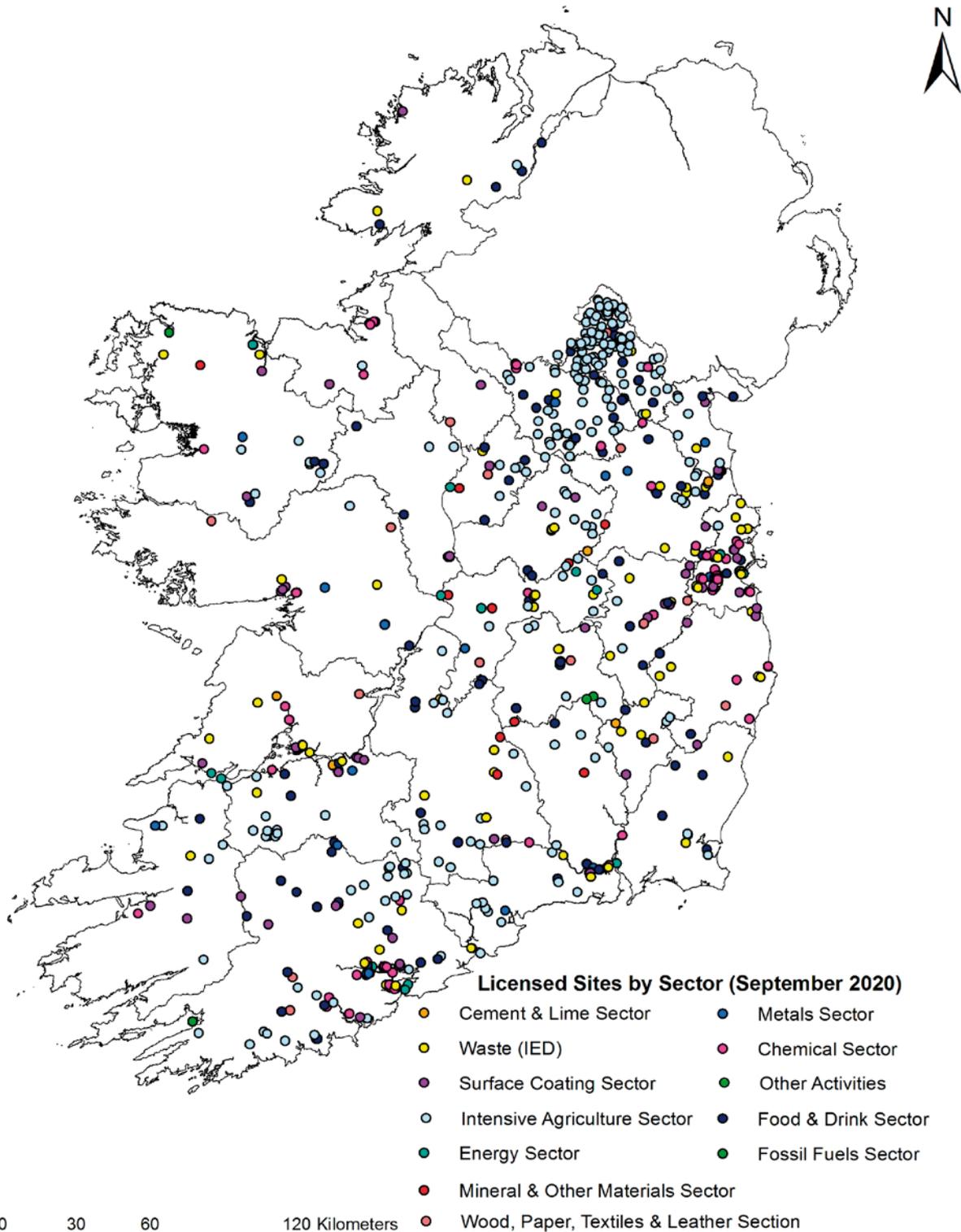




Across Europe, the IED regulates around 50,000 of the largest industrial installations, covering a wide range of sectors. Installations include power plants, cement, lime, chemicals, food and drink, waste treatment, incineration

and the intensive rearing of pigs and poultry. There are over 800 active installations in Ireland. The key sectors licensed by the EPA are illustrated in Figure 10.3.

Figure 10.3 Breakdown of active EPA licences per industry sector – September 2020 (Source: EPA)





Next to the IED, which focuses on the control of pollution at the source (i.e. at industrial installations), there are a number of additional pieces of environmental legislation at the European level that address industrial activities. These include legislation setting overall emission limits, those requiring reporting of emissions and waste generated, and those stipulating better environmental quality, reducing emissions and controlling pollution (e.g. National Emission Ceilings Directive, EU Emissions Trading Scheme, European Pollutant Release and Transfer Register Regulations, Water Framework Directive, Environmental Liability Directive and Waste Statistics Regulations). These are addressed in other chapters of this report. Topic Box 10.2 explains the development and adoption of best available techniques (BAT) conclusions.

Topic Box 10.2 Best Available Techniques

To ensure a consistent approach across EU Member States, licence/permit conditions are based on the use of best available techniques (BAT). BAT standards (known as BAT conclusions) are prepared by a technical working group of the Joint Research Centre of the European Commission, Member States, industry and civil society and are then legally adopted in the Official Journal of the EU. To date, there have been 16 sectoral BAT conclusions produced including those for power plants, chemical industry, intensive agriculture, food and drink, waste treatment and waste incineration (European IPPC Bureau, 2020). When a new BAT conclusion is adopted all licence/permit conditions for existing installations falling under the main activity of the relevant BAT conclusion have to be reconsidered and, if necessary, updated to ensure compliance within 4 years.

Following licence/permit updates, plant operators are then legally required to meet emission levels specified in the BAT conclusions, unless a detailed derogation request based on costs and benefits is received, assessed and formally granted. In Ireland, this process is regulated by the EPA.

Benefits from the Environmental Regulation of Industry

Environmental regulation of industry contributes a large dividend in terms of environmental and human health improvements.

Although environmental regulation is sometimes perceived as a threat to competitiveness, it often contributes a large dividend in terms of environmental and human health improvements (Figure 10.4). The cost of not implementing current EU environmental legislation (industrial, air quality, water framework, etc.) is broadly estimated at €55 billion across the EU. This cost relates not only to environmental impacts but also to human health impacts, as a result of breaches of air quality standards, for example (COWI/Eunomia, 2019). In addition, international and Irish evidence indicates that environmental regulations incentivise firms to introduce innovations with environmental benefits that could raise revenue and reduce production costs (Siedschlag *et al.*, 2019).

Pioneering research undertaken by a Trinity College Dublin research team looking at the impact of the IPPC Directive (the precursor of the IED) on the Irish environment identified that there were aggregate pollution reductions in Ireland over a 7-year period of 22 per cent for the chemical sector, 28 per cent for the food and drink sector, 40 per cent for the pharmaceutical sector and 45 per cent for the power generation sector (Styles and Jones, 2010).

The rest of this chapter is structured as follows.

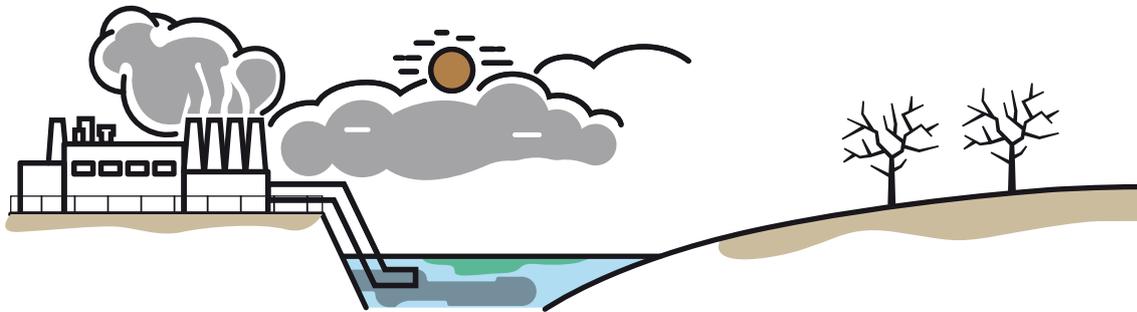
- emissions from licensed facilities
- resource use in industrial sectors
- waste generated by industrial sectors
- circular economy for resource use and waste
- enforcement of EPA licences for industrial facilities
- policy measures for Ireland's transition to a more sustainable and climate-neutral industry
- research on industry and the environment.



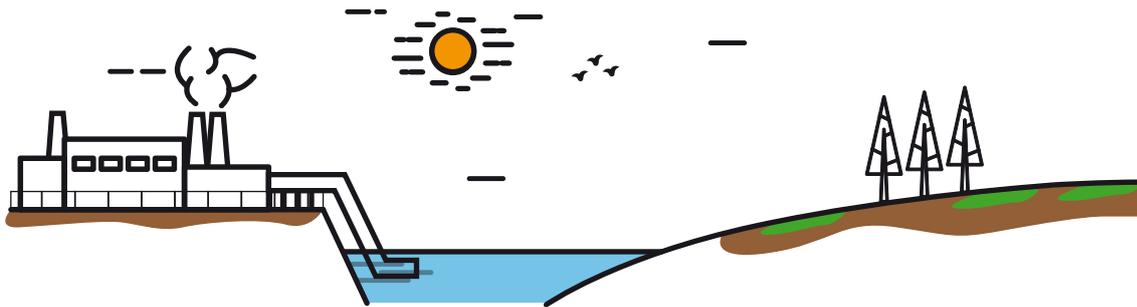


Figure 10.4 Impact of Industry on the environment in the past, present and future (Source: EPA)

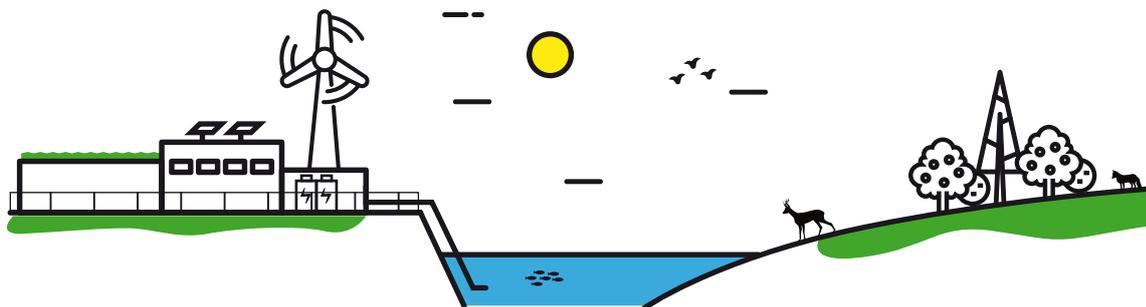
PAST



PRESENT



FUTURE





2. Emissions from Licensed Facilities

Emissions to Water from Industrial Facilities

Industrial pollutant releases to water can have an impact on surface water quality. Industrial wastewater discharges can be directly to water or indirectly to water via sewers, with Irish Water's consent, for treatment in an EPA-licensed municipal wastewater treatment plant.

Industrial pollutant releases to water include compounds that contain nutrients such as nitrogen (referred to as total nitrogen) and phosphorus (total phosphorus), which can cause eutrophication. Releases are also described in terms of their total organic carbon (TOC) content. High levels of organic content in a natural water body will undermine an ecosystem's operation, for example by affecting oxygen levels in the water. 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 products, microplastics, trace organics and residues present a potentially serious threat from industry to human health and ecosystems, and are not commonly monitored in the environment.

Industrial pollutant releases to water can have an impact on surface water quality although the impact is determined by the characteristics of the water body and, thus, how susceptible it is to the effects of pollution. In Ireland, the overall emissions from industry to waters are relatively small in comparison with those from urban wastewater treatment plants. Total direct industrial emissions to water of total nitrogen, total phosphorus, total organic carbon and heavy metals represent less than 3 per cent of the total emissions from urban wastewater treatment plants in Ireland.

Figure 10.5 describes the releases to water from industry (directly to water and indirectly via the sewer/urban wastewater treatment plants) and, for comparison purposes, directly from urban wastewater treatment plants in the period 2007-2017. Direct releases from industry have been proportionately small in this period except for the emissions of metals. There has been a significant decrease in emissions of metals to water from industry in the past 5 years, which mirrored the implementation period for the environmental objective licence reviews undertaken by the EPA (Figure 10.6). The largest improvements were from the mining sector. The cessation of operations at one installation resulted in large environmental improvements, although other sites met the reduced metal limits in their licences through a combination of improved water management practices including reducing flows, segregation of uncontaminated waters and introducing abatement measures.

However, in recent work carried out to identify significant pressures on water bodies, the EPA has identified 34 EPA-licensed facilities (30 industrial and 4 waste) as exerting a significant pressure on waters, with five of these facilities (all food and drink) assessed to be the primary causes of pressure on nearby watercourses (Source EPA Water Programme). In addition, there are 27 EPA-licensed facilities on the provisional list of waste and industrial sites that cause/exert significant groundwater pressures. Nine of these sites are from the waste sector, eight are from the chemical sector and four are surface-coating facilities.

As outlined in Topic Box 10.1 above, under the IED regime, a host of new BAT conclusions have been or will be published, with each coming into effect within a 4-year window. This effectively means that mandatory emission limits for industrial activities, including power plants and chemical and food and drink sites, will be lowered further overall between now and 2030.

Indirect water emissions from industry (to sewers and urban wastewater treatment plants) are those that undergo further treatment in a downstream wastewater treatment plant prior to discharge to receiving waters. These indirect emissions are predominantly from the food and drink sector (50%) and the chemical sector (31%). In terms of organic content (TOC), indirect emissions have almost doubled in the past 5 years (Figure 10.7) and this is largely due to the expansion of the food and drink sectors. These emissions are putting pressure on the wastewater treatment infrastructure, which was noted in a recent European report as being uniquely already over capacity (EEA, 2019a). The recent EPA publication describes in greater detail the urgency of the need to upgrade our wastewater infrastructure (EPA, 2019). Even state-of-the-art municipal wastewater treatment facilities may have difficulty removing persistent and trace organics, and it is preferable that these wastewaters are treated at the source of generation prior to discharge to sewers.

There were a small number of unauthorised industrial releases (chlorinated substances) to sewers in 2007-2010 due to failed bunding and leakage issues, which accounted for almost 90 per cent of the indirect industrial emissions over that whole period. (Figure 10.5)

In summary, industrial emissions to water represent a small proportion of overall emissions to water that are routinely monitored. However, current policies do not address the full scope of the industrial pollution load to the environment, and greater focus needs to be placed on the fate of emerging and trace pollutants discharging from industry (Figure 10.4).



Figure 10.5 Total reported releases from industry (direct/indirect) to water and urban wastewater releases to water in the period 2007-2017 (Source: EPA <http://www.epa.ie/enforcement/prtr/>)

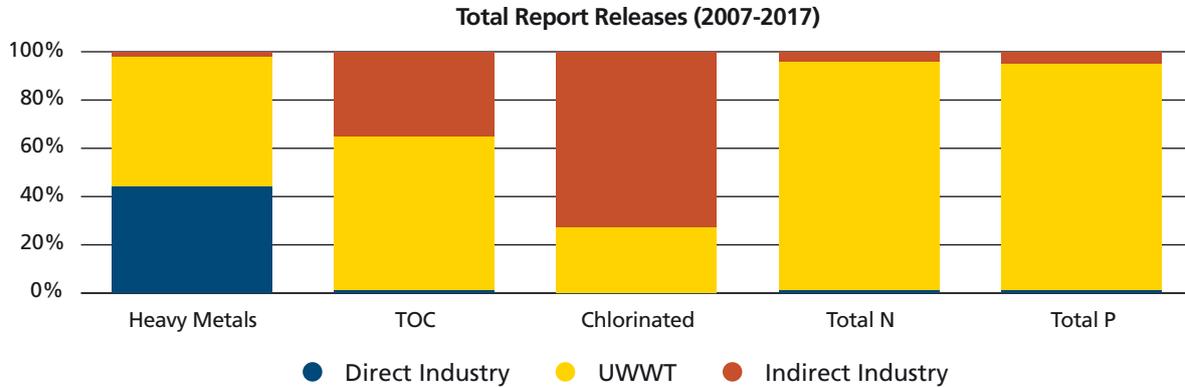


Figure 10.6 Total reported releases of heavy metals from industry direct to water in the period 2007-2017. During this time the EPA initiated 87 reviews of licences to ensure compliance with Surface Water Regulations (Source: EPA <http://www.epa.ie/enforcement/prtr/>)

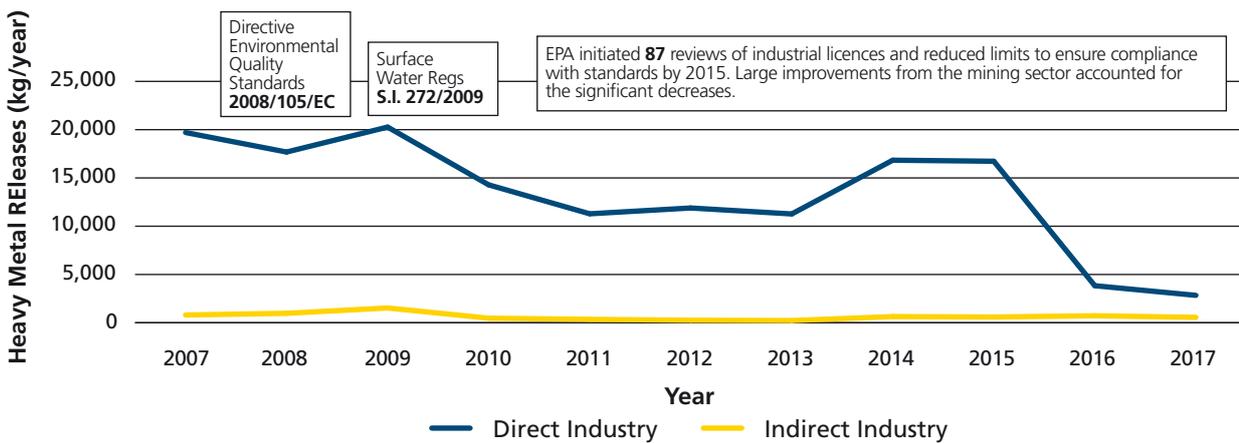
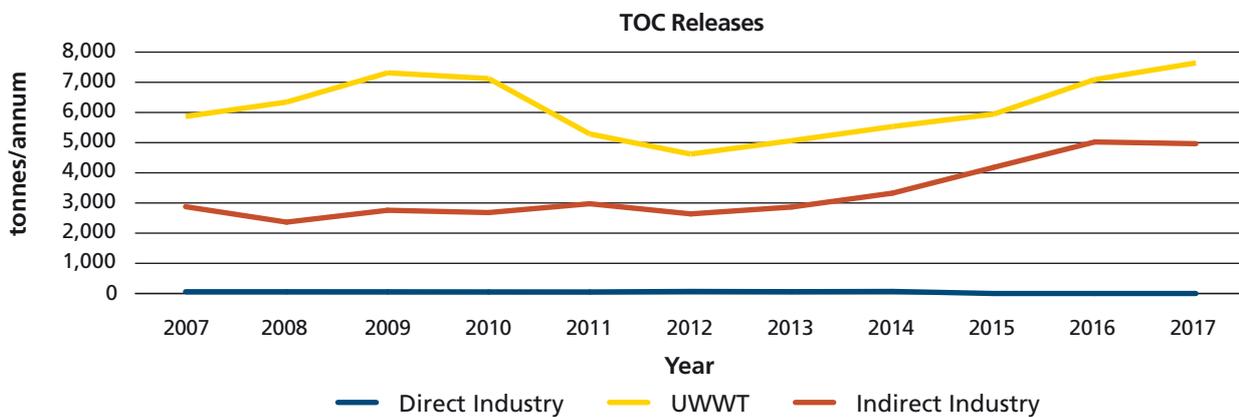


Figure 10.7 Total reported TOC releases from industry (direct/indirect) to water and urban wastewater releases to water in the period 2007-2017 (Source: EPA <http://www.epa.ie/enforcement/prtr/>)





Emissions to Air from Industrial Facilities

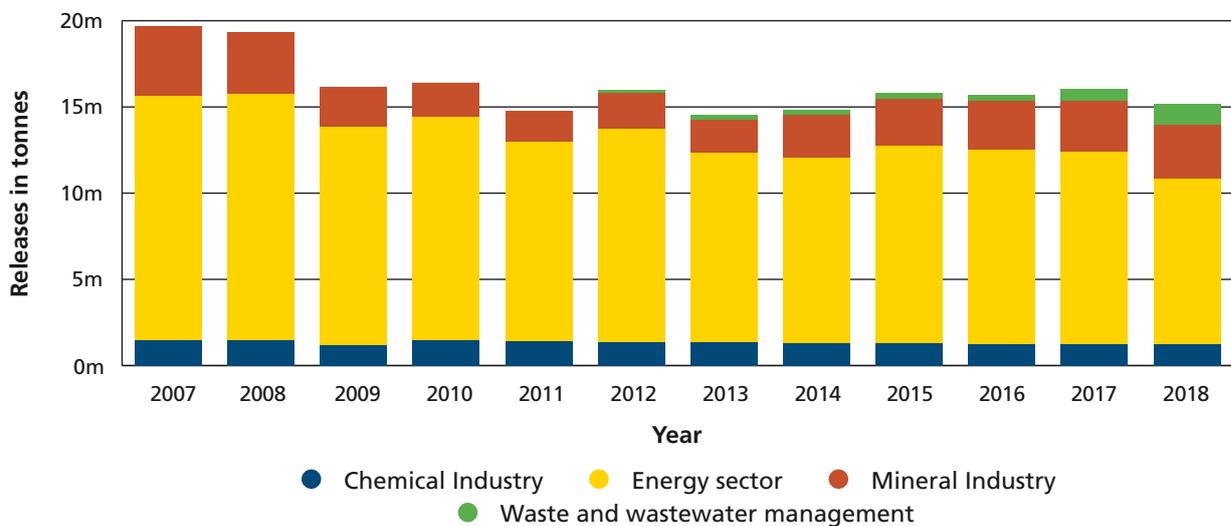
Emissions to air from licensed facilities, including power stations, represent a significant proportion of Ireland's emissions to air of greenhouse gas and other air pollutants, including sulphur dioxide, nitrogen oxides and particulate matter.

Industrial pollutant releases to air include releases of greenhouse gases such as carbon dioxide and methane, and acidifying pollutants such as sulphur oxides. Also included are pollutants that can have impacts on human and environmental health, such as nitrogen oxides, particulate matter (in this case, particulate matter of 10 microns or less in diameter, PM₁₀) and heavy metals including, in particular, cadmium, lead and mercury. Releases of these pollutants to air can affect ambient air quality. Local air quality is, however, also determined by how these pollutants disperse in the atmosphere.

Emissions to air from licensed sites come mainly from the energy and mineral sectors (cement) and represent a significant proportion of Ireland's emissions to air: 30 per cent of greenhouse gases (mainly carbon dioxide and methane), 45 per cent of sulphur dioxide, 15 per cent of nitrogen oxides and 15 per cent of PM_{2.5} (EPA, 2020). The impacts of air pollutants on human health and vegetation are dealt with in Chapter 3 of this report. Greenhouse gas emissions from industry are addressed separately by the EU emissions trading system (EU ETS; Directive 2003/87/EC) (Chapter 2).

Pollutant releases to air of carbon dioxide from industrial facilities decreased by 23 per cent between 2007 and 2018 (Figure 10.8). The most recent figures, from 2018, show that 21 facilities reported carbon dioxide releases of 15,200 kilotonnes, with the energy sector responsible for 63 per cent of the total. In 2018, carbon dioxide releases comprised more than 99 per cent of the total reportable pollutant greenhouse gas release to air of 15,279 kilotonnes, as reported in the Pollutant Release and Transfer Register.

Figure 10.8 Total national carbon dioxide releases (Source: EPA <http://www.epa.ie/enforcement/prtr/>)





Large Combustion Plants

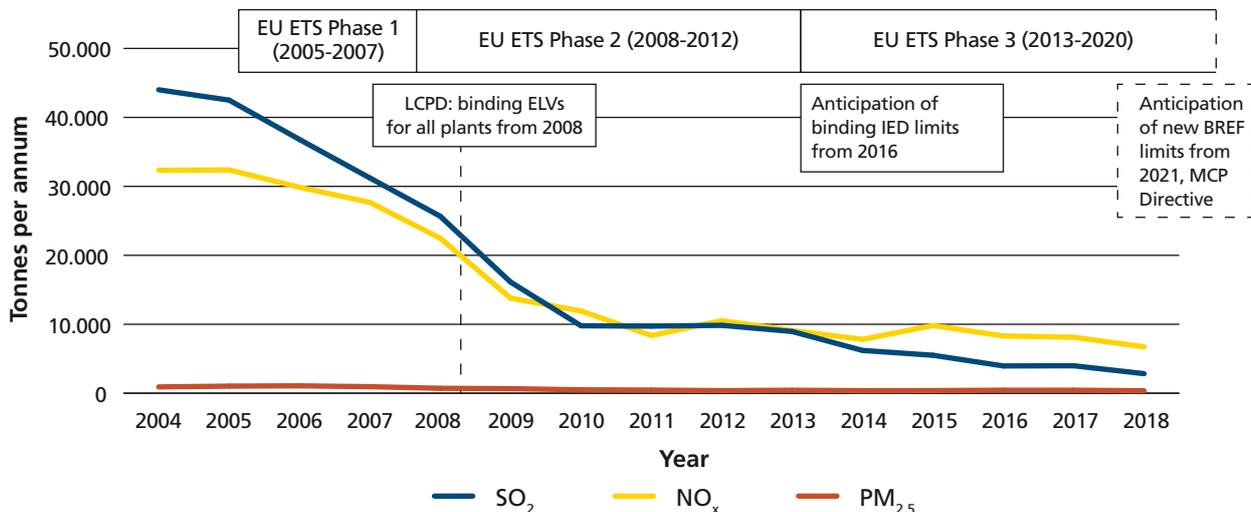
Improvements in emissions from large combustion plants, including the energy sector, in recent years can be attributed to increased regulation and tighter emission limit values.

Large combustion plants are typical backbone infrastructures producing electricity and/or heat across industrial sectors, including in electricity supply, oil refineries, food and some chemical industries. Across Europe, these facilities contribute to 47 per cent of sulphur dioxide emissions, 15 per cent of nitrogen oxide emissions and 2 per cent of dust (as total suspended particles) emissions. (EEA, 2020a). Since 2004, emissions from large combustion plants in the 28 EU Member States have decreased: by 86 per cent for sulphur dioxide, 59 per cent for nitrogen oxides and 84 per cent for dust (as total suspended particles) (EEA, 2020b).

In an Irish context, there have also been considerable improvements in emissions from the energy sector in the past few years. These improvements are mainly attributed to increased regulation under the EU Emissions Trading Scheme and the IED, with associated tighter emission limit values requiring improved abatement, changes in fuel mix and improvements in energy efficiency (Figure 10.9). In parallel, there has been a significant reduction (over 95%) in emissions of heavy metals (cadmium and nickel) to air from the sector in the past 10 years.

The new BAT conclusions on large combustion plants will become the reference for setting licence/permit conditions in Europe. As well as being more stringent, the new requirements also consider new classes of pollutants, notably mercury, hydrochloric acid, hydrogen fluoride and ammonia. The implementation of the Medium Combustion Plant (MCP) Directive, which recently came into force for plants between 1 and 50 MW, will further reduce emissions of key air pollutants such as nitrogen oxides and PM₁₀.

Figure 10.9 Emissions from the energy sector in Ireland (Source: EPA, 2020)





Ammonia Emissions from Facilities in the Intensive Agriculture (Pig and Poultry) Sector

The intensive agriculture (pig and poultry) sector accounts for approximately 10 per cent of the ammonia emissions arising in Ireland.

As outlined in Chapter 13, the agriculture sector accounts for virtually all (99%) ammonia emissions in Ireland. The EPA regulates the intensive agriculture (pig and poultry) sector, which combined accounts for approximately 10 per cent of these emissions. The BAT conclusions for this sector, which must be complied with by 2021, set, for the first time at the EU level, limits for ammonia emissions to air from animal housing and for excretions of nitrogen and phosphorus for various categories of pigs or poultry. Compliance with the ammonia limits will require an ammonia control programme incorporating measures such as nutritional management, forced ventilation, air cleaning and cooling systems and, in specific cases, abatement techniques.



3. Resource Use in Industrial Sectors

Industrial sectors account for a fifth of total energy consumption in Ireland (SEAI, 2018). Over half of this energy is consumed by three sectors in producing food, basic metals and non-metallic mineral products (e.g. cement and lime). The growth of data centres means that this sector is expected to be a large energy consumer in the future.

The EPA is required to consider energy efficiency in assessing licence applications, while for certain sectors the BAT conclusions set thermal energy consumption levels that are incorporated into EPA licences.

The data available regarding water consumption from the industrial sector in Ireland is limited, and limited data is also available from Eurostat (2017a,b). Information around water consumption is expected to improve with the new water abstraction licensing system that the EPA is now bringing into operation. Analysis of water consumed by 100 EPA-licensed facilities in 2014 (Stockil *et al.*, 2016) revealed that the largest water users or abstractors are the food sector, production of basic metals, non-metallic mineral production and mining.

Topic Box 10.3 Data Centres and Energy Usage

Data centres underpin our digital economy by processing, storing and transacting digital data. While they run solely on electricity, most facilities maintain standby generators to provide continuous power in the event of an emergency, such as a grid supply failure. Many sites also have dual supplies within the distribution network to minimise the risk from local supply disruption. Data centre energy demand was estimated at 10 per cent of electricity consumption in 2019 (Bitpower Energy Solutions, 2020).

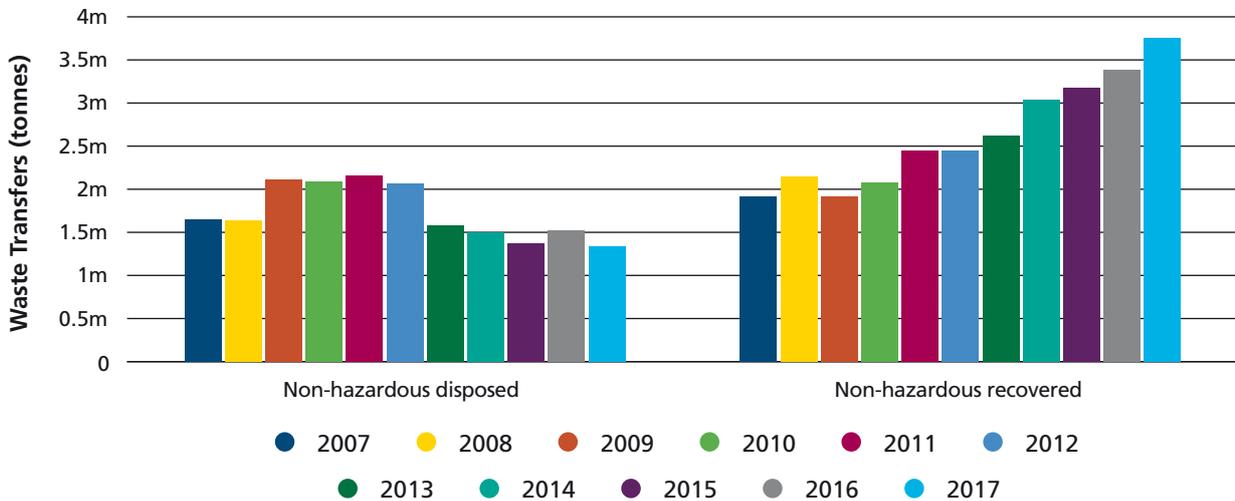
By 2028, data centres could account for 29 per cent of Ireland's electricity consumption in a median demand scenario (EirGrid Group, 2019).

The Industrial Emissions Directive (IED) applies to installations with generating capacity of 50 MWth (thermal input) and above, and includes standby plants. Data centres with on-site emergency generating capacity (e.g. diesel generators) only, which do not generate primary power on site, will not generally require an IED licence though the individual generators are required to be registered in accordance with the Medium Combustion Plant (MCP) Directive. The MCP Directive applies to combustion plants with a rated thermal input capacity of between 1 and 50 MWth. The registration deadline depends on the capacity of the plant and whether it is new or existing plant. Most data centres operating in Ireland fall into this category. There are currently (November 2020) 171 registered generators.⁴

4 <http://www.epa.ie/mcp/#register>.



Figure 10.10 Total national non-hazardous waste transfers 2007-2017 (Source: EPA <http://www.epa.ie/enforcement/prtr/>)



4. Waste Generated by Industrial Sectors

Industrial sectors account for around two-thirds of the total hazardous waste generated in Ireland, with the chemical industry producing a quarter of this amount.

Hazardous waste can pose a risk to health or the environment if not managed and disposed of correctly. The IED is the primary policy initiative in relation to the regulation of waste-related aspects of industrial activities. In general, the primary focus of the IED regulatory regime is more on the management of environmental releases and there has been less emphasis on minimisation and recovery, including preparing waste for reuse, within the licensing process. This is likely to change in the future, as there could be more emphasis on the development of the circular economy for resource use and waste.

Industrial sectors accounted for just over half (56%) of the total non-hazardous waste generated in Ireland in 2016, with the food and drink sector representing a large proportion (16%). See Figure 10.10 for details. There were significant year-on-year increases in the recovery of non-hazardous waste between 2011 and 2017. These are partially attributed to waste flows going to the waste to energy (incinerator) facilities that became operational in these years.

Industrial sectors also accounted for around two-thirds (67%) of total hazardous waste generated in Ireland in 2016, with the chemical industry representing the largest proportion (25%) (Eurostat, 2019). The cement and lime sector (18%) is also significant (Eurostat, 2019). In the chemical sector there has been a switch to cleaner biosynthesis production in recent years in Ireland, with less hazardous waste generated per installation as a consequence (Topic Box 10.4).



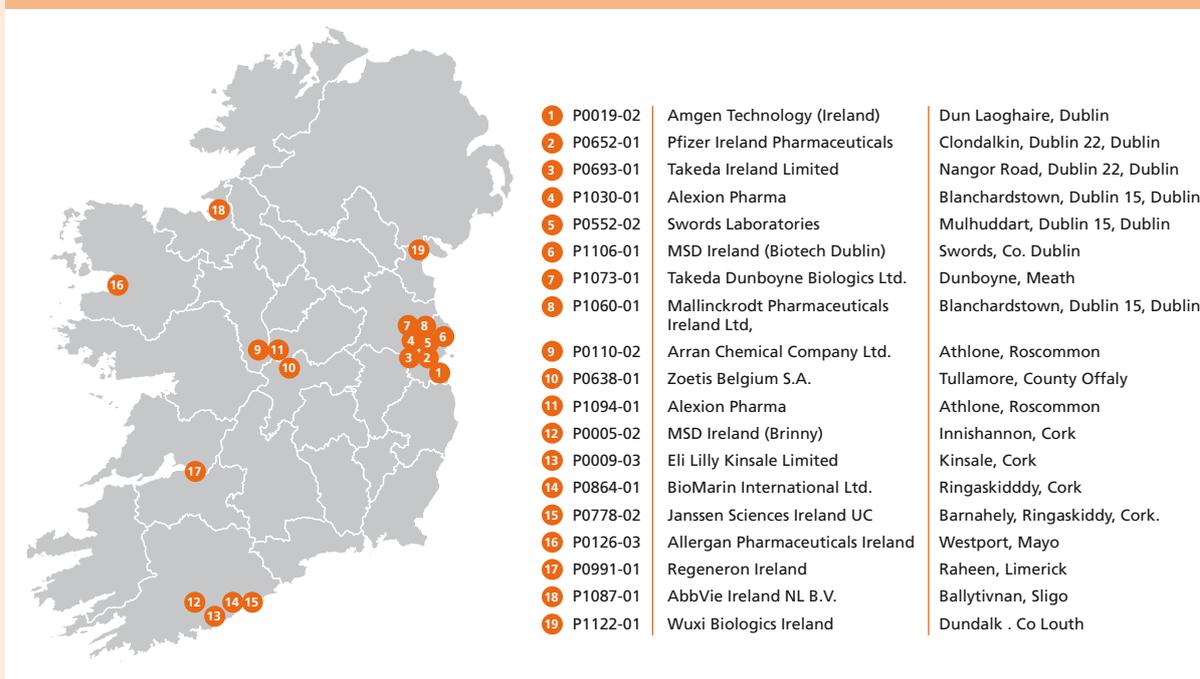


Topic Box 10.4 Transition to Cleaner and More Efficient Biologically Based Pharmaceutical Production

The chemical/pharmaceutical industry represents the largest share of total hazardous waste generated in Ireland. The industry is making significant efforts to develop cleaner and more efficient processes for manufacturing pharmaceuticals.

In recent years in Ireland there has been a transition from the manufacture of active pharmaceutical ingredients (APIs) by bulk synthesis and chemical API manufacture to biologically based production processes. Over the last 10 years, Ireland has received over €10 billion of investment in biopharmaceutical production. This investment has resulted in Ireland’s biotechnology manufacturing base increasing from 3 facilities in 2004 to over 20 facilities in operation, under construction or in planning today. Six of the top 15 best-selling pharmaceuticals worldwide are produced in Ireland (Central Bank of Ireland, 2020).

Figure 10.11 Location of biologically-based pharmaceutical production installations in Ireland



Biologically based production processes represent a clean and safe option for the manufacture of human medicines by virtue of the following characteristics:

- low emergency or fire risk due to small quantities of chemicals
- low hazardous waste generation (no hazardous chemicals involved in the manufacturing process other than minor quantities for chromatography storage and cleaning purposes)
- low atmospheric emissions (little or no volatile organic compound emissions due to the small quantities of solvents or other hazardous chemicals in manufacturing process)
- inherently low environmental risk because of the water-based process.

The data are not yet available to undertake a fully robust analysis of the environmental performance of pharmaceutical production by biologically based production methods, as there are only a small number of sites currently in full production, although a number are moving into full-scale production in the coming years. (See Figure 10.11). Based on the available data to date, it is apparent that hazardous waste generation is a fraction of that from traditional chemical production. Non-hazardous waste generated and water use are of a similar order of magnitude based on the small number of actual biologically based production sites that are fully operational at present.

The EPA plans to undertake a fuller analysis of the environmental footprint of the biologically based production installations in the coming years when there is a greater number of sites in full production.



The actual number of facilities that report hazardous waste transfers (e.g. conveyance off-site for treatment elsewhere) of greater than 2 tonnes is outlined in Figure 10.12. It is noteworthy that one-quarter of the facilities reporting hazardous waste transfers are from the energy and food and drink sectors whereas, in tonnage terms, transfers from these sectors combined are less than 1 per cent of Ireland's total hazardous waste.⁵

There was an overall increase in hazardous waste transferred from EPA-licensed facilities in the period 2007-2017. There were significant increases in hazardous waste recovered in Ireland and abroad, and decreases in hazardous wastes disposed of in Ireland and abroad in this period (Figure 10.12). The figure illustrates the large quantities of hazardous waste transferred in 2008 from the remediation of contaminated soil from a closed industrial facility that had been involved in the production of glass.

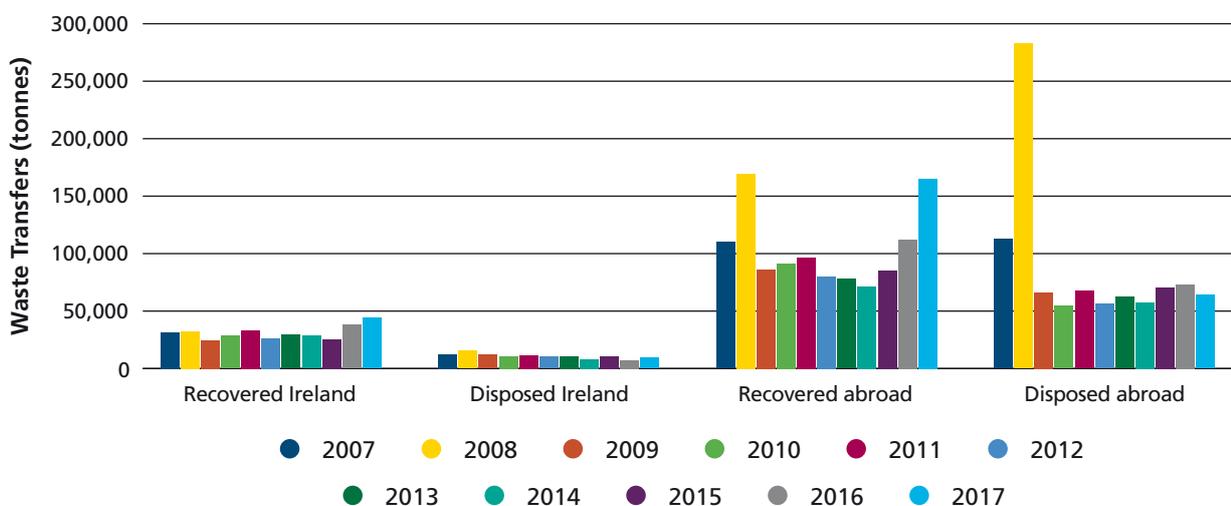
The data on hazardous waste transfers indicate that the positive trend to send hazardous waste for recovery treatment, rather than disposal, continued in 2017. However, they also highlight that Ireland has not moved significantly towards self-sufficiency. A lack of domestic infrastructure, due in part to economies of scale, and potential for public opposition, combined with the often more favourable cost option of treatment and disposal abroad, have meant that export continues to be a significant treatment route for Ireland's hazardous waste. Further details relating to industrial waste management nationally are presented in Chapter 9.

5. Circular Economy for Resource Use and Waste

Policy measures in the circular economy, waste and resource efficiency areas, including possible BAT conclusions, could help to reduce industrial waste generation and improve recovery in the coming years.

There are generally no site-specific targets set against which waste minimisation or waste recovery rates can be benchmarked. The implementation of BAT conclusions (Topic Box 10.2) is likely to have some positive influence in terms of energy efficiency, minimising resource use and waste generation, and promoting the efficient management of materials and residue recovery. BAT conclusions typically have several specific waste and resource efficiency-related conclusions, which are implemented by IED installations. However, in general these waste-related BAT conclusions tend to be qualitative rather than setting specific quantitative targets. It thus remains to be seen exactly how effective the BAT process will be in influencing waste generation and recovery levels. A recent report by Ricardo Energy & Environment and VITO (2019) highlighted greater opportunities for IED to contribute to the circular economy through the publication of the final number of sectoral BAT conclusions.

Figure 10.12 Total national industrial hazardous waste transfers in the period 2007-2017
(Source: EPA <http://www.epa.ie/enforcement/prtr/>)



⁵ <http://www.epa.ie/enforcement/prtr/>



Apart from the specific waste management or industry-related policies, other broader policy measures in the waste and resource efficiency area will also have a positive impact on industrial waste generation and recovery in the coming years, specifically policy measures in relation to the circular economy.

The European Commission's Circular Economy Package (EC, 2018), one of the main blocks of the European Green Deal agenda for sustainable growth, sets out a strategic framework of measures that will help stimulate Europe's transition towards a circular economy, boost global competitiveness, foster sustainable economic growth and generate new jobs. As part of the Circular Economy Package, the Commission will clarify rules on by-products and end-of-waste status. This will help support the development of industrial symbiosis – a process by which the waste of one company can become resources for another company.

Industrial symbiosis is also already used extensively at site level by many production installations. For example, many use exothermal processes delivering heat to processes requiring additional energy. There are many examples of industrial symbiosis at a national level, including:

- ash from power sector used in cement industry or brick manufacture
- by-product from chemical plant used as fertiliser
- solvent recovery for use in paint manufacture
- hazardous solid waste material recovered for use as a biomass fuel.

More recently, as part of the European Commission's European Green Deal (EC, 2019) launched in December 2019, there will be a considerable step up in action on chemicals. The Green Deal is a core part of the Commission's growth strategy, and it includes ambitious measures to tackle climate and environment-related challenges, including action to advance 'Towards a zero-pollution ambition for a toxic free environment'. As part of this action to ensure a toxic-free environment and eliminate pollution, the Commission plans to present a chemicals strategy for sustainability. This strategy will aim to better protect citizens and the environment from hazardous chemicals and encourage innovation in the development of safer and more sustainable alternatives.

6. Enforcement of EPA Licences for Industrial Facilities

A range of enforcement options are open to the EPA to deal with licence breaches.

After a licence is issued by the EPA, inspectors from the EPA's Office of Environmental Enforcement are tasked with the enforcement of the licence. The IED contains mandatory requirements on environmental inspections. The EPA has robust systems in place covering environmental inspections and draws up annual inspection plans accordingly. The IED requires site visits at frequencies ranging from every year to every 3 years, depending on environmental risk-based criteria.

Where licence breaches are detected, the EPA can take a number of enforcement actions. These include recording non-compliances with licence conditions; undertaking additional site inspections, audits or emissions monitoring; opening compliance investigations; issuing statutory notices; taking prosecutions or injunctions; and ultimately suspending or revoking a licence if the environmental issue has not been satisfactorily resolved.

The EPA Compliance and Enforcement Policy⁶ sets out the enforcement actions the EPA takes, having regard to five guidance principles: risk based, proportionality, consistency, transparency and the polluter-pays principle.

The EPA receives complaints from members of the public in relation to licensed facilities. Each complaint is recorded and investigated; some may require a visit to the site in question. In total 84 per cent of all complaints received from the public relate to odour (57%) and noise (27%).

One enforcement tool the EPA employs is the National Priority Sites system, which identifies and publishes the names of licensed sites that are enforcement priorities. Each licensed site receives a score based on its compliance status against four criteria: compliance investigations, complaints, incidents and non-compliances. The first National Priority Sites list was launched by the EPA in July 2017 and the list has been updated and published at the end of each quarter since then. Sites come off the list when they have made the necessary improvements in compliance. Summary information on the National Priority Sites during 2019 and 2020 is given in Figure 10.13 below.

6 <http://www.epa.ie/pubs/reports/enforcement/oeenforcementpolicy.html>



Only 2 out of the 20 sites that were National Priority Sites during 2017 were on the list at the end of the fourth quarter of 2019. This demonstrates the effectiveness of the system in driving compliance and reflects significant environmental improvements in compliance at 18 sites.

The food and drink (agri-food) sector continues to face challenges in maintaining environmental compliance as the industry adapts to increased agricultural production and intensification under the Harvest 2020 and Foodwise 2025 strategies. Although this sector again had the poorest compliance record in 2018 and 2019, it should be noted that there are many operators within this sector that operate in compliance and manage their facilities in an environmentally sound manner.

Figure 10.13 National Priority Sites summary details in 2019 and 2020



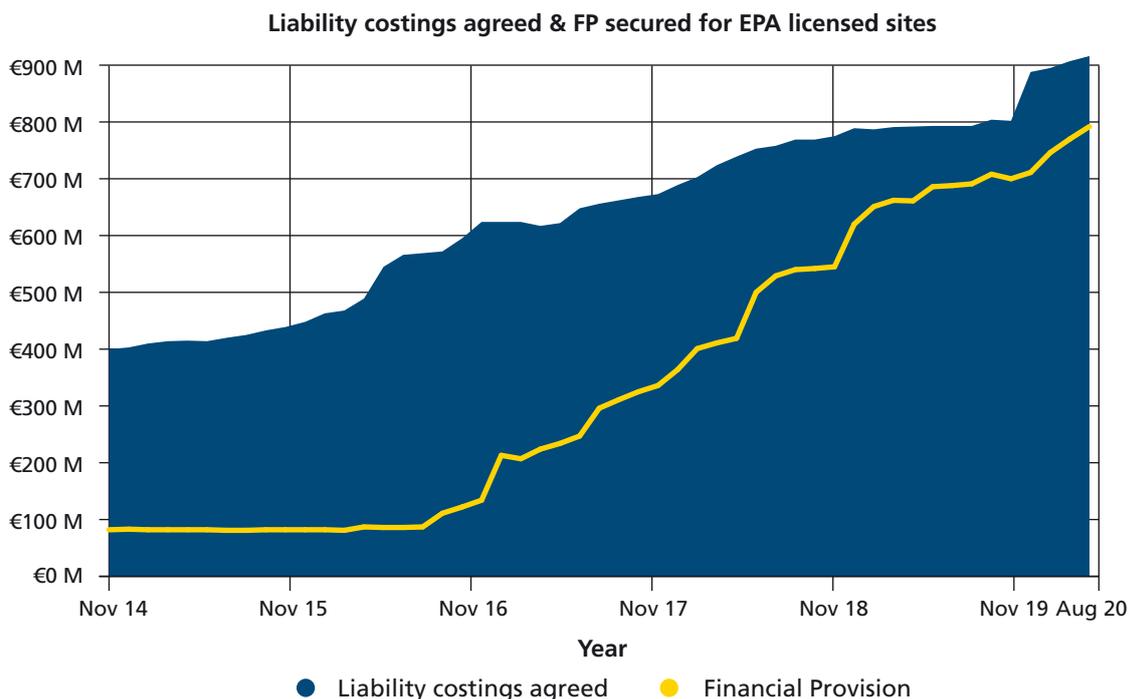
Financial Provisions for the Remediation and Proper Closure of Industrial Sites

The prevention and remediation of environmental damage from the closure of authorised activities are strategic priorities for the EPA.

In recent years, the EPA has made significant progress in ensuring licensees make financial provision to cover environmental liabilities at licensed sites. Financial provision is required to pay for site remediation, aftercare and any potential clean-up that may be required, for example following an incident. Having adequate financial provision in place is essential to manage environmental risks and to minimise the exposure of the state to the cost of remediating environmental damage if operators fail to do so.

The total costs agreed for the environmental liabilities of EPA licenced sites were €912 million by the end of August 2020 and the amount of financial provisions in place was €792 million (Figure 10.14).

Figure 10.14 Financial provision in place November 2014 to August 2020 (Source: EPA)





7. Industry and the National Transition Ambition

Demonstrating and measuring sustainability and adapting to climate change are key challenges for Irish industry.

Although significant uncertainties exist regarding the extent and impact of climate change in Ireland on industrial sectors, it is vital that industry seeks to reduce its exposure to projected changes. A recent report by the United Nations Framework Convention on Climate Change (UNFCCC) showed that a group of the world's largest companies, worth collectively nearly \$17 trillion, have valued the cost of climate change risks to their businesses at almost \$1 trillion. On the positive side the authors also noted potential gains from business opportunities of almost \$2 trillion (CDP, 2019). Therefore, having robust plans in place to adapt to climate change is key to business success. One such approach is the adoption of ISO 14090 'Adaptation to climate change – principles, requirements and guidelines'. Achievement of this standard aims to help organisations assess climate change impacts and put plans in place for effective adaptation. Other business-led initiatives such as green accounting and green investments, carbon disclosure and corporate social responsibility (CSR) programmes, also contribute to transition imperatives. The National Plan for Corporate Social Responsibility (DJEI, 2017), promoting environmental practices that enhance a company's profile and competitiveness, remains a very relevant transition-supporting policy.

From a national perspective, the government has introduced policy measures and actions aimed at taking action on climate change. Most notably, under the Climate Action and Low Carbon Development Act 2015, there is a requirement for the government to prepare a series of national mitigation plans and national adaptation frameworks. This is covered in Chapter 2, Climate Change.

Under the National Adaptation Framework, a series of sectoral adaptation plans have recently been prepared, including a plan for the electricity and gas networks sector (DCCA, 2019a). This plan highlights the impacts on the energy networks from observed recent weather events and incorporates a vulnerability assessment of the energy network. Gas-fired combustion turbines, for example, had available output reduced by around 8 per cent during the 2018 heat wave in Ireland. Furthermore, at least one existing plant had capacity reduced by up to 50 per cent during that heat wave because of cooling water issues (DCCA, 2019a).

The government's Climate Action Plan, launched in 2019, sets required targets to achieve Ireland's ambition to achieve climate neutrality by 2050 (DCCA, 2019b). Action 42, for example, requires all business representative groups, including Irish Business and Employers Confederation, Business in the Community, Irish Representative Association for Small and Medium Enterprises, Small Firms Association Chambers Ireland and others, to create partnerships of companies that sign up to a climate-neutral trajectory.

Cost-effective measures in the Climate Action Plan highlight significant opportunities and potential changes for the industrial sector, particularly in food processing and other manufacturing. In food processing, measures include phasing out the use of oil as a fuel and replacing it with biomass and electricity. In cement production, measures include the use of alternative fuels, such as solid recovered fuels and other waste streams, substituting for fossil fuels. Increasing the use of alternative fuels in the cement sector to 80 per cent by 2030 will help to offset a forecast 40 per cent increase in production over the period (DCCA, 2019b). An immediate priority of the plan is to establish networks in key sectors, including data centres, pharmaceuticals, and food and drink, to promote industry-led sectoral plans (see Topic Box 10.3).

Breakthrough technologies such as carbon capture, utilisation and storage and hydrogen could, in theory, help heavy industries such as cement and chemicals achieve high levels of decarbonisation. Indeed, the future viability of companies in these subsectors may come to depend on the commercialisation of these technologies (CDP Europe, 2020).



8. Research on Industry and the Environment

Research programmes are vital for providing integrated solutions for many of the complex environmental challenges facing the industry sectors in Ireland.

The EPA has a statutory role in coordinating environmental research in Ireland. Since 2016, the EPA has funded up to 46 new research projects relevant to the Environment and Industry area; a commitment of €5.3 million. Funding came from the EPA Research Programme 2014-2020 and the EPA Green Enterprise Scheme.

These projects include research undertaken by teams in Queen's University Belfast and the National University of Ireland Galway that identified several phosphorus treatment and recycling technologies that could effectively compete with existing technologies and provide small-to medium-scale solutions for the agri-food sector (Macintosh *et al.*, 2019). This research project followed a related study by Ryan *et al.* (2016), which evaluated phosphorus recovery technologies in an Irish context. Further work is ongoing in University College Cork aiming to demonstrate a circular economy approach to dairy-processing wastewater through the reuse of valuable components in the effluent within the local and global economy. The Algeopolymer project, led by a team in the University of Limerick, researched the potential reuse of industrial wastes, such as bauxite and fly ash, as core ingredients in geopolymers (Ujaczki *et al.*, 2019).

Funded research can also assist the EPA in identifying behavioural change tools to promote going beyond

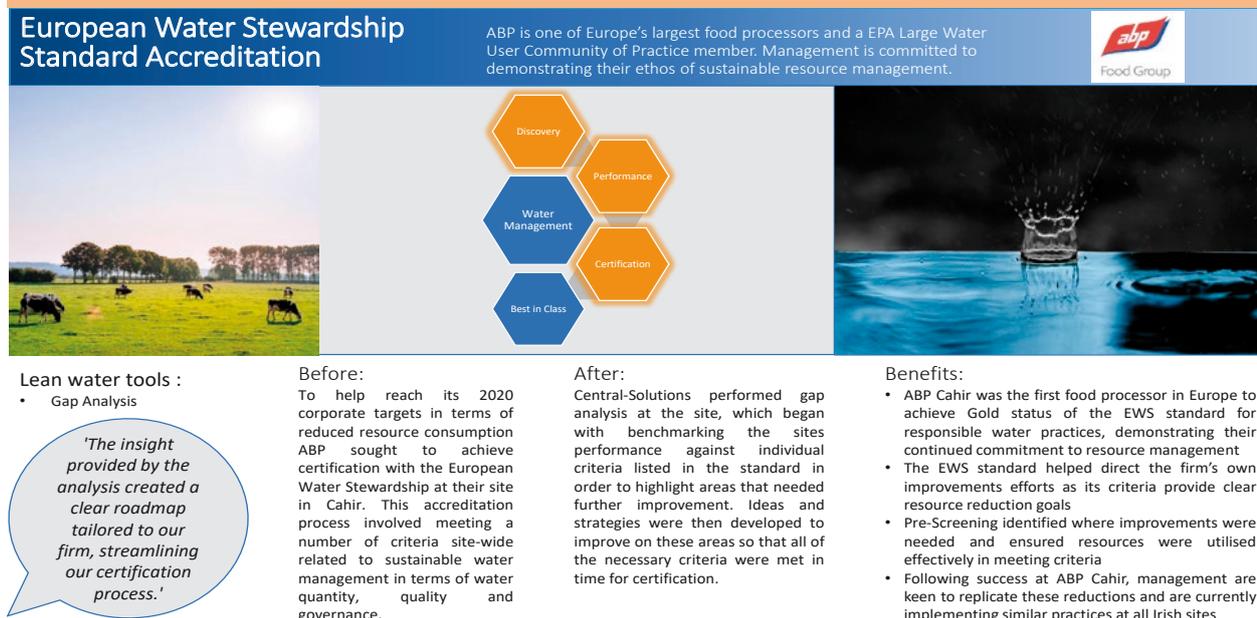
compliance in the regulated community (Keely *et al.*, 2020) and to assist smarter remote enforcement (Collins *et al.*, 2014; McDermott *et al.*, 2015).

Research programmes provide integrated solutions for many of the complex environmental challenges facing industry. A case in point is current research also under way at the University of Limerick with industrial partners. The team is looking at the potential of waste and the opportunity it presents to recover valuable metals from the likes of mine tailings, bauxite residue and industrial filter cakes.

The concept of water stewardship allows companies to understand their water-related risks and implement strategies that minimise them and promote the business's long-term sustainability. These risks may be physical, reputational, financial or regulatory. Following consultation with major water users in Ireland, Stockil *et al.* (2016) reported exciting opportunities to further improve Ireland's attractiveness as an investment location and as a leader in water stewardship practices on the international stage (Figure 10.15).

At a global level, the area of monitoring emissions from industry is expected to be revolutionised with the launch of a new satellite system capable of tracking air pollutants from every large power station in the world in real time. Developed by the non-profit emissions reduction software company Watt Time and supported by Google, the project will use a global network of satellites to measure carbon dioxide emissions before making the data public. Satellite technologies cannot replace all ground-based monitoring, and it remains to be seen how steady and sensitive the measurements will be, but, if successful, this approach could supplement enforcement efforts.

Figure 10.15 European Water Stewardship Standard Certification for Responsible Water Practices (Source: Central Solutions, 2017)





9. Conclusions

Industrial Emissions

The environmental performance of Irish industry has improved in recent decades. However, industry still generates a significant amount of hazardous waste and emissions discharged to the environment, especially air emissions.

There have been significant and sustained decreases in releases of certain air pollutants from a range of industries in the period 2007-2017. Releases of sulphur oxides, nitrogen dioxide, nitrogen oxides and PM₁₀ particulate matter have significantly decreased. These decreases are due to changes in the fuel type used at combustion plants and improvements in abatement technology at these and a range of other facilities, including the cement, food and drink, and chemical sectors. Decarbonisation of industry, stimulated by climate change mitigation policies, is expected to be the main driver of further reductions in industrial air pollutant and greenhouse gas emissions in the medium and long terms.

Greening Industry

While the Industrial Emissions Directive and earlier legislation have delivered concrete achievements in reducing pollution, a transition to a greener industrial sector will require integrated approaches, with stronger control of pollution at source and the use of innovative technologies. These policy-driven reductions are a clear success story to build upon. Challenges, however, remain for the energy sector in terms of transforming it to meet the environmental and decarbonisation targets now required.

Food, Drink and Intensive Agriculture Sectors

The food and drink (agri-food) sector continues to face challenges in maintaining environmental compliance as the industry adapts to increased agricultural production and intensification under the Harvest 2020 and Foodwise 2025 strategies.

The trend of increased releases in ammonia and methane to air from the intensive agriculture sector is due to an increase in the number of these facilities and in expansions at existing installations, driven in part by the growth of agricultural export activity.

Waste

Positive trends include recent increases in industrial waste transfers undergoing recovery and reductions in waste undergoing disposal. The change can be viewed as movement towards the implementation of EU waste policies where increasing emphasis is placed on the higher tiers of the waste hierarchy of prevention and minimisation, reuse, recycling, recovery and disposal. However, the overall increase in quantities of hazardous and non-hazardous waste transfers suggests that there is scope for improvement in resource use and consumption in industrial facilities.

Hazardous Waste

The data on hazardous waste transfers indicate that the positive trend of increasingly sending hazardous waste for recovery treatment, rather than disposal, continued in 2017. However, they also highlight that Ireland has not moved significantly towards self-sufficiency. A lack of domestic infrastructure, in part due to a lack of economies of scale and the often more favourable cost option of treatment and disposal abroad, has meant that export continues to be a significant treatment route for Ireland's hazardous waste.

Best Available Techniques (BAT)

Several of the sectoral BAT conclusions produced in the past few years will require a technical assessment of almost half the existing EPA licences from the intensive agriculture, chemical, energy, food and drink, and waste treatment sectors in the coming years. This process represents an opportunity to modernise installations and keep environmental protection in Ireland in line with developing technologies and standards.

The impacts and costs of pollution from industry to the environment and human health remain high. Industry will need continued improvements in emission reductions and abatement technologies. Existing policy instruments are expected to lead to further reductions in industrial emissions but current policies do not address the full scope of the industrial pollution load to the environment.

Future Regulation and Integration

A review of the implementation of the Industrial Emissions Directive across Europe is under way at present. As part of this exercise, the European Commission is looking at the case for the regulation of additional activities (e.g. aquaculture) and at greater regulatory coherence across European legislation including the Water Framework Directive, the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) Regulation, the IED, and so forth. These changes will ensure a consistent approach across EU Member States in preventing, reducing and eliminating, as far as possible, emissions arising from industrial activities into air and water and onto land.



Chapter Highlights for Environment and Industry



Pollutant emissions to air from industry represent a significant proportion of Ireland's total air emissions. However, releases of air pollutants by industry have significantly decreased (by over 70%) during the past decade. Overall, environmental regulation and improved pollutant abatement technology, among other factors, have delivered significant reductions in pollution and will continue to do so under new tighter standards up to 2030.



The food and drink sector continues to face many challenges in maintaining environmental compliance as the industry adapts to increased agricultural production and intensification. This sector has featured strongly on the EPA priority sites list. Investment is needed to ensure that facilities in the food and drink sector meet their environmental obligations set out in EPA licences covering areas such as odour controls, noise limits and the operation of wastewater treatment systems.



Environmental regulation provides a requirement that industry modernises and meets best practice in relation to controls on waste and emissions, as these actions taken to reduce emissions contributes a large dividend in terms of environmental and human health improvements. Industry can gain competitive advantages and more local support from being sustainable and having a good environmental compliance history.



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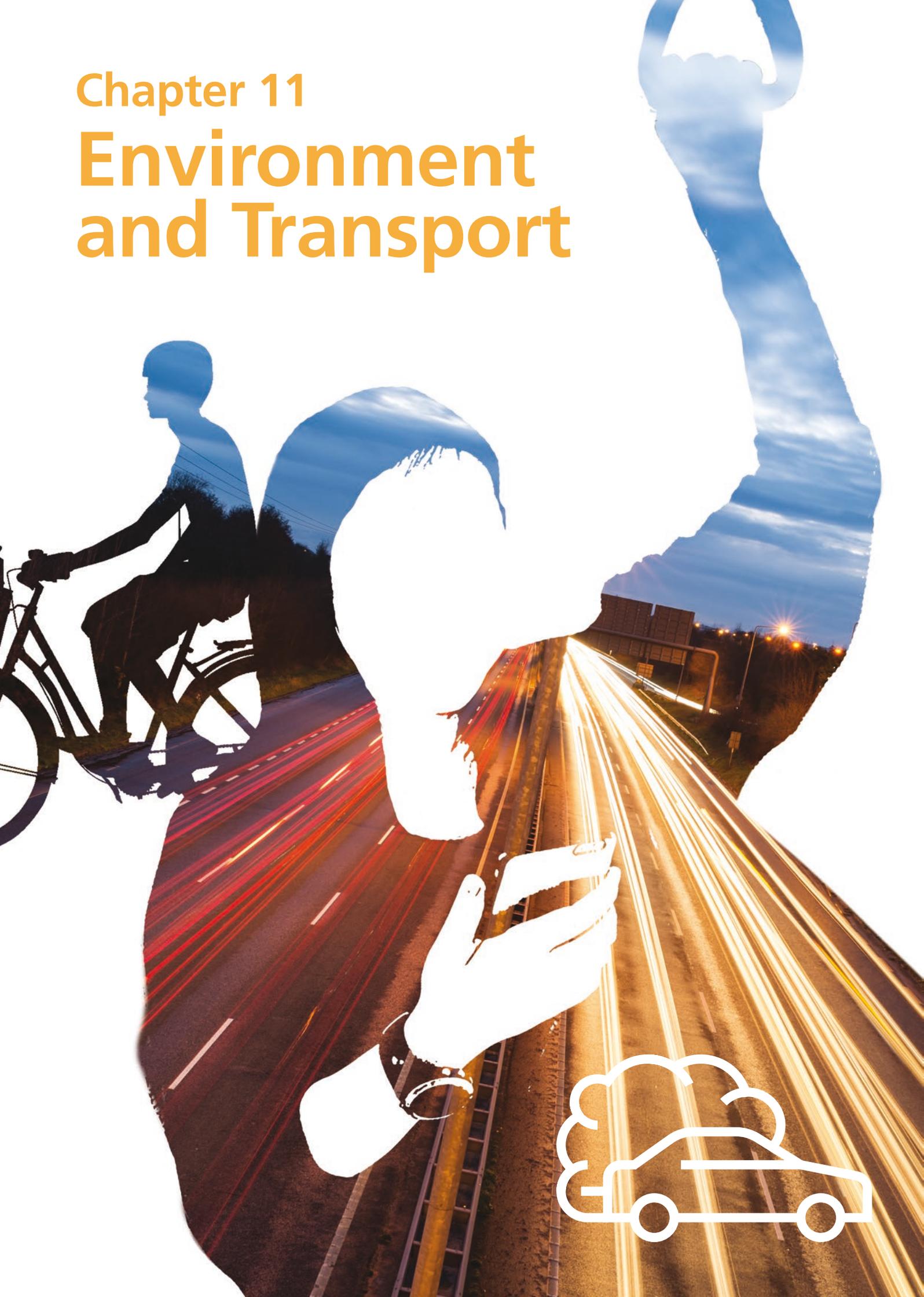
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Chapter 11

Environment and Transport





Environment and Transport

1. Introduction

Transport systems provide connectivity for delivering the goods, services, amenities and employment that underpin human wellbeing. A sustainable, accessible and efficient transport system is not only important for welfare but has a key function in trade and the economy. It also facilitates tourism and is an employer and source of government revenue in itself. Yet transport is also a major consumer of energy and material resources, and a key source of environmental pressures in Ireland, particularly of greenhouse gases, air pollutants and noise. It takes up large swathes of land and contributes to urban sprawl, the fragmentation of habitats and the sealing of surfaces (EEA, 2019a). Reducing the impact of transport systems is one of the biggest challenges to delivering a sustainable and low-carbon economy and society. The European Environment Agency (EEA), in its state of the environment report 2020, highlighted transport and mobility systems as particularly damaging to the environment. The EEA reported that transport is one of the key sectoral areas where system change is needed (EEA, 2019a).

Designing a sustainable transport and mobility system needs a managed policy-driven transformation, a path in which the driving forces behind the environmental pressures are avoided, shifted and improved. The current path presents great challenges, with increased travel demand, congestion and environmental pressures, affecting quality of life, economic competitiveness and the environment. Continuing on this path risks deepening lock-in of undesirable outcomes long into the future. This chapter explores the environmental pressures, their underlying driving forces and the responses required to move on to a path of sustainability in the transport sector. A sustainable path is characterised not only by lower environmental pressures, but also by win-win outcomes, for human health and wellbeing, for cleaner and quieter town and city centres, and for the economy.

2. Environmental Pressures from Transport

Energy Consumption

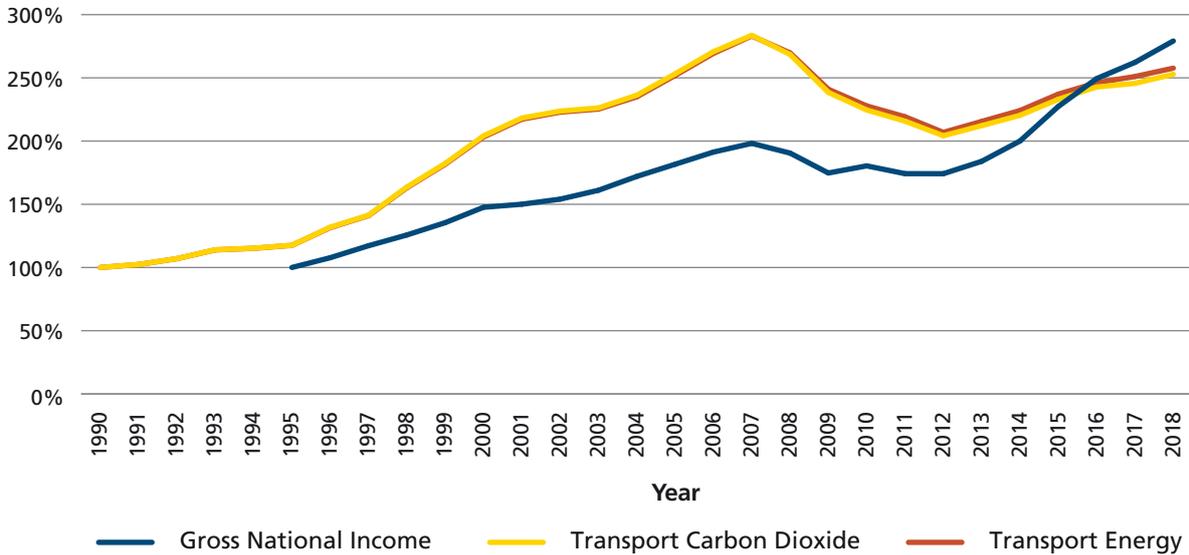
Transport is the largest energy-consuming sector in Ireland, with a 42 per cent share of final consumption, most of which is imported oil.

Consumption of energy has been strongly driven by economic and population growth, but also by decades of public and private choices that affect the transport system. Figure 11.1 shows that growth in energy consumption exceeded that of the economy until 2007. This was followed by continual declines until 2012, and a resumption as the economy recovered. Consumption in 2018 was 25 per cent higher than in 2012, having increased every year since then. Aviation alone grew by 7.9 per cent in 2018, accounting for 21 per cent of energy used for transport, second only to private cars, and more than heavy and light goods vehicles combined (SEAI, 2019a). The continuing growth in transport energy consumption is a major concern for the two headline environmental pressures that arise from transport: greenhouse gas emissions and air pollution. Figure 11.1 shows that increases in energy consumption have driven near-linear increases in transport carbon dioxide emissions, despite increased electrification and biofuels.





Figure 11.1 Trends in transport carbon dioxide emissions, energy by final consumption and in the economy by gross national income at constant market prices (Source: SEAI 2019b and CSO 2019a)



Greenhouse Gas Emissions

While transport is a key sector globally for the reduction of greenhouse gas emissions, the scale of the challenge is even more pronounced in Ireland.

Table 11.1 shows that in 2018 Ireland's transport emissions per capita were the fourth highest in the EU-27, and well above the average. EPA data show that transport is Ireland's second largest emitter, behind agriculture, at 20.3 per cent of the national total emissions, or 12.2 million tonnes of carbon dioxide equivalent in 2019 (EPA, 2020f). Even though these data exclude international aviation, consistent with international reporting convention, emissions still grew by 137 per cent between 1990 and 2019. The urgency of addressing climate change led to the Paris Agreement of 2015, which aims to limit global temperature increases to well below 2°C and close to 1.5°C. Increasing national transport emissions contribute to the difficulty in meeting our emissions reduction targets, towards this ultimate goal. Excluding international flights, transport accounts for 27 per cent of the emissions that need to be reduced to meet emission reduction targets to 2020 and 2030. Continuing growth of emissions highlights the need for further progress and additional measures, such as those announced in the 2019 Climate Action Plan, to achieve a long-term low-carbon climate-neutral economy. The stated ambition for climate neutrality by 2050 implies that Ireland will need to eliminate greenhouse gas emissions from land transport almost entirely by then.

Table 11.1 Transport carbon dioxide emissions per capita, Rank in EU-27, 2018 (Sources: Crippa et al., 2019; Eurostat, 2020)

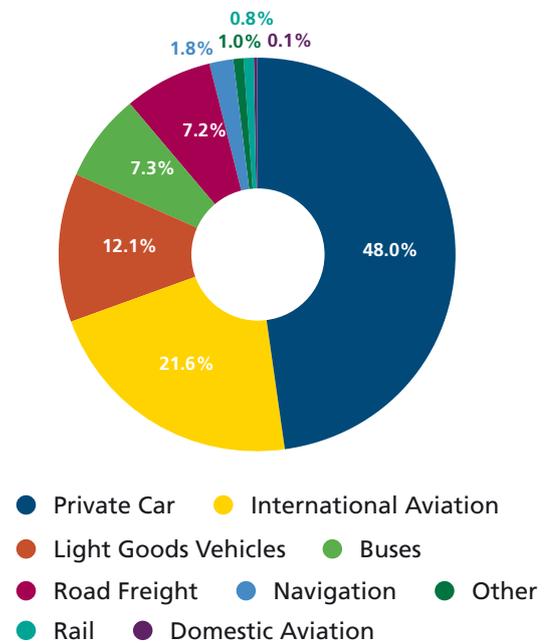
RANK	STATE	CARBON DIOXIDE PER CAPITA (TONNES)
1	Luxembourg	10.23
2	Austria	2.77
3	Slovenia	2.76
4	Ireland	2.51
5	Belgium	2.31
–	EU average	1.80





The data illustrated in Figure 11.1 are for the total environmental pressure of all carbon dioxide emissions from transport (SEAI, 2019b). This highlights growth of 158 per cent between 1990 and 2018, when international flights and transport electricity are included. Figure 11.2, breaks down the latest EPA Provisional Greenhouse gas Inventory data to show the emissions from different Transport modes that dominated in 2019. The private car was the largest contributor, at 48 per cent, followed by international aviation, at 22 per cent, and road freight (trucks), at 7 per cent. The remaining emissions are predominantly from light goods vehicles (vans) and buses. Since 1990, carbon dioxide emissions from the private car fleet have grown by 139 per cent, from international flights by 209 per cent and from road freight by 104 per cent. These patterns show how choices have led to transport becoming more individualised and motorised, driving up emissions, with a shift in freight away from the more sustainable mode of rail (O'Mahony *et al.*, 2012). Recently, the National Travel Survey suggests that there has been little shift to walking, cycling, rail and bus, with a slight decline noted from 2013 to 2019 (CSO, 2020a) (Passenger Transport section in 3. Understanding the Drivers of Transport Environmental Pressures). The place of international flights in policy to reduce emissions is discussed in Topic Box 11.1.

Figure 11.2 Shares of Irish carbon dioxide emissions by mode of transport, 2019
(Source: EPA, 2020f)



Topic Box 11.1 International Flights and Reducing Greenhouse Gas Emissions

Greenhouse gas emissions from international flights are a growing problem globally and are particularly high in Ireland. Irish per capita emissions, at 0.64 tonnes of carbon dioxide equivalent per capita, were the fifth highest in the European Union in 2017 (EEA, 2020a) and more than 20 per cent higher than our neighbour the United Kingdom.

The Chicago Convention of 1944 is the key international framework, which set principles for air transport, including the tax exemptions on aviation fuel. The 1997 Kyoto Protocol directed wealthier countries to pursue emissions reductions through the International Civil Aviation Organization (ICAO), with shipping also treated on a global basis. In 2010, the ICAO agreed aspirational goals to improve the fuel efficiency of international aviation by 2 per cent per annum until 2050, with the aim of keeping net emissions at the 2020 level. The ICAO's own analysis, however, showed that emissions continued to grow. In response, it proposed a full transition to biofuels and improved efficiencies by 2050.



Since 2012, the EU, which accounts for 35 per cent of global aviation emissions, has included the aviation sector in the Emissions Trading System. Flights to and from countries outside the European Economic Area are excluded, to facilitate development of a new global agreement. In 2016, the ICAO adopted the Carbon Offsets and Reduction Scheme in International Aviation (CORSIA), which comes into effect with a voluntary phase in 2021. The overall CORSIA target remains keeping net emissions at the 2020 level, but with a different approach whereby airlines are required to buy emissions reduction credits from other sectors to compensate for any increased activity, or use lower carbon fuels.



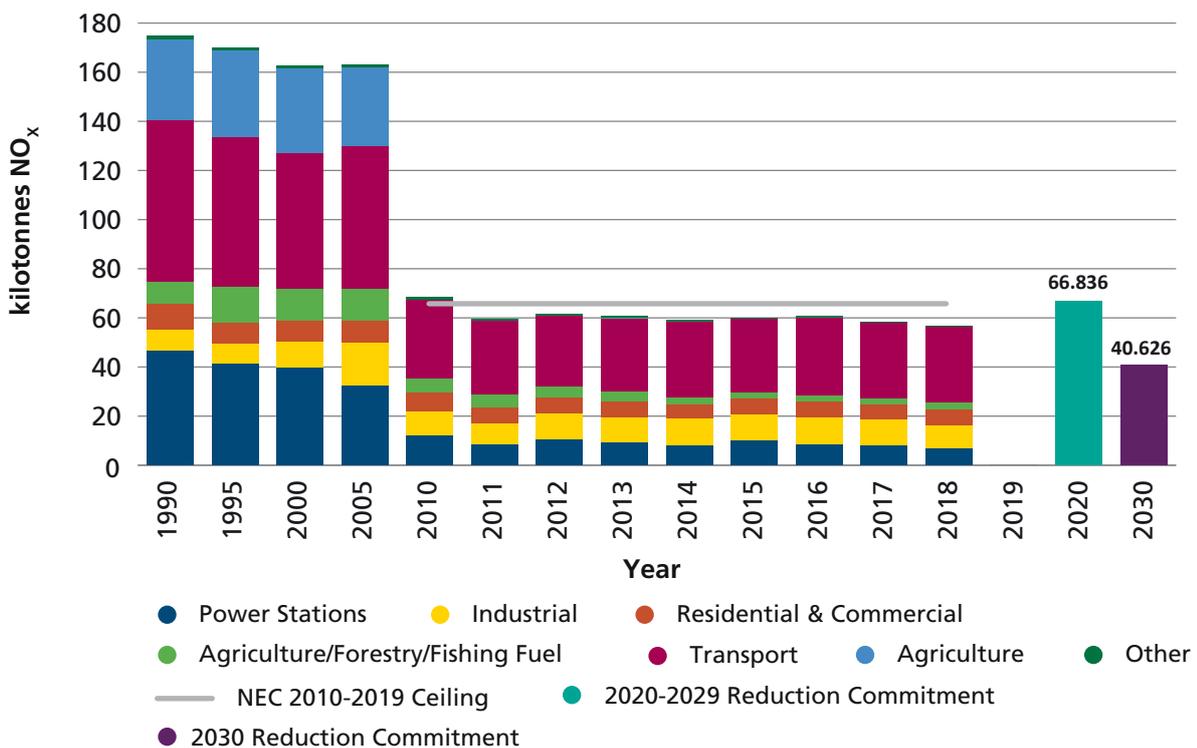
Emissions of Air Pollutants from Transport Sources

Transport is a major source of air emissions and air pollution, arising primarily from the burning of diesel and petrol in standard internal combustion engine vehicles.

The majority of the emissions to air from transport in Ireland arises from diesel and petrol consumption by private cars and heavy goods vehicles (trucks). This is similar to the main sources of carbon dioxide emissions, as shown in Figure 11.2. To protect the environment and human health from air pollution, the EU has implemented a regulatory framework, for all sectors of activity, in the National Emissions Ceilings Directive (2016/2284/EU). Ireland has targets to limit emissions of sulphur dioxide, nitrogen oxides (NO_x), ammonia, non-methane volatile organic compounds (NMVOCs) and fine particulate matter (PM_{2.5}). In Ireland, transport is the principal source of NO_x emissions, contributing approximately 41 per cent of the total in 2018, and a smaller contributor to sulphur dioxide, ammonia, NMVOCs and PM_{2.5} (EPA, 2020b). NO_x emissions are projected by the EPA to achieve compliance with the Directive in 2030, provided that the measures announced in the Climate Action Plan (including significant electrification of the transport sector) are implemented in full (EPA, 2020b). Figure 11.3 highlights the historical and projected future trends in NO_x emissions in Ireland.

In the last three decades the general trend has been downward for a number of key air pollutants from transport, in contrast to the upward trend in CO₂ emissions in the same period. These patterns are common across the EU, as air pollution targets are tightened in all Member States. Technological improvements that were expected to be effective in reducing air pollution, through EU fuel quality and vehicle emissions standards, have not delivered the projected pollutant reductions for nitrogen dioxide and have also not delivered for carbon dioxide. It is hoped that the introduction of newer passenger vehicles, that meet the Euro 6D-TEMP and follow-on standards, will contribute to improvement in some pollutants. In Ireland, the replacement of vehicles with newer, more efficient models has also contributed; a useful co-benefit of policy for energy and carbon efficiency. However, recent increases in the size of the national vehicle fleet and moves towards diesel engines have limited further improvement (EPA, 2020b). Industry data also appear to show an increasing dominance of the more energy- and carbon-intensive sport utility vehicle (SUV) market segment, at 39.4 per cent of registrations in 2019 and increasing (SIMI, 2020).

Figure 11.3 Trend in NO_x emissions 1990-2030, current and future emission ceilings (Source: EPA, 2020b)



Note: Article 4(3) of the National Emissions Ceilings Directive provides that emissions of NO_x and NMVOCs from categories 3B (manure management) and 3D (agricultural soils) are not counted for the purpose of complying with 2020 and 2030 ceilings.



Impacts of Air Pollutants on the Quality of Air We Breathe

Air pollutants have damaging effects on the environment and human health.

The impact of air pollutants on health and the environment is covered in more detail in Chapter 3 and Chapter 14. The major pollutants of concern from transport are nitrogen dioxide and particulate matter; transport is the main source of nitrogen dioxide.

Nitrogen dioxide can become particularly troublesome where pollution becomes concentrated, in urban areas and near transport networks, and for those with vulnerable health status. The EPA monitors a range of other air pollutants in line with the EU air quality directives. In its annual Air Quality in Ireland reports, the EPA compares Irish air quality both with EU legal limit values and with World Health Organization guideline values. In Ireland, road transport is the largest source of carbon monoxide, copper, zinc and black carbon emissions. It is also a significant source of coarse particulate matter (PM₁₀), lead, mercury and chromium emissions. The EPA's most recent Air Quality in Ireland report highlighted an exceedance of the EU annual average legal limit values in 2019 at one urban traffic station in Dublin, due to pollution from transport (EPA, 2020e).

Public concern about the negative impacts of air pollution from transport is rising (EEA, 2019b), with poor air quality linked to serious health implications, both short term (acute temporary complaints such as headache, breathing difficulty or eye irritation) and long term (chronic ongoing conditions including asthma, reduced liver function and cardiovascular disease) (EPA, 2019). Ever-expanding research is demonstrating links to even wider impacts on human health such as on cognitive development (Zhang *et al.*, 2018) and mental health (Braithwaite *et al.*, 2019). Recent Irish research has shown the negative health impacts on the Irish public (Carthy *et al.*, 2020; Quintyne *et al.*, 2020).

This is particularly important for more vulnerable groups such as children and pregnant women. Recognising the considerable impact of transport air pollution on human health and ecosystems, while some progress has been made, the European Environment Agency notes that its continuing contribution to poor air quality requires systemic changes in how we transport people and goods, rather than relying on efficiency measures alone (EEA, 2019a).

Noise

Noise from transport networks is the most widespread source of environmental noise exposure in Ireland.

In 2018, the World Health Organization (WHO) published *Environmental Noise Guidelines for the European Region* (WHO, 2018). This established how noise pollution in our towns and cities is increasing, and how excessive noise particularly from transport sources is a health risk, with effects on sleep, cardiovascular and metabolic function, in addition to the nuisance caused. In Ireland, the expansion of the national road infrastructure has led to increased transport activity, and thus continuing this pattern is likely to lead to increasing noise exposure. Noise modelling carried out in Ireland during 2017 estimates that 15.6 per cent of the population are exposed to noise levels above 55 dB L_{den}, with more than 90 per cent of this exposure attributable to road traffic noise (EEA, 2019a). The WHO has recommended daytime noise levels from road traffic of 53 dB L_{den}, and night-time levels of 45 dB L_{night} as the thresholds above which adverse health effects can start to occur, (WHO, 2018). A transport system that promotes increased road usage, and the private car in particular, is likely to lead to increasing noise exposure levels, even with a larger numbers of electric vehicles. Technical measures for reduction of noise exposure have their limitations, so reducing demand and encouraging major modal shifts to walking, cycling and public transport should be the long-term goal. It will also be important as we move to more integrated spatial and transport planning, that 'quiet areas' continue to be protected (see Chapter 4 for more details).

Other Environmental Pressures

Transport sources drive a range of other environmental impacts.

Road transport expansion is associated with urban sprawl. The related land-take and habitat fragmentation have impacts on biodiversity, ecosystem services and habitat resilience. The sealing of surfaces can increase run-off during high-precipitation events. There are also growing adaptation challenges for management of the impacts of climate disruption. In recent years, both central and local governments have begun building resilience to climate change through transport adaptation planning. EPA research in the Methodologies for Financing and Costing of Climate Impacts and Future Adaptation Actions (TACT) project¹ considers the potential vulnerability of national transport infrastructure to increasing extreme weather events. Management of environmental pressures by local authorities and state agencies is necessary, but, in addition to this environmental protection, there is also a pressing need for integrated strategic long-term policy at the national level, to prevent and minimise the variety of environmental pressures.

¹ The project, funded by the EPA, ran from 2018 until 2020. See <http://erc.epa.ie/smartsimple/displayProject.php?projectCode=2018-CCRP-DS.13>.



3. Understanding the Drivers of Transport Environmental Pressures

Passenger Transport

Key sectoral indicators are pointing in the wrong direction at the national level.

Analysis can help to understand the driving forces of environmental pressures and can support the development of evidence-based policymaking that considers the full range of policy solutions available. The Intergovernmental Panel on Climate Change (IPCC) considers drivers such as demand, infrastructure, technology, and the public policy, private market and lifestyle factors that underlie these (Sims *et al.*, 2014).

While transport greenhouse gas emissions are a challenge globally, Table 11.1 indicates that in Ireland this is more pronounced. In recent decades, alongside the push of economic and population growth, Ireland has experienced low-density and sprawl patterns of spatial development (EEA and FOEN, 2016; Ahrens and Lyons, 2019), and an infrastructure investment priority on road development and mobility dominated by private cars. All these factors are associated with higher levels of greenhouse gas emissions, and increased road congestion. They are represented in long-term trends towards more private and motorised transport, and at best marginal increases in the active modes of walking and cycling (CSO, 2020a). In contrast to other European countries, a higher proportion of public transport is by bus than rail, and rural areas have limited access. While some progress has been made on key transport air pollutants, these drivers are of major concern regarding greenhouse gas emissions, noise, urban sprawl and land-take, and biodiversity. These patterns of development implicitly increase mobility demand and related emissions, and risk long-term 'lock-in' to unsustainable patterns that are difficult to escape (Seto *et al.*, 2016). More dispersed and sprawling development can imply private benefits, but these must be weighed against their societal environmental and economic costs, such as the cost of providing public services to lower density patterns (OECD, 2018).

The most recent National Travel Survey, of 2019, suggests that journey distances and durations have increased since the first national survey in 2012 (CSO, 2020a). In 2019, almost two-thirds (64.9%) of journeys were made as a driver of a private car, or 77.6 per cent by 'private motorised transport'², with little shift to sustainable modes in recent years³. In addition, the survey

showed that 43.6 per cent of all journeys in 2019 were of shorter distances, less than 4 kilometres, which are ideal for active modes. Within this, 51.5 per cent of journeys of less than 2 kilometres were by car, rising to 66.1 per cent for journeys between 2 and 4 kilometres. Together, this suggests the potential for switching to active modes for shorter journeys, particularly when noting apparent gains in sustainable modes in some urban areas.



The impact of the reliance on private vehicle transport on greenhouse gas emissions is compounded by increasing journey lengths and the energy and carbon inefficiency of the vehicle choice. The total distance travelled by cars rose by more than 14 per cent between 2012 and 2018 (SEAI, 2019a). Gains from improvements in the energy efficiency of new private cars are also being overwhelmed as consumers favour larger, less efficient vehicles such as SUVs (SEAI, 2019a). Carbon efficiency has shown only minor improvement. Biofuels have increased to 3.9 per cent of road and rail transport energy consumption in 2018, from 2.4 per cent in 2010 (SEAI, 2019a), and 8,827 battery electric cars were licenced in Ireland between 2010 and 2019⁴ (CSO, 2020b). While increasing, this remains a tiny fraction of the national car fleet, which stood at over 2.1 million vehicles licenced in 2018.

The problem of road traffic congestion is also of note here, as Irish cities frequently place high in global surveys. In the INRIX survey from 2018, Dublin ranked as the 15th most congested city, with Galway 50th, Limerick 72nd and Cork 80th (INRIX, 2018).⁵ Congestion is known to have negative effects not just on the environment and economic competitiveness, but also on quality of life and human health, through concentration of air pollution, increased stress, obesity and lost time.

2 'Private motorised transport' is taken here as car drivers, car passengers, taxi/hackney, lorry, motorcycle and van. It excludes the new 'other' category of e-mobility at 0.7% in 2019, see CSO (2020a).

3 The 'sustainable modes,' defined here as walking, cycling and public transport, have declined by 1.2% from 2013 (22.8%) to 2019 (21.6%).

4 This is the number of new and used electric cars, not including other vehicle types. Over the same time period, 51,014 new and used hybrid cars, including petrol, diesel and plug-in options, were added to the fleet in Ireland. It is important to note, that in general, hybrid vehicles have less potential to eliminate carbon emissions than battery electric vehicles.

5 In the 2018 TomTom index, similar results are found: Dublin was ranked as the 14th most congested city in the world, with Cork at 70th and Limerick at 94th (TomTom, 2019).



Freight Transport

Improving the sustainability of freight requires achieving a modal shift to rail, yet Irish rail freight has seen decades of decline and freight activity has shifted in the opposite direction: to road.

The emissions outcomes of freight depend on factors such as the level and type of economic activity, whether the mode used is road or rail, and the demand-side efficiency factors of capacity usage, logistics, vehicle type and fuel. Ireland experienced a significant growth in freight activity up to a peak in 2007, and this growth was particularly strong in the freight-intensive construction sector. The economic recession saw a major drop in activity from that seen during the house- and road-building boom. There has been an increase in freight activity since the recession, measured by tonne-kilometres, linked to the economic recovery. However, it remains 39 per cent below its peak in 2007 (SEAI, 2019a), owing to the reduced trade in construction materials.

A key plank of improving the sustainability of freight in the EU is achieving a modal shift to rail, yet Irish rail freight has seen decades of decline and a shift in the opposite direction: to road (O'Mahony *et al.*, 2012). Ireland now has the lowest proportion of rail freight in the EU-28, apart from Cyprus and Malta (McKinnon, 2019), pushing a shift towards the more energy- and emissions-intensive road modes. The energy efficiency of Irish road freight per tonne-kilometre is poor by international standards (SEAI, 2014), and does not appear to have improved since 2000. This suggests that factors such as logistics, matching vehicle to load and empty running are continuing to make freight more inefficient, as found in the previous analysis by O'Mahony *et al.* (2012). On the other hand, the carbon efficiency of road freight has changed only marginally, as biofuels now make up 4 per cent of energy consumed. Taken together, these factors have led to a continued increase in freight carbon dioxide emissions for the last 8 years. A discussion of decarbonisation of freight is included in Topic Box 11.2. The research study by Mulholland *et al.* (2020), for the EPA, discusses a variety of efficiency measures for transport decarbonisation and includes some logistical measures.

Declining rail freight volumes in Ireland have sometimes been attributed to short distances and economics, through lack of cost competitiveness with road freight. However, distance need not be a limiting factor according to Booz & Company (2009), which offered examples of short freight distances in Ireland that continued to be economically viable. The viability of these routes is perceived as coming about through innovative logistics solutions and cost reductions. It is also notable that other relatively small countries, such as Portugal and New Zealand, have proven more successful. An expansion of the rail freight logistics network could be developed

as part of a 2050+ rail vision, including rail heads, bypass lines, and consolidation and distribution services at stations. It is plausible that providing the required systems and infrastructure, and internalising the societal costs of roads (such as road traffic accidents, congestion, emissions, noise and habitat fragmentation) in transport pricing, could alter the economics to favour rail.

Road modes almost exclusively generate the external societal costs of transport in the EU (Directorate-General for Mobility and Transport, 2019a). Owing to the relatively high costs of accidents and congestion of road freight, EU average external costs of heavy goods vehicles (€0.042 per tonne-kilometre), are more than three times as high as those of rail freight (€0.013 per tonne-kilometre). Passenger transport shows an even greater difference, with average external costs of the private car (€0.120 per passenger-kilometre) more than four times as high as rail (€0.028 per passenger-kilometre), and electrified rail cheaper still.

Light goods vehicles are a significant source of emissions (Figure 11.2), almost half as much as heavy goods vehicles. They have been separated in the data only since 2014, and increases may be attributed to factors such as increased carriage of goods and just-in-time deliveries. The EEA has suggested that there is scope for a reduction in light vehicle trips through providing a service that facilitates consolidation of small shipments (EEA, 2020b). This could be combined with new facilities at rail stations to enhance the feasibility of switching freight to rail in the long term.

Topic Box 11.2 Five decarbonisation initiatives for freight transition

The global freight expert, and IPCC lead author on transport, Professor Alan McKinnon, discussed freight transition at the Climate Change Advisory Council's 2019 workshop on 'Transition of Irish Transport: Issues, Approaches and Options' (McKinnon, 2019).

McKinnon (2018) applies the avoid-shift-improve (ASI) framework to future freight transition, through a hierarchy of five decarbonisation initiatives: demand management; shifting to lower intensity modes; logistics and vehicle loading; improving energy efficiency; and reducing carbon intensity by using electric vehicles, compressed natural gas vehicles, etc. He outlines a plethora of advanced future-proofed levers and options at each level and considers implications. McKinnon concludes that meeting an 80 per cent greenhouse gas reduction target by 2050 may not be possible without demand management, and notes that freight shift to rail is ideal. He also discusses the unique needs of freight, as distinct from passenger transport, which often are not sufficiently separated.



Projections and Policies

Reducing greenhouse gas emissions and making transport in Ireland sustainable require the implementation of fundamental and significant policy changes.

As outlined in Chapter 2, the EPA has projected under its 'with additional measures' scenario that transport greenhouse gas emissions will peak at 12.4 million tonnes of carbon dioxide equivalent in 2020. Table 11.2 illustrates a decline to 4.4 million tonnes in 2040, if the measures announced in the 2019 Climate Action Plan are fully implemented (EPA, 2020c). This projection involves a set of economic assumptions about how oil price affects energy demand, and the successful completion of all policies and measures in place at the time of the study. The EPA 'with additional measures' projection of 2020 foresees an average annual reduction in transport greenhouse gas emissions of 4.7 per cent per year to 2040. Assuming a drop in transport emissions by 80 per cent of 1990 levels by 2050 would require an average reduction of 4.2 per cent per year, indicating that the decarbonisation measures in the Climate Action Plan can be effective if fully and successfully implemented.

Work on the latest EPA emissions projections started in late 2019 and they are underpinned by strong projected growth in key sectors of the economy. The impact of the coronavirus pandemic (COVID-19) is not included in these figures; for 2020, and probably for some time thereafter, it is expected that there will be a downward impact on both greenhouse gas and air pollutant emissions, particularly NO_x emissions. In April 2020 alone, petrol deliveries were over 72.5 per cent lower than in April 2019 and diesel deliveries almost 55.5 per cent lower (CSO, 2020c). As a result of reduced traffic, the EPA observed some significant decreases in the concentrations of nitrogen dioxide at urban traffic stations, with decreases of up to 50 per cent compared with the January average (EPA, 2020d).

Staying at home and staying local reduce travel demand, benefiting air quality and helping to tackle climate change. In exiting from pandemic measures, it is important to be aware that the recovery steps will shape Ireland for decades, as is known to occur with major policy developments. Such junctures offer the opportunity to focus on climate action measures, as part of a green recovery stimulus, to rebuild our economy, generate new jobs and respond to climate change.

Recognising that the emissions reductions required of transport are set to deepen, the national Climate Action Plan (Government of Ireland, 2019) established a number of new measures to meet the 2030 greenhouse gas targets for transport, while noting relevant measures already implemented. Five core areas can be highlighted from the Climate Action Plan: (i) compact development in spatial planning, (ii) shift to active and public transport, (iii) the carbon tax, (iv) biofuels and compressed natural gas and (v) electric vehicles. International evidence, including that from the IPCC, shows that:

- Spatial planning for compact development, to avoid trips and minimise distances, can deliver significant emissions reductions (Sims *et al.*, 2014). Ireland's National Planning Framework (NPF) aims for 40 per cent of future housing development to be within or close to the existing footprint of built-up areas (Government of Ireland, 2018). The balance is envisaged on a mix of sites, extending urban areas on sustainable transport corridors, and regeneration and renewal of rural towns and villages to arrest the decline of rural communities. This will be implemented through housing planning, local authority development plans and regional spatial and economic strategies, with independent scrutiny from the Office of the Planning Regulator. Local government will therefore play a key role in determining the actual outcome, in the mix of compact and dispersed development that arises.

Table 11.2 EPA 'with additional measures' projection for Transport to 2040 Source: EPA (2020c)

	1990	2005	2016	2018	2020	2030	2040
Greenhouse Gas Emissions (in million tonnes CO ₂ eq)	5.2	13.1	12.3	12.2	12.4	7.6	4.4



- The plan notes an existing target for the addition of 500,000 active and public transport journeys⁶ per day by 2035, and supporting projects.⁷ Evidence is not available to determine whether reaching this journey target will accommodate growing demand or lead to an actual modal shift from private car. Pathways that pursue substantial modal shift are typically based on longer term transformation of transport systems and infrastructure (Sims *et al.*, 2014).
- International evidence suggests that carbon taxes can complement regulatory measures, as part of an appropriate policy mix, but also have limitations, as passenger demand is 'inelastic' (Sims *et al.*, 2014).
- Improving carbon efficiency, through raising biofuel blend rates to 10-12 per cent of petrol and diesel, can be effective, but has historically been subject to sustainability challenges (CCAC, 2019a). Compressed natural gas for road freight provides a marginal improvement on life-cycle greenhouse gas emissions (Sims *et al.*, 2014).
- The flagship measure in the plan, to increase electric vehicle numbers to 936,000, would require diffusion rates similar to those achieved in the world leader, Norway.⁸ Although the latest EPA projections indicate that this measure, if successfully achieved in full, can significantly reduce both air pollutant and greenhouse gas emissions from transport, it is important that it be accompanied by measures to reduce demand and shift travel to active and public transport modes. Otherwise we may tackle the climate challenge by achieving 'greener congestion' with attendant long-term economic, health and wellbeing impacts.



International evidence shows that some transport environmental pressures have been successfully addressed through environmental management, and that technical improvements can reduce some forms of air pollution. However, it also clearly shows that marginal and incremental efficiency is not sufficient to reduce transport greenhouse gas emissions, while also meeting the multiple social and economic objectives of transport. Delivering on this requires a 'sustainable mobility transformation'.



6 Total public transport journeys in 2017 were 300.8 million (CSO, 2019b).

7 Projects include the National Transport Authority 2035 Strategy with MetroLink, the Dublin Area Rapid Transit (DART) Expansion Programme, BusConnects and the addition of 200 kilometres of segregated cycle lanes.

8 Increasing the number of electric vehicles, to 936,000 by 2030, is approximately one third of the current national fleet of 2.7 million in 2018. Important to considering the feasibility of reducing emissions is the proportion of the future fleet this may involve. This is not clear from the target. It is worth noting, that in the case of Norway, achieving such rates of diffusion required significant state supports.



4. Sustainable Mobility Transformation

Framing and Thinking

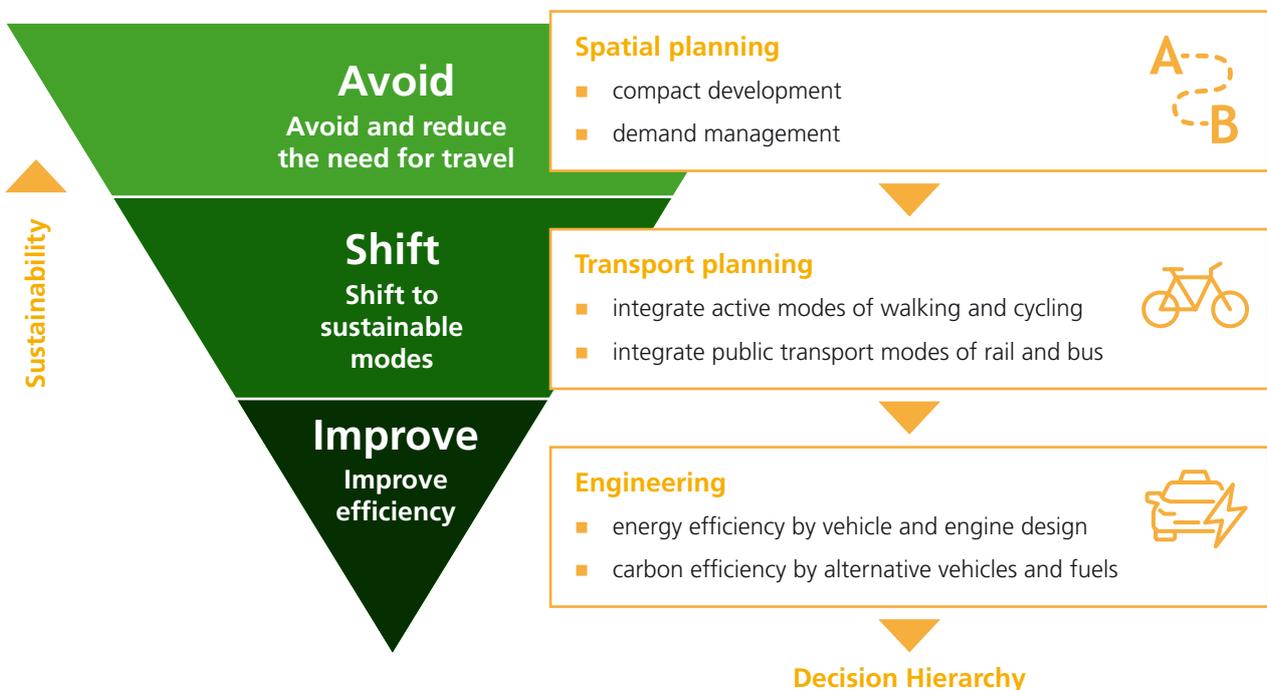
The new framing is represented in transport by moves from the low-carbon approach to the comprehensive sustainability approach in the ASI framework: avoid-shift-improve.

A fundamental change has occurred in the framing of and thinking on climate policy globally. This has evolved from focusing on short-term mitigation, by technical efficiency, to long-term transition and transformation, by systemic and structural change. Achieving sustainable mobility requires a similar transformation, along with the wider organisational and policy systems that the transport sector depends on, notably integrated spatial and transport planning.

The IPCC has noted the rise in global transport greenhouse gas emissions, despite efficiency, as transport activity has increased, while becoming more individual and motorised. The new framing is represented in transport by moves from the low-carbon approach to the comprehensive sustainability approach in the ASI framework (Devaney and Torney, 2019). This approach involves moving through a hierarchy of actions: *avoid* – avoiding journeys where possible, through innovative spatial planning, compact development and demand management; *shift* – shifting mode to the more sustainable modes of walking, cycling and public transport; and lastly *improve* – improving the energy and carbon efficiency of vehicles, including improved designs, choosing smaller vehicles, and switching to alternative powertrains and renewable fuels.

This hierarchy is illustrated in Figure 11.4. The approach is now a standard,⁹ and is recognised by the IPCC, the EEA and the Organisation for Economic Cooperation and Development's International Transport Forum. More recently, in the Irish context, it has been recognised by the Climate Change Advisory Council (CCAC, 2019a) and the National Economic and Social Council (Devaney and Torney, 2019).

Figure 11.4 The hierarchy of transport sustainability in the *avoid-shift-improve* framework (Source: EPA, adapted from EEA, 2016)



⁹ Behavioural and social practice-based measures can be used to support 'avoid' demand management, and to encourage mode 'shift', where supporting systems and infrastructure are made available. Such measures can also be employed at the level of 'improve', to influence factors such as vehicle purchase and driving style.



The Department for Transport, Tourism and Sport has also acknowledged that the ASI framework is the best practice approach (DTTAS, 2019a). Building on this consensus, the next steps required are to:

- ensure that appropriate evidence is made available to inform decision-making at each level
- design policies and measures that can deliver effectively on each level and
- apply governance and investment arrangements that fulfil the needs of the policy cycle.

Evidence and Scenarios

Energy and emissions modelling of transport in Ireland is predominantly focused on compliance with greenhouse gas and air pollution targets, in the medium term, up to 2030 and 2040.

A framework for ‘sustainable mobility transformation’ has key requirements that have been fleshed out in detail internationally, including in the IPCC assessment reports. A core approach is to support decision-makers with appropriate evidence that allows the different potential long-term pathways, and their implications, to be more clearly understood. Energy and emissions modelling of transport in Ireland is predominantly focused on compliance with greenhouse gas and air pollution targets, in the medium term up to 2030, and recently to 2040. The cost effectiveness analysis and marginal abatement cost curves that are used to inform mitigation policy choice are limited to ‘improve’ measures for energy and carbon efficiency. This leaves key gaps in exploring the priority measures of ‘avoid’ and ‘shift’. In addition, these models focus on the cost per tonne of emissions mitigated, and, while this is one of the relevant considerations, it could also act as a barrier to change. This is particularly the case where capital costs are higher, and where the full benefits of new measures to society cannot be fully captured, which are common characteristics of public transport projects.

Future visions and scenarios, including modelled pathways, are important contributors to policymaking. This evidence allows policymakers to consider the outcomes and implications of different paths. Existing modelling of emissions mitigation, by improvements in efficiency, needs augmentation with scenarios that allow consideration of the implications of major long-term changes in spatial and demand patterns, and in the potential for a considerable shift in modes to active and public transport. Scenario methods allow for wide variety in the complexity and approach to visions and analyses of potential future change. These range from summary assessments that draw on existing worldwide evidence, through narrative visions built with and by policymakers, using structured and facilitated strategic techniques, to modelled pathways that seek to quantify the impact of measures.

Some advantages of modelled pathways are the indication of potential quantified emissions reductions they can provide, and also the comparability of measures. For example, in terms of ‘avoid’ measures, modelling could help to identify the higher emissions implications of further low-density spatial planning, and also the effectiveness of deeper measures for shifting to active and public transport modes. Modelling pathways that consider ASI measures, in the form of reduced demand and mode shift, would require further model development in Ireland. It would be useful to consider the relationship between enhancing modelling capabilities and the existing analytical contributions of the Department of Transport, Tourism and Sports, in its National Investment Framework for Transport in Ireland, and the demand forecasts in the Strategic Investment Framework for Land Transport.

As modelling and scenario studies are key tools used in support of policymaking, the enhancement of the capacity to model or quantify the spatial planning ‘avoid’ measures and transport planning ‘shift’ measures could assist in enabling further policy development in these areas. Sims *et al.* (2014) provide a comprehensive review of the sectoral transport-specific models that are designed specifically to consider compact spatial planning and mode shift measures.¹⁰

As detailed by the IPCC, supporting a sustainable mobility transformation requires the use of long-term horizons in scenario studies, to 2050 and beyond (Sims *et al.*, 2014). The panel highlights that the lifetimes of transport infrastructure range from 50 to more than 100 years, a key factor in lock-in. The application of long time horizons is therefore one of the critical conditions of sustainable mobility and is mirrored in the need for long-term visions and planning.

Sustainable urban mobility planning (SUMP) is now the default transport-planning concept in the EU, arising from the Urban Mobility Package (COM(2013) 91), with guidelines issued by the European Commission (Rupprecht Consult, 2019). Long-term scenario and vision building are central to this process, with good practice examples as diverse as the central region of Macedonia and cities such as Lisbon, Manchester and Prague (Directorate-General for Mobility and Transport, 2019b). SUMP requires the integration of key functions of spatial and mobility planning, and in Edinburgh, SUMP was led by the council’s spatial policy team (Rupprecht Consult, 2019). The Greater Manchester SUMP integrated spatial and mobility planning after recognising the growing pressure of population growth in the region (Directorate-General for Mobility and Transport, 2019b), an appropriate comparison for Ireland. Integration of policy actors and related themes are important considerations, often including multi-level

¹⁰ These include land use planning that favours high-density or polycentric urban forms; public transport-oriented developments with mixed uses; and high-quality city environments (Sims *et al.*, 2014, p. 637).



institutional participation of relevant local authorities with national Departments and agencies, and even harmonising climate-neutral policymaking with spatial and transport planning. National integration with emissions policy and modelling is exemplified by the German federal greenhouse gas-neutral plan to reduce transport emissions by 100 per cent by 2050, with 50 per cent based on avoid and shift (German Environment Agency, 2014).

Long-term analysis is an enabler of long-term spatial and transport planning. Timescales of 30 years plus, to 2050 and beyond, allow the analysis, and ultimately policy planning, to envision the major system shifts that can overcome carbon lock-in. The current medium-term focus in mitigation, predominantly to 2030, also prevents full consideration of the key priority avoid and shift measures, some of which emerge more significantly from longer time horizons.

A transformation focus includes avoid and shift measures, and can integrate the variety of policy objectives that are relevant to transport. By definition, this requires long-term scenarios that also analyse significant structural and systems change. In the political process that follows, by understanding these alternative pathways, and their environmental, social and economic implications, policymakers can then consider which path delivers the best outcomes, across all policy objectives.

Topic Box 11.3 EPA Research Programme 2014-2020

Environment and Transport

Since 2016, the EPA has funded up to 20 new research projects relevant to the Environment and Transport area, representing a commitment of €3.1 million. These projects were funded mostly under the Climate and Sustainability Pillars of the EPA Research Programme 2014-2020.

Examples of EPA-funded research projects include research on

- production of advanced gaseous biomethane transport fuel in an integrated circular bioenergy system
- metrics of climate neutrality in the context of deep decarbonisation in Ireland by 2050
- critical infrastructure vulnerability to climate change
- eco-driving: trends and potential impacts for Irish heavy-duty vehicles
- emissions from and fuel consumption associated with off-road vehicles and other machinery
- behavioural response to sustainable travel policy incentives.

More information is available from <http://www.epa.ie/researchandeducation/research/>

Policies and Measures

A reliance on measures for improving the energy and carbon efficiency of vehicles is evident in Irish policy. We also need to consider avoiding journeys where possible, through innovative spatial and transport planning for compact development, and for shifting to low-carbon transport systems of walking, cycling and public transport.

While improving energy and carbon efficiency by technical means is a necessary approach, it is unlikely to deliver sustainable mobility or climate neutrality on its own. It is known that improving vehicle decarbonisation is required, including alternative powertrains and biofuels, yet it is also known that relying on these measures is not optimal, and may not even be feasible (Rogelj *et al.*, 2018; EEA, 2019a; McKinnon, 2019; Windisch, 2019). Relying on decarbonisation continues the path already seen in Ireland in recent decades. With insufficient action on avoid and shift, this could lead to an increase in the number of journeys by private car, truck and other road vehicles. This path would drive a range of negative side effects, directly linked to use of road vehicles, including air pollution,¹¹ noise, congestion and road traffic accidents, and impose unnecessary costs on human wellbeing, the economy and the environment. However, a comprehensive package of measures that could deliver an avoid and shift transformation, instead of marginal and efficiency change, has yet to be articulated for Ireland. The comprehensive approach in Germany, previously alluded to, is a useful example. The IPCC also provides a vital summary table of the ASI measures, assessing both short- and long-term possibilities for reducing greenhouse gas emissions, with their barriers and opportunities (Sims *et al.*, 2014, pp. 634-636).

Considering that ASI exists as a hierarchy (see Figure 11.4), policy first needs to consider changes to spatial planning and demand management. This will require increased density for new development, and plans to deal with the legacy of lock-in from past urban sprawl and road-dominated infrastructure planning. The NPF envisages a shift away from a low-density business-as-usual development model, setting Ireland's first brownfield development target, and at the same time may also enable a large degree of greenfield development, and more extensive housing provision in rural areas. The legislation underpinning the NPF commits the government to regular reviews of the NPF, offering further opportunities to enhance the level of ambition in relation to urban consolidation and avoidance of urban sprawl, as the

¹¹ All roads vehicles produce particulates from tyre and brake wear. Although electric vehicles prevent particulates from engine fuel burning, they cannot prevent those other forms of air pollution. Electric vehicles also contribute to increased greenhouse gases in the countries in which they are produced.



government comes to understand the mechanics of implementing its starting brownfield development targets. A number of relevant policy processes are noted in the following section.

Enhanced short-term actions to prevent further sprawl and the development of emissions-intensive infrastructure, and to overcome barriers to active and public transport options, may also be required (Sims *et al.*, 2014). Avoiding sprawl means redoubling efforts to promote the alternative of well-located, good-quality, affordable, and active and public transport-centred communities – otherwise known as compact development in the NPF.

Topic Box 11.4 details what, in a major report, the European Environment Agency and the Swiss Federal Office of the Environment described as essential guidelines to prevent sprawl (EEA and FOEN, 2016).

Topic Box 11.4 Five Essential Guidelines to Prevent Urban Sprawl from the European Environment Agency (Source: EEA)

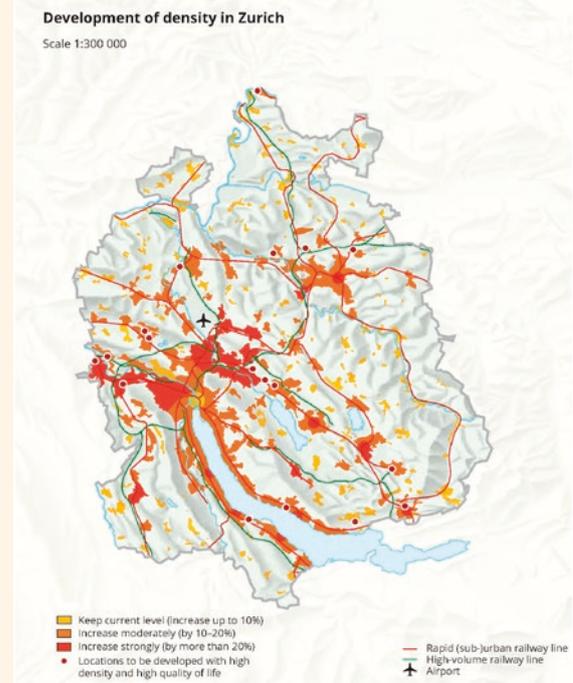
Five essential guidelines to support efforts to control urban sprawl:

- a clear separation of building zones and non-building zones, and long-term settlement restriction
- building in only designated building zones
- preventing the dispersed expansion of built-up areas
- the densification of existing built-up areas and minimum densities of new built-up areas
- the integrated planning of transport and settlement development.

Urban sprawl is essentially a permanent spatial pattern, and sustainability becomes more and more difficult to achieve as sprawl advances. Addressing sprawl, while accommodating population growth and urbanisation, requires increased density of development and integrated planning of sustainable transport. This requires redevelopment of low-density land in key locations, for compact development and a variety of uses. Dense village-centre type development, and block and city zone development, can be combined with mixed use to accommodate employment. Involving both national and local planning functions, developments would need the provision of high-quality public amenities and services, to promote attractiveness. Plans to avoid urban sprawl while accommodating population growth in the Swiss Canton of Zurich are discussed in Topic Box 11.5.

Topic Box 11.5 Avoiding Urban Sprawl in Zurich

Map 11.1 An example of densification from the Canton of Zurich, Switzerland (Source: Regierungsrat Kanton Zürich, 2014)



The EEA discusses the case of the Canton of Zurich, where planning will densify existing built-up areas by approximately 20 per cent by 2040, effectively eliminating urban sprawl (EEA, 2016). Research in the Swiss national research programme on new urban quality concluded that the urbanisation of suburban areas is one of the main tasks for society in the 21st century, to accommodate a 20 per cent growth in population.

Almost no further expansion of built-up areas is now allowed in the Canton of Zurich. Therefore, any increases in population have to be accommodated mostly in the existing built-up areas. The necessary densifications are relatively modest: on average, less than 20 per cent of the existing density as shown in Map 11.1. The densification takes the existing settlement types into account. Rural areas keep their rural character with densification of less than 10 per cent. The highest levels of densification (> 20%) occurs in the suburban areas shown in red.



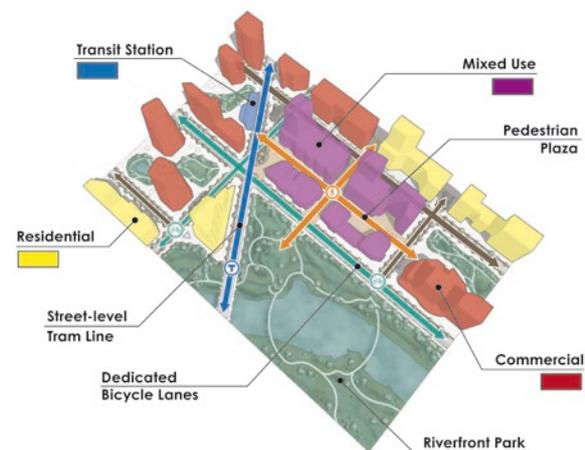
Spatial and development planning needs to be deeply integrated with long-term sustainable transport planning, for active and public modes, to 2050 and beyond. This is a careful synchronisation and coordination, working in tandem with and reinforcing each other. Transit-oriented development allows the integration of planning for settlement with strategic policy for active and public transport infrastructure (Seto *et al.*, 2014). Since the middle of the 20th century, transit-oriented development has been applied successfully in many cities, from Amsterdam, Stockholm and Vienna to Hong Kong, Melbourne and Vancouver, to promote dense and compact urban forms within walking and cycling distance of public transport. This has the impact of both avoiding journeys and cutting their distances, and making sustainable transport modes convenient and desirable, by concentrating urban development around public transport hubs. Applied to freight, it involves planning for economic activity that leads to concentrating the highest density of goods movement near rail. The feasibility of long-term expansion of Irish rail freight needs to be considered, in line with linkages between rail, road and shipping networks, the logistics of goods movement and advanced communication technologies.

The IPCC notes that urban redevelopment and investments in new infrastructure, linked with integrated urban planning, transit-oriented development and more compact urban forms that support cycling and walking, can all lead to modal shifts. Such mitigation measures could evolve to possibly reduce greenhouse gas intensity by 20-50 per cent below the 2010 baseline by 2050 (Sims *et al.*, 2014), depending on policy and country. Applying the integrated approach involves a sustainability hierarchy, from avoid and reduce, to shifting to active modes and public transport. It requires giving priority to expanding walking and cycling, followed by rail and then bus. The EEA highlights the importance of the change between modes as first-/last-/only-mile options (EEA, 2020b), acknowledging that public transport hubs are not destinations. Effective planning of modal shift requires systemic provision for active and public transport modes, at journey beginning and end. It facilitates the use of the public transport system as the backbone of mobility, without the private car. Mobility sharing and information technology also offer approaches to assist mode shift and reductions in demand.

The measures included in the National Development Plan and NPF are a useful addition. It is now necessary to advance the discussion by considering the potential of deepening avoid and shift measures in the long term, to 2050 and beyond. Discussions that consider enabling a deepening of avoid and shift have begun to emerge in Ireland (CCAC, 2019b), including transit-oriented development (NTA, 2013; NESAC, 2019); the hierarchy of active and public modes (JCCA, 2019); shifting to walking and cycling (DTTAS, 2019b); rail expansion (CCAC, 2019a; DTTAS, 2019c); and high-speed rail (An Taoiseach, 2019).

The dublinbikes scheme is an example of an effective measure to shift journeys to active modes in Ireland. Widely regarded as one of the most successful shared bike schemes in Europe, dublinbikes was established as a partnership between Dublin City Council and JC Decaux in 2009, and has been expanded since then. This public bicycle rental scheme is free for the first half hour. It now has more than 100 stations across the city, generating over 30 million bicycle journeys since opening, 96 per cent of which have been for free (dublinbikes, 2020). Other cities have been successful in establishing successful cycling cultures. Beside the recognised cities of Amsterdam and Copenhagen, there are solutions around cycling being rolled out in cities such as Seville. Here 80 km of segregated cycling lanes was constructed in one go. In Seville, the 'build it and they will come' approach increased cycling from an average of 6000 to 67,000 bicycle trips daily. The network has now grown to 180 km, and the aim is to increase the current 9 per cent of trips a day to 15 per cent.

To illustrate a further success story of modal shift internationally, Topic Box 11.6 discusses a shift to public transport in Vienna.



Urban design of transit-oriented development (Source: Rotbert, J.)



Topic Box 11.6 Shifting to Public Transport in Vienna



Vienna is a city celebrated for its high quality of life, and also its approach to modal shift to public transport. The ‘Vienna model’ featured at the EPA’s National Climate Conference in 2019. The city introduced an unlimited public transport ticket for a flat fee of €365 a year in 2012, far cheaper than the European average. The city has benefited from policy that has consistently prioritised the development and expansion of its train, metro, tram and bus lines. The new €1 a day ticket is aimed at encouraging a switch from the private car, by increasing use of the available public transport. Additional costs, on top of the annual public subsidy of €700 million, are met by a major increase in the sale of annual tickets and additional measures.

The Vienna model has been successful in supporting modal shift, with public transport journeys growing to 950 million in 2017, almost 20 per cent higher than 2007. Public transport now supplies 38 per cent of journeys, with just 29 per cent by private car according to the city transport company, Wiener Linien. They estimate that every person who switches to public transport saves up to 1.5 tonnes of carbon dioxide per year, with reductions in air pollution in parallel (Wiener Linien, 2019). Vienna aims for a vision of desirable and affordable places to live, delivering both numbers of housing and quality of life. To achieve this, the mobility element of this vision integrates spatial and transport planning, and also prioritises the active modes of walking and cycling, along with public transport.

The final step in the hierarchy is to consider the ‘improve’ approach to remove carbon emissions from vehicles. This is achieved through electric and other zero carbon technology, across passenger and freight activity, both public and private. Decarbonisation involves maximising alternative powertrains, including electric and hydrogen fuel cells, and also biofuels. The decarbonisation of public transport also facilitates the win-win of improving air quality, particularly in challenging urban locations. Public sector leadership has an important role to play in catalysing the move to low-carbon vehicles, in the fleet procurement of local authorities, state agencies and public institutions.

Governance and Investment

The long-term transformation required is a complex task, involving trade-offs between the interests of different stakeholders, operating at different scales.

The choice of a sustainable pathway can be enabled by providing appropriate governance and institutional structures for implementation and review, underpinned by evidence and knowledge capacity, and, critically, supported by political will and targeted investment.

The transformation required is a complex task, involving trade-offs between the interests of different stakeholders, operating at different scales (Devaney and Torney, 2019). Governance involves consideration of the interests of institutional, society and market actors together, to understand what shared visions can achieve, and what tensions must be resolved. This requires public participation and dialogue, and the centrality of just transition. The recent additions to Irish climate policy implementation and monitoring frameworks, under the Climate Action Plan, are an example of the institutional and policy structures that can be harnessed to enhance coordinated and integrated governance for sustainable mobility.

A key finding from the IPCC, through policy experience globally, is the need for long-term national strategies and visions, supported by short-term regional and local implementation plans (Sims *et al.*, 2014). In Ireland, this requires giving priority to enhanced evidence-based integration of spatial and transport planning, with investment targeting substantial change in current patterns and outcomes.

Institutional arrangements for long-term spatial and transport planning in Ireland are improving to the point where policymakers can begin to consider how we can avoid journeys in the first place, through better spatial planning and demand management, working in concert with the mobility planning and investment necessary to bring about a major shift from the private car to the sustainable modes of walking, cycling and public transport. Further capacity building, across the relevant institutions, can support the practice of long-term integrated spatial and transport planning.

A prerequisite for the more joined-up approach to sustainable and climate action-centred spatial and transport planning is policymaking structures at the appropriate geographical level. Those making the decisions – in Ireland the elected members of the local government system – must be equipped with the relevant information to make decisions in line with sustainable outcomes. The issue of the appropriate geographical level is critical because strategic action on climate-centred spatial and transport planning requires the consideration of issues that must take account of, but go beyond, the level of individual local authorities, of which there are 31 in Ireland.



In addition to the NPF, the regional assemblies have recently adopted regional spatial and economic strategies, which have included the first metropolitan area strategic plans for the major cities. The National Transport Authority has also begun the process of preparing metropolitan area transport strategies, in conjunction with the local authorities. Furthermore, under Action 65 of the Climate Action Plan, the Department of Housing, Local Government and Heritage will prepare a climate action toolkit and audit framework, for local authority development planning. Local authority spatial plans must be reviewed to take on board the new national and regional policies, and will be subject to oversight by the Office of the Planning Regulator. Taking account of these advances, substantial institutional change has taken place, which is highly relevant to enhancing the scope for a strategic approach to integrated spatial and transport planning for sustainable mobility.

In parallel, the crucial top-down role of investment in driving change is widely recognised. Modifications to planning density can come at little or no capital cost, requiring local development plans to come into alignment. However, in some cases they may entail capital costs of redevelopment of existing settlement in strategic locations – effectively a housing cost. Infrastructure for modal shift entails capital costs that must be considered. This requires the identification of funding streams to support new infrastructure development and deliver the many synergies and benefits it offers. Opportunities to provide funding have been considered by the National Economic and Social Council (NESC, 2019).

5. Conclusions

Environmental Pressures and Transport

Transport is a leading source of environmental pressures in Ireland, including greenhouse gas emissions, air pollution and noise emissions. While some air pollutants can be effectively reduced by technological means, international evidence has clearly shown that greenhouse gas emissions are a growing problem. The analysis of historic driving forces suggests that the push of increased economic activity and population growth has coincided with public policy and private market factors that have often favoured more dispersed settlement patterns, road development and the private car. Transport greenhouse gas emissions in Ireland need to be eliminated by 2050, and yet the trends are not responding in the right direction. On its current pathway, the transport sector will not deliver these reductions. Changing to a pathway to address these challenges will require fundamental transition and significant policy change (CCAC, 2019a).

Sustainable Mobility Transformation

To make Ireland 'a leader in responding to climate disruption', as per the Climate Action Plan (Government of Ireland, 2019, p. 37), a fundamental change in Irish transport policy is required. This needs to be aimed at delivering long-term avoid and shift, followed by improve. Measures that reduce greenhouse gases can also deliver co-benefits of reduced air pollution and noise emissions and improve wellbeing and the economy by tackling growing traffic congestion. Addressing the challenge with the urgency implied by 'early action' will offer the ability not just to reduce environmental pressures, but to improve health outcomes and to counter the higher economic costs of locked-in pathways. A sustainable mobility transformation offers numerous benefits for wellbeing, for society and for the economy.



Avoid-Shift-Improve

A standard policy approach for changing transport systems has emerged internationally, as a hierarchy of avoid-shift-improve, which is about using a holistic and integrated systems perspective. Avoid is achieved through spatial planning and demand management; shift through moving to active modes of walking and cycling, followed by rail and bus; and, finally, improve through the energy and carbon efficiency of vehicles. The change in framing and thinking recognises that improvements in energy and carbon efficiency are necessary but not sufficient. Reaching a sustainable transformation of mobility requires an acceleration of all measures, including avoid and shift (Rogelj *et al.*, 2018). This approach offers a plethora of benefits, but also has key requirements. The process begins by taking long-term spatial and transport planning together, followed by the last step, switching to carbon-free vehicles and fuels.

Current greenhouse gas mitigation policy mainly focuses on improving carbon efficiency, through increasing electric vehicle numbers by 2030. Energy and carbon efficiency improvement is important, and the public sector can play a leadership role in enabling it. The decarbonisation of public transport will also further improve air quality. However, as efficiency is an 'end of pipe' measure, when pursued on its own it is not optimal and may not be feasible. Continuing the current path will deepen lock-in to a 'greener congestion' that is difficult to escape. Comparison with international evidence suggests that the avoid and shift measures in Ireland could benefit from enhancement. To effectively implement the framing and thinking of ASI, Ireland needs action in three key areas, described earlier in this chapter: (i) evidence and scenarios, (ii) policies and measures and (iii) governance and investment.



Long Term Systemic Approach

Firstly, developing evidence and scenarios involves implementing analytical, scenario and visioning techniques that integrate to include all avoid-shift-improve approaches. Specifically, they must also include demand reduction and mode shift measures, augmenting the current modelled pathways that address energy and carbon efficiency. Secondly, a well-designed transport system is a project of transformation towards sustainability, and must be supported by appropriate policies and measures. A long-term systemic approach is crucial to this objective. It requires deep integration of spatial, transport and transition planning, at all levels, to implement measures that deliver compact development, and expand active and public transport infrastructure for modal shift, to overcome the dominance of the private car.

Finally, in practical terms, this requires backing by appropriate governance and investment to complete the policy cycle. This involves a long-term strategic approach to integrate policy, facilitate participation and just transition, manage trade-offs and achieve win-wins. It requires institutional structures that support implementation of sustainable mobility transformation, from national to local level, and policy development and review arrangements that can effectively deliver. While this approach offers the potential to avoid the significant economic costs associated with environmental impacts, urban sprawl and traffic congestion, it also requires consideration of targeted investment, particularly for enhanced active and public transport infrastructure.

Moving Forward with the Ambition of Climate Neutrality

Recent policy and institutional reforms, to enhance the strategic capability of Ireland's spatial and transport-planning processes, are a positive start. But this process needs follow-through, and ongoing enhancement of the ambition for transformational change, if we are to realise the promise of the ASI approach. Metropolitan planning and transport policies are being developed, and an independent body has been put in place to oversee the spatial plan-making process at regional and local levels, which has climate action as a key part of its assessment criteria. The scene is now set for the honing of strategic and analytical capabilities, in relation to the sustainability requirements of our evolving and future planning and transport policies.



Chapter Highlights for Environment and Transport



The transport sector has a significant impact on the environment, including being responsible for 20 per cent of Ireland's greenhouse gas emissions. A sustainable mobility transformation is required, with the next decade crucial, whereby necessary journeys are made by sustainable modes such as walking, cycling and public transport, followed by using electric vehicles where unavoidable. For this transformation to happen we need to start fast-tracking the measures in the Climate Action Plan and other necessary measures.



Long-term, integrated spatial and transport planning can achieve compact development 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.



While challenging, the long-term changes required in transport can deliver multiple benefits in reducing greenhouse gases, tackling growing traffic congestion, reducing air pollution and noise emissions, and enhancing our wellbeing and the economy.



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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, energy use has changed remarkably since the foundation of the state. Access to low-cost energy and technological development have improved our quality of life and been a key enabler of economic and social development. Further transformation of Ireland's energy systems is required if these social and economic gains are to be maintained and enhanced.

Electrification in the 1950s provided widespread access to the multitude of uses to which electricity can be applied. These uses have accelerated in recent decades through the development of consumer electronics, digital systems and the digital economy. When it was commissioned in 1929, hydropower from the Ardnacrusha power station, on the River Shannon, was the main source of electrical energy in Ireland. As a consequence of the growing demand for the convenience and cleanness of electricity, its contribution was increasingly overtaken in subsequent decades by electricity generation based on combustion of coal, oil, peat and gas. Wind power has recently become an important part of the energy mix, with coal and peat being phased out.

Transport and heating systems are largely based on the direct combustion of fossil fuels. Clean electric-powered heating and transport systems are becoming increasingly available; however, accelerated uptake of these clean systems is needed.

As a consequence, Ireland's energy systems are highly reliant on fossil energy and are largely dependent on fossil fuel systems, with lock-ins that need to be addressed. The dangers of fossil energy use for the stability of our climate, as well as its impacts on human health and the environment, are well understood. Reversing the current fossil energy lock-in and transitioning to renewable and sustainable energy sources is a challenge. It also provides a unique social and economic opportunity for sustainable development, with multiple benefits for human health, the environment and the stability of our climate. These issues are explored here through an assessment of the main activities by which energy is provided and consumed in Ireland, with a focus on electricity generation, transport and heating.

Lock-in is defined as a situation in which the future development of a system, including infrastructure, technologies, investments, institutions and behavioural norms, is determined or constrained ('locked in') by historic developments (IPCC, 2018). Here we are specifically referring to fossil energy lock-in.

2. Energy Use, Human Health and Environmental Protection¹

Energy use is central to all human activities; however, the energy choices we make and solutions that we adopt give rise to very different health and environmental outcomes.

Combustion-related energy use releases environmentally damaging by-products that have significant adverse impacts on human health, the climate and our environment. Addressing the range of adverse impacts caused by our energy use, while maintaining and enhancing our lifestyles, health and wellbeing, is a central element of a series of United Nations (UN) conventions and global policies, as well as key European Union (EU) and national policies (section 3). The approaches taken can be summarised as follows:

- reducing energy waste and loss through increasing energy efficiency
- reducing emissions through mitigation technologies (e.g. sulphur removal and carbon capture and storage)
- switching to clean and sustainable energy solutions.

The last of these would include energy from non-combustion sources, such as hydropower, wind or solar energy, and use of hydrogen. These do not give rise to combustion-related impacts, but there is a need to be cognisant of their social and environmental impacts. The issues are outlined here, with some being explored in more detail in Chapters 2 Climate, and 11 Transport.

¹ <https://www.eea.europa.eu/publications/transforming-the-eu-power-sector>



The main climate and environmental impacts of the combustion of fossil fuels include:

- the direct production of reactive gases such as nitrogen oxides, sulphur dioxide and particulates, including black carbon (soot/diesel particulates)
- the production of secondary pollutant gases and particulates such as ozone, ammonium nitrate, ammonium sulphate and condensed compounds such as organic carbons
- the release of heavy metals such as mercury and the formation of persistent organic pollutants (POPs) such as polycyclic aromatic hydrocarbons, which build up in ecosystems and in food chains
- the release of greenhouse gases (GHGs) such as carbon dioxide and methane.

The relative impacts on air quality and climate change depend 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. The most immediate impacts are local, over timescales of seconds to days. Acidification, ozone production and the build-up of heavy metals occur over longer periods of time and are regional and hemispheric in scale (Chapter 3).

Emissions of GHGs have global impacts over long periods of time, from decades to centuries or longer (e.g. fossil carbon dioxide emissions disrupt the natural carbon cycle in the atmosphere, oceans and land for centuries to millennia). This is the key driver of climate change and ocean acidification (Chapter 2). At a global level important negative impacts and risks are associated with the extraction, processing, transport and storage of fossil fuels (Olson and Lenzmann, 2016).

The combustion of biofuels can also result in significant emissions. These vary with fuel type and the combustion system used. Such emissions are being addressed through processes such as the Biofuels Obligation Scheme (DCCAE, 2019) (Table 12.1). However, sustainably produced biofuels, such as wood, biogas and ethanol, have reduced impacts on the climate system. The use of such fuels with mitigation technologies such as carbon capture and storage can provide significant negative emissions of carbon dioxide, which are required to prevent the dangerous impacts of climate change (IPCC, 2018).

Nuclear energy is not produced in Ireland. Ireland is one of a number of EU Member States that does not have nuclear power in its domestic electricity generation mix. Nuclear power generation in Ireland is currently prohibited by legislation. The potential dangers of waste produced by nuclear fission are well known, as is the need for safe management of these wastes with strong national and international oversight bodies.

3. European Union and National Energy Policy

Ireland is not positioned to meet its 2020 renewable energy target. Further steps are needed to meet its 2030 targets, and beyond.

Historically, energy policy has been based mainly on issues of supply, security and price. The industrial revolution led to the widespread use of fossil energy in various forms across all economic sectors. The implications of this for our environment, human health and climate are increasingly apparent. As outlined in Topic Box 12.1, UN conventions on a range of international policy issues have emerged to address these implications. However, it is action to address climate change that requires the most radical developments in energy policy. More specifically, there is a requirement to achieve net zero carbon dioxide emissions in order to protect the climate system (and achieve climate neutrality goals).

This imperative provides the basis for EU climate and energy policy as well as national policy, as articulated in the 2015 White Paper, *Ireland's Transition to a Low Carbon Energy Future 2015-2030* (DCCAE, 2015). It is also central to the EU Green Deal (EC, 2019a) and proposed EU climate legislation (EC, 2020). The Green Deal includes the EU 2050 climate neutrality goal, which constitutes the basis for the EU long-term strategy under the Paris Agreement (UNFCCC, 2015). Similarly, EU Member States, including Ireland, will submit Long-Term Emissions Strategies (LTES)² under the 2015 Paris Agreement. These should reflect the messages from science on emissions pathways so that the Paris Agreement and EU climate goals can be achieved (Chapter 2).

By setting an emissions and energy pathway to 2050, the LTES provide a framing for shorter term actions to 2030, under the Paris Agreement Nationally Determined Contribution process (UNFCCC, 2015). The first EU Nationally Determined Contribution is based on its climate and energy package for the period 2020-2030. The level of ambition in this package may be increased under the EU Green Deal (Chapter 2).

At a national level, Ireland's energy policy remains as articulated in the energy White Paper, *Ireland's Transition to a Low Carbon Energy Future 2015-2030* (DCCAE, 2015), which would ultimately see a move away from fossil fuel use. The National Policy Position on climate change (Government of Ireland, 2014) includes energy in its ambition to reduce carbon dioxide emissions by at least 80 per cent by 2050. These policy goals have been expanded under the National Mitigation Plan (Government

² *The Paris Agreement and associated UN Framework Convention on Climate Change decisions require the development and submission of long-term low GHG emission development strategies.*



of Ireland, 2017) and the Climate Action Plan (Government of Ireland, 2019), which contain a series of actions to reduce GHG emissions and include an assessment of how effective carbon pricing will contribute to the required energy transition.

Ireland has specific energy targets under the 2020 climate and energy package (EC, 2009). This sets out targets for the share of energy from renewable sources being consumed and used in transport by 2020. The share of renewable energy use in electricity and heating is determined nationally. The Renewable Energy Share (RES) target includes subsidiary targets for electricity (RES-E), transport (RES-T) and heat (RES-H). The overall RES target for 2020 is 16 per cent. The subsidiary targets are 40 per cent, 10 per cent and 12 per cent for RES-E, RES-T and RES-H, respectively. Currently, Ireland is not on track to achieve these targets, with RES-E at 33 per cent, RES-T at 7.4 per cent and RES-H at 6.5 per cent in 2018, with the contribution from renewable energy to final energy consumption at 11.0 per cent (SEAI, 2019a).

After 2020, Ireland will establish revised targets that are aligned with its national contribution to achievement of the EU-wide targets of at least a 32 per cent share for renewable energy and at least a 32.5 per cent improvement in energy efficiency. Under the Climate Action Plan (Government of Ireland, 2019), a target of 70 per cent for renewable electricity has been established for 2030. The level of national ambition is outlined in the 2020 National Energy and Climate Plan (Topic Box 12.1).



Topic Box 12.1 National Energy and Climate Plan 2021-2030

Ireland's National Energy and Climate Plan 2021-2030 (NECP)³ published in 2020, recognises the need for a rapid transition to a net zero-carbon energy system. It outlines the policy goals to facilitate an energy transition to a low carbon energy system, providing secure supplies of competitive energy to citizens.

The objectives of the NECP are framed by the EU net-zero target for 2050 and outlined according to the key dimensions of the EU Energy Union. They are articulated under the following headings: decarbonisation, energy efficiency, energy security, the energy market and research, innovation and competitiveness. The objectives include:

Decarbonisation: GHG Emissions and Removals

- Reduce emissions from sectors outside the EU's Emissions Trading System by 30 per cent (relative to 2005 levels) by 2030.

Decarbonisation: Renewable Energy

- Achieve a 34 per cent share of renewable energy in energy consumption by 2030.
- Increase electricity generated from renewable sources to 70 per cent with at least 3.5 GW coming from offshore renewable energy, up to 1.5 GW coming from grid scale solar energy and up to 8.2 GW coming from onshore wind capacity.

Energy Efficiency

- Contribute towards the EU target of achieving at least a 32.5 per cent improvement in energy efficiency by 2030 and the aims established under the Energy Efficiency Directive.

Energy security

- Maintain the security of Ireland's energy system in the most cost-effective manner.

Internal energy market

- Deepen the integration of Ireland's wholesale electricity market, and its regulation, with the EU internal energy market.
- Develop further interconnection to facilitate Ireland's 2030 target of 70 per cent renewable electricity.
- Further align Ireland's retail electricity market with the EU internal energy market.
- Support customers' participation in the energy system, enabling them to sell excess electricity they have produced back to the grid.

Research, innovation and competitiveness

- Ensure that the best scientific evidence and advice is available to underpin government policy and support the policies and measures in Ireland's NECP.
- Develop and deploy new low-emissions technologies in the coming years.

3 <https://www.gov.ie/en/publication/0015c-irelands-national-energy-climate-plan-2021-2030/>



United Nations Energy – Related Policy Development

The dangers of smoke and fumes from energy-related combustion have been known for a long time, with various ventilation systems being used to reduce immediate impacts. These issues became more critical during the 20th century, when the impacts of smog on human health and mortality resulted in air quality policies being adopted at city or national levels (Chapter 3).

In the 1970s the impacts of sulphur and other emissions at a continental scale resulted in the first international convention to address these impacts (i.e. the 1979 United Nations Economic Commission for Europe Convention on Long-range Transboundary Air Pollution; UNECE, 1979). It initially focused on acidification linked to sulphur produced by coal combustion and its impacts but has evolved to address wider issues, including particulate matter (PM), ozone, POPs and heavy metals.

The global impacts of fossil emissions of GHGs were addressed in the 1992 UN Framework Convention on Climate Change (UNFCCC, 1992). Actions were advanced under the 1997 Kyoto Protocol, in which developed nations agreed to reduce their emissions of key GHGs. The 2015 Paris Agreement has global reach and aims to reduce GHG emissions to net zero during this century.

The 2013 Minamata Convention (UNEP, 2013) addresses the global impacts of mercury release, including that from fossil fuel combustion. Related EU policies are outlined in Chapters 2 and 3. These conventions and protocols inform and frame EU and national energy policy.

In addition, the UN Sustainable Development Goals, adopted in 2015, include targets to increase substantially the share of renewable energy in the global energy mix and to promote investment in energy infrastructure and clean energy technology.



4. Energy Consumption in Ireland

Combustion of mainly imported fossil fuels made up 89 per cent of Ireland's total energy use in 2018. Locally produced renewable energy made up about 10 per cent of energy used.

Since the formation of the state, energy consumption⁴ in Ireland has increased substantially as our population has grown, our technologies have advanced, and our economic activity has increased. Energy consumption data from 1990 to 2018 are shown in Figure 12.1. These data show that peak energy consumption occurred in 2008, at 190,116 megawatt-hours (MWh). Fossil energy, including coal, oil and peat combustion, made up 96 per cent of the energy consumed. Renewable energy contributed just 4 per cent of the energy consumed (SEAI, 2019a).

Energy demand dropped significantly during the financial crisis but has been increasing since 2014 as economic activity has increased. In 2018, energy consumption in Ireland was 170,414 MWh. This remains lower than in 2008 while economic activity, as measured by gross domestic product, was 8.2 per cent and higher than before the economic crisis. Energy efficiency policy and actions are likely to have contributed to these changes on the energy demand side.

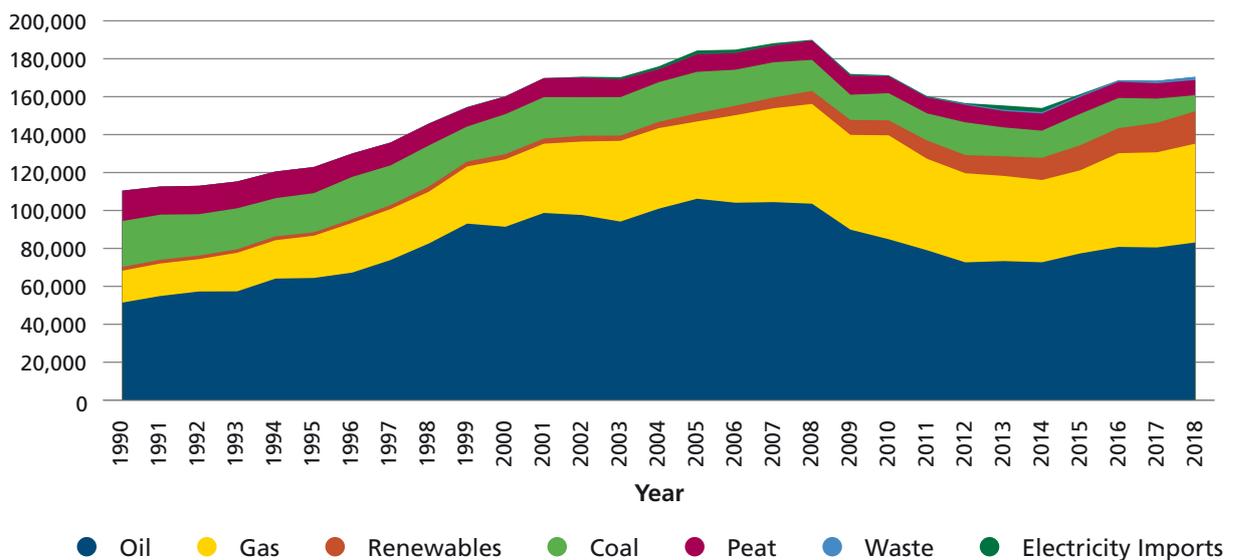
In 2018, combustion of fossil fuels made up 89 per cent of Ireland's total energy use. Renewable energy, including biomass, made up 10 per cent, with the residual 1 per cent being non-renewable waste. This percentage of renewable energy has increased significantly relative to 2008 but remains low compared with the European average of just under 20 per cent.⁵ Taking fossil energy out of Ireland's energy system by 2050 would require an annual increase in renewable energy use of 2-3 per cent of total energy use.

Current Energy Use in Key Sectors

Fossil energy use is consistently Ireland's largest greenhouse gas emissions (carbon dioxide) source and the main source for a number of key air pollutants.

The impacts of energy use vary across sectors and energy type. Location and timing can vary, resulting in different exposure profiles. A summary of the main energy uses in 2018 is shown in Table 12.1, along with the emissions of carbon dioxide and air pollutants. In 2018, most energy was used in transport, with 94 per cent of this being provided by the direct consumption of fossil fuels. Heating was the second largest energy use, with oil and gas being the main energy types used. Electrical power generation consumed about 31 per cent of total primary energy. Owing to losses, about 20 per cent is available for use by customers (SEAI, 2019a).

Figure 12.1 Energy consumption (MWh) according to the main fuel types in Ireland from 1990 to 2018 (Source: SEAI)



⁴ Here, primary energy consumption means total energy consumed including energy lost in generation, processing and transmission, which is not available to consumers. This lost energy makes up about 18 per cent of the total consumed energy.

⁵ https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Share_of_energy_from_renewable_sources_2018_infograph.jpg



Table 12.1 Energy use in 2018 and emissions of carbon dioxide, particulate matter and nitrogen oxides
(Source: EPA)

FUEL TYPE	KEY POLLUTANTS LINKED TO FOSSIL ENERGY USE							
	Energy		Carbon dioxide		Fine particulate matter (PM _{2.5})		Nitrogen oxides	
	PJ ^a	% share	kt	% share	kt	% share	kt	% share
Liquid fuels	255.2	47.5	18,602	51.7	2.43	23.3	56.7	77.1
Refinery gas	3.8	0.7	300	0.8	0.00	0.0	0.2	0.3
Gasoline	34.4	6.4	2406	6.7	0.20	1.9	1.25	1.6
Kerosene	39.6	7.4	2830	7.9	0.12	1.1	2.2	3.0
Jet kerosene	0.2	0.0	15	0.0	0.00	0.0	0.18	0.1
Fuel oil	2.46	0.4	180	0.5	0.05	0.5	0.2	0.3
LPG	7.6	1.4	485	1.3	0.01	0.1	0.5	0.7
Gasoil/diesel/DERV	161.2	30.1	11,815	32.9	1.95	18.8	49.6	67.4
Petroleum coke	6.1	1.1	571	1.6	0.10	0.9	2.9	3.7
Solid fuels	59.9	11.2	6080	16.9	6.54	63.1	6.46	8.7
Coal	31.4	5.9	2952	8.2	3.17	30.6	4.01	5.4
Peat	28.5	5.3	3128	8.7	3.37	32.5	2.5	3.3
Natural gas	188.6	35.3	10,459	29.1	0.14	1.4	8.4	11.4

^a 1 petajoule (PJ) is equivalent to 277,778 MWh.

Note: DERV is White Diesel or Road Diesel; kt is kilotonne; LPG is liquid petroleum gas.

The Transport Sector

Energy used in transport has increased continuously since 2012, in line with the economic recovery, and made up 35 per cent of the primary energy consumed in 2018, producing 31 per cent of carbon dioxide emissions and 50 per cent of nitrogen oxide emissions.

In 2018, transport accounted for 35 per cent of the primary energy consumed, with approximately 7 per cent of this being used in aviation (SEAI, 2019a). Road transport used approximately 27 per cent of total energy while rail used less than 1 per cent. Road transport was the largest contributor to Ireland's energy-related pollutant emissions such as particulate matter, nitrogen oxides and carbon dioxide in 2018. Passenger car use represented almost half of the energy use within transport.

Transport and mobility are complex issues that are central to our economic and social systems but also create burdens for these systems. Current transport systems largely reflect historical development and settlement patterns. These have given rise to systematic and structural mobility issues relating to, for example, transport modes, road congestion and working arrangements. Integrated approaches to spatial and mobility planning can contribute to reducing transport-related economic and social losses as well as reduced energy use in transport.

The extent of the dependence of transport systems in Ireland on liquid fossil fuels is unsustainable. A range of zero emission or low-emission transport solutions exists. These solutions include electrification and emerging hydrogen-based transport, which can be deployed across a range of transport modes without addressing systemic and structural issues. However, strategic approaches to planning, mobility and energy that embrace the avoid-shift-improve framework discussed in Chapter 11 can have multiple gains, including for overall energy use in transport and its impacts. Currently, there are several issues related to the extent of energy used in transport:



- Energy use in transport contributes to poor air quality in cities and urban areas during periods of high population exposure such as rush hour and can be problematic in areas of traffic build-up.
- The continued use of fossil energy in transport systems is a significant contributor to climate change, with road transport being the largest energy source of GHGs in Ireland.
- There are economic and social costs resulting from delays because of congestion and energy wastage.

A transition to clean energy would by itself significantly reduce impacts on health, the environment and climate. The requirements for decarbonisation and the protection of human health provide key catalysts for this transition. However, the comprehensive sustainability approach in the 'avoid-shift-improve' framework (discussed in Chapter 11) would accelerate and embed this in an integrated way.

The Residential Sector

The residential sector/buildings accounted for approximately 19 per cent of energy consumption in 2018 and produced 22 per cent of carbon dioxide emissions and 24 per cent of PM_{2.5} emissions.

Residential energy use in Ireland peaked in 2010. Fuel type, building standards and the efficiency of appliances fundamentally determine the demand for energy and environmental burden. In the short term, residential energy use can reflect weather events, with high use, and loss, during cold spells. As shown in Figure 12.2, energy sources for heating changed significantly during the 1990s, with a shift from coal and peat to oil and natural gas, particularly in large urban areas. Since 2000, the profile of residential energy use has remained relatively stable. This is displayed in Figure 12.3. Over this period oil has remained the main fuel used in residential heating. In 2018 the residential sector/buildings accounted for approximately 19 per cent of energy consumption in Ireland (SEAI, 2019a).

Figure 12.2 Energy (MWh) used for residential heating in Ireland from 1990 to 2018 (Source: SEAI)

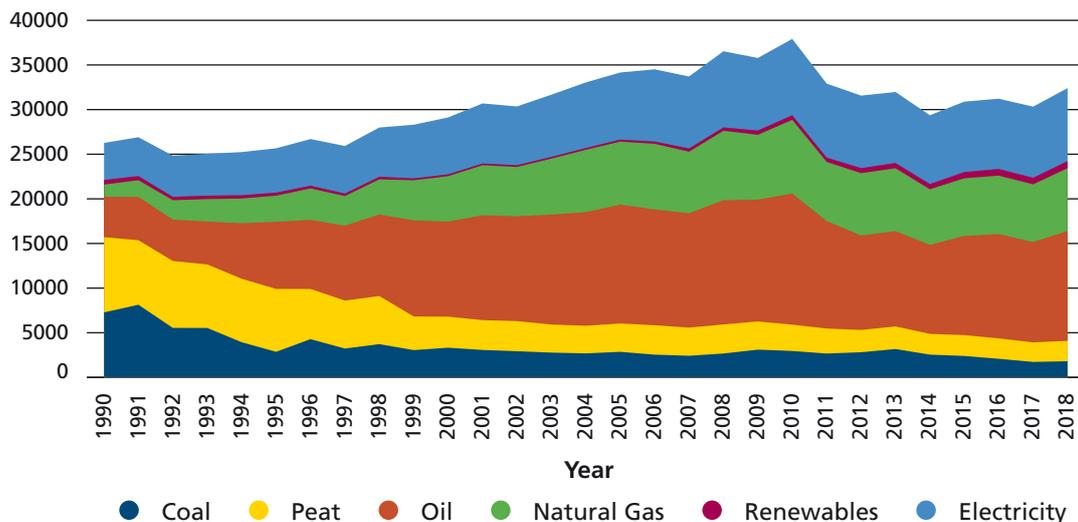
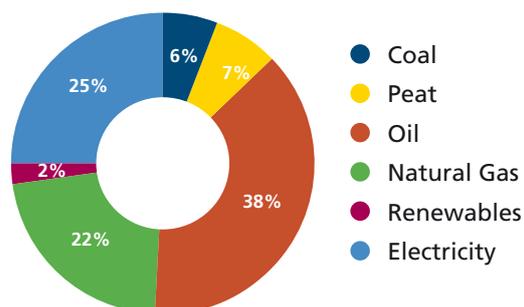


Figure 12.3 Residential energy use profile in 2018; this mix has remained relatively stable since 2000 (Source: SEAI)



The shift to natural gas from solid fuels has had considerable benefits for air quality in cities and urban areas that have access to gas networks. However, the rate of change has not continued, with the energy use profile being relatively stable over recent decades. Emissions from solid fuel use are the largest source of fine particulate matter (PM_{2.5}) which can have significant adverse impacts on air quality (Chapter 3). Personal everyday choices can impact air quality (Figure 12.4).



Figure 12.4 Actions to improve ambient air quality (Source: EPA)



Many residential properties in Ireland are poorly insulated. The Climate Action Plan (Government of Ireland, 2019) stated that over 80 per cent of homes and other buildings in Ireland assessed for their Building Energy Rating (BER) have a rating of C or worse. Consequently, much of the energy used to heat homes is lost rapidly because of poor insulation (SEAI, 2018). This entails ongoing costs for households, reduces comfort and can lead to health issues, including increases in winter morbidity and mortality rates (DCCA, 2017). Energy poverty is a critical issue for vulnerable groups and individuals.

The combination of poor insulation and fossil energy heating systems represents a significant systemic and household-level lock-in to energy-related emissions. There are considerable benefits to addressing these lock-ins through reducing energy waste and losses (e.g. through increased building energy efficiency). This improves comfort and has long-term cost savings and health and climate benefits.

Future housing and building standards should be designed to provide energy-efficient and cost-effective housing and building. The nearly zero energy building standards came into force for public buildings in January 2019 and will come into force for all other buildings in January 2021 (eISB, 2019). Small-scale energy solutions such as solar panels and emerging energy storage solutions can contribute to reduced dependence on combustion for energy and generate energy for community use, thereby increasing resilience. Deployment of these standards and solutions can ensure energy security comfort and low operational costs along with high air quality and low to zero carbon dioxide emissions.

Without effective efficiency measures, current business and residential energy use is inefficient and costly and contributes to air pollution, with impacts on human health and the environment. The continued use of fossil energy in heating systems is a significant contributor to climate change. Its replacement with cleaner options such as heat pumps can be enabled by increasing the energy efficiency of homes and buildings by the use of insulation and retrofitting. Modern buildings are more energy efficient than older ones and future buildings can contribute to distributed micro-energy generation and storage.

Dealing with the significant legacy of poorly insulated buildings is a significant challenge. This can be addressed by reducing energy waste and loss through deep retrofits. These involve extensive insulation and energy efficiency measures and can be costly.⁶ However, schemes exist or are emerging to assist in such renovations. These investments, coupled with a greater use of renewables on the electricity grid and the phasing out of peat, coal and oil use, can significantly reduce or eliminate the air pollution and climate impacts from housing and the wider built environment. A wider range of schemes is available to enhance the energy efficiency of businesses.⁷

⁶ <https://www.seai.ie/grants/home-energy-grants/>

⁷ <https://www.seai.ie/business-and-public-sector/business-grants-and-supports/>



Electricity Generation, Electrification and Industry

Increased use of wind energy and the switch to gas from coal for electricity generation means that the carbon intensity of electricity in Ireland has decreased; however, there is still a way to go to reach zero fossil emissions and climate neutrality.

Electricity generation in Ireland has evolved around a centralised generation capacity supported by a complex transmission grid and distribution system with limited storage (e.g. via pumped hydropower). The centralised generation was based on the combustion of coal, oil and peat and, later, gas. This model is being increasingly challenged by the requirements to provide access to renewable energy such as wind power and increasing options for small-scale energy generation and storage.

In 2018 there was a significant decline in the combustion of coal in electricity generation. This was combined with an increasing uptake of wind energy. Gas made up around 13.7 per cent of the reduction in coal and peat generation, while wind made up 53.8 per cent. The remainder was made up of increased electricity imports (26.7%) and non-renewable waste generation (5.8%). To an extent, this reflects the increasing costs of carbon emissions under the European Emissions Trading System (ETS). The ETS is a key pillar of European climate policy and applies to the power generation sector as well as other large emitting sectors, as detailed in Chapter 2. It also reflects the cost-effectiveness and efficiency of wind power, which provided 28 per cent of the total electricity generated, with renewables at 33 per cent (SEAI, 2019b). Consequently, the carbon intensity of electricity in Ireland dropped from 896 grams of carbon dioxide equivalent per kilowatt-hour (g CO₂eq/kWh) in 1990 to 375 g CO₂eq/kWh in 2018, a decrease of almost 60 per cent (SEAI, 2019a). Electricity generation will need to reach zero fossil carbon emissions in the coming decades for Ireland to become climate neutral by 2050.



Electricity generation and its distribution require careful management to ensure supply and avoid excessive costs. It is regulated by the Commission for Regulation of Utilities.⁸ Combustion-based electricity generation is itself highly energy intensive, with about 50 per cent of the energy being lost in the generation process. Wind and hydropower generation do not suffer these transformation losses. This means that while wind represented just over 16 per cent of Ireland's generated electrical energy in 2018, it amounted to 28 per cent of the total electrical energy used by consumers (Table 12.2).

While Ireland has excellent renewable energy resources, with strong and relatively consistent winds off the Atlantic Ocean, there are considerable technological and management challenges in bringing renewable and distributed energy generation onto the grid. Addressing these challenges and availing of the opportunities provided by distributed generation are central to the decarbonisation of electricity generation. These opportunities include enabling the uptake of directly generated energy from wind and solar sources, along with the deployment of sophisticated energy storage and management systems. This is essential for the large-scale uptake of wind energy. The emergence of cheap solar power generation is a significant win-win situation for climate, air quality, energy security and energy efficiency. The national grid, which is managed by EirGrid, will need to be a proactive enabler of this transition.

Table 12.2 Breakdown of energy by electricity generation and use in 2018 (Source: SEAI)

ELECTRICITY GENERATION	INPUT	GENERATED	LOSSES
Total energy	191,086GJ (53,079 MWh)	91,565GJ (25,435 MWh)	
Hydropower	1.3%	2.2%	
Biogas	6.7%	3.8%	
Wind	16.3%	28.0%	52%
Fossil gas	53.9%	51.8%	
Coal	10.7%	7.0%	
Peat	10.3%	6.8%	
Oil	0.8%	0.5%	

Note: GJ is gigajoule.

⁸ <https://www.cru.ie/>



Electrification

Electrification has considerable benefits in terms of ease of use, end-user efficiency and reduction in maintenance and operational costs. Increasing use of electrical energy in homes and businesses has been an ongoing trend since national electrification. This has accelerated over recent decades through the widespread use of electrical appliances and the emergence of digital systems and the digital economy.

Electrification is projected to increase with the electrification of transport and heat being promoted as efficient and effective options to reduce emissions of key pollutants and, in particular, to decarbonise these sectors. From a climate perspective, electrification based on renewable energy can provide a pathway for large-scale decarbonisation.

The demands of electrification and the emergence of a range of renewable energy sources at a range of scales provide considerable challenges for current power generation systems and models, including for the grid and its resilience (see Topic Box 12.2 below). Innovative solutions, including enhanced energy management and storage systems, are likely to be part of the next national grid system.

Topic Box 12.2 EirGrid Strategic Objectives 2020-2025



EirGrid is the Irish state-owned electricity transmission system operator. It is a public limited company registered under the Companies Acts and its shares are held by the minister responsible for energy in Ireland. EirGrid operates and develops the national transmission grid infrastructure and interconnections with neighbouring grids to meet the needs of all electricity users and it also operates the Single Electricity Market. EirGrid ensures that electricity is reliably available in a cost-effective manner.

The EirGrid Strategy 2020-2025 (EirGrid, 2019) states its purpose – to Transform the Power System for Future Generations. Its primary goal is to Lead the Island's Electricity Sector on Sustainability and Decarbonisation. The strategy is shaped by two factors – climate change and the impending transformation of the electricity sector. The transition to low-carbon and renewable energy will have widespread consequences. There will be major changes in how electricity is generated and in how it is bought and sold. There will also be major changes in how electricity is used, such as for transport and heat. The electricity system will carry more power than ever before and most of that power will come from renewable sources. Coal, peat- and oil-based generation will be phased out in the next decade.

While this happens, new technology will allow electricity users to generate and store power and return any surplus to the grid. Combined with real-time consumption information from electricity users, this creates opportunities for all. Realising these opportunities will require a significant transformation of the electricity system. More importantly, these changes will need to be managed in a coordinated and cost-effective way. EirGrid Group has a unique role to play in leading the radical transformation that is now required and states that it will be a beacon towards an ultimate future for electricity that is sustainable and free from carbon.

The EirGrid Strategy 2020-2025 closely aligns with the government's Climate Action Plan published in 2019 and with the recently published Programme for Government 2020. Seventy per cent of electricity will be generated from renewable sources by 2030 and this target will require EirGrid to break new ground in the amount of renewable electricity we manage on the electricity system. In real terms, up to 10,000 megawatts of additional renewable generation will be connected to the electricity system and it will be able to accommodate 95 per cent of electricity from renewable sources at any one time.



Energy Efficiency

Increasing energy efficiency has many benefits, including long-term savings, but barriers include financial obstacles and these need to be addressed to enable the uptake of energy-efficient solutions.

The lower energy use in 2018 relative to 2008 seen in Figure 12.1, which is also evident in residential energy use, can in part be attributed to a reduction in energy waste through energy efficiency measures. Figure 12.5 shows how simple energy rating labelling can inform consumer choices and reduce energy waste. Reducing and, where feasible, eliminating energy waste by increasing energy efficiency is one of the most cost-effective ways to reduce energy demand (see Figure 12.5). It is exemplified by the uptake of efficient lighting systems in the public and private sector. This has resulted in the removal of highly inefficient lights and their replacement with light-emitting diode (LED) lighting systems, which can use 80 per cent less energy.

Energy ratings on appliances and tools have also been a factor in reducing energy demand. The BERs for houses and buildings increase awareness of energy use and of the benefits and savings that accrue from energy efficiency and investments. This trend in increasing energy labelling is also increasing consumer awareness but there are barriers to consumer uptake. Energy-efficient choices tend to require significant upfront investment, with savings occurring over time. Approaches to address these issues are needed, including the provision of financial and fiscal instruments that enable or advance the efficiency transition (e.g. linking loans and mortgages for energy-efficient choices/investment or linking taxation/value-added tax to efficiency ratings).

Figure 12.5 The A-G energy label (Source: SEAI⁹)



Losses in electricity generation, transmission and processing made up about 50 per cent of the total energy consumed in electricity generation, meaning that approximately 50 per cent of the original energy used to generate electricity was available for use by consumers. The use of renewable energy reduces or eliminates generation losses, which are significant for combustion-related generation. Reducing these losses also contributes to meeting energy targets and decarbonisation. Overall, reducing the loss and waste of energy has multiple benefits for the climate and human health and wellbeing.

Renewable Energy and Wind Energy

Wind, bioenergy and solar energy can provide additional opportunities for Irish businesses and consumers.

Ireland has excellent indigenous renewable energy resources, and renewable energy is playing an increasing role in the domestic energy supply (SEAI, 2019b). Ireland has more onshore (land-based) and offshore energy potential than most other European countries. In 2019 wind power is estimated to have provided 31.5 per cent of electricity in Ireland. Currently, there is 12 GW worth of energy from offshore wind in active development. This will significantly add to the current renewable generation capacity of over 3.7 GW, almost all of which is onshore. This has resulted in reduced costs for consumers and reduced imports of fossil energy. For more on the offshore wind sector see Topic Box 12.3.

9 <https://www.seai.ie/home-energy/energy-labelling-and-ecodesign/energy-labelling/>



Topic Box 12.3 Offshore Wind Energy Sector in Ireland (Source: SEAI)

Globally, the offshore wind energy sector is developing rapidly, with a current total capacity of 27 gigawatts (GW). Almost 80 per cent of this capacity is in Europe. The annual growth rate is almost 30 per cent annually. EU capacity is projected to increase by at least a factor of four by 2030, with offshore wind becoming the EU's largest source of electrical energy in the 2040s.

Ireland has one of the best offshore renewable energy resources in the world and has the capacity to accommodate high levels of offshore generation. This provides a significant opportunity to decarbonise our electricity system and to advance the decarbonisation of the energy used in transport and heating, including through the production of hydrogen for energy storage and for use in heating and transport.

The development of Ireland's offshore wind resources is critical if Ireland is to meet the 2030 renewable energy targets in the Climate Action Plan (Government of Ireland, 2019). The Programme for Government 2020¹⁰ commits Ireland to a long-term plan to take advantage of Ireland's significant offshore energy potential, which also provides Ireland with a significant energy export opportunity. However, Ireland currently has only one offshore wind farm, Arklow Bank Wind Park, which has a capacity of 25 MW. Ireland's national capacity will need to increase to at least 3.5 GW to contribute 70 per cent of renewable electricity by 2030, equivalent to four Moneypoint power stations. This ambition was increased further to 5 GW by 2030 in the recently ratified Programme for Government.

A number of planned offshore energy projects are expected to be progressed to the next stage of development. These would contribute to meeting the 2030 target for offshore wind once the Marine Planning and Development Management Bill is passed. The Offshore Renewable Energy Development Plan (OREDP) (DCCA, 2014) is the policy framework for offshore renewables in Ireland. A new OREDP is currently being developed. Along with the development of the National Marine Planning Framework (DHLGH, in preparation), it should accommodate the increased ambition.

Exploiting offshore wind will, however, require significant changes to our energy system. A strategy for exploiting this energy resource is needed, involving research, innovation and investments. The strategy's focus should be on production, transport, storage and use relating to this renewable resource. It is important that any adverse societal and environmental impacts from offshore energy development are addressed so that the benefits of this resource are available to all and opportunities are maximised. The Sustainable Energy Authority of Ireland is already funding work in this area under the National Energy Research, Development and Demonstration Programme.



(Credit: SEAI)

10 <https://static.rasset.ie/documents/news/2020/06/draft-programme-for-govt.pdf>



There is also an increased interest in microgeneration, with the popularity of solar panels increasing at domestic, business and farm levels. Linking these to the grid and the development of prosumer supports, including smart meters and energy citizen schemes, and advances in storage at a range of scales can add considerably to the levels of renewable energy used. Interest and adoption of these technologies increases awareness of energy management and the potentials of smart energy systems.

The continued uptake of these diverse energy resources and the realisation of the 70 per cent target for renewable energy by 2030 is dependent on the evolution of the national grid to accommodate and manage the uptake of large-scale renewable energy from offshore wind farms and small-scale microgeneration at domestic scales.

5. Challenges and Comparisons

The energy challenges that Ireland faces are significant but not unique. Similar transitions are required at European and global levels. There are opportunities to share learning and experiences with our European and international partners in the transition process. Some comparisons and shared issues are explored here.

Addressing Carbon Lock-In

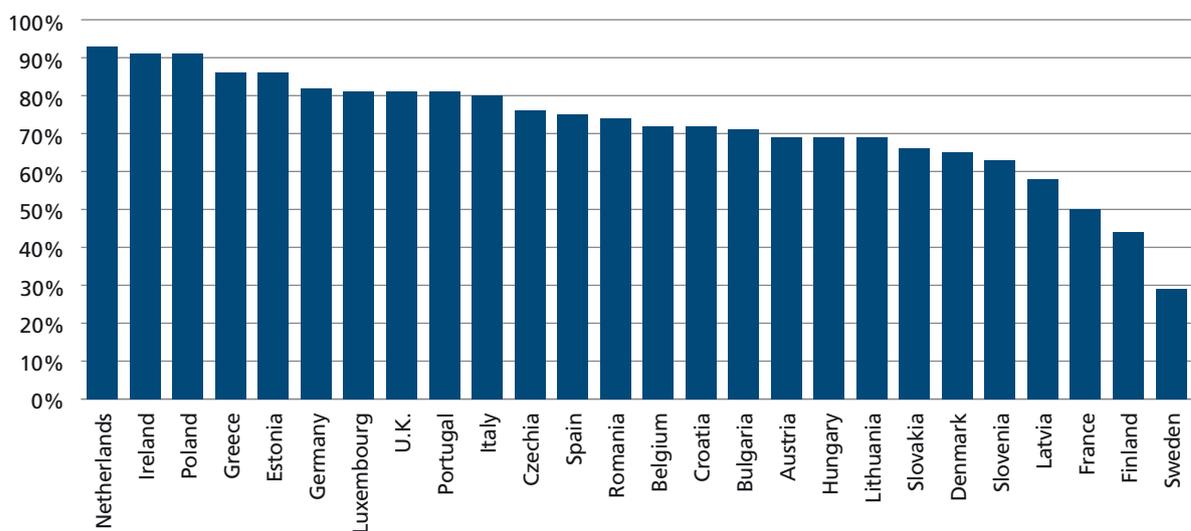
Current fossil carbon lock-ins in electricity generation, building and transport need to be assessed, quantified and managed as part of the transition away from these energy sources.

Carbon lock-in is a term that refers to the degree to which economies are effectively committed to long-term fossil fuel consumption because of the prevalence of significant long-term investments in fossil-based infrastructures and financial, institutional and other systems that support and maintain energy systems.

These systems have been fundamental to development pathways for many advanced economies, both in Europe and globally. However, the recognition of the threats and risks posed by the continued use of fossil energy for our climate, environment and health means that these lock-ins should be addressed as part of the transformation process.

The fossil carbon lock-in in electricity generation, building and transport needs to be assessed, quantified and managed as part of this transition. Figure 12.6 shows the scale of fossil energy use across the EU (2016 data); of the EU Member States, Ireland, the Netherlands and Poland are the most dependent on fossil energy.

Figure 12.6 Fossil fuels in the energy mix by EU Member State in 2016 (Source: Eurostat)





While there has been progress in the decarbonisation of electricity, Ireland remains almost 90 per cent dependent on fossil energy. This dependency is both expensive, with imported fossil energy costing on average €4.8 billion from 2010 to 2018 (CSO, 2020), and environmentally unsustainable (CSO, 2019).

Financing the Transition and Fossil Fuel Subsidies

Effective frameworks for investment in Ireland's energy transition are required and redirection of fossil fuel subsidies of over half a billion euros annually can contribute to this process.

Parties to the Paris Agreement have agreed to make finance flows consistent with a pathway towards low GHG emissions and climate-resilient development (Chapter 2). This goal is increasingly reflected in EU policy such as the Green Deal (EC, 2019a) and in the mandates of financing institutions and banks such as the European Investment Bank (EIB). Large-scale investment in energy infrastructure will be crucial to decarbonising the energy sector. EirGrid secured €530 million in funding directly from the European Commission to support the Celtic Interconnector project. The EIB has an aim to support €1 trillion of investments

in climate action and environmental sustainability from 2021 to 2030 and to gradually increase the share of its financing dedicated to climate action and environmental sustainability to 50 per cent of its operations in 2025. The EIB has already funded energy infrastructure in Ireland and could become a very important supporter of low-carbon transformation in Ireland in the future. The Paris Agreement goal would also envisage the phase out of subsidies for fossil fuel production and use. The EU is committed to phasing out environmentally harmful subsidies (EC, 2019b).

These subsidies are diverse and include those provided for the exploration, production, distribution and purchase of fossil fuels, including coal, peat, oil and gas. The International Energy Agency data for 2018 suggest that these subsidies amount to over €339 billion annually at a global level and that these have increased in recent years, with oil being the most heavily subsidised. These are more than double the estimated subsidies for renewable energy sources (Matsumura and Adam, 2019).

The Central Statistics Office has applied international standards and methods to provide an analysis of fossil fuel subsidies in Ireland (CSO, 2018). This research paper also covers direct potentially environmentally damaging subsidies, and these are presented in Table 12.3.

Table 12.3 Direct potentially environmentally damaging subsidies for 2012-2016, including fossil fuel subsidies (Source: CSO, 2018)

	FOSSIL FUEL SUPPORTS, MILLION EUROS				
	2012	2013	2014	2015	2016
PSO Levy: electricity generation from peat	94.2	94.8	119.0	121.9	115.4
PSO Levy: security of electricity supply	42.2	61.0	104.7	47.3	0.0
Petroleum exploration and production promotion	1.3	0.5	1.6	2.2	2.4
Electricity allowance	176.7	161.0	154.6	149.6	150.7
Gas allowance	20.6	16.3	21.8	18.8	19.2
Fuel allowance	211.4	228.1	217.7	214.2	230.9
Other supplements (heating allowance)	11.2	–	8.1	7.4	6.7
Fuel grant for disabled drivers/passengers	–	–	–	–	8.6
Total fossil fuel supports	557.6	561.7	627.5	561.4	533.9

Note: PSO is Public Service Obligation.



A number of schemes are designed to address social and economic issues, and their removal would be problematic for equity and social justice reasons. However, the scale of these subsidies suggests that options to orientate the schemes to address underlying issues such as energy poverty as a result of poor construction and to promote non-fossil solutions are considerable. This could be strategically managed to ensure that long-term benefits and savings are accrued. There is a focus on retrofitting social housing, which could advance the development and wider deployment of these solutions.

Ensuring that subsidies for energy are both socially and environmentally progressive should be part of this process. This can be envisaged as part of the 'just transition'. This is discussed in Chapter 2: Climate Change. This would include transition to energy-efficient homes that use renewable energy. Investment to support the development and deployment of renewables in 2018 amounted to €383 million, mainly as a result of the Public Service Obligation supports for renewable energy generation, which were in the order of €375 million.

Energy Information

Clearer information can assist consumers on their energy choices and their implications.

Energy use is central to our lives but largely goes unnoticed and unquantified. Energy information is often obscure and difficult to include in decision-making. Making information about energy use, as well as information about energy options and solutions, more accessible will assist consumers to make choices around energy. This can be enhanced by the inclusion of associated environmental impacts, information on investment portfolios and media price reporting on energy production (Figure 12.7). This can enable and promote positive actions around energy management, investment choices and supporting prosumers who wish to support clean energy options. Steps in this process would include:

- using standard units for energy to enable the energy use to be more easily estimated at a range of timescales
- linking energy ratings to energy use and switching between energy choices
- providing information on the carbon content and other emissions associated with the energy commodity being produced, traded or used
- enabling transparency around fiscal incentives, or deterrents, and their impacts.

Figure 12.7 How long does it take to use 1kW (1000W)?
(Source: adapted from Electric Ireland, www.electricireland.ie)

How long does it take to use 1kW? (1000W)

A kilowatt-hour is a standard unit of electricity and is the amount of energy or joules used in an hour





Currently, a variety of units are used for energy production, reporting, use and trading. These include barrels, litres, tonnes of oil equivalent and other industry-specific units. For clarity, this report uses the international standard energy units of joules (J) and watt-hours (Wh). A watt is a unit of energy used in 1 second, with the unit of energy being a joule. The joule replaced the calorie in 1969. The calorie is still used in popular discussion of foods and dieting. One joule is equivalent to about 0.24 calories.

The use of standard energy units, along with price data and environmental impacts, would assist in comparisons and decision-making. This would allow individuals, households, communities and businesses to better understand and manage their energy use. The provision of such information could also be included in media and communications materials along with environmental impacts.

Energy and Negative Emissions

Ireland will need to plan for large-scale removal of carbon dioxide from the atmosphere (negative emissions) and a national framework for advancing robust negative emissions solutions is required.

Scientifically, it is recognised that there will be a need for large-scale removal of carbon dioxide from the atmosphere, which is termed negative emissions, to offset any overshoot of the carbon budgets required to meet the temperature goal of the Paris Agreement (IPCC, 2018) (Chapter 2). The scale required of such negative emissions will depend on the overshoot of carbon dioxide emissions relative to the Paris Agreement temperature goal and the scale of residual emissions of non-carbon dioxide GHGs from food production systems that cannot be reduced to zero.

Currently, the management of terrestrial sinks is the main approach for the provision of negative emissions or removal of carbon dioxide. A new national land use strategy could support further use of terrestrial sinks. However, the capacity and resilience of these sinks is limited, and management systems are needed to ensure that they are robust and quantifiable. While full estimates of the scale of negative carbon dioxide emissions that Ireland requires need to be developed, it is likely that these will be significant. They would include the long-term storage of carbon dioxide in geological or similarly secure systems for periods that are akin to those needed for the storage of nuclear wastes.

Globally, future energy systems will be central to the delivery of required large-scale negative carbon dioxide emissions (e.g. through the use of bioenergy with carbon capture and storage (BECCS) or direct air capture; IPCC, 2018). However, there are limits to how much land can be used sustainably for BECCS, and there are also environmental and food security risks (IPCC, 2019). These issues will need to be addressed but future energy systems are likely to have a key role in providing negative emissions. A national framework for the analysis and delivery of negative emissions solutions is required to complement the national decarbonisation process. In combination, these should have the objectives of reaching net zero carbon emissions in the coming decades and providing a framework for further negative emissions, at least until the end of this century.

EPA Research Programme 2014-2020 Environment and Energy

Since 2016, the EPA has funded up to 32 new research projects relevant to the Environment and Energy area; a commitment of €3.4 million. These projects were funded mostly under the Climate and Sustainability Pillars of the EPA Research Programme 2014-2020.

Examples of EPA-funded research projects include research on:

- green adsorbents for clean energy
- the production of advanced gaseous biomethane transport fuel in an integrated circular bioenergy system
- residential solid fuel use in Ireland and the transition away from solid fuels
- the potential for negative emissions technology in Ireland
- developing the potential of community energy action groups in the transition to a low-carbon society
- the Long-range Energy Alternatives Planning (LEAP) model and GHG emissions in Ireland analytical tool 1990-2030.

More information is available from <http://www.epa.ie/researchandeducation/research/>



6. Conclusions

Energy and Climate Change

Energy is essential to economic, social and cultural development. Ireland's energy systems are currently highly reliant on fossil energy, with many systemic and structural lock-ins. However, progress has been made on addressing these, particularly in the area of electricity generation, which has seen a significant uptake of renewable energy. This has to be accelerated over the coming years and a number of strategic plans have been articulated to do this.

Halting climate change at a level that is manageable is the key driver of the energy transition. This transition will have many benefits for sustainable economic and social development, human health and wellbeing, as well as for the environment and ecosystems. It will be progressed in line with European and global partners and be a driver of economic activity. It will be supported by the EU Green Deal as well as by investments from major European and international banks.

Becoming climate neutral by 2050 is a huge challenge. It entails rapid carbonization and delivery of large-scale carbon dioxide removal solutions (negative emissions) by 2050 which will need to be continued to the end of this century. Energy systems will need to deliver these as well as sustaining economic and social development. Energy and its use will need to be smart, efficient and designed to support carbon removals. Planning for this is urgent, as is investment in solutions that are currently available to enhance efficiency and utilise Ireland's renewable energy potential. This is an essential step in ensuring that Ireland's next one hundred years are secure and prosperous.



Ceri Breeze / Shutterstock.com

Energy Use is our Largest Source of Greenhouse Gas and Other Air Pollution

Fossil fuels provide almost 90 per cent of the energy used in Ireland. This reflects a high degree of lock-in to fossil energy systems, which have significant negative impacts on climate, health, ecosystems, biodiversity and water quality in Ireland and globally. Systemic and societal changes are required to enable the transition to net zero carbon emission energy systems. Citizens, communities and businesses need to be part of the transition, which will require strategic planning and investments. Incentives for more community participation in renewable energy generation projects are expected to be provided under the 2020 Renewable Electricity Support Scheme.

Eliminate Carbon Dioxide Emissions from Energy from Fossil Fuels by 2050

A transition of the energy system is needed to achieve climate neutrality by 2050. The elimination of fossil carbon dioxide emissions will be part of this transition.

The implementation of a transition strategy that encompasses energy providers and users is needed. Systemic, institutional, technological and financial barriers need to be addressed. The engagement of citizens and stakeholders is essential. Schemes such as the Renewable Electricity Support Scheme can incentivise the introduction of additional significant renewable electricity generation from a wide range of technologies, contributing to national and EU-wide renewable and decarbonisation targets out to 2030 and beyond.

Ireland's Renewable Energy Potential Should be Realised

Globally and in Ireland there is considerable renewable energy potential. Ireland has excellent renewable resources and it is planned that the economic and social potential of offshore wind around Ireland's coast will be developed. Systems to harvest, store and manage renewable energy resources are required. These will be a mix of existing and new technologies, which will be deployed at a range of scales to deliver energy needs in a resilient and secure manner. Elements of this include a smarter grid, more efficient distribution and smarter use. The Climate Action Plan (Government of Ireland, 2019) target of 70 per cent renewable electricity by 2030 is a step in this process.



Energy Transformation has Multiple Benefits for Health, Wellbeing and the Environment

The required transformation will require significant investments from public and private sector stakeholders. There will be significant medium and longer-term economic benefits and savings, including reduced dependency on imported fossil energy, energy security and energy resilience. Reduced emissions will directly and indirectly benefit human health and ecosystems.

Planning for Large-Scale Carbon Dioxide Removal (Negative Emissions)

Cumulative carbon dioxide emissions will determine the global temperature increase. Large-scale removals of atmospheric carbon dioxide are likely to be required. These will limit warming to well below 2°C or limit the increase to 1.5°C, and offset GHG emissions that cannot be reduced to zero (i.e. those from food production). Removals by sinks such as forests are not likely to be sufficient to offset these emissions. The future energy systems will be central to the delivery of required large-scale negative carbon dioxide emissions (e.g. through BECCS or direct air capture).



Chapter Highlights for Environment and Energy



Almost 90 per cent of Ireland's total energy use is provided by combustion of, mostly imported, fossil fuels. This is not sustainable. The resultant emissions are damaging for our health and our environment and continue to drive climate change. To transform this situation, we need to start fast-tracking the measures in the Climate Action Plan and other necessary solutions. Strategic planning is required to transform this situation by 2050, including accelerated actions to 2030.



Transitioning to a clean energy future is essential for the protection of human health, climate and the environment, while having many benefits for sustainable development. The investment and implementation of currently available solutions to enhance efficiency and utilise Ireland's renewable energy potential needs to be urgently rolled out.



Current fossil carbon lock-ins in electricity generation, but particularly in buildings and transport, need to be assessed, quantified and managed as part of the rapid transition away from these energy sources. Such a transition will require effective frameworks for investment. The redirection of fossil fuel subsidies can contribute to this process.



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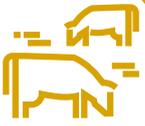


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Chapter 13

Environment and Agriculture





Environment and Agriculture

1. Introduction

Agriculture in Ireland

The agri-food sector is Ireland's oldest indigenous industry and continues to play a vital role in Ireland's economy, as well as shaping its landscape and environment.

Food produced by Ireland's farmers, fishermen and agri-food companies is exported to over 180 countries worldwide. In 2019, agri-food exports were worth €14.5 billion (Bord Bia, 2020), almost 10 per cent of total exports, and accounted for 173,000 jobs, representing 7.7 per cent of total employment (DAFM, 2019a), demonstrating the importance of the sector to the Irish economy. In 2015, the Department of Agriculture, Food and the Marine (DAFM) published a 10-year strategy for the agri-food industry, Food Wise 2025 (DAFM, 2015a), identifying the opportunities and challenges faced by the sector. The strategy outlines ambitious growth targets for the industry, including an 85 per cent increase in exports to €19 billion and the creation of 23,000 additional jobs along the supply chain, from production to high-end value-added product development. These targets are set against a 3-year (2012-2014 inclusive) baseline. A guiding principle of the strategy is that 'environmental protection and economic competitiveness are equal and complementary: one will not be achieved at the expense of the other'. However, significantly increasing food production without depleting the natural resources on which the sector depends remains a fundamental challenge. Evidence now shows that the objective of environmental protection is not being met (EPA, 2019a). Damage to the environment from agriculture activity undermines the credibility of Ireland's clean, green image on which the Food Wise 2025 vision is constructed. Currently, plans for the development of a new 10-year strategy for the period to 2030 present an opportunity to address the negative effects on the environment that have occurred in recent years with respect to water quality, greenhouse gas emissions, ammonia emissions and biodiversity. The EPA has outlined these challenges in its recent submission to DAFM in relation to the strategy.¹

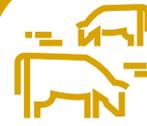
Topic Box 13.1 Agriculture in Ireland – past to present

Ireland's countryside has been shaped by agriculture throughout the last two centuries. Up to the middle of the 1800s, smallholdings of less than 5 acres were prevalent. These produced cereals and raised livestock to generate income to pay landlords, and potatoes to provide subsistence for smallholders, cottiers and labourers. Post famine, the area devoted to cereals more than halved as grassland and cattle numbers increased. This change occurred because of social, political and other factors, including the non-availability of workers for the then labour-intensive cereal production and improved shipping and transport of goods by rail. Improved modes of transport made it easier to move agricultural produce over large distances, leading to a decline in the area devoted to cereal production, not only in Ireland but also across northern Europe. In addition, increased living standards in the UK resulted in a growing demand for meat and dairy products (CSO, 2016). These changes form the basis of the largely grass-based livestock production systems that currently exist in Ireland. Market and policy developments in recent decades have further reinforced the dominance of livestock production.



Agricultural production is not solely associated with the production of food. Farming, when carried out in a manner that is sensitive to the environment, can provide valuable ecosystem services to society, ranging from protecting water from pollution to maintaining nutrient cycles and enhancing biodiversity. These broader ecosystem services need to become an increasingly important part of day-to-day farming in Ireland.

¹ <http://www.epa.ie/pubs/epasub/epasubmissionontheagri-foodstrategy2030.html>



Irish Agriculture, Climate and Weather

Ireland's weather and changing climate are key issues for the agricultural sector.

There is a marked diversity of soil types in Ireland, with over 450 soil series identified, each of which has different physical, chemical and biological properties, with series-specific environmental and economic responses as a result. A temperate climate with significant quantities of rainfall makes Ireland naturally suited to grass-based agricultural production. Weather patterns are variable, shown by the extremes that Ireland has experienced in recent years, and can affect grass and crop growth and the ease with which heavy machinery can access land for field operations.

Climate change is altering weather patterns, with different areas of the world affected in different ways. This has implications for food production and biodiversity globally, and Ireland is no exception to this. Projections of temperature and rainfall by Met Éireann and Climate Ireland^{2,3} suggest that Ireland will see an increase of between 1°C and 1.6°C in mean annual temperatures by mid-century, with the largest increases in the east of the country. The number of frost days is projected to decrease by between 50 per cent and 62 per cent and the growing season length to increase by 35-40 days by mid-century.

Rainfall amounts are projected to decrease significantly, with the frequency of heavy rainfall events increasing by approximately 20 per cent, most notably in winter. This will lead to extended dry periods in the summer months. These changes to our weather system will have wide-ranging effects, from extended periods of drought-like conditions leading to potential water shortages to increased water run-off volumes during intense rainfall events. Ireland has experienced changes in weather patterns in recent years and further changes will potentially lead to increased environmental impacts and the emergence of plant and animal diseases that have not been prevalent in Ireland before. Research funded by the Environmental Protection Agency (EPA) and Met Éireann has noted that three high-impact events have occurred since 2000, which is equal to the total number of high-impact events observed in the previous century (Chapter 2).

² <https://www.met.ie/climate/climate-change>

³ <https://www.climateireland.ie/>



2. The Structure of Irish Agriculture

Farms in Ireland vary in size and production type, covering almost 68 per cent of the country's land area, with most farmers involved in livestock farming.

Land cover data from 2018 (Chapter 5) show that, of Ireland's 7.04 million hectares, 4.76 million hectares is used for agriculture (67.6% of the land area) and 672,085 hectares is used for forestry (9.5% of the land area). Approximately 25,000 farmers (17% of the total) manage over 2 million hectares on farms of over 50 hectares (CSO, 2018). A further 1.8 million hectares are managed by 55,000 farmers on holdings of between 20 and 50 hectares, and nearly half of all farmers (60,000) work the remaining 0.6 million hectares, on farms averaging 10 hectares in size. Pasture, silage and hay accounted for 80.6 per cent of the area farmed in 2019, with 11.5 per cent devoted to rough grazing and 7.9 per cent to crop production (CSO, 2020).

In 2016, there were 137,500 farms in Ireland (CSO, 2018). In total, 20 per cent of farms (28,100 farms) had an output greater than €50,000 per year, with 12 per cent having an output greater than €100,000. These economically larger farms produced 75 per cent of the agricultural output using 44 per cent of the total farmed area. Of the remaining 80 per cent, 43,800 farms produced less than €8,000 output per annum, demonstrating the large number of small farms in Ireland producing outputs of between €8,000 and €50,000. More than half of all farms were in the Border, Midland and Western (BMW) region. The average farm size nationally was 32.4 hectares. Farms in the Southern and Eastern region were 41.3 per cent larger than those in the BMW region, with an average farm size of 38.3 hectares compared with 27.1 hectares in the BMW region. More than 55 per cent of farmers in Ireland were aged 55 years and older, with only 5 per cent aged less than 35 years.

Specialist beef production was the most common type of farming system, with 72,400 (52.7%) farms in this category. Mixed grazing livestock and specialist dairying were the next most common types, with 16,900 (12.3%) and 16,700 (12.1%) farms, respectively. There were 15,200 (11.1%) specialist sheep farms. The remainder was made up of specialist tillage farms, mixed crop and livestock farms, mixed crop farms, and intensive pig, poultry and horticulture enterprises.



The Structure of Irish Agriculture

Land cover data from 2018 shows that, of Ireland's

7.04 million hectares.



4.76 million

hectares is used for agriculture (67.6% of the land area).

672,085 hectares is used for forestry (9.5% of the land area).



Approximately

25,000 farmers

(17% of the total) manage over

2 million hectares on farms of over

50 hectares

(CSO, 2018).



A further **1.8 million** hectares are managed by

55,000 farmers on holdings of between **20** and **50** hectares.



Nearly half of all farmers

60,000

work the remaining

0.6 million

hectares, on farms averaging 10 hectares in size.

Pasture, silage and hay accounted for **80.6** per cent of the area farmed in 2019, with **11.5** per cent devoted to rough grazing and **7.9** per cent to crop production (CSO, 2020).



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In total, **20** per cent of farms

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More than half of all farms were in the Border, Midland and Western (BMW) region.



The average farm size nationally was

32.4 hectares.

Farms in the Southern and Eastern region were **41.3** per cent larger than those in the

BMW region with an average farm size of **38.3** hectares compared with

27.1 hectares in the BMW region.



More than **55** per cent of farmers in Ireland were aged

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The remainder was made up of specialist tillage farms, mixed crop and livestock farms, mixed crop farms, and intensive pig, poultry and horticulture enterprises.





Economic Situation

Farm type, market volatility, weather conditions, increased production costs and direct payments all contribute to different and changing farm incomes.

The principal measure used in Teagasc's annual National Farm Survey is Family Farm Income, representing the economic return secured by the farm family from labour, land and capital (Teagasc, 2020a). The average Family Farm Income across the 92,720 farms represented by the survey was approximately €24,000 in 2019, a 2 per cent increase on 2018. Family Farm Incomes vary from year to year and are reflective of inherent volatility, weather conditions and increased production costs. Income levels on tillage farms, however, showed a decrease of 15 per cent, with increased income levels for dairy and livestock farms. For the dairy sector, milk production increased by 5.3 per cent in 2019 with average income increasing by 9 per cent to €66,570 in 2019. In general, farm incomes continue to be highly reliant on direct payments. In 2019 the average total direct payment received was €18,452 per farm and this accounted for 77 per cent of average farm income. In terms of individual schemes, agri-environmental schemes were more important on cattle rearing farms than on dairy and tillage farms accounting for up to 12 per cent of total payments on such farms. Of particular importance is that, although direct payments were lowest on cattle-rearing farms, their overall contribution to farm income, at 160 per cent is the highest recorded. Furthermore, when comparing farm systems in terms of their market income, it is evident that income from cattle rearing and sheep farms is less than zero, indicating that on average these farms are loss-making.



Food Wise 2025

The significant pressures on the environment as a result of agriculture growth resulting from FoodWise 2025 need to be mitigated urgently, and resolved to meet the EU legislative requirements.

Food Wise 2025 is a 10-year strategy agreed by a range of stakeholders, both public and private, and adopted by government as an overarching strategy for the Irish agri-food sector. Food Wise 2025 identified significant growth opportunities across all subsectors of the Irish agri-food industry. It predicted that growth would be driven largely by an expansion in dairy, beef, seafood and consumer food and drinks products and that, cumulatively, there was the potential for projected growth in gross value added of 70 per cent for the sector by 2025. However, by early 2020 these growth projections were largely met. Such rapid expansion has presented a significant challenge for the sector as it seeks to realise opportunities without damaging the environment on which it depends.

Halfway through the implementation of the strategy, there is evidence of significant environmental challenges arising from agricultural activities that must be addressed. Contributions from the sector's activities in relation to a wide variety of environmental pressures and targets and adaptation challenges are discussed in this report in relation to climate (Chapter 2), air quality (Chapter 3), nature/biodiversity (Chapter 6) and water quality (Chapters 7 and 8). Specific significant environmental pressures that require immediate and concerted action are discussed in the following sections of this chapter. Ireland has a reputation for high-quality natural food production and critical to this reputation is that food produced in Ireland has a low environmental footprint, in conjunction with adherence to strict traceability and animal welfare criteria. However, this reputation is now at risk as a result of current trends in air pollutant emissions (most importantly ammonia), greenhouse gas emissions, water quality and biodiversity decline. More fundamentally, these important issues, if not addressed, have the potential to undermine the ability of agriculture as we know it to continue to produce food and other products.



3. Current Trends

Greenhouse Gases and Agriculture

On-farm agricultural practices accounted for 35.3 per cent of national total greenhouse gas emissions in 2019, with emissions mainly consisting of methane and nitrous oxide.

The United Nations Framework Convention on Climate Change reporting guidelines on annual inventories for Parties included in Annex I to the Convention (UNFCCC, 2014) describe the scope and reporting of greenhouse gas emissions inventories. They specify the methodologies and procedures to be followed for submitting consistent and comparable data on an annual basis in a timely, efficient and transparent manner to meet the needs of the Convention.

On farm agricultural practices accounted for 35.3 per cent of national greenhouse gas emissions in 2019, with emissions mainly consisting of methane from livestock and nitrous oxide from the management of manures, the application of manures to soil, the deposition of excreta by grazing animals and synthetic nitrogen fertiliser application to soils. In addition, carbon dioxide emissions arise from the application of urea and lime to soils (EPA, 2019b). Agricultural emissions are included in Ireland's Effort Sharing Decision emissions reduction target for 2020 (EU, 2009) and the Effort Sharing Regulation target for 2030 (EU, 2018a). Both pieces of legislation govern only emissions from non-emissions trading scheme sectors, with agriculture currently accounting for up to 45 per cent of this total.

The trend in greenhouse gas emissions from agriculture (EPA, 2020a) is, as is the case for all gaseous emissions from the sector, largely determined by the size of the national cattle herd and application rates of nitrogen fertilisers. In 1990, greenhouse gas emissions from the sector were 19.3 million tonnes of carbon dioxide equivalent (Mt CO₂ eq), which increased to 22.0 Mt CO₂ eq in 1998 in line with growth of the national cattle herd from 6.82 million animals in 1990 to 7.59 million animals in 1998. Over the same period nitrogen fertiliser application increased from 379,311 tonnes in 1990 to 431,999 tonnes in 1998. Emissions subsequently decreased to 18.5 Mt CO₂ eq in 2011, with an associated decrease in the national cattle herd to 6.42 million animals and a decrease in nitrogen fertiliser application to 295,795 tonnes. Since then emissions have been on an upward trajectory as a result of the removal of milk quotas and the implementation of Food Wise 2025 and its predecessor Food Harvest 2020. In 2019 the national cattle herd included 7.11 million animals and 367,364 tonnes of nitrogen fertiliser were applied; in the same year the national greenhouse gas emissions from the sector were 21.2 Mt CO₂ eq.

Under the Kyoto Protocol Ireland has elected to account for emissions and removals associated with the carbon pools in soil and biomass, which occur through the management of forests, grazing land and croplands. These estimates are dominated by significant carbon dioxide emissions from the drainage of organic/peaty soils, mainly in grasslands. The area involved is approximately 330,000 hectares and accounts for 8 per cent of the land area devoted to grassland. This means that, overall, Irish grassland is a net source of carbon dioxide to the atmosphere when it could and should be a net sink. Up to 2030, this will become a major focus because of European legislation on emissions and removals from land use, land use change and forestry (EU, 2018b). Hedgerows and non-forest woody features and the biomass contained therein are currently receiving a lot of focus. Estimates suggest, however, that their inclusion in national emissions inventories is far outweighed by existing emissions sources, such as the drainage of organic/peaty soils in grasslands, which will need to be tackled through a programme of work to convert them to net carbon sinks. Hedgerows are, however, important for biodiversity and the Irish landscape and for these reasons alone their protection is warranted.



Projections for the agriculture sector in the absence of any abatement measures suggest that greenhouse gas emissions will continue to grow steadily, mainly because of continued increases in the size of the dairy herd, and that by 2030 the contribution of agriculture to non-ETS emissions will be 50.0 per cent (EPA, 2020a) as efficiency gains and the effects of policies and measures are seen in other economic sectors. However, implemented and planned policies and measures are unlikely to change the status of the agriculture sector as a significant contributor to national emissions. It is forecast that dairy cow numbers will increase by 10.2 per cent between 2020 and 2030, reaching 1.64 million head, with a concurrent increase in nitrogen fertiliser use of 8.8 per cent over the same period.



Ammonia and Other Air Pollutants Emanating from Agriculture

The agriculture sector is almost exclusively responsible for the largest source of ammonia emissions in Ireland, accounting for 99 per cent of the national total in 2018. Significant implementation of on-farm abatement measures is needed to bring Ireland back into compliance with the current national emission ceiling and to meet the 2030 emission ceiling for this air pollutant.

Agriculture is the source of a number of transboundary air pollutants, including ammonia, nitrogen oxides, non-methane volatile organic compounds (NMVOCs) and particulate matter, which have local, regional and transboundary effects. National emissions reduction targets exist for each of these pollutants, as outlined in Chapter 3. Similar to other European Member States, the agriculture sector is the largest source of ammonia in Ireland, accounting for 99 per cent of the national total in 2018 (EPA, 2020b). As with other gaseous emissions from the sector, the trend in ammonia emissions is largely determined by the size of the national cattle herd and extent of nitrogen fertiliser application. Emissions of ammonia from agriculture peaked in 1998 at 122.2 kilotonnes (kt), having increased by 12 per cent since 1990. Emissions subsequently reduced to 102.6 kt in 2011 before returning to an upward trajectory in response to growth plans for the sector as a result of Food Harvest 2020, Food Wise 2025 and the removal of milk quotas in 2015. Projections of ammonia emissions suggest that they will continue to grow in line with further anticipated growth in the national dairy herd (EPA, 2020b). Total national emissions in 2018 were 119.4 kt, which is above the current national emissions ceiling limit of 116 kt (Chapter 3). This was the third consecutive year in which Ireland breached its emissions target for this pollutant. The latest projections suggest that unless there is significant implementation of abatement measures at the farm level Ireland will continue to be in breach of national emissions ceiling targets up to 2030 and beyond (Topic Box 13.2).



Topic Box 13.2 Teagasc marginal abatement cost curve analysis for ammonia emissions

Similar to greenhouse gases, Teagasc has also produced marginal abatement cost curve analysis for ammonia emissions (Teagasc, 2015, 2020b). The most recent analysis published in September 2020 identifies 13 abatement measures with 80 per cent of the total abatement potential being met by the use of protected urea fertiliser and the use of low-emission slurry spreading techniques for cattle slurry. The report further suggests that under two of the future growth scenarios for the agriculture sector that target emission levels for 2030 will be met if the measures identified are implemented in full.

As is the case for measures identified in the greenhouse gas marginal abatement cost curve analysis, the measures identified require widespread adoption and on-the-ground verification of their efficacy to be included in national emissions inventory and projection estimates. Ireland's emissions reduction target for 2020 is a 1 per cent reduction on 2005 emission levels, with a 5 per cent reduction by 2030 from the same base. In 2020, however, emissions are projected to be 4.6 per cent above 2005 levels and, in 2030, 8.0 per cent above 2005 levels without the adoption of significant abatement measures. Every effort must now be made to implement the measures identified in the marginal abatement cost curve analysis to bring Ireland onto a pathway towards compliance with its ammonia emission target for 2030.

Agricultural emissions of nitrogen oxides and NMVOCs are not accounted for in terms of compliance with agreed emissions reduction targets for these pollutants (Chapter 3). The sector is, however, an important source of emissions of both of these pollutants. Agriculture is the second largest source of nitrogen oxide emissions in Ireland (contributing 32.4% of the 2018 total), with emissions mainly associated with synthetic fertiliser application, urine and dung deposited by grazing animals and the application of manures to soils. Agriculture is the largest source of NMVOC emissions, accounting for 39.4 per cent of the national total in 2018; emissions are associated with manure management and fertiliser application to soils.



With respect to particulate matter, agriculture is responsible for 7.4 per cent of total national emissions of particulate matter < 2.5 µm in size, 31.7 per cent of emissions of particulate matter < 10 µm in size and 18.9 per cent of emissions of total suspended particulates. Furthermore it is estimated that up to 15 per cent of particulate matter < 2.5 µm in size in Ireland is derived from ammonia emissions from agriculture (DCCAE, 2020).

National emissions reduction targets are in place for particulate matter < 2.5 µm in size for 2020 and 2030 under the National Emission Ceilings Directive (2016/2284/EU). Emissions from agricultural sources are included in the compliance assessment. Emissions of particulate matter from agriculture arise from manure management, fertiliser application to soils and both on-farm and off-farm handling and transport of bulk agricultural products.

Finally, the use of pesticides is the major contributor to hexachlorobenzene emissions to air in Ireland (EPA, 2020b). Hexachlorobenzene is present as an impurity in or a by-product of some pesticides, such as chlorothalonil. A ban on the use of this pesticide came into effect in May 2020.

Biodiversity and Agriculture

Changes in and intensification of agricultural practices have impacted on biodiversity. There are, however, locally led projects that the sector could learn from, in which farmers are working to restore specific habitats and conserve species on their farms.

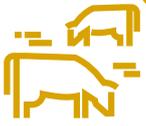
Agriculture depends on biodiversity, with Irish agriculture having a particular advantage in that grassland is the majority land cover in Ireland. Our landscape has been shaped by millennia of agricultural activity, with intensification of agriculture in recent decades leading to a loss of biodiversity, with significant implications for flora and fauna. Since 1994 it has been compulsory for every EU Member State to have agri-environmental schemes in

place in an effort to halt the decline in biodiversity. This is the primary way that farmers are rewarded for farming in an environmentally friendly manner. In Ireland, these voluntary schemes have evolved from the four iterations of the Rural Environmental Protection Scheme (REPS) to the current GLAS scheme. The value of these schemes to biodiversity has, however, been difficult to ascertain and there would be benefits from planning such schemes at a landscape scale. Additionally, there has been limited success in attracting higher value sectors, such as the dairy sector, into these schemes.

The most recent report under the EU Habitats Directive (92/43/EEC) (DCHG, 2019a) suggested that 57 per cent of listed species have a 'favourable conservation status', 15 per cent have an 'inadequate status' and 15 per cent have a 'bad status'; 72 per cent of species demonstrate a stable or improving status, while 15 per cent demonstrate ongoing declining trends. Functioning habitats are key to species survival; however, 85 per cent of listed habitats were assessed as having an 'unfavourable conservation status', with 46 per cent in a declining condition and 2 per cent in an improving condition. Agriculture and other activities are having negative effects on a wide range of habitats and species, such as wetlands, fish, molluscs, terrestrial mammals and vascular plants. Drainage of land, fertiliser application, clear-felling, undergrazing and abandonment of land are known pressures that, although local in extent, may influence a much wider area, especially if they affect groundwater supplies or nearby watercourses. Other studies have indicated a decline of 14 per cent in bee species (NPWS, 2014). Bumblebees are especially affected, with 7 out of 20 species at risk of extinction. Among bird species, 19 per cent had increased in number, but 18 per cent of breeding species and 16 per cent of wintering species were in decline. Of the 10 per cent of species on the Red List, 24 per cent are regarded as 'threatened' and 15 per cent are 'critically endangered'.

The *6th National Report to the Convention on Biological Diversity* (DCHG, 2019b) describes the decline in farmland bird species, such as the corncrake and yellowhammer, as indicative of changes in agricultural practices and a nationwide reduction in mixed farming with small-scale cereal growing, with a move instead to specialisation and livestock production. The decline in bees, butterflies and other insects is stated to be largely the result of monoculture and the drive for ever-increasing levels of productivity, characterised by a loss or neglect of hedgerows, farmland edges and scrub.

The National Biodiversity Action Plan 2017-2021 (DCHG, 2017), developed by the National Parks and Wildlife Service, includes 119 targeted actions under seven strategic objectives. The Plan specified 'enhanced appreciation of the value of biodiversity and ecosystem services amongst policy makers, business, stakeholders, local communities, and the general public' as one of its seven key objectives. It includes a vision 'that biodiversity



and ecosystems in Ireland are conserved and restored, delivering essential benefits for all sectors of society and that Ireland contributes to efforts to halt loss of biodiversity and the degradation of ecosystems in the EU and globally'. There is currently a growing recognition of the importance of biodiversity and 'greening' measures in agricultural policy; for example, the contribution of natural capital⁴ was included in Food Wise 2025 and Bord Bia's Origin Green initiative.

The introduction of locally-led and results-based projects in which farmers input into the design of on-farm projects should provide useful information for the future design of agri-environment-climate measures. In April 2020, the National Parks and Wildlife Service and Teagasc published a book on the role of result-based payments in agri-environmental projects and programmes (Teagasc and NPWS, 2020). In particular, EU LIFE and European Innovation Partnerships (EIPs) have been developed to support specific habitats and species. The EIPs are a new initiative that began in 2016. They are funded by the DAFM under the Rural Development Programme, with total funding of €59 million available. There are currently 23 projects/operational groups in place across Ireland (Figure 13.1). One such project, the BRIDE project,⁵ which runs until 2022, aims to design and implement a cost-effective, results-based approach to conserve, enhance and restore habitats in lowland intensive farmland.

Figure 13.1 Irish EIP-AGRI operational groups (Source: NUI Galway and National Rural Network)

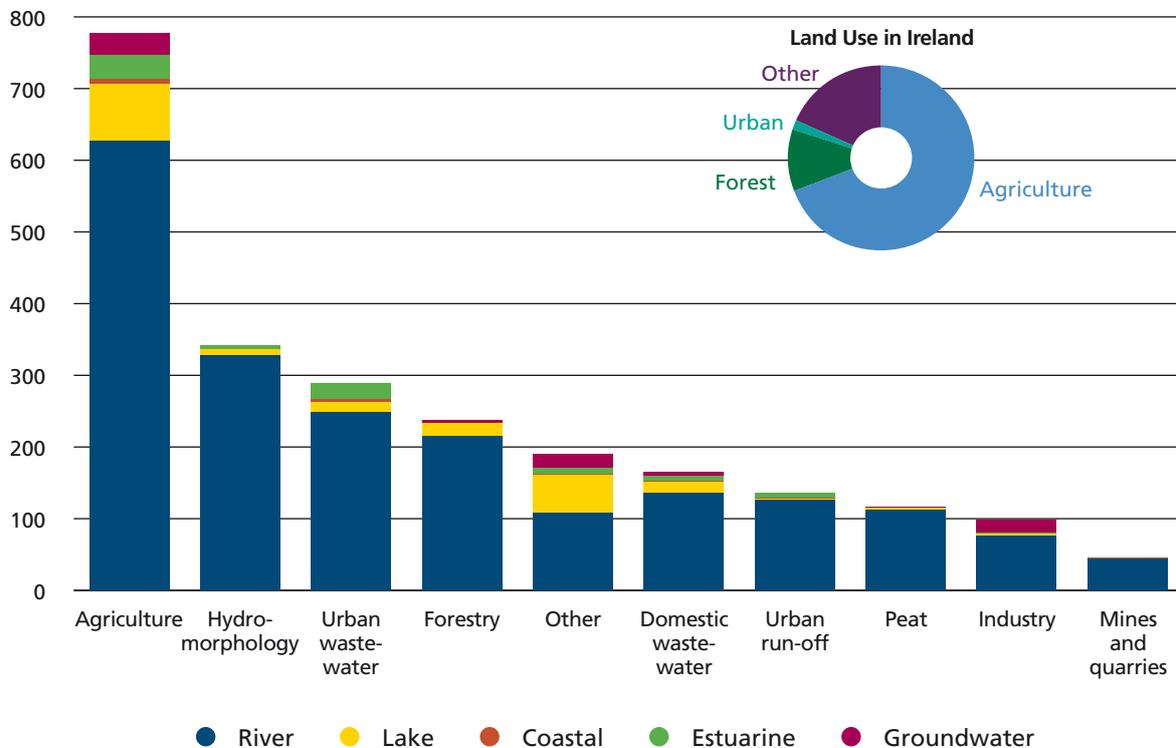


4 Natural capital is defined as the stock of natural assets such as geology, soil, air, water and all living things. Humans derive ecosystem services from natural capital, which makes human life possible.

5 <https://www.thebrideproject.ie/>



Figure 13.2 Significant pressures on Ireland's aquatic environment



Water Quality and Agriculture

Nutrient pollution (caused by too much nitrogen and phosphorus in our waters) is the key water quality issue impacting on our rivers, lakes and estuaries.

Nutrient loss to waters can lead to excess growth of algae and plants, which in turn leads to eutrophication of rivers, lakes and marine waters. Phosphorus is typically the key nutrient associated with eutrophication of rivers and lakes, while excess loss of nitrogen impacts on estuaries and coastal waters (EPA, 2018a). Agriculture, as the most prevalent land use in Ireland, exerts the most pressure on water quality (Figure 13.2), impacting on just over half (780) of the 1452 water bodies that are 'at risk' of not achieving their water quality objectives (EPA, 2019b).

The EPA's most recent report on water quality in Ireland (EPA, 2019b) found that water quality has declined. Two of the main issues driving this deterioration are the excessive levels of nutrients and sediment entering our water courses. Land management practices, including agriculture, forestry and peat extraction, all contribute to this problem. In particular, increased agricultural activity in recent years, through increased cattle numbers and fertiliser use, has led to increased nutrient loadings, which in turn impact negatively on water quality (Figure 13.3).

Significant improvements in controlling nutrient losses from agricultural point sources have been made over the last decade, with investments being made in increased storage capacity and improved farm infrastructure. However, significant challenges remain with regard to the control of diffuse losses of nutrients from land, arising from chemical and organic fertiliser use. Diffuse phosphorus losses occur most often from overland flow on poorly draining (heavy) soils. These types of heavy soils are common in parts of Cavan, Monaghan, Wexford, Limerick and Meath. Only a very small amount of phosphorus needs to be lost relative to the amount used on the land to cause water quality problems. The best solutions are therefore measures that break the pathway connecting the nutrient source to the watercourse. Examples of these measures include buffer zones, hedges, farm ponds and management of ditches. On the other hand, diffuse losses of nitrogen occur in freely draining soils where nitrogen easily infiltrates through the soil into groundwater before being discharged into river systems and onwards to estuaries and coastal waters. This is a concern for Cork, parts of Tipperary, Kilkenny, Carlow and parts of Wexford. In these areas the solutions centre on using less nitrogen fertiliser and using it more efficiently.

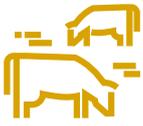
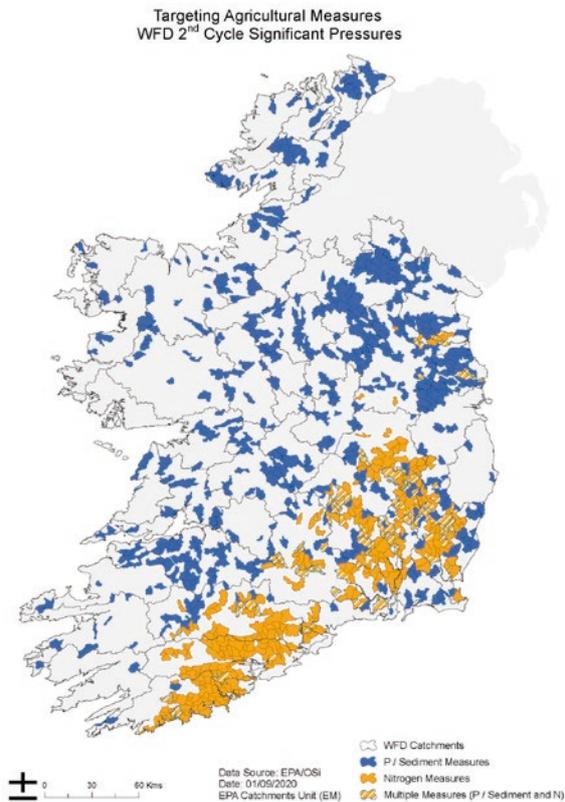


Figure 13.3 Targeting agricultural measures
(Source: EPA)



Siltation caused by poor practice in the drainage of rivers and land drainage has been identified as having widespread environmental impacts. Agricultural sources of silt include land drainage, river bank collapse from cattle accessing watercourses, lack of buffer/riparian zones or catch crops on tillage land, farm roadways, poaching of wet soil by animals and exposed soils during reseedling. Measures aimed at reducing siltation are similar to those proposed for reducing phosphorus loss as they need to break the pathway between the source of the silt and watercourses. Good practice examples include well-designed and targeted buffer zone, farm ponds and managed ditches.

Reducing the impact of agriculture on water quality requires urgent, coordinated and evidence-based intervention. Under the national River Basin Management Plan 2018-2021 (DHPLG, 2018), action is now being targeted in 190 Areas for Action. Where water quality is being impacted by agricultural activities in these areas, 30 new farm sustainability advisors (twenty from Teagasc and ten from the dairy industry), under the Agricultural Sustainability Support and Advice Programme (ASSAP), are working with farmers to identify the problems and implement the right measures in the right places. This is a free and confidential advisory service funded

and involving collaboration between the DAFM, the Department of Housing, Planning and Local Government, Local Authority Waters Programme and Dairy Sustainability Ireland.

Drinking Water and Agriculture

Protecting drinking water sources from the pesticide MCPA and slurry spreading are important public health issues in Ireland.

The quality of drinking water sources can be affected by many factors such as soil type, geology, agricultural practices, industrial, municipal and domestic discharges and heavy rainfall events. As a result, the treatment of water for use as a potable supply is complex in nature. There are two sources of drinking water in Ireland, namely public water supplies and private water supplies (which includes group water schemes and private wells). Agricultural activities pose a significant risk to drinking water sources through the storage and use of pesticides and through microbial contamination. While the quality of drinking water in public supplies remains high, with over 99 per cent microbiological and chemical compliance after treatment, persistent pesticide failures in some supplies remain (EPA, 2020c).

Pesticides, mainly MCPA (2-methyl-4-chlorophenoxyacetic acid), are used to control rushes, ragwort and thistles. They are also used in parks, on sports grounds and on golf courses, as well as in private gardens. MCPA is the most common pesticide found in drinking water (63% of all cases in 2019). At the end of 2019, the EPA was investigating 31 supplies serving just under 294,300 people because of failures to meet the necessary pesticide standard. This was a decrease from 42 supplies affecting 283,500 people at the end of 2018. It is important to note that pesticides may have been sprayed on land that is far from drinking water sources (lakes, groundwater or rivers) and that a considerable period of time may elapse between spraying and when contamination is found in water samples as part of routine monitoring. A perverse incentive exists whereby rush-dominated swards may be controlled through the use of products such as MCPA so that lands remain or become eligible for payments under the Common Agricultural Policy (CAP). This means that drinking water sources are being put at risk because of the eligibility rules for payments under the CAP. Efforts are needed to encourage the responsible use of pesticides and, where possible and feasible, the use of non-chemical methods for weed control should be considered. Further information on the protection of drinking water from pesticides can be found on the EPA website.⁶

6 <http://www.epa.ie/water/dw/protectingdrinkingwatersupplies/>



Microbial contamination of drinking water supplies (by *Escherichia coli*, *enterococci* or *Cryptosporidium*, for example) can arise from human or animal faeces or from water treatment plants that aren't operating to the standards needed to clean and disinfect water. Poor farm management practices or land spreading of manure close to drinking water abstraction points and private wells can also lead to contamination. The risk to supplies may also be increased as a result of poorly constructed abstraction points and private wells. Additionally, in the case of private wells serving individual houses, disinfection practices may not be in place, which could increase the risk even further.

It is well known that the drinking water quality in private water supplies is consistently poorer than that in public water supplies (EPA, 2020d). Private supplies mostly serve rural areas, with the source for most supplies being a spring or a well. While contamination can come from a number of sources, slurry spreading close to the source and animals being allowed to roam too close to the source increase the risk of contamination. This is also a potential source of verocytotoxigenic *E. coli* (VTEC) contamination – this issue is dealt with in more detail in Chapter 14.

Soil Fertility

There have been significant improvements in soil pH status in recent years, reversing past trends. Continued emphasis on lime application is required to improve nutrient use efficiency.

Efficient production of livestock and crops is a critical first step in ensuring sustainability from both an environmental and an economic standpoint. One important aspect that underpins efficient production is soil fertility. Soil pH plays a key role in soil fertility and maintaining soil pH at the optimum level increases nutrient availability and the microbiological activity of the soil, resulting in better nutrient utilisation. For a number of years there were increasing concerns that soil pH levels were not being kept at their optimum through the regular targeted application of lime. Between 2014 and 2016 only 34 per cent of soil samples were at the optimum pH (Teagasc, 2019b), and between 2017 and 2019 57 per cent of soil samples were at the optimum pH (Teagasc, pers. comm.). National statistics on lime use show that its use declined from 1.7 million tonnes per annum in the 1980s to under 0.9 million tonnes per annum in 2014. However, there has been a growth in the quantities of lime applied to soils in recent years, with 1.04 million tonnes applied in 2018. The quantity of lime applied in 2019 however reduced to approximately 800,000 tonnes.

Soil phosphorus and potassium levels also showed a decline in the period between 2007 and 2016 (Teagasc, 2019c), with only 38 per cent of soil samples sufficient in phosphorus and 45 per cent sufficient in potassium for optimal grass and crop production in 2016. Overall, only 10 per cent of soils were at optimum fertility in terms of pH, soil phosphorus and soil potassium. As with pH control, there are some indications that the situation is



improving, with 43 per cent of soil samples sufficient in phosphorus and 50 per cent sufficient in potassium in 2017-2019 (Teagasc, pers. comm.). The Smart Farming initiative has found that maintaining soil fertility at optimum levels represents the largest cost saving on participating farms.

It is crucial that soil fertility and soil pH are addressed on farms in a coordinated manner as one of the most important responses to reduce agricultural emissions to air, soil and water.

4. What's Being Done

Common Agricultural Policy and Common Agricultural Policy Reform

Post 2020, the Common Agricultural Policy (CAP) is expected to set ambitious new requirements with respect to environmental protection and climate change that will be based on results and performance.

The CAP is a system of subsidies and support programmes for agriculture operated by the EU. Originally launched in 1962 it was developed as a partnership between agriculture and society, and between Europe and its Member State farmers. The main aims of the policy are to secure a decent standard of living for farmers and a stable, secure and varied food supply for European citizens. A key facet of the current iteration of the CAP is the application of 'greening' rules, which was supported by the 2014-2020 Rural Development Programme for Ireland (DAFM, 2015b).⁷ The CAP is currently undergoing significant reform and is likely to set ambitious new requirements with respect to environmental protection and climate change. These requirements are likely to include the preservation of carbon-rich soils through the protection of wetlands and peatlands; the use of nutrient management tools to improve water quality and reduce nitrous oxide and ammonia emissions; and the use of crop rotation instead of crop diversification. The European Commission has also proposed a more flexible system of administration to shift the emphasis from rules and compliance to results and performance-based indicators. This will allow Member States to tailor policies to local and national needs.

The new greening architecture of the CAP offers significant opportunities to raise the overall environmental performance of the agricultural sector. It is essential that measures introduced under the new CAP can show quantifiable and verifiable environmental gains and attract intensive farmers. 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.

EU Biodiversity Strategy for 2030

Biodiversity loss and climate change are interlinked. Maintaining our soils, our forests and our wetlands will help to mitigate and adapt to climate change.

The recently published EU Biodiversity Strategy for 2030 (EC, 2020a) aims to establish protected areas for at least 30 per cent of the land in Europe and restore degraded ecosystems on land through an increase in organic farming and biodiversity-rich landscape features; halting and reversing the decline in pollinators; reducing the use of pesticides by 50 per cent by 2030; and planting 3 billion trees by 2030. The strategy requires every European Member State to play a role, based on objective ecological criteria, recognising that each country has a different quantity and quality of biodiversity.

As custodians of our land, farmers are pivotal. When biodiversity is lost on agricultural land farmers are the first to see the consequences, and when it is restored they are the first to see the benefits. To support the sustainability of both nature and farming the EU Biodiversity Strategy is aligned with developments in the new CAP and the EU's Farm to Fork Strategy (EC, 2020b).

⁷ Payment for a compulsory set of 'greening measures' was implemented to enable the CAP to be more effective in delivering its environmental and climate objectives.



Farm to Fork Strategy

The Farm to Fork Strategy is an opportunity to improve the environment that agriculture depends on.

The Farm to Fork Strategy (see Figure 13.4) aims to make food systems fair, healthy and environmentally friendly (EC, 2020b). It identified the need for an accelerated transition to more sustainable food systems, which among other objectives should have a neutral or positive environmental impact, help to mitigate climate change and adapt to its impacts and reverse the loss of biodiversity. A legislative framework will be proposed to support the implementation of the strategy and the development of sustainable food policy.

Significantly, under the strategy the European Commission will take action on two major fronts. First, a target to reduce nutrient losses by at least 50 per cent, while ensuring no deterioration in soil fertility, will aim to reduce synthetic fertiliser use by at least 20 per cent by 2030. Second, targets will be implemented to reduce the overall use of chemical pesticides by 50 per cent and the use of more hazardous pesticides by 50 per cent by 2030.

Figure 13.4 Farm to Fork
(European Commission, 2020b)



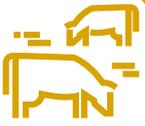
Nitrates Action Programme and Derogation Review

Intensively stocked livestock farms with Nitrates Directive derogations will be required to further improve efficiencies and reduce their environmental footprint across a range of issues.

The Nitrates Directive (91/676/EEC)⁸ aims to protect water quality by reducing pollution from agricultural sources and promoting the use of good agricultural practice. It forms an integral part of the Water Framework Directive (2000/60/EC) and is one of the key instruments in the protection of waters against pollution from agricultural practices. All EU Member States are required to prepare Nitrates Action Programmes that outline the rules for the management of livestock manures and fertilisers and their application to soil. Ireland's Fourth Nitrates Action Programme runs from 2018 to 2021; this will be reviewed and will form the basis for its Fifth Nitrates Action Programme. Ireland has taken an approach whereby the whole national territory is defined as a nitrate vulnerable zone under the Nitrates Directive. Furthermore, Ireland also uses the national implementation of the Directive to control phosphorus as well as nitrogen. Phosphorus is a key driver of freshwater eutrophication. Under the programme there is a closed period when land spreading of manure and fertiliser is prohibited, and minimum manure storage requirements are set for different geographical zones nationally and legal limits are established for nutrient use.

The Department of Housing, Local Government and Heritage is the lead authority for the European Union (Good Agricultural Practice for Protection of Waters) Regulations (S.I. No. 605 of 2017). The DAFM implements and operates the nitrates derogation (S.I. No. 65 of 2018), including inspections of participant farms and imposition of penalties for non-compliance. Ireland's nitrates derogation allows farmers to farm at higher stocking rates, above 170 kg of livestock manure nitrogen/hectare, subject to additional conditions designed to protect the environment. The derogation is seen as an important facility for more intensive farmers and almost 7000 intensively stocked farms availed of the derogation in 2018. It is estimated that these 7000 farms represent 11 per cent of the farmed area and 20 per cent of bovine livestock. A further 5000 farms representing 13 per cent of bovine livestock exceed the 170 kg of livestock manure nitrogen/hectare limit but these farms either export manure or take other actions to comply with the limit. It is recognised that compliance of a higher standard is required from these farmers to ensure that a greater level of environmental efficiency is achieved.

⁸ <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31991L0676&from=EN>



A national interim review of Ireland's nitrates derogation was undertaken in 2019 (DAFM, 2019b). This review examined further opportunities for derogation farms to improve efficiencies and continue to reduce their environmental footprint, particularly in relation to water, climate and air quality. Several recommendations were made including the adoption of nutrient management planning, training programmes on best practice in nutrient efficiency, specific rules and requirements in relation to the spreading of slurry using low-emission spreading techniques, grass sward measurement and implementation of a minimum clover content in swards.

The Teagasc Agricultural Catchments Programme was established with funding from the DAFM. It aims to evaluate the environmental and economic effects of the Nitrates Action Programme measures. The Agricultural Catchments Programme works with over 300 farmers across six water catchments, with a multidisciplinary team evaluating both the environmental and the economic effects of the Nitrates Directive and Ireland's water quality challenges. It is currently in its fourth phase, covering the period to 2023.

Sustainability Programmes

Voluntary programmes operated by the sector aim to improve sustainability and reduce wastage of resources.

Sustainability programmes include Agricultural Catchments, Origin Green and Smart Farming (Topic Box 13.3).

Origin Green, launched in 2012, is a voluntary sustainability programme led by Bord Bia that brings together the food industry, from farmers to food producers, retailers and food service operators. According to Bord Bia the programme enables Ireland's food industry to set and achieve measurable sustainability targets that respect the environment and serve local communities, with progress independently assessed and verified. To this end, on-farm assessments are a key component of the programme, with over 100 auditors undertaking approximately 800 audits per week. The audit criteria cover greenhouse gases, biodiversity, water measures, energy efficiency, soil management and socio-economic factors, in addition to quality assurance. To date, over 50,000 farmers are in the Sustainable Beef and Lamb Assurance Scheme and the Sustainable Dairy Assurance Scheme. The Sustainable Egg Quality Assurance Scheme covers 97 per cent of Irish egg production and similar schemes are being developed for other types of poultry production and pig production. Following each audit, farmers receive a feedback report detailing their performance, which is then reassessed every 18 months. In addition, over 300 companies, representing 90 per cent of Irish food and drink exports, have implemented independently verified and annually monitored sustainability plans.

Topic Box 13.3 Smart Farming

Smart Farming is an initiative led by the Irish Farmers' Association in partnership with the EPA that brings together the knowledge of Teagasc, the Fertilizer Association of Ireland, the EPA, University College Dublin and others⁹. This voluntary initiative focuses on ways to reduce costs inside the farm gate and at the same time protect the environment through better resource management in eight key areas: feed, grassland, water, inputs, time management, soil fertility, machinery management and energy use. In 2018, the average cost saving on participation farms was €7,170, with an associated average greenhouse gas emission reduction of 9 per cent (IFA, 2019). The largest cost savings were seen on dairy farms.



EPA and LAWPRO Focus Action to Improve Water Quality

Water bodies that need improvement and protection have been prioritised as Areas for Action under the River Basin Management Plan.

A large number of our water bodies require further action because of water quality issues. The EPA and the Local Authority Waters Programme (LAWPRO) led a detailed programme of collaboration with local authority personnel and public bodies to determine, at a regional level, which water bodies should be prioritised as Areas for Action in the national River Basin Management Plan 2018-2021 (Chapter 7). The process was based on national water protection priorities, scientific evidence, local expertise, data and knowledge of public body staff, and local priorities such as amenity value. In total, 190 Areas for Action were identified for priority action, including 726 water bodies. Public engagement sessions on the Areas for Action are being carried out on a phased basis by the Local Authority Water and Communities Office (LAWCO). Information on where these areas are, and the reasons for their selection and when they will be addressed, is available at <https://www.catchments.ie/areas-for-action/>.

⁹ www.smartfarming.ie



Local Water Catchment Assessments to Locate Problem Areas

Water catchment walks and assessments are being carried out to evaluate water quality problems at the field scale level.

In 2018, the LAWPRO Catchment Assessment Team was established to carry out Local Catchment Assessments within the 190 Areas for Action. The purpose of the Local Catchment Assessments is to carry out catchment, stream, street and shore walks to evaluate water quality problems at the field scale, the options for addressing them and how to implement agreed actions at water body level to improve water quality. Thirty-five scientists are undertaking the work as part of LAWPRO. The Catchment Assessment Teams are also working closely with other bodies (Topic Box 13.4) that have local knowledge and expertise and can contribute to the implementation of actions. Further information is provided in Chapter 7.



Topic Box 13.4 Agricultural Sustainability Support and Advice Service engaging with farmers

An integral part of the work being undertaken to improve water bodies involves close collaboration with farmers. This work is being carried out by the Agricultural Sustainability Support and Advice Service (ASSAP)¹⁰. The ASSAP advisory programme has 20 Teagasc advisors, funded by the DAFM and Department of Housing, Local Government and Heritage and ten specialist dairy advisors, funded by Dairy Sustainability Ireland. ASSAP is focusing on knowledge exchange and collaboration with farmers to co-design the best solutions that are specific to each farm. It is encouraging behavioural change, best practice and more environmentally sustainable farming practices. The 30 expert advisors are working directly with farmers and their existing advisors on voluntary farm-level action plans – looking at yards, lands and nutrient management planning. Up to 5000 farmers are to receive support and advice. This support will focus on issues within the 190 prioritised catchment Areas for Action. In addition, 18,000 dairy farmers will receive advice on sustainable farming practices under the Dairy Sustainability Initiative.¹¹



All of these schemes and advisory initiatives have the potential to make a significant contribution to improving farm practices nationally, with the overall objective of reducing the environmental impacts of agricultural activities. This will be achieved only through a coordinated programme of activities based on mutual cooperation and respect among all stakeholders. Monitoring, verification and reporting are important components of implementation, providing the necessary evidence to gauge performance at both farm and catchment levels. Dialogue and consensus are essential, as is ongoing knowledge exchange based on the evidence.

¹⁰ [https://www.teagasc.ie/media/website/publications/2019/Agricultural-Sustainability-Support-and-Advisory-Programme-\(ASSAP\).pdf](https://www.teagasc.ie/media/website/publications/2019/Agricultural-Sustainability-Support-and-Advisory-Programme-(ASSAP).pdf)

¹¹ <http://eda2018.eu/dairy-sustainability-ireland/>



Climate Action Plan and Greenhouse Gas Emissions Marginal Abatement Cost Curve for Irish Agriculture

Climate abatement measures require widespread on-farm adoption and verification.

In 2012, Teagasc published its first greenhouse gas emissions marginal abatement cost curve for Irish agriculture (Teagasc, 2012). This was followed by a second iteration (Teagasc, 2018), which was undertaken in the context of Food Wise 2025. This second iteration investigated 16 separate measures aimed at reducing emissions from livestock, manure management, fertiliser use and land use. The report suggested that mitigation of methane and nitrous oxide emissions could yield a reduction in emissions of 1.85 Mt CO₂ eq per annum. Furthermore, the report suggested that there is the potential for sequestration of 2.7 Mt CO₂ eq associated with land use measures. An emissions target of 17.5–19 Mt CO₂ eq by 2030 under the government's Climate Action Plan (DCCAE, 2019) has been agreed for the agriculture sector. The measures identified to achieve this target, however, exist on paper only and require widespread on-farm adoption. On-the-ground verification of their use for inclusion in national emissions inventory and projection estimates is also required.

In 2019 the DAFM launched a public consultation on Ag-Climatise: A Draft National Climate and Air Roadmap for the Agriculture Sector to 2030 and Beyond. This document set out the unique climate and air challenges facing Irish agriculture, the opportunities that may arise from meeting emission targets and ambitions. At the time of writing of this report (October 2020), the final plan has not as yet been published. This plan will also form the basis of required activities in the agriculture sector under the National Air Pollution Control Programme.

National Air Pollution Control Programme

Implementation of the adopted Code of Good Agricultural Practice for reducing ammonia emissions will be central to reducing emissions, but other measures could be needed.

Reporting of air pollutants is an obligation for all European Member States (Chapter 3) and annual emissions of air pollutants are regulated under the National Emission Ceilings Directive. Article 10(1) of this Directive requires a National Air Pollution Control Programme to be developed. A draft programme for Ireland was submitted to the European Commission in 2019, with an updated final version to be submitted in autumn 2020. The agricultural sector is a significant contributor to nitrogen oxide, NMVOC and particulate matter emissions in Ireland; however, it is almost solely

responsible (> 99%) for national ammonia emissions and as such the sector will have to play a significant role in reducing these emissions. A Code of Good Agricultural Practice for reducing ammonia emissions was published in late 2019 (DAFM, 2019c). The measures outlined in the Code are voluntary but will play an important role when adopted at farm level in decreasing ammonia emissions and moving Ireland onto a pathway towards compliance.

Additionally Teagasc (2015, 2019a, 2020b) has produced marginal abatement cost curves of the abatement of ammonia from Irish agriculture. This type of analysis represents an economic and technical assessment of the best available abatement techniques, based on scientific, peer-reviewed research conducted by Teagasc and associated national and international partners.

Industrial Emissions Licences for Pig and Poultry Installations

Ammonia emissions and organic fertiliser (slurry and manure) from the intensive pig and poultry sectors must be properly managed to prevent environmental pollution.

Intensive pig and poultry-rearing installations are required to hold an Industrial Emissions Licence from the EPA. These installations have the potential to impact on the environment; for example, ammonia emissions can negatively impact on sensitive habitats, such as mosses (bryophytes), and organic fertiliser (slurry and manure) can impact on water quality if not managed properly.

Chapter 10 provides further details of the licensing process for these and other installations. Each licence includes conditions that control the operation of the activities and requires licensees to prevent, reduce and eliminate as far as possible emissions into air, water and land arising from such activities.

The licence conditions are in addition to the requirements of other environmental regulations, including the European Union (Good Agricultural Practice for Protection of Waters) Regulations and the Animal By-products regulations.



Research Responses

A range of research projects is examining the broad environmental challenges facing the agri-food sector.

The EPA continues to invest significant resources into environmental research both through its own research calls and through co-funding of projects with other bodies. Since 2016, the EPA has funded 78 new research projects relevant to the Environment and Agriculture area; an investment of €15 million. These projects were funded across the three Pillars of the EPA Research Programme 2014-2020. The most recent awards in relation to agriculture are largely focused on reducing nutrient loss to water, evaluating land use and land use management in the context of soil carbon, quantifying carbon and other emissions to the atmosphere from upland burning, and identifying scenarios for carbon neutrality for the agriculture sector. In terms of water, the focus of the research is on the achievement of Water Framework Directive goals. Projects funded include identification of the pressures associated with farm roadways acting as a conduit for nutrient transport, the effect of forest management on inland waters, the exclusion of livestock from watercourses, and management of riparian buffer zones. Further information on currently funded projects and end-of-project reports are available on the EPA website.¹²

Several research projects are currently examining soil carbon stocks, one with a view to creating a more robust system of reporting for national greenhouse gas emission and removal inventories for grassland and cropland; another study is examining the peatland properties influencing greenhouse gas emissions and removals. Furthermore, the National Policy Position on Climate Action and Low Carbon Development includes a key action to develop 'an approach to carbon neutrality in the agriculture and land-use sector, including forestry, which does not compromise capacity for sustainable food production'. In response, the EPA has recently funded a project aimed at developing scenarios in which this key action may be met. The recently published AgriBenchmark report explored the possibilities of benchmarking nutrient performance on Irish farms using data from the National Farm Survey (Murphy *et al.*, 2019). The results of this study suggest that there is scope to increase nutrient use efficiency. Furthermore, the study suggests that effective knowledge transfer is central to achieving potential improvements in nutrient management.

Through the Stimulus and CoFoRD (Programme of Competitive Forestry Research for Development) programmes, and through various joint initiatives with other state bodies and European agencies, the DAFM has strongly supported climate change research relevant to the Irish agri-food sector, committing €19 million to 25 projects that include climate change elements in 2013-2017 alone. A number of research proposals have recently been funded in response to the DAFM Research Call 2019 under the 'Environment & Climate Smart Approaches to Agri-Food Systems' topic. One of these projects aims to identify mechanisms whereby the greenhouse gas and ammonia footprints of pasture-based production systems can be lowered, while another is specifically aimed at furthering our understanding of ammonia abatement techniques in an Irish context. Two further projects are investigating novel technologies for the reduction of methane emissions and developing farm sustainability tools for efficient nutrient management.

In addition, the DAFM has used other transnational call processes to make awards from its funding programmes in the agri-environmental area. These include collaborative transnational partnerships in European Research Area Networks (ERA-Nets) and EU Joint Programming Initiatives. Further details are available on the DAFM website.¹³ The DAFM is on the governing board of the Joint Programming Initiative on Agriculture, Food Security and Climate Change (FACCE-JPI) and the Global Research Alliance initiative. The Global Research Alliance initiative has 56 member countries and aims to find ways in which food production can be produced without increasing greenhouse gas emissions.

¹² <http://www.epa.ie/researchandeducation/research/>

¹³ <https://www.agriculture.gov.ie/research/>



5. Conclusions

Environmental Pressures and Sustainability

It is clear from this integrated environmental review of agriculture that change is now required in the sector to ensure its environmental sustainability. Ireland has a reputation for natural food production and critical to this reputation is the appeal that food produced in Ireland has a low environmental footprint. However, this reputation is at risk of being irreversibly damaged because of current growth trends in air pollutant emissions (most importantly ammonia) and greenhouse gas emissions, and the decline in water quality and biodiversity. Business as usual will not reverse these trends; systemic change is required across the food system to address the challenges. The sector is responsible for approximately a third of national greenhouse gas emissions and over 99 per cent of national ammonia emissions and has been identified as the largest significant pressure on our water resources.

Food Wise 2025

A core principle of the Food Wise 2025 strategy was that 'environmental protection and economic competitiveness are equal and complementary: one cannot be achieved at the expense of the other'. The strategy also stated that 'future food production systems must be as focused on managing and sustaining our natural resources as they are on increasing production'. However, the evidence shows that these two objectives have not been met and that the economic growth of the sector in recent years has occurred at the expense of the environment, as witnessed by the negative trends in water quality, greenhouse gas emissions, ammonia emissions and biodiversity. It is also clear from the evidence that agricultural and other land

management practices are key drivers of these negative trends. Further work is now urgently required to address this imbalance, most importantly in the context of the new strategy for the sector to 2030 that is currently being developed. The agri-food and land management sectors in both the public and the private arenas also need to become, and be seen to be, strong advocates for a clean and well-protected environment, as they have been for intensification and efficiency. This re-balancing of focus needs to be a top priority for the sectors; otherwise, commitments to sustainability and environmental protection risk being seen to be of lesser importance than commitments to expansion, intensification, competitiveness and efficiency.

Climate Change

As a society we will all face the consequences of climate change and we must adapt to the changes in our climate that are foreseen. The agriculture sector will also have to adapt to these changes, as well as addressing the challenge of reducing its greenhouse gas emissions. Ireland will experience extended periods of drought-like conditions leading to potential water shortages, increased run-off volumes during intense rainfall events and the emergence of plant and animal diseases that have previously not been prevalent in Ireland. These challenges must be faced in conjunction with addressing environmental pressures, placing further emphasis on the development of holistic responses that are wide-ranging and designed to deliver multiple environmental, social and economic benefits.

The establishment of the Teagasc Carbon Navigator, marginal abatement cost curves, Smart Farming initiative and ASSAP are examples of good practice. However, much wider uptake and implementation of measures at the farm level is needed.





Nutrients and Soil Fertility

Issues surrounding soil fertility need to be addressed to enhance nutrient use efficiency particularly on our more intensive farms. Soils at optimum fertility and soil pH status recycle nutrients more efficiently, leading to a reduction in the inputs needed to maintain or increase levels of grass and crop production, while also reducing nutrient loss. This has wide-ranging positive outcomes for all of the environmental pressures identified and is a win-win solution from both an economic and an environmental standpoint. Policy decisions are now required to address and implement mitigation options; however, given the complex nature of the interface between soil, environmental and meteorological conditions a one-size-fits-all approach is unlikely to be successful across Ireland. Nutrients behave differently in the landscape depending on the soil type and the setting, for example, and actions to address nutrient loss must take this into account. In many areas the existing pressures have already exceeded the capacity of soil and water bodies to accept nutrients and sediment without causing significant harm. This provides the rationale for the adoption of region-specific integrated programmes of measures.

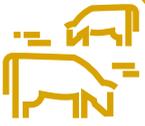
Biodiversity Protection

The decline and/or loss of biodiversity, including certain species of farmland birds and bees, butterflies and other insects, must be addressed as a matter of urgency. Current EU LIFE and EIP projects funded under the Rural Development Programme should serve as a significant stepping stone for the national roll-out of measures in which the maintenance and/or re-introduction of specific habitats are a prerequisite for sustainable food production. EPA-funded research has estimated that the annual value of animal pollination to home-produced crops in Ireland is €20-59 million per year, while the contribution of global pollination services to Ireland's balance of trade is >€150 million per year.

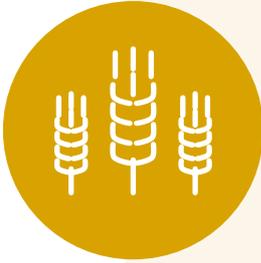


Farm and Catchment-level Approaches

A more holistic farm-and-catchment-level approach encompassing all environmental pressures will be fundamental for making progress towards more environmentally sustainable and low-carbon food production. The implementation of mitigation measures will also require monitoring and verification to gain recognition as part of both EU and international reporting mechanisms, for example being able to prove that land is a net sink for carbon. A network of integrated catchment/land use management plans informed by farm and nutrient management plans, catchment assessments and associated Areas for Action could form the basis of a more joined-up collaborative and cooperative approach to environmental management of our farms. This could provide the mechanism to reduce the cumulative environmental footprint of agricultural systems in Ireland, in an integrated way, covering areas such as biodiversity, greenhouse gases, climate change, air quality and water quality. Such an integrated approach could also identify and highlight the assimilative capacity of agricultural/catchment landscapes to process nutrient loads associated with intensification. It would also contribute significantly to the branding and marketing of Irish agricultural produce at home and abroad.



Chapter Highlights for Environment and Agriculture



Agricultural practices are identified in EPA reports as being one of the main pressures responsible for the decline in water quality nationally. Moreover, the agriculture sector is responsible for approximately one-third of national greenhouse gas emissions and over 99 per cent of national ammonia emissions. Biodiversity is also under pressure from land use changes and intensive farming. Ireland's reputation as a food producer with a low environmental footprint is at risk of being irreversibly damaged. Outcome-focused and activity metrics are required to allow for tracking of the sector's performance and accountability in improving sustainability and protecting the environment.



Economic growth in the agri-food sector in recent years is happening at the expense of the environment, as evidenced by trends in water quality, emissions and biodiversity all going in the wrong direction. Business-as-usual scenarios will not reverse these trends. New measures must go beyond improving efficiencies and focus on reducing total emissions by breaking the link between animal numbers, fertiliser use and deteriorating water quality. Measures are also needed to address new EU strategies including the Farm to Fork Strategy, which sets ambitious but sustainable targets to 'transform the EU's food system'.

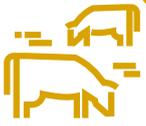


The adoption of a more holistic farm and catchment-level approach, encompassing all environmental pressures, will be fundamental to progress towards more environmentally sustainable and carbon-neutral food production.



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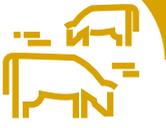
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Chapter 14

Environment, Health and Wellbeing





Environment, Health and Wellbeing

1. Introduction

Our health and wellbeing are inextricably linked to our surrounding environment. In helping to prevent damage to our environment, we are, in turn, protecting our own health. Understanding the interconnections between environmental opportunities, threats and human health and wellbeing is vital and fundamental to developing good environmental and public health policy. The European Environment Agency recently published a comprehensive assessment of how the environment influences health and wellbeing in Europe (EEA, 2020a). It reports that 13 per cent of all deaths in the EU were attributable to the environment, and observe that the most vulnerable people in society are hardest hit by environmental stressors. While government policy can achieve aspects of environmental safeguarding and protection, active engagement and participation by Irish citizens is essential if real and meaningful change is to be made.

This chapter opens by reviewing our relationship with our environment. It then looks at specific health risk areas and emerging issues.

2. Health Benefits of our Natural Environment

Getting outdoors and using our 'green' and 'blue' spaces can offer a multitude of health benefits. These range from increasing our levels of wellbeing and physical activity to reducing stress, improving mental health and using these spaces for community interaction and enhanced social cohesion.

Ireland has an abundance of 'green spaces' – parks, forests, communal gardens and meadows – and 'blue spaces' – rivers, lakes, canals and coastlines. There is an ever-growing body of evidence showing that engagement and contact with the surrounding natural environment is associated with measurable improvements in the health and wellbeing of the population (Lovell *et al.*, 2018). Exposure to green spaces has been shown to have a positive influence on a range of health outcomes. These include a reduced prevalence of type II diabetes and stroke; reduced risk of cardiovascular disease and death; improved pregnancy outcomes including reduced risk of low-birth-weight babies; and lower levels of depression and depressive symptoms (Braubach *et al.*, 2017; Sarkar *et al.*, 2018; Twohig-Bennett and Jones, 2018). Similarly, exposure to blue spaces has demonstrated benefits for mental health and wellbeing and for levels of physical health (Gascon *et al.*, 2017). Research commissioned by the Environmental Protection Agency (EPA) in partnership with the Health Service Executive (HSE) and undertaken by the Economic and Social Research Institute and University College Dublin (UCD) confirms that a health dividend flows from engaging with our native landscape, our parks and our surface waters – our green and blue spaces (Dempsey *et al.*, 2018a; Grilli *et al.*, 2020; Scott *et al.*, 2020).





Topic Box 14.1 Environment, Health and Wellbeing – EPA Research Programme 2014-2020

Since 2016, the EPA has funded 80 or so new projects relevant to the Environment, Health and Wellbeing area: a commitment of €10.6 million. These projects were funded mostly under the Sustainability (Health and Wellbeing), Water (Safe Water) and Climate Pillars of the EPA Research Programme 2014-2020.

Examples of EPA-funded projects include research on:

- residential solid fuel use
- the impact of nitrogen dioxide on health with particular emphasis on vulnerable groups
- antimicrobial resistance and the environment
- noise and health: evidence from Ireland
- evaluating the health benefits derived from green and blue spaces
- sources, pathways and environmental fate of microplastics
- potential sources and environmental fates of certain phthalates and
- elucidating levels and pathways of human exposure in Ireland to POP-BFRs (brominated flame retardants restricted under the Stockholm Convention on persistent organic pollutants and PFOS (Perfluorooctane sulfonic acid).

More information is available at <http://www.epa.ie/researchandeducation/research/>
EPA research reports related to environment, health and wellbeing are available at <http://www.epa.ie/pubs/reports/research/health/>

Childhood exposure to the natural environment has positive effects on physical, cognitive and social development (Strife and Downey, 2009). In addition, evidence is now highlighting the significant lifetime benefits for health and wellbeing that childhood exposure to nature offers. A recent nationwide study from Denmark involving over 900,000 people demonstrated that children who grew up in the presence of high levels of green space had a much lower risk of developing mental health problems in adulthood than those who lived with the lowest levels of green space (Engemann *et al.*, 2019).

The mental health and wellbeing benefits of engaging with green and blue spaces are of particular importance given the increasing prevalence and burden of psychiatric disorders at both national and global levels. According to the most recent *Health at a Glance: Europe* report, which provides an analysis of the state of health of European Union (EU) citizens and of the performance of EU health systems, Ireland has one of the highest prevalences of mental health disorders in Europe (OECD and EU, 2018).

The Wider Benefits of Green Spaces for Individuals, Communities, Society and the Environment

The benefits of green spaces also go beyond those direct physical and mental health and wellbeing benefits that accrue.

Green infrastructure and vegetation such as trees and hedging reduce people's exposure to many environmental hazards and stressors brought about by the concentration of everyday human activity, the presence of artificial surfaces and the effects of climate change, particularly in urban areas. Specifically, green infrastructure and vegetation can help to reduce air pollution and, in some cases, improve air quality (Abhijith and Kumar, 2019), decrease temperatures associated with the urban heat island phenomenon and provide a cooling effect (Bowler *et al.*, 2010), and improve water quality and reduce flooding risk. Importantly, green spaces can provide quiet or tranquil places, protecting citizens against noise pollution from sources such as traffic, particularly in urban areas.

Our green and blue spaces also have social benefits, acting as hubs to strengthen community interaction and social cohesion and to reduce social exclusion. These social benefits can further enhance health and wellbeing. Spaces such as community gardens, allotments and urban parks can be particularly beneficial in this regard. Recent research from England found that people who spend more time outdoors in nature and those with a higher appreciation of nature were more likely to engage in a range of pro-environmental behaviours (Alcock *et al.*, 2020).



Topic Box 14.2 Preliminary Findings from the BlueHealth project – Irish Data Analysis

The BlueHealth project is an EU-funded Horizon 2020 research project investigating residential exposure to, and recreational contact with, 'blue' spaces (e.g. coasts, rivers and lakes) and a range of health and wellbeing outcomes.

This project explores the health-promoting potential of 'blue' spaces. Part of the project involves collecting data from representative samples of people in 18 countries, across four seasonal waves, about visits they made to blue spaces. In Ireland a total of 1059 people took part.

Preliminary analyses reveal that better general health appeared more prevalent in coastal areas, while psychological wellbeing (measured by the World Health Organization's WHO-5 wellbeing index) also appeared to be better in more coastal areas but not in greener areas. People who visited various types of blue space at least once a week were also more likely to have better health and psychological wellbeing. People who perceived 'a little' or 'a lot' of blue space within 10-15 minutes' walk from their home experienced better psychological wellbeing.

This research is ongoing and further valuable insights are expected. Find out more at: www.bluehealth2020.eu/projects/bluehealth-survey.

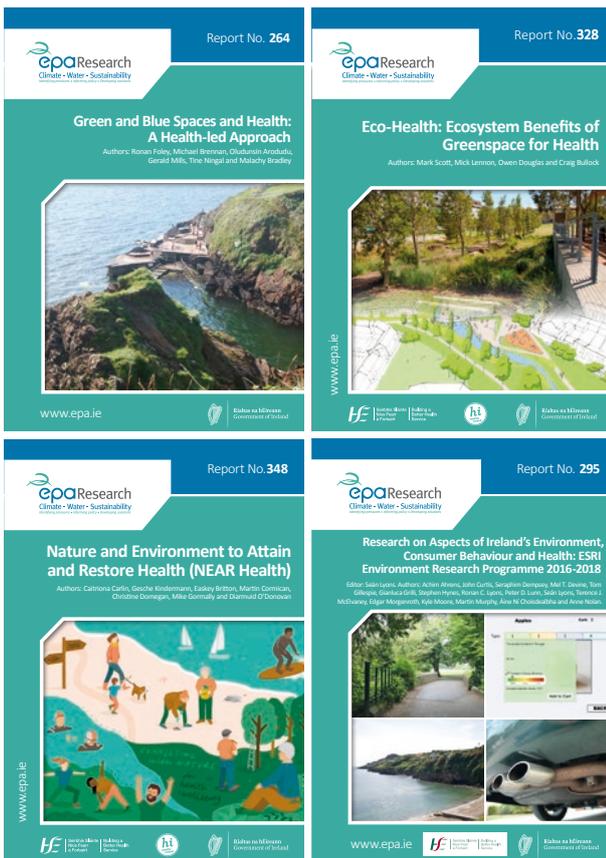


Providing health-promoting environments is therefore an essential requirement for healthy, thriving and inclusive communities. An investment in well-designed, good-quality and accessible green and blue spaces is an investment in public health; therefore, providing health-promoting environments in urban spatial planning should be viewed as a necessary and integral component. Under the government's National Planning Framework 2040 there is a welcome alignment of public health considerations and policy within the spatial planning framework, including commitments to:

- integrate public health policies, such as Healthy Ireland and the National Physical Activity Plan, with planning policies
- integrate safe and convenient alternatives to the car by prioritising the accessibility of walking and cycling in existing and proposed developments
- promote more sustainable forms of travel and activity-based recreation by further developing greenways, blueways and peat (brown) ways
- integrate green and blue infrastructure planning and the preparation of statutory land use plans
- support green and blue adaptation efforts to enhance resilience to climate change, such as creating green spaces and parks for the management of urban micro-climates
- ensure that the planning system will be responsive to our national environmental challenges and that development occurs within environmental limits, having regard to the requirements of all relevant environmental legislation and the sustainable management of our natural capital
- improve air quality and help prevent people being exposed to unacceptable levels of pollution in our urban and rural areas through integrated land use and spatial planning that supports public transport, walking and cycling as modes of transport preferable to the private car and that promotes energy-efficient buildings and homes, heating systems with zero local emissions, green infrastructure planning and innovative design solutions
- promote the proactive 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 (S.I. 140/2006) through national planning guidance and noise action plans.



Importantly, many of the health-relevant actions under the National Planning Framework 2040 are also linked to and reinforced by the government's Climate Action Plan. It is essential that the ambitions of the National Planning Framework 2040 are realised through appropriate implementation and translation from national level through to regional and local levels, where local development plans and proposals are made. It is also important that, from the outset, urban environments and green and blue spaces are collaborative and inclusive in their design and implementation. This will ensure that the various needs of local stakeholders and end-users, of all ages, are appropriately considered and catered for. Spaces designed to support specific functions have a tendency to attract more limited user groups. By contrast, multifunctional areas incorporating spaces supporting active mobility, sports, physical activity, relaxation and opportunities for social interaction can provide an array of health benefits for multiple user groups (Grilli *et al.*, 2020; Scott *et al.*, 2020).



3. National Issues around Protecting our Environment, Health and Wellbeing

Drinking Water

Safe drinking water is essential for public health. The microbiological quality of private water supplies remains inferior to that of public supplies. While most public water supplies are safe, further improvements are necessary to make sure that they stay safe in the future.

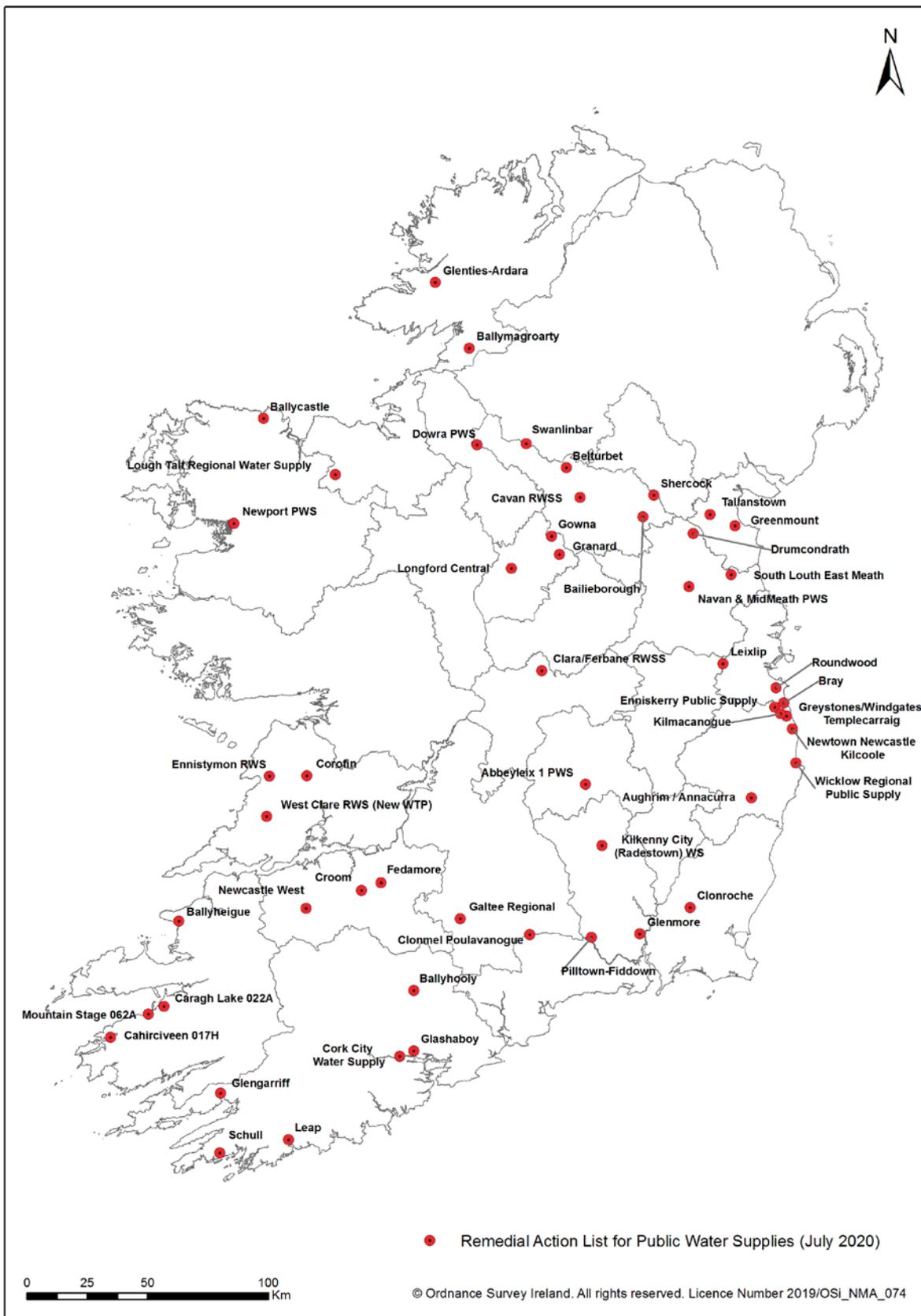
Safe drinking water is essential for public health. To be considered safe, water must not contain microorganisms and substances that could endanger health, such as pathogenic parasites, chemical contaminants or particulates. In addition to the standard monitored and regulated contaminants of drinking water, knowledge about further risks to water quality is emerging from a better understanding of the issues around new chemical formulations and the combined use of chemicals (adverse impacts of mixtures) and their occurrence in the environment, which is discussed later in this chapter.

Most public drinking water in Ireland is drawn from rivers and lakes (80%), and the remainder originates from groundwater boreholes (13%) and springs (7%). In 2019, Ireland had 787 public water supplies serving 1.3 million households.

The results of the 2019 drinking water monitoring programme for public water supplies shows 99.9 per cent compliance with the microbiological standards and 99.6 per cent compliance with the chemical standards, based on over 120,000 test results (EPA, 2020a). While this indicates that the majority of public water supplies are safe, further improvements are necessary to make sure that they stay safe in the future, thereby avoiding the risk of 'boil water notices' or 'do not consume notices'. In total, 67 boil water notices were in place in 16 counties affecting 695,364 consumers in 2019. Of those boil water notices, 59 were in place for more than 30 days, meaning they are classed as long-term notices requiring investment in infrastructure to address. Two boil water notices for over 600,000 consumers in 2019 highlights the vulnerability of our drinking water supplies. Details on the reasons for the boil water notices, performance in fixing the supplies, along with the names of the supplies with boil water notices in place during 2019 are provided in the EPA report on *Drinking Water Quality in Public Supplies 2019* (EPA, 2020a). The overall compliance figures also mask slightly inferior results for a few individual parameters, notably trihalomethanes (THMs) at 96.1 per cent compliance, which is lower than in other European counties. The EPA has identified 52 supplies (as at July 2020) that are most in need of upgrading, replacement or improved operational control (Figure 14.1).



Figure 14.1 Public water supplies needing remedial action, July 2020 (Source: EPA)





Microbiological contamination

The most important indicators of the quality of drinking water are the microbiological parameters, in particular the bacterium *Escherichia coli* (*E. coli*) and enterococci. The presence of *E. coli* and enterococci in drinking water indicates that the water treatment plant is not operating adequately or that faecal contamination has entered the water distribution system after treatment. The incidence of *E. coli* in public water supplies has significantly reduced from 87 in 2007 to only seven in 2019 due to improvements in guidance, controls and management of disinfection at water treatment plants. The number of supplies with enterococci failures remains low, with only two in 2019 compared with six in 2018.

The microbiological quality of private water supplies remains inferior to that of public supplies. Many private wells are at risk of contamination from sources such as septic tanks, land-spreading of slurry, animals grazing near the wellhead, and chemical and fuel storage tanks. It is estimated that up to 30 per cent of private wells in operation in Ireland are contaminated with *E. coli* (EPA, 2017). Moreover, findings from EPA-funded research that assessed 212 private wells in four areas of the country found that only 35 per cent were properly protected against contamination (Gill *et al.*, 2018). Of particular concern is the continued and increasing prevalence of a particular strain of *E. coli* called Shiga-toxin/verocytotoxin-producing *E. coli* (STEC/VTEC), which produces a powerful toxin that can cause serious illness. Younger (< 4 years old) and older populations and those who are immunocompromised are particularly vulnerable to STEC/VTEC infection. Over the past decade, Ireland has consistently reported one of the highest incidences of STEC/VTEC in the EU, reporting ten times the EU average in 2017 (HSE HPSC, 2019a). Irish families are particularly vulnerable to this strain of bacteria because of the high proportion of rural dwellers who rely on private wells and septic tanks, the large cattle population and Ireland's diverse geology and climate.



Cryptosporidium and *Giardia* are genera of microscopic parasites found in human and animal waste that can cause gastroenteritis and persistent diarrhoea (contaminated water may come from lakes or ponds, swimming pools, drinking water or ice). While there is no overall trend for cryptosporidiosis in Ireland, the number of cases in 2018 (629 cases) was the highest reported since 2007. Ireland has consistently reported the highest crude incidence of cryptosporidiosis of any EU Member State since 2012. Contact with effluents from farm animals is the main risk factor for cryptosporidiosis. Health surveillance data show that people who are not served by public water supplies were over-represented in sporadic cases, relative to the distribution of households by water supply type nationally (HSE HPSC, 2019b).

Figure 14.2 shows the number of cases of giardiasis reported in Ireland between 2004 and 2018 (HSE HPSC, 2019c), showing a six-fold increase in the last 6 years. There were 270 cases reported in 2018, which is the highest reported incidence in Ireland but is similar to the reported incidence at EU level. According to the HSE, the increase in recent years is believed to be largely due to changes in laboratory practice for selecting stools for testing coincident with the introduction of newer, more sensitive molecular detection techniques. Much remains to be learned about the true epidemiology of giardiasis in Ireland, but it is clear that it causes a much larger burden of disease than previously thought.

Focus on MCPA and rush control

BEWARE! Spraying herbicides can very easily lead to breaches of the drinking water standard for pesticides, particularly if using MCPA products.

Why?

- MCPA is water soluble and takes several weeks to break down.
- Herbicides in poorly drained areas reach a water table near the surface which are prone to runoff to nearby water bodies.

What to do?

- Use non-chemical control methods, e.g. cutting, drainage, seed improvement.
- If spraying, target only the root affected plant.
- If spraying, cut rushes one month before or one month after spraying to improve the effect of the spray.
- Consider weed spraying with an appropriate herbicide as a rush control option.

REMEMBER!

- A SINGLE drop of pesticide lost to a water body such as a typical small stream (1 metre wide, 0.3 metres deep), for example, can be enough to breach the legal limit for pesticides in drinking water of 0.1 parts per billion along 30 km of its length.
- Always read and follow the product label.
- Be aware of how near water bodies (ditches, streams, ponds, rivers, lakes, etc.), drains or wells are to where you are working.
- Field out if the treatment area is in the vicinity of a drinking water abstraction point or well.

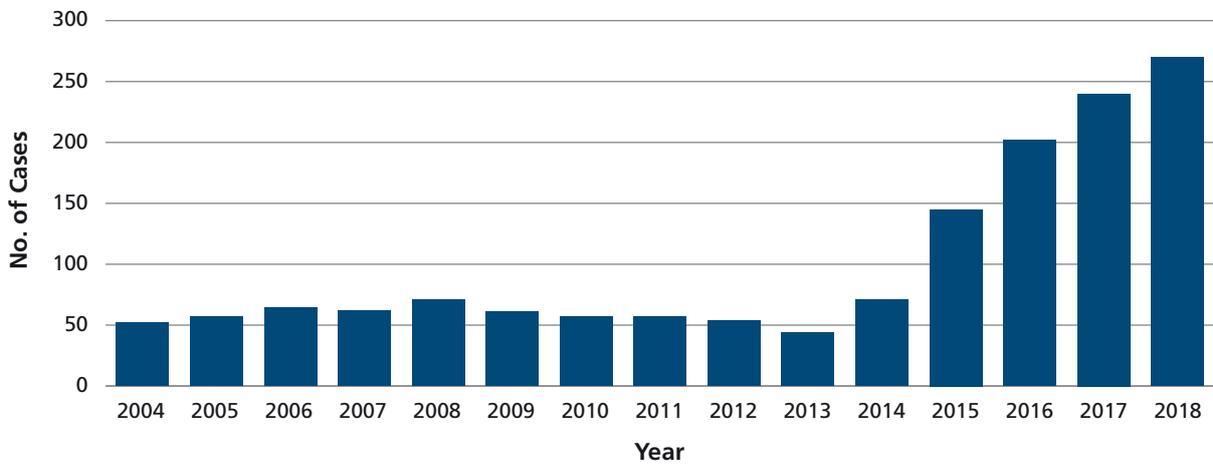
For further information on related topics such as container storage, triple rinsing, Integrated Pest Management or a list of approved Pesticide Abolition sites:
www.pca.gov.ie/pesticide_guidance, www.teagasc.ie or www.epa.ie

Protecting Drinking Water from Pesticides
Herbicide Use in Grassland

Preventing herbicide use on the use of pesticides to protect drinking water.



Figure 14.2 Number of cases of giardiasis in Ireland 2004-2018 (Source: HSE HPSC, 2019c)



Trihalomethane contamination

THMs are formed when chlorine used in the disinfection of raw water reacts with naturally occurring organic matter in the water. The European Commission currently has an infringement case against Ireland because of the number of water supplies failing to meet the THM standard. In May 2020, the Commission issued a reasoned opinion stating that Ireland has failed to take the measures necessary to ensure THM compliance in 31 public water supplies and 13 private group water schemes. The Department of Housing, Local Government and Heritage is coordinating Ireland's response.

Lead contamination

Lead, which is a toxic compound, is found in drinking water when it dissolves from lead pipework, mains connections and plumbing fittings. The standard for lead in drinking water is 10 µg/l. Lead is very harmful to the development of the nervous system and can cause long-term damage to health. In June 2015, the Irish Government published a National Lead Strategy, which is overseen by the Department of Housing, Local Government and Heritage. While Irish Water is carrying out works to replace lead pipes and connections, the full extent of lead pipework in public buildings, such as schools and hospitals, and in state-owned buildings, such as local authority housing, is still unknown and there are no plans reported to carry out replacement works. Action is needed in this area to eliminate lead from drinking water.

Pesticide contamination

The term 'pesticides' includes a wide range of products, but in Ireland it is herbicides that pose the greatest threat to drinking water. The most commonly found pesticide is MCPA (2-methyl-4-chlorophenoxyacetic acid), which is used for rush control in grassland. Pesticides should not be present in drinking water and the Drinking Water

Regulations S.I. 122/2014 (as amended) set standards that are considerably below the levels that would affect people's health. The drinking water standards for pesticides were exceeded in 27 supplies in 2019, which is an improvement in compliance with the standards for pesticides compared with 34 supplies with pesticides exceedances in 2018 and 48 supplies in 2017. There is some cause for optimism, as the EU statistical office, Eurostat, reports a 28 per cent reduction in pesticide sales in Ireland in the years 2011-2018 (Eurostat, 2020).

Emerging contaminants

Although the impact of certain individual chemicals and biological vectors is known, people are also exposed in their daily lives to novel pathogens and complex mixtures of a wide variety of environmental chemicals. Concerns have grown about the 'cocktail effect', namely mixtures of chemicals that are present in the environment at low concentrations that, in combination, may cause harm (e.g. Quinn *et al.*, 2015; Hartmann *et al.*, 2018). Contaminants of concern that are undergoing assessment through research include nano-particles, persistent pharmaceuticals and per- and polyfluorinated alkyl substances (PFAS), which are a group of more than 4700 widely used synthetic chemicals that accumulate over time in humans and in the environment (EEA, 2019a), most of which are little understood. The EPA water monitoring programmes include those for the Sentinel monitoring of a wide range of substances, many of which would be considered substances of emerging concern. The emerging risks associated with chemical exposure is addressed in more detail later in this chapter.

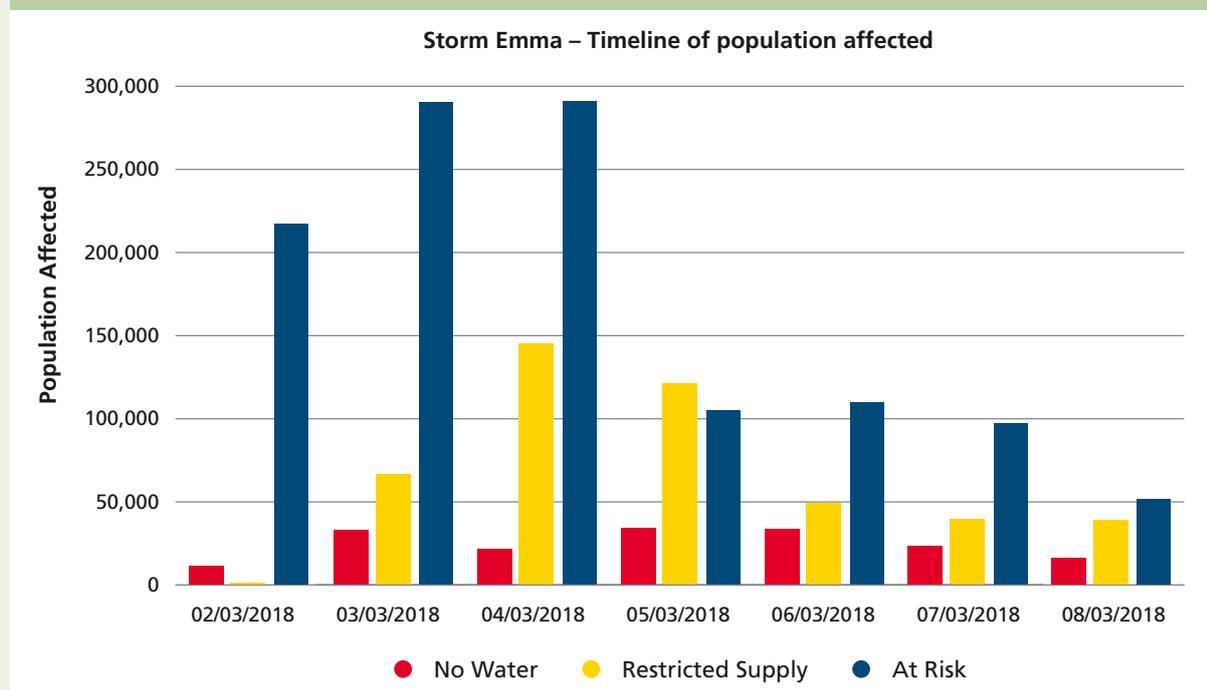


Topic Box 14.3 Water Services, Extreme Weather and Climate Change

There is a need to improve the resilience of drinking water services.

During 2018, Ireland experienced extreme weather events that affected public water supplies and the delivery of water to consumers. In March, Storm Emma resulted in large amounts of snow and extremely cold weather. Schools, offices, shops and most public services were closed for several days, and people had difficulty leaving their homes to travel even short distances. Many water treatment plants were inaccessible and Irish Water could not respond to operational alarms and issues when they occurred. This particularly affected smaller supplies and, for example, nine supplies in Waterford were put on boil water notices as a precaution. Many people were also affected by water restrictions or had no water at all (Figure 14.3).

Figure 14.3 Storm Emma – Timeline and population affected by water restrictions (Source: Irish Water)



The summer of 2018 posed other challenges for drinking water supplies. High temperatures and no rainfall in June and July meant that Ireland experienced drought conditions. This, coupled with increased demand for water during that time, resulted in Irish Water introducing the first ever National Water Conservation Order nationwide hosepipe ban in July. The order remained in place until September 2018. Water demand and supply levels were monitored daily by Irish Water to ensure that water remained available for consumers, farmers, businesses and other services.

The challenges posed by these climate extremes in 2018 demonstrate the need to have resilient water supplies that can cope with short-term events such as snow, or longer term events such as a summer drought. Drinking water safety plans play an essential role, as they identify what could go wrong in advance, so that action can be taken to reduce the risk of problems arising or to lessen the impact if something does go wrong.

Urban Wastewater

Improvements are needed in urban wastewater collection and treatment to maintain water quality and thereby protect public health. Raw sewage from 35 towns and villages (the equivalent of 78,000 people) is currently being released into the environment every day.

Over one billion litres of wastewater are collected every day and treated at 1100 treatment plants before being discharged into the environment (EPA, 2020b). There are deficiencies in many public sewers and wastewater

treatment plants thanks to a legacy of underinvestment. As a result, wastewater is one of the main threats to the quality of Ireland's rivers, lakes and estuaries, but it also poses a potential threat to public health. Public exposure to discharges, which can contain pathogens and pollutants such as microplastics, detergents and personal care products, may occur if those discharges are near bathing or recreational waters.

In October 2020, raw sewage from 35 towns and villages (the equivalent of 78,000 people) was still being released into the environment every day from urban areas as well as



from smaller coastal towns and villages. This is a reduction from 43 towns and villages discharging raw sewage when the EPA published *Ireland's Environment: An Assessment 2016*. The discharged raw sewage can contain harmful bacteria and viruses and pose a health risk to people who come into contact with it. It also threatens aquatic ecosystems and the amenity value of our waters.

The issue of nuisance odours is one about which the EPA frequently receives complaints regarding certain licensed sites, including wastewater works. Odour nuisance can negatively affect human health and wellbeing, particularly if people are exposed for extended periods (EPA, 2019). Almost half of the complaints received by the EPA annually about wastewater works relate to odour.



Domestic Wastewater Treatment Systems

Poorly designed, installed and maintained domestic wastewater treatment systems are a risk to public health.

In Ireland, there are an estimated 500,000 domestic wastewater treatment systems (DWWTS), i.e. septic tanks and more advanced packaged/filter treatment systems, treating wastewater from houses not connected to a public sewerage system. Owners of DWWTS are required to operate and maintain their systems so that they do not pose a risk to human health or the environment.

DWWTS that are properly designed, installed and maintained can provide long-term, effective treatment of domestic wastewater. However, DWWTS can result in reduced water quality and threaten public health if they are poorly constructed or not operated satisfactorily.

The *Domestic Waste Water Treatment Systems Inspections and Enforcement 2019* report (EPA, 2020c) details the findings of 1160 local authority inspections carried out in 2019. Nearly half (580) of the systems inspected did not meet the necessary standards, which is consistent with previous years' findings. The local authorities identified more serious issues with nearly 300 systems, which were

found to be a risk to human health or the environment. Twenty-seven per cent of systems that failed in report years 2013-2019 had yet to be fixed in mid-2020. Failures are due to construction defects and householders not maintaining/cleaning out (desludging) systems. There is further information for householders on the EPA's website about how to check a DWWTS and take action if it is defective. The government's recently expanded septic tank grant scheme broadens the availability of grants and increases the amount of the maximum grant available to €5000.

Bathing Water

While nearly three-quarters of Ireland's bathing waters are classified as excellent, some urban beaches are under pressure, and Ireland ranks well below the EU average for excellent bathing water quality.

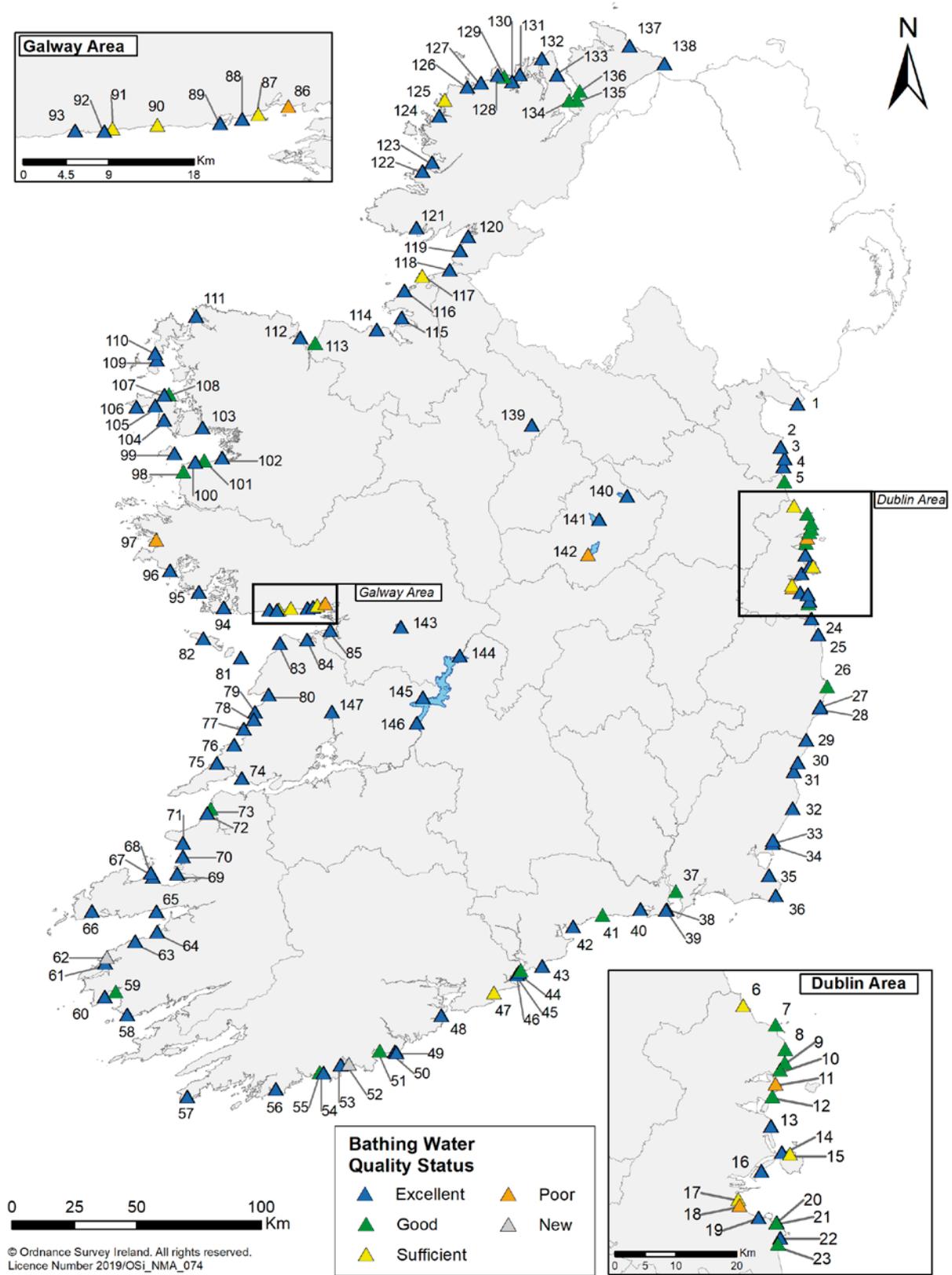
There are 147 bathing waters identified in Ireland under the Bathing Water Regulations: 138 on the coast and nine inland (Figure 14.4). Overall, the quality of bathing waters in Ireland improved in 2019, with 95 per cent of sites (140 of 147) meeting or exceeding the minimum required standard: this is up from 94 per cent in 2018 (EPA, 2020d). The 2019 results show that 107 (73%) were classified as 'excellent', up from 103 in 2018; 24 (16%) were classified as 'good', up from 22 in 2018; and nine (6%) were classified as 'sufficient', down from 12 in 2018. As in 2018, the water quality at five beaches was classified as 'poor'. They were Merrion Strand, Dublin; Portrane (the Brook) Beach, Dublin; Ballyloughane Beach, Galway; Clifden Beach, Galway; and Lilliput, Lough Ennell, Westmeath. When a bathing water is classified as poor, it means that there is a risk of periodic pollution, with the potential to cause illness such as stomach upset, skin rash and infections of the ear, nose and throat. Merrion Strand had been classified as 'poor' for 5 years in a row, meaning that this strand was declassified as a bathing water in 2020.

Three new bathing water sites, all in Dublin, were classified for the first time in 2019. They were the Forty Foot Bathing Place (classified as 'excellent'); White Rock Beach (classified as 'excellent'); and Sandycove Beach (classified as 'good'). Two additional beaches, Inchydoney East Beach, Cork, and Cúas Crom, Kerry, were added to the national bathing waters list in 2019 and will be classified following the 2020 bathing season.

The EPA bathing water quality report for 2019 (EPA, 2020d) notes that, in the case of 50 bathing water pollution incidents notified to the EPA in 2019, 54 per cent were linked to urban wastewater (sewage treatment) discharges, 18 per cent were linked to agricultural run-off and 12 per cent were linked to septic tank discharges.



Figure 14.4 Bathing water quality map of Ireland 2019 (EPA, 2020d)





Improvements in urban wastewater systems should continue to be made to limit the impact of wastewater on bathing waters and thereby reduce risks to public health. Local authorities should implement appropriate measures to increase the number of bathing waters classified as good or excellent and, where practical, consider designating more of the beaches that are regularly used by bathers. There are a number of ongoing environmental research projects that aim to improve knowledge and practice around bathing water quality and protection: the National University of Ireland (NUI) Galway PIER project, which is funded by the EPA; the County Wexford-led Duncannon Blue Flag Farming and Communities Scheme; and the Acclimatize project and the EU SwimProject, both involving UCD.

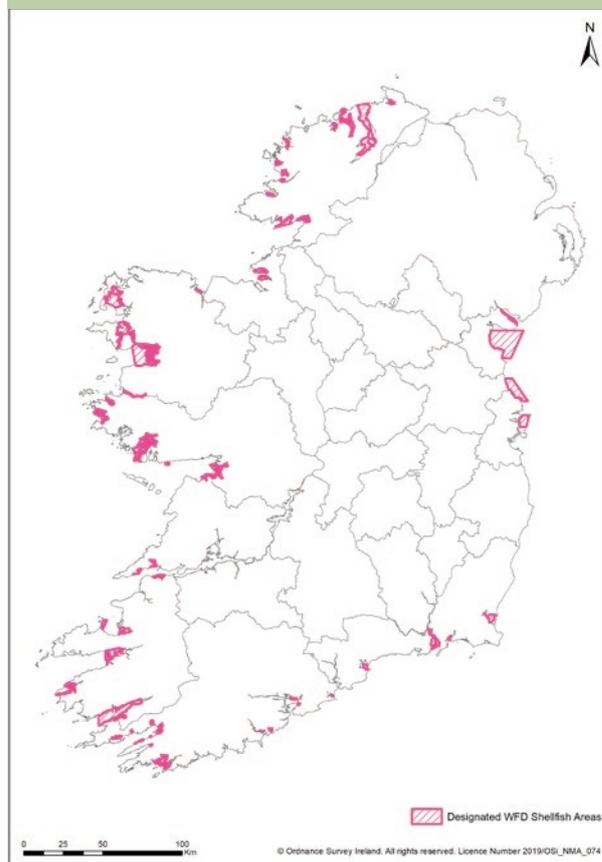
During the bathing season, the EPA's beaches.ie website (www.beaches.ie) shares the latest information on bathing water quality and any water restrictions in place for identified bathing waters, as well as information on a number of other monitored bathing waters.

Shellfish Waters

Live bivalve molluscs for human consumption, such as mussels, can be harvested only from shellfish production areas that meet specified water quality requirements.

Irish coastal waters provide ideal conditions for shellfish production, including oysters, mussels, cockles, scallops and clams. To support shellfish life and growth and to contribute to the high quality of edible shellfish products, the Quality of Shellfish Waters Regulations (S.I. No. 268 of 2006, as amended) required pollution reduction programmes to be developed for designated shellfish areas. Under these Regulations, there are 64 designated shellfish-growing areas in Ireland, which have specified physical, chemical and microbiological water quality requirements (Figure 14.5).

Figure 14.5 Designated shellfish-growing areas in Ireland (Source: EPA)



Norovirus is a leading cause of gastroenteritis in humans and is found in high concentrations in municipal wastewater. Bivalve molluscan shellfish such as oysters are filter feeders and can become contaminated with human pathogens including norovirus when produced in areas affected by municipal wastewater discharges. Wastewater treatment is a critical control to reduce the extent of pathogen discharge into aquatic environments. Disinfection is usually carried out using ultraviolet (UV) lamps, which kill or inactivate most of the bacteria and viruses in the water. Based on an assessment of Irish Water's annual monitoring returns, there are currently 18 towns in Ireland that have UV treatment in place at their wastewater treatment plants to protect shellfish waters.

To protect against illness, the Sea Fisheries Protection Authority and the Marine Institute, under service contract to the Food Safety Authority Ireland, operate a shellfish monitoring regime and analyse shellfish samples for the presence of biotoxins. The controls are such that consumption of Irish shellfish poses little risk to public health. However, illegal shellfish harvesting can present a risk to public health if contaminated shellfish makes its way into the food chain. Consumers and food businesses should purchase live bivalve molluscs only from suppliers



that are approved by the Sea Fisheries Protection Authority to place live shellfish on the market for human consumption.

A mapping application on Irish shellfish biotoxin and phytoplankton status is available on the Marine Institute's website.¹ This provides the latest information on shellfish safety data for shellfish producers, food business operators and consumers. The Marine Institute also publishes a weekly Harmful Algal Blooms (HAB) Bulletin to provide information on the potential development and current status of harmful and toxic algae in Irish coastal waters, which can enter the human food chain through shellfish consumption.

Air Quality

The burning of solid fuels for home heating and our current reliance on private conventionally fuelled vehicles cause much of Ireland's air pollution.

Air pollution is the most significant environmental contributor to the burden of disease worldwide, causing an estimated six to seven million premature deaths each year (UN Environment, 2019). In Ireland, there are an estimated 1300 premature deaths annually due to poor air quality (EEA, 2020b), due predominantly to fine particulate matter (with a diameter less than 2.5 µm, PM_{2.5}). There is no known safe level of air pollution. Even brief periods of exposure to high concentrations of air pollutants have a measurable adverse impact on health (WHO, 2006).

In general, Ireland's air quality is deemed good when assessed against EU air quality standards. However, monitoring in 2019 at a Dublin city centre monitoring site at St John's Road West found elevated nitrogen dioxide levels which shows that local urban air pollution issues needed to be tackled (Chapter 3). When compared with the more stringent WHO guideline values, which are set for the protection of human health, some challenges for certain air pollutants emerge, specifically emissions of fine particulate matter (EPA, 2020e). The burning of solid fuels for home heating, our current reliance on private conventionally fuelled (especially diesel) motor vehicles and emissions from agriculture are to blame for many of the air pollution issues that Ireland is currently experiencing. More extensive information on the contribution of these activities to air pollution and the steps to tackle emissions is given in Chapter 3; some specific actions are detailed in the paragraphs below.

Burning solid fuels such as coal, peat and wood products in our homes releases microscopic, airborne particles called particulate matter (PM), which are complex mixtures of various harmful chemicals. Those with underlying respiratory conditions, such as asthma and chronic obstructive pulmonary disease, are particularly vulnerable to air pollution. A switch from burning solid fuels by all households would ensure a better environment for those particularly vulnerable populations, such as children with asthma. Reducing our use of solid fuels for home heating would be a triple win in terms of the benefits it would afford: (1) it would improve the quality of air we breathe in our homes; (2) it would reduce the levels of outdoor air pollution, which exposes the wider population to pollutants such as PM; and (3) it could help limit carbon dioxide emissions, which are contributing to climate change.

An immediate national ban on 'smoky' coals is necessary if air quality and public health are to be significantly improved. A ban on the selling, buying and burning of 'smoky' coal is currently in force across several areas of the country and, from September 2020, the ban was extended to a further 13 towns² with populations over 10,000 people. However, nationwide coverage and implementation of the ban is essential if we are to seriously and proactively tackle this public health matter. To make real and effective reductions in the damaging effects and premature deaths caused by air pollution we need to move to cleaner and more efficient ways of heating our homes that reduce emissions of air pollutants and carbon dioxide. In addition, it will be crucial to ensure that the extension of this ban encourages a switch to cleaner alternatives, rather than from coal to other polluting solid fuels such as wet wood and peat. Another proactive step that should be implemented is an amendment to the Building Regulations to explicitly prohibit the inclusion of open fireplaces and solid fuel heating systems in all new houses, particularly those in urban areas.



¹ <http://webapps.marine.ie/HABs/BiotoxinMap>

² Smoky coal will be banned in the following 13 towns from September 2020: Ashbourne, Ballina, Carrigtwohill, Castlebar, Cavan, Cobh, Enniscorthy, Killarney, Longford, Mallow, Midleton, Tramore, Tullamore.



Measures to tackle transport-related air pollution must also be urgently adopted and implemented, e.g. by using cleaner alternatives to the private car such as cycling, walking, taking public transport, carpooling, moving to cleaner modes of public transport and expanding the electric car recharging network to encourage and support more environmentally friendly means of transport (EPA, 2020e). The importance of good spatial and urban planning is also essential in this regard to provide key infrastructure to allow and encourage more active travel by citizens.

It is recognised that exposure to air pollution has an unequal impact on groups of society: the elderly, children, those in poor health and groups with lower socio-economic status are the most adversely affected (EEA, 2018). An analysis of air pollution and admissions to St. James's Hospital, Dublin, for respiratory and cardiovascular disorders identified a higher risk of mortality among those from lower socio-economic groups (Cournane *et al.*, 2017). This points to a need for more urgent focus on and action targeting the most at-risk groups of society to ensure that inequalities in exposure are adequately addressed by current and future policy, practice and interventions.

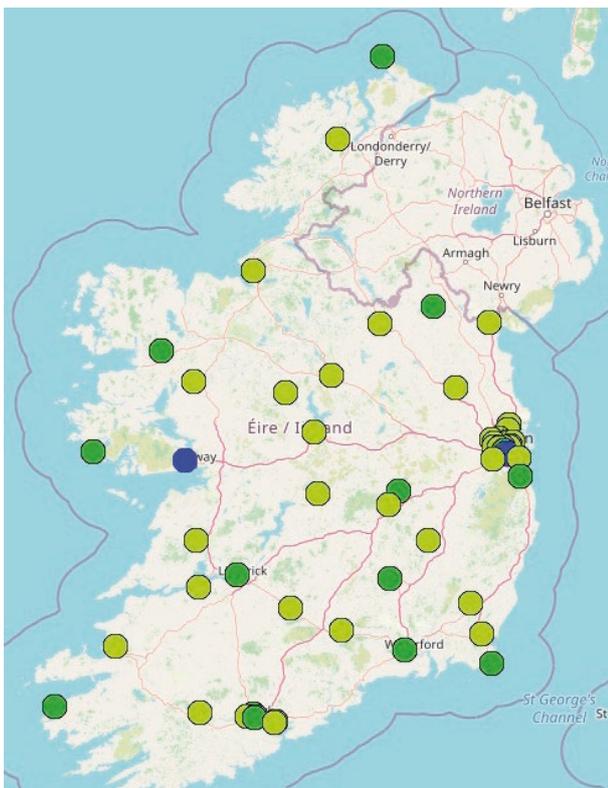
The EPA's Air Quality Index for Health (AQIH) provides a real-time (updates every 2-5 minutes) assessment of air quality across Ireland and categorises it on a scale of 1-10. The higher the reading, the poorer the air quality; a reading of 1-3 denotes good air quality in the area and a reading of 10 denotes very poor air quality in the area (Figure 14.6). The real-time analysis and health advice messages provided by the AQIH for each region are a useful tool in helping to better protect people's health, particularly the health of those who may be quite sensitive to air pollution (e.g. adults and children with heart or lung conditions including asthma, older people).

An analysis undertaken by the EPA and the HSE's Public Health Team examined the relationship between short-term AQIH and acute hospital admissions in the Dublin region (unpublished data). The findings indicated that, when the AQIH was fair or poor in the region, there was an increase in admissions of individuals with asthma (estimated by the HSE to be approximately 470,000 people) and atrial fibrillation (irregular heartbeat, affecting > 3 per cent of the population over 50) (Smyth *et al.*, 2015), with a 70 per cent increase in same-day asthma admissions on days when poor air quality was reported. This piece of research demonstrates the benefit of the AQIH as a suitable short-term measure to raise people's awareness of air quality in their region and of the AQIH's potential to be used as a tool, particularly by those more vulnerable populations, to help them adequately prepare for, and reduce their exposure to, air pollution.



Figure 14.6 Air Quality Index for Health map and accompanying health messages for at-risk groups and the general population (Source: EPA)

ACCOMPANYING HEALTH MESSAGES FOR AT-RISK GROUPS AND THE GENERAL POPULATION			
BAND	INDEX	AT-RISK INDIVIDUAL *	GENERAL POPULATION
Good	1	Enjoy your usual outdoor activities	Enjoy your usual outdoor activities
	2		
	3		
Fair	4	Adults and children with lung problems, and adults with heart problems, who experience symptoms, should consider reducing strenuous physical activity, particularly outdoors.	Enjoy your usual outdoor activities
	5		
	6		
Poor	7	Adults and children with lung problems, and adults with heart problems, who experience symptoms, should reduce strenuous physical activity, and particularly if they experience symptoms.	Anyone experiencing discomfort such as sore eyes, cough or sore throat should consider reducing activity, particularly outdoors
	8		
	9	People with asthma may find they need to use their reliever inhaler more often. Older people should also reduce physical exertion.	
Very Poor	10	Adults and children with lung problems, adults with heart problems, and older people should avoid strenuous physical activity.	
		People with asthma may find they need to use their reliever inhaler more often.	



Environmental Noise

The WHO has classified transport-related noise (from road, rail and air traffic) as the second leading environmental cause of ill health after air pollution, which highlights noise as a pollutant and health risk that needs more attention nationally.

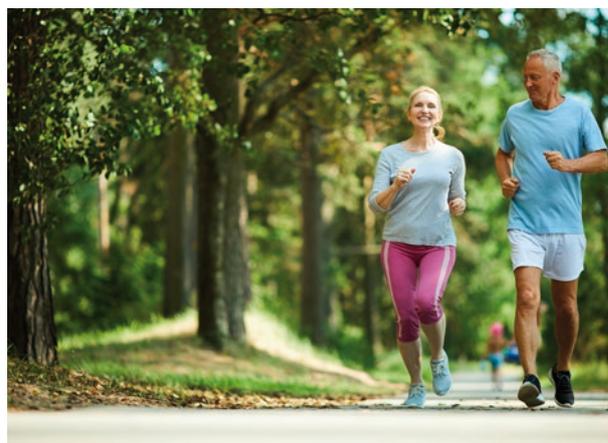
The adverse effects on health of long-term exposure to excessive noise are of increasing concern, and the WHO has classified transport-related noise (from road, rail and air traffic) as the second leading environmental cause of ill health after air pollution (WHO, 2011). In Europe, at least 20 per cent of the population currently resides in areas where noise levels are deemed to be harmful to health. It is estimated that long-term exposure to noise contributes to 48,000 new cases of heart disease and 12,000 premature deaths every year, while 22 million people suffer severe annoyance and 6.5 million experience severe sleep disturbance. Moreover, it is estimated that 12,500 children may suffer learning impairment every year due to aircraft noise alone (EEA, 2019b).



In Ireland, most recent data indicate that 14.4 per cent of the urban population (equivalent to about 430,000 people, based on the Central Statistics Office 2016 census) are exposed to road noise levels above the Environmental Noise Directive (2002/49/EC) guideline values (EEA, 2019b). This indicates that a substantial portion of the population may be experiencing some adverse effects on health and wellbeing caused by noise. Transport-related noise impact is addressed in Ireland through the implementation of the Environmental Noise Directive, and Chapter 4 includes a more detailed overview of the requirements under that Directive and information on what is currently being done to tackle environmental noise.

From a human health and wellbeing perspective, the issue of environmental noise requires action on two fronts: firstly, the proactive management of noise that is likely to have a significant negative impact on health and wellbeing; and, secondly, the preservation and increased provision and accessibility to designated quiet areas, particularly in areas with a high population density. These are areas that are 'largely undisturbed by noise from traffic, industry or recreational activities' (EEA, 2014). Quiet areas are important in providing a haven of natural soundscape for citizens, particularly in urban areas, as well as benefiting biodiversity (EEA, 2014). Public parks and other green and blue spaces often represent more tranquil environments that not only provide a buffer against excessive urban noise but also provide a multitude of additional benefits that can improve our health and wellbeing, e.g. attenuating air pollution, reducing flood risk, reducing excessive temperatures.

Objective 65 of the government's National Planning Framework 2040 recognises environmental noise and proposes measures to more proactively manage noise given the anticipated urban growth (particularly residential) in the coming years. Effective implementation of this objective through national noise planning guidance and noise action plans, coupled with continued implementation of the Environmental Noise Directive, will be essential if meaningful progress is to be made in reducing the population's exposure to excessive environmental noise.



Chemicals in the Environment

People are chronically exposed to a multitude of environmental chemicals in their everyday lives from various sources and through multiple pathways posing potential risks to their health and their environment.

Today, many chemicals play a hugely beneficial role in our lives, e.g. medicines for treating illnesses, pesticides and herbicides used in agriculture, solvents used in the electronics industry, and substances used as flame retardants in furnishings. However, when chemicals end up in the wrong products or places, including our environment, they can cause harm. Currently, there are approximately 35,000 chemicals either manufactured in or imported into the EU in quantities greater than 1 tonne per year. Of these, about 60 per cent are considered, to some degree, to pose potential risks to human health and/or the environment. In general, there is limited knowledge of the nature and extent of the effects of chemical pollution on human health and the environment, and it has been suggested that the contribution of chemical pollution to the global burden of disease is likely to be underestimated (Landrigan *et al.*, 2017). With projected increases in the production of chemicals, continued emissions of hazardous and persistent chemicals and increased use of pharmaceuticals because of an ageing population, it is deemed unlikely that the burden chemicals put on health and the environment will decrease in the near future (EEA, 2019b).

People are chronically exposed to a multitude of chemicals in their everyday lives from various sources and through multiple pathways, e.g. consumption of contaminated food or water, breathing polluted air and dust, and direct contact with certain materials. The categories of chemicals to which the EU is paying particular attention are outlined in Topic Box 14.4.



Topic Box 14.4 Categories of chemicals of concern

Pharmaceuticals and veterinary products

Effective treatment of many illnesses depends on access to pharmaceuticals, yet pollution caused by some pharmaceuticals is of growing concern. The metabolic and/or chemical stability of certain pharmaceuticals means that the vast majority (up to 90% in some cases) of the active ingredient can be excreted unmetabolised and enter wastewater treatment plants and our environment. Of particular concern is the presence of antibiotics, which are extensively used in human and veterinary medicine. The release of these antimicrobials and of antimicrobial-resistant microbes from humans and animals into the environment can accelerate the development and dissemination of antimicrobial resistance, which is an issue of global concern.



Endocrine disruptors

Endocrine disruptors are chemicals that interfere with the normal working of the hormone systems of humans and animals. Hormones control a large number of vital body functions and processes such as energy levels, reproduction ability, regulation of growth and development and responses to stress and injury. Endocrine disruptors include a wide range of substances, e.g. some pharmaceuticals, pesticides and other industrial chemicals. Many endocrine disruptors, e.g. phthalates, have been used extensively in manufacturing products such as cosmetics, toys and fabrics. In 2018, the European Commission published a communication for a comprehensive European framework on endocrine disruptors (EC, 2018), which sets out a strategic approach to ensure that European citizens and the environment are protected from these chemical substances. It is anticipated that many of the actions proposed in the Communication will be incorporated into the Commission's proposed Chemicals Strategy, being developed as part of the commitments set out in the European Green Deal.

Persistent organic pollutants

Persistent organic pollutants (POPs) are substances that are chemically very stable, that bioaccumulate in the food web and that pose risks to human health and the environment. Most POPs are synthetic, e.g. pesticides (such as DDT) and flame retardants, while others are produced unintentionally e.g. dioxins (through activities such as the uncontrolled burning of waste). As their name suggests, these chemicals can persist for very long periods. Certain POPs such as the PFAS, which are extensively used as stain repellents in common household items and in firefighting foams, have been referred to as 'forever chemicals' given their highly persistent nature. Human exposure to certain POPs has been associated with adverse effects such as immunotoxicity and neurotoxicity (Gascon *et al.*, 2013). Ireland is a signatory to the United Nations Stockholm Convention, which sets out, *inter alia*, measures to eliminate the use and release of harmful POPs.

Ozone-depleting substances and fluorinated greenhouse gases

The ozone layer is a natural band of gas in the upper atmosphere (the stratosphere) protecting humans and other animal life from harmful UV radiation from the sun. A group of substances called ozone-depleting substances (ODSs), once widely used in refrigeration, air conditioning and firefighting systems, have depleted the ozone layer. The hole in the ozone layer caused by ODSs has resulted in higher than normal exposure to UV radiation in certain parts of the globe. The additional exposure to UV radiation can have a number of serious consequences for health such as increased risk of skin cancer and eye cataracts and suppression of the immune system. Consequently, the use of ODSs has been severely restricted and in some cases banned. It is notable that, from a climate change perspective, many of the substances introduced to replace ODSs have a very high global warming potential and are themselves being phased out under the F-gas Regulations (EU No 517/2014) and the United Nations Montreal Protocol.



Humans and other organisms in the environment are exposed to chemical mixtures that can interact and have additive or synergistic 'cocktail' effects, thereby exerting a greater impact than a single chemical in isolation. The risk assessment approach used under the chemicals legislation is primarily centred around single substances. A paradigm shift in the approach to risk assessment and regulation of chemicals is urgently needed – one centred more around chemical mixtures and families/groups of certain chemicals, thereby preventing regrettable substitutions (i.e. replacing a banned chemical with an alternative that may have similar or worse effects on health) (Swedish Government, 2019). While hugely challenging and complex, efforts are being made towards achieving this ambition. For example, the European Food Safety Authority (EFSA) recently published guidance on harmonised methodologies assessing the risks of combined exposure to multiple chemicals for human health, animal health and the environment (EFSA Scientific Committee, 2019). In addition, from a regulatory standpoint, there have been new restrictions on the placing on the market of articles containing four phthalates, which probably have serious effects on health because of their endocrine-disrupting properties.

However, the issue of legacy chemicals, i.e. those that are no longer used or manufactured but persist in the environment or are contained in old products, remains of concern, particularly in the context of Europe's ambition to achieve a more circular economy. From the chemical perspective, there is a risk of unintended adverse health impacts resulting from reusing or recycling products containing hazardous and/or legacy chemicals that were sold before restrictions were in place. These chemical substances can be difficult and costly to detect and remove. This issue and its role as a potential barrier to the circular economy has been explicitly recognised in the EU Action Plan for the Circular Economy (EC, 2015). The Action Plan is thus committed to 'the promotion of non-toxic material cycles and better tracking of chemicals of concern in products to facilitate recycling and improve the uptake of secondary raw materials'. This commitment to a toxin-free zero-pollution environment is also embraced in the EU Commission's current strategy, the European Green Deal. As part of the implementation of the Circular Economy Action Plan, the revised Waste Framework Directive (2008/98/EC), which came into force in 2018, tasked the European Chemicals Agency (ECHA) with establishing a database to collect information on products containing certain hazardous substances. Companies that produce, import or supply articles containing designated hazardous substances that are to be placed on the EU market must submit this information for inclusion in the database. Due to be rolled out in January 2021, it is anticipated that the SCIP database³

[Substances of Concern In articles as such or in complex objects (Products)] will help to decrease the generation of waste containing hazardous substances, improve waste treatment operations and allow authorities to better monitor the use of substances of concern in articles and take appropriate action where needed.



Plastic Pollution

We are now in a situation in which plastic pollution has reached every corner of our planet and plastic is one of the most widespread and persistent environmental pollutants we face today.

Plastics are chemical polymers. The durability, adaptability and relatively low cost of plastic have seen its widespread use within modern society over the past 70 years, and plastic is now one of the most ubiquitously used materials in everyday life. However, the consequences of such mass production and extensive use, particularly in terms of waste management of plastics and the generation of plastic debris, were not anticipated. The result means that plastic pollution has reached every corner of our planet and plastic is one of the most widespread and persistent environmental pollutants we face today.

Of particular concern is the issue of microplastics – small plastic particles less than 5 mm in length. Microplastics can be intentionally manufactured as additives for various consumer products, such as cosmetics and cleaning products, but can also be formed from the breakdown of larger plastic products, shed from synthetic clothing during washing and produced by car tyres during abrasion while driving. The pathway by which such contaminants reach our water environment is relatively clear (e.g. urban run-off, industrial effluent discharges, breakdown of marine litter), but new research by Roblin *et al.* (2020) has identified the presence of microplastics in the air we breathe, including at remote locations on the west coast, implying the global nature of this challenge.

³ <https://echa.europa.eu/scip-database>



In addition to the consequences of physical ingestion of microplastics by marine and freshwater biota, and indeed humans, the role that microplastics play as a vehicle for, and potential source of, other harmful chemicals and microorganisms may be of particular concern from human and ecological health perspectives. Hazardous chemicals, including a wide range of endocrine disruptors, heavy metals and pathogenic bacteria, have been found to be associated with microplastics. Hazardous chemicals may have been intentionally or unintentionally added during the production process, may have arisen during the recycling process or may have been already present in the environment and simply absorbed onto the surface of the plastic (Gallo *et al.*, 2018). Humans are exposed to chemicals from plastic, and the potentially hazardous 'hitchhikers' they contain, many times a day by a number of routes.

In response to rising concern, the WHO recently undertook an extensive analysis of published research related to microplastics in drinking water and concluded that, of the three forms of potential hazards associated with microplastics (i.e. physical particles, chemicals and pathogenic bacteria as biofilms), the chemicals and microbial biofilms associated with plastic particles are currently of low concern for health (WHO, 2019). While there was insufficient evidence to draw firm conclusions on the hazard from and potential toxicity of the physical plastic particles themselves, they are currently not deemed to be a concern for health. The need for further research to advance our understanding and provide more accurate assessments of exposure to, and the health impact of, microplastics was highlighted.

As noted by the WHO, water suppliers have an additional role to play in implementing effective control measures and treatment processes that prioritise the removal of microbial pathogens and chemicals, as this will have the added benefit of simultaneously removing plastic particles.

Plans for restrictions on the use of plastics have already been initiated at national and EU level, e.g. the EU Single Use Plastics Directive (2019/904). At the request of the European Commission, ECHA has prepared a restriction dossier under the EU REACH Regulation (Regulation on the Registration, Evaluation, Authorisation and Restriction of Chemicals), which will target intentionally added microplastics in a wide range of consumer and professional products including paints, construction materials and medicinal products. If adopted, it is estimated that these restrictions could see a reduction in microplastic emissions of 400,000 tonnes over 20 years. Ireland's Department of Housing, Local Government and Heritage has legislated to prohibit the manufacture, import, export, sale and supply of certain personal care and cleaning products containing plastic microbeads.

Towards a Zero-pollution Ambition for a Toxic-free Environment

The vision of attaining a non-toxic environment is one that continues to be prioritised at a European level, most recently through the ambitions of the European Commission's European Green Deal.

Chemicals policies have spawned a wide range of regulations aimed at limiting damage to the environment and human health (Collins *et al.*, 2020). The ambitious vision of attaining a non-toxic environment is one that continues to be prioritised at a European level. The Seventh Environment Action Programme set out the EU's ambitious long-term vision of attaining a non-toxic environment by providing a safer, cleaner environment where the risks posed by chemicals are minimised.

Furthermore, as part of the European Commission's European Green Deal (EC, 2019), launched in December 2019, there will be a considerable step-up in action on chemicals. As part of this action, to ensure a 'toxin-free environment' and eliminate pollution, the Commission plans to present a chemicals strategy for sustainability that aims to better protect citizens and the environment from hazardous chemicals and also to encourage innovation in developing safer and more sustainable alternatives. A zero-pollution action plan for air, water and soil has also been proposed.

One area in which Ireland risks not achieving a zero-pollution and non-toxic environment is land-spreading of sewage sludge from wastewater treatment plants. Sewage sludge which is a thick, soft mix of solid and liquid matter left over from the treatment process, is rich in nutrients and is used as a soil enhancer or fertiliser on agricultural land. Irish Water estimates that the quantities of sewage sludge generated nationally (currently 58,630 tonnes dry solids) will increase by more than 80 per cent by 2040 as new wastewater treatment plants are established and existing ones upgraded.⁴ While sewage sludge is treated before being spread on land to ensure that certain contaminants are removed, an EPA-funded research project (Healy *et al.*, 2017) found that many non-priority metals and contaminants of emerging concern (e.g. phthalates) that are potentially harmful to health, but are not currently legislated for, may be applied repeatedly to land, potentially accumulating in soils and entering the food chain and our surface waters through run-off.

The EPA routinely monitors surface waters across Ireland for a range of priority and priority hazardous substances, including herbicides, insecticides, polyaromatic hydrocarbons, solvents and metals, under its Water Framework Directive (2000/60/EC) monitoring programmes. Environmental quality standards (EQSs)

⁴ <https://www.water.ie/projects-plans/our-plans/wastewater-sludge-management/Final-NWSMP.pdf>



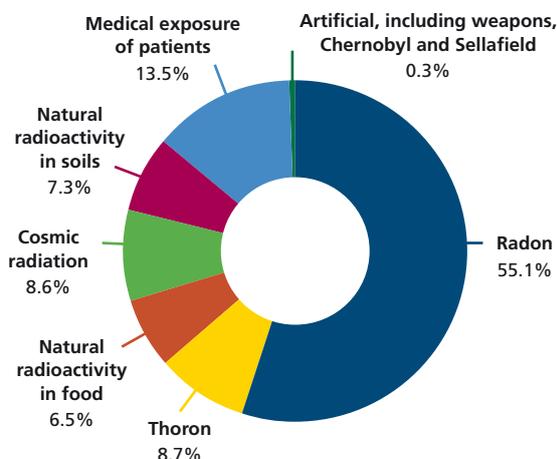
for each of these substances have been established at a European level. Work is commencing on identifying new chemicals of emerging concern of regional or local importance for Ireland (river basin-specific pollutants), which will establish national EQSs and new monitoring programmes.

Radioactivity

Exposure to radon is the most significant cause of exposure to radiation for the Irish public: other sources of radioactivity in the Irish environment do not pose a significant risk to public health.

Natural radioactivity in our environment is made up of both cosmic radiation, which originates in outer space, and geological radiation, which comes from the long-lived radionuclides present in rocks and soil from the time of the formation of the Earth. Artificial radiation in the environment originates from its use in medical diagnosis and treatment and the operation of nuclear power plants and reprocessing plants. Past accidents at nuclear installations and atmospheric nuclear weapons tests are also sources of artificial radionuclides in the environment. The most significant source of artificial radionuclides in the Irish marine environment is discharges from the Sellafield nuclear fuel reprocessing plant in Cumbria. However, the radiation exposure from Sellafield discharges represents only a very small fraction of the overall average annual dose received by a person in Ireland, as shown in Figure 14.7.

Figure 14.7 Sources of radiation. The most significant contribution to human exposure to radioactivity is from naturally occurring radon gas (Source: EPA)

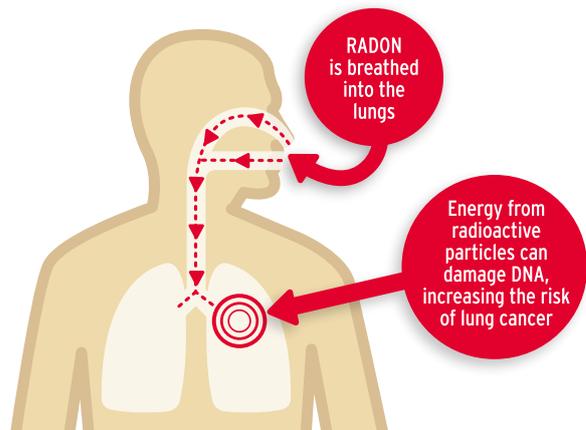


Radon

Indoor radon exposure remains a significant public health concern for the Irish population and is the second leading cause of lung cancer in Ireland.

Radon is a radioactive gas formed in the ground by the radioactive decay of uranium, which is present in all rocks and soils. Radon is diluted to very low concentrations outdoors; however, it can build up to high concentrations inside buildings. Ireland has a more significant radon problem than many of its European neighbours. This is mostly due to its geology and partially due to its climate. Radon is an invisible, colourless and tasteless gas that is carcinogenic and is linked to the development of 300 cases of lung cancer each year in Ireland (Figure 14.8) (Dempsey *et al.*, 2018b). It is also associated with certain kinds of skin cancer (Wheeler *et al.*, 2012).

Figure 14.8 Radon damages the lungs, increasing the risk of lung cancer (Source: EPA, www.radon.ie)



The EPA has tested over 60,000 homes and identified about 9000 homes that are above a level of natural radioactivity that is considered safe from the perspective of the occupier's health. However, it is estimated that about 160,000 homes are above this safe reference level in Ireland. High radon concentrations can be found in any part of the country; however, the EPA has categorised certain areas that are more prone to radon as high-radon areas. The EPA's interactive map, available at <https://www.epa.ie/radon/>, will show whether a building is in a high-radon area and provide information on testing and remediation.

The most cost-effective way of protecting the population against radon is the correct installation of passive prevention systems in new buildings. EPA-funded research reveals that implementing the building regulations relating to radon prevention has resulted in a 13 per cent reduction in average radon concentrations in Irish homes (McGrath and Byrne, 2019).



Topic Box 14.5 Radioactivity Monitoring Programme

Artificial radioactivity in the Irish environment has been routinely monitored since 1982. These data show that, although the levels of artificial radionuclides in the Irish environment are detectable, they are low and do not pose a significant risk to the health of the Irish population. The results of this monitoring are publicly available on the EPA's website.⁵ The main elements of the EPA's radioactivity monitoring programme are outlined below.

The National Radiation Monitoring Network

This is a network of 21 stations across Ireland that constantly monitor radiation levels in the environment, with the support of Met Éireann, local authorities and the defence forces. Rainwater and aerosol samples from these stations are measured in the laboratory, while data from online gamma dose-rate monitors are sent live to the EPA's website and international reporting systems. This network ensures that Ireland receives the first measurements in the event of a radioactive 'cloud' reaching the country. The network plays an important role in the National Plan for Nuclear and Radiological Emergency Exposures.

The Marine Monitoring Programme

The EPA carries out its Marine Monitoring Programme to determine the levels of radioactivity in the marine environment. Samples of seawater, seaweed, sediment, fish and shellfish are collected from fixed locations around the coast, in the Irish Sea and from fishing ports. These data provide a baseline against which measurements can be compared and will enable elevated radiation values to be identified quickly.

Radioactivity in food products and drinking water

Samples of drinking water, milk, 'complete meals', cereals and individual foodstuffs are also collected and analysed for radioactivity. The data collected are used to calculate the radiation doses received by the Irish population from artificial radioactivity. These are small compared with those received as a result of natural radiation and do not constitute a significant health risk.

Non-ionising Radiation

According to the World Health Organization, no health effects have been identified for electromagnetic fields exposure at levels below the guidelines set for members of the public.

In May 2019, the EPA was given responsibility for monitoring public exposure to non-ionising radiation as well and providing advice to the Minister for the Environment, Climate and Communications and general information to the public. Non-ionising radiation is more commonly referred to as electromagnetic fields (EMFs), which are needed for all forms of telecommunications (mobile phones, Wi-Fi, Bluetooth, etc.) and are produced when electricity is generated, transmitted and used (Figure 14.9). Other bodies and agencies involved in this area of activity include the Department of Environment, Climate and Communications, Commission for Communications Regulation, Health and Safety Authority and ESB.

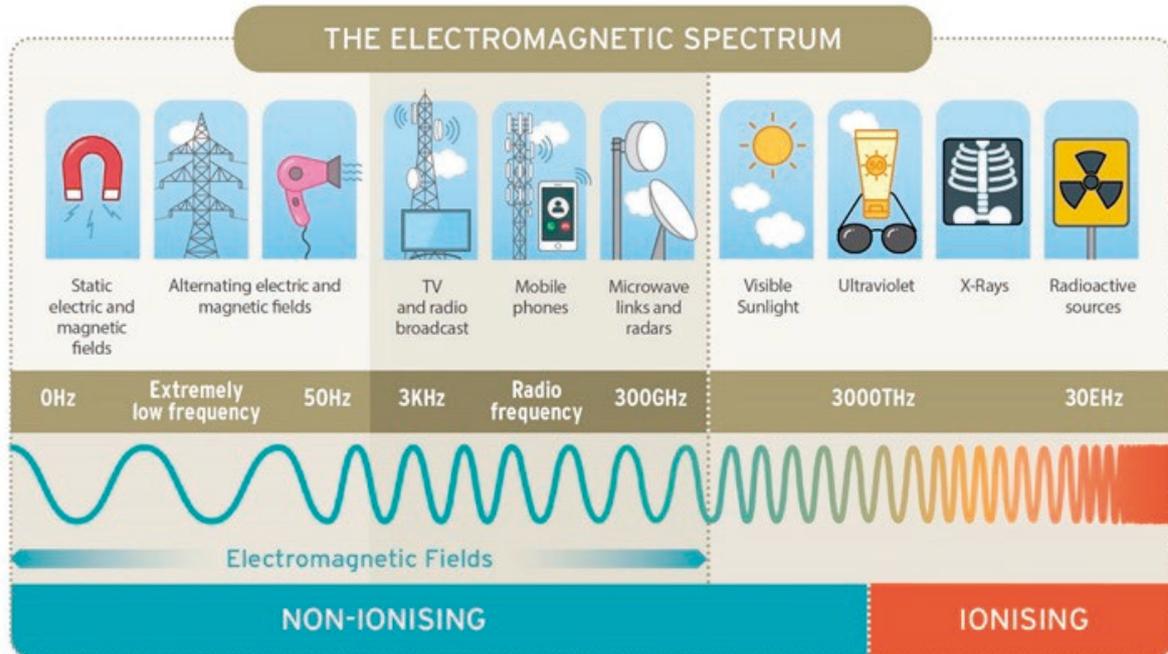
Typical EMF levels in Ireland are low and well below the levels set in the international recommendations for members of the public. The introductions of new technologies, such as 5G, may result in a slight increase but the total exposure is expected to remain low with no consequences for public health.

According to the WHO, no health effects have been identified for EMF exposure at levels below the guidelines set for members of the public. This conclusion is in line with the 2015 report *Electromagnetic Fields in the Irish Context*, prepared on behalf of the Irish Government by the National Institute for Public Health and the Environment of the Netherlands (RIVM, 2015). The effects of radiofrequency EMFs, including the frequencies used and envisaged for 5G, have been subject to significant research. No health effects have been shown at levels below the ICNIRP guidelines for members of the public; therefore, no consequences for public health are expected from exposure to 5G. The EPA works closely with the WHO on EMF issues, and has published a public information pamphlet on 5G (EPA, 2020f).

⁵ <http://www.epa.ie/radiation/monassess/per/>



Figure 14.9 Non-ionising radiation and the electromagnetic spectrum (Source: EPA)



OSPAR Monitoring of Radiation in the Marine Environment

Tracking discharges of radioactive substances and concentrations of radionuclides in the marine environment is covered in the OSPAR Convention.

Ireland is one of 16 Contracting Parties to the 1992 Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention). The Oslo-Paris Commission's 2010-2020 Strategy for the Protection of the Marine Environment of the North-East Atlantic has identified five areas of interest to maintain the region's ecosystem. One of these involves preventing the pollution of the North-East Atlantic by ionising radiation through progressive and substantial reductions in discharges, emissions and losses of radioactive substances. The EPA collates and reports data on annual discharges of radioactive substances from licensed facilities and annual concentrations of radionuclides in the marine environment. While levels of artificial radioactivity in the Irish marine environment remain detectable, they are low and broadly consistent with levels reported previously, posing no risk to the health of the Irish population.



4. Global Issues – Local Challenges

Ireland is not alone in working on developing solutions for some of the most significant environmental, health and wellbeing challenges it currently faces. Antimicrobial resistance, air pollution, climate change and urbanisation pose considerable threats to Irish society and the global population. While global action is often key to enabling a coordinated and accelerated response across nations, it is essential that national solutions and individual actions are developed in tandem to address issues at a local level.

Antimicrobial Resistance

The issue of antimicrobial resistance is now one of the most serious global concerns affecting human health. The environmental dimension of antimicrobial resistance is now receiving more attention.

Widespread and excessive use, overuse and misuse of antimicrobial agents, particularly antibiotics, has significantly contributed to the development, spread and evolution of antimicrobial resistance (AMR) worldwide. AMR occurs when microorganisms such as bacteria, viruses and fungi develop the ability to resist the action of the drugs (antimicrobials such as antibiotics, antivirals and antifungals) designed to combat them and are capable of multiplying in their presence. Antibiotics enter the environment through discharges from human sewage treatment plants and septic tanks, as well as through farm animal excreta. It is unfortunately commonplace that antimicrobials that were relied on and effective 20 years ago now fail. The report on the O'Neill review of AMR (UK Government and Wellcome Trust, 2016) estimated that, by 2050, AMR infections may become the leading cause of deaths globally.

'A post-antibiotic era means, in effect, an end to modern medicine as we know it.' – Dr Margaret Chan, Former WHO Director-General

The environmental dimension of AMR, as reported by Gaze and Depledge (2017), is not well understood, in particular the complexity of interactions in the wider environment. Our water, soil and air are extremely vulnerable to discharge and release of antimicrobials and resistant microorganisms, as well as other resistance-promoting chemicals, such as biocides and heavy metals, through various routes. They also represent important potential routes of transmission of AMR to humans, animals and the food chain. The pivotal role that the environment plays in the persistence and dissemination of AMR is now being recognised; however, the extent of its role represents a significant knowledge gap. Insights are lacking on its attributional role in the selection and spread of AMR, its impact on human, animal and ecological health and on management and remediation strategies to curb its further evolution.

AMR is of such concern at a national level that it has been identified as a strategic risk to Ireland's future wellbeing in the Irish Government's National Risk Assessment since it was first published in 2014. Ireland's first National Action Plan on AMR (iNAP; Figure 14.10) was published in 2017 (Government of Ireland, 2017) and recognises that joint coordinated action is needed to deal with the threat of AMR to public health, animal health and the environment. The plan represents an ambitious 3-year multi-stakeholder effort to implement actions to prevent, monitor and combat AMR across the health, agricultural and environmental sectors in Ireland, which is consistent with the requirement of a One Health approach to tackling the issue of AMR.





Figure 14.10 Ireland’s first National Action Plan on AMR (iNAP) (Source: Government of Ireland, <https://www.gov.ie/en/publication/ec1fdf-irelands-national-action-plan-on-antimicrobial-resistance-2017-2020/>)

		<p>STRATEGIC OBJECTIVE 1: Improve awareness and knowledge of AMR</p>
<p>IRELAND'S NATIONAL ACTION PLAN ON ANTIMICROBIAL RESISTANCE 2017 - 2020</p>		<p>STRATEGIC OBJECTIVE 2: Enhance surveillance of antibiotic resistance and antibiotic use</p>
		<p>STRATEGIC OBJECTIVE 3: Reduce the spread of infection and disease</p>
		<p>STRATEGIC OBJECTIVE 4: Optimise the use of antibiotics in human and animal health</p>
		<p>STRATEGIC OBJECTIVE 5: Promote research and sustainable investment in new medicines, diagnostic tools, vaccines and other interventions</p>

The first detection of the AMR bacteria carbapenemase-producing Enterobacterales (CPE) in European seawater was reported in Ireland in 2017 (Mahon *et al.*, 2017). Untreated sewage discharged in the area was found to be the likely source of the CPE detected in this study. CPE is currently one of the superbugs that is most difficult to treat and, in October 2017, it was declared a public health emergency in Ireland.⁶ Sewage, which contains pooled urine and faeces from the surrounding population, is a significant transmission route of AMR to the environment. This finding again highlights the absolute urgency and increased pace required for Irish Water to address the major issue of untreated sewage from the equivalent of 77,000 people being released into the Irish environment every day.

In October 2019, the European Centre for Disease Prevention and Control and the European Commission’s Directorate-General for Health and Food Safety carried out a country audit to review policies and activities relating to AMR in Ireland. The EPA, with support from the Department of Housing, Local Government and Heritage, arranged a dedicated environment-focused day that provided a broad overview of progress and goals in various areas relevant to the international audit delegation. The unpublished report concluded that: ‘In general, the commitment of actors, in all sectors and at all levels, to the control of AMR in Ireland is a positive example for other countries. There has been progress in AMR control on many levels and, while AMR will likely remain a significant

challenge for the country, there are several achievements to build upon for future actions.’ More specifically for the environmental sector, the report concluded that: ‘In relation to the environmental sector, the monitoring of watch list substances under the Water Framework Directive is being carried out. The competent authorities are also working to address the issues with the quality of the water supply, untreated wastewater and the correct disposal of medicines. Additionally, the environmental and veterinary sectors have undertaken multiple actions on awareness raising, surveillance of AMR and research.’

Monitoring antimicrobial use and resistance trends is vital to inform policy developments and monitor the impact of interventions over time. While there is established surveillance of antimicrobial use and AMR in the human and animal health sectors (Government of Ireland, 2019a), there is currently a lack of systematic surveillance of antimicrobials and AMR in the environment, other than the EU Water Framework Directive ‘watch list’, which all Member States currently undertake to monitor. This means that there are no baseline data on which to track changes or assess the extent of AMR in the environment. Ireland is not alone in this regard and has an opportunity to take action on this. A systematic surveillance system for AMR in the environment, integrated with existing human and animal surveillance systems, would be a solid basis for safeguarding the health of humans, animals and ecosystems against the threat of AMR.

⁶ <https://www.hse.ie/eng/about/who/healthwellbeing/our-priority-programmes/hca/european-antibiotics-awareness-day/public-health-emergency/>



Climate Change

Climate change has a wide range of direct and indirect impacts on physical health, as well as psychological and wellbeing effects. There has been a considerably rise in 'eco-anxiety' among the public because of the magnitude of this issue.

Climate change is one of the greatest challenges facing the health of our society. Without action, climate change will undoubtedly have profound and wide-ranging impacts on human health and wellbeing and has the potential to challenge the substantial health gains we have achieved over recent decades (EASAC, 2019). Climate change can have direct impacts on health through physiological effects and injuries or death due to severe weather extremes such as heat waves, cold snaps, flooding, storms and increases in UV radiation levels affecting the occurrence of skin cancers. Indirect effects of climate change brought about by ecological changes can result in the spread of vector-borne and climate-sensitive infectious diseases, cause food and water insecurity, enhance the effects of aeroallergens (such as pollen and mould spores), increase the adverse impact of air pollutants and reduce air quality and cause population displacement (WHO, 2018). In addition to the physical health impacts, climate change is already having profound impacts on psychological wellbeing and mental health (Hayes *et al.*, 2018). These effects are particularly felt by those living in ecologically sensitive areas such as those prone to flooding. However, there is now also a recognised rise in 'eco-anxiety' among the general public, brought about by a sense of despair and distress around the scale and magnitude of the threat we face.

'The impact of climate change will be felt by every individual, household, and community across Ireland.'
– Climate Action Plan, 2019

The 2018 Intergovernmental Panel on Climate Change (IPCC) Special Report on global warming of 1.5°C (IPCC, 2018) highlighted that global warming is likely to reach 1.5°C above pre-industrial levels between 2030 and 2052, should temperature continue to rise at its current rate. There is considerable confidence that there will be a wide range of negative health consequences associated with such a rise in temperature, which could disproportionately affect vulnerable and disadvantaged populations (Ebi *et al.*, 2018). The 2015 Paris Agreement, which is frequently cited as potentially the strongest health agreement of this century, makes the 'right to health' a fundamental principle guiding action on climate change and sustainable development (WHO, 2018).

In addition to direct effects there are indirect health effects of climate disruption. Research by Flood *et al.* (2020) identifies that the likely future impacts of climate change in Ireland in terms of physical changes relate to temperature, precipitation and sea level rise, with the most prominent risks associated with projected increases in extreme weather conditions and an increased likelihood of river and coastal flooding. This research undertook a preliminary economic assessment of the potential impacts of climate disruption and has highlighted those risks with the potential to cause substantial disruptions to economic activity. These include the costs of disruptions to essential services including threats to critical infrastructure that supports health such as drinking water supply and treatment, and waste water treatment, and power supply.

From a national perspective, the government's National Adaptation Framework 2040 requires the preparation of sectoral adaptation plans, including a plan for the health sector.⁷ The current plan will focus on a number of climate scenarios with profound health implications, namely increased exposure to UV radiation and the sun, worsening air pollution and severe weather events. Moreover, the government's Climate Action Plan,⁸ launched in 2019, sets ambitious targets to achieve Ireland's, and the EU's, ambition to reach climate neutrality by 2050.

On an individual basis, there is much that can be achieved in our own households to help to combat climate change. These actions may also have a multitude of co-benefits for our health and wellbeing and for the wider environment. Simple actions include leaving cars at home and walking, cycling or taking public transport, considerably reducing the amount of food waste we generate by planning our meals and buying only what we need, consuming a more balanced diet rich in plant-based foods and eating less red and processed meats, as well as using cleaner fuels for home heating and improving the overall energy efficiency of our homes to reduce the need for heating.

⁷ <https://assets.gov.ie/38322/fd5750277357421cb2472687e9b33d8f.pdf>

⁸ <https://www.gov.ie/en/publication/ccb2e0-the-climate-action-plan-2019/>



Loss of Ecosystems and Biodiversity

Healthy ecosystems provide essential food and biomass, help maintain the quality of our water, soils and air, regulate floods, absorb greenhouse gases and protect us from increasingly extreme weather patterns.

Biodiversity matters for a whole variety of reasons: ethical, emotional, environmental and economic. It is the very foundation of our society and the basis of our economic success and wellbeing (EC, 2008). Despite many strategies and targets, Europe continues to lose biodiversity at an alarming rate and the aims of many policies will not be achieved (EEA, 2019b). The cumulative pressures of climate change, chemical use, emissions to air and water, exposure to noise, unsustainable resource use and excessive consumption, land use and urban expansion all act to increase vulnerability and accelerate deterioration. The World Economic Forum reports that biodiversity loss and ecosystem collapse are one of the biggest threats facing humanity in the coming decade (WEF, 2020). The health and wellbeing of our society and our economy depend on the services of our ecosystems; accordingly, the chronic degradation observed cannot be allowed to endure. In 2019 the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) published a major global assessment on the status of ecosystems and biodiversity. The IPBES Chair, Sir Robert Watson, noted that: 'The health of ecosystems on which we and all other species depend is deteriorating more rapidly than ever. We are eroding the very foundations of our economies, livelihoods, food security, health and quality of life worldwide.' (IPBES, 2019). The IPBES global assessment also reviews the health dividend provided by nature and the risks associated with damage to natural systems. Aside from the obvious dividends, such as clean air, clean water and food provision, it was noted, for example, that 70 per cent of cancer drugs are natural or synthetic products inspired by nature and that approximately four billion people rely primarily on natural medicines.

In May 2020 the European Commission published the latest EU Biodiversity Strategy for 2030, *Bringing Nature Back into our Lives* (EC, 2020), which pledges to show

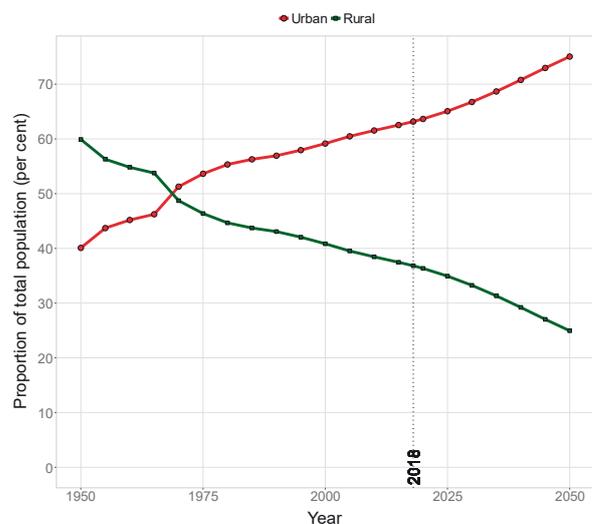
ambition to reverse biodiversity loss, lead the world by example and by action, and help agree and adopt a transformative post-2020 global framework at the 15th Conference of the Parties to the Convention on Biological Diversity. A principal ambition in this new EU strategy is that 'the world should commit to the net-gain principle to give nature back more than it takes'. The health dividend flowing from secure ecosystems and thriving diversity is recognised in Ireland's current National Biodiversity Action Plan 2017-2021 (DCHG, 2017) and also in its National Health Strategy, which notes that delivering a healthier future will result in people living in a health-promoting sustainable environment (Government of Ireland, 2013). In the public consultation for the National Risk Assessment (Government of Ireland, 2019b) biodiversity emerged as a key national risk and as one of the most important priorities cited by respondents.

Urbanisation

Urbanisation is one of the key demographic 'mega-trends' that is shaping and defining our future world.

It is estimated that, by 2050, two-thirds of the global population will live in urban centres. In Ireland, an estimated 63 per cent of the population currently lives in urban areas, and this number is set to rise to over 75 per cent by 2050 (UN, 2018) (Figure 14.11). The population is predicted to increase by 20 per cent to over 5.6 million by 2040 (ESRI, 2018).⁹

Figure 14.11 Predicted percentage of Ireland's population in urban and rural areas, 1950-2050 (Source: UN DESA, Population Division)



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⁹ From 2018 Revision of World Urbanization Prospects ©(2018) United Nations. Reprinted with the permission of the United Nations. <https://population.un.org/wup/Country-Profiles/>.



Urbanisation can support the emergence of obesogenic environments, promoting more sedentary, inactive lifestyles and leading to an increase in obesity, a reduction in physical activity and increased prevalence of chronic diseases.

Obesogenic environment: 'the sum of influences that the surroundings, opportunities, or conditions of life have on promoting obesity in individuals or populations.' – Swinburn et al. (1999)

Other health challenges arising from urbanisation include exposure to excessive noise and poor air quality. Moreover, increased urban living means that there may be fewer opportunities for engaging with our natural environment, which can in itself be detrimental to our physical and mental health. Strong health-centred urban design, policies and planning are therefore vital for Ireland's transition to more compact urban living. Planning policy and practice should commit to prioritising a modal shift away from the currently high dependence on private internal combustion engine-powered motor vehicles to amenities and networks that support more active travel and living. While the government's National Planning Framework 2040 moves towards aligning health considerations and policy within the spatial planning framework, local government has a vital role implementing programmes that promote active living at a community level. Given the rising level of urbanisation and population growth, coupled with the increasing public health burden of obesity and physical inactivity, it is critically important that health-centred design and planning is prioritised and appropriately implemented at local and national levels.

5. Conclusions

Interconnected Solutions

Our health and wellbeing are inextricably linked to our surrounding environment. Many of the issues we face that damage our environment and our health and wellbeing are closely interconnected. Harnessing the co-benefits of solutions is essential for effective and efficient environmental and health protection. Solutions that can help to address one issue can deliver substantial co-benefits for others. For example, providing integrated health-promoting environments in urban planning can promote more active travel, reduce air pollution through the use of fewer private vehicles, act as quiet areas buffered from environmental noise and improve the physical and mental health of those walking or cycling. Moreover, meeting the targets of the Paris Agreement would be expected to save over one million lives globally each year from the effects of air pollution alone by 2050 (WHO, 2018).





Environment Health in All Policies Approach

Developments in government policies have, in the past, led to tension and unintended consequences that have reduced the quality of our environment. Going forward, it is crucial that policies and measures are carefully formulated to maximise synergies, minimise unintended negative consequences and ultimately yield improvements and co-benefits for the environment and the health and wellbeing of our society. Importantly, an 'Environment Health in All Policies' approach should be adopted across government, whereby policies across all sectors must systematically consider the implications of decisions on the environment and human health, capture synergies and prevent negative impacts and inequity in exposures and outcomes. Including public health considerations and co-benefits in environmental policy development is a clear opportunity.

Individual Actions

From an individual perspective, greater action is needed at a household level to proactively tackle the various avoidable health consequences that we and our families face every day. Equally, as individuals, we need to engage more with our green and blue spaces as they offer a multitude of health and wellbeing benefits. While it is clear that the changes and action required to avert major challenges such as climate change, air pollution and plastic pollution use are no doubt beyond the immediate reach of the individual, the influence that individual action or choice can have on others may indeed help lay important foundations for further action and shift society's view of what is considered 'normal'. The importance of small individual actions must therefore not be underestimated.

Specific Environment and Health Challenges

The following are specific environment and health challenges.

- A switch away from solid fuel burning by all householders would ensure a better environment for those vulnerable populations in society, such as people, and particularly children, with asthma. It would also help to limit our carbon dioxide emissions, which are contributing to climate change.
- The incidence of STEC/VTEC in Ireland is the highest in Europe and the number of cases is growing year on year. A coordinated 'One Health' approach (i.e. recognising the interconnection between people, animals, plants and their shared environment) is urgently needed to tackle this issue, particularly in the light of climate change and increasing extreme weather events.
- Improvements are needed at public drinking water supplies identified by the EPA as in need of upgrading, replacement or improved operational control. There is also a need to improve resilience against weather events and climate extremes.
- Irish Water must urgently address the issue of untreated sewage from the equivalent of 78,000 people being released into the Irish environment every day. Wastewater facilities must be established, and infrastructurally and operationally improved, at a much faster pace.
- A formalised national take-back scheme for unused or expired human medicines and legacy contaminants is needed to offer a safe disposal mechanism to the public and prevent unnecessary environmental contamination.
- Consideration should be given to applying stricter limits and standards for a broader range of metals, chemicals and contaminants in sewage sludge, which are subsequently recycled to land, as a proactive step to protect our environment and human health from contaminants of existing and emerging concern.
- Systematic environmental surveillance of antimicrobial use and AMR and of emerging pollutants of concern is required to contribute to protecting human, animal and ecosystem health.
- Exposure to radon results in an estimated 300 cases of lung cancer each year. Research has shown that better building practices have resulted in a 13 per cent reduction in the average radon concentration in Irish homes and that stronger regulation is the most effective way of protecting the population from radon.



Chapter Highlights for Environment, Health and Wellbeing



A good-quality, well-protected environment has significant health and wellbeing benefits; research has shown that access to clean green and blue spaces in our environment is good for us. The provision of health-promoting environments in urban planning is central to Ireland's transition to more compact and urban living.



Greater individual action needs to be taken to proactively tackle avoidable health consequences linked to the environment. Actions include radon testing, testing private wells, maintaining septic tanks, eliminating use of smoky fuels, reducing wasteful consumption, preventing littering and making sustainable commuting decisions.



There are risks to our environment and our health from climate disruption, chemical exposure, and underinvestment in drinking water and wastewater treatment infrastructure. These risks must be addressed through state investment in targeted research, in monitoring and enforcement actions, and through investment by Irish Water in the necessary water services infrastructure.



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Chapter 15

Environmental Performance, Policy and Implementation





Environmental Performance, Policy and Implementation

1. Introduction

The 2016 state of the environment report identified the need to improve the tracking of plans and policies and the implementation of environmental legislation as one of the seven key environmental challenges for Ireland (EPA, 2016). The European Commission recognises that the poor implementation of environmental law and policies has many negative effects, including environmental, economic and social costs, an unequal playing field for economic operators, and the loss of credibility of both national authorities and the European Union (EU). It estimates that the full implementation of EU environmental legislation could save the EU economy around €55 billion every year in health costs and direct costs to the environment (EC, 2019a).



Improve the tracking of plans and policies and the implementation and enforcement of environmental legislation to protect the environment.

This chapter provides a summary assessment of the current state of implementation of environmental legislation, policy, plans and programmes in Ireland and examines the outlook for Ireland in terms of achieving full compliance with commitments and targets within five core policy areas: climate, air, nature, water and waste. Some aspects relating to sustainable development, key global trends and emerging issues are also covered. The chapter concludes with some suggested mechanisms for improving the implementation and integration of environmental policy, plans and programmes in Ireland.

Ireland's Environmental Legislation and Policy Landscape

The majority of Ireland's environmental laws stem from European directives.

Ireland has a range of laws and policies designed to protect air and water, safeguard nature, address climate change and promote the circular economy and sustainable development. Some of the key laws and policies are shown in Figure 15.1. Most of Ireland's environmental laws stem from European directives and regulations (which themselves may stem from United Nations (UN)/ international obligations, such as the Paris Agreement).

They commit Ireland to binding targets and objectives, which are implemented via a range of national plans and programmes, such as the River Basin Management Plan (RBMP), the National Air Pollution Control Programme (NAPCP) and the Climate Action Plan.

Ireland's Sectoral Policies, Plans and Programmes

Successfully integrating environmental considerations into sectoral plans and programmes is challenging. A proactive approach is needed to integrate environmental considerations into all sectoral policymaking.

There is increasing recognition that achieving the desired environmental objectives set for air, water, climate, etc., requires the necessary pollution prevention and control measures and actions to be fully incorporated across sectoral decision-making and policymaking at all levels, including, for example, agriculture, fisheries, built environment, tourism, forestry, energy and transport. Some of the key sectoral plans and programmes currently in place in Ireland are listed in Figure 15.2. The need for greater and more consistent integration of environmental considerations into sectoral policymaking is well recognised (e.g. OECD, 2019; UN, 2019). This issue is discussed further towards the end of this chapter, under 'Improving implementation and integration'.



Aerial view of Galway city



Figure 15.1 Summary of key selected environmental legislation, policies and plans in place in Ireland across the key thematic areas

<p> Climate Action</p> <p>Objectives Reduce greenhouse gas emissions, improve energy efficiency and renewable energy, assess and manage adaptation to climate change</p> <p>Global</p> <ul style="list-style-type: none"> UN Framework Convention on Climate Change Paris Agreement Kyoto Protocol <p>European Directives and Policies</p> <ul style="list-style-type: none"> EU Green Deal 2020 Climate and Energy Package 2030 Climate and Energy Framework Emissions Trading Directive Effort Sharing Regulation Floods Directive EU Strategy on Adaptation to Climate Change LULUCF Regulation (EU 2018/841) <p><i>Draft/in preparation:</i></p> <ul style="list-style-type: none"> EU Climate Law <p>National Policies/Plans</p> <ul style="list-style-type: none"> Climate Action and Low Carbon Development (Amendment) Bill 2020 Climate Action Plan (2019) National Mitigation Plan (2017) National Adaptation Framework (2018) National Policy Position on Climate Action and Low Carbon Development (2013) Climate Action and Low Carbon Development Act (2015) Sectoral adaptation and mitigation plans (various) National Energy and Climate Plan (2021-2030) <p>Local/regional plans</p> <ul style="list-style-type: none"> Local authority Adaptation Plans (2019) and Low Carbon Roadmaps Flood Risk Management Plans 	<p> Air Quality</p> <p>Objectives Maintain and improve air quality and reduce emissions of specified air pollutants to protect human health and the environment</p> <p>Global</p> <ul style="list-style-type: none"> UN Air Convention (also known as the Convention on Long-range Transboundary Air Pollution) <p>European Directives and Policies</p> <ul style="list-style-type: none"> EU Green Deal Clean Air Package CAFE Directive National Emission Ceilings Directive Emissions directives e.g. Industrial Emissions Directive, Vehicle (Euro) Emission standards, Ecodesign Directive for stoves <p>National Policies/Plans</p> <ul style="list-style-type: none"> National Air Pollution Control Programme (2019) <p><i>Draft/in preparation:</i></p> <ul style="list-style-type: none"> National Clean Air Strategy <p>Local/regional plans</p> <ul style="list-style-type: none"> Low Smoke Zones 	<p> Nature</p> <p>Objectives Protect and conserve Ireland's natural heritage and biodiversity, including designated species and habitats</p> <p>Global</p> <ul style="list-style-type: none"> Convention on Biological Diversity and associated Strategic Plan for Biodiversity 2011-2020 Bonn Convention Ramsar Convention on Wetlands of International Importance Convention on International Trade in Endangered Species of Wild Fauna and Flora <p>European Directives and Policies</p> <ul style="list-style-type: none"> EU Green Deal Habitats Directive Birds Directive EU Biodiversity Strategy for 2030 Marine Strategy Framework Directive <p>National Policies/Plans</p> <ul style="list-style-type: none"> National Biodiversity Action Plan (2017-2021) All-Ireland Pollinator Plan (2015-2020) National Peatlands Strategy 2015 National Raised-Bog SAC Management Plan 2017 <p>Local/regional plans</p> <ul style="list-style-type: none"> Local authority Biodiversity Action Plans and Green Infrastructure Strategies
<p> Water Quality</p> <p>Objectives Improve and maintain good water quality, including groundwater, rivers, lakes, estuaries, coastal waters and bathing waters</p> <p>Global</p> <ul style="list-style-type: none"> OSPAR Convention MARPOL Convention <p>European Directives and Policies</p> <ul style="list-style-type: none"> Water Framework Directive Marine Strategy Framework Directive Bathing Water Directive Groundwater Directive Nitrates Directive Urban Waste Water Treatment Directive <p>National Policies/Plans</p> <ul style="list-style-type: none"> River Basin Management Plan (RBMP) (2018-2021) Nitrates Action Programme Marine Strategy Framework Directive Programme of Measures <p>Local/regional plans</p> <ul style="list-style-type: none"> Priority areas for action (under the RBMP) 	<p> Waste and Circular Economy</p> <p>Objectives Reduce waste generation, improve waste management and promote more efficient resource use</p> <p>Global</p> <ul style="list-style-type: none"> Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal <p>European Directives and Policies</p> <ul style="list-style-type: none"> EU Green Deal Circular Economy Action Plan Waste Framework Directive Individual producer responsibility directives on Packaging, WEEE, End-of-life Vehicles, Batteries and Accumulators, etc. Landfill Directive Waste Shipment Regulation Single-use Plastics Directive <p>National Policies/Plans</p> <ul style="list-style-type: none"> National Waste Policy 2020-2025, A Waste Action Plan for a Circular Economy Climate Action Plan (2019) National Waste Prevention Programme (last reviewed 2018) National Hazardous Waste Management Plan (2014-2020) <p>Local/regional plans</p> <ul style="list-style-type: none"> Regional Waste Management Plan 2015-2021 Litter management plans 	<p> Cross-cutting and Integrated Environmental Assessment</p> <p>Objectives Improve environmental protection and promote sustainable development</p> <p>Global</p> <ul style="list-style-type: none"> UN Sustainable Development Agenda 2030 Landscape Convention <p>European Directives and Policies</p> <ul style="list-style-type: none"> EU Green Deal Industrial Emissions Directive Strategic Environmental Assessment Directive Environmental Impact Assessment Directive Environmental Liabilities Directive Common Agricultural Policy <p>National Policies/Plans</p> <ul style="list-style-type: none"> National Implementation Plan for the Sustainable Development Goals (2018-2020) Our Sustainable Future (2012) Project Ireland 2040 National Landscape Strategy EPA Enforcement and Compliance Policy <p>Local/regional plans</p> <ul style="list-style-type: none"> Local authority Landscape Character Assessments

CAFE, Clean Air for Europe; LULUCF, land use, land use change and forestry; MARPOL Convention, International Convention for the Prevention of Pollution from Ships; OSPAR Convention, Convention for the Protection of the Marine Environment of the North-East Atlantic; SAC, Special Area of Conservation; WEEE, waste electrical and electronic equipment.



Figure 15.2 Overview of some of the important sectoral policies, plans and programmes in place in Ireland

 <p>Built Environment</p> <p>National</p> <ul style="list-style-type: none"> National Planning Framework/Project Ireland 2040 <p>Regional</p> <ul style="list-style-type: none"> Regional Spatial and Economic Strategies <p>County/city</p> <ul style="list-style-type: none"> County and city development plans <p>Local</p> <ul style="list-style-type: none"> Local area plans, masterplans and SDZ planning schemes 	 <p>Rural Development</p> <p>National</p> <ul style="list-style-type: none"> Rural Development Programme Action Plan for Rural Development 	 <p>Agriculture</p> <p>National</p> <ul style="list-style-type: none"> Food Wise 2025 Good Agricultural Practice Regulations and Nitrates Action Programme (2017-2021) Code of Good Agricultural Practice for Reducing Ammonia Emissions from Agriculture Agriculture, Forestry and Seafood Adaptation Plan <p>Draft/in preparation</p> <ul style="list-style-type: none"> Agri-food Strategy 2030 CAP Strategic Plan Ag-Climatise – National Climate and Air Roadmap for the Agriculture Sector to 2030 and Beyond Our Rural Future – Rural Development Policy 	 <p>Forestry</p> <p>National</p> <ul style="list-style-type: none"> National Forestry Programme (2014-2020) Forests and Water: Achieving Objectives under Ireland's RBMP 2018-2021 Agriculture, Forestry and Seafood Adaptation Plan Forest Policy Review <p>Draft/in preparation</p> <ul style="list-style-type: none"> Plan for Forestry and Freshwater Pearl Mussel <p>Local</p> <ul style="list-style-type: none"> Individual forest plans
 <p>Fisheries</p> <p>National</p> <ul style="list-style-type: none"> Harnessing Our Ocean Wealth (2012) European Maritime and Fisheries Fund Operational Programme (2014-2020) Agriculture, Forestry and Seafood Adaptation Plan Seafood Operational Programme National Strategic Aquaculture Plan 	 <p>Peatlands</p> <p>National</p> <ul style="list-style-type: none"> National Peatlands Strategy (2015) National Raised Bog SAC Management Plan (2017-2022) Biodiversity Action Plan 	 <p>Energy</p> <p>National</p> <ul style="list-style-type: none"> National Energy and Climate Plan (2021-2030) Offshore Renewable Energy Development Plan Electricity and Gas Networks Adaptation Plan <p>Draft/in preparation</p> <ul style="list-style-type: none"> Renewable Electricity Policy and Development Framework <p>County</p> <ul style="list-style-type: none"> Local authority renewable energy strategies 	 <p>Transport</p> <p>National</p> <ul style="list-style-type: none"> Smarter Transport (2009-2020) National Policy Framework on Alternative Fuels Infrastructure for Transport National Ports Policy (2013) Transport Infrastructure Adaptation Plan <p>Draft/in preparation</p> <ul style="list-style-type: none"> National Investment Framework for Transport Investment <p>Local</p> <ul style="list-style-type: none"> Integrated Implementation Plan for Greater Dublin Area Metropolitan Area Transport Strategies (for Cork, Limerick, Waterford and Galway) Port and Harbour Master Plans
 <p>Water Services</p> <p>National</p> <ul style="list-style-type: none"> Water Services Strategic Plan and Strategic Funding Plan (2019-2024) Water Quality and Water Services Infrastructure Adaptation Plan <p>Draft/in preparation</p> <ul style="list-style-type: none"> National Water Resources Plan 	 <p>Marine</p> <p>National</p> <p>Draft/in preparation</p> <ul style="list-style-type: none"> National Marine Planning Framework 	 <p>Tourism</p> <p>National</p> <ul style="list-style-type: none"> National Greenway Strategy <p>Draft/in preparation</p> <ul style="list-style-type: none"> Fáilte Ireland 10-Year Tourism Strategy <p>Regional</p> <ul style="list-style-type: none"> Ireland's Ancient East Wild Atlantic Way Ireland's Hidden Heartlands Draft Tourism Masterplan for the Shannon <p>County</p> <ul style="list-style-type: none"> Local Authority Tourism Strategies <p>Local</p> <ul style="list-style-type: none"> Various visitor management plans 	 <p>Health</p> <p>National</p> <ul style="list-style-type: none"> Healthy Ireland One Health National Radon Control Strategy



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 is available from the EPA. See <http://www.epa.ie/monitoringassessment/assessment/seal/>

b Guidance on Appropriate Assessment is available from the National Parks and Wildlife Service. See <https://www.npws.ie/protected-sites/guidance-appropriate-assessment-planning-authorities>

c Guidance on Environmental Impact Assessment is available from the Department of Housing, Local Government and Heritage and the EPA. See <http://www.epa.ie/pubs/advice/eia/> and <https://www.housing.gov.ie/planning/environmental-assessment/environmental-impact-assessment-eia/eia-portal>

CAP, Common Agricultural Policy; EPA, Environmental Protection Agency; SAC, Special Area of Conservation; SDZ, strategic development zone.



2. European Assessment of Ireland's Environmental Performance

The European Commission's 2019 Environmental Implementation Review

The latest European Commission Environmental Implementation Review (EIR) paints a mixed picture of Ireland's environmental performance.

The Commission launched the EIR as a tool to identify implementation issues within Member States at an early stage and seek solutions before issues reach the stage of infringements. The EIR comprises a 2-yearly cycle of analysis, dialogue and peer-to-peer support. The second EIR package, adopted in April 2019, includes 28 country reports, which map progress since the first EIR in 2017 and contain priority actions for each Member State.



Ireland's EIR for 2019 (EC, 2019b) notes that, in general, the country has good air quality, its soils are in good condition (with the exception of peat areas) and important steps have been taken towards a circular economy. It found that some progress has been made on the designation of Special Areas of Conservation (SACs) and on drawing up conservation objectives for these sites, on air quality and reducing emissions, and on waste policy in applying economic instruments.

The EIR for 2019 also identified several examples of good practice from Ireland, including good use of EU co-financing for environmental projects, especially through the LIFE programme and European Investment Bank loans, a very strong track record in environmental research and development and the availability of geographic information system data on ecosystems and their services.

Despite the progress made, the EIR found that Ireland faces a number of significant environmental challenges, notably in the areas of water management, nature protection and access to justice. It noted that Ireland's water services continue to cause concern, as evidenced by a low compliance rate with the Urban Waste Water Treatment Directive (91/271/EEC), problems with drinking water and below-average bathing water quality, while both the abstraction of water and hydromorphological changes are still not well controlled. The EIR identified that the significant gaps remaining in Ireland's designation of SACs need to be addressed and conservation measures be established for all sites as a priority. It noted that, although Ireland has made progress in finalising the National Raised Bog SAC Management Plan and on protecting raised bogs, only slow progress has been made in protecting blanket bog sites. A number of priority actions for Ireland are

identified in the EIR in the areas of water, air, nature, waste and the circular economy, and access to justice; these are highlighted in topic boxes throughout this chapter.

Infringement Procedures for Breach of European Environmental Law

Open infringement and European court cases against Ireland for breaches of environmental law mainly relate to failures in implementing nature, water and Environmental Impact Assessment (EIA) legislation.

The Commission has the power to bring legal action – an infringement procedure – against Member States for failing to implement EU environmental law. These procedures can arise on the basis of the Commission's own investigations or following complaints from citizens, businesses or other stakeholders. Infringement 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 European law, the Commission may decide to refer the matter to the European Court of Justice, which, in certain cases, can impose financial penalties. Most cases are resolved before being referred to the Court.

Unresolved infringements indicate ongoing structural, administrative and legislative deficiencies in the implementation of environmental legislation and can be damaging to Ireland's international reputation. As of 10 November 2020, there were 16 infringement cases and four European Court of Justice cases open against Ireland for breaches of environmental law, mainly relating to failures in implementing legislation on nature, water, EIAs and access to justice (Table 15.1).

There are four current infringement cases under EU nature legislation, which relate to (1) a failure to classify Special Protection Areas (SPAs) under the Birds Directive (2009/147/EC; infringement 1998/2290 and C-418/04 – *Commission v Ireland*); (2) peat extraction in the Habitats Directive (92/43/EEC) protected areas (infringement 2010/2161); (3) the designation of SACs under the Habitats Directive (infringement 2015/2006, referred to Court 2 July 2020); and (4) the failure to establish penalties under European Commission Invasive Alien Species Regulations (infringement 2018/2319). With regard to EU water legislation, there are four current infringements, which relate to (1) non-conformity and shortcomings in the transposition of the Water Framework Directive (2000/60/EC; infringement 2007/2238); (2) a failure to comply with the Urban Waste Water Treatment Directive (infringement 2013/2056 and C-427/17 – *Commission v Ireland*); (3) a failure to comply with the Drinking Water Directive (98/83/EC) due to exceedances of trihalomethanes (THMs) (infringement 2017/4007); and (4) a failure to meet obligations on environmental quality



standards for pollutants under the Priority Substances Directive (2455/2001/EC; infringement 2019/2286). There are currently three open infringements relating to EIA legislation: (1) implementation of the EIA Directive (2014/52/EU) in relation to projects in or likely to affect Natura 2000 sites (infringement 2000/4384 and C-215/06 – *Commission v Ireland*); (2) a failure to take account of new modifications to the EIA Directive (infringement 2017/0368); and (3) EIA and peat extraction activities (infringement 2019/4007). With regard to access to justice legislation, current infringements relate to (1) access to justice provisions under the Industrial Emissions Directive (2010/75/EU) and EIA Directive (2011/92/EU) (infringement 2012/4028) and (2) the Environmental Liability Directive (2004/35/EC) (infringement 2020/2110).

The remaining three open infringements relate to EU chemicals legislation (non-conformity with Seveso-III Directive (2012/18/EU; infringement 2019/2275)), marine legislation (late reporting on updates under the Marine Strategy Framework Directive (2008/56/EC; infringement 2018/2359)) and climate action legislation (Directive 2018/410/EU amending Directive 2003/87/EC to enhance cost-effective emission reductions and low-carbon investments, and Decision (EU) 2015/1814 (2019/0327)).

The number of open infringements fluctuates over time, as existing infringement procedures are closed and new ones are opened. Updated information on infringements is available on the Commission website (https://ec.europa.eu/info/law/infringements_en). Closing the current infringement procedures, and avoiding future ones, will require proactive action and prioritised legislation and enforcement by the government and public authorities in Ireland.

The 2019 EIR notes that access to justice remains an issue in Ireland. The Commission has recommended that Ireland should make an effort to lower the cost of bringing an environmental legal action to court and better inform the public about their rights to access justice, notably in relation to air pollution and nature (Topic Box 15.1).

Table 15.1 Summary of active and closed infringements proceedings against Ireland for breaches of EU environmental legislation (Source: European Commission)

	NUMBER OF ACTIVE INFRINGEMENTS (TO 10 NOVEMBER 2020)		NUMBER OF CLOSED INFRINGEMENTS (1 JANUARY 2002 TO 10 NOVEMBER 2020)
	Infringements	European Court of Justice cases	
Nature	4	2	11
Water	4	1	16
EIA	3	1	9
Chemicals	1	0	8
Marine	1	0	0
Climate action/floods	1	0	7
Access to justice/justice	2	0	2
Waste	0	0	33
Air	0	0	19
Other	0	0	7 ^a
Total	16	4	112

^a The 'other' closed infringements comprised three relating to the Seveso Directive and one each relating to noise (non-transposition of Directive 2002/49/EC), the INSPIRE Directive (failure to fulfil reporting obligations), the Integrated Pollution Prevention and Control Directive (reporting obligation) and the Nagoya Protocol on Access to Genetic Resources.



Topic Box 15.1 Priority Actions for Ireland on Information, Public Participation and Access to Justice, as Identified by the European Commission (EC, 2019b)

- Identify and document all spatial datasets required for the implementation of environmental law, and make the data and documentation at least accessible 'as is' to other public authorities and the public through the digital services foreseen in the INSPIRE Directive.
- Better inform the public about their rights to access justice, notably in relation to air pollution and nature.
- Ensure that individuals and environmental non-governmental organisations can bring environmental challenges without facing prohibitive costs, including in nature and air quality cases.

3. Assessment of Ireland's Performance Against Environmental Legislation, Plans and Programmes

Environmental Enforcement Performance of Local Authorities

The EPA has designed a Performance Framework to help local authorities to continue to improve their work in environmental enforcement.

The EPA's latest report on local authority environmental enforcement performance found that local authorities increased their environmental enforcement activities in 2018 (EPA, 2020a). They also handled and investigated an increased number of environmental complaints (over 78,000) in 2018, mainly relating to waste and litter issues (Figure 15.3). The EPA also receives complaints in relation to how local authorities carry out their environmental duties – over 1100 of these complaints were received by the EPA in 2018.

Figure 15.3 Breakdown of the environmental complaints received by local authorities directly in 2018



Several areas where local authorities could improve environmental enforcement were identified in the EPA report, as follows:

- ensure waste is segregated at source by businesses and householders to improve recovery
- improve sharing of information on waste enforcement to ensure that illegal waste activities can be detected and prevented
- increase farm inspection numbers to previous levels at a minimum, to improve water quality (e.g. there were about 650 fewer farm inspections undertaken in 2018 than in 2017)
- coordinate action and increase enforcement of the Solid Fuel Regulations¹ to improve air quality.

The challenge posed by increasing shared service delivery and the need to better coordinate and cooperate to deliver national environmental enforcement priorities were also identified in the report.

¹ S.I. No. 326/2012 – Air Pollution Act (Marketing, Sale, Distribution and Burning of Specified Fuels) Regulations 2012d.



Enforcement of EPA-licensed Industrial and Waste Facilities

Most environmental complaints relate to odour and noise.

The EPA's latest industrial and waste licence enforcement report 2018 examines the overall performance of regulated industrial and waste licensed facilities (EPA, 2018). It highlights that, overall, the level of compliance among industrial and waste licensed sites in 2018 was good and that the EPA's National Priority Sites system is continuing to drive investment and environmental improvements at licensed sites, as discussed in Chapter 10. This is borne out in a 22 per cent reduction in the number of complaints received in 2018, a downwards trend that continued in 2019. Of the 900 environmental complaints received in 2018, the majority (84%) related to odour and noise. Most complaints related to ten facilities in the food and drink and the waste transfer/landfill sectors. The report identified a number of areas for improvement:

- The food and drink (agri-food) sector continues to face challenges in maintaining environmental compliance as the industry adapts to increased agricultural production.
- Complaints from members of the public remain an issue for the waste sector.

At the end of 2019, over 60 EPA-licensed sites were identified as significant pressures to either groundwater or surface water bodies under the Water Framework Directive second-cycle RBMP.



Ireland's Performance on Climate

Unlike most European countries, Ireland has not reduced greenhouse gas emissions.

Ireland's climate policy is rapidly evolving. The 2015 Climate Action and Low Carbon Development Act created statutory obligations for successive 5-yearly National Mitigation Plans, detailing actions required to achieve Ireland's greenhouse gas mitigation obligations. Ireland's first National Mitigation Plan was adopted in 2017 with the aim of closing the gap towards Ireland's 2020 targets and preparing for the 2030 targets. It contains separate sectoral mitigation measures for the electricity generation, transport, built environment and agriculture sectors. It was, however, criticised for not setting out a sufficiently clear roadmap for how the necessary reductions are to be achieved and was subsequently found by the Supreme Court in July 2020 not to meet the requirements of the 2015 Climate Action and Low Carbon Development Act. In 2019 the government published its Climate Action Plan (Government of Ireland, 2019), which is aimed at enabling Ireland to meet its 2030 emissions reduction targets and laying the foundations for achieving climate neutrality by 2050. Further detail on the targets and measures included in the Climate Action Plan is provided in Chapter 2. As part of a commitment to updating the 2015 climate legislation by establishing a 2050 target in law, introducing a new regime for carbon budgets and strengthening the role of the Climate Change Advisory Council, the government also intends to provide a statutory basis for the Climate Action Plan in law and published a Climate Action (Amendment) Bill in October 2020.

Alongside these national developments, the EU 2030 Climate and Energy Framework adopted in 2014 commits Member States to preparing 10-year rolling National Energy and Climate Plans (NECPs). These provide a new framework within which governments must plan their climate and energy objectives, targets, policies and measures in an integrated manner. The first NECPs for 2021-2030 must ensure that the EU's 2030 targets for greenhouse gas emissions reductions, renewable energy, energy efficiency and electricity interconnection are met. Ireland's NECP, published in August 2020, incorporates all planned policies and measures that were identified up to the end of 2019 and that collectively will deliver an anticipated 30 per cent reduction by 2030 in non-Emissions Trading System (ETS) greenhouse gas emissions (from 2005 levels).



The greenhouse gas emissions index shown in Figure 15.4 shows that, compared with the trend in total EU-28 emissions, Ireland has not reduced greenhouse gas emissions since 1990. The latest European state of the environment report (EEA, 2019a) noted that Ireland's greenhouse gas emissions in 2017 were the third highest

in the EU, at 13.3 tonnes of carbon dioxide equivalent per person, compared with an EU average of 8.8 tonnes of carbon dioxide equivalent per person. Despite an increased renewable energy share over the past 5 years, Ireland (at 10.7%) remains well below the EU average (17.5%) (Figure 15.5).

Figure 15.4 Trend in Ireland's greenhouse gas emissions from 1990 to 2018 compared with the EU-28 average (Source: EEA/Eurostat https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=sdg_13_10&plugin=1)

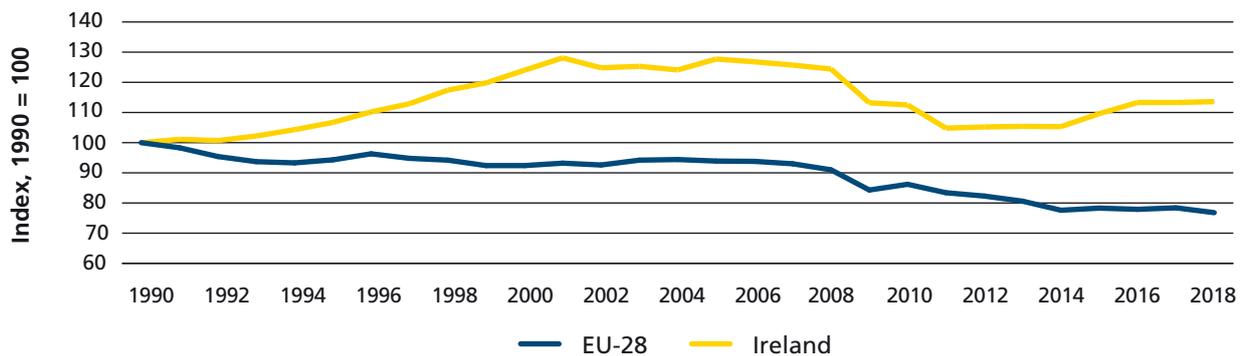
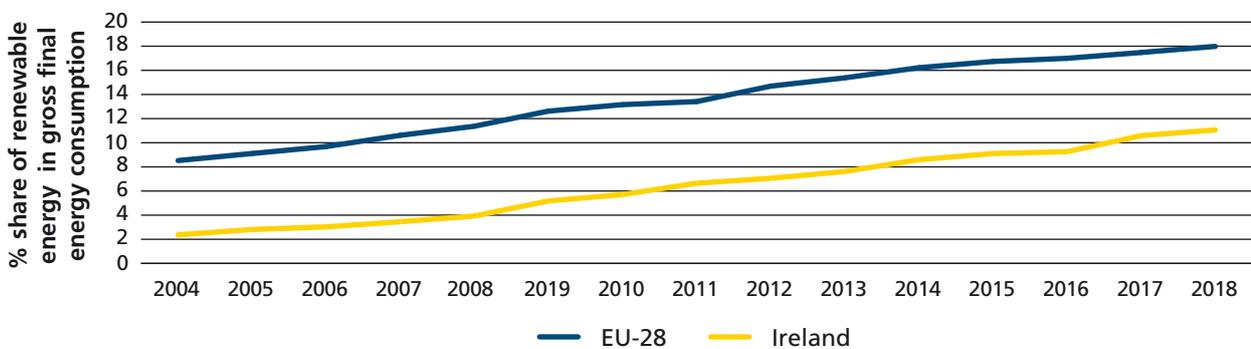


Figure 15.5 Share of renewable energy in Ireland from 2004 to 2018 compared with the EU-28 average (Source: Eurostat https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=sdg_07_40&plugin=1)



The EPA's latest greenhouse gas emissions data for 2019 show that, while some progress has been made in the energy sector in the last several years, emissions in other sectors have been generally increasing or not decreasing fast enough to achieve Ireland's long-term decarbonisation goals. Agriculture continues to be the largest source of emissions, representing 35 per cent of total national emissions in 2019, and emissions are projected to continue increasing towards 2030 absent the implementation of measures outlined in the 2019 Climate Action Plan. The transport and energy industries sectors represented 20 per cent and 16 per cent, respectively, of total greenhouse gas emissions in 2019. The transport sector has been the fastest growing source of greenhouse gas emissions,



showing a 10 per cent increase between 2013 and 2019. The EU ETS covers greenhouse gas emitters in the industry, power and aviation sectors, while all other non-ETS sectors are covered by the EU Effort Sharing Decision.

In 2019, Ireland exceeded its annual EU emissions budget under the Effort Sharing Decision for the fourth year in a row, by almost 7 million tonnes, and is therefore not on the pathway required to meet its 2020 targets. Ireland's non-ETS emissions are projected to be only 2-4 per cent below 2005 levels in 2020, compared with the EU target of 20 per cent (EPA, 2020b). Although the impact of COVID-19 will narrow this gap, it is expected that Ireland will still need to rely on purchasing credits or allowances in order to comply with its 2020 targets. Achieving the 2030 targets will require full implementation of the 2019 Climate Action Plan and the use of flexibilities in relation to land use, land use change and forestry. As outlined in Chapter 2, the pace of emissions reduction will need to accelerate beyond 2030. The Commission did not include any priority actions on climate action in its most recent EIR report, noting that it will first need to assess Ireland's National Energy and Climate Plan 2021-2030.



Ireland's Performance on Air

While most air pollutants were below the EU limit and target values for ambient air quality in 2019, there was an exceedance of the nitrogen dioxide annual limit value at a Dublin monitoring location. The World Health Organization's (WHO) guideline values for air quality at 33 EPA monitoring stations were also exceeded, mostly because of the levels of fine particles in the air. Ireland's emissions of ammonia and nitrogen oxides breached agreed limits.

The EU has developed a comprehensive body of air quality legislation, which establishes health-based standards and objectives for a number of air pollutants, including particulate matter, nitrogen oxides and ammonia. More recent EU clean air policy and legislation require significant improvement of air quality, moving the EU closer to the more stringent guideline values recommended by the WHO.

While air quality in Ireland compares favourably overall with that in other EU Member States, which itself is generally improving, recent improvements in monitoring suggest that localised air quality in Ireland's cities, towns and villages is likely to be poorer than previously reported, particularly during the winter when solid fuels are used for home heating. As outlined in Chapter 3, urban air pollution is attributable mainly to emissions from solid fuel burning (particulate matter) and transport (nitrogen oxides). While most air pollutants were below the EU limit and target values for ambient air quality in 2019 (EPA, 2020c), there was an exceedance of the nitrogen dioxide annual limit value at a Dublin monitoring location. WHO's guideline values for air quality at 33 EPA monitoring stations were also exceeded, mostly because of the levels of fine particles in our air (see Table 15.3). There were also two breaches of the WHO guideline value for ground-level ozone in 2019 and four breaches of the European Environment Agency (EEA) guideline value for polycyclic aromatic hydrocarbons (EPA, 2020c).

Nitrogen oxides emissions are projected to reduce and to be compliant, provided that planned measures, particularly in relation to the Climate Action Plan, are implemented (EPA, 2020d). As discussed in Chapter 13, Ireland's ammonia emissions have been rising steadily since 2011, linked to the expansion of the dairy sector. Ammonia is harmful to human health as a precursor of secondary particulate matter and it also poses a significant threat to water quality and ecosystems. Ireland is currently in breach of its ammonia reduction target and is not projected to meet its 2020 or 2030 targets. Current projections indicate that compliance with the 2030 reduction target for non-methane volatile organic compounds (NMVOCs) will also be a challenge (EPA, 2020d).

Addressing the main sources of air pollution (transport, solid fuel burning and agriculture) will require an integrated cross-sector response from government. In this context, while the government's 2019 Climate Action Plan will result in positive benefits for air quality, the continuing lack of a National Clean Air Strategy is a significant gap. Tackling air pollution in a more coordinated and integrated way will deliver multiple health, climate, environmental and societal benefits (Topic Box 15.2).



Topic Box 15.2 Examples of Smart, Integrated Solutions to Tackle Air Pollution and Deliver Multiple Benefits

- Tackle road transport emissions by increasing investment in public transport and walking and cycling infrastructure rather than relying solely on car owners to switch to electric cars. Re-align the location of the housing supply to ensure more supply closer to centres of employment and public transport infrastructure rather than in suburban car-served locations. As well as improving air quality, reducing greenhouse gas emissions and reducing noise pollution, this would also alleviate traffic congestion and have added benefits for people's health, wellbeing and quality of life, as well as improving the attractiveness of urban centres and public spaces.
- Tackle ammonia emissions from agriculture by transitioning to low-emission technologies (e.g. low-emission slurry spreading techniques) coupled with improved soil fertility and nutrient management, which maximises nutrient uptake and results in a lower risk of run-off of nutrients and pathogens into watercourses.
- Combine regulatory and enforcement efforts to reduce 'smoky' emissions from solid fuel heating with a greatly expanded systematic and target-based programme of retrofitting homes with insulation and heat pumps, resulting in warmer, more comfortable homes and associated health benefits.

It is clear that, despite significant progress in recent decades, more needs to be done to further protect human health and the environment from air pollution and to fulfil Ireland's EU and international obligations on air quality. The priority actions for Ireland on air quality, identified by the Commission in its 2019 EIR, are shown in Topic Box 15.3.



Topic Box 15.3 Priority Actions for Ireland on Air Quality as Identified by the European Commission (EC, 2019b)

- Take action, in the context of the forthcoming NAPCP, to reduce emissions from the main emission sources.
- Accelerate the reduction of nitrogen oxide emissions. This will require, for example, a further reduction in transport emissions, particularly in urban areas (and may require proportionate and targeted urban vehicle access restrictions), and/or fiscal incentives.
- Reduce ammonia emissions to comply with currently applicable national emission ceilings, for example by introducing or expanding the use of low-emission slurry spreading techniques.
- Reduce emissions of volatile organic compounds.

The NAPCP is the main governance measure by which EU Member States must ensure that the reduction commitments for 2020 and 2030 are met. The first NAPCPs were due by 1 April 2019. Ireland submitted a draft NAPCP to the Commission in April 2019. As the latest projections show that Ireland is facing challenges in meeting reduction targets (as outlined above), an NAPCP with updated emission reduction policies is currently being finalised.

The Irish Government's 2019 Climate Action Plan will have positive benefits for air quality, particularly in relation to the promotion of electric vehicles and upgrades to housing, including insulation and modes of home heating. The government in late 2019 commenced public consultation on *Ag-Climatise – A Draft National Climate & Air Roadmap for the Agriculture Sector to 2030 and Beyond*, to develop a roadmap for how Ireland's agri-food sector can meet the necessary emissions reduction targets for both air pollutants and greenhouse gases. It sets out a series of 13 proposed actions to be implemented between 2021 and 2030 to deliver emissions reductions, as well as further actions to build partnerships and prepare for the future. Encouragingly, the consultation document recognises the synergies with other environmental priorities and the multiple benefits that can be delivered for air quality, climate, water quality and biodiversity arising from actions such as improvements in nutrient management. The final *Ag-Climatise* is expected to be published shortly.



Ireland's Performance on Nature

Significant conservation, knowledge and protected area designation gaps remain to be resolved to safeguard nature, given that 85 per cent of protected habitats have been identified as being in an 'unfavourable' (either bad or inadequate) conservation status.

Ireland's third National Biodiversity Action Plan was adopted in 2017. Protected areas now account for approximately 17 per cent of Ireland's land area but only 2 per cent of marine territories. Under the Convention on Biological Diversity, Ireland adopted a target in 2010 that 10 per cent of all coastal and marine areas would be conserved through protected areas, while the EU Biodiversity Strategy for 2030 has committed to a minimum of 30 per cent protection of the EU's sea areas, with strict protection for a third of these areas. The Commission's EIR for 2019 noted that, following earlier European Court of Justice rulings, on the basis of the latest update, Ireland's terrestrial Natura 2000 network under the Birds and Habitats Directives is now considered to be complete but that further designation of SPAs under the Birds Directive is required, particularly for the corncrake. The EIR further notes that there is also a lack of clarity on the level of implementation of conservation measures for designated sites and that significant knowledge and designation gaps remain in Ireland's marine Natura 2000 network. The Commission's most significant concern is the conservation of raised and blanket bogs and the issue of turf cutting within protected areas, which is still the subject of an infringement procedure (2010/2161). The Commission's report also notes that Ireland has conservation issues in SPAs, for example the decline of wading birds, particularly the curlew, reconciling the protection of the hen harrier with forestry and wind-farm development, and addressing the cutting of hedgerows and the burning of uplands during the nesting season of birds (EC, 2019b).

As discussed in Chapter 6, the most recent Habitats Directive Article 17 report (NPWS, 2019) identified 85 per cent of Ireland's listed habitats as having an 'unfavourable' (either bad or inadequate) conservation status, which is a higher proportion than the EU average of 72 per cent (European Court of Auditors, 2020). Almost half of all Ireland's listed habitats (46%) are demonstrating ongoing declines. These ongoing declines are of real concern, particularly in Ireland's peatland, grassland, woodland and marine habitats. None of Ireland's listed peatlands was in a favourable conservation status in 2019 (Figure 15.6). The main drivers of these declines are agricultural practices, which are negatively affecting over 70 per cent of habitats, particularly ecologically unsuitable grazing, abandonment, pollution, drainage and reclamation practices.

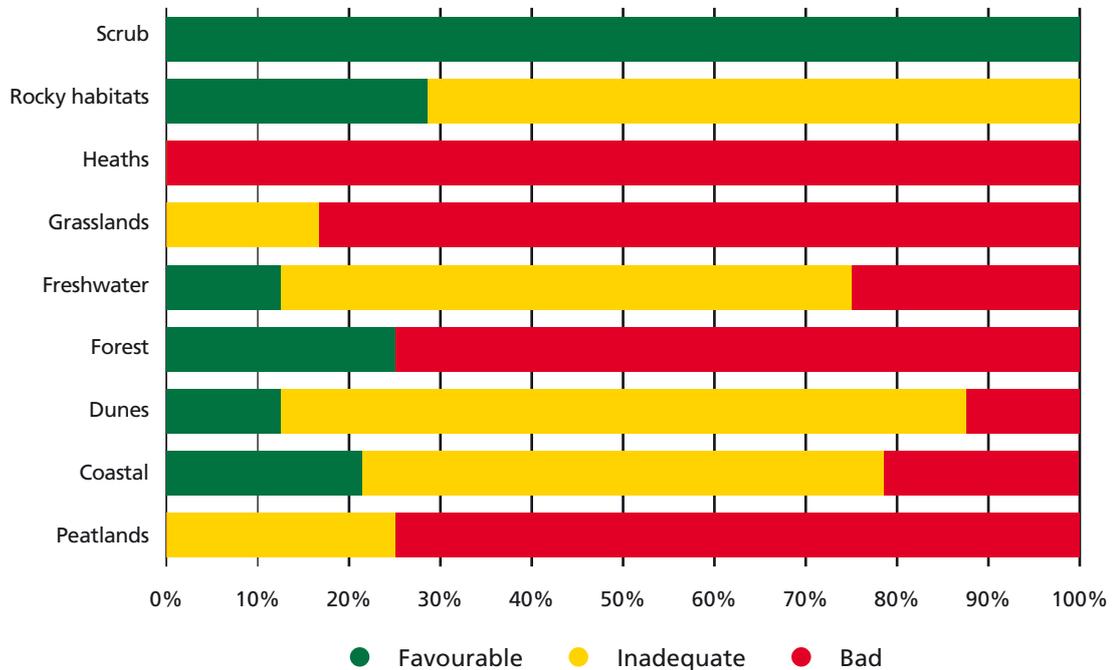
The picture was somewhat better for protected species, with 57 per cent of listed species reported as being in a 'favourable' conservation status and 72 per cent demonstrating stable or improving trends (NPWS, 2019). Ireland is a European stronghold for many of the listed EU species such as the otter. The proportion of EU protected species demonstrating ongoing decline is 15 per cent. In relation to birds, almost 20 per cent of Ireland's breeding bird species are in long-term decline, while the populations of over half of Ireland's wintering birds are declining over the short term². Habitat loss, climate change and cumulative impacts represent the biggest pressures.

Given the broadly negative status of semi-natural habitats, the status of unprotected species is unlikely to be positive. To date, 9.9 per cent of Ireland's approximately 31,500 species have had their conservation status systematically assessed according to the International Union Conservation of Nature Red List Process. Of the 3110 species assessed, 2.7 per cent are now regionally extinct, 14.8 per cent fall into a threat category (critically endangered, endangered or vulnerable) and a further 9.2 per cent are considered 'near threatened'. Of the 15 resident butterfly species systematically monitored in Ireland by the Irish Butterfly Monitoring Scheme coordinated by the National Biodiversity Data Centre, five have experienced strong or moderate population declines between 2008 and 2019 (Judge and Lysaght, 2020; NBDC, 2019).

² Article 12 reported data <https://nature-art12.eionet.europa.eu/article12/report?period=3&country=IE>



Figure 15.6 Conservation status of listed habitats, 2019 (based on 59 individual habitat assessments)
(Source: NPWS, 2019)



Overall, the outlook for biodiversity both at a European level and in Ireland is stark. Recent reports show that the loss of species and habitats is increasing at a much faster rate than previously thought. For example, populations of farmland birds and grassland butterflies in Europe have declined by more than 30 per cent since 1990. The European state of the environment report (EEA, 2019a) acknowledged that the overall objective of the EU Biodiversity Strategy to halt the loss of biodiversity and ecosystem services by 2020 will not be met. A recent audit by the European Court of Auditors examined the contribution of the Common Agricultural Policy (CAP) to maintaining and enhancing biodiversity. It found that the formulation of the agriculture targets in the EU Biodiversity Strategy makes it difficult to measure progress; the way the Commission tracks biodiversity expenditure in the EU budget is unreliable; the impact of CAP direct payments is limited or unknown; and the Commission and Member States have favoured lower impact rural development measures. It recommended that the Commission improves the design of its next biodiversity strategy, enhances the contribution made to biodiversity by direct payments and rural development action, tracks biodiversity-related expenditure more accurately and develops reliable indicators that are suited to monitoring progress in farmland biodiversity (European Court of Auditors, 2020).

The priority actions for Ireland to improve nature protection, as identified by the Commission in its 2019 EIR, are shown in Topic Box 15.4.



Topic Box 15.4 Priority Actions for Ireland on Nature and Biodiversity as Identified by the European Commission (EC, 2019b)

- Complete the Natura 2000 designation process for both terrestrial and marine environments. Put in place clearly defined conservation objectives and the necessary conservation measures so that they may meet their objective of maintaining or restoring species and habitats of community interest to a favourable conservation status across their natural range.
- Take action to ensure that burning in uplands (especially in Natura 2000 areas) and hedgerow cutting are fully compatible with the requirements of the Birds and Habitats Directives.
- Increase efforts to manage blanket bogs.
- Take practical steps to address the serious decline of waders, and further develop the conservation programme for the curlew, both in Natura 2000 sites and in the wider countryside.
- Ireland is urged to notify its provisions on penalties, as required by Article 30(4) of the Invasive Alien Species Regulation, as soon as its national legislation is adopted.



Ireland's Performance on Water

Ireland is not on track to meet its Water Framework Directive objectives for 2021, and achieving full compliance by 2027 will be a major challenge.

European Union water legislation puts in place an extensive protective framework to ensure high standards for all water bodies in the EU and addresses specific pollution sources (e.g. from agriculture, urban areas and industrial activities). Water policy and management in Ireland is directed by the Water Framework Directive, which sets an objective of achieving at least 'good status' for all its waters by 2015 (or, with extensions, by 2021 or 2027). Ireland adopted its second RBMP in 2018, which sets out the measures to be taken up to 2021 to achieve compliance with Water Framework Directive objectives. Preparation of Ireland's third RBMP for 2022-2027 is currently underway.

Despite a lot of good work being undertaken over the past 20-30 years, Ireland is falling short in achieving the Water Framework Directive 'good status' objective. While good progress has been made in tackling the most seriously polluted water bodies in Ireland, overall water quality trends in Ireland's rivers, lakes and estuaries are a significant cause for concern, as discussed in Chapter 7 and summarised in Table 15.3. Ireland is not on track to meet the Water Framework Directive objectives for 2021, and achieving full compliance by 2027 will be a significant challenge. Nearly half of Ireland's surface waters are failing to meet their water quality objectives, and high status river sites are in serious decline. The EPA's recent water quality report 2013-2018 (EPA, 2019) recorded a net decline in 128 river water bodies, or 5.5 per cent, since the previous assessment cycle of 2010-2015. After nearly 15 years of a declining trend in riverine nutrient inputs to marine areas, the trend has started to reverse and nutrient inputs have gradually increased since 2013/2014, linked with losses from agriculture and discharges from wastewater treatment plants.

As discussed in Chapter 7, agriculture is the main pressure on water quality in Ireland, followed by hydromorphology and wastewater. Agriculture is a significant pressure for over 50 per cent of waters at risk of not meeting their target of 'good status' by 2027, and tackling diffuse agricultural pollution is challenging. The Agricultural Sustainability Support and Advisory Programme was established as part of a more collaborative approach to implementing the second RBMP between 2018 and 2021. The programme provides a free and confidential advisory service to farmers and works alongside the Local Authority Waters Programme to facilitate targeted actions to improve water quality.

The Urban Waste Water Treatment Directive sets standards for treating urban wastewater at large urban areas to protect the environment and people's health. The final deadline for Ireland to comply with this directive was 2005. Despite this obligation, the latest EPA report (EPA, 2020e) found that less than half (44%) of the total wastewater load from Ireland's large urban areas was treated to the required standards in 2019. The main factor in Ireland's poor compliance is the failure at Ringsend in Dublin, which treats over 40 per cent of the country's urban wastewater. Raw sewage continues to be discharged from 35 towns and villages without treatment. Five large towns and cities discharging into sensitive areas, including Cork, did not have the more stringent level of treatment required to remove phosphorus and/or nitrogen. Improvements are needed at 113 priority urban areas to eliminate raw sewage, prevent water pollution, protect freshwater pearl mussels and bathing waters and meet EU standards. The need for Ireland to improve wastewater treatment infrastructure and put an end to direct discharges of raw sewage was highlighted by the Commission in its EIR (Topic Box 15.5).

While 95 per cent of Ireland's bathing waters met the minimum standard of 'sufficient' in 2019 and 89 per cent were 'excellent' or 'good' (EPA, 2020f), the proportion of Irish coastal bathing waters at 'excellent' quality (73% in 2019) is below the EU average (85% in 2019) (EEA, 2019b). Urban wastewater is the greatest pressure affecting bathing water, again emphasising the need for urgent and prioritised improvements in the collection and treatment of urban wastewater.



Topic Box 15.5 Priority actions for Ireland on Water Quality and Management as Identified by the European Commission (EC, 2019b)

- Ensure timely adoption and reporting of RBMPs as well as Flood Risk Management Plans.
- Ensure compliance with the Urban Waste Water Treatment Directive by ending direct discharges of untreated wastewater. Ensure that wastewater is collected and appropriately treated throughout the country. Complete water infrastructure projects for agglomerations that are in breach of the directive as soon as possible.



Ireland's Performance on Waste and the Circular Economy

The Commission's 2019 EIR noted Ireland's lack of a national strategy for the circular economy, which it identified as a priority action for Ireland.

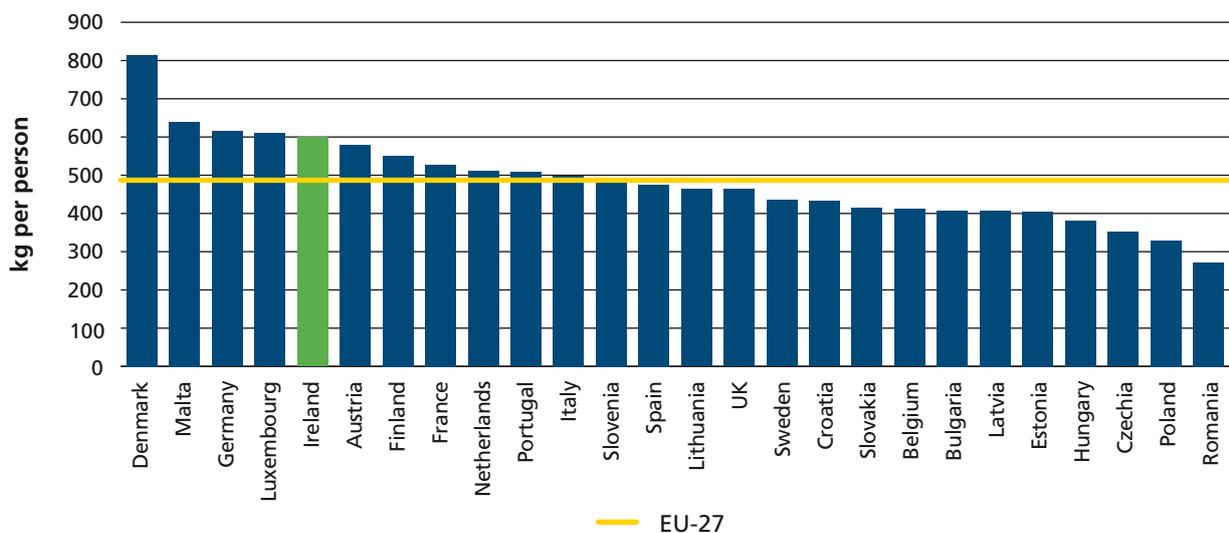
European waste policy has long been centred on the waste hierarchy.³ The EU Circular Economy Action Plan, adopted in 2015, emphasises the need to move towards a life-cycle-driven 'circular' economy, reusing resources as much as possible and bringing residual waste close to zero. It complements and updates pre-existing European waste management legislation setting down binding targets for waste recycling. The Department of the Environment, Climate and Communications (DECC) published *A Waste Action Plan for a Circular Economy: Ireland's National Waste Policy 2020-2025* in September 2020, which aims to ensure that Ireland not only meets legal targets but also takes full advantage of the opportunities of the new economy.

Over 2.9 million tonnes of municipal waste was generated in Ireland in 2018, equating to 600 kg per person, up 4 per cent from 577 kg per person in 2017. This is well above the EU average of 492 kg per person (Figure 15.7) (EPA, 2020g). The large variation in municipal waste generation across EU Member States reflects differences in consumption patterns and economic wealth, as well as ongoing differences in how countries manage and report municipal waste, despite efforts by Eurostat to improve harmonisation in waste reporting.

As outlined in Chapter 9, the steady progress Ireland has made in meeting EU recycling targets has slowed in recent years. Ireland's overall recycling rate for municipal waste of 38 per cent in 2018 (EPA, 2020g) was well below the European average of 47 per cent and significantly behind the leading EU country, Germany, where 67 per cent of municipal waste was recycled in 2018.⁴ While Ireland should be very close to meeting its recycling target for 2020, achieving compliance with future more stringent targets will present a significant challenge.

There was a significant reduction in the landfill rate between 2012 and 2018, from 41 per cent to 15 per cent, driven by an increase in the landfill levy and increased incineration capacity nationally. Waste incineration with energy recovery increased substantially in the same period, from 17 per cent to 43 per cent (EPA, 2020g). These trends indicate that waste movements away from landfill in Ireland have gone largely to incineration rather than recycling. The Commission cautioned in its EIR that the increased use of incineration must not prevent Ireland from meeting post-2020 recycling targets. The EIR also recommended that Ireland could achieve further progress by introducing tax incentives for households to encourage waste prevention and recycling (Topic Box 15.6), while noting that Ireland has made an effort to increase public awareness and participation via several awareness and education measures, including on food waste and separate collections.

Figure 15.7 Municipal waste generated in EU Member States in 2018 (Source: EPA, 2020g)



³ Reducing waste generation, increasing material reuse and recycling, diverting waste from landfill and limiting energy recovery to non-recyclable materials.

⁴ Eurostat indicator 'Recycling rate of municipal waste' (online data code: SDG_11_60) available online at: https://ec.europa.eu/eurostat/databrowser/view/sdg_11_60/default/table?lang=en (accessed 19 October 2020).



Topic Box 15.6 Priority Actions for Ireland on Waste and the Circular Economy as Identified by the European Commission (EC, 2019b)

- Develop a more coherent circular economy policy framework.
- Introduce new policy instruments, including economic instruments, to promote prevention and make reuse and recycling more economically attractive.
- Shift reusable 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.
- Provide more timely waste generation and management data.

The rate of circular (secondary) use of material in Ireland has remained consistently low, at less than 2 per cent, which is well below the EU average (11% in 2017).⁵

Ireland's eco-innovation performance has continued to improve. Ireland ranked 11th in the EU Eco-innovation Index in 2017 (latest data available), very close to the EU average. The EIR recognised that Ireland is very strong in research and development, attracting many researchers and large amounts of early-stage green investment. The EPA and Enterprise Ireland have developed several support measures to help businesses adopt resource-efficient and circular economy practices.

4. The European and Global Policy Context

With the 'European Green Deal' and the Global Context, the European Environmental Policy Sphere is Rapidly Changing

Large-scale policy, demographic, economic and geopolitical developments are at play, including post-pandemic green recovery proposals, which will have significant consequences for the environment and associated responses.

The European Green Deal, published in 2019, is a wide-ranging policy response to a range of key environmental challenges (EC, 2019a). This policy document is expected to shape environmental policy across the EU and in Ireland for the next decade. The Green Deal provides in one overarching action plan a high-level response to challenges ranging from climate to efficient use of resources, the circular economy, restoring biodiversity and cutting pollution. It includes linked policy responses that cover the Circular Economy Action Plan, a Farm to Fork Strategy and an EU Biodiversity Strategy for 2030. The deal covers investment and finance aspects.

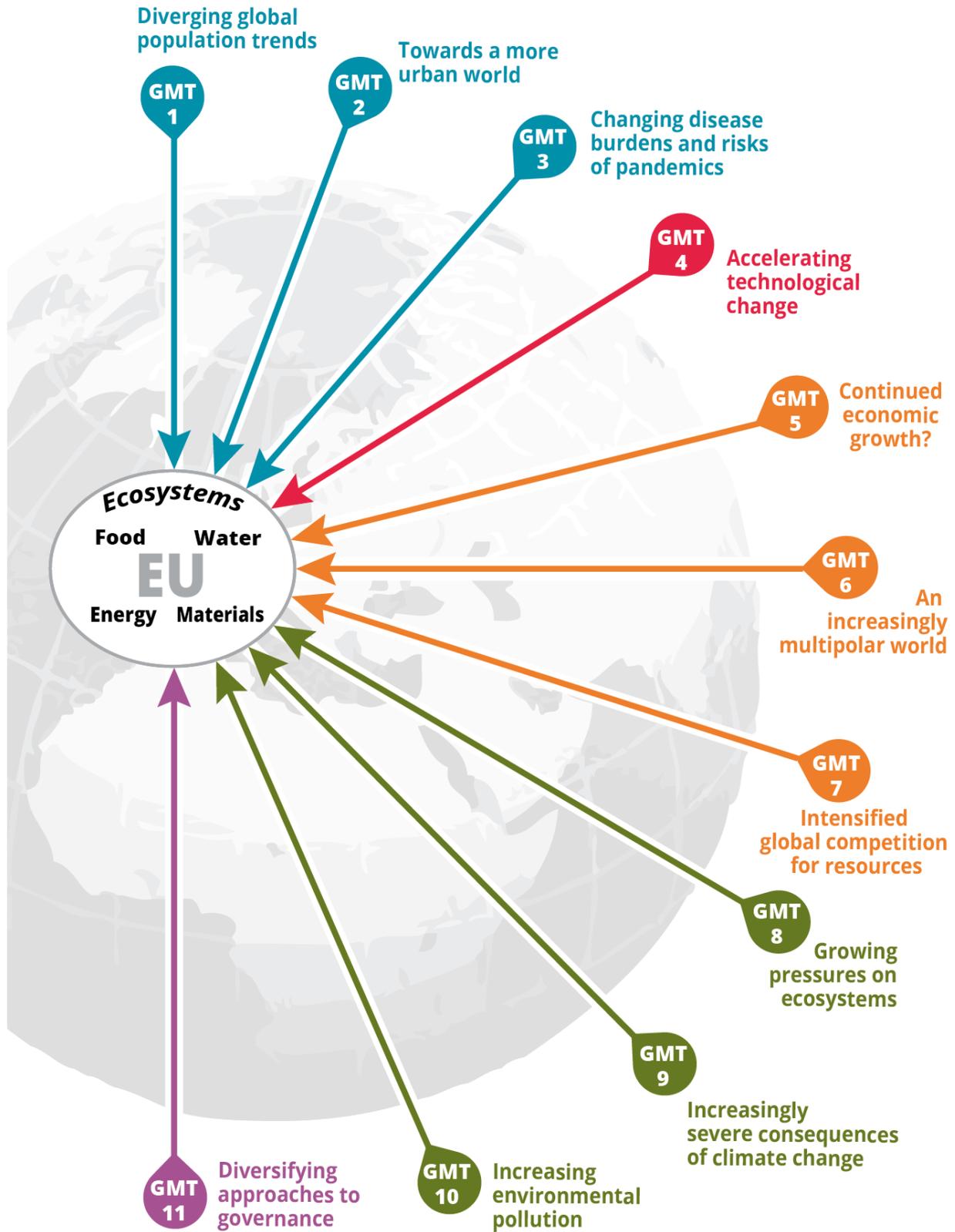
In today's globalised world, for example, developments elsewhere can influence the availability and price of natural resources and energy in Europe, and increasing environmental pollution in other parts of the world contributes to direct environmental and human harm in Europe, and vice versa.

In recent years the policy focus in Europe, and in turn Ireland, has increasingly moved towards strategies with a long-term societal transition perspective, with 2050 goals being set for climate, biodiversity and the circular economy, etc. Adopting this long-term transition perspective requires consideration of how Europe's environment and societies might be affected by large-scale, long-term global megatrends. The EEA has identified and assessed 11 global megatrends considered important for Europe's environment in the long term (Figure 15.8), with the aim of providing an improved basis for strategic European environmental policymaking.

⁵ Eurostat indicator 'Circular material use rate' (online data code: SDG_12_41) available online at: https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=sdg_12_41&plugin=1 (accessed 19 October 2020).



Figure 15.8 The 11 global megatrends identified by the EEA (2015)





The ongoing revolution in data and knowledge, sometimes referred to as the ‘fourth industrial revolution’, is another key driver at European level. Emerging data sources, such as Earth observation and Earth systems models, can now be combined with socioeconomic data and contextual analysis to enable better informed policy decisions towards achieving the Sustainable Development Goals (SDGs) and environmental agreements (EEA, 2019a). ‘Big data’ generated through artificial intelligence and technological analytics can be used to generate new environmental knowledge to inform environmental assessment processes and advance better decision-making. Future sensor technology should allow disaggregation of spatial and demographic information at a detailed level. A combination of satellites and airborne and ground-based networks can be used to monitor developments (e.g. land use change, deforestation, drainage) and associated impacts at the local, regional and global levels in near real time, enabling rapid responses to changing circumstances. In addition, citizen science can enable the timely, cost-effective collation of *in situ* data from dispersed sources. All these new data collection, mapping and assessment advances will generate new insights and knowledge about the state of the environment, which in turn will inform policy responses to deal with the issues identified.

Ireland and the United Nations Sustainable Development Goals

Ireland has committed to the UN’s 2030 Agenda for Sustainable Development and to fully achieving the SDGs by 2030.

The UN’s 2030 Agenda for Sustainable Development and its SDGs are becoming a major influence and driver in environmental policy.⁶ For example, the Commission’s Green Deal (EC, 2019a) is an integral part of its strategy to implement the UN’s 2030 Agenda and the SDGs. This puts the ‘sustainable development goals at the heart of the EU’s policymaking and action’. The importance of the SDGs for environment policy is also highlighted in the recent state of the environment report from the EEA (2019a).

In Ireland, the *Sustainable Development Goals National Implementation Plan 2018-2020*, published by the DCCAE in 2018, provides for a whole-of-government approach to implementing the UN SDGs (DCCAE, 2018). The plan provides an ‘SDG Matrix’ that identifies the government departments responsible for each of the 169 SDG targets. According to the DCCAE, the plan identifies four strategic priorities to guide implementation: awareness, participation, support and policy alignment.

Another important national SDG policy document is Ireland’s Voluntary National Review report. This is Ireland’s report to the UN High-level Political Forum (Government of Ireland, 2018). The report looks at Ireland’s performance against each of the 17 SDGs, mainly using a range of Eurostat indicators developed for the SDGs. In Ireland, the task of gathering statistics on all of the SDG goals, targets and indicators, including the environmental indicators, has been given to the Central Statistics Office (CSO).⁷ The CSO, in collaboration with Ordnance Survey Ireland (OSI), has developed the Geohive public platform ‘for exploring, downloading and combining publicly available data relating to the UN and the European Union (EU) Sustainable Development Goals’.⁸ The Geohive also provides spatial data and includes ‘story maps and videos that provide a narrative to the SDGs and enable non-technical users to visualise the data’.

5. Improving Environmental Performance and Policy Implementation

Coherent Governance Structures are Key to Effective Implementation of Environmental Legislation and Policy

With the ever-expanding range and complexity of environmental policy and legislation, plans and programmes in place across different departments and regulatory bodies – which increasingly require cross-sectoral action – a review of national environmental governance in Ireland is timely. This review could consider the governance structures that would allow better coordination and integration of environmental protection work, and that would support the full implementation and enforcement of environmental legislation and policies. It could examine how to be more effective at providing information on the substantial range of work that is already carried out on the protection of Ireland’s environment.

In its 2019 EIR of Ireland, the Commission identified specific priority actions for Ireland to strengthen environmental governance, which are outlined in Topic Box 15.7.

6 <https://sustainabledevelopment.un.org/post2015/transformingourworld>

7 <https://www.cso.ie/en/unsdgs/>

8 <https://irelandsdg.geohive.ie/>



Topic Box 15.7 Priority Actions for Ireland to Strengthen Environmental Governance as Identified by the European Commission (EC, 2019b)

- Better inform the public about compliance promotion, monitoring and enforcement. At a minimum, this should involve publishing information on the outcomes of administrative enforcement action and of the follow-up to detected cross-compliance breaches on nitrates and nature.
- Provide more information on the practical aspects of cooperation and coordination between inspectors, police, prosecutors and others to combat environmental crime.
- Improve the publication of information on environmental damage.
- Ireland can further improve its overall environmental governance (such as transparency, citizen engagement, compliance and enforcement, as well as administrative capacity and coordination).
- Increase efforts to be a party to relevant multilateral agreements, by signing and ratifying multilateral agreements that are not yet signed or ratified.

The Organisation for Economic Co-operation and Development (OECD)'s recent review of the EPA highlighted that the fragmented nature of Ireland's environmental legislation is reflected in the way environmental protection responsibilities are dispersed across numerous public bodies and two government departments, with limited formal coordination structures (OECD, 2020).

Suggested Enablers for Improving the Implementation and Integration of Environmental Policy in Ireland

The remainder of this section discusses suggested enablers to help with continued improvement in the implementation and integration of environmental policy in Ireland. These suggestions have been informed by the findings of the Commission EIR (EC, 2019b) and key European and international reports (EEA, 2019a; UN, 2019). The insights gained from the EPA's involvement in reviewing plans and programmes as part of the Strategic Environmental Assessment (SEA) process and in regulation, monitoring and research across a range of environmental policy areas have also informed these suggestions.

Policy effectiveness hinges on good policy design; the common elements of good policy design, as identified by the UN, are outlined in Topic Box 15.8.

Topic Box 15.8 Common Elements of Good Policy Design (UN, 2019)

1. Setting a long-term vision through inclusive, participatory design processes.
2. Establishing a baseline of environmental conditions, quantified science-based targets and milestones.
3. Effectively integrating environmental, social and economic concerns.
4. Conducting *ex ante* and *ex post* cost-benefit or cost-effectiveness analyses to ensure that public and private funds are being used with optimal efficiency and effectiveness and that social aspects are being considered in sufficient detail.
5. Building in monitoring regimes during implementation that support adaptive policies, ideally involving affected stakeholders.
6. Conducting post-intervention evaluation of policy outcomes and impacts to close the loop for future policy design improvement.

The OECD's Indicators of Regulatory Policy and Governance (iREG) (OECD, 2018) show that, despite recent progress, Ireland still ranks well below average among OECD countries in the areas of stakeholder engagement in developing regulations and in *ex post* evaluation of regulations (i.e. whether or not the regulations are working and achieve their aims), highlighting the scope for improvements in these areas.



Integration and Policy Coherence

While there is a growing recognition of the need for more joined-up policymaking to tackle the complex and interdependent nature of environmental problems, actual mechanisms for promoting environmental and sectoral policy integration and coherence are not widely applied globally (UN, 2019). There is certainly scope for greater application of statutory assessments such as SEA and Appropriate Assessment, or non-statutory forms of sustainability appraisal, to improve the mainstreaming of environmental considerations into sectoral plans and programmes, such as those listed in Figure 15.2. To be effective, this integration needs to happen both in a vertical direction at different levels of the decision-making process, from national down to local level, and horizontally across sectoral decision-making, including transport, the built environment, energy, agriculture, etc.

Ultimately, however, more coherent policies, legislation and plans are needed both at European and at national level, instead of the 'silo-thinking' that has been characteristic of the past.

The UN 2030 Agenda for Sustainable Development calls on all countries to enhance policy coherence as an essential means of implementation for all the SDGs (SDG Target 17.14). The OECD has published recommendations designed to assist governments' efforts to enhance policy coherence for sustainable development and develop institutional mechanisms to align and coordinate actions among levels of government. Recommendations include encouraging formal governance arrangements and informal working methods that support effective communication between ministries and departments, and between ministries and other public sector bodies under their aegis; the use of high-level coordinating mechanisms; building capacity in public administrations and aligning training strategies and programmes with the principles and integrated nature of the SDGs; and engaging proactively with stakeholders in different phases of the policy cycle (OECD, 2019).

As part of efforts to improve policy coherence and resolve policy inconsistencies and conflicts, environmentally harmful policies and incentives also need to be identified and resolved, including aspects relating to Ireland's system of subsidies and taxes (e.g. subsidies on fossil fuels that hinder emissions reduction efforts and in fact promote pollution). The Commission has repeatedly stressed that there is potential for Ireland to improve how its tax system can support environmental objectives (EC, 2019b).

Developing Links between Land Use, Spatial Planning and Environmental Protection

There have been important recent developments in Ireland's spatial planning arena, including a new National Planning Framework with a long-term outlook to 2040, the establishment of Regional Assemblies to implement spatial planning decisions at a regional level, and the development of integrated metropolitan planning and transport policies. Another significant development has been the establishment of the Office of the Planning Regulator, an independent body, to provide oversight of regional and local-level plan-making and ensure that this is consistent with national and regional policies, which has climate action as a key part of its assessment criteria. The development of Ireland's first National Marine Planning Framework, currently under development, is another important milestone towards making informed and coordinated decisions about how to use marine resources sustainably.

Several chapters in this report have highlighted the need for more integration around land use management to serve as a means of coordinating how people, nature, food production, energy production and other economic activities can coexist and be supported to be developed in a sustainable manner. A new, more coordinated approach to land use management and all that this includes could be developed to steer Ireland's response to climate change, biodiversity loss and other environmental challenges in an integrated way in the years and decades ahead. Land mapping (land cover and land use) and environmental sensitivity mapping are the processes and tools needed to gather information for effective land management. In Ireland, the EPA and OSI are undertaking a dedicated national land cover programme. This aims to supplement previous maps such as CORINE (Coordination of Information on the Environment) with a national land cover map that is much more detailed in spatial resolution and classification structure. This work is covered in more detail in Chapter 5.

The application of an SEA can also be effective in ensuring that environmental and climate considerations are integrated into the development of public plans and programmes. An Environmental Sensitivity Mapping Webtool has been developed with EPA funding to support the SEA processes in Ireland.⁹ The webtool can highlight the relative environmental sensitivity of different areas and can be used 'to provide early warning, inform on the potential for land use conflicts and, in this way, provide a critical evidence basis for sectoral planning discussions and for developing alternatives that avoid or minimise potentially incompatible or unsustainable zonings' (González Del Campo *et al.*, 2019).

9 <https://www.enviromap.ie/>



The People Dimension and Community Engagement

To succeed, the development and implementation of environmental plans and programmes requires engagement and buy-in from businesses, farming, local communities and individuals. Communities, citizens and businesses need to be supported and empowered to protect and improve their environment. Both the climate action and the sustainable development agendas recognise the need for social considerations to be better factored into environmental and sectoral policymaking, to ensure a just transition and deliver on the broader range of the SDGs. This is reflected in the Commission's Green Deal, which focuses on enabling European citizens and businesses to benefit from the shift to a sustainable future in a way that is just and socially fair.

Implementation Requires Investment

Ultimately, improving the implementation of environmental policies, plans and programmes will require much greater levels of investment. This includes increased public funding for critical services such as water and wastewater treatment infrastructure and public transport. More widely, sustainable finance options will be needed to fund solutions and investment in green technologies, as well as funding for nature and community projects, monitoring, regulation and oversight. Securing this scaled-up investment hinges on political will, underpinned by public support.

Measuring Performance is Central to Driving Implementation

To improve implementation, developments are needed in how the performance of environmental and sectoral plans, policies and strategies are tracked and measured. It is difficult to gauge progress without tangible targets. Implementation improves when plans/programmes contain objectives, measures and actions that are measurable, verifiable and reportable. Monitoring of the environmental performance of plans/programmes could be improved with the development of a standardised set of objectives, targets and indicators for different environmental media, at difference scales. Opportunities for the sharing of resources and data would lessen the financial burden of monitoring. Performance data should be publicly available, for example by the publication of annual indicator reports

Learning from Good Practice

Ireland already has many examples of delivering positive results for environmental protection where there are clear policies, commitments and resources, including the regulation of industry and LIFE nature conservation projects. The Water Framework Directive governance structures provide a positive example of collaboration across multiple public authorities, while on the enforcement side, the NIECE network for compliance and enforcement is an internationally recognised example of good practice. Improvements in Building Energy Ratings were driven by changes in the building regulations. In terms of public engagement, recent positive developments include the National Water Forum, the local authority Community Water Officers, the Citizen's Assembly and the National Dialogue on Climate Action.

There are also some promising signs that improved policy coherence is starting to emerge. For example, the NECPs are intended to improve consistency between energy and climate policies and could therefore become a good practice example of how to link sector-specific policies with other interlinked themes such as agriculture-nature-water and transport-air-noise-health, with a view to fostering synergies and delivering co-benefits. Similarly, the Ag-Climate roadmap currently being developed by the Department of Agriculture, Food and the Marine seeks to link agriculture-climate-air-ecosystems. At the EU level, improved levels of environmental and cross-sectoral policy coherence are evident in the revised Bioeconomy Strategy, Circular Economy Package and the Green Deal.

Building on these collective findings, some suggested enablers for improving Ireland's implementation, integration and monitoring of environmental legislation, policy, plans and programmes are presented in Table 15.2.



Table 15.2 Suggested enablers for improving the implementation and integration of environmental policy, plans and programmes in Ireland

ENABLERS FOR IMPROVING IMPLEMENTATION			
 <p>Governance Strong implementation structures and governance arrangements are needed to ensure that legislation and policy is implemented and plans and programmes are delivered at the appropriate levels. There is a need for coordinated and integrated approaches as the delivery of many of the targets will require cross-sectoral action</p>	 <p>Measurable targets Implementation improves when plans/ programmes contain objectives and measures that are measurable, verifiable and reportable</p>	 <p>Enforcement Greater oversight and enforcement is needed to address a lack of implementation and poor compliance in a number of key environmental policy areas such as those as identified in EPA enforcement reports</p>	 <p>Investment Far greater investment is needed to fully implement all of Ireland's environmental legislation, policies, plans and programmes, including increased public funding for critical services, nature and community projects, monitoring, regulation and oversight and sustainable finance options to fund solutions in green technologies</p>
ENABLERS FOR IMPROVING INTEGRATION			
 <p>Overall vision A long-term vision is needed for Ireland's environment and a coherent overarching and ambitious plan for achieving this</p>	 <p>Collaboration With many of the key environmental challenges requiring coordinated cross-sectoral action, greater collaboration is needed across government departments and public authorities</p>	 <p>Development planning The National Planning Framework and reformed governance structures should facilitate more coordinated long-term development planning. The new Office of the Planning Regulator will undertake independent reviews of all local authority statutory development plans to ensure consistency with relevant regional and national policies, including on climate action</p>	 <p>Integrated land mapping An integrated approach to land mapping at national and regional level would enable Ireland to plan, coordinate and deliver the various datasets and interventions needed for sustainable land use management and to tackle key environmental challenges</p>
 <p>New data and evidence High-quality, accessible and up-to-date environmental information is needed to inform better, more integrated plan-making action at different levels. This includes new decision support tools, mapping capabilities, etc.</p>	 <p>Closing gaps There are gaps in Ireland's environmental policy that need to be addressed. Notable examples include the National Clean Air Strategy, which is yet to be published, and the continuing lack of a national landscape characterisation map</p>	 <p>Role of SEA Promote and strengthen the role of SEA and improve the effectiveness of these assessments in influencing planning policy decisions at national, regional and local levels</p>	
ENABLERS FOR IMPROVING MONITORING AND PUBLIC PARTICIPATION			
 <p>Monitoring and reporting Ongoing monitoring of implementation progress is essential, so that the performance of plans, policies and strategies can be tracked and measured. Performance data should be publicly available, for example by publishing annual indicators, to provide accountability and transparency around how well environmental commitments are being met</p>	 <p>Tracking Environmental policies, plans and programmes cut across and intersect a wide range of sectoral policies, plans and programmes across various departments and public authorities. A centralised government database (for example on the gov.ie website) would facilitate better tracking of plans and programmes and improve public information, as well as help identify synergies and gaps</p>	 <p>Public participation To succeed, the development and implementation of both sectoral and environmental plans and programmes requires engagement and buy-in from businesses, farming, local communities and individuals. Communities, citizens and businesses need to be supported and empowered to protect and improve the environment and to demand that development takes place in an environmentally sustainable way</p>	 <p>Access to justice Further improve information about citizens' rights to accessing justice in environmental matters and enable them to bring environmental challenges without facing prohibitive costs</p>



6. Conclusions

Summary Assessment of Ireland's Implementation Performance

This section presents a summary of the EPA's assessment of Ireland's performance in implementing key environmental policy and legislation in the areas of climate, air, nature, water and waste/circular economy, based on the high-level

performance assessments presented earlier in this chapter and the findings presented elsewhere in this report.

Selected relevant indicators for each of these policy areas are presented in Table 15.3, illustrating the current status/level of compliance, the dominant trend over the past 20-25 years, and the outlook/prospective of Ireland meeting the relevant policy objectives/targets.

Table 15.3 Current assessment and outlook for Ireland across five key environmental policy areas (Source: EPA, based on evidence and assessments presented in this report)

	POLICY AREA	CURRENT		NOTES
		ASSESSMENT	OUTLOOK	
 CLIMATE	Climate			
	Greenhouse gas (GHG) emissions			Greenhouse gas (GHG) emissions have not been sufficiently decoupled from economic activity. Ireland had the third highest per capita GHG emissions in the EU in 2017 (EEA, 2019a), resulting in a current assessment of very poor. Our 2020 target will not be met without relying on purchasing credits or allowances (EPA, 2020b). Decarbonisation of energy will need to be accelerated rapidly to achieve our 2030 target and enable achievement of the current or emerging 2050 transition objective. Steps to reduce other GHG emissions are urgently needed.
	Renewable energy share			Despite considerable expansion in recent years, Ireland's renewable energy share (at 10.7%) remains well below the EU average (17.5%), with fossil energy making up 90% of Ireland's energy needs. Ireland looks set to fall short of reaching binding EU renewable energy targets for 2020. National targets for 2030 imply significant further expansion in this period which will then need to continue.
	Climate adaptation			There have been good advances on the planning and governance side, with the establishment of the Climate Action Regional Offices, and all sectors and Local Authorities now have climate adaptation strategies and plans in place. However, there is little evidence of the implementation of these strategies or plans to date.
	Overall climate assessment			While there has been some progress on renewable energy and ambitious climate action and adaptation plans, Ireland's failure to significantly reduce GHG emissions results in a 'very poor' current assessment. Meeting 2030 targets and our 2050 transition objective will require the full implementation of current policies and measures and significant national investments.



	POLICY AREA	CURRENT ASSESSMENT	OUTLOOK	NOTES
AIR	Air quality			
	Particulate matter (PM _{2.5} and/or PM ₁₀)			Compliant in 2019 with EU limits but a number of exceedances of WHO guideline values in urban areas (EPA, 2020c). Increased monitoring is highlighting high levels in many Irish cities, towns and villages. Particulate matter from the burning of solid fuel is estimated to cause 1300 premature deaths per year. Low-smoke zones and climate action measures will have benefits for air quality and health.
	Nitrogen oxides (nitrogen oxide and nitrogen dioxide)			Concentrations are moderate but increasing due to growth in traffic numbers. EU air quality limit values for nitrogen dioxide were exceeded during 2019 at one site in Dublin (EPA, 2020c); indications are that there will be exceedances at further monitoring stations in the future. Climate action measures will have co-benefits for air quality and health.
	Ozone (ground level)			Compliant in 2019 with EU limits but some exceedances of WHO guideline values in the past and exceedances at two sites in 2019 (EPA, 2020c). Measures to reduce nitrogen oxides will impact the potential for formation of ozone in sunny weather conditions. There is a risk from impact of transboundary ozone (from outside Ireland).
	Polycyclic aromatic hydrocarbons (PAH)			Polycyclic aromatic hydrocarbons (PAH) are emitted residentially from the combustion of solid fuels, such as peat, wood and coal. PAH are known carcinogens. Compliant in 2019 with EU limits but exceedances of EEA reference values at four sites indicate that PAH in ambient air are due to the burning of solid fuels is a large problem in Ireland's cities and towns (EPA, 2020c). Low-smoke zones and climate action measures will have benefits for air quality and health.



	CURRENT		
POLICY AREA	ASSESSMENT	OUTLOOK	NOTES
Emissions to air			
Nitrogen oxides			Ireland's national emissions limit for nitrogen oxides has been exceeded since 2010, although emissions decreased slightly in 2018. Lower EU limits will come into effect in 2030. Based on the latest EPA projections (EPA, 2020d) nitrogen oxide emissions are projected to reduce and to be compliant, provided planned measures, particularly in relation to the Climate Action Plan, are implemented; however, further measures may be required to ensure compliance in 2030.
Sulphur dioxide			Emissions have decreased by 93.3% since 1990, owing to fuel switching and reduced sulphur content of fuels. On track to meet 2030 targets (EPA, 2020d).
Non-methane volatile organic compounds (NMVOCs) emissions			Emissions of non-methane volatile organic compounds (NMVOCs) are increasing, arising from the food and beverage industry and the storage and handling of animal manures and synthetic fertilisers. Emissions of NMVOCs decreased slightly in 2018. Currently slightly off track to meet 2030 emissions target (EPA, 2020d), indicating further measures are required.
Ammonia emissions			Ammonia emissions are increasing, linked with agriculture. Emissions breached national ceiling under the National Emission Ceilings Directive in 2018 for the third successive year (EPA, 2020d). Currently not on track to meet 2030 emissions target. The underlying drivers are the use of animal manure and nitrogen fertilisers, which can be reduced through widespread adoption of on-farm measures.
Particulate matter (PM _{2.5} and/or PM ₁₀) emissions			Emissions of particulate matter (PM _{2.5}) have decreased by 62.8% since 1990, mainly due to fuel switching in the residential and commercial sectors, and improvements in vehicle engine technology. There was a small increase in emissions of particulate matter in 2018, mainly due to increased heating requirements in homes and buildings. Projected to meet 2030 EU emissions target subject to agreed national actions being implemented (EPA, 2020d).
Overall air assessment			While overall air quality in Ireland is good, there are localised issues with some pollutants (such as particulates) that have serious potential health impacts, resulting in an overall current assessment of 'moderate'. Ireland is generally meeting EU air quality limits but not some WHO guideline values in places, and nitrogen oxides exceedance in 2019 is a warning about not being complacent in tackling air pollution. Not on track to meet National Emission Ceilings Directive targets for ammonia due to emissions from agriculture. Mixed progress in reducing overall emissions from transport and energy. Overall, Ireland's prospect of meeting targets and policy objectives is heavily dependent on agreed national measures being implemented.



POLICY AREA	CURRENT ASSESSMENT	OUTLOOK	NOTES
Nature			
Conservation status of EU protected habitats			Based on the latest assessments (NPWS, 2019), 15% of EU protected habitats have a favourable conservation status, while 85% have an inadequate or a bad status. In terms of the trends in EU protected habitats, 53% are stable, 46% are declining, and only 2% are improving.
Conservation status of EU protected species			Based on the latest assessments (NPWS, 2019), 57% of EU protected species have a favourable conservation status; 30% have an inadequate or a bad status. In terms of the trends in EU protected species, 55% are stable, 17% are improving, 15% are declining, and 13% are unknown.
Status and trends of bird populations			Almost 20% of Ireland's breeding bird species are in long-term decline. Approximately 30% of breeding species populations are stable or have increased over the long term. This includes some relatively recent colonists. Some of our breeding farmland songbirds are under increasing pressures from the modernisation and intensification of agricultural practices. Breeding waders such as the curlew and lapwing have seen a 93% decline in breeding populations over the long term. The populations of over half of wintering birds are declining over the short term, this includes waders and duck species. Ireland's wintering waterbirds may be responding to climate change as many species are showing a north-easterly shift in their range across Europe.
Butterflies			Butterfly populations are sensitive to changes in climate and land use. The Irish Butterfly Monitoring Scheme, coordinated by the National Biodiversity Data Centre (NBDC), shows that the current long-term trend is of moderate decline. Across 15 common and widespread species, the highest butterfly populations observed since the monitoring scheme began in 2008 were recorded in 2010 and the lowest in 2016. Five species have experienced serious or moderate population declines since 2008, three species have increasing populations, four have stable populations and three are too variable to assign a statistically rigorous trend (NBDC, 2019; Judge and Lysaght, 2020).
Overall nature assessment			Overall current assessment is 'very poor'. Deteriorating trends dominate, especially for protected habitats. In the absence of far-reaching measures, the outlook is largely not on track to meeting policy objectives.


NATURE



	POLICY AREA	CURRENT ASSESSMENT	OUTLOOK	NOTES
WATER	Water			
	River water quality			Current assessment is 'poor'. Only 53% of river water bodies have a good or high status (EPA, 2019). Trend shows a mixed picture with some improvements, but notably there have been serious declines in the number of high status sites and an increase in poor status waters. Significant challenges remain to achieving full compliance.
	Lake water quality			Current assessment is 'poor'. Only 50% of lake water bodies have a good or high status (EPA, 2019). Trend shows a mixed picture. Significant challenges remain to achieving full compliance.
	Transitional water quality			Current assessment is 'very poor'. Only 38% of transitional water bodies have a good or high status (EPA, 2019). Trend shows a mixed picture. Significant challenges remain to achieving full compliance.
	Coastal water quality			Current assessment is 'very good', with 80% of coastal water bodies having a good or high status (EPA, 2019). Trend is stable. Largely on track to achieving full compliance but some issues remain.
	Marine environment			The Marine Strategy Framework Directive Article 17 report found that 6 of the 11 MSFD descriptors were compatible with good ecological status, indicating partial compliance (DHLGH, 2020). Trend information is not available. Challenges remain for achieving full compliance.
	Groundwater quality			92% have a good or high status (EPA, 2019). Trend is improving, although there are elevated nitrate concentrations at some monitoring stations, particularly in the south and south-east region, and localised issues with pathogens linked to domestic wastewater treatment systems. The presence of hazardous substances in groundwater is not a widespread water quality issue. Largely on track to achieving full compliance.
	Urban wastewater treatment			Over half (56%) of the wastewater load was not compliant with EU treatment standards in 2019 (EPA, 2020e). Improvements are needed at 113 priority urban areas to eliminate raw sewage, prevent water pollution, protect freshwater pearl mussels and bathing waters and meet EU standards. Trend is improving, but from a low base; progress is slow and significant challenges remain to achieving full compliance.
	Bathing water quality			95% have a sufficient status, 89% have an excellent or a good status (EPA, 2020f). Trend is improving. Largely on track to achieving full compliance with 'sufficient' target, but still below EU average for 'excellent'.



	POLICY AREA	CURRENT ASSESSMENT	OUTLOOK	NOTES
	Drinking water quality			Private supplies have poorer compliance and substantially worse drinking water quality than public water supplies with challenges remaining. While compliance is over 99% in public supplies (EPA, 2020h), there is a concern about long-term boil water notices, detections of <i>Cryptosporidium</i> and elevated levels of disinfection by-products (THMs), lead and pesticides. As of July 2020, there are 52 public water supplies on the EPA's Remedial Action List. Irish Water's progress at implementing solutions for these supplies has been subject to delays and increasing uncertainty. Remaining issues need to be addressed through upgrade and replacement programmes.
	Overall water assessment			Overall, current assessment is 'poor'. Trends are mixed, with serious declines in pristine river sites. In terms of outlook, significant challenges remain to achieving full compliance and meeting policy objectives.
 WASTE AND CIRCULAR ECONOMY	Waste and the circular economy			
	Generation of municipal waste			Generation of municipal waste increased in 2018 to 600 kg/person (up from 577 kg/person in 2017) (EPA, 2020e). Mixed trend over past 20 years, correlating closely with variations in disposable income, indicating a failure to decouple waste generation from economic activity. Reducing waste generation will require the implementation of new waste prevention and consumption reduction measures.
	Recycling of municipal waste			Recycling rates have stagnated since 2010 and more recently shown a decline (EPA, 2020e). Waste characterisation studies show that a large share of recyclable waste (packaging, food) is put in the wrong bin and so is not being recycled. On track to meet 2020 target but the much more stringent targets for 2025 and 2030 will pose a challenge.
	Recycling of packaging waste			Meeting current targets but recycling rates for some packaging streams are stagnating or declining and much more stringent targets will apply from 2025 and 2030 (EPA, 2020e). Significant challenge to meet future targets for individual packaging streams, in particular plastic. Waste characterisation studies show that two-thirds of plastic packaging waste presented in kerbside bins is not currently recyclable in Ireland.
	Landfilling of municipal waste			Landfill rates have fallen steadily in Ireland, from 84% in 2001 to just 14% in 2018 (EPA, 2020e). However, meeting the 2030 limit of 10% municipal waste disposed to landfill will be challenging.
	Biodegradable waste diversion from landfill			Currently compliant with 2020 target by a large margin and trend is improving with brown bin roll-out and more widespread mechanical pre-treatment of residual waste prior to landfilling (EPA, 2020e).



POLICY AREA	CURRENT ASSESSMENT	OUTLOOK	NOTES
Collection and recovery of electrical and electronic waste			Compliant with current collection and recovery targets; however, significantly increased targets apply from 2019. Rates are gradually improving (EPA, 2020e); expected to achieve compliance with new targets by a close margin.
Circular (secondary) material use rate			Rates of circular (secondary) material use have remained consistently low in Ireland since 2010 at below 2% compared with an EU average of 11% in 2017 (EC, 2019b).
Overall waste and circular economy assessment			Overall current assessment is 'poor'; while Ireland is meeting current targets, recycling rates for municipal waste and packaging have levelled off and in some cases declined and waste generation remains high and linked to economic activity, while circular use of material remains very low. Publication of new national waste policy is welcome. Achieving future EU targets and circular economy goals will be dependent on rigorous implementation of waste legislation, policy initiatives and measures.

CURRENT ASSESSMENT: Summary assessment 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/fully achieving objectives

OUTLOOK: Current prospect 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, 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.



Overall Assessment of Progress

It is clear from the trends that the scale of improvements being made is insufficient to meet long-term objectives and that, despite policy efforts, the majority of Ireland's agreed environmental targets will not be met.

Since the first edition of Ireland's state of the environment report in 1996, there have been many examples of environmental improvement in Ireland. This is seen especially where problems have been well identified and are manageable and where regulatory and technological solutions have been readily available, such as in the areas of waste management, industrial emissions and wastewater discharges. Further improvements can be achieved through the more effective implementation of existing policies. It is clear from the trends, however, that the scale of improvements being made is insufficient to meet long-term objectives and that, despite policy efforts, the majority of Ireland's environmental targets and commitments will not be met. For climate, biodiversity and water, most targets will not be met in the short to medium term, while for air and waste, although Ireland is meeting many of its current targets, a concerted effort will be needed to achieve the more stringent longer term targets in the future.

Similar to the trend across Europe and globally (EEA, 2019a; UN, 2019), it appears that environmental policy efforts, improvements and efficiency gains in Ireland are being offset by increasing demand, driven by population and economic growth and unsustainable patterns of production and consumption, as well as climate change. These have resulted in an overall deterioration in many aspects of Ireland's environment. The most recent state of the European environment report for 2020 (EEA, 2019a) concludes that European policies have been more effective in improving efficiency than in protecting ecosystems and human health and wellbeing, and the same appears true in Ireland. That report calls for more systemic, transformative policy frameworks to tackle climate breakdown and the biodiversity crisis and to implement sustainable development. The most recent UN GEO-6 report (UN, 2019) makes a similar call for more ambitious and effective policies, including sustainable consumption and production, greater resource efficiency and improved resource management, integrated ecosystem management, and integrated waste management and prevention. The EEA report recommends embracing the 2030 Agenda and the UN SDGs as an overarching framework for policymaking and action, as well as fully implementing existing policies, improving policy coherence and addressing current policy gaps.

Building on these collective findings, with better implementation and more integrated, ambitious policies, many of these issues could be minimised and trends reversed. The suggested enablers for improving the implementation of environmental policy in plans and programmes in Ireland include more effective governance structures, measurable targets, enhanced oversight and enforcement, and greater investment. For improving integration, suggested enablers are more integrated development and land mapping, SEA, collaboration, closing policy gaps, and using new data and evidence to inform policy. The enablers for improving monitoring and public participation include monitoring and reporting on implementation and performance, tracking plans and programmes, greater public awareness and engagement in the entire process and enhanced access to justice.





Chapter Highlights for Environmental Performance, Policy and Implementation



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 being made are insufficient to meet long-term EU and national objectives such as those covering water quality, air quality, nature protection, reducing emissions to air and the ambition for a climate-neutral economy and climate neutrality by 2050. To improve implementation, sustained improvements are needed in how the performance of environmental and sectoral plans, policies and strategies are coordinated and tracked, their effectiveness is measured and the outputs of such measurements are fed back into reviews and future updates.



The successes in environmental policy implementation to date, for example around industrial emissions and waste management, were hard won. These successes are being offset by increased levels of population growth, unsustainable patterns of production/consumption and climate change, resulting in a net decline in the state of Ireland's environment. To reverse these trends, Ireland needs to improve the implementation and enforcement of existing environmental legislation and policy at all scales, from national to local levels. This can be supported through more effective governance structures, greater focus on monitoring and performance evaluation, enhanced oversight and enforcement, and higher levels of investment.



Tackling the complex and interlinked challenges facing the environment will require the development of more integrated, coherent and ambitious environmental policy frameworks and a clear national policy position for Ireland's environment.



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Chapter 16

Conclusions





Conclusions

1. Introduction

Four years from now, we envisage that the next state of the environment report will provide evidence of solutions to the environmental challenges outlined in this report being implemented, and at an accelerating pace. We hope to be reporting on improved compliance rates with environmental targets and presenting case studies about projects that are making a difference to the local environment and communities across the country. Solutions already exist in many cases; based on solid research they are articulated in national plans relating to climate, biodiversity, water and a circular waste economy, for example. If fully implemented, these plans will improve Ireland's environment. The focus in the short term now needs to be on accelerating the implementation of these plans.

Our report attests to a greater awareness of the problems and the challenges we face as well as a greater awareness about the positive benefits of a clean environment for health and wellbeing. Notwithstanding the difficulties people face during the on-going COVID-19 crisis that began in March 2020, we live in a time when there is societal momentum for change. The crisis has led many of us to redefine what we truly value and has shown us the importance of the natural environment in our local areas. Ireland's green and blue spaces are essential components of Ireland's health infrastructure and include urban parks, coasts, lakes and rivers, forests and bogs. Clean and protected green and blue spaces allow people to get out in nature and away from the everyday stresses to the benefit of health and wellbeing.¹

The environmental challenges that Ireland faces are giving rise to complex and systemic issues. These cut across different key environmental topics, such as water, air, soil, waste and biodiversity, and across organisations and sectors, business and all levels of society. They are taxing economically, technically, sociologically and administratively. Reducing greenhouse gas (GHG) emissions, adapting to climate change and protecting biodiversity are the main challenges. But there are other issues that require urgent attention, including managing the health risks from pollutants, chemicals and pathogens in the environment. Then there is the challenge around our consumption of resources and failing to maximise the value of the resources we have extracted. Integrated solutions will be needed to address these challenges,

bringing with them change, and associated losses and gains to sectoral interests. Many of the actions needed are linked; for example, there are synergies between biodiversity protection, land use and Ireland's transition to a climate-neutral, climate-resilient society.

Unspoilt areas are being squeezed out and we are losing our pristine waters and the habitats that provide vital spaces for biodiversity. New measures are needed to deal with many of these challenges, but, as this assessment shows, full implementation of, and compliance with, existing directives, legislation and plans could make a significant difference as well.

Ireland needs an overall integrated national policy position on the environment, or it risks existing environmental protection measures failing or competing with each other. This policy position could set out the ambition for protecting Ireland's environment in the short, medium and long term. It could also set out how the legacy of a protected environment for future generations to enjoy could be achieved, as well as emphasise the importance of a clean, safe and protected environment for health and wellbeing. It should be a national policy position that all government departments, agencies, businesses, communities and individuals can sign up to in order to play their part in protecting our environment.

This chapter will discuss an environmental scorecard for Ireland (section 2), Ireland's environment in a European context (section 3) and overall key SOE messages for Ireland (section 4). It concludes with a final section on the highlights from the individual chapters of this report (section 5).



¹ Using green and blue spaces will benefit both your physical and mental health <http://www.epa.ie/newsandevents/news/name,69592,en.html>



Existing Measures Have Been Only Partially Successful in Addressing Environmental Issues

The Environmental Protection Agency (EPA) 2016 state of the environment report outlined that Ireland was at a crossroads in terms of how it addressed the global environmental challenge of climate change (EPA, 2016). Four years on, projections show that Ireland will not meet its 2020 targets for reducing GHG emissions by domestic actions alone. The purchase of reductions is likely to be required to ensure compliance with EU requirements. The latest GHG data compiled by the EPA for 2019 show that Ireland exceeded its annual emissions allocation for 2019 under the EU's Effort Sharing Decision by almost 7 million tonnes, and is therefore not on the pathway required to meet its 2020 targets (EPA, 2020a). This follows an exceedance of 5 million tonnes in 2018. EPA projections on GHG emissions for reductions this decade out to 2030 indicate that it will be a serious challenge to meet these targets too; however, it could potentially be achieved if decisive action is taken now to implement the commitments and measures in the Climate Action Plan (EPA, 2020b; DCCAE, 2019).

Water quality in Irish rivers has further declined over the past 4 years. Biodiversity continues to be at risk due to habitat loss and damage. Too few of Ireland's sea areas have been designated as marine protected areas. Local authorities still receive tens of thousands of complaints each year about waste and litter issues.

We need a common understanding about what the circular economy means for how we consume and use raw materials and how we can maximise the value of materials and products during their lifespan and extract the maximum value of resources within waste. A large share of packaging waste is not currently recyclable in Ireland, and packaging recycling rates have been gradually declining since 2012. Sectoral plans for transport, energy and agriculture will need to demonstrate that they remain focused on achieving their environmental commitments through good-quality environmental data and evidence. These are all major systemic issues requiring immediate and relentless action. The Strategic Environmental Assessment process provides a mechanism for the environmental effects of sectoral plans to be assessed and monitored. What is lacking is an obligation to report on this monitoring. Better and more integrated implementation of existing legislation, plans and policies is needed to reverse the negative environmental trends outlined in this report, but new measures are also needed to change how the environment is viewed and protected.

Where there are Clear Policies, Commitment and Resources, there have been Positive Results for Environmental Protection

There are positive areas to highlight as well. Since the first of the series of Ireland's state of the environment reports was published in 1996, many examples of environmental improvement have been recorded. These include successes in the areas of industrial regulation and emissions, waste management and wastewater discharges. For the most part, these improvements are more apparent where site-specific problems were identified and where regulatory regimes, technological solutions and investment have been readily available. Over the last 20 years, 120 poorly operated landfills have been replaced by four modern facilities and we have moved from disposing of nearly 100 per cent of municipal waste to landfill to sending a residual of 15 per cent to landfill. The plastic bag levy has also altered behaviours. Industrial regulation is working efficiently with environmental information openly available on-line to all. There have also been improvements in the monitoring of drinking water and air quality.

National and community-level initiatives are now working well to improve the environment. They include initiatives to prevent food waste, work on Ireland's Citizens' Assembly climate module, the National Dialogue on Climate Action, integrated action to improve water quality in catchments, citizen science projects and nature conservation projects such as those covered by the European Innovation Partnership for Agriculture Productivity and Sustainability (DAFM, 2019), the LIFE and Leader programmes and other funding mechanisms. The EPA-coordinated and more widely coordinated, national environmental research projects provide expert scientific support and evidence for environmental policy development, implementation and broader decision-making. We need to better use the knowledge gained from best practice projects and research to help protect and improve our natural environment and human health.



Responding to Environmental Challenges in Uncertain Times

The response to the 2020 coronavirus pandemic is an example of a whole-of-government and whole-of-society response to tackling a public health emergency (Topic Box 16.1). A similar response between society and government is needed to tackle Ireland's key environmental issues, such as climate change and biodiversity loss. During the pandemic restrictions, people observed changes in their local environments – both positive and negative – that are linked to how Ireland's people, its communities and its economy go about business generally.

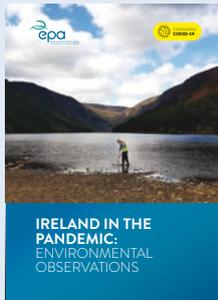
The transition out of the coronavirus crisis will provide an opportunity to deliver wider environmental and environmental health and wellbeing dividends. Quieter roads, less traffic and a better appreciation of local green and blue spaces, together with their biodiversity, including wildflowers, butterflies and birds, were valued as quality-of-life improvements that we should strive to maintain and improve on. At the very least, we need to ensure that economic interventions contribute to a more sustainable, less carbon-intensive economy; facilitate the development of a national infrastructure that is fully climate resilient; leave space and wild places for biodiversity, ecosystem services and people; and ensure that emissions and air pollutants are controlled to protect public health. As outlined in Chapter 1, any national economic stimulus package needs to have a strong green investment focus, allied to strong public awareness. This will present real opportunities to advance Ireland's environmental transition ambitions and its adaptive capacity while delivering enduring economic and social benefits.





Topic Box 16.1 The Environment During the Coronavirus (COVID-19) Pandemic

The Department of Health confirmed a total of 2010 COVID-19-related deaths and 69,473 cases of COVID-19 on 19 November 2020.² As well as affecting public health, the necessary restrictions to limit the transmission of the coronavirus very quickly gave rise to a severe recession and unprecedented levels of unemployment (Department of Finance, 2020). The coronavirus pandemic continues to affect many aspects of Irish society, including the environment.



The EPA report *Ireland in the Pandemic: Environmental Observations* (EPA, 2020c) details how environmental issues were affected during the COVID-19 mandatory 'stay at home' and subsequent restriction periods. Primarily, the combination of less traffic on the roads, the curtailment of industrial activities and flights and the increase in the number of people working from home led to changes in emissions and in the generation of waste. The report's findings were as follows:

- Air quality improved in urban areas, with a significant decrease in pollution from traffic, but no apparent change to date in pollution from burning solid fuels in the home. The situation in relation to emissions in urban areas from the burning solid fuels in the home could change as winter approaches.
- There was a sharp rise in household waste and a decrease in commercial and retail waste reflective of people being at home and closed commercial and retail premises. In tandem with the increase in domestic waste, there was evidence of an increase in illegal dumping, and enquiries to the EPA website increased fourfold in relation to illegal backyard burning.
- A large increase in environmental complaints was recorded during the initial restriction period. The EPA worked with local authorities and others to make sure that complaints were addressed. In addition, the EPA investigated complaints received from the public about licensed facilities.

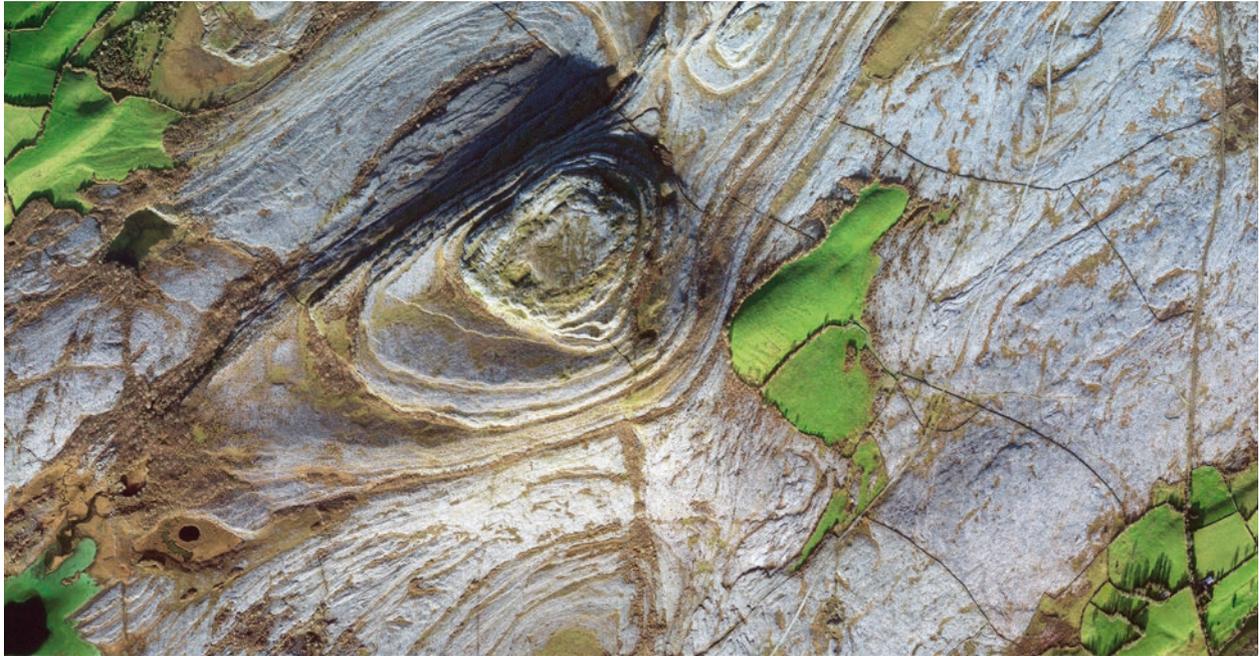


A further joint report from the EPA and the SEAI is expected to be published in 2020 covering GHG emissions during the COVID crisis. Ongoing work in the preparation of this report has indicated that there was a decrease in air pollutants and GHG emissions from the transport and energy sectors with agricultural emissions largely unaffected. Lower fuel prices may have an impact on efforts to decouple industrial emissions from economic growth as COVID restrictions ease (EPA, 2020d).

COVID-19 stay safe at work poster published by the Department of Health.

A small-scale research study, commissioned for this report, looked at the main environment-related impacts arising from the COVID-19 pandemic in Ireland, both positive and negative (O'Leary *et al.*, 2020a). This study provides a detailed assessment of data across several environmental areas for March and April 2020, which includes the time frame from the implementation of initial restrictions (12 March) to the start of the eventual lock-down (27 March). Data for May 2020 were also included where available (see Figure 1.1 in Chapter 1 for a summary of the findings). A further COVID-19-related research study examined issues around access to and use of blue and green spaces during the initial phases of the COVID-19 pandemic in Ireland (Kindermann *et al.*, 2020). This research highlights that 'the COVID-19 new normal presents a unique transformative opportunity to rapidly "reset the system", to alter behaviours and attitudes towards blue/green spaces for the betterment of our environments, and for our health and wellbeing'.

² <https://www.gov.ie/en/news/7e0924-latest-updates-on-covid-19-coronavirus/>.



Aerial view of parts of the Burren, Co. Clare

2. Environmental Scorecard for Ireland

A wide range of environmental regulations, plans and policies are now in place in Ireland to protect and improve the environment. The evidence presented in this report indicates that some legislation, plans and policies have been more effective than others at improving regulation and reporting and have been more successful at addressing very specific environmental issues. However, we are now dealing with different challenges where we need a much stronger focus on integrating the environment into sectoral policies and addressing wider systemic issues.

The summary scorecard analysis shown in Table 16.1 suggests that the scale of improvements now being made is insufficient to meet long-term objectives and targets, especially for more diffuse and systemic issues. The objective to deliver on people's expectations to live in a healthy and protected environment will not be met in the short or medium term (2030) without transformative changes. Table 16.1 summarises the trends and outlook for Ireland across selected policy areas.



Table 16.1 Current summary assessment and future outlook scorecard for Ireland for selected environmental policy areas (Source: EPA, 2020, based on evidence and assessments presented in this report)

POLICY AREA	CURRENT ASSESSMENT	OUTLOOK
Climate 	<p>Continuing high emissions result in a 'very poor' current assessment, despite progress on renewable energy, ambitious climate action and adaptation plans and strategies, and new governance structures (e.g. the Climate Action Regional Offices). 2020 emissions reductions targets will not be met without relying on purchasing credits or allowances.</p>	<p>Major transitions and system change is needed to become a climate-neutral economy and society by 2050. The Climate Action Plan is the first step in the right direction, but accelerating implementation is needed to meet longer term (2050) targets. Latest projections suggest that, if all Climate Action Plan measures are adopted and fully implemented, 2030 targets will be met. A focus is also needed on delivering on the ambitions outlined in the climate adaptation plans and strategies.</p>
Air Quality and Emissions 	<p>While overall air quality in Ireland is good, there was an exceedance of nitrogen dioxide at one Dublin monitoring site in 2019. This exceedance is a warning about not being complacent in tackling air pollution. On occasions, air quality is not meeting all World Health Organization guideline values for some air pollutants (mainly particulates) that have serious potential health impacts. Ireland is not meeting EU targets on emissions of ammonia to air under the National Emissions Ceiling (NEC) Directive (2016/2284/EU); agriculture is the main source of ammonia emissions. Mixed progress in reducing the overall emissions to air from transport and energy sources.</p>	<p>There is a risk of further exceedances of emissions targets set in the NEC Directive. Also, there is a risk of local exceedances of air quality standards if reductions are not made in home heating emissions from burning solid fuels and in transport emissions from vehicles in urban areas. The exceedance of the NEC Directive for ammonia will continue unless measures are adopted at farm level. The prospect of meeting air quality targets is heavily dependent on national measures being implemented.</p>
Water 	<p>Overall, current assessment is poor. Trends are mixed with serious declines in pristine river sites. Just over 50% of surface water is in a satisfactory ecological condition. This means that almost half fails to meet the legal requirements of the Water Framework Directive (2000/60/EC). There have been deteriorating water quality trends over the past 20 years, especially for rivers, where there have been major decreases in the numbers of the cleanest and best quality rivers. Progress remains slow in improving urban wastewater treatment, eliminating untreated sewage discharges and reducing nutrient loss from agriculture.</p>	<p>Outlook is mixed, and significant challenges remain to achieving full compliance and meeting policy objectives. Extensive targeted action on water catchments, enforcement of existing legislation and implementation of best practice policies could potentially turn around the deteriorating trends. This depends on environmentally sustainable improvements in agriculture, wastewater investment and better management of nutrients and other land use drivers. A key factor is balancing nutrient emissions from the intensive agriculture sector with the need for better environmental protection.</p>



POLICY AREA	CURRENT ASSESSMENT	OUTLOOK
Nature 	 <p>Overall, current assessment is very poor. Deteriorating trends dominate, especially for EU protected habitats, with 85% of EU protected habitats having an unfavourable status. The picture for EU protected species is mixed, but 15% are in decline, with freshwater species most at risk. Agricultural practices are a key pressure. Habitat changes point towards a deteriorating trend in overall biodiversity. Some species, such as the curlew and some freshwater species, are under threat; measures are needed to halt their decline.</p>	 <p>Largely not on track to meet policy objectives. The outlook for biodiversity is challenging unless there are fundamental changes. Climate change adds to the challenge. Transformative change is needed to achieve the vision in the National Biodiversity Action Plan 2017-2021.</p>
Waste and Circular Economy 	 <p>While Ireland is meeting current targets, recycling rates have levelled off for municipal waste and packaging and in some cases declined. Waste generation remains high and linked to economic activity, while circular use of material remains very low. Most of the environmental complaints from the public relate to waste and litter, which means that waste enforcement work is still a key function for local authorities. There have been improvements in waste management brought about through the introduction of waste licensing and producer responsibility legislation and the amount of waste we landfill has decreased in favour of energy recovery.</p>	 <p>Work is needed to move towards a life-cycle-driven 'circular' economy, preventing waste, maximising use of resources during their life cycle and, where waste is generated, increasing the amount that is recycled. Illegal dumping, littering and the level of plastic waste in our seas are concerns that demand solutions. The publication of a new national waste policy, a Waste Action Plan for a Circular Economy, is welcome and brings a renewed impetus for change. Achieving future EU recycling targets, dealing with capacity challenges and achieving the circular economy goals will be dependent on the implementation of waste legislation, policy initiatives and related measures.</p>
Radon 	 <p>A modest reduction in indoor concentrations of radon has been measured since the 1990s (13%). Awareness levels nationally are high, at 75%. A government-led National Radon Control Strategy was adopted in 2014 and this has had a legal basis since 2019. Work carried out under the strategy addresses prevention in new buildings, raising awareness, providing advice, supporting radon services and addressing radon in workplaces. This work is supported by a comprehensive research programme. However, testing and remediation rates have not improved.</p>	 <p>Testing and remediation rates remain low, with approximately 6% of private homes tested. Of those homes that have been tested and are above the reference level, only 20% of householders take action to reduce radon concentrations. Financial support is needed for householders to increase testing and remediation rates. Workplace testing and remediation should become routine in high-risk areas. Radon testing should be a requirement when selling or renting a home. Building regulations should require stronger preventative measures to protect new buildings. The national retrofit programme should include measures to ensure that radon concentrations are addressed.</p>



CURRENT ASSESSMENT: Summary assessment 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/fully achieving objectives

OUTLOOK: Current prospect 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, 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.

3. Ireland in a European Context

The 2020 state of Europe's environment report from the European Environment Agency (EEA) (published in 2019) adds to the growing body of evidence from international organisations advocating for more urgency in protecting the environment, safeguarding biodiversity and tackling climate change (EEA, 2019). The evidence in this EEA report resonates with that outlined in other recent significant publications, including the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) report on biodiversity (IPBES, 2019), Intergovernmental Panel on Climate Change (IPCC) reports on climate (IPCC, 2018, 2019) and the Green Deal from the European Commission (EC, 2019a). According to the EEA, 'the overarching challenge of this century is how we achieve development across the world that balances societal, economic and environmental considerations' (EEA, 2019).

Sustainability needs to become the guiding principle for ambitious and coherent policies and actions across society. The EEA report suggests that the focus now must be on scaling up, speeding up, streamlining and implementing the many solutions and innovations – both technological and social – that already exist, while stimulating additional research and development, catalysing behavioural shifts and, vitally, listening to and engaging with citizens.

The EEA outlines that 'achieving the EU's 2050 sustainability vision is still possible, but it will require a shift in the character and ambition of actions. That means both strengthening established policy tools and building on them with innovative new approaches to governance' (EEA, 2019). The EEA has identified seven key areas to get Europe back on track to achieve its 2030 and 2050 goals and ambitions (Topic Box 16.2). These seven key areas cover complex issues that Ireland is also grappling with, such as water quality, air quality in urban areas, resource use, climate change, biodiversity, ecosystem damage and environmental risks to health and wellbeing. The EEA's call for systemic change, founded on the principles of sustainable development, equally applies to Ireland.

The EEA also provides data that allow Ireland's environmental performance to be benchmarked against that of other European countries. This is done through its online environmental indicator series.³

³ https://www.eea.europa.eu/data-and-maps/indicators/#c0=30&c12-operator=or&b_start=0



Topic Box 16.2 The EEA Seven Key Areas to get Europe Back on Track to Achieve its 2030 and 2050 Goals and Ambitions

The seven key areas identified by the EEA are as follows (EEA, 2019):

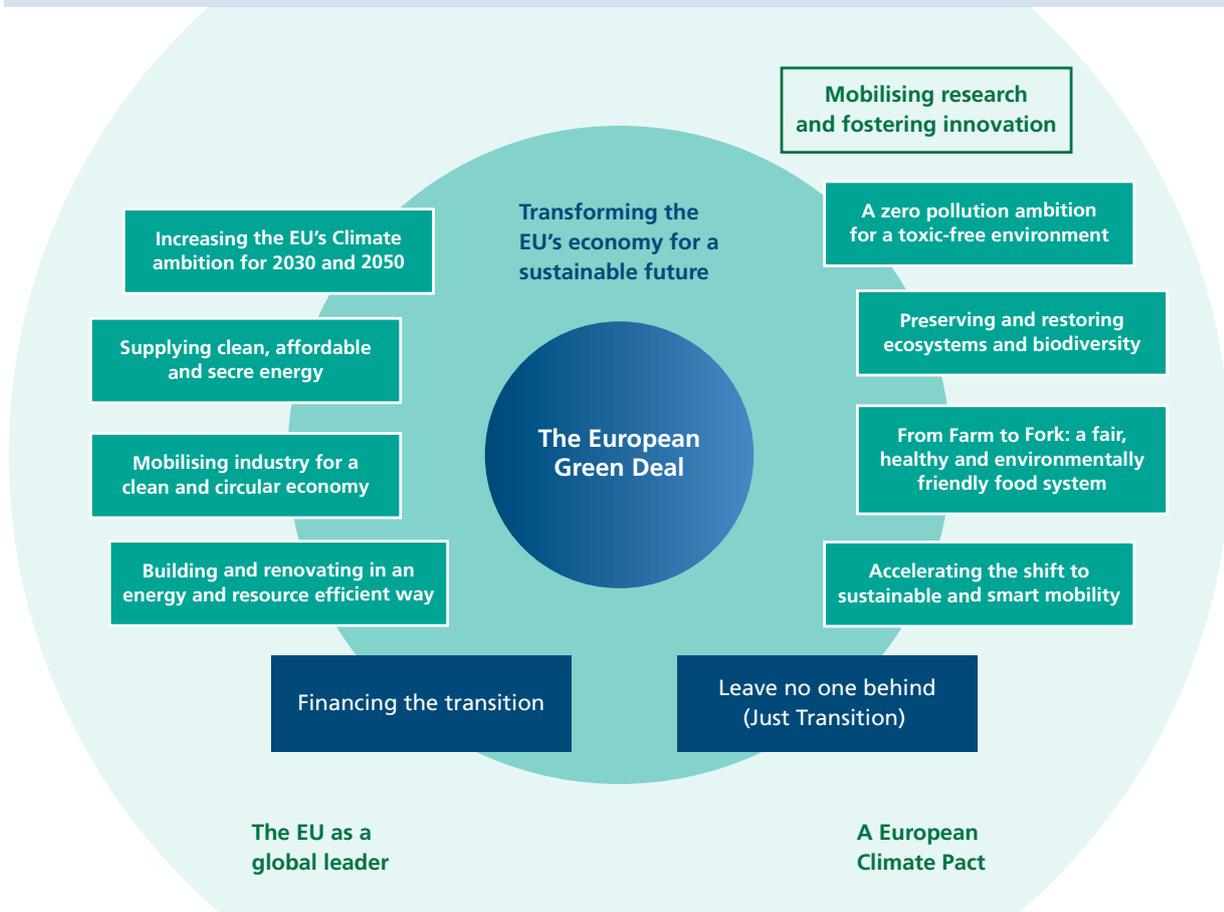
- 1. Strengthening policy implementation, integration and coherence.** Full implementation of existing policies would take Europe a long way towards achieving its environmental goals up to 2030.
- 2. Developing more systemic, long-term policy frameworks and binding targets.** The coverage of long-term policy frameworks needs to be extended to other important systems and issues, starting with the food system, chemicals and land use.
- 3. Leading international action towards sustainability.** Europe cannot achieve its sustainability goals in isolation. The EU has significant diplomatic and economic influence, which it can use to promote the adoption of ambitious agreements in areas such as biodiversity and resource use.
- 4. Fostering innovation throughout society.** Changing trajectory will depend critically on the emergence and spread of diverse forms of innovation that can trigger new ways of thinking and living.
- 5. Scaling up investments and reorienting finance.** Although achieving sustainability transitions will require major investments, Europeans stand to gain hugely – both because of avoided harms to nature and society and because of the economic and social opportunities that they create.
- 6. Managing risks and ensuring a socially fair transition.** Successful governance of sustainability transitions will require that societies acknowledge potential risks, opportunities and trade-offs, and devise ways to navigate them. Policies have an essential role in achieving ‘just transitions’.
- 7. Linking knowledge with action.** Achieving sustainability transitions will require diverse new knowledge, drawing on multiple disciplines and types of knowledge production. This includes evidence about the systems driving environmental pressures, pathways to sustainability, promising initiatives and barriers to change.

On an annual basis, the Central Statistics Office (CSO) in Ireland also publishes environmental information online that includes data comparing Ireland's performance with other countries. The latest report, *Environmental Indicators Ireland 2020*, provides indicators that compare Ireland with other EU Member States for the latest year for which data are available (CSO, 2020). In many cases, the CSO comparisons use data provided by the EPA and EEA. The global and environmental economy domains are also covered by the CSO. Some of the benchmarked areas highlighted by the CSO in its main findings include performance around air pollutant emissions, greenhouse gas emissions, land use, energy and biodiversity.





Figure 16.1 European Green Deal (Source: EC, 2019a)



At the European level, the new Green Deal from the European Commission promises a commitment to 'tackling climate and environmental-related challenges that is this generation's defining task' (EC, 2019a; Figure 16.1). The Green Deal includes policy documents on a Circular Economy Action Plan, a Farm to Fork Strategy and an EU Biodiversity Strategy for 2030. These initiatives are expected to shape environmental policy in Ireland for the next decade. They will also help to support a green recovery after the COVID-19 pandemic has passed and will have the capacity to deliver better environmental performance across all sectors. To succeed, these initiatives will need engagement and commitment from government, business, agriculture, local communities and individuals.

Linked to the implementation of the Green Deal the European Commission published a proposal in October 2020 for an 8th Environmental Action Programme.⁴ This proposal includes a new monitoring framework aimed at measuring and communicating whether the objectives of the Green Deal are being met. In the proposal the Commission outlines that 'the overarching aim of the 8th Environment Action Programme (EAP) is to accelerate the Union's transition to a climate-neutral, resource-efficient clean and circular economy in a just and inclusive way and achieve the environmental objectives of the United Nations' Agenda 2030 and its Sustainable Development Goals, fully endorsing the environmental and climate objectives of the European Green Deal'.

4 <https://ec.europa.eu/environment/pdf/8EAP/2020/10/8EAP-draft.pdf>



4. Key Environmental Messages for Ireland

The overall assessment from this report shows not only that there is a need for urgent approaches to address climate change and biodiversity decline, but also that there are other environmental priorities for Ireland, including tackling air and water pollution, investing in water services, improving recycling rates and improving air quality.

When Dáil Éireann declared a climate and biodiversity emergency in 2019, Ireland was acknowledged as one of the first countries to officially recognise the gravity of these challenges (Dáil Éireann, 2019). As defining concerns for this century, these problems are global challenges and have been highlighted in recent assessment reports from the United Nations Environment Programme (UNEP, 2019), the IPCC (2018, 2019) and the EEA (2019).

However, Ireland must also set priorities to tackle specific environmental challenges in other areas. Protecting water quality is one such area. Waste management is another. This report presents a mixed picture on many aspects of the state of the environment in Ireland. One emerging area that needs more attention is the environmental impact of chemicals. Action in this area will both protect health and deliver on the zero-pollution ambition for a toxic-free environment proposed in the European Green Deal.

Indeed, because of the multifaceted nature of many of the issues highlighted in this assessment's overall key SOE messages (Table 16.2) and chapter highlights (Table 16.3), the consequence of fixing an issue in one area will often lead to co-benefits for another area. For example, measures to reduce GHG emissions should also reduce other air pollutants, in turn benefiting public health.

Furthermore, a consistent call for better implementation and delivery of legislation, strategies, plans, programmes and policies runs throughout the messages in this report. There are plans and programmes in place for many areas, which, if fully implemented, would go a long way towards resolving persistent environmental issues. Moreover, if we are serious about protecting the environment, we need to resource it. Sustainable finance options are needed to fund solutions and investment in green technologies, as well as to provide funding for nature and community projects, monitoring, regulation and oversight.

The spatial aspect of environmental issues has been mentioned in several chapters. The indications are that much better approaches to managing conflicting land uses and practices are needed to protect the environment. For example, we need to leave space for nature, maintain setback spaces along rivers to protect water quality, consider nature-based solutions for flood mitigation,

promote areas best suited to high nature value farming and set out peatlands areas to be restored as spaces for carbon storage, flood attenuation and nature. We must step back from intensive agricultural and land use practices that are affecting or posing threats to the environment and human health.



Green, blue and quiet areas could be identified and protected in cities and large towns. However, at the same time we need to keep space for recreation and tourism and have spaces for farming to prosper; we also need to allow sustainable economic growth, housing and development. We need to identify the right locations for energy projects and industry. In relation to agriculture, we must recognise that there is a role for the 'right measure in the right place', including appreciating and recognising exemplary practice where it exists. However, these local variations must be underpinned by fundamental changes across the food system to address the core challenges. There needs to be a recognition that planned growth cannot be uniform across the country and that local environmental factors need to ultimately determine where growth takes place.

The EPA has identified chapter highlights at the end of each of the chapters in this report. These are collated and shown in Table 16.3 at the end of this chapter. These 'chapter highlights' cover thematic, sectoral and integrated messages. These have been used to identify the 'overall key messages from SOE 2020 for Ireland' (Table 16.2). Still relevant, the key actions for the protection of the environment in Ireland from the 2016 state of the environment report have also been accounted for when developing these overall key SOE messages.

Sustained progress in addressing the overall key SOE messages and the chapter highlights is necessary to meet people's rightful expectations to live in a healthy environment, for Ireland to evolve as a sustainable, carbon-neutral, climate-resilient economy, and to safeguard nature and protect people's health and wellbeing.



Figure 16.2 Overall key messages from the 2020 state of environment report for Ireland

We Need Vision and Implementation to Protect Ireland's Environment and our Health and Wellbeing



SOE 1: Environmental Policy Position

A national policy position for Ireland's environment.

ACTIONS – WHAT IS NEEDED?

There are many interlinkages and dependencies between environmental policies and legislation. These links could be better connected and reinforced through an integrated national policy position on protecting Ireland's environment.



SOE 2: Full Implementation

Full implementation of existing environmental legislation and a review of the governance around the coordination on environmental protection across public bodies.

ACTIONS – WHAT IS NEEDED?

Full implementation of, and compliance with, existing environmental directives and legislation is a must to protect the environment. A review of environmental governance is needed to develop structures to achieve full implementation. This review should also develop recommendations for governance structures that help with improving coordination and linking up environmental protection work across different departments, organisations and regulatory bodies.



SOE 3: Health and Wellbeing

Protecting the environment is an investment in our health and wellbeing.

ACTIONS – WHAT IS NEEDED?

Managing the environmental and radiological risks to health from chemicals and other pollutants is still a major part of environmental protection. Green and blue spaces as well as quiet areas also need to be protected as they provide social spaces for communities and enable a connection to nature, with evidence showing that spending time in such spaces is good for health.

Step Up to Protect the Environment Around Us as it is Under Increasing Threat



SOE 4: Climate

Systemic change is required for Ireland to become the climate-neutral and climate-resilient society and economy that it aspires to be.

ACTIONS – WHAT IS NEEDED?

More urgency is needed to deliver actions on climate mitigation and adaptation and to ensure that Ireland meets its international obligations to reduce greenhouse gas (GHG) emissions. While Ireland's GHG emissions, with full implementation of the Climate Action Plan, are projected to decrease by an annual average reduction of 3% between 2021 and 2030, further measures are required to meet national and EU ambitions to keep the global temperature increase to 1.5°C.



SOE 5: Air Quality

Adoption of measures to meet the World Health Organization air quality guideline values should be the target to aim for in the Clean Air Strategy.

ACTIONS – WHAT IS NEEDED?

The publication and implementation of the planned National Clean Air Strategy is needed to protect Ireland's air quality. The adoption of the World Health Organization guideline values as national air quality standards within the strategy would provide for a higher level of public health protection. Integrating air pollution controls, noise mitigation measures and climate action, for example in transport management, can bring multiple benefits.



SOE 6: Nature

Safeguard nature and wild places as a national priority and to leave a legacy for future generations.

ACTIONS – WHAT IS NEEDED?

Nature and wild places are at risk in Ireland and need to be better safeguarded, both locally and in protected areas. The next Biodiversity Action Plan needs to be more ambitious and identify the pathway to transformative change for nature protection in Ireland. It needs to develop and further strengthen the protection of our national network of protected areas for future generations and to reverse wider current trends in biodiversity and habitat loss.



SOE 7: Water Quality

Improve the water environment and tackle water pollution locally at a water catchment level.

ACTIONS – WHAT IS NEEDED?

The water quality in Ireland’s rivers, lakes and estuaries needs to be better protected through evidence-based measures, integrated water catchment-based projects and initiatives and by reducing the amount of nutrients ending up in water courses.



SOE 8: Marine

Reduce the human-induced pressures on the marine environment.

ACTIONS – WHAT IS NEEDED?

As an island nation with an extensive marine area, Ireland needs to ensure that robust governance and legal frameworks are in place to protect the marine environment.

System Change – Delivery on Sectoral and Societal Outcomes Needs to be Accelerated



SOE 9: Clean Energy

Ireland needs to move rapidly away from the extensive use of fossil fuels to the use of clean energy systems.

ACTIONS – WHAT IS NEEDED?

The emissions from the combustion of mainly imported fossil fuels are damaging for our health and our environment and drive climate change. The transition from reliance on fossil energy to a clean energy future for heating, electricity and transport is essential for the protection of human health, the climate and the environment and has multiple benefits for sustainable development and energy security.



SOE 10: Environmentally-sustainable Agriculture

An agriculture and food sector that demonstrates validated performance around producing food with a low environmental footprint.

ACTIONS – WHAT IS NEEDED?

A more holistic farm management and water catchment-level management approach, encompassing all environmental pressures, will be fundamental to progress towards a more environmentally-sustainable and carbon-neutral food production system.



SOE 11: Water Services

Drinking water and wastewater infrastructure must meet the needs of our society.

ACTIONS – WHAT IS NEEDED?

Action is needed nationally to address the underlying causes for the delays in delivering improvements in drinking water and urban wastewater infrastructure. Addressing the legacy of under-investment and fixing the shortcomings highlighted in successive EPA reports on drinking water and urban wastewater need to be prioritised. The resilience of water-related infrastructure must also improve to guard against the impacts of weather events and climate extremes on water services and the water environment.



SOE 12: Circular Economy

Move to a less wasteful and circular economy where the priority is waste prevention, reuse, repair and recycling.

ACTIONS – WHAT IS NEEDED?

Changing our behaviours on resource consumption, waste management and recycling are actions that everybody, from business to individuals, can take to protect the environment.



SOE 13: Land Use

Promote integrated land-mapping approaches to support decision-making on sustainable land use.

ACTIONS – WHAT IS NEEDED?

The development of an integrated national approach to land mapping could support better decision-making on land use and management practices. It could contribute significantly to mapping land use change and managing competing pressures on the environment, such as agriculture, urbanisation, tourism and recreation, energy projects, carbon sinks, ecosystem services and space for nature.



WE NEED VISION AND IMPLEMENTATION TO PROTECT IRELAND'S ENVIRONMENT AND OUR HEALTH AND WELLBEING

SOE 1: Environmental Policy Position

A National Policy Position for Ireland's Environment

There are many interlinkages and dependencies between environmental policies and legislation. These links could be better connected and reinforced through an integrated national policy position on protecting Ireland's environment.

Nationally we tend to examine separately how different parts of the environment function and how we address challenges such as climate, biodiversity, water, air and waste. The different environmental challenges are covered by different departments, public agencies/organisations and local authorities. Implementation is carried out under different pieces of national legislation, policies, plans and programmes. However, modern environmental problems are complex and cross-cutting and need to be tackled in an integrated way. Currently, there is no overall national policy position for Ireland's environment that joins up all

these areas. There are several examples internationally of national plans, objectives and strategies for the environment that could help with developing a national policy vision for Ireland on the environment. These are covered in a background research paper for this report (O'Leary *et al.*, 2020b).

The objective of the national policy position would be to deliver more effective protection of Ireland's environment through more comprehensive integrated policy development and effective implementation. We need to have policies that work together under one policy position to integrate all of these environmental components. We should look at a whole of system approach to environmental protection and we need to think more about how environmental systems fit together and interact. We need to have policies that work together under one umbrella to integrate all these functionalities. This could be done through a national policy position that covers all environmental issues.



Aerial view of Poulhasserry Bay, Co. Clare



WE NEED VISION AND IMPLEMENTATION TO PROTECT IRELAND'S ENVIRONMENT AND OUR HEALTH AND WELLBEING

SOE 2: Full Implementation

Full Implementation of Existing Environmental Legislation and a Review of the Governance Around the Coordination on Environmental Protection Across Public Bodies

Full implementation of, and compliance with, existing environmental directives and legislation is a must to protect the environment. A review of environmental governance is needed to develop structures to achieve full implementation. This review should also develop recommendations for governance structures that help with improving coordination and linking up environmental protection work across different departments, organisations and regulatory bodies.

The implementation of environmental legislation needs to improve across several directives, regulations and plans. There are currently 16 infringement cases and four European court cases being pursued against Ireland by the European Commission for breaches of environmental law across different areas (Chapter 15).

One recent example is the case that the European Commission is currently taking to the European Court of Justice against Ireland in relation to the designation of SACs under the Habitats Directive (92/43/EEC). The Commission is reporting that 154 Sites of Community Importance (out of 423) have not yet been designated as SACs in the Atlantic biogeographical region, that site-specific conservation objectives have not been established for 87 sites and that the necessary conservation measures have not been established at any of the 423 sites.⁵

Another infringement case is related to the slow progress being made in closing out the infrastructure improvements needed in sewage collection and treatment in order to meet the requirements of the Urban Waste Water Treatment Directive (91/271/EEC). In 2019 the Court of Justice of the European Union declared that Ireland has failed to fulfil its obligations under the Urban Waste Water Treatment Directive. Ireland now risks substantial fines if Irish Water does not promptly complete the works needed to ensure that waste water from all large urban areas is properly treated before it is released into rivers, estuaries and coastal waters.

The European Commission, in its Environmental Implementation Review (EIR) for Ireland (EC, 2019b), has mapped out national strengths, opportunities and weaknesses in how EU environmental policies and laws are applied. As outlined in Chapter 15, Ireland's EIR 2019 report notes that, in general, the country has good air quality, that soils are in good condition – except for peat

areas – and that important steps have been taken to move towards a circular economy. It found that progress has been made in several areas. The EIR stated that Ireland faces several significant environmental challenges, notably in the areas of water management, nature protection and access to justice. The assessment did not cover climate change.



At a local level the investigation of complaints and the enforcement of legislation is an essential part of protecting the environment. In 2018, local authorities, the NPWS and the EPA received approximately 80,000 environmental complaints (Chapters 6 and 15). Local authorities dealt with over 78,000 of these complaints, with waste and litter being the issues that local authorities received the most complaints about. These complaints data are striking as they show the scale of issues that environmental enforcement authorities deal with annually at a more local level.

The implementation of environmental legislation and environmental actions covered in national and sectoral plans needs to be measurable, verifiable and reportable. There is a need to further integrate indicator tracking and performance accounting across all plans and programmes. The performance data should be publicly available, for example, through the publication of annual indicator reports. This needs to be coupled with a focus on the full implementation and enforcement of existing environmental legislation. Chapter 15 provides some suggested enablers for improving Ireland's implementation, integration and monitoring of environmental legislation, policy, plans and programmes. A review of governance structures would allow for the identification of areas for improvement in the coordination of environmental protection work. The aim would be to develop recommendations for structures that work to achieve full implementation and enforcement of environmental legislation and policies and more effective protection of Ireland's environment. The review could cover the overall governance structures needed to ensure that Ireland's policies and governance structures are working together in an integrated way to protect Ireland's environment into the future.

5 https://ec.europa.eu/commission/presscorner/detail/en/IP_20_1235



WE NEED VISION AND IMPLEMENTATION TO PROTECT IRELAND'S ENVIRONMENT AND OUR HEALTH AND WELLBEING

SOE 3: Health and Wellbeing

Protecting the Environment is an Investment in our Health and Wellbeing

Managing the environmental and radiological risks to health from chemicals and other pollutants is still a major part of environmental protection. Green and blue spaces as well as quiet areas also need to be protected as they provide social spaces for communities and enable a connection to nature, with evidence showing that spending time in such spaces is good for health.

Many environmental issues are associated with our daily lives and where we live: the quality of the air we breathe, the state of our local riverside walks or how we manage our waste. Often, they are linked to our own consumption patterns and the amount of unnecessary waste that we generate – be it food or herbicides, energy wastage or car exhaust emissions. Our most pressing environmental concerns often relate to losing something that is important to us. There are many examples, including the loss of the use of the local beach for swimming due to a restriction because of pollution, the loss of a drinking water supply because of contamination, the demise of a local pristine river for fisheries and wildlife or the absence of the call of an iconic species of wildlife such as the curlew. We need to recognise and better promote the benefits of a good-quality environment for health and wellbeing (Chapter 14). The provision of clean, safe and nature-friendly green and blue spaces is important for improving our health and wellbeing. The inclusion and maintenance of health-promoting environments and protection of quiet areas in urban planning are now recognised as important considerations. The benefits of these recreational areas for local communities were clearly demonstrated during the initial stay-at-home restriction period of the coronavirus pandemic.

There are emerging environmental and health risks that need to be considered. The risk that antimicrobials in the environment and antimicrobial resistance pose to health is now highlighted through Ireland's National Action Plan on Antimicrobial Resistance 2017-2020 (Chapter 14). An emerging area that needs more attention is chemicals in the environment and the measures needed to deliver on the zero-pollution ambition for a toxin-free environment, as outlined in the European Green Deal. The EEA has reported in its 2020 report *Healthy Environment, Healthy Lives: How the Environment Influences Health and Wellbeing in Europe* that 'a significant proportion of the burden of disease in Europe continues to be attributed to environmental pollution resulting from human activity' (EEA, 2020a). The report highlights how the quality of

Europe's environment plays a key role in determining our health and wellbeing. There will, however, need to be a clear focus on implementing the various aspects of the European Green Deal to resolve the issues identified.



In addition, we need to continue to make information more easily available to allow individuals to make informed decisions about protecting their health and the environment. Individual action is also important to protect citizens and households from avoidable health consequences linked to the environment (such as radon testing and building design, testing of private wells used for drinking water, septic tank maintenance and using cleaner choices of fuel for home heating). Exposure to radon results in an estimated 300 cases of lung cancer in Ireland each year; research has shown that better building practices have resulted in a 13 per cent reduction in the average radon concentration in Irish homes and that stronger regulation is the most effective way of protecting the population from radon exposure (Chapter 14).



STEP UP TO PROTECT THE ENVIRONMENT AROUND US AS IT IS UNDER INCREASING THREAT

SOE 4: Climate

Systemic Change is Required for Ireland to Become the Climate-neutral and Climate-resilient Society and Economy that it Aspires to Be

More urgency is needed to deliver actions on climate mitigation and adaptation and to ensure that Ireland meets its international obligations to reduce greenhouse gas (GHG) emissions. While Ireland's GHG emissions, with full implementation of the Climate Action Plan, are projected to decrease by an annual average reduction of 3 per cent between 2021 and 2030, further measures are required to meet national and EU ambitions to keep the global temperature increase to 1.5°C.

To become a climate-neutral economy and society, as well as to achieve carbon neutrality in the agriculture sector, Ireland needs to urgently accelerate its efforts to reduce GHG emissions, implement climate mitigation strategies and rollout adaptation plans (Chapters 2, 11, 12 and 13). An urgent and just transition to the use of cleaner fuels and renewables for electricity generation, heating and transport is needed. A just transition away from fossil fuels and reducing GHG emissions means that the change must be just and inclusive, putting people first, and must pay attention to the regions, industries and workers who will face the greatest challenges (Chapter 2). Implementation will require authoritative, coherent and rigorous and transparent oversight, with ownership across sectors and society. This transition will have benefits for other environmental areas such as air quality, human health and biodiversity.

Internationally, the Paris Agreement commits to GHG emissions reductions that are designed to keep global temperature increases this century well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C. Projections indicate that Ireland will not reach its 2020 obligations to reduce its share of GHG emissions (EPA, 2020b). The latest GHG data released by the EPA show that in 2019 Ireland exceeded its annual emissions allocation under the EU's Effort Sharing Decision by almost 7 million tonnes, and is therefore not on the pathway required to meet its 2020 targets (EPA, 2020a). This follows exceedance of 5 million tonnes in 2018 and 3 million tonnes in 2017. These figures again show that Ireland is falling short in terms of lowering our emissions, achieving carbon neutrality by 2050 and playing our part in responding to global climate change which requires holding the increase in the global temperature to well below 2°C above pre-industrial levels. As outlined for the past 2 years we need swift implementation of climate action measures to put Ireland on the right track to meet

its commitments. No one sector is the sole target of the required emissions cuts; rather, wider system changes are needed across economic sectors.

In Ireland, there is currently a significant gap between the allocated carbon budget for 2030 and the current situation in relation to GHG emissions. However, the latest EPA GHG emissions projections for the period 2019-2040 show that Ireland can meet its current EU target to reduce GHG emissions by 30 per cent by 2030 (EPA, 2020b). This will require full and accelerated implementation of the measures in the 2019 Climate Action Plan (DCCA, 2019) and if we succeed would result in a 3 per cent average annual emissions reduction from 2021 to 2030. This implementation needs to start now and will require proactive implementation and greater ambition across government, the economy, industry, agriculture and society to reach 2030 targets.

Ireland's land and seas are going to be important factors in meeting the GHG targets through carbon storage on land under the 'land use, land use change and forestry (LULUCF) regulation' and renewable energy generation from wind offshore (Chapters 5, 12 and 13). The use of the land as a carbon sink for carbon sequestration will need to be developed, with clear evidence-based spatial plans and time frames for this work. Research is ongoing around the topic of LULUCF, which will be one of the key initiatives to help Ireland achieve its GHG emissions targets in the future.





STEP UP TO PROTECT THE ENVIRONMENT AROUND US AS IT IS UNDER INCREASING THREAT

Peatland is an area that merits far more attention and protection in Ireland (Chapter 5). Peatlands are important in the Irish context for storing carbon, provided that the bog ecosystem is not degraded or dried out. However, many peatlands, even in protected areas, are in a poor state from drainage and peat harvesting and are acting as a large net source of carbon. Peatland restoration involves rewetting to reduce emissions. With community support and involvement in projects such as the Living Bog Project, there is recognition now that how we view the importance of these bogs is changing. The Living Bog Project is the largest raised bog restoration project ever undertaken in Ireland.⁶ Projects such as this could be an important part of Ireland's path to reducing carbon emissions by transforming large areas of land from a net source of carbon, as is currently the case, to a net carbon sink.

While we need to do more to reduce emissions, Ireland also needs to prepare for changes in its climate and to adapt to the consequences of climate change for its villages, towns and cities, services, agriculture and environment. While applicable throughout the country as a coastal nation our coasts and coastal communities are particularly vulnerable. Progress has been made over the past few years in developing a range of climate action, adaptation and mitigation plans (Chapter 2). Adaptation plans that set out the changes needed are now in place for local authorities and different sectors. Implementation of the actions and measures in these plans is the next step needed.

SOE 5: Air Quality

Adoption of Measures to Meet the World Health Organization Air Quality Guideline Values Should be the Target to Aim for in the Clean Air Strategy

The publication and implementation of the planned National Clean Air Strategy is needed to protect Ireland's air quality. The adoption of the World Health Organization guideline values as national air quality standards within the strategy would provide for a higher level of public health protection. Integrating air pollution controls, noise mitigation measures and climate action, for example in transport management, can bring multiple benefits.

Poor air quality is a significant cause of premature mortality and has a number of health impacts, especially in urban areas (EEA, 2020a). According to latest estimates, 1300 premature deaths in Ireland per year can be attributed to air pollution (EPA, 2020e; EEA, 2020b), linked mainly to levels of fine particulate matter (PM_{2.5}). While Ireland's air quality is generally good, there are concerning localised issues, including an exceedance of the annual average nitrogen dioxide EU limit value at one traffic monitoring location in Dublin city during 2019.

Meeting the air quality and health protection standards set by the World Health Organization (WHO) should be a priority in the government's planned clean air strategy (Chapter 3). In 2019, levels of air pollutants were above the WHO guideline values for health at 33 monitoring stations across Ireland – mostly as a result of the exceedances of the WHO guidelines values for particulates from the burning of solid fuel in cities, towns and villages.

Reductions in air pollutants are needed from the energy (including home heating), transport and agriculture sectors. The main sources of pollutants that contribute to local air quality in urban areas are transport and home heating. The burning of solid fuel for heating releases particulate emissions that contribute significantly to air pollution in towns and cities. A move towards cleaner and more efficient ways of heating our homes and restrictions and improved standards on the quality and use of these solid fuels would improve the situation.

6 <http://raisedbogs.ie/>



STEP UP TO PROTECT THE ENVIRONMENT AROUND US AS IT IS UNDER INCREASING THREAT

More accessible information on air quality is being made available to inform the public about local air quality. This information is vital for vulnerable populations. The National Air Quality Monitoring Programme now has 84 monitoring stations providing real-time monitoring data for a range of locations across the country. The number of stations in the network has more than trebled since 2017.

There are many similarities between the solutions needed to tackle air pollution, climate action and noise pollution, particularly in relation to transport management. The integration of actions across these areas can bring many co-benefits. Strategic noise mapping provides details on transport-based noise exposure levels in our largest cities and in the vicinity of Ireland's busiest roads, rail and at Dublin airport (Chapter 4). The Project Ireland 2040 National Planning Framework includes an objective covering the proactive management of environmental noise where it is likely to have significant adverse impacts on health and quality of life (Government of Ireland, 2019). However, national noise planning guidance is required to implement this objective and to ensure that the right development takes place in the right locations. The need for good acoustic design to reduce environmental noise should be a planning consideration for residential developments near noisy locations.



SOE 6: Nature

Safeguard Nature and Wild Places as a National Priority and to Leave a Legacy for Future Generations

Nature and wild places are at risk in Ireland and need to be better safeguarded, both locally and in protected areas. The next Biodiversity Action Plan needs to be more ambitious and identify the pathway to transformative change for nature protection in Ireland. It needs to develop and further strengthen the protection of our national network of protected areas for future generations and to reverse wider current trends in biodiversity and habitat loss.

There is unprecedented pressure on nature and wild areas (Chapters 6, 7 and 8). There are global tipping points around the extent of biodiversity loss and Ireland is not immune to these. Expert reports from the National Parks and Wildlife Service (NPWS) have documented the status of Ireland's habitats and species (DCHG, 2019a,b). In Ireland habitats listed under the Habitats Directive are still in decline, 85 per cent of EU protected habitats are reported as being in unfavourable status with 46 per cent demonstrating ongoing declines, with no discernible improvements in this area over the past 6 years since NPWS last reported on status. It will take time for the fruits of some measures to be translated into the reversal of trends, such as the considerable investment that has been directed into raised bog restoration.

Nationally, Ireland needs to intensify its efforts to protect nature. According to the European Commission, Ireland needs to do more to ensure compliance with nature directives and protect designated areas (Chapter 15).

While protected habitats are in decline, in relation to listed species, the NPWS have reported that the situation is mixed. What is positive is that some species, such as the buzzard and pine marten, are holding their own or even extending their range. But species such as the curlew continue to be at risk of extinction as a breeding bird in Ireland. Conservation schemes have been set up to try and prevent this from happening. The protection of the curlew is a real test case for conservation in Ireland. If conservation schemes are not successful in protecting an iconic species such as the curlew, which is steeped in Irish heritage and folklore, then the outlook for other species that are also dependent on habitats such as low intensity grazing areas, late cut meadows, open bogs and wetlands might not be favourable.



STEP UP TO PROTECT THE ENVIRONMENT AROUND US AS IT IS UNDER INCREASING THREAT

The interim review of the implementation of the National Biodiversity Action Plan 2017-2021 has reported on areas where progress has been made and also on areas that need more work (Biodiversity Working Group, 2020). The review also notes that in relation to the decline in EU protected habitats, the main drivers of decline are agricultural practices which are negatively impacting over 70 per cent of habitats, particularly ecologically unsuitable grazing, abandonment and pollution. Areas identified in the interim review where progress has been made include the LIFE projects and the European Innovation Partnership projects, which are local-led projects, developed with farmers and communities and covering areas such as habitat and species protection (including hen harrier, freshwater pearl mussel, corncrake) on a range of farmland types. The review also reports on progress of raised bog restoration arising from funds from the Climate Action Plan. The interim review identified areas within the current biodiversity plan that need more emphasis including building on the success of the Burren Programme, developing new farming models to aid both the diversification of agriculture and an appropriate reduction in intensification in some areas, developing management plans for protected habitats and species, developing restoration plans for species in severe decline, and accelerating the establishment of Marine Protected Areas.

Nature protection work needs to be linked to public information and engagement campaigns that actively involve and engage citizens and foster a better appreciation of nature and its benefits to society. Data about species trends are collected not only through the NPWS, but also from citizen science projects such as those operated by the National Biodiversity Data Centre and Birdwatch Ireland. Resourcing of citizen science work is important for nature protection and needs to be further developed. This citizen science work provides an important evidence base on long-term trends in species. It gets people involved locally in nature protection and in recording changes about species distribution and breeding success.

It is not only protected areas that are at risk. Local impacts are evident too. For example, the excessive cutting of hedgerows, the overuse of herbicides and the infilling of small wetlands place multiple pressures on local environments. The functions of hedgerows, ponds and field drains as ecological reservoirs and corridors in the countryside need to be better understood, appreciated and protected.

Adopting biodiversity buffer distancing measures on farms by keeping activities back from hedges for field margins, leaving space for wildflowers and leaving space alongside streams and rivers could all help to protect our local wildlife. Overall, Ireland needs to prioritise actions to achieve the transformative change required to bend the curve of biodiversity loss. The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services has recommended five interventions or levers (IPBES, 2019). These levers are: incentives and capacity-building; cross-sectoral cooperation; pre-emptive action; decision-making in the context of resilience and uncertainty; and environmental law and implementation. Action across these levers and other areas is needed now to address the challenges facing biodiversity in Ireland.





STEP UP TO PROTECT THE ENVIRONMENT AROUND US AS IT IS UNDER INCREASING THREAT

SOE 7: Water Quality

Improve the Water Environment and Tackle Water Pollution Locally at a Water Catchment Level

The water quality in Ireland's rivers, lakes and estuaries needs to be better protected through evidence-based measures, integrated water catchment-based projects and initiatives and by reducing the amount of nutrients ending up in water courses.

The EPA water quality in Ireland report, covering data from 2013 to 2018, shows that only around half of Ireland's surface water bodies are in a satisfactory ecological condition (EPA, 2019a) (Chapter 7). Estuaries are in the worst condition overall, and our rivers have suffered the greatest number of declines in ecological health in the recent reported period (2013-2018). There has also been an increase in nutrient concentrations, an increase in the number of water bodies given a poor or bad status, and a continued loss of high status sites (EPA, 2019a, b). Long-term trends show a significant loss of our most pristine river waters, the number of which has declined tenfold since the late 1980s. Currently there are only 20 such sites left in the country.

One-third of rivers and lakes and one-quarter of estuaries have excess nutrients in them. There is also evidence that nutrient concentrations in Ireland's rivers and nutrient inputs to its marine environment are increasing (EPA, 2020f). Nitrogen pollution in the south and south-east of the country is damaging the ecological health of many estuaries and nearshore coastal waters. Agriculture is the most common source of excess nutrients in waters. Urban wastewater is another major source. These nutrients are promoting algae growth and damaging the ecological health of rivers, lakes and estuaries. Other significant water issues that need to be tackled are physical changes and modifications to water courses. Weirs, changes to bankside habitats, drainage and changes to flows can all have an impact on biodiversity including the migration of fish species. More consideration needs to be given to using natural water retention measures on land and nature-based solutions in flood risk management and planning. The impacts of climate change and extremes in water temperatures and water flows are likely to exacerbate the damage caused by underlying water pollution.

There are initial signals indicating some improvements in river water quality in the 190 priority areas for action that were identified in the current National River Basin Management Plan 2018-2021 (Government of Ireland, 2018). These priority areas comprise 726 water bodies across all water categories. Further monitoring and assessment will be needed to confirm this trend and the specific reasons for the improvements. Overall however, river water quality has decreased in Ireland; a significant 5.5 per cent net decline since 2010-2015 has been recorded for the period 2013-2018, indicating that further actions are needed to reverse this trend (Chapter 7).

Targeted actions at a water catchment level, based on science and integrated catchment management and the targeted protection and restoration of good-quality rivers (blue dot sites), are now the main strategies being employed to tackle water pollution. But this work is a slow and resource-intensive process. Any further intensification of the agricultural sector, in the absence of effective strategies to reduce the loss of nutrients to waters, could potentially wipe out any of the improvements seen. Ireland also needs to foster the careful management of soil and land management practices to avoid nutrient and sediment losses into water catchments (Chapter 5).

What is clear is that there must be targeted, integrated and collaborative working between authorities, stakeholders and communities as part of the national water catchment-based approach if we are to make real progress in stopping the overall decline in water quality.





STEP UP TO PROTECT THE ENVIRONMENT AROUND US AS IT IS UNDER INCREASING THREAT

SOE 8: Marine

Reduce the Human-induced Pressures on the Marine Environment

As an island nation with an extensive marine area, Ireland needs to ensure that robust governance and legal frameworks are in place to protect the marine environment.

Ireland's offshore waters are in a good condition, but near-shore and estuarine waters are less so (Chapter 8). Additional measures and mitigation are required to protect our valuable marine ecosystems, habitats and species from anthropogenic pressures.

Of the commercial fish and shellfish stocks assessed by the Marine Institute, 34 are considered to be compatible with Good Environmental Status, while 44 are not (Chapter 8). The compatibility of 99 stocks with Good Environmental Status is unknown. Overall, the status of commercial fish and shellfish stocks is not fully compatible with Good Environmental Status. Crucial to protecting fisheries and the health of the associated food webs is a transition to sustainable fisheries and heeding scientific advice and catch limits. A number of non-commercial fish species are also threatened because of habitat loss/disruption and by-catch. Other species, such as some marine bird species and other top predators, migratory baleen whales and deep-diving cetaceans, remain vulnerable to environmental degradation from human activities.

Protecting the ecosystems in which marine species live should be a key part of the sustainability question. Ireland's marine environment is nearly 10 times the size of its land area.⁷ There is a target that 10 per cent of these coastal and marine areas should be conserved as Marine Protected Areas. At present, just over 2 per cent of these areas are designated. Ireland's seagrass and kelp beds are an important habitat for many types of marine life, as well as a store of carbon. These types of blue carbon stores are areas for further research in Ireland. Some of Ireland's estuaries are affected by eutrophication, which is caused by increased nutrients and excessive algae growth (EPA, 2019a). The specific factors causing the decline in ecological status of estuaries should be addressed through the action programmes developed under the Water Framework Directive.

A total of 1.9 million people live within 5 km of the coast, representing 40 per cent of the population and 40,000 people live less than 100 metres from the coast (CSO, 2019). Sea temperatures have been rising and future warming is expected to increase the intensity of storms (Desmond *et al.*, 2017). Sea level rises have already been recorded. Ireland as an island will need clear plans in place to adapt to these changes. The implications of climate change could be felt most closely along our coastal and marine areas. Climate change will put pressure on existing ecosystems as well as on the structure of the coastline itself and on coastal communities. Research is showing that nature-based solutions and the managed realignment of coastal habitats could be part of the measures to protect against sea level rise.

Ireland is not immune to the worldwide problem of marine plastic and litter. This turns up on our coastline from rivers and local land-based sources, recreation, from the fishing sector and from further afield, carried by the wind and ocean currents. Local clean-ups while beneficial are effective for only a short while. To really clean up and improve the situation there needs to be continued efforts to tackle the source of the waste in the first place.

In terms of policy development, the joined-up implementation of directives and policies where there are crossovers, such as those covering water quality (e.g. the Water Framework Directive and the Marine Strategy Framework Directive), nature directives, fisheries and those tackling waste, are areas for consideration to protect the marine environment.



⁷ <https://www.marine.ie/Home/site-area/irelands-marine-resource-real-map-ireland>



SYSTEM CHANGE – DELIVERY ON SECTORAL AND SOCIETAL OUTCOMES NEEDS TO BE ACCELERATED

SOE 9: Clean Energy

Ireland needs to Move Rapidly Away from the Extensive Use of Fossil Fuels to the Use of Clean Energy Systems

The emissions from the combustion of mainly imported fossil fuels are damaging for our health and our environment and drive climate change. The transition from reliance on fossil energy to a clean energy future for heating, electricity and transport is essential for the protection of human health, the climate and the environment and has multiple benefits for sustainable development and energy security.

Transport is a major driver of GHG emissions and air pollution because of its reliance on fossil fuels (Chapter 11). GHG emissions from this sector are increasing. This is not only a case of exceeding GHG targets, it is also a health and quality-of-life issue. Dublin is now ranked as one of the most congested cities in Europe for road traffic. There are plans to improve the emissions performance of the transport sector over the next decade by using electric vehicles, but public transport also needs to play a major role. Under the Climate Action Plan, the target is to increase the number of electric vehicles by 2030 to about one million. This requires a major shift in consumers' choice of transport, which needs to be strongly promoted. We also need to focus on the challenge of greening public transport. These are all positive from a GHG and air pollution perspective, but it does not solve all of the environmental impacts, such as noise emissions along busy motorways and land take for any additional road building programmes to tackle congestion.

'Avoid, shift and improve' is the hierarchy of change needed to transition to a sustainable transport system (Chapter 11). We should look at the avoidance of emissions through better spatial planning, more accessible low-carbon public transport and reducing unnecessary travel where possible. Technology and new working methods could also reduce the demand for travel, resulting in reduced emissions. Improvements include using more energy-efficient vehicles, electric vehicles and non-fossil fuels. A shift away from a reliance on personalised car use to low-carbon public transport, particularly in urban areas, is needed to reduce emissions, noise pollution and congestion. Simplest of all, spatial planning should be improved through the design of cleaner, greener and quieter towns and cities that facilitate and encourage more cycling and walking. This has been achieved in many places across Europe.



Energy from fossil fuel provides almost 90 per cent of the energy used in electricity generation, heating and transport (Chapter 12). To become carbon neutral, this trend will need to be reversed, with the bulk of energy needing to come from renewables in the future. Overall, the energy sector is the biggest source of GHG emissions, when fuel used for electricity generation, transport and heating is included. It is also the major pressure on local air quality. Ireland has abundant natural resources for the development of a modern, clean and efficient renewable energy sector that uses wind, solar and ocean energy. Any such transition will need to be implemented within a spatial planning framework that ensures the protection of human health and other national resources, including nature and landscape. It must have people at its core and plan for the changes to local areas and economies that come with this transition away from fossil fuels. The Climate Action Plan includes a target of 70 per cent electricity generated from renewable sources by 2030, the upgrading of 500,000 existing homes to a Building Energy Rating of B2 equivalent by 2030 and the phase-out of coal and peat electricity generation (DCCA, 2019). The achievement of these targets will require a concerted cross-sectoral and integrated approach to energy and land use planning and construction standards.



SYSTEM CHANGE – DELIVERY ON SECTORAL AND SOCIETAL OUTCOMES NEEDS TO BE ACCELERATED

SOE 10: Environmentally-sustainable Agriculture

An Agriculture and Food Sector that Demonstrates Validated Performance Around Producing Food with a Low Environmental Footprint

A more holistic farm management and water catchment-level management approach, encompassing all environmental pressures, will be fundamental to progress towards a more environmentally-sustainable and carbon-neutral food production system.

The core principle of Food Wise 2025 was that 'environmental protection and economic competitiveness are equal and complementary: one will not be achieved at the expense of the other' (DAFM, 2015). While the Food Wise 2025 strategy has delivered the intensification and growth that it promised, the pressures on the natural environment have increased, with as a consequence trends in water quality, GHG emissions, ammonia and biodiversity all going in the wrong direction.

The loss of nutrients from agriculture is severely affecting water quality (Chapter 7). The carbon balance for agriculture is negative, with more GHG emissions produced from the sector than are saved through carbon sinks associated with farmland and forestry (Chapter 13). Intensive agriculture and land use changes are having an impact on nature, habitats and species (Chapters 6 and 13). Ammonia emissions to air continue to rise, exceeding the EU limit in 2016, 2017 and 2018, driven by the expansion of the agricultural sector (Chapters 3 and 13). The food and drinks sector is the main industrial sector identified by the EPA for which improvements are needed to improve compliance with EPA licences (EPA, 2019c).



These deteriorating trends present a significant threat to Ireland's environment, which underpins our health and wellbeing and our economy; including to the agricultural sector, which depends on Ireland's reputation and marketing advantage as a food-producing nation with strong environmental credentials. It can be argued that the national agricultural intensification programme has failed to protect the environment, as the business side of the programme has outbalanced the environmental sustainability side. This shortcoming should be readdressed in the next agri-food strategy to 2030, currently in development. A key aspect for the next agri-food strategy will be to address the EU Farm to Fork Strategy⁸ and its targets to transform the EU's food system. Ireland's agri-food strategy will need to focus on breaking the link between animal numbers, fertiliser use and deteriorating water quality and resultant impacts on aquatic biodiversity. Such a move would also result in reductions in GHG and ammonia emissions and improved biodiversity. The strategy should encourage the promotion of more widespread high-nature-value farming initiatives, particularly in high status water body areas. It should also support and promote outcome-based agri-environmental schemes that would provide payments for results and ecosystem service activities rather than the current 'payments for costs incurred or income foregone' approach. An EPA submission, 'SEA Scoping for Agri-Food Strategy to 2030',⁹ provides further detail. Focusing on promoting the full and transparent integration of the findings of the Strategic Environmental Assessment into the agri-food strategy, the submission advocates that the key relevant environmental challenges for Ireland, as set out above, should be addressed in the strategy.

Measures and supports for farmers should be targeted and should aim to deliver multiple benefits for climate, air pollution and air quality, biodiversity, water quality and flood attenuation where possible. The introduction of a holistic farm planning approach would support farmers to achieve their business goals while meeting multiple environmental targets. Supportive programmes such as Teagasc guidance measures, the Smart Farming Programme and the Agricultural Sustainability Support and Advisory Programme need to be rolled out more widely to deliver quantifiable environmental outcomes. Measurable, reportable and verifiable data and evidence are needed to demonstrate that the agriculture sector is playing its part in reversing negative trends and making lasting environmental improvements.

⁸ https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/actions-being-taken-eu/farm-fork_en

⁹ EPA SEA submission are available here: <http://www.epa.ie/pubs/epasub/epasubmissionontheagri-foodstrategy2030.html>



SYSTEM CHANGE – DELIVERY ON SECTORAL AND SOCIETAL OUTCOMES NEEDS TO BE ACCELERATED

SOE 11: Water Services

Drinking Water and Wastewater Infrastructure must meet the Needs of our Society

Action is needed nationally to address the underlying causes for the delays in delivering improvements in drinking water and urban wastewater infrastructure. Addressing the legacy of underinvestment and fixing the shortcomings highlighted in successive EPA reports on drinking water and urban wastewater need to be prioritised. The resilience of water-related infrastructure must also improve to guard against the impacts of weather events and climate extremes on water services and the water environment.

Drinking water is a priority area for action to protect public health (Chapter 14). While the quality of public supplies remains high, it is not always secure from failures at treatment plants or, in some cases, treatment processes need upgrading to reduce risks to the supply. A total of 67 boil water notices were in place in 2019, affecting almost 700,000 people.¹⁰ Of those boil water notices, 59 were in place for more than 30 days, meaning they are classed as long-term notices requiring investment in infrastructure to address. Two boil water notices for over 600,000 consumers in 2019 highlights the vulnerability of our drinking water supplies. In 2020, 52 public supplies managed by Irish Water were on the EPA's Remedial Action List (RAL).¹¹ The RAL details those supplies in need of upgrades or improvements. For example, the RAL includes drinking water treatment plants that do not have appropriate treatment for the parasite *Cryptosporidium*. These supplies need to be prioritised for investment. However, delays and increasing uncertainty in Irish Water's planning and delivery of critical improvements to water treatment plants are making supplies vulnerable to failure, posing a risk to the health of a large proportion of the population (EPA, 2020g).

In addition to those served by public supplies, over one million people get their water from private supplies. Animal or human waste (as demonstrated by positive results for the bacterial indicator *E. coli*) was found in 62 small private supplies serving commercial or public buildings in 2018.¹² Improvements are needed in the management and disinfection of these supplies to eliminate risks to public health.

The increasing prevalence of the verocytotoxin-producing *E. coli* (VTEC) bacterial pathogen in household private wells in rural areas is a significant cause for concern. Those households in areas with septic tanks and their water supplies (such as wells or boreholes) should have these systems checked and maintained to safeguard against waterborne pathogens.

Improvements are needed in urban waste water treatment to protect water quality and in some areas to deal with untreated sewage discharges and overflows that could affect public health and bathing water (EPA, 2020h). Repeated delays in some essential projects mean that raw sewage discharges will continue past 2021 in 33 locations around the country (Chapter 14). The delays by Irish Water in treating these discharges is not acceptable as funding for these waste water projects is one of the top priorities mandated into Irish Water's Capital Investment Plan. Action is needed to prevent further delays in progressing these projects through the various project stages prior to construction. Irish Water needs to do more to deliver on its commitments and legal duty under EPA waste water authorisations to fix waste water issues, while ensuring that public information about plans to fix untreated sewage discharges is made available locally.

10 <http://www.epa.ie/newsandevents/news/pressreleases2020/name,69121,en.html>

11 RAL accessed 8 September 2020; see <http://www.epa.ie/water/dw/rall>

12 <http://www.epa.ie/newsandevents/news/pressreleases2020/name,67472,en.html>



SYSTEM CHANGE – DELIVERY ON SECTORAL AND SOCIETAL OUTCOMES NEEDS TO BE ACCELERATED

SOE 12: Circular Economy

Move to a Less Wasteful and Circular Economy Where the Priority is Waste Prevention, Reuse, Repair and Recycling

Changing our behaviours on resource consumption, waste management and recycling are actions that everybody, from business to individuals, can take to protect the environment.

Ireland has reached a plateau in relation to waste management; to further deliver the necessary waste prevention and circular economy ambitions will be a challenge. Recent waste statistics show that Ireland needs to do more on waste, with the decreases in the recycling rates for packaging waste a timely reminder of the continued requirement to evolve national waste management policies (EPA, 2020i,j). Overall municipal waste, construction and demolition waste, hazardous waste, waste electrical and electronic equipment and end-of-life vehicle waste generation is increasing with economic prosperity and population growth. A total of 14 million tonnes of waste was generated in Ireland in 2018 across all sectors. This is significant, and waste generation continues to be closely linked with economic growth, lifestyle and consumption patterns; these are links that have yet to be broken.



Plastic now makes up one-fifth of waste in household recycling and residual bins. We need to focus more on prevention and not just on the recycling and recovery of the waste that is produced. Campaigns such as Stop Food Waste are based on this approach. We are at a real point of transition in the waste area. New waste plans and strategies are expected over the next few years as Ireland starts to move to a more circular economy (Chapter 9). One such plan that has already been published in 2020 is the *Waste Action Plan for a Circular Economy* which covers national waste policy for the period 2020-2025 (Government of Ireland, 2020). There are also capacity issues to resolve. Landfill and waste-to-energy treatment is at capacity in Ireland and the country is highly dependent on export markets to treat residual, recyclable and hazardous wastes. Reductions in hazardous waste can be seen across some industrial sectors as companies change to clean production processes (Chapter 10).

Waste targets under the Climate Action Plan (DCCAE, 2019) and the Waste Action Plan for a Circular Economy are to reduce the percentage of municipal waste sent to landfill to 10 per cent by 2035, to reduce food waste by 50 per cent by 2030 and to recycle 70 per cent of packaging waste by 2030. Meeting the 2025 plastic recycling target of 50 per cent and the 2030 target of 55 per cent will be challenging (Chapter 9).

We need to continue to provide evidence-based information on consumption burdens, waste generation and impacts to allow sustainable choices to be made more easily. Consideration should be given to bringing forward a more informative eco-labelling scheme, as envisaged by the Green Deal, that presents clear signals to consumers and rewards more sustainable goods and services. In parallel with better signalling to consumers on products, it is essential to continue messaging on the quality of our consumption behaviours to remind us that our everyday lifestyles, activities and use of resources should not affect our health and that of our environment.

Measures to encourage changes in behaviour, as well as enforcement, are needed to deal with littering in both urban and rural areas, to prevent waste crime and to punish those who break the law. Illegal waste activity ranges from littering to backyard burning and large-scale unauthorised waste disposal. We need to step up enforcement efforts nationally to stamp out fly tipping and illegal dumping. Litter is still a major problem and results in thousands of complaints every year to local authorities. It also results in significant clean-up costs. It needs to become socially unacceptable to litter. Local authorities have a major role to play in tackling waste crime. There needs to be improved information sharing on waste enforcement to ensure that illegal waste activities can be quickly detected and prevented, remediated where necessary and penalised where they do occur.

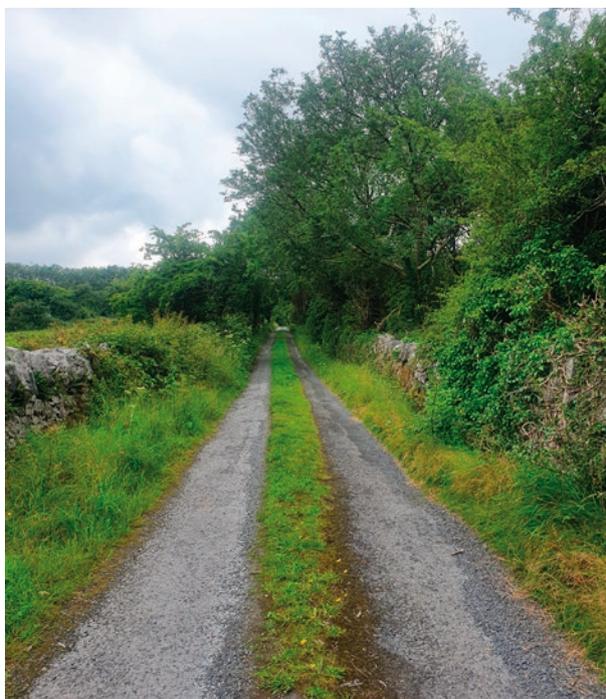
The circular economy approach should be central to any new waste strategies. To implement this, we will need targeted approaches to research and development, food waste, construction waste, plastics, hazardous waste and other priority waste streams. Regular data updates are needed on the sustainability of our waste practices and on where our waste ends up for final disposal or recovery. This information will help to reassure the public that when they make the effort to recycle their waste there are checks and balances in place to ensure that it is managed properly.



SYSTEM CHANGE – DELIVERY ON SECTORAL AND SOCIETAL OUTCOMES NEEDS TO BE ACCELERATED

SOE 13: Land Use**Promote Integrated Land-mapping Approaches to Support Decision-making on Sustainable Land Use**

The development of an integrated national approach to land mapping could support better decision-making on land use and management practices. It could contribute significantly to mapping land use change and managing competing pressures on the environment, such as agriculture, urbanisation, tourism and recreation, energy projects, carbon sinks, ecosystem services and space for nature.



EPA land cover mapping uses satellite imagery data to develop CORINE (Coordination of Information on the Environment) land cover maps (Chapter 5). These maps tell us a lot about the changes in Ireland's land cover over the past decades. They have documented the loss of wetlands, especially peatlands, which is evident when the long-term trends are looked at. They also show that forest cover is low overall compared with other European countries.

The use of earth observation and detailed satellite-based mapping, for example through further developments of the CORINE land cover maps, is expected to play a more important role in environmental protection in Ireland in the future. An important project led by Ordnance Survey Ireland, in partnership with the EPA and others, is now under way to make this happen. Using satellite data, the project team are developing a new detailed National

Land Cover Map that could help with monitoring the environment by charting changes within river catchments and quantifying the extent of and changes to carbon sinks such as bogs and forests, for example.

An Environmental Sensitivity Mapping Webtool has already been developed for use in Ireland.¹³ While developed mainly for Strategic Environmental Assessment work, this webtool has wider applications. The mapped outputs from this webtool allow users to 'highlight the relative environmental sensitivity of different areas' and can be used to provide early warnings, inform the potential for land use conflicts and 'provide a critical evidence basis for sectoral planning discussions and for developing alternatives that avoid or minimise potentially incompatible or unsustainable zonings'.

A vision for the future could be a network of integrated catchment and land use management plans that could form the basis of a more integrated collaborative and cooperative approach to the environmental management of Ireland's countryside (Chapter 13). It is not only the countryside where land mappings approaches can be used. These approaches also have relevance in urban areas, for example in tracking the extent of green and blue space for recreation and for the assessment of noise and air pollution from traffic sources.

'The world is changing, and Ireland is changing too. The best way for our country to address the changes that we will continue to face, is to plan for the change' – this is one of the messages from Project Ireland 2040 (Government of Ireland, 2019). This National Planning Framework has been put in place to guide Ireland's development and investment over the next two decades. It provides for an expected population growth of one million people in the next two decades.

To ensure balanced, sustainable development to 2040, national policy objectives in the framework on climate, environmental protection and natural resources will need to be progressed. The development of a coordinated, integrated national approach to land mapping, land cover and land use and management practices could help with the sustainable delivery of this project, as well as other national and sectoral plans. To achieve all of this we also need to inform, engage and support communities, farmers, businesses and sectors in the transition to sustainable and resilient land use practices.

13 <https://www.enviromap.ie/>



5. Conclusions

Overall, Ireland needs a national policy position for its environment that connects the various environmental challenges and guides the protection of the environment.

The overarching message from this report is that change is needed in how we look after our environment. However, economy or society cannot make the right sustainable choices if the systems or policies around them make it difficult to implement measures to protect the environment. Collaboration, integration and better connectivity across the different systems and policies are needed, as many are interlinked. Ireland has many sectoral plans in place with environmental commitments, but the environment continues to be affected and at risk – what we need is implementation, monitoring of plans and projects, and accountability to ensure that plans/projects are being carried out in the right way, in the right place and at the right time. A national policy position for Ireland's environment could help to achieve all of this.

Research has demonstrated that our health and the state of the environment are intrinsically linked. System changes are needed in the energy, transport and agriculture sectors to improve sustainability and reduce emissions, which are damaging our environment and our health. We need to accelerate the implementation of measures needed to meet climate action commitments. Ireland needs to improve its performance in protecting nature and natural resources at community and national levels. Improvements are also needed in implementing environmental legalisation and policy.

Evidence-based policy decisions using assessment tools such as integrated environmental assessment, system-based approaches, spatial planning, the precautionary principle and ecosystem services assessment should play a central part in protecting Ireland's environment into the future. The United Nations Sustainable Development Goals could also be considered when dealing with complex and interlinked environmental challenges.¹⁴ As post-COVID-19 national economic stimulus packages are being developed, now is also a good time to consider opportunities to leverage enduring environmental and public health benefits that address the challenges raised in this report.

We know that environmental protection is a local issue with global consequences. Ireland's environment is what connects us to our local places. It is part of our natural heritage and is where we live. When added together, the solutions taken at home, in businesses or at a field level can result in local improvements to global problems. Such local perspectives and community engagement, linked with national policies, leadership and direction, are part of the transition needed to protect Ireland's environment into the future.

Finally, it is useful to reflect again here on the 45 chapter highlights covering thematic, sectoral and integrated areas that have been identified in the report. They outline the scale of the challenges that need solutions. These 45 key chapter highlights are shown in Table 16.3.

Stay safe and keep the environment safe. It is our health and environment that matter, and this decade will be pivotal to how we deal with the challenges around protecting both.



¹⁴ <https://www.gov.ie/en/policy-information/ff4201-17-sustainable-development-goals/>



Table 16.3 The 45 chapter highlights covering thematic, sectoral and integrated areas from Ireland’s Environment – An Integrated Assessment 2020

NUMBER	CHAPTER HIGHLIGHTS
Introduction (1)	The absence of an overarching national environmental policy position is negatively affecting integration and progress across multiple environmentally related strategies, plans and programmes: the sum of the parts do not make up a coherent whole.
Introduction (2)	As Ireland emerges from the COVID-19 pandemic crisis and looks to stimulate economic recovery, it needs to apply a ‘green investment’ approach and avoid lock-in, or a return, to carbon-intensive consumption and unsustainable production behaviours, services and technologies. A clean environment provides the opportunity to deliver on health and economic dividends that will assist resilience and support recovery.
Introduction (3)	Protection of our waters, air, soil, ecosystems and biodiversity should not just be an ambition driven by altruism, as these systems and species provide essential supporting services for our wellbeing and our economy. The delivery of trusted and actionable knowledge about our environment is essential to allow Ireland to plan with any degree of certainty for a better future.
Climate (1)	Ireland’s climate is changing. Mitigation and adaptation action that is planned, coordinated and prioritised is required to build the resilience of society and the economy in the face of current and projected climate change impacts.
Climate (2)	The next decade needs to be one of major developments and advances in relation to Ireland’s response to climate change. We need to start implementing ambitious policies now. Full and early implementation of ambitious policies and measures can deliver Ireland’s current and future commitments to a climate-neutral economy and climate-resilient society by 2050.
Climate (3)	The scale and pace of greenhouse gas emissions reductions must accelerate. Reducing emissions requires far-reaching transformative change across the whole economy, including in agriculture, energy, transport, waste, land use, food, buildings and industry. Ireland’s greenhouse gas emissions profile – with over one-third of emissions coming from agriculture and a high dependency on fossil fuels – is particularly challenging. Ireland must also maximise the use of land as carbon stores, for example through grasslands, wetlands and forestry, to meet targets.
Air (1)	Monitoring and research show that Ireland has air quality issues that need to be resolved. Poor air quality has implications for public health. Identified solutions need to be implemented for the causes of poor air quality, which mainly relate to the residential use of solid fuels for home heating, emissions from transport, especially from diesel and petrol engine passenger cars, and ammonia-related emissions from livestock farming.
Air (2)	Using home heating choices that reduce air emissions, along with improved standards for the quality of solid fuel available, will help to minimise local air quality impacts. Reducing our reliance on diesel- and petrol-fuelled passenger cars and the adoption of best practices to reduce agricultural ammonia emissions on farms will have co-benefits for air quality, the climate, human health and biodiversity. In addition, the implementation of the commitments in the government’s Climate Action Plan will have co-benefits for air quality.
Air (3)	The need for a National Clean Air Strategy supported by WHO standards is more pressing than ever. The publication and roll-out of actions as part of the National Clean Air Strategy will be a necessity. The adoption of the WHO guideline values as national air quality standards would provide for a higher level of public health protection.
Noise (1)	National noise planning guidance for local authorities is needed. This will support and promote the proactive management of noise where it is likely to have significant adverse impacts on health and quality of life. The guidance will also help to implement the noise objective in Project Ireland – National Planning Framework 2040 and should also consider the 2018 WHO noise and health guidelines.



NUMBER	CHAPTER HIGHLIGHTS
Noise (2)	Noise pollution complaints from the public have been increasing and current measures do not always allow for them to be adequately addressed. Local authorities need to take a much stronger leadership role in dealing with noise issues, particularly in more urban areas.
Noise (3)	Integrating air pollution and noise mitigation measures (and climate actions), particularly in transport management, can bring many benefits. Such integration of options could be explored under the plans for a clean air strategy for Ireland. Local authorities should also designate quiet areas in their cities for health and wellbeing value.
Land and soil (1)	Our soils and land need to become net sinks for capturing and storing carbon dioxide. The facilitation of further carbon storage will require widespread rehabilitation and protection of peatlands, increased levels of forestry and woodland, and changes to land management practices. Where land management is providing a store for carbon, this should be maintained or enhanced. Where land management is resulting in emissions of carbon dioxide, this source should be reduced or eliminated, and where land is degraded or has lost its ability to absorb or store carbon dioxide it should be restored. Nationally, there needs to be a concerted effort to fully implement the commitments of the strategies and plans to protect and restore peatlands.
Land and soil (2)	A progressive approach to land cover, land use and land management is required to promote land practices that are sustainable and right for our environment and our people. Implementing such an approach will help coordinate, prioritise and measure Ireland's response to significant environmental issues such as climate change and the decline in nature across multiple sectors. An integrated national approach to land mapping will be needed to support this work.
Land and soil (3)	We need to continue to improve our knowledge of soils and the functions and services they provide. Careful management of soil enrichment and land management activities will avoid or minimise GHG emissions into the air, as well as nutrient and sediment losses into water catchments. This needs to happen from the national policy level to the local management scale, covering cross-sectoral activities on farms, forest plantations and peatlands and within both urban and rural areas.
Nature (1)	Ireland needs to prioritise actions to protect nature. The challenges facing vital pollinators such as bumblebees, and the extensive loss of the curlew as a breeding bird species, should be the alarm calls needed nationally to focus on the transformative changes required in how we value and protect nature. More engagement on nature protection across stakeholder groups is needed, together with a review of governance, with solutions fast-tracked at policy and regulatory levels to protect habitats and halt biodiversity loss.
Nature (2)	The challenges involved in protecting Ireland's habitats and species are now more serious than ever and need urgent action. But nature can bounce back under the right conditions. Implementing national biodiversity policies, such as the National Biodiversity Action Plan, requires an increased level of collaboration and coordination across multiple sectors and the whole of society. This can also give rise to indirect co-benefits for other sectors and environmental issues such as climate change and water quality.
Nature (3)	Education, monitoring and citizen science initiatives are vital steps in protecting biodiversity. To promote more proactive and widespread engagement we need to continue to systematically survey habitats and species, track threats from invasive species and develop collaborative projects between scientists, farming sectors and the public. Regulatory aspects also need to be in place, with conservation plans for the management of Natura 2000 areas.



NUMBER	CHAPTER HIGHLIGHTS
Water (1)	Ireland has seen a continuing decline in high status water bodies and an increase in the number of water bodies in poor ecological health. Even more stark is the dramatic reduction in the number of our most pristine rivers, which have fallen in 30 years from over 500 sites in 1990 to only 20 sites in 2020. Rapid action is needed to protect our remaining pristine sites before they are lost. More urgent focus also needs to be given to protecting our estuaries, as these water bodies have the worst status overall and specific measures for their improvement and protection should be identified and implemented.
Water (2)	The decline in river water quality is being driven primarily by nutrient pollution coming from agriculture and wastewater systems. Fertiliser spreading, slurry spreading and other nutrient losses that are causing pollution need to be covered by tighter measures in the next River Basin Management Plan and Nitrates Action Programme. Irish Water must ensure that the necessary wastewater infrastructure is in place and is not causing pollution, as legally required in EPA authorisations.
Water (3)	Overall, water quality has declined in Ireland, despite the actions taken to date to reverse this trend. Continued targeted action at local water catchment level that is based on science is key to improving water quality. The Local Authority Waters Programme and Agricultural Sustainability Support and Advisory Programme have key roles in implementing this targeted action and providing guidance at water catchment and farm levels to improve water quality. There also needs to be a national focus on measures to deliver solutions that protect and restore all water bodies.
Marine (1)	Ireland's marine waters are clean and reasonably healthy but not as biologically diverse and productive as they could be. They are affected by several human-induced pressures including fishing, climate change and marine litter such as plastics.
Marine (2)	The area covered by Marine Protected Areas needs to be expanded significantly to meet the international requirement to conserve 10 per cent of all coastal and marine areas, rising to 30 per cent in future targets under the EU Biodiversity Strategy 2030. The expansion will promote the remediation of environmental damage and the protection of marine ecosystems and biodiversity.
Marine (3)	As an island nation with an extensive marine area, Ireland needs to ensure that robust governance and legal frameworks are in place to protect marine ecosystems and the services they provide to society. There needs to be governance systems in place that coordinate and integrate the implementation of directives where there are crossovers, such as those covering marine strategy, marine spatial planning, water quality, waste, biodiversity and protecting fish stocks.
Waste (1)	Ireland needs to do more to prevent waste at all stages of a product's life cycle, incentivise reuse and repair, increase recycling and extract the maximum resources from waste that cannot be recycled. Implementing the policy initiatives under the <i>Waste Action Plan for a Circular Economy</i> will be central to delivering the systemic changes needed.
Waste (2)	Strong, consistent, multi-agency enforcement and campaigns to change public behaviour are needed to effectively target littering in urban and rural areas, to prevent waste crime and to ensure that those who break the law are held accountable.
Waste (3)	How we manage and recycle our waste needs to be reviewed. Municipal and packaging waste recycling rates have stagnated or declined but improved segregation of kerbside bins could bring about significant improvement in rates. Landfill and waste-to-energy treatment in Ireland is at capacity and the country is highly dependent on export markets to treat residual, recyclable and hazardous wastes. We need to build in resilience to Ireland's waste management capacity in the event of emergencies.



NUMBER	CHAPTER HIGHLIGHTS
Industry (1)	Pollutant emissions to air from industry represent a significant proportion of Ireland's total air emissions. However, releases of air pollutants by industry have significantly decreased (by over 70%) during the past decade. Overall, environmental regulation and improved pollutant abatement technology, among other factors, have delivered significant reductions in pollution and will continue to do so under new tighter standards up to 2030.
Industry (2)	The food and drink sector continues to face many challenges in maintaining environmental compliance as the industry adapts to increased agricultural production and intensification. This sector has featured strongly on the EPA priority sites list. Investment is needed to ensure that facilities in the food and drink sector meet their environmental obligations set out in EPA licences covering areas such as odour controls, noise limits and the operation of wastewater treatment systems.
Industry (3)	Environmental regulation provides a requirement that industry modernises and meets best practice in relation to controls on waste and emissions, as these actions taken to reduce emissions contributes a large dividend in terms of environmental and human health improvements. Industry can gain competitive advantages and more local support from being sustainable and having a good environmental compliance history.
Transport (1)	The transport sector has a significant impact on the environment, including being responsible for 20 per cent of Ireland's greenhouse gas emissions. A sustainable mobility transformation is required, with the next decade crucial, whereby necessary journeys are made by sustainable modes such as walking, cycling and public transport, followed by using electric vehicles where unavoidable. For this transformation to happen we need to start fast-tracking the measures in the Climate Action Plan and other necessary measures.
Transport (2)	Long-term, integrated spatial and transport planning can achieve compact development 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.
Transport (3)	While challenging, the long-term changes required in transport can deliver multiple benefits in reducing greenhouse gases, tackling growing traffic congestion, reducing air pollution and noise emissions, and enhancing our wellbeing and the economy.
Energy (1)	Almost 90 per cent of Ireland's total energy use is provided by combustion of, mostly imported, fossil fuels. This is not sustainable. The resultant emissions are damaging for our health and our environment and continue to drive climate change. To transform this situation, we need to start fast-tracking the measures in the Climate Action Plan and other necessary solutions. Strategic planning is required to transform this situation by 2050, including accelerated actions to 2030.
Energy (2)	Transitioning to a clean energy future is essential for the protection of human health, climate and the environment, while having many benefits for sustainable development. The investment and implementation of currently available solutions to enhance efficiency and utilise Ireland's renewable energy potential needs to be urgently rolled out.
Energy (3)	Current fossil carbon lock-ins in electricity generation, but particularly in buildings and transport, need to be assessed, quantified and managed as part of the rapid transition away from these energy sources. Such a transition will require effective frameworks for investment. The redirection of fossil fuel subsidies can contribute to this process.
Agriculture (1)	Agricultural practices are identified in EPA reports as being one of the main pressures responsible for the decline in water quality nationally. Moreover, the agriculture sector is responsible for approximately one-third of national greenhouse gas emissions and over 99 per cent of national ammonia emissions. Biodiversity is also under pressure from land use changes and intensive farming. Ireland's reputation as a food producer with a low environmental footprint is at risk of being irreversibly damaged. Outcome-focused and activity metrics are required to allow for tracking of the sector's performance and accountability in improving sustainability and protecting the environment.



NUMBER	CHAPTER HIGHLIGHTS
Agriculture (2)	Economic growth in the agri-food sector in recent years is happening at the expense of the environment, as evidenced by trends in water quality, emissions and biodiversity all going in the wrong direction. Business-as-usual scenarios will not reverse these trends. New measures must go beyond improving efficiencies and focus on reducing total emissions by breaking the link between animal numbers, fertiliser use and deteriorating water quality. Measures are also needed to address new EU strategies including the Farm to Fork Strategy, which sets ambitious but sustainable targets to ‘transform the EU’s food system’.
Agriculture (3)	The adoption of a more holistic farm and catchment-level approach, encompassing all environmental pressures, will be fundamental to progress towards more environmentally sustainable and carbon-neutral food production.
Health and wellbeing (1)	A good-quality, well-protected environment has significant health and wellbeing benefits; research has shown that access to clean green and blue spaces in our environment is good for us. The provision of health-promoting environments in urban planning is central to Ireland’s transition to more compact and urban living.
Health and wellbeing (2)	Greater individual action needs to be taken to proactively tackle avoidable health consequences linked to the environment. Actions include radon testing, testing private wells, maintaining septic tanks, eliminating use of smoky fuels, reducing wasteful consumption, preventing littering and making sustainable commuting decisions.
Health and wellbeing (3)	There are risks to our environment and our health from climate disruption, chemical exposure, and underinvestment in drinking water and wastewater treatment infrastructure. These risks must be addressed through state investment in targeted research, in monitoring and enforcement actions, and through investment by Irish Water in the necessary water services infrastructure.
Environmental performance, tracking plans and programmes (1)	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 being made are insufficient to meet long-term EU and national objectives such as those covering water quality, air quality, nature protection, reducing emissions to air and the ambition for a climate-neutral economy and climate neutrality by 2050. To improve implementation, sustained improvements are needed in how the performance of environmental and sectoral plans, policies and strategies are coordinated and tracked, their effectiveness is measured and the outputs of such measurements are fed back into reviews and future updates.
Environmental performance, tracking plans and programmes (2)	The successes in environmental policy implementation to date, for example around industrial emissions and waste management, were hard won. These successes are being offset by increased levels of population growth, unsustainable patterns of production/consumption and climate change, resulting in a net decline in the state of Ireland’s environment. To reverse these trends, Ireland needs to improve the implementation and enforcement of existing environmental legislation and policy at all scales, from national to local levels. This can be supported through more effective governance structures, greater focus on monitoring and performance evaluation, enhanced oversight and enforcement, and higher levels of investment.
Environmental performance, tracking plans and programmes (3)	Tackling the complex and interlinked challenges facing the environment will require the development of more integrated, coherent and ambitious environmental policy frameworks and a clear national policy position for Ireland’s environment.



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An Ghníomhaireacht Um Chaomhnú Comhshaoil

Tá an GCC freagrach as an gcomhshaoil a chosaint agus a fheabhsú, mar shócmhainn luachmhar do mhuintir na hÉireann. Táimid tiomanta do dhaoine agus don chomhshaoil a chosaint ar thionchar díobhálach na radaíochta agus an truaillithe.

Is féidir obair na Gníomhaireachta a roinnt ina trí phríomhréimse:

- Rialáil:** Rialáil agus córais chomhlíonta comhshaoil éifeachtacha a chur i bhfeidhm, chun dea-thorthaí comhshaoil a bhaint amach agus díriú orthu siúd nach mbíonn ag cloí leo.
- Eolas:** Sonraí, eolas agus measúnú ardchaighdeán, spriocdhírthe agus tráthúil a chur ar fáil i leith an chomhshaoil chun bonn eolais a chur faoin gcinnteoireacht.
- Abhcóideacht:** Ag obair le daoine eile ar son timpeallachta glaine, táirgiúla agus dea-chosanta agus ar son cleachtas inbhuanaithe i dtaobh an chomhshaoil.

I measc ár gcuid freagrachtaí tá:

CEADÚNÚ

- Gníomhaíochtaí tionscail, dramhaíola agus stórála peitрил ar scála mór;
- Sceitheadh fuíolluisce uirbigh;
- Úsáid shrianta agus scaoileadh rialaithe Orgánach Géinmhodhnaithe;
- Foinsí radaíochta ianúcháin;
- Astaíochtaí gás ceaptha teasa ó thionscal agus ón eitlíocht trí Scéim an AE um Thrádáil Astaíochtaí.

FORFHEIDHMÍÚ NÁISIÚNTA I LEITH CÚRSAÍ COMHSHAOIL

- Iniúchadh agus cigireacht ar shaoráidí a bhfuil ceadúnas acu ón GCC;
- Cur i bhfeidhm an dea-chleachtais a stiúradh i ngníomhaíochtaí agus i saoráidí rialáilte;
- Maoirseacht a dhéanamh ar fhreagrachtaí an údaráis áitiúil as cosaint an chomhshaoil;
- Caighdeán an uisce óil phoiblí a rialáil agus údaruithe um sceitheadh fuíolluisce uirbigh a fhorfheidhmiú;
- Caighdeán an uisce óil phoiblí agus phríobháidigh a mheasúnú agus tuairiscíú air;
- Comhordú a dhéanamh ar líonra d'eagraíochtaí seirbhíse poiblí chun tacú le gníomhú i gcoinne coireachta comhshaoil;
- An dlí a chur orthu siúd a bhriseann dlí an chomhshaoil agus a dhéanann dochar don chomhshaoil.

BAINISTÍOCHT DRAMHAÍOLA AGUS CEIMICEÁIN SA CHOMHSHAOIL

- Rialacháin dramhaíola a chur i bhfeidhm agus a fhorfheidhmiú lena n-áirítear saincheisteanna forfheidhmithe náisiúnta;
- Staitisticí dramhaíola náisiúnta a ullmhú agus a fhoilsiú chomh maith leis an bPlean Náisiúnta um Bainistíocht Dramhaíola Guaisí;
- An Clár Náisiúnta um Chosc Dramhaíola a fhorbairt agus a chur i bhfeidhm;
- Reachtaíocht ar rialú ceimiceán sa timpeallacht a chur i bhfeidhm agus tuairiscíú ar an reachtaíocht sin.

BAINISTÍOCHT UISCE

- Plé le struchtúir náisiúnta agus réigiúnacha rialachais agus oibriúcháin chun an Chreat-treoir Uisce a chur i bhfeidhm;
- Monatóireacht, measúnú agus tuairiscíú a dhéanamh ar chaighdeán aibhneacha, lochanna, uiscí idirchreasa agus cósta, uiscí snámha agus screamhuisce chomh maith le tomhas ar leibhéil uisce agus sreabhadh abhann.

EOLAÍOCHT AERÁIDE & ATHRÚ AERÁIDE

- Fardail agus réamh-mheastacháin a fhoilsiú um astaíochtaí gás ceaptha teasa na hÉireann;
- Rúnaíocht a chur ar fáil don Chomhairle Chomhairleach ar Athrú Aeráide agus tacaíocht a thabhairt don Idirphlé Náisiúnta ar Ghníomhú ar son na hAeráide;

- Tacú le gníomhaíochtaí forbartha Náisiúnta, AE agus NA um Eolaíocht agus Beartas Aeráide.

MONATÓIREACHT AGUS MEASÚNÚ AR AN GCOMHSHAOIL

- Córais náisiúnta um monatóireacht an chomhshaoil a cheapadh agus a chur i bhfeidhm: teicneolaíocht, bainistíocht sonraí, anailís agus réamhaisnéisiú;
- Tuairiscí ar Staid Timpeallacht na hÉireann agus ar Tháscairí a chur ar fáil;
- Monatóireacht a dhéanamh ar chaighdeán an aeir agus Treoir an AE i leith Aeir Ghlain don Eoraip a chur i bhfeidhm chomh maith leis an gCoinbhinsiún ar Aerthruailliú Fadraoin Trasteorann, agus an Treoir i leith na Teorann Náisiúnta Astaíochtaí;
- Maoirseacht a dhéanamh ar chur i bhfeidhm na Treorach i leith Torainn Timpeallachta;
- Measúnú a dhéanamh ar thionchar pleananna agus clár beartaithe ar chomhshaoil na hÉireann.

TAIGHDE AGUS FORBAIRT COMHSHAOIL

- Comhordú a dhéanamh ar ghníomhaíochtaí taighde comhshaoil agus iad a mhaoiniú chun brú a aithint, bonn eolais a chur faoin mbeartas agus réitigh a chur ar fáil;
- Comhoibriú le gníomhaíocht náisiúnta agus AE um thaighde comhshaoil.

COSAINN RAIDEOLAÍOCH

- Monatóireacht a dhéanamh ar leibhéil radaíochta agus nochtadh an phobail do radaíocht ianúcháin agus do réimsí leictreamaighnéadacha a mheas;
- Cabhrú le pleananna náisiúnta a fhorbairt le haghaidh éigeandálaí ag eascairt as taismí núicléacha;
- Monatóireacht a dhéanamh ar fhorbairtí thar lear a bhaineann le saoráidí núicléacha agus leis an tsábháilteacht raideolaíochta;
- Sainseirbhísí um chosaint ar an radaíocht a sholáthar, nó maoirsiú a dhéanamh ar sholáthar na seirbhísí sin.

TREOIR, ARDÚ FEASACHTA AGUS FAISNÉIS INROCHTANA

- Tuairiscíú, comhairle agus treoir neamhspleách, fianaise-bhunaithe a chur ar fáil don Rialtas, don tionscal agus don phobal ar ábhair maidir le cosaint comhshaoil agus raideolaíoch;
- An nasc idir sláinte agus folláine, an geilleagar agus timpeallacht ghlan a chur chun cinn;
- Feasacht comhshaoil a chur chun cinn lena n-áirítear tacú le hiompraíocht um éifeachtúlacht acmhainní agus aistriú aeráide;
- Tástáil radóin a chur chun cinn i dtithe agus in ionaid oibre agus feabhsúchán a mholadh áit is gá.

COMHPHÁIRTÍOCHT AGUS LÍONRÚ

Oibriú le gníomhaireachtaí idirnáisiúnta agus náisiúnta, údaráis réigiúnacha agus áitiúla, eagraíochtaí neamhrialtais, comhlachtaí ionadaíocha agus ranna rialtais chun cosaint comhshaoil agus raideolaíoch a chur ar fáil, chomh maith le taighde, comhordú agus cinnteoireacht bunaithe ar an eolaíocht.

BAINISTÍOCHT AGUS STRUCHTÚR NA GNÍOMHAIREACHTA UM CHAOMHNÚ COMHSHAOIL

Tá an GCC á bainistiú ag Bord Iánaimeartha, ar a bhfuil Ard-Stiúrthóir agus cúigear Stiúrthóir. Déantar an obair ar fud cúig cinn d'Oifigí:

- An Oifig um Inbhuanaitheacht i leith Cúrsaí Comhshaoil
- An Oifig Forfheidhmithe i leith Cúrsaí Comhshaoil
- An Oifig um Fhianaise agus Measúnú
- An Oifig um Chosaint ar Radaíocht agus Monatóireacht Comhshaoil
- An Oifig Cumarsáide agus Seirbhísí Corparáideacha

Tugann coistí comhairleacha cabhair don Ghníomhaireacht agus tagann siad le chéile go rialta le plé a dhéanamh ar ábhair imní agus le comhairle a chur ar an mBord.

